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RESEARCH

# Interaction of sexual violence perpetration and victimization on suicide attempts in Korean adolescents on additive and multiplicative scales: a population-based cross-sectional study

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## Abstract

**Purpose** To evaluate the associations and interaction between sexual violence perpetration and victimization on suicide attempts using a large representative sample of adolescents from South Korea.

**Methods** Based on data from 515,247 adolescents aged 12–18 years from the Korea Youth Risk Behavior Web-Based Survey (2006–2012), a nationally representative repeated cross-sectional survey, we obtained self-reports of suicide attempts over the past year and of lifetime sexual violence perpetration and victimization. Using complex survey weights, weighted logistic regression models were employed to estimate the odds ratios (ORs). The interaction analyses were conducted on both additive and multiplicative scales. All analyses were conducted separately for boys and girls.

**Results** Lifetime prevalence of sexual violence perpetration were 1.3% for boys and 0.4% for girls, and about 40% of those perpetrating sexual violence were also victims. After adjusting for several covariates, sexual violence perpetration was independently associated with suicide attempts in boys ($OR_{adjusted}$ for boys 1.80 [95% confidence intervals: 1.53, 2.11]), whereas in girls, the association was only marginally significant ($OR_{adjusted}$ for girls 1.27 [1.00, 1.63]). We found the negative multiplicative and additive interaction between the sexual violence perpetration and victimization on suicide attempts for both boys and girls (the ratio of ORs 0.30 [0.23, 0.39] for boys and 0.20 [0.12, 0.31] for girls; relative excess risk due to interaction − 1.20 [–1.91, − 0.50] for boys and − 2.33 [–3.00, − 1.66] for girls).

**Conclusion** Sexual violence perpetration and victimization were independently and interactively associated with suicide attempts in adolescents, with a sub-additive interaction found between these two variables. Public mental health services and policies should recognize the importance of actively involving adolescents who had sexually perpetrated others as key intervention targets.

**Keywords** Adolescent · Suicide attempts · Sexual violence · Victimization · Perpetration · Interaction

**Abbreviations**
n number
wn weighted number

## Introduction

Suicide among adolescents has become a major public health concern worldwide. Recent studies indicate that the suicide mortality rate for individuals aged 10 to 19 was 3.77 per 100,000 worldwide in 2020 [1]. South Korea, in particular, has a notably high rate of suicide deaths and attempts compared to other countries [2]. In South Korea, the trend of suicide attempts remains alarming, with girls reporting

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higher rates than boys [3]. A meta-analysis of 67 studies demonstrated that girls attempt suicide more frequently than boys, with an odds ratio of 1.96 in non-clinical adolescents, underscoring a consistent gender disparity in suicide attempts [4]. Additionally, several studies have highlighted a significant association between suicide attempts and victimization from sexual violence, a relationship that appears consistent across different cultures [5, 6]. However, little is known about the effects of sexual violence perpetration on suicidality among the general adolescent population. Given that adolescence is a critical period for the development of sexuality, self-image, and problem-solving skills, it is crucial to examine how sexual violence affects both perpetrators and victims within this age group.

The term "sexual violence perpetration or offense" encompasses any sexual activity that occurs without obtaining or granting consent freely, including rape, sexual harassment, and non-consensual video recording. Sexual violence perpetration by adolescents is frequently reported, with 9% of U.S. adolescents aged 14 to 21 involved in such activities during 2011 and 2012 [7], 5% of sexual offenses committed by adolescents in Singapore in 2006 [8], and 11.4% of sexual assault offenders in South Korea in 2010 being juveniles aged 18 or younger [9]. While sexual violence is typically a form of gender-based violence with men as perpetrators and women as victims, it is important to acknowledge that women can also perpetrate sexual violence through physical, verbal, or psychological means, and men can be victims as well. Examining the mental health of adolescents who commit sexual violence is of particular interest, as their criminal profiles and developmental trajectories differ from those involved in other types of violence [10, 11]. A meta-analysis has highlighted that psychopathology, such as depression and suicidal tendencies, is a notable characteristic of adolescent sexual offenders, distinguishing them from adolescent non-sexual offenders [12]. However, it is important to note that most studies included in this meta-analysis were conducted within psychiatric or correctional facilities [12].

Representative data on adolescents could help to accurately estimate the association between sexual violence perpetration and mental health at the population level. Previous studies conducted in community settings in the United States have shown that adolescents who perpetrate sexual violence are more likely to engage in suicide risk behaviors, experience depressive symptoms, and exhibit post-traumatic stress symptoms [13, 14]. However, these studies often overlooked factors such as alcohol and substance abuse, experiences of sexual violence victimization, and puberty—elements that are closely linked to sexual violence perpetration, victimization, and suicidality [15–17]. Furthermore, studying adolescents who perpetrated sexual violence in the general population should take selection bias into account. The lack of consideration of external validity could result in spurious associations between variables due to non-response bias [18]. Therefore, incorporating a complex survey design is essential for making accurate population-based inferences.

More importantly, previous studies have reported a high prevalence of the co-occurrence of sexual perpetration and victimization [19–21]. Both experiences of sexual violence perpetration and victimization can lead to social ostracization and stigmatization, which may increase the risk of suicide attempts among adolescents who are still developing their self-image. The overlap of these experiences might indicate significantly poorer coping mechanisms, emotional regulation, or a particularly vulnerable social environment compared to experiencing either type of violence alone, suggesting a potential synergistic effect on suicide attempts. While one study examined the joint effects of sexual violence perpetration and victimization on depressive and post-traumatic stress symptoms [14], the magnitude and direction of their interactions were not directly assessed, especially on an additive scale. Assessing additive interaction is important because it is more relevant to public health than multiplicative interaction and could provide insight into etiologic mechanisms [22]. Thus, the additive interaction may provide insight into the frequently reported overlap of sexual violence perpetration and victimization. Although previous studies have reported that both sexual violence perpetration and victimization are associated with an increased risk of suicide attempts, it is possible for interactions to take any direction. Moreover, it is important to conduct separate analyses for each gender, since it has been demonstrated that suicide attempts and sexual victimization are more prevalent in girls, whereas sexual perpetration is more prevalent in boys [4, 23]. Differences in the interaction between sexual violence perpetration and victimization may exist between boys and girls.

Therefore, we conducted a population-based cross-sectional study to assess the association between the sexual violence perpetration and victimization and suicide attempts among Korean adolescents. All analyses were performed separately by gender, based on evidence that youth experiences of sexual violence and suicide attempts differ markedly by gender. We hypothesized that adolescents who have experienced sexual violence perpetration would be more likely to report suicide attempts within the past year than those who have not for both boys and girls. We hypothesized that perpetration and victimization have a synergetic interaction and that this interaction would vary by gender. Secondary analyses also explored the association between sexual violence experiences and depressive symptoms and suicidal ideation. Although these mental health issues are

less severe than suicide attempts, they are strongly associated with suicide risk and need to be addressed [24]. We expect the results of this study to inform public mental health agencies about the implementation of preventative measures for both adolescent perpetrators and victims of sexual violence.

## Methods

### Study design and participants

The Korea Youth Risk Behavior Web-Based Survey (KYRBS) is a nationally representative population-based repeated cross-sectional survey that investigates health-related behaviors such as tobacco and alcohol use, mental health, and sexual behaviors among adolescents across all 17 provinces in South Korea (aged 12–18, grades 7–12). The participants were selected using nationwide stratified multistage random cluster sampling to represent middle and high school students across the country. The target population of the KYRBS consists of all middle and high school students in South Korea for a given year. Initially, the population was divided into 117 strata using regions and school types as stratification variables. The number of sample schools was allocated using a proportional distribution method based on the population composition. Stratified cluster sampling was employed, with the school as the primary sampling unit and the class as the secondary sampling unit. All students in the selected classes were surveyed, excluding those with long-term absenteeism, special needs, or dyslexia. Staff responsible for the sample schools received related training prior to the survey. On the survey day, students were escorted to the school's computer lab and randomly assigned to a computer. As the KYRBS is an anonymous, self-administered online survey, the supervising staff informed the participants before the survey began that the results would not be shared with anyone. The complex survey weight used in this study, provided by the Korea Centers for Disease Control and Prevention, is the product of the inverse of the sampling rate and the inverse of the response rate, multiplied by the post-adjustment rate. The KYRBS response rates were The KYRBS response rates were 90.9%, 94.8%, 95.1%, 97.6%, 97.7%, 95.5%, and 96.4% from 2006 to 2012 [25].

Among the 519,473 participants, we excluded 3 who had no data on suicide attempts ($n = 519{,}470$). We also excluded 4,223 participants who denied to provide their demographic information including age ($n = 515{,}247$). A detailed description of the KYRBS and its measurements can be found elsewhere [25, 26].

### Outcome measures

The primary outcome was the occurrence of suicide attempts over the past year. Suicide attempts were assessed using the following questions: "During the past 12 months, did you ever actually attempt suicide?" [27] Participants provided binary responses of either "yes" or "no" in response to those questions. We also used depressive episodes and suicidal ideation as secondary outcome variables. Depressive episodes were assessed using the following question: "During the last 12 months, did you ever have feelings of sadness or despair that have interrupted your daily life for at least 2 weeks?" Suicidal ideation was assessed using the following question: "During the past 12 months, have you ever seriously considered attempting suicide?" The KYRBS has used these measurement methods for 16 years (2005–2020) to monitor mental health in Korean adolescents [26]. Other national epidemiological investigations such as the Korea National Health and Nutrition Examination Survey and the Korean Community Health Survey have adopted the same questionnaires to monitor depression and suicidality in the Korean population [28, 29].

### Exposure measures

Participants self-reported sexual violence perpetration and victimization in the survey. Participants who answered "yes" to the single question, "Have you ever sexually perpetrated another" were classified as sexual violence perpetrators; those who did not were classified as the reference group. Sexual violence victimization was measured using the question, "Have you ever been sexually victimized by another?" for the yes and no responses, respectively. A similar single-question assessment of sexual violence was used in the Youth Risk Behavior Survey in the United States [30]. In South Korea, where adolescent sexuality remains a taboo subject, discussions and recognition of sexual violence have been limited. From 2006 to 2012, perceptions of sexual violence in South Korea were likely confined to illegal coercive intercourse by non-partners, potentially overlooking "less violent" offenses such as sexual harassment or stalking, which may not have been widely recognized as sexual violence perpetration.

### Covariates

We used pre-specified potential confounders for the multivariate regression model. We confirmed the empirical associations between sexual violence perpetration, victimization, and adolescent suicide attempts using univariate regression model. The covariates were age, urbanicity, study year, household socioeconomic status (SES), residential

status, body mass index (BMI), cigarette smoking, alcohol consumption, drug use, physical activity, insufficient sleep, subjective health, subjective happiness, premature puberty, early sexual debut, sexual orientation, and sexually transmitted diseases. The age ranged from 12 to 18 and was binarized into 12–15 and 16–18 years to reflect developmental stages [31]. The urbanicity of participants' residence was determined by their location. The study year ranged from 2006 to 2012 and was automatically encoded by the survey system. All other variables were measured by self-report. The household socioeconomic status was assessed on a five-point scale (very low, low, middle, high, and very high) and the categorized into low, middle and high group to maintain a sufficient sample size. The residential status was an indicator of where and who the participant lives with (living with family, relatives, friends or alone, and facility such as an orphanage). The BMI was calculated based on self-reported height and weight, and categorization was made on the basis of gender- and age-specific percentiles according to Korean growth standards [32]. The cigarette smoking was defined as one or more days of cigarette smoking during the past 30 days. The alcohol consumption was defined as having had one or more drinks in the last 30 days. The drug use was defined as ever using habitual and intentional drug in lifetime. The physical activity was defined as at least 30 min of moderate-intensity exercise on three or more days per week, or strength training on three or more days per week in the past week. The insufficient sleep was assessed on a five-point (very sufficient, sufficient, average, insufficient, and very insufficient) and was defined as having insufficient or very insufficient sleep in the past week. The poor subjective health and happiness were assessed on a five-point (strongly agree, agree, neutral, disagree, and strongly disagree) and were defined as disagreeing or strongly disagreeing with feeling healthy/happy normally. The sexual orientation was defined based on whether there was sexual contact with a same-sex partner (same-sex orientation), an opposite-sex partner (opposite-sex orientation), or unknown if there was no sexual contact. The early sexual debut was defined as having first sexual intercourse before age 12. The premature puberty was defined as having experienced nocturnal emissions (in the case of boys) or menarche (in the case of girls) before the age of 12 years old. The history of sexual transmitted disease was defined as ever having sexual transmitted disease in lifetime.

### Statistical analysis

All analyses were conducted separately for boys and girls. The 1-year prevalence and standard errors of suicide attempts and sexual violence were calculated using survey weights to represent the entire population of Korean adolescents. Based on the KYRBS data, the prevalence of suicide attempts was 4.8%, thereby satisfying the rarity assumption that enables the approximation of odds ratios (ORs) to relative risk [33]. While applying the survey weights, we calculated the ORs for suicide attempts between adolescents with and without experiences of sexual violence perpetration using multivariate logistic regression models. The associations between sexual violence victimization and suicide attempts were also analyzed using the multivariate logistic regression models. The study year was excluded from the pre-specified covariate set as it has no empirical relationship to either exposures or outcomes. We sequentially introduced covariates in the models to check for confounding effects on the estimated associations, and we presented the results in the Supplementary Results.

Interaction analyses were conducted on both an additive and multiplicative scale. We used An additive interaction occurs when the combined effect of two exposures is larger (or smaller) than the sum of its individual effects; an interaction on a multiplicative scale refers to a combined effect that is greater (or smaller) than the product of the individual effects [34]. Additive interactions were assessed using the relative excess risk due to interaction (RERI). The positive additive interaction was indicated by RERI values $> 0$, while the opposite indicated a negative additive interaction [35]. Multiplicative interactions were estimated using the product of perpetration and victimization in the outcome analysis. The positive multiplicative interaction was indicated by the ratio of ORs values $> 1$, while the opposite indicated a negative multiplicative interaction.

Using the same methodology, we conducted an additional analysis using depressive episodes and suicidal ideation as secondary outcome variables. We also calculated the E-value, which can be used to assess the robustness of the identified associations to the potential unmeasured confounders [36]. We applied Firth's penalized logistic regression models as a sensitivity analysis to minimize potential bias from the rare exposure and outcome, despite not encountering any non-convergence issues in the main analysis [37]. Statistical analyses were conducted using SAS software version 9.4.

## Results

### Prevalence of sexual violence and participants' characteristics

Of the 267,423 boys and 247,824 girls, representing 3,846,676 adolescents in Korea aged 12 to 18 years, 3.6% of boys ($n = 9,604$) and 6.1% of girls ($n = 15,082$) attempted suicide over a year. Lifetime prevalence of sexual violence

perpetration were 1.3% for boys ($n=3,424$) and 0.4% for girls ($n=921$). Lifetime prevalence of sexual violence victimization were 1% for boys ($n=2,732$) and 1.6% for girls ($n=3,941$). Among those who perpetrated sexual violence, 1,430 of boys (41.8%) and 360 of girls (39.1%) were also victims (Fig. 1). Table 1 shows the characteristics of the participants, stratified by their experience of sexual violence perpetration. In boys, all characteristics, except for urbanicity, significantly differed between those with and without experience of sexual violence perpetration, while in girls, all characteristics, except for urbanicity and premature puberty, also showed significant differences. Sixteen potential confounders except for the study year were statistically associated with the sexual violence perpetration and victimization and suicide attempts and they were used as covariates in the multivariate regression analysis (supplementary Table 1).

## Independent association of the sexual violence perpetration and victimization with suicide attempts

Table 2 shows the independent associations of sexual violence perpetration and victimization with suicide attempts among boys and girls. Among boys who had perpetrated sexual violence to others, the OR for suicide attempts within a year was 5.12 (95% confidence intervals [CI] 4.54, 5.78), and for girls, it was 4.89 (95% CI 4.00, 5.97). In the final model that adjusted for demographic, psychosocial and sexual characteristics, the association between sexual violence perpetration and suicide attempts was still significantly significant for boys (OR 1.80 [95% CI 1.53, 2.11], E-value 3.00), while for girls, it was not statistically significant but approached significance closely (OR 1.27 [95% CI 1.00, 1.63], E-value 1.86). For sexual violence victimization, the crude OR for suicide attempts was 5.03 among boys (95% CI 4.39, 5.77) and 4.22 among girls (95% CI 3.80, 4.68). In the final model, the results indicated that sexual violence victimization was significantly associated with higher odds for suicide attempts for both boys and girls (OR for boys 1.68 [95% CI 1.39, 2.04], E-value 2.75; OR for girls 2.15 [95% CI 1.91, 2.43], E-value 3.72). For the depressive symptoms and suicidal ideation, all associations remained statistically significant except for girls who had engaged in sexual violence perpetration, although the strength of these associations was attenuated (Supplementary Table 2). The results of the sequential modelings, which demonstrate changes in the association between sexual violence perpetration, victimization experiences, and suicide attempts as influenced by specific sets of covariates, are presented in Supplementary Tables 4 and 5. In the Firth's penalized logistic model, we found similar but slightly attenuated estimates of the independent and interactive associations between sexual violence perpetration and victimization with suicide attempts for both boys and girls (Supplementary Tables 5–7).

## Interaction between sexual violence perpetration and victimization on suicide attempts

The results of the interaction analysis found that the negative multiplicative and additive interaction between perpetration and victimization of sexual violence both for boys (Table 3) and for girls (Table 4). In boys, the ORs for suicide attempts were 1.98 (95% CI 1.64, 2.39, E-value 3.37) for perpetration-only experiences, 1.87 (95% CI 1.46, 2.40, E-value 3.15) for victimization-only, and 1.65 (95% CI 1.28, 2.14, E-value 2.69) for experiences involving both perpetration and victimization, with boys reporting no such experiences serving as the reference category. We observed that the statistically significant negative additive and multiplicative interaction between perpetration and victimization among boys (RERI −1.20 [95% CI −1.91, −0.50]; ratio

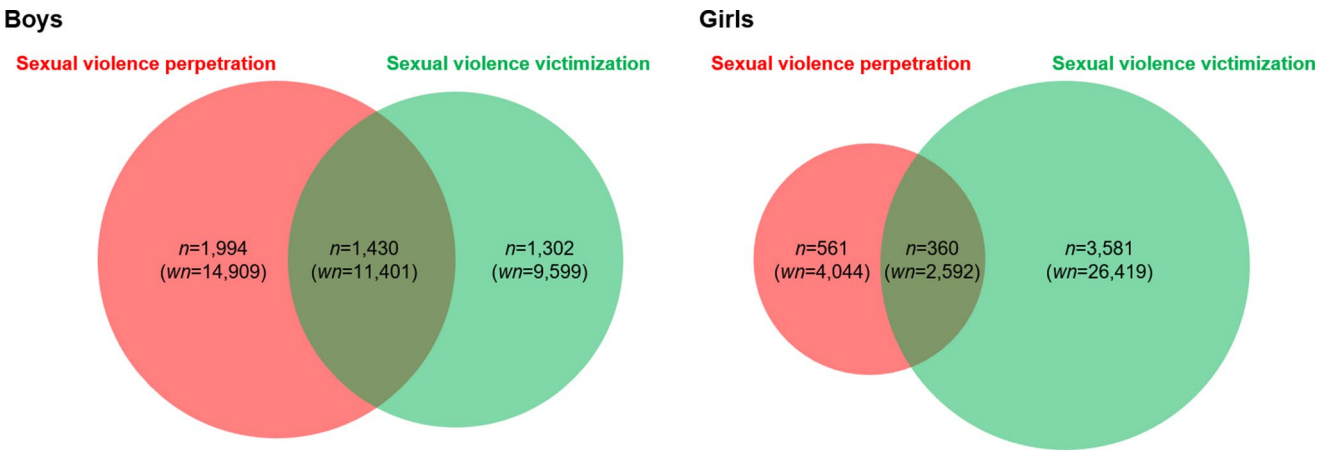


**Fig. 1** Venn diagram of the total number of experienced sexual violence perpetration and victimization among adolescents in South Korea during 2006–2012. On the left is the Venn diagram for boys, and on the right is the one for girls. *Abbreviation* n, number; wn, weighted number

**Table 1** Characteristics of Korean adolescents with and without experience of sexual violence perpetration in pooled 2006–2012 KYRBS data ($n = 515,247$, sampling-weighted $n = 3,846,676$)

| | Boys | | | Girls | | $p$ value |
|---|---|---|---|---|---|---|
| | No SVP | SVPa | | No SVP | SVPa | |
| | N (%) | N (%) | $p$ value | N (%) | N (%) | |
| Age group | | | < 0.0001 | | | 0.01 |
| 12–15 years old | 157,080 (59.5) | 1859 (54.3) | | 143,274 (58.0) | 574 (62.3) | |
| 16–18 years old | 106,919 (40.5) | 1565 (45.7) | | 103,629 (42.0) | 347 (37.7) | |
| Urbanicity | | | 0.09 | | | 0.01 |
| Rural | 35,147 (13.3) | 500 (14.6) | | 32,129 (13.0) | 148 (16.1) | |
| Small city | 99,454 (37.7) | 1276 (37.3) | | 96,815 (39.2) | 363 (39.4) | |
| Large city | 129,398 (49.0) | 1648 (48.1) | | 117,959 (47.8) | 410 (44.5) | |
| Study year | | | < 0.0001 | | | 0.33 |
| 2006 | 36,642 (13.9) | 377 (11.0) | | 33,933 (13.7) | 138 (15.0) | |
| 2007 | 38,284 (14.5) | 625 (18.3) | | 34,793 (14.1) | 134 (14.6) | |
| 2008 | 38,258 (14.5) | 537 (15.7) | | 35,518 (14.4) | 138 (15.0) | |
| 2009 | 38,524 (14.6) | 539 (15.7) | | 34,986 (14.2) | 143 (15.5) | |
| 2010 | 37,506 (14.2) | 506 (14.8) | | 34,499 (14.0) | 112 (12.2) | |
| 2011 | 37,124 (14.1) | 464 (13.6) | | 37,477 (15.2) | 140 (15.2) | |
| 2012 | 37,661 (14.3) | 376 (11.0) | | 35,697 (14.5) | 116 (12.6) | |
| Household SES | | | < 0.0001 | | | < 0.0001 |
| Low | 61,609 (23.3) | 969 (28.3) | | 61,550 (24.9) | 337 (36.6) | |
| Middle | 119,793 (45.4) | 1165 (34.0) | | 122,960 (49.8) | 310 (33.7) | |
| High | 82,597 (31.3) | 1290 (37.7) | | 62,393 (25.3) | 274 (29.8) | |
| Living with | | | < 0.0001 | | | < 0.0001 |
| Family | 250,853 (95.0) | 2831 (82.7) | | 235,945 (95.6) | 715 (77.6) | |
| Relatives | 3697 (1.4) | 159 (4.6) | | 3155 (1.3) | 57 (6.2) | |
| Friends/alone | 7710 (2.9) | 193 (5.6) | | 6914 (2.8) | 60 (6.5) | |
| Facility | 1739 (0.7) | 241 (7.0) | | 889 (0.4) | 89 (9.7) | |
| BMI | | | < 0.0001 | | | < 0.0001 |
| Underweight | 20,383 (7.7) | 252 (7.4) | | 17,009 (6.9) | 58 (6.3) | |
| Normal | 167,669 (63.5) | 2039 (59.6) | | 166,841 (67.6) | 513 (55.7) | |
| Overweight | 16,835 (6.4) | 170 (5.0) | | 14,434 (5.9) | 46 (5.0) | |
| Obesity | 15,645 (5.9) | 198 (5.8) | | 8710 (3.5) | 32 (3.5) | |
| Missing | 43,467 (16.5) | 765 (22.3) | | 39,909 (16.2) | 272 (29.5) | |
| Premature puberty | | | < 0.0001 | | | 0.05 |
| No | 223,632 (84.7) | 2455 (71.7) | | 116,242 (47.1) | 404 (43.9) | |
| Yes | 40,367 (15.3) | 969 (28.3) | | 130,661 (52.9) | 517 (56.1) | |
| Smoking cigarette | | | < 0.0001 | | | < 0.0001 |
| No | 220,597 (83.6) | 2110 (61.6) | | 228,687 (92.6) | 535 (58.1) | |
| Yes | 43,402 (16.4) | 1314 (38.4) | | 18,216 (7.4) | 386 (41.9) | |
| Drinking alcohol | | | < 0.0001 | | | < 0.0001 |
| No | 197,566 (74.8) | 1878 (54.9) | | 195,361 (79.1) | 451 (49.0) | |
| Yes | 66,433 (25.2) | 1546 (45.1) | | 51,542 (20.9) | 470 (51.0) | |
| Drug use | | | < 0.0001 | | | < 0.0001 |
| No | 259,398 (98.3) | 2766 (80.8) | | 244,419 (99.0) | 704 (76.4) | |
| Yes | 4601 (1.7) | 658 (19.2) | | 2484 (1.0) | 217 (23.6) | |
| Physical activity | | | < 0.0001 | | | < 0.0001 |
| No | 131,952 (50.0) | 1576 (46.0) | | 184,559 (74.8) | 588 (63.8) | |
| Yes | 132,047 (50.0) | 1848 (54.0) | | 62,344 (25.3) | 333 (36.2) | |
| Insufficient sleep | | | < 0.0001 | | | < 0.0001 |
| No | 171,396 (64.9) | 1871 (54.6) | | 139,088 (56.3) | 437 (47.4) | |
| Yes | 92,603 (35.1) | 1553 (45.4) | | 107,815 (43.7) | 484 (52.6) | |
| Subjective health | | | < 0.0001 | | | < 0.0001 |
| Healthy | 245,798 (93.1) | 3067 (87.6) | | 223,586 (90.6) | 792 (86.0) | |
| Not healthy | 18,201 (6.9) | 357 (10.4) | | 23,317 (9.4) | 129 (14.0) | |

**Table 1** (continued)

| | Boys | | | Girls | | *p* value |
|---|---|---|---|---|---|---|
| | No SVP | SVPa | | No SVP | SVPa | |
| | N (%) | N (%) | *p* value | N (%) | N (%) | |
| Happiness | | | < 0.0001 | | | < 0.0001 |
| Happy | 231,382 (87.7) | 2748 (82.3) | | 210,053 (85.1) | 673 (73.1) | |
| Unhappy | 32,617 (12.3) | 676 (19.7) | | 36,850 (14.9) | 248 (26.9) | |
| Early sexual debut | | | < 0.0001 | | | < 0.0001 |
| No | 259,482 (98.3) | 2317 (67.7) | | 244,906 (99.2) | 642 (69.7) | |
| Yes | 2456 (0.9) | 891 (26.0) | | 900 (0.4) | 201 (21.8) | |
| Missing | 2061 (0.8) | 216 (6.3) | | 1097 (0.4) | 78 (8.5) | |
| Sexual orientation | | | < 0.0001 | | | < 0.0001 |
| Unknown | 213,246 (80.8) | 1453 (42.4) | | 206,985 (83.8) | 440 (47.8) | |
| Other-sex | 46,621 (17.7) | 736 (21.5) | | 37,240 (15.1) | 188 (20.4) | |
| Same-sex | 4132 (1.6) | 1235 (36.1) | | 2678 (1.1) | 293 (31.8) | |
| Ever had STD | | | < 0.0001 | | | < 0.0001 |
| No | 263,031 (99.6) | 3051 (89.1) | | 246,544 (99.9) | 825 (89.6) | |
| Yes | 968 (0.4) | 373 (10.9) | | 359 (0.2) | 96 (10.4) | |
| Lifetime SVV | | | < 0.0001 | | | < 0.0001 |
| No | 262,697 (99.5) | 1994 (58.2) | | 243,322 (98.6) | 561 (60.9) | |
| Yes | 1302 (0.5) | 1430 (41.8) | | 3581 (1.4) | 360 (39.1) | |

KYRBS: Korean Youth Risk Behavior Survey, SMD: Standardized mean difference, SVP: Sexual violence perpetration, SVV: Sexual violence victimization, SES: Socioeconomic status, BMI: Body mass index, STD: Sexually transmitted disease

**Table 2** Associations of sexual violence perpetration and victimization with suicide attempts among Korean adolescents using various models by gender ($n = 515,247$, sampling-weighted $n = 3,846,676$)

| Models | Case *n* / Control *n* | Case *n* / Control *n* | Crude OR (95% CI) | Adjusted OR[a] (95% CI) |
|---|---|---|---|---|
| Sexual violence perpetration | No SVP | SVP | | |
| Boys | 9091 / 254,908 | 513 / 2911 | 5.12 (4.54, 5.78) | 1.80 (1.53, 2.11) |
| Girls | 14,868 / 232,035 | 214 / 707 | 4.89 (4.00, 5.97) | 1.27 (1.00, 1.63) |
| *Sexual violence victimization* | *No SVV* | *SVV* | | |
| Boys | 9189 / 255,502 | 415 / 2317 | 5.03 (4.39, 5.77) | 1.68 (1.39, 2.04) |
| Girls | 14,270 / 229,613 | 812 / 3129 | 4.22 (3.80, 4.68) | 2.15 (1.91, 2.43) |

To estimate the odds ratios (ORs), all models used weighted logistic regression

*Abbreviations* SVP: Sexual violence perpetration, OR: Odds ratio

[a]The covariates that were used in adjustment: age, study year, urbanicity, household socioeconomic status, residential status, body mass index, premature puberty, cigarette smoking, alcohol consumption, drug use, physical activity, insufficient sleep, subjective health, happiness, early sexual debut, sexual orientation, and sexually transmitted diseases

**Table 3** Interaction between perpetration and victimization of sexual violence and suicide attempts among male adolescents in South Korea ($n = 515,247$, sampling-weighted $n = 3,846,676$)

| | No SVP ($n = 263,999$) | | SVP ($n = 3,424$) | | *OR (95% CI) for SVP versus no SVP within SVV strata* |
|---|---|---|---|---|---|
| | Case *n* / Control *n* | OR (95% CI) | Case *n* / Control *n* | OR (95% CI) | |
| No SVV ($n = 264,691$) | 8942 / 253,755 | Reference | 247 / 1747 | 1.98 (1.64, 2.39) | 1.96 (1.62, 2.36) |
| SVV ($n = 2,732$) | 149 / 1153 | 1.87 (1.46, 2.40) | 266 / 1164 | 1.65 (1.28, 2.14) | 1.53 (1.00, 2.36) |
| *OR (95% CI) for SVV versus no SVV within SVP strata* | | 1.85 (1.44, 2.37) | | 1.48 (0.98, 2.22) | |

Measure of interaction on additive scale: RERI (95% CI) = -1.20 (-1.91, -0.50)

Measure of interaction on multiplicative scale: ratio of ORs (95% CI) = 0.30 (0.23, 0.39)

*Abbreviation* SVP, sexual violence perpetration; SVV, sexual violence victimization

**Table 4** Interaction between perpetration and victimization of sexual violence and suicide attempts among female adolescents in South Korea ($n = 515,247$, sampling-weighted $n = 3,846,676$)

| | No SVP ($n = 264,903$) | | SVP ($n = 921$) | | *OR (95% CI) for SVP versus no SVP within SVV strata* |
|---|---|---|---|---|---|
| | Case *n* / Control *n* | OR (95% CI) | Case *n* / Control *n* | OR (95% CI) | |
| No SVV ($n = 243,883$) | 14,150 / 229,172 | Reference | 120 / 441 | 1.82 (1.36, 2.45) | 0.77 (0.57, 1.04) |
| SVV ($n = 3,941$) | 718 / 2863 | 2.36 (2.08, 2.67) | 94 / 266 | 0.85 (0.60, 1.20) | 0.44 (0.26, 0.76) |
| *OR (95% CI) for SVV versus no SVV within SVP strata* | | 2.36 (2.08, 2.67) | | 0.68 (0.38, 1.23) | |

Measure of interaction on additive scale: RERI (95% CI) = -2.33 (-3.00, -1.66)

Measure of interaction on multiplicative scale: ratio of ORs (95% CI) = 0.20 (0.12, 0.31)

*Abbreviation* SVP, sexual violence perpetration; SVV, sexual violence victimization

of ORs 0.30 [95% CI 0.23, 0.39], E-value 3.05). In girls, the ORs for suicide attempts were 1.82 (95% CI 1.36, 2.45, E-value 3.04) for perpetration-only experiences and 2.36 (95% CI 2.08, 2.67, E-value 4.15) for victimization-only, with girls reporting no such experiences serving as the reference category. The association between experiences involving both perpetration and victimization and suicide attempts were not statistically significant (OR 0.85 [95% CI 0.60, 1.20], E-value 1.63). We also found negative additive and multiplicative interaction among girls (RERI −2.33 [95% CI −3.00, −1.66]; ratio of ORs 0.20 [95% CI 0.12, 0.31]; E-value 3.9).

## Discussion

In this nationally representative cross-sectional survey of Korean adolescents, we found the independent and interactive effects of lifetime sexual violence perpetration and victimization on one-year prevalence of suicide attempts. Boys who had experienced sexual violence perpetration alone had 1.8 times higher odds of reporting suicide attempts after adjustment of several covariates, while for girls, the association was not statistically significant but approached significance closely. Boys and girls who experienced sexual violence victimization alone had 1.68-times and 2.15-time higher odds of reporting suicide attempts than those who were neither perpetrators nor victims. There were negative multiplicative and additive interaction effects between the sexual violence perpetration and victimization on suicide attempts both for boys and girls, indicating that the interactive effect of perpetration and victimization was less than the sum and product of the estimated effects of perpetration and victimization alone.

These results are consistent with previous finding that adolescents who have sexually perpetrated others reported higher odds of suicidal behaviors [13]. There were smaller associations between suicidality and sexual violence perpetration in this study compared to a previous study conducted in the US (in the previous study, the OR for boys was 1.96 and for girls it was 1.99) [13]. This discrepancy may be explained by the higher prevalence of sexual violence perpetrated by adolescents in previous studies conducted in the United States (in the previous study, 4.8% of boys and 1.3% of girls reported perpetrating sexual violence) [13]. Our study also found the association and interaction of sexual perpetration and victimization with two other outcomes, depressive symptoms and suicidal ideation, which are highly correlated with suicide attempts [38]. The results of the present study are similar to those of a community-based cross-sectional study in the United States that found depressive symptoms were associated with sexual perpetration both in boys and girls, but the associations were stronger among boys and less strong among girls than in the current study [39]. Taking into account internalizing psychopathology, such as suicidal ideation and depressive symptoms, could be helpful in interpreting the association between suicide attempts and sexual violence perpetration. In future research, it will be beneficial to explore how internalizing and externalizing psychopathologies impact suicide attempts in relation to sexual violence perpetrators.

We initially hypothesized that there would be a synergistic interaction between perpetration and victimization of sexual violence and suicide attempts. Contrary to our expectations, there was a negative interaction between sexual violence perpetration and victimization in this study, and it appears that co-occurring experiences do not appear to be synergistic regarding the risk of suicide attempts. There are three possible ways to interpret the negative interaction between sexual violence perpetration and victimization in relation to suicide attempts. First, adolescents involved in both sexual violence perpetration and victimization could be of special interest in clinical care than those only with perpetration of sexual violence, as current practices primarily focus on mental health of victims only. Second, as a result of using cross-sectional data within a complex causal framework,

interaction analysis could reveal spurious associations if victimization of sexual violence acted as an effect modifier, confounder, or mediator. Finally, there is the possibility of competing antagonism if the mechanisms of sexual violence perpetration and victimization effects on suicide attempts are similar, then co-occurring of these two factors compete to result in suicide attempts [40]. The results partially aligns with the existing research that there is no difference between sexual violence perpetration and victimization in correlation with substance use [41]. According to the interpersonal theory of suicide, three psychological factors contribute to the risk of suicide attempts: perceived burdensomeness, thwarted belongingness, and acquired capability [42]. Both sexual violence perpetration and victimization could lead to potential social ostracization, stigma, and punishment. These psychosocial consequences can increase perceived burdensomeness and thwarted belongingness as a shared motivation for suicide attempts. However, as this cross-sectional study design precludes causal claims, further studies, especially longitudinal studies, are needed to investigate the mechanisms of the negative interaction between sexual violence perpetration and victimization on suicide attempts.

Moreover, this study found the varied effects of sexual violence perpetration and victimization on suicide attempts between genders. Although the additive and multiplicative interactions were negative for both boys and girls, the independent associations showed different association patterns between genders. In boys, the association strengths of perpetration and victimization were similar. However, sexual violence victimization appeared to be more strongly associated with suicide attempts in girls, whereas perpetration was statistically not associated. These findings suggest that experiences of sexual violence are differentially perceived within the context of gender and that these variations manifest in differing degrees of association with suicide attempts. As these results differ from those of a study conducted in the United States, which found similar associations between sexual violence perpetration and suicide risk across genders, this discrepancy may be attributed to differences in the study populations and the prevalence of sexual violence [13].

### Strengths and limitations

This study has several limitations. First, because we used a cross-sectional survey, we could not identify the exact temporal sequence of experiences of sexual violence and mental health. Despite restricting temporality to some extent by limiting the outcome measurement intervals to within a year, the use of cross-sectional survey data precludes causal claims of these results. Therefore, a prospective cohort study with a larger sample size is needed to reduce the possibility of reverse causality. Second, the data were restricted to the participants' self-reports of a broad experience of sexual violence. The self-reported lifetime prevalence of the sexual violence perpetration and victimization in Korean adolescents was lower than that reported in previous studies conducted in the United States [7, 13], which tends to lead to associations with the null hypothesis. In addition, the characteristics of sexual violence can vary in terms of the type, age of onset, characteristics of counterparts, and the number of sexual violence experiences. A clear definition of sexual violence would reduce these non-random measurement errors. In addition, there is a possibility of recall bias in sexual violence reports because individuals with mental health problems are more likely to recall and report their lifetime violence experiences [43, 44]. Third, even with representative data being used, it may still be possible to identify blind spots when defining a population. As adolescents who commit clear and severe acts of sexual violence against others are more likely to be expelled from school, placed in juvenile detention centers, or run away from home, it is difficult to extrapolate these results to these populations. Finally, unmeasured confounders such as childhood adverse events and comorbid psychiatric and medical conditions could affect the association between sexual violence perpetration and suicidal behaviors [45]. The post hoc calculations of the E-value showed that for this finding to be explained by an unknown confounder, the confounder would have to be associated with both sexual violence perpetration and suicide attempts by an odds ratio of at least 3.00 for boys and 1.86 for girls.

Despite these limitations, this study had several strengths. To the best of our knowledge, this is the first study to address independent and interactive associations between the sexual violence perpetration and victimization and suicide attempts on a national scale in South Korea. Furthermore, the use of large-sample data allowed us to control for several confounders that could not be adjusted in previous studies, such as alcohol and drug use, puberty, and sexual behavior.

## Conclusion

The sexual violence perpetration and victimization were independently associated with suicide attempts in boys, but only the victimization of sexual violence was associated with suicide attempts in girls. On a population level, the co-occurrence of perpetration and victimization of sexual violence does not appear to significantly increase the odds of suicide attempts compared to experiencing only one type of sexual violence. The negative interaction between perpetration and victimization was more pronounced among girls than boys. While further research is needed to explore these findings in depth, public mental health services and

policies should recognize the importance of actively involving adolescents who had sexually perpetrated others as key intervention targets.

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**Author contributions** HK and SJJ designed and conceptualized the study. HK and SJJ acquired, analyzed, and interpreted the data. HK drafted the manuscript. SJJ, JWK, and JSY critically reviewed the manuscript for intellectual content. SJJ obtained the funding and supervised the study. All authors have approved the final manuscript.

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**Data Availability** The KYRBS dataset can be accessed publicly at http://yhs.cdc.go.kr. To obtain the dataset, researchers must complete a straightforward application process through the official website, and usage of the dataset is permitted only after access is granted via the site.

## Declarations

**Ethical approval** The KYRBS was approved by the Institutional Review Board of the Korea Centers for Disease Control and Prevention. The Korea Centers for Disease Control and Prevention approved the use of the KYRBS for research and publication of results. All procedures in this study complied with the ethical standards of the relevant national and institutional committees on human experimentation and were carried out in accordance with the Ethical Principles for Medical Research from the Helsinki Declaration of 1975, revised in 2008.

**Consent to participate** The written informed consent was obtained from all participants.

**Competing interests** The authors declare no competing interests.



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