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# The sequential association between school bullying and oral health related quality of life (OHRQoL) in Chinese children and adolescents

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## Abstract

**Background** School bullying has negative impacts on the overall health of children and adolescents, but the association between bullying and oral health-related quality of life (OHRQoL) is still unclear.

**Methods** In this study, a two-wave prospective design was used to collect data in Yunnan Province, southwest China. A total of 5,346 children and adolescents aged 10–17 years were included in the study through two-stage randomized cluster sampling. Univariate and multivariate logistic regression models were employed to assess the sequential associations between baseline bullying and the subsequent OHRQoL. Stratified analyses were further performed to evaluate the effect modification by important demographic variables.

**Results** The prevalence of school bullying was 16.40%. After adjustment, bullying involvement at baseline was associated with increased odds of subsequent poor OHRQoL (odds ratio, OR: 1.77, 95% CI: 1.50–2.11). Victims and bully-victims were seen significantly deteriorated OHRQoL, with ORs of 1.81 (95% CI: 1.50–2.19) and 2.10 (95% CI: 1.35–3.33). For different types of bullying victimization, only verbal victimization displayed a significant association with OHRQoL (OR: 2.07; 95% CI: 1.63–2.65). Bullying involvement was significantly associated with all four subdomains of OHRQoL, particularly for social well-being (OR: 1.91, 95% CI: 1.60–2.27). Stratified analyses revealed prominent effect modification by age, sex, ethnicity, and left-behind status in bullying-OHRQoL association.

**Conclusion** Our findings suggest that children and adolescents who experienced school bullying had a significantly higher risk of subsequently poor OHRQoL, particularly for verbal victims. Targeted interventions should be designed and implemented.

**Keywords** School bullying, Quality of life, Oral health, Children, Adolescents, Mental health

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## Introduction

Oral diseases are affecting approximately 3.5 billion people globally, and almost half of the world's population suffer from untreated oral diseases [1]. Dental caries are the most prevalent oral diseases among children, with around 43% of children suffering from pain and discomfort worldwide due to dental caries [1]. Oral diseases frequently recur, particularly among those who have poor hygiene habits, leading to adverse physical, social, and mental consequences [2]. Oral health-related quality of life (OHRQoL) is used to quantify the impact of oral conditions on overall well-being of individuals, encompassing functional, emotional, and social aspects [3]. Oral health status is strongly associated with OHRQoL. Studies indicated that children and adolescents with oral conditions such as dental caries, periodontal disease, or malocclusion reported poorer OHRQoL [4, 5]. Additionally, other factors such as socioeconomic status, social support, mental conditions, and demographic characteristics were also prominently related to OHRQoL [6–8].

School bullying refers to repeated deliberate aggressive behaviors that occur in a school setting and involves an imbalance of power [9]. Generally, it is face-to-face aggression in physical, verbal, and relational forms. However, in the internet era, bullying can also happen at online settings, referred to as cyberbullying [10]. According to the Global School-based Student Health Survey (GSHS), school bullying affected approximately 33% of children and adolescents worldwide [11]. In China, a meta-analysis indicated that the prevalence of bullying victimization was 22.7% [12]. Bullying can lead to a variety of negative health outcomes, including anxiety, depression, low self-esteem, and psychosomatic symptoms [13]. More seriously, previous studies have shown that bullying victimization was strongly associated with suicidal risk [14].

Some scholars have identified the potential impacts of bullying on oral health. Bullying-induced stress can lead to dietary changes (e.g., increased consumption of sugary foods) and deteriorated oral hygiene [15], which can contribute to the occurrence of dental diseases. A recent study reported that bullying victimization was associated with a 2.5-fold increased risk of missing teeth [16]. Additionally, research has also reported that stress caused by bullying can increase inflammation and contribute to periodontal problems [17]. Published evidence indicates that school bullying might be potentially associated with poor OHRQoL. However, only two published Brazilian studies had investigated the hypothesized association between school bullying and OHRQoL in youngsters. One found moderate bullying was associated with a 1.5-fold risk of poorer OHRQoL [18], another reported a positive correlation between bullying and OHRQoL scores [19]. Considering they were all cross-sectional in

nature, and participants were chosen from non-probabilistic sampling design, the association between school bullying and OHRQoL undoubtedly needs to be further investigated by longitudinal studies of large representative samples of children and adolescents.

In the current study, through the analysis on database collected from a prospective two-wave survey, we aim to ascertain the sequential association between school bullying and OHRQoL in a large sample of Chinese children and adolescents. The major findings of this study are expected to provide crucial evidence for developing intervention strategies to improve OHRQoL among juveniles who are involved in school bullying. The following major hypotheses will be tested: (1) There is in general a statistically significant sequential association between school bullying involvement and OHRQoL; (2) Different roles and types of bullying show discordant sequential associations with OHRQoL; (3) Important demographics prominently moderate the bullying-OHRQoL association.

## Methods

### Study design and participants

Analytical database of the current study was derived from the Mental Health Survey for Children and Adolescents in Yunnan (MHSCAY), a large epidemiological program aiming at promoting mental and behavioral health status in youths in southwest China Yunnan province [20]. We used two-wave longitudinal data collected in one of our study sites (Jinghong city): the first-wave baseline survey was conducted in December 2023 ( $T_0$ ), and the second-wave follow-up survey was performed 3 months later in March 2024 ( $T_1$ ). Participants were selected using a two-stage simple random cluster sampling method with probability proportionate to sample size (PPS): in the first stage, 7 schools were randomly selected from all schools in Jinghong; in the second stage, 3 to 5 classes were randomly selected from each grade of the chosen schools, and all eligible students in the selected classes were included in the survey. Detailed inclusion and exclusion criteria for survey participants can be referred to in our previous publication [21]. In both waves of the survey, information was collected using the same self-administered questionnaire. The study protocol was reviewed and approved by the Ethics Committee of Kunming Medical University (KMMU2023MEC019). As all study subjects were minors under 18 years old, written informed consents were obtained from their guardians prior to the survey.

### Measurements

A structured, self-administered questionnaire was delivered to collect information related to the following domains: demographic and familial characteristics [age,

gender, ethnicity (dichotomized into Han majority and ethnic minorities), whether left-behind children, parental marital status, family income, etc.], school bullying, OHRQoL, depression and anxiety symptoms, etc.

### School bullying

Bullying measured at baseline ( $T_1$ ) was the primary exposure of this study. We used the Chinese version of the Olweus Bullying Questionnaire (OBVQ) to measure 3 types of traditional bullying [22]. The OBVQ consists of 12 questions, with the frequency of a specific bullying scenario ranged from “never” to “several times a week”. Participants were defined as victims, bullies, and bully-victims when they answered being bullied, bullying others, or bullying others while being bullied “two or three times a month” or more frequently as recommended [23]. Cyberbullying was measured by a single question “Have you ever been bullied on the Internet or via cell phone?” [24]. The Cronbach’s  $\alpha$  for the OBVQ was 0.732 (95% Bootstrap CI: 0.721–0.743) for our analytical sample.

### Oral health-related quality of life (OHRQoL)

The primary outcome of this study was OHRQoL at  $T_2$ , measured by using the short form of the Child Perceptions Questionnaire for 11–14-year-old Children (CPQ<sub>11–14</sub>, RSF: 16), which includes 4 dimensions (oral symptoms, functional limitations, emotional well-being, and social well-being) [25]. A 5-point Likert scale was employed for all questions, with scores ranging from 0 to 4 corresponding to “never”, “rarely”, “sometimes”, “often”, and “daily”. A higher total score reflects poorer OHRQoL. Although CPQ<sub>11–14</sub> was originally developed for the 11–14-year-old age group, subsequent validation studies have shown acceptable validity and reliability across a broader age range [26, 27]. In this study, the Cronbach’s  $\alpha$  of the CPQ<sub>11–14</sub> was 0.932 (95% Bootstrap CI: 0.926–0.943).

### Depression and anxiety

Symptoms of depression and anxiety at baseline ( $T_1$ ) were included in the analysis as important controlling covariates. The Patient Health Questionnaire-9 (PHQ-9) and the Generalized Anxiety Disorder Scale (GAD-7) were used to measure the two features [28, 29]. The two tools contain 9 and 7 questions, all measured by using 4-point Likert style responses to gauge frequency of a specified scenario in the past two weeks from “not at all” to “almost every day”. A higher combined score for either of the two instruments indicates severer symptoms of depression or anxiety. A uniform cut-off of 5 has been recommended for both scales for screening purpose [29, 30]. The Cronbach’s  $\alpha$  coefficients for the PHQ-9 and GAD-7 in this study were 0.894 (Bootstrap 95% CI: 0.891–0.901) and 0.921 (Bootstrap 95% CI: 0.917–0.924), respectively.

### Statistical analysis

Double entry and consistency checking of the survey data were performed using the Epidata 3.1. All statistical analyses were conducted using the R software (version 4.4.1). Appropriate descriptive statistical analyses were used to summarize the characteristics of the participants. The scores for overall OHRQoL and its subdomains were dichotomized based on their medians. Univariate and multivariate logistic regression models were employed to assess crude and adjusted sequential associations between baseline school bullying and the subsequent OHRQoL. Stratified analyses were further performed to evaluate effect modification on the above sequential associations by important demographic variables. The significance level for all statistical analyses was set at  $p < 0.05$ , two-sided, except for univariate logistic regression, where a more lenient criterion of  $p < 0.10$  was used to screen for possible covariates.

## Results

### General characteristics of the participants

A total of 6,014 participants were investigated at  $T_1$ , of whom 5,346 completed the follow-up survey at  $T_2$ , with an effective follow-up rate of 88.89%. Table 1 presents the general characteristics of the 5,346 study subjects who successfully finished both waves of the survey. Their average age was 13.73 (SD: 1.76) years, 51.52% were girls, more than two-thirds were ethnic minorities, 25.01% were the only child in the family, 40.95% and 23.98% experienced positive depression and anxiety symptoms at baseline.

At  $T_1$ , bullying involvement was reported by 877 (16.40%) participants, with the majority being victims (710, 13.28%). OHRQoL was dichotomized by the median score (12), there were statistically significant differences between participants with good and poor OHRQoL at  $T_2$  in all other baseline characteristics, except for whether the participants were left-behind children. Moreover, compared with study subjects of good OHRQoL, study subjects of poor OHRQoL were observed higher rates in positive baseline depression symptoms (57.24% versus 23.98%), anxiety symptoms (35.90% versus 11.57%), and bullying involvement (21.31% versus 11.30%) (Table 1).

### The sequential association between school bullying and overall OHRQoL

After adjusting for other covariates screened out in univariate model, multivariate logistic regression revealed that bullying involvement at  $T_1$  was associated with increased odds of subsequent poor OHRQoL at  $T_2$  (OR: 1.77, 95% CI: 1.50–2.11) (Table 2). Further analyses on roles of bullying involvement and types of bullying victimization are presented in Fig. 1: for roles of bullying, victims and bully-victims reported significantly poorer

**Table 1** General characteristics of participants

Variables	All subjects (N=5,346) (N, %) / (M±SD)	Good OHRQoL (n=2,619) (N, %) / (M±SD)	Poor OHRQoL (n=2,727) (N, %) / (M±SD)	$\chi^2$ / t	p
Age	13.73±1.76	13.02±1.74	13.65±1.74	-13.39	<0.001
Gender				247.16	<0.001
Boys	2592 (48.48)	1557 (59.45)	1035 (37.95)		
Girls	2754 (51.52)	1062 (40.55)	1692 (62.05)		
Ethnicity				18.71	<0.001
Han (majority)	1741 (32.57)	927 (35.39)	814 (29.85)		
Minorities	3605 (67.43)	1692 (64.60)	1913 (70.15)		
Grade				187.69	<0.001
Primary school	907 (16.97)	608 (23.21)	299 (10.96)		
Junior high school	3293 (61.59)	1590 (60.71)	1703 (62.45)		
Senior high school	1146 (21.44)	421 (16.07)	725 (26.59)		
Only child				4.62	0.032
Yes	1336 (25.01)	688 (26.31)	648 (23.76)		
No	4006 (74.99)	1927 (73.69)	2079 (76.24)		
Boarding students				88.99	<0.001
Yes	3081 (57.63)	1339 (51.13)	1742 (63.88)		
No	2265 (42.37)	1280 (48.87)	985 (36.12)		
Left-behind children				1.49	0.222
Yes	475 (8.89)	220 (8.40)	255 (9.35)		
No	4871 (91.11)	2399 (91.60)	2472 (90.65)		
Family income				7.52	0.006
Stable	5094 (95.41)	2515 (96.21)	2579 (94.64)		
Unstable	245 (4.59)	99 (3.79)	146 (5.36)		
Parents' marriage status				5.36	0.021
In marriage	4260 (79.70)	2121 (80.99)	2139 (78.44)		
Other status	1085 (20.30)	498 (19.01)	588 (21.56)		
Depression (PHQ-9≥5)				611.33	<0.001
Yes	2189 (40.95)	628 (23.98)	1561 (57.24)		
No	3157 (59.05)	1991 (76.02)	1166 (42.76)		
Anxiety (GAD-7≥5)				433.84	<0.001
Yes	1282 (23.98)	303 (11.57)	979 (35.90)		
No	4064 (76.02)	2316 (88.43)	1738 (64.10)		
Bullying involvement				97.69	<0.001
Yes	877 (16.40)	296 (11.30)	581 (21.31)		
No	4469 (83.60)	2323 (88.70)	2146 (78.69)		
Role of bullying				100.48	<0.001
Victims	710 (13.28)	237 (9.05)	473 (17.35)		
Bullies	108 (2.02)	26 (0.99)	33 (1.20)		
Bully-victims	59 (1.10)	33 (1.26)	75 (2.75)		
Type of victimization				97.39	<0.001
Physical	10 (1.40)	7 (0.27)	3 (0.11)		
Verbal	387 (54.51)	122 (4.77)	265 (10.12)		
Relational	66 (9.30)	32 (1.16)	34 (1.34)		
Cyber	13 (1.83)	4 (0.18)	9 (0.30)		
Multiple	234 (32.96)	72 (2.81)	162 (6.19)		

OHRQoL, with ORs of 1.81 (95% CI: 1.50–2.19) and 2.10 (95% CI: 1.35–3.33); for different types of bullying victimization, participants reported previous verbal victimization (OR: 2.07; 95% CI: 1.63–2.65) and those who had experienced multiple types of victimization (OR:

1.92; 95% CI: 1.41–2.65) were observed increased risk of poor OHRQoL; no significant associations with poor OHRQoL were found for physical, relational, and cyber victimization.

**Table 2** Crude and adjusted associations between bullying involvement and OHRQoL

Variables	Univariate model Crude OR (95% CI)	Multivariate model Adjusted OR (95% CI)
Age +1 year	1.23 (1.19–1.27)***	1.09 (1.01–1.19)*
Gender: Girl (Ref: Boys)	2.39 (2.15–2.68)***	1.95 (1.72–2.20)***
Ethnicity: Minorities (Ref: Han majority)	1.29 (1.15–1.44)***	1.14 (0.99–1.30)
Grade (Ref: Primary school)		
Junior high school	2.18 (1.87–2.54)***	1.29 (0.99–1.69)
Senior high school	3.50 (2.92–4.21)***	1.29 (0.81–2.04)
Only child: Yes (Ref: No)	0.87 (0.77–0.99)*	0.89 (0.77–1.02)
Boarding students: Yes (Ref: No)	1.69 (1.52–1.89)***	1.33 (1.15–1.54)***
Left-behind children: Yes (Ref: No)	1.12 (0.93–1.36)	
Family income: Unstable (Ref: Stable)	1.44 (1.11–1.87)**	1.24 (0.94–1.66)
Parents' marriage status: Other (Ref: In marriage)	1.17 (1.02–1.34)*	0.96 (0.82–1.11)
Depression: Yes (Ref: No)	4.24 (3.78–4.78)***	2.40 (2.07–2.79)***
Anxiety: Yes (Ref: No)	4.28 (3.71–4.95)***	1.82 (1.52–2.18)***
Bullying involvement: Yes (Ref: Uninvolved)	2.12 (1.83–2.48)***	1.77 (1.50–2.11)***
Role of bullying (Ref: Uninvolved)		
Victims	2.16 (1.83–2.56)***	
Bullies	1.37 (0.82–2.32)	
Bully-victims	2.46 (1.64–3.77)***	
Type of victimization (Ref: Non-involved)		
Physical	0.46 (0.10–1.67)	
Verbal	2.35 (1.89–2.95)***	
Relational	1.15 (0.71–1.88)	
Cyber	2.44 (0.79–9.00)	
Multiple	2.44 (1.84–3.25)***	

\*\*\* $p<0.001$ ; \*\* $p<0.01$ ; \* $p<0.05$

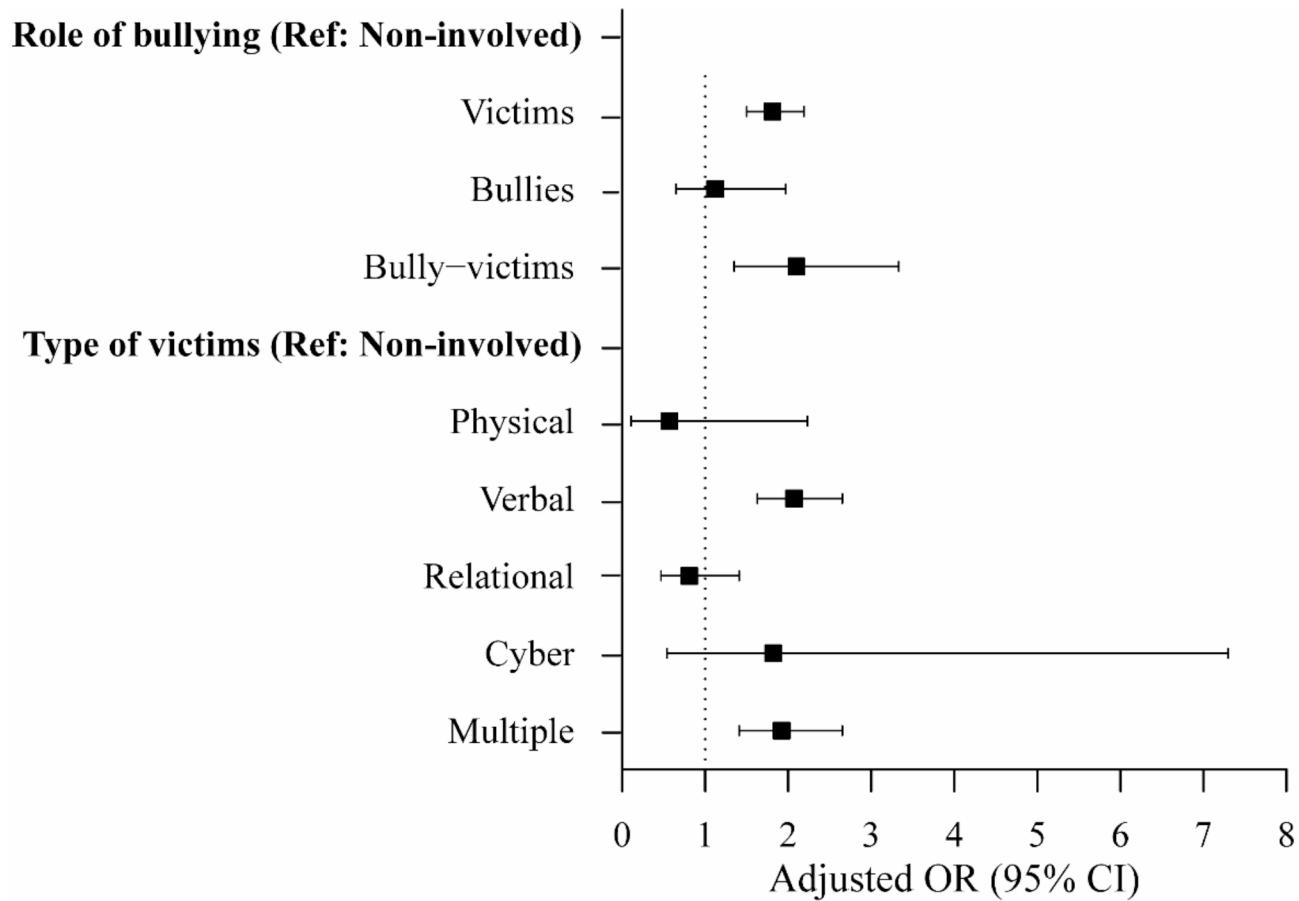
### School bullying and subdomains of OHRQoL

Further analysis disclosed that bullying involvement was significantly associated with an increased risk of poor OHRQoL across all four subdomains, and the association was particularly strong for the dimension of social well-being (adjusted OR: 1.91, 95% CI: 1.60–2.27), followed by oral symptoms (adjusted OR: 1.68, 95% CI: 1.42–2.00), emotional well-being (adjusted OR: 1.57, 95% CI: 1.32–1.86), and functional limitations (adjusted OR: 1.44, 95% CI: 1.21–1.70) (Table 3). The adjusted associations with subdomains of OHRQoL for different roles of bullying and different types of bullying victimization were shown in supplementary material, Figure S1: for different roles of bullying, victims and bully-victims were observed statistically significant associations with all 4 subdomains of OHRQoL, and the associations were generally stronger for bully-victims. Across the 4 subdomains, victims were observed the strongest association with social well-being (OR: 1.95, 95% CI: 1.62–2.37), while bully-victims reported the strongest association with oral symptoms (OR: 2.28, 95% CI: 1.47–3.65). No statistically significant associations with the four subdomains of OHRQoL were found for bullies. For different types of bullying victimization, verbal and multiple victimization were observed statistically significant associations with all four subdomains of OHRQoL, and the strongest associations were

found for the subdomain of social well-being (OR = 2.29 for verbal, OR = 1.98 for multiple).

### Stratified analysis by key demographics

We also investigated potential effect modification by key demographics through a series of stratified analysis, and the results were collectively summarized in Fig. 2: among all stratified factors, age posed the strongest effect modification on bullying-OHRQoL associations, with a stronger association typically observed in younger children; sex also exerted prominent influence, with girls showing a higher risk in bullying related poor OHRQoL, however, for bully-victims, this association was only significant in boys; as to ethnicity, compared to Han majority, ethnical minorities largely reported higher risk of bullying associated poor OHRQoL, except for verbal victimization, where a much stronger OR was detected in Han majority participants; non-left-behind children showed statistically increased risk of poor OHRQoL nearly for all roles of bullying involvement and all types of victimization, nevertheless, the bullying-OHRQoL associations were all insignificant for their left-behind counterparts.

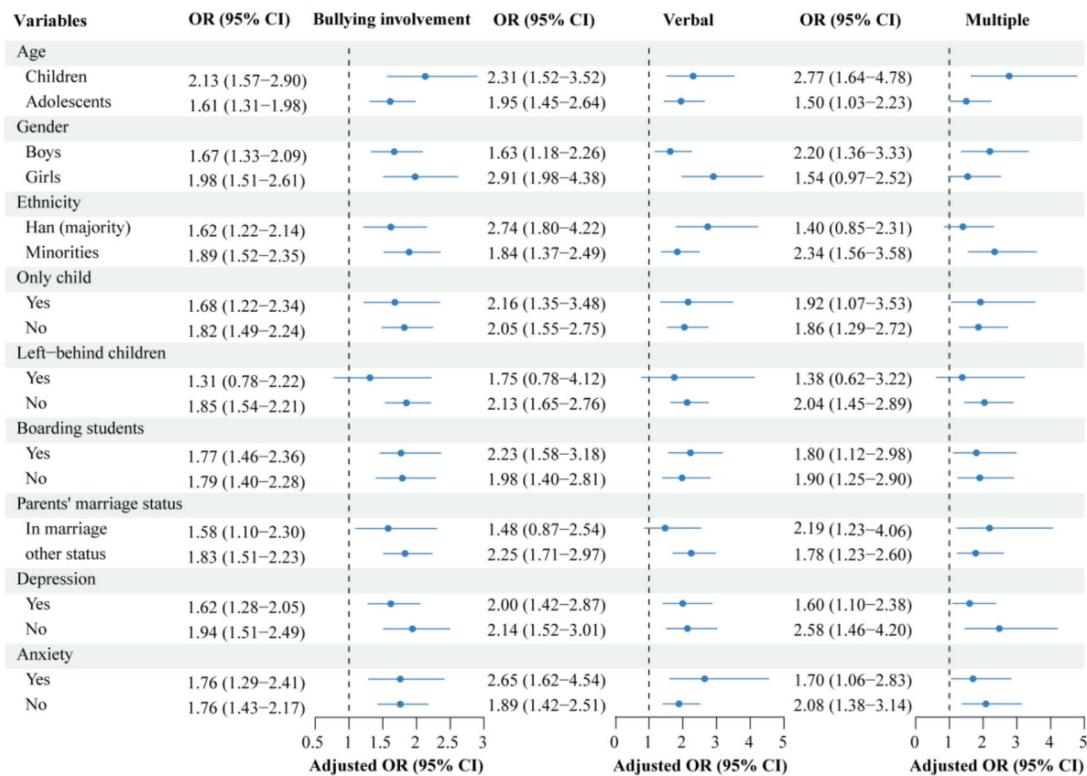
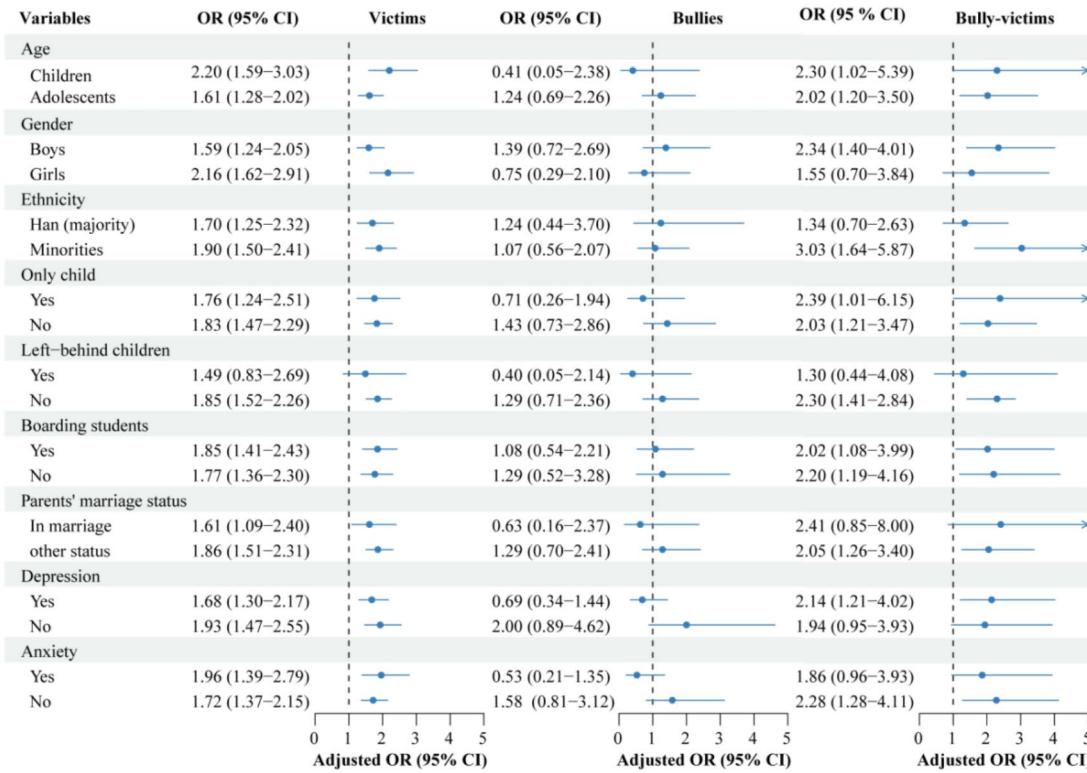


**Fig. 1** Associations between roles of bullying, types of victimization and OHRQoL. ORs were adjusted for age, sex, ethnicity, grade, whether only-child, whether boarding student, family income status, parental marriage status, baseline depression and anxiety

**Table 3** Adjusted associations between bullying involvement and subdomains of OHRQoL

Variables	Oral symptom Adjusted OR (95% CI)	Functional limitation Adjusted OR (95% CI)	Emotional well-being Adjusted OR (95% CI)	Social well-being Adjusted OR (95% CI)
Age +1 year	1.07 (0.99–1.16)	1.05 (0.97–1.14)	1.08 (1.00–1.17)*	1.05 (0.97–1.13)
Gender (Ref: Boys)	1.80 (1.60–2.03)***	1.65 (1.46–1.85)	2.11 (1.87–2.38)***	1.70 (1.50–1.91)***
Ethnicity: Minorities (Ref: Han majority)	1.00 (0.89–1.15)	1.25 (1.10–1.43)***	1.19 (1.04–1.78)*	1.27 (1.11–1.44)***
Grade (Ref: Primary school)				
Junior high school	1.53 (1.18–1.90)**	1.19 (0.92–1.54)***	1.36 (1.04–1.78)*	1.24 (0.95–1.61)
Senior high school	2.16 (1.38–3.38)***	1.39 (0.89–2.19)	1.36 (0.86–2.16)	1.19 (0.76–1.87)
Only child: Yes (Ref: No)	1.00 (0.86–1.14)	0.91 (0.80–1.05)	0.90 (0.79–1.04)	0.79 (0.69–0.91)***
Boarding student: Yes (Ref: No)	1.21 (1.05–1.39)**	1.46 (1.27–1.69)***	1.38 (1.19–1.59)***	1.11 (0.96–1.28)
Family income: Unstable (Ref: Stable)	1.20 (0.90–1.59)	1.30 (0.98–1.74)	1.26 (0.94–1.27)	1.41 (1.06–1.89)*
Parents' marriage status: Other status (Ref: In marriage)	0.86 (9.74–1.00)*	0.94 (0.81–1.09)	1.05 (0.91–1.23)	1.04 (0.90–1.21)
Depression: Yes (Ref: No)	1.96 (1.69–2.28)***	2.28 (1.96–2.65)***	2.14 (1.85–2.50)***	2.06 (1.77–2.39)***
Anxiety: Yes (Ref: No)	1.36 (1.13–1.62)***	1.71 (1.43–2.05)***	2.12 (1.77–2.54)***	1.80 (1.50–2.16)***
Bullying involvement: Yes (Ref: Uninvolved)	1.68 (1.42–2.00)***	1.44 (1.21–1.70)***	1.57 (1.32–1.86)***	1.91 (1.60–2.27)***

\*\*\* $p < 0.001$ ; \*\* $p < 0.01$ ; \* $p < 0.05$

**a. Bullying involvement and types of victimization****b. Roles of bullying involvement****Fig. 2** Stratified analysis showing effect modification by key demographics in bullying-OHRQoL associations

## Discussion

In this large sample prospective study, we examined the sequential relationship between school bullying and OHRQoL among Chinese children and adolescents. We found that individuals involved in bullying had an immediately increased risk of poor OHRQoL. When considering the roles of bullying, both victims and bully-victims reported significantly deteriorated OHRQoL. For different types of bullying victimization, only verbal victimization displayed a significant association with OHRQoL. For the 4 dimensions of OHRQoL, the strongest association with school bullying was found in social well-being, followed by oral symptoms. Further stratified analyses revealed prominent effect modification by age, sex, ethnicity, and left-behind status in bullying-OHRQoL association. All the above findings provide valuable scientific evidence for effectively preventing bullying-related oral health problems and improving OHRQoL in children and adolescents.

Children and adolescents involved in school bullying were generally observed a 1.77-fold risk of deteriorated OHRQoL in the near future. Although sequential association has not been reported previously, results from cross-sectional studies were comparable. For example, Alwadi & Vettore reported a higher OHRQoL score among bullying victims [OR 1.56 (95% CI: 1.20–2.03)] [18]. Tristão et al. found that bullying was positively correlated with CPQ scores (correlation coefficient: 0.420) [19]. We found this association was more prominent among victims, possibly because the positive association between bullying victimization and untreated dental caries and gingival bleeding has been established [31]. It has been reported that victims typically exhibited poorer oral habits than perpetrators [15]. Besides, victims face a considerably higher risk of anxiety and depression [32], which are closely associated with poor oral health habits including nail biting, thumb or finger sucking, and teeth grinding [33]. Depression can influence oral health by altering the salivary composition, leading to a higher plaque, tartar, and gingival index [34]. Both anxiety and depression can act as mediating factors in the pathway between bullying and OHRQoL. Specifically, they can lead to neglect in oral hygiene and avoidance in necessary oral care behaviors among victims [35], contributing to degradation of OHRQoL. Additionally, bullying victims are less likely to proactively seek out oral health services due to low self-esteem or negative feelings, which may further affect their OHRQoL [36].

Among different types of bullying victimization, we found that only verbal victimization was significantly associated with subsequently reported poor OHRQoL. As verbal bullying usually occurs at a low cost, the victims may suffer more frequent perpetration, which causes repeated harm to their mental health [37]. From

the perspective of social identity theory, the discriminatory remarks born by verbal bullying victims could lead to emotional distress, resulting in reduced self-esteem and self-worth [38]. Children with low self-esteem were more likely to experience oral health problems and low OHRQoL [39, 40]. Therefore, when intervening school bullying associated oral health outcomes, victims, especially verbal victims should be prioritized.

Two dimensions of OHRQoL showed the strongest association with school bullying: social well-being and oral symptoms. Oral problems like dental caries, gum diseases, and misaligned teeth have been linked to impaired social functioning in children and adolescents [41, 42]. Those issues may cause individuals avoid smiling or speaking in social situations, or even become targets of teasing or bullying from their peers [43–45]. Consequently, children subjected to school bullying may perceive social difficulties due to oral problems. As for the association between bullying and oral symptoms, emotional stress induced by bullying might trigger oral problems and exacerbate oral symptoms [17, 46]. Additionally, bullying experiences may increase dental anxiety [17], which could lead to excessive worry about oral health, resulting in increased negative evaluations of oral symptoms. Our findings suggested that oral health interventions for victims of school bullying should focus on improving social well-being and oral symptoms.

Stratified analysis revealed that the strength of bullying-OHRQoL association varied considerably across different subgroups, with stronger associations observed in younger children, girls, and ethnic minorities. The disparity could be explained by the fact that older adolescents, as compared to younger children, are better equipped with skills to mitigate the negative consequences of bullying [47]. Furthermore, the mental health impact of bullying appears more pronounced in girls than boys [47], and social identity theory indicated a higher bullying risk among ethnic minorities in areas with diverse ethnic concentrations [48, 49]. Interestingly, our findings suggested that bullying was only significantly associated with OHRQoL in non-left-behind children. In contrast, for left-behind children, this association was insignificant, likely due to their enhanced survival protection system, which fosters skills like self-flexibility and independence in the absence of parental guidance [50]. Additionally, left-behind children may exhibit a higher level of resilience than non-left-behind children [51], enabling them to withstand adversity [52]. They may also adapt by altering their social networks, relying on relatives (grandparents), teachers, or peers to replace parental roles, fostering closer “peer siblings” relationships [53]. These factors could equip left-behind children with better skills and strategies to counteract negative consequences of bullying, such as deteriorated oral health.

This prospective study provided stronger evidence in supporting the sequential association between school bullying and OHRQoL in a large sample of Chinese children and adolescents. However, several limitations should be acknowledged. First, self-reported data may introduce recall bias and social desirability bias, therefore, future studies may consider alternative reporting sources (parents, teachers, caregivers). Second, our study participants were drawn from a single province in southwestern China, limiting the generalizability of the findings to other youth populations outside Yunnan, as cultural, socioeconomic, or educational differences may influence the bullying-OHRQoL association. Third, although multiple covariates were controlled for, other important confounders, such as children's oral health status (caries, periodontal condition, etc.), parental education, access to dental care, and community-level socioeconomic status, were not collected, potentially resulting in unadjusted confounding bias. Furthermore, the three-month observation period may be insufficient to observe longer-term effects. Therefore, future longitudinal studies with extended follow-up periods, more diverse populations, and additional oral health data are needed.

## Conclusion

In this population-based perspective study, we systematically explored the sequential association between school bullying and OHRQoL. We found that children and adolescents involved in school bullying at baseline generally reported poorer subsequent OHRQoL, especially for verbal bullying victims. Besides, the bullying-OHRQoL association tends to be stronger in some subgroups. These findings highlight the importance of targeted interventions to improve oral health status for children and adolescents who are involved in school bullying. Specifically, oral health promotion programs should be designed and implemented for bullying victims. Moreover, interventions addressing school bullying should also consider integrating oral health promotion schemes simultaneously.

## Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12889-025-22684-6>.

Supplementary Material 1

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None.

## Author contributions

YX (Yuanyuan Xiao) and NZ conceived the study. SW and JL conducted the data analysis and prepared the first draft. GZ, YH, SL, YX (Yi Xiang), XL, and XW contributed to the data collection and data management. YX (Yuanyuan Xiao) and NZ critically revised the manuscript. All authors read and approved

the final manuscript, and were responsible for the decision to submit for publication.

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## Data availability

The data analyzed in this study can be made available by the corresponding author upon request.

## Declarations

### Ethics approval and consent to participate

The study protocol has been reviewed and approved by the Ethics Committee of Kunming Medical University. All study procedures were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

### Consent for publication

Not applicable.

### Competing interests

The authors declare no competing interests.

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