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The rate of condom use among sexually active adolescents: A nationwide cross-sectional study in Taiwan from 2012 to 2016

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TITLE

The rate of condom use among sexually active adolescents: A nationwide cross-sectional study in Taiwan from 2012 to 2016

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ABSTRACT

Objective: Adolescents’ risky sexual behaviors are associated with sexually transmitted infections and unwanted pregnancies. This study aimed to estimate the sexual intercourse and condom use rates at first and last sex among Taiwanese adolescents in Grades 7–12.

Design: A secondary data analysis of the Taiwan Global School-Based Student Health Survey’s 2012–2016 data. The survey was anonymous, cross-sectional, and nationwide.

Setting: Taiwan high school students (Grades 7-12).

Participants: The sample comprised 27,525 students from junior high schools (Grades 7–9) and senior high schools, comprehensive schools, vocational high schools, and night schools (Grades 10–12).

Main outcome measures: The rate of ever having had sexual intercourse; the rates of condom use at first and last sex.
Results: The sexual intercourse rate in each school type (in ascending order) was junior high school (1.62%), senior high school (4.14%), comprehensive school (9.08%), vocational high school (14.03%), and night school (41.09%). Condom use rate decreased from 57.07% (95% confidence interval [CI] = 54.31%–59.83%) at first sex to 25.72% (95% CI = 23.34%–28.10%) at last sex ($p < .0001$), which is lower than in Western countries. The condom use rate (in ascending order) was junior high school (first sex: 37.67%, last sex: 19.76%), night school (55.83%, 22.62%), vocational high school (61.13%, 25.78%), comprehensive school (62.83%, 28.61%), and senior high school (68.38%, 34.96%). The condom use rate at first and last sex did not differ significantly between the sexes. Adolescents with one sexual partner were more likely to use condoms than those with multiple sexual partners.

Conclusions: This study highlights that, despite the low sexual intercourse rate (4.95%), there is lower condom use at last sex than at first sex, which indicates that many sexually active Taiwanese adolescents are not practicing protected sex, especially among junior high school students.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- The Taiwan Global School-Based Student Health Survey (GSHS) was cross-sectional and based on a large nationally representative sample.
- The GSHS allows for a fair comparison of the sexual intercourse and condom use rates between Taiwanese students and students from other countries (i.e. cross-country comparison).
- In addition, the survey was anonymous and therefore encouraged honest responses to sensitive questions (such as sexual behaviors) from participants.
- Since the survey was self-administered, there might be response bias.
- Regarding survey question design, ‘sexual intercourse’ might be misinterpreted as non-vaginal sex and the frequency of condom use between the first and last sex was not asked.

INTRODUCTION
Adolescent risky sexual behavior is an important public health issue because of its association with sexually transmitted infections (STIs) and teenage pregnancies, which increase the medical and social burden. In Taiwan, the number of newly reported HIV/AIDS cases increased from 2012–2016,[1] and the estimated incidence rate of HIV among adolescents aged 13–24 years was about 20 per 100,000 population during this period.[2] Condoms are considered the most effective contraception to protect against STIs. Condom use at last high-risk sex is one of the indicators of the Millennium Development Goals’ monitoring that was established by the United Nations International Children’s Emergency Fund to tackle STIs.[3] In Taiwan, the sexual intercourse rates among adolescents aged 13–15 years increased from 2.2% (male) and 1.8% (female) in 2006 to 5.4% (male) and 5.3% (female) in 2016.[4] Furthermore, the contraception use rate among these adolescents increased from 56.2% (male) and 58.1% (female) in 2006 to 74.8% (male) and 77.7% (female) in 2016.[4] However, whether sexually active adolescents in Taiwan actually practice protected sex (i.e., use condoms) remains unclear.

It has long been speculated that adolescent sexual behaviors are influenced by school type and education programs.[5] In Taiwan, public education has been compulsory from primary school to junior high school since 1968. Since 2014, a full 12-year compulsory education program has been implemented. Junior high school students in Grade 9 take a high school entrance examination to continue their education, which is designed as a screening tool to assign students to various school programs for Grades 10–12. Students who aspire to receive higher education mostly attend regular senior high schools. Other educational opportunities include vocational high schools and comprehensive schools, which are workplace-oriented and emphasize vocational skills. Night school curricula vary, ranging from vocational to academic courses. Therefore, in this study, we aimed to estimate the sexual intercourse and condom use rates at first and last sex among Taiwanese adolescents across school types by using nationally representative data of Grade 7–12 students. To our knowledge, this study is the first to examine whether sexually active adolescents in Taiwan actually practice protected sex by using the data from a large nationally representative sample.

METHODS
We performed a secondary analysis of the 2012–2016 data of the Taiwan Global School-Based Student Health Survey (GSHS). The Taiwan GSHS is a nationwide cross-sectional study that surveys the health behaviors of Grade 7–9 (aged 12-15) and Grade 10–12 (aged 15-18) students every other year.[6]

The survey was conducted by the Health Promotion Administration (HPA), Ministry of Health and Welfare of Taiwan, in collaboration with the United States’ Centers for Disease Control and Prevention.[6] The Taiwan GSHS was translated into Chinese from the English version. The HPA first categorized schools into four geographic levels (i.e., big city, small city, urban town, and rural town) according to the population density of their locations. Next, the HPA used a two-step “probability proportional to size” method at each geographic level for sampling, where the sample schools were drawn before the sample classes.[6] They invited all students from the sample classes to participate. The survey was anonymous and no identifying information was collected. Additional details of the Taiwan GSHS’s methodology are reported elsewhere.[6]

From 2012–2016, there were 29,040 participants, and the response rates were 93.3% in 2012, 89.6% in 2013, 93.7% in 2014, 90.2% in 2015, and 92.6% in 2016.[7] Junior high school students were surveyed in 2012, 2014, and 2016, and Grade 10–12 students (including senior high school, comprehensive, vocational high school, and night school students) were surveyed in 2013 and 2015. As illustrated in Figure 1, a total of 27,525 students were included in this study after excluding those who did not indicate their sex (n = 62) and those who gave contradictory answers to the eight survey questions (Table S1, online supplementary material) about sexual behaviors (n = 1,453).

We selected some questions from the GSHS (Table S2), which were of two types: demographics and sexual behaviors. The demographic variables included sex, age, degree of urbanization, school type, and grade. The variables regarding sexual behaviors were ever having had sexual intercourse, number of lifetime sexual partners, condom use, and non-condom use at first sex and last sex. The outcome variables were ever having had sexual intercourse and condom use at first and last sex.

We used the chi-square test to examine the association between the students’ sex and the outcome variables (sexual intercourse and condom use at first and last sex) in each school type. McNemar’s test was conducted to investigate the consistency of condom use at first and last sex.
for students who had one sexual partner and those who had more than one sexual partner. We conducted all analyses using SAS 9.4 (SAS Institute, Cary, NC, USA). The significance level was 0.05.

**Ethics**

This study was approved by the Institutional Review Board of the Chang Gung Memorial Hospital (202001534B0). Informed consent was not required because the survey was anonymous.

**Patient and public involvement**

No patients were involved.

**RESULTS**

**Sexual intercourse rate by sex, school type, and grade**

Overall, the sexual intercourse rate was 4.95% (Figure 1). The ascending order of sexual intercourse rate by school type was junior high school (1.62%), senior high school (4.14%), comprehensive school (9.08%), vocational high school (14.03%), and night school (41.09%).

Regarding the students’ sex, males (5.33%) were significantly more likely to ever have had sexual intercourse than females (4.53%) across all school types ($p = 0.002$) (Table 1). However, the difference in the sexual intercourse rates between junior high school males (1.73%) and females (1.51%) was statistically non-significant. From Grades 10–12, the sexual intercourse rate among males was higher than among females (male: 11.25%; female: 9.83%; $p = 0.0208$). The sexual intercourse rates of male and female 10–12 grade students in each school type are listed in Table 1. The sexual intercourse rate generally increased by grade in all school types and both sexes, except for night school and female vocational high school students (Figure 2).
Table 1. Rates of ever having had sexual intercourse, condom use at first and last sex among adolescents in Taiwan from 2012 to 2016, by sex

|                          | Male (%)                     | Female (%)                   | p         |
|--------------------------|------------------------------|------------------------------|-----------|
| **Sexual intercourse**   |                              |                              |           |
| Total                    | 775/14531 (5.33%)            | 588/12994 (4.53%)            | 0.0020 *  |
| Grade 7-9                |                              |                              |           |
| Junior High school       | 156/9027 (1.73%)             | 125/8286 (1.51%)             | 0.2534    |
| Grade 10-12              | 619/5504 (11.25%)            | 463/4708 (9.83%)             | 0.0208 *  |
| Senior high school       | 74/1505 (4.92%)              | 53/1559 (3.4%)               | 0.0352 *  |
| Comprehensive school     | 240/2518 (9.53%)             | 157/1855 (8.46%)             | 0.2245    |
| Vocational high school   | 132/1048 (12.6%)             | 170/1104 (15.4%)             | 0.0613    |
| Night school             | 173/433 (39.95%)             | 83/190 (43.68%)              | 0.3836    |
| **Condom use at first sexual intercourse** |                              |                              |           |
| Total                    | 384/688 (55.81%)             | 332/549 (60.47%)             | 0.3164    |
| Grade 7-9                |                              |                              |           |
| Junior High school       | 41/118 (34.75%)              | 43/105 (40.95%)              | 0.3397    |
| Grade 10-12              | 343/570 (60.18%)             | 279/444 (62.84%)             | 0.3877    |
| Senior high school       | 40/65 (61.54%)               | 40/52 (76.92%)               | 0.0754    |
| Comprehensive school     | 142/224 (63.39%)             | 93/150 (62.00%)              | 0.7847    |
| Vocational high school   | 72/121 (59.50%)              | 101/162 (62.35%)             | 0.6276    |
| Night school             | 89/160 (55.63%)              | 45/80 (56.25%)               | 0.9268    |
| **Condom use at last sexual intercourse** |                              |                              |           |
| Total                    | 186/725 (25.66%)             | 146/566 (25.80%)             | 0.9545    |
| Grade 7-9                |                              |                              |           |
| Junior High school       | 26/133 (19.55%)              | 23/115 (20.00%)              | 0.9291    |
| Grade 10-12              | 160/592 (27.03%)             | 123/451 (27.27%)             | 0.9296    |
| Senior high school       | 27/70 (38.57%)               | 16/53 (30.19%)               | 0.3343    |
| Comprehensive school     | 67/227 (29.52%)              | 42/154 (27.27%)              | 0.6345    |
| Vocational high school   | 27/125 (21.60%)              | 47/162 (29.01%)              | 0.1546    |
| Night school             | 39/170 (22.94%)              | 18/82 (21.95%)               | 0.8603    |

*p*: p-values were obtained from Chi-square test.

*: p-values < 0.05

Condom use at first and last sexual intercourse

The overall condom use rate decreased from 57.07% at first sex to 25.72% at last sex (Figure 1). In terms of school type, the ascending order of the condom use rate was junior high school (first sex: 37.67%, last sex: 19.76%), night school (55.83%, 22.62%), vocational high school (61.13%, 25.78%), comprehensive school (62.83%, 28.61%), and senior high school.
Moreover, the condom use rates at both first and last sex were not statistically different between male and female adolescents (Table 1).

When investigating the decrease in the condom use rate, we observed that adolescents who used condoms at first sex (58.16%) mostly switched to using a non-condom contraceptive method at last sex (33.97%). In contrast, those who did not use any contraception (24.28%) and those who used non-condom contraception (17.56%) at first sex mostly did not change their method of birth control at last sex, regardless of the number of lifetime sexual partners (1 vs. > 1) (Table 2).

Table 2. Inconsistent use of condom at first and last sexual intercourse among adolescents in Taiwan from 2012 to 2016, by number of lifetime sexual partner

| First sexual intercourse | Last sexual intercourse | Total | No contraception | Condom | Other methods | p     |
|-------------------------|------------------------|-------|------------------|--------|--------------|-------|
|                         |                        |       |                  |        |              |       |
| Overall                 |                        | 1207  | 241 (19.97%)     | 316 (26.18%) | 650 (53.85%) | <.0001 |
| No contraception        | 293 (24.28%)           | 178 (14.75%) | 25 (2.07%)     | 90 (7.46%)   |
| Condom                  | 702 (58.16%)           | 28 (2.32%)     | 264 (21.87%)   | 410 (33.97%) |
| Other methods           | 212 (17.56%)           | 35 (2.9%)      | 27 (2.24%)     | 150 (12.43%) |
| No. of lifetime sexual partners >1 |        |       |                  |        |              |       |
| Total                   | 598                    | 131 (21.91%) | 124 (20.74%)    | 343 (57.36%) | <.0001  |
| No contraception        | 158 (26.42%)           | 93 (15.55%)   | 15 (2.51%)     | 50 (8.36%)   |
| Condom                  | 326 (54.52%)           | 18 (3.01%)     | 96 (16.05%)    | 212 (35.45%) |
| Other methods           | 114 (19.06%)           | 20 (3.34%)     | 13 (2.17%)     | 81 (13.55%)  |
| One lifetime sexual partner |                |       |                  |        |              |       |
| Total                   | 606                    | 109 (17.99%) | 192 (31.68%)    | 305 (50.33%) | <.0001  |
| No contraception        | 134 (22.11%)           | 85 (14.03%)   | 10 (1.65%)     | 39 (6.44%)   |
| Condom                  | 374 (61.72%)           | 9 (1.49%)      | 168 (27.72%)   | 197 (32.51%) |
| Other methods           | 98 (16.17%)            | 15 (2.48%)     | 14 (2.31%)     | 69 (11.39%)  |

p: p-values were obtained from McNemar’s test.

Percentages in Table 2 are total percentages.

The overall total (1207) does not equal to the total (598+606=1204) at the lower half of the table because subjects who did not respond to the questions about

i) the number of lifetime sexual partners,

ii) the method of contraception use at first and last sexual intercourse

were not included in McNemar’s test.
In addition, we noted that the condom use rate at first and last sex among those with one lifetime sexual partner was statistically significantly higher than that of those with multiple lifetime sexual partners. At first sex, the condom use rate among those with one sexual partner and multiple lifetime sexual partners was 61.72% and 54.2% ($p = 0.0113$), respectively. At last sex, the condom use rate among those with a single sexual partner (31.68%) was higher than that of those with multiple lifetime sexual partners (20.74%) ($p < .0001$). Regarding consistency in condom use, students with one sexual partner were more likely to use condoms at first and last sex (27.72%) than those with multiple sexual lifetime partners (16.05%) ($p < .0001$).

**DISCUSSION**

**Sexual intercourse**

This nationwide cross-sectional study revealed that the overall rate of ever having had sexual intercourse among adolescents (Grades 7–12) in Taiwan was 4.95% (5.33% of males and 4.53% of females) during 2012–2016. Our rates are similar to several studies in other Asian countries and regions, such as South Korea (Grades 7–12: 3.9% overall, opposite-sex intercourse; 5.5% of males, 2.2% of females),[8] Hong Kong (Grades 7–12: 5.2% overall, 5.6% of males, 4.7% of females),[9] and other South-East Asian countries.[10] On the other hand, our figures are considerably lower than those of developed Western countries.[11-12] For instance, in the United States, the sexual intercourse rate among Grade 9–12 students is 41.2% (43.2% of males and 39.2% of females).[12] It is possible that Confucian culture plays an important role in adolescent sexual behaviors in Asian countries,[13] and this could potentially explain the discrepancy between our results and those obtained from Western countries.

In this study, male students were more likely to ever have had sex than female students. The rate in Grades 7–9 was 1.62% (1.73% of males and 1.51% of females) and that in Grades 10–12 was 10.60% (11.25% of males and 9.83% of females), which is consistent with previous reports.[13]

More importantly, we observed that the school type had a huge impact on adolescent sexual behaviors in Taiwan. Our analysis found that the sexual intercourse rate was lowest among junior high school students and that it generally increased with the grade. This might be because older...
adolescents were more likely to engage in intimate sexual behaviors than younger adolescents. Among the Grade 10–12 students, night schools had the highest sexual intercourse rate, while senior high schools had the lowest. Some night school students were relatively older married adolescents, which may have led to the high sexual intercourse rate. As previously hypothesized,[5] the students’ educational and career aspirations and the school type may influence their sexual behaviors. Our findings highlight that academically oriented schools (e.g., senior high schools) tend to have lower sexual intercourse rates than those that place a heavier emphasis on vocational skill training (e.g., comprehensive and vocational high schools).

**Condom use and implications**

Despite the low sexual intercourse rate, we found that the practice of protected sex (as indicated by the condom use rate) was not common among adolescents in Taiwan when compared with data obtained from Western[14-16] and South-East Asian countries.[10] In this study, only a quarter of sexually experienced respondents had used a condom at last sex (male: 25.66%, female: 25.80%), which was approximately half of those who used condoms at first sex (male: 55.81%, female: 60.47%). In contrast, in Western countries such as the United States, the condom use rates at first sex among adolescents (age 15–17 years) are as high as 77% (male) and 74.6% (female)[15] and the rates at last sex (age 13–19 years) are 61% (male) and 47% (female).[14] In a study of nationwide surveys conducted in 33 countries from 2013 to 2014, developed Western countries, such as Great Britain, Denmark, Finland, France, Spain, and Switzerland, were found to typically have a condom use rate of over 40% at last sex among adolescents aged 14–16.[16] Moreover, countries participating in the GSHS in the South-East Asian and Western Pacific regions generally have a higher condom use rate (at last sex) than the rate (25.72%) we obtained.[10] For instance, the condom non-use rates at last sex among GSHS participants aged 12–15 years in Nepal, Bangladesh, Thailand, Cambodia, Laos, and Malaysia were estimated to be 52.6% (2015), 58.7% (2014), 33.8% (2015), 56.2% (2013), 46.7% (2015), and 66.8% (2012), respectively.[10] In summary, the above comparisons show that Taiwanese adolescents’ condom use (both at first and last sex) is not as prevalent as in Western developed countries and other countries participating in the GSHS.

In addition to cross-country comparisons, we investigated how school type and the students’ sex influenced the condom use rate. Across school types, the condom use rate at first and last sex
varied considerably. Notably, night schools had the highest sexual intercourse rate and the second lowest condom use rate at both first and last sex. Moreover, despite having the lowest sexual intercourse rate, sexually experienced junior high school students were the least likely to use condoms at first and last sex. This highlights the urgent need to instill a proper understanding of protected sex while adolescents are still in their formative years, especially in junior high schools.

Our study also showed that the students’ sex did not seem to influence the condom use rate at first and last sex. It has long been assumed that sex equality plays an important role in condom use.[16] Our study suggests that across all school types and grades, male and female adolescents in Taiwan are of equal standing in terms of condom use decisions, in contrast to studies conducted elsewhere.[17]

The decrease in the condom use rate and increase in the non-condom contraception rate at last sex was possibly due to the teenagers being more concerned about potential pregnancy than the contraction of STIs, as speculated in previous studies.[18] Our data support this hypothesis; most participants in our study who used condoms at first sex (58.16%) changed to using non-condom contraceptive methods at last sex (33.97%) (Table 2). In addition, our results suggest that adolescents with one lifetime sexual partner were more likely to use condoms at last sex than those with multiple sexual partners. This might be because those who stayed with a single sexual partner were more likely to understand the importance of protected sex and the risk associated with having multiple sexual partners than those who did not. Nevertheless, adolescents with multiple sexual partners who did not use condoms could potentially pose a huge public health risk in Taiwan, since having multiple sexual partners and sexual intercourse without using condoms are associated with the susceptibility to STIs.[3]

**Strengths and limitations**

A strength of this study is that our analysis was based on a large nationally representative sample. The GSHS used in this study allows for a fair comparison of the sexual intercourse and condom use rates between our students and others. However, there are several limitations to our study. First, sex is a sensitive issue in Taiwan; therefore, sexual behavior data collected by the GSHS might be underreported and susceptible to recall bias. Second, sexual intercourse was not defined explicitly, and the Taiwan GSHS did not ask about the sex of the participants’ sexual partner(s). Thus, ‘sexual intercourse’ might be misinterpreted as other forms of sex (e.g., oral sex
and intercourse between heterosexuals only). Third, the comparison of the condom use rate at first and last sex is insufficient for drawing definite conclusions regarding condom use consistency. Additionally, respondents might use condoms and other contraceptive methods simultaneously, leading to biased responses. Therefore, we recommend incorporating questions with a clear definition of sexual intercourse and questions about the frequency of condom use in future GSHS.

In conclusion, the finding of lower sexual intercourse and condom use rates at first and last sex than in many developed countries indicates that the practice of protected sex is not prevalent among Taiwanese adolescents. This is further supported by our findings that most adolescents who used condoms at first sex switched to non-condom contraception at last sex and that adolescents with multiple sexual partners were less likely to use condoms.

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Contributors

WHSS designed the study, analyzed the data, and drafted the manuscript. PRL and LCS analyzed and interpreted the data, prepared the dataset, and revised the manuscript. All authors read and approved the manuscript in its present form.

Competing interests

None declared.

Data availability statement

No data are available.

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REFERENCES

1 Taiwan Centers for Disease Control. Statistics of HIV/AIDS [updated 22 Aug 2019]. https://www.cdc.gov.tw/En/Category/MPage/kt6yIoEGURtMQu3nQ7pA (accessed 11 Sept 2020).

2 Taiwan Centers for Disease Control. Epidemic trend and prevention effectiveness of HIV/AIDS. https://www.cdc.gov.tw/En/Professional/ProgramResultInfo/ppxd4Xu5zcYwcLHniXKk6w?programResultId=8XOWLPdD6JI5pNt9p0zrKQ (accessed 6 Nov 2020).

3 Waage J, Banerji R, Campbell O, et al. The Millennium Development Goals: a cross-sectoral analysis and principles for goal setting after 2015. *Lancet* 2010;376:991–1023. doi:10.1016/S0140-6736(10)61196-8

4 Health Promotion Administration, Ministry of Health and Welfare, Taiwan. Statistical yearbook of health promotion 2016 [updated 28 Dec 2019]. https://www.hpa.gov.tw/EngPages/Detail.aspx?nodeid=3850&pid=10649 (accessed 6 Nov 2020).

5 Kirby D. The impact of schools and school programs upon adolescent sexual behavior. *J Sex Res* 2002;39:27–33. doi:10.1080/00224490209552116 [published Online First: 12 December 2002].

6 Health Promotion Administration, Ministry of Health and Welfare, Taiwan. Taiwan global school-based student health survey (GSHS) [updated 28 Dec 2016]. https://www.hpa.gov.tw/Pages/Detail.aspx?nodeid=1077&pid=6205 (accessed 11 Sept 2020).

7 Health Promotion Administration, Ministry of Health and Welfare, Taiwan. Health promotion administration annual report [updated 28 Dec 2016]. https://www.hpa.gov.tw/EngPages/List.aspx?nodeid=1070 (accessed 11 Sept 2020).

8 Kim GH, Ahn HS, Kim HJ. Type of sexual intercourse experience and suicidal ideation, plans, and attempts among youths: a cross-sectional study in South Korea. *BMC Public Health* 2016;16:1229. doi:10.1186/s12889-016-3895-y [published Online First: 7 December 2016].

9 Wong WCW, Choi EPH, Holroyd E, et al. Impact of household composition and satisfaction with family life on self-reported sexual health outcomes of high-school students in Hong Kong. *BMJ Sex Reprod Health* 2020;46:184–91. doi:10.1136/bmjsrh-2019-200372 [published Online First: 21 November 2019].
10 Smith L, Jackson SE, Vancampfort D, et al. Sexual behavior and suicide attempts among adolescents aged 12–15 years from 38 countries: a global perspective. *Psychiatry Res* 2020;287:112564. doi:10.1016/j.psychres.2019.112564 [published Online First: 7 September 2019].

11 Scott RH, Wellings K, Lindberg L. Adolescent sexual activity, contraceptive use, and pregnancy in Britain and the U.S.: a multidecade comparison. *J Adolesc Health* 2020;66:582–88. doi:10.1016/j.jadohealth.2019.11.310 [published Online First: 8 February 2020].

12 Kann L, McManus T, Harris WA, et al. Youth risk behavior surveillance—United States, 2015. *MMWR Surveill Summ* 2016;65:1–174.

13 Zuo X, Lou C, Gao E, et al. Gender differences in adolescent premarital sexual permissiveness in three Asian cities: effects of gender-role attitudes. *J Adolesc Health* 2012;50(Suppl 3):S18–25. doi:10.1016/j.jadohealth.2011.12.001 [published Online First: 1 March 2012].

14 Koumans EH, Welch R, Warner DL. Differences in adolescent condom use trends by global region. *J Adolescent Health* 2020;66:S36–S37.

15 Holway GV, Brewster KL, Tillman KH. Condom use at first vaginal intercourse among adolescents and young adults in the United States, 2002–2017. *J Adolesc Health* 2020;67:606–08. doi:10.1016/j.jadohealth.2020.03.034 [published Online First: 16 May 2020].

16 de Looze M, Madkour AS, Huijts T, et al. Country-level gender equality and adolescents' contraceptive use in Europe, Canada and Israel: findings from 33 Countries. *Perspect Sex Reprod Health* 2019;51:43–53. doi:10.1363/psrh.12090 [published Online First: 28 February 2019].

17 Vasilenko SA, Kreager DA, Lefkowitz ES. Gender, contraceptive attitudes, and condom use in adolescent romantic relationships: a dyadic approach. *J Res Adolesc* 2015;25:51–62. doi:10.1111/jora.12091 [published Online First: 8 November 2013].

18 Samkange-Zeeb FN, Spallek L, Zeeb H. Awareness and knowledge of sexually transmitted diseases (STDs) among school-going adolescents in Europe: a systematic review of published literature. *BMC Public Health* 2011;11:727. doi:10.1186/1471-2458-11-727 [published Online First: 25 September 2011].
Figure legends

Figure 1. Flow chart of analysis illustrating the overall rates of ever having had sexual intercourse and condom use among adolescents in Taiwan from 2012 to 2016.

Figure 2. The rate of ever having had sexual intercourse of Taiwan adolescents from 2012 to 2016, by sex, school type and grade.
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**Figure 1.** Flow chart of analysis illustrating the overall rates of ever having had sexual intercourse and condom use among adolescents in Taiwan from 2012 to 2016

73x108mm (300 x 300 DPI)
Figure 2. The rate of ever having had sexual intercourse of Taiwan adolescents from 2012 to 2016, by sex, school type and grade

108x60mm (300 x 300 DPI)
### Table S1. Taiwan GSHS Questions that were used to determine whether respondents had sexual intercourse and to evaluate the validity of responses

| Question                                                                 | Option                                      |
|-------------------------------------------------------------------------|---------------------------------------------|
| 1. Have you ever had sexual intercourse?                                 | A. Yes                                      |
|                                                                         | B. No                                       |
| 2. How old were you when you had sexual intercourse for the first time?  | A. I have never had sexual intercourse       |
|                                                                         | B. 11 years old or younger                   |
|                                                                         | C. 12 years old                             |
|                                                                         | D. 13 years old                             |
|                                                                         | E. 14 years old                             |
|                                                                         | F. 15 years old                             |
|                                                                         | * G. 16 or 17 years old                     |
|                                                                         | * H. 18 years old or older                  |
| 3. During your life, with how many people have you had sexual intercourse?| A. I have never had sexual intercourse       |
|                                                                         | B. 1 person                                 |
|                                                                         | C. 2 people                                 |
|                                                                         | D. 3 people                                 |
|                                                                         | E. 4 people                                 |
|                                                                         | F. 5 people                                 |
|                                                                         | G. 6 or more people                         |
| 4. The first time you had sexual intercourse, what method of birth control did you use to prevent pregnancy? | A. I have never had sexual intercourse       |
|                                                                         | B. No method was used to prevent pregnancy  |
|                                                                         | C. Birth control pills                       |
|                                                                         | D. Condoms                                  |
|                                                                         | E. Depo-Provera (or any injectable birth control, Nuva Ring (or any birth control ring), Implanon (or any implant), or any IUD |
|                                                                         | F. Withdrawal                               |
|                                                                         | G. Some other method                        |
|                                                                         | H. Not sure                                 |
| 5. The last time you had sexual intercourse, did you or your partner use a condom? | A. I have never had sexual intercourse       |
|                                                                         | B. Yes                                      |
|                                                                         | C. No                                       |
| 6. The last time you had sexual intercourse, did you or your partner use any other method of birth control, such as withdrawal, rhythm (safe time), birth control pills, or any other method to prevent pregnancy? | A. I have never had sexual intercourse       |
|                                                                         | B. Yes                                      |
|                                                                         | C. No                                       |
|                                                                         | D. I do not know                            |
| 7. After having sexual intercourse, have you or your partner ever used emergency after-sex contraceptive pills to prevent pregnancy? | A. I have never had sexual intercourse       |
|                                                                         | B. Yes                                      |
|                                                                         | C. No                                       |
|                                                                         | D. I do not know                            |
8. Have you or your sexual partner ever had an induced abortion?

| Option                        | Description                                                      |
|-------------------------------|------------------------------------------------------------------|
| A. I have never had sexual intercourse | |
| B. Yes | |
| C. No | |
| D. I do not know | |

**No sexual intercourse:** Answered ‘No’ for Qn. 1 and ‘I have never had sexual intercourse’ for Qn. 2-8

**Had sexual intercourse:** Answered ‘Yes’ for Qn. 1 and other than ‘I have never had sexual intercourse’ for Qn. 2-8

**Invalid response:** Contradictory response such as answered ‘Yes’ for Qn. 1 and answered ‘I have never had sexual intercourse’ for any one of Qn. 2-8

*In 2012, option G became ‘16 years old or older’ without option ‘H. 18 years old or older’. However, starting from 2013, option G and H were ‘16 or 17 years old’ and ‘18 years old or older’ respectively. Therefore, in our analyses throughout this paper, we combined the data of option ‘G. 16 or 17 years old’ and ‘H. 18 years old or older’ into ‘16 years old or older’.*

---

**Table S2.** The variables in GSHS involved in data analyses

| Variable                    | Question / Description                                                                 | Option                                                                 |
|-----------------------------|----------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| **Demographics**            | What is your sex?                                                                       | A. Male                                                                |
|                             |                                                                                        | B. Female                                                              |
|                             | How old are you?                                                                        | A. 11 years old or younger                                             |
|                             |                                                                                        | B. 12 years old                                                        |
|                             |                                                                                        | C. 13 years old                                                        |
|                             |                                                                                        | D. 14 years old                                                        |
|                             |                                                                                        | E. 15 years old                                                        |
|                             |                                                                                        | *F. 16 years old                                                       |
|                             |                                                                                        | *G. 17 years old                                                       |
|                             |                                                                                        | *H. 18 years old or older                                              |
|                             | **Degree of urbanization**                                                              | Big city / Small city / Urban town / Rural town                        |
|                             | In what grade are you?                                                                  | A. Grade 1 #                                                           |
|                             |                                                                                        | B. Grade 2 #                                                          |
|                             |                                                                                        | C. Grade 3 #                                                          |
|                             | **School type**                                                                         | Junior high school / Senior high school / Vocational high school       |
|                             |                                                                                        | / Comprehensive school / Night school                                 |
| **Sexual behaviors**        | Have you ever had sexual intercourse?                                                   | A. Yes                                                                 |
|                             |                                                                                        | B. No                                                                  |
|                             | During your life, with how many people have you had sexual intercourse?                  | A. I have never had sexual intercourse                                 |
|                             |                                                                                        | B. 1 person                                                            |
|                             |                                                                                        | C. 2 people                                                            |
|                             |                                                                                        | D. 3 people                                                            |
|                             |                                                                                        | E. 4 people                                                            |
|                             |                                                                                        | F. 5 people                                                            |
|                             |                                                                                        | G. 6 or more people                                                    |
|                             | The first time you had sexual intercourse, what method of birth control did you use to | A. I have never had sexual intercourse                                 |
|                             | prevent pregnancy                                                                      | B. No method was used to prevent pregnancy                             |
|                             |                                                                                        | C. Birth control pills                                                 |
|                             |                                                                                        | D. Condoms                                                             |
|                             |                                                                                        | E. Depo-Provera ( or any injectable birth control, Nuva Ring (or any   |
|                             |                                                                                        | birth control ring), Implanon ( or any implant), or any IUD            |
|                             |                                                                                        | F. Withdrawal                                                          |
|                             |                                                                                        | G. Some other method                                                   |
|                             |                                                                                        | H. Not sure                                                            |
The last time you had sexual intercourse, did you or your partner use a condom?

A. I have never had sexual intercourse
B. Yes
C. No

The last time you had sexual intercourse, did you or your partner use any other method of birth control, such as withdrawal, rhythm (safe time), birth control pills, or any other method to prevent pregnancy?

A. I have never had sexual intercourse
B. Yes
C. No
D. I do not know

* In 2012, option F was 16 years old or older. However, from 2013 to 2016, option F was changed to 16 years old and option G (17 years old) and option H (18 years old or older) were added.

** The data for ‘Degree of urbanization’ and ‘School type’ were entered by those who collected the data, they were not answered by students.

# Grade 1, 2 and 3 mean Grade 7, 8 and 9 when GSHS was conducted in 2012, 2014 and 2016. Grade 1, 2 and 3 mean Grade 10, 11 and 12 when GSHS was conducted in 2013 and 2015.

References

1. Taiwan - Global School-based Student Health Survey (GSHS) 2016 [Available from: https://www.cdc.gov/gshs/countries/westpacific/taiwan.htm accessed 2 Nov 2020.
### STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

| Item No | Recommendation | Page No |
|---------|----------------|---------|
| **Title and abstract** | 1 (a) Indicate the study’s design with a commonly used term in the title or the abstract | 1 |
| | 1 (b) Provide in the abstract an informative and balanced summary of what was done and what was found | 1 |
| **Introduction** | 2 Explain the scientific background and rationale for the investigation being reported | 2-3 |
| **Objectives** | 3 State specific objectives, including any prespecified hypotheses | 2-3 |
| **Methods** | 4 Present key elements of study design early in the paper | 3-4 |
| | 5 Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | 3-4 |
| | 6 (a) Give the eligibility criteria, and the sources and methods of selection of participants | 3-4 |
| | 7 Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | 3-4 |
| | 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 | 3-4 |
| | 9 Describe any efforts to address potential sources of bias | 3-4 |
| | 10 Explain how the study size was arrived at | 3-4 |
| | 11 Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | 3-4 |
| | 12 (a) Describe all statistical methods, including those used to control for confounding | 3-4 |
| | (b) Describe any methods used to examine subgroups and interactions | 3-4 |
| | (c) Explain how missing data were addressed | 3-4 |
| | (d) If applicable, describe analytical methods taking account of sampling strategy | 3-4 |
| | (g) Describe any sensitivity analyses | 3-4 |
| **Results** | 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 | 5-7 |
| | (b) Give reasons for non-participation at each stage | 5-7 |
| | (c) Consider use of a flow diagram | 5-7 |
| | 14* (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders | 5-7 |
| | (b) Indicate number of participants with missing data for each variable of interest | 5-7 |
| **Outcome data** | 15* Report numbers of outcome events or summary measures | 5-7 |
| **Main results** | 16 (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make | 5-7 |
clear which confounders were adjusted for and why they were included

(b) Report category boundaries when continuous variables were categorized

(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period

Not relevant

Other analyses 17 Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses 5-7

Discussion

Key results 18 Summarise key results with reference to study objectives 8-11

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 10-11

Interpretation 20 Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence 8-11

Generalisability 21 Discuss the generalisability (external validity) of the study results 8-11

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 11

*Give information separately for exposed and unexposed groups.

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.
The rate of condom use among sexually active adolescents: A nationwide cross-sectional study in Taiwan from 2012 to 2016

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TITLE

The rate of condom use among sexually active adolescents: A nationwide cross-sectional study in Taiwan from 2012 to 2016

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Word count: 3,608

ABSTRACT

Objective: Adolescents’ risky sexual behaviors are associated with sexually transmitted infections (STIs) and unwanted pregnancies. This study aimed to estimate the sexual intercourse and condom use rates at first and last sex among Taiwanese adolescents in Grades 7–12.

Design: A secondary data analysis of the Taiwan Global School-Based Student Health Survey’s 2012–2016 data. The survey was anonymous, cross-sectional, and nationwide.

Setting: Taiwan high school students (Grades 7-12).

Participants: The sample comprised 27,525 students from junior high schools (Grades 7–9) and senior high schools, comprehensive schools, vocational high schools, and night schools (Grades 10–12).

Main outcome measures: The rate of ever having had sexual intercourse; the rates of condom use at first and last sex.
Results: The sexual intercourse rate in each school type (in ascending order) was junior high school (1.62%), senior high school (4.14%), comprehensive school (9.08%), vocational high school (14.03%), and night school (41.09%). Condom use rate decreased from 57.07% (95% confidence interval [CI] = 54.31%–59.83%) at first sex to 25.72% (95% CI = 23.34%–28.10%) at last sex ($p < .0001$). The condom use rate (in ascending order) was junior high school (first sex: 37.67%, last sex: 19.76%), night school (55.83%, 22.62%), vocational high school (61.13%, 25.78%), comprehensive school (62.83%, 28.61%), and senior high school (68.38%, 34.96%). Condom use at first and last sex were both associated with older age at sexual debut. Better knowledge of STIs and having one lifetime sexual partner were associated with condom use at first and last sex, respectively.

Conclusions: This study highlights that, despite the low sexual intercourse rate (4.95%), there is lower condom use at last sex than at first sex, which indicates that many sexually active Taiwanese adolescents are not practicing protected sex, especially among junior high school students.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- The Taiwan Global School-Based Student Health Survey (GSHS) was cross-sectional and based on a large nationally representative sample.
- The GSHS allows for a fair comparison of the sexual intercourse and condom use rates between Taiwanese students and students from other countries (i.e. cross-country comparison).
- In addition, the survey was anonymous and therefore encouraged honest responses to sensitive questions (such as sexual behaviors) from participants.
- Since the survey was self-administered, there might be response bias.
- Regarding survey question design, ‘sexual intercourse’ might be misinterpreted as non-vaginal sex and the frequency of condom use between the first and last sex was not asked.

INTRODUCTION

Adolescent risky sexual behavior is an important public health issue because of its association with sexually transmitted infections (STIs) and teenage pregnancies, which increase
the medical and social burden. Adolescent risky sexual behavior refers to sexual behaviors which put adolescents at risk of contracting STIs, unintended pregnancies, abortions, and subsequent psychological distress.[1] Examples of such behaviors include unprotected sexual intercourse and having sexual intercourse with multiple partners.[1] In Taiwan, the number of newly reported cases of human immunodeficiency virus / acquired immunodeficiency syndrome (HIV/AIDS) increased from 2012–2016,[2] and the estimated incidence rate of HIV among adolescents aged 13–24 years was about 20 per 100,000 population during this period.[3] Condoms are considered the most effective contraception to protect against STIs. Condom use at last high-risk sex is one of the indicators of the Millennium Development Goals’ monitoring that was established by the United Nations International Children’s Emergency Fund to tackle STIs.[4] In Taiwan, the sexual intercourse rates among adolescents aged 13–15 years increased from 2.2% (male) and 1.8% (female) in 2006 to 5.4% (male) and 5.3% (female) in 2016.[5] Furthermore, the contraception use rate among these adolescents increased from 56.2% (male) and 58.1% (female) in 2006 to 74.8% (male) and 77.7% (female) in 2016.[5] However, the predominant form of contraception was not reported. More importantly, whether sexually active adolescents in Taiwan actually practice protected sex (i.e., use condoms) remains unclear.

It has long been speculated that adolescent sexual behaviors are associated with school type and education programs.[6] In Taiwan, public education has been compulsory from primary school to junior high school since 1968. Since 2014, a full 12-year compulsory education program has been implemented. Junior high school students in Grade 9 take a high school entrance examination to continue their education, which is designed as a screening tool to assign students to various school programs for Grades 10–12. Students who aspire to receive higher education mostly attend regular senior high schools. Other educational opportunities include vocational high schools and comprehensive schools, which are workplace-oriented and emphasize vocational skills. Night school curricula vary, ranging from vocational to academic courses. Therefore, in this study, we aimed to estimate the sexual intercourse and condom use rates at first and last sex among Taiwanese adolescents across school types by using nationally representative data of Grade 7–12 students. To our knowledge, this study is the first to examine whether sexually active adolescents in Taiwan actually practice protected sex by using the data from a large nationally representative sample.
METHODS

We performed a secondary analysis of the 2012–2016 data of the Taiwan Global School-Based Student Health Survey (GSHS). The Taiwan GSHS is a nationwide cross-sectional study that surveys the health behaviors of Grade 7–9 (aged 12-15) and Grade 10–12 (aged 15-18) students every other year.[7]

The survey was conducted by the Health Promotion Administration (HPA), Ministry of Health and Welfare of Taiwan, in collaboration with the United States’ Centers for Disease Control and Prevention.[7] The Taiwan GSHS was translated into Chinese from the English version. The HPA first categorized schools into four geographic levels (i.e., big city, small city, urban town, and rural town) according to the population density of their locations. Next, the HPA used a two-step “probability proportional to size” method at each geographic level for sampling, where the sample schools were drawn before the sample classes.[7] They invited all students from the sample classes to participate. The survey was anonymous and no identifying information was collected. Additional details of the Taiwan GSHS’s methodology are reported elsewhere.[7]

From 2012–2016, there were 29,040 participants, and the response rates were 93.3% in 2012, 89.6% in 2013, 93.7% in 2014, 90.2% in 2015, and 92.6% in 2016.[8] Junior high school students were surveyed in 2012, 2014, and 2016, and Grade 10–12 students (including senior high school, comprehensive, vocational high school, and night school students) were surveyed in 2013 and 2015. As illustrated in Figure 1, a total of 27,525 students were included in this study after excluding those who did not indicate their gender (n = 62) and those who gave contradictory answers to the eight survey questions (Table S1, online supplementary material) about sexual behaviors (n = 1,453).

We selected some questions from the GS (Table S2), which were of four types: demographics, knowledge regarding STIs, substance use, and sexual behaviors. The demographic variables included gender, age, degree of urbanization, school type, and grade. To determine the subjects’ knowledge regarding STIs, we analyzed if they agree to the statement “Even if they had received the cervical cancer vaccine, women still need to have a Pap smear regularly”. Regarding substance use, we looked into whether the participants were current smokers (defined as smoking
cigarettes on at least one day during the past 30 days)[9] and current heavy alcohol users (defined as consuming \( \geq 5 \) drinks of alcoholic beverages per day in the past 30 days).[10] The variables regarding sexual behaviors were ever having had sexual intercourse, number of lifetime sexual partners, condom use, and non-condom use at first sex and last sex. The outcome variables were ever having had sexual intercourse and condom use at first and last sex.

We used the chi-square test to examine the association between the students’ gender and the outcome variables (sexual intercourse and condom use at first and last sex) in each school type. McNemar’s test was conducted to investigate the consistency of condom use at first and last sex for students who had one sexual partner and those who had more than one sexual partner. In univariate analysis, we used chi-square test to examine the association between demographics, risk/protective factors, and outcome variables (condom use at first and last sex). Regarding multivariate analysis, we used logistic regression with forward selection to locate important factors for condom use at first and last sex. The adjusted odds ratio (AOR) with 95% confidence interval (CI) was made to show the direction and magnitude of the association between demographics, risk/protective factors, and outcome variables (condom use at first and last sex). We conducted all analyses using SAS 9.4 (SAS Institute, Cary, NC, USA). The significance level was 0.05.

**Ethics**

This study was approved by the Institutional Review Board of the Chang Gung Medical Foundation (202001534B0). Informed consent was not required because the survey was anonymous.

**Patient and public involvement**

No patients were involved.

**RESULTS**

**Sexual intercourse rate by gender, school type, and grade**

Overall, the sexual intercourse rate was 4.95% (Figure 1). The ascending order of sexual intercourse rate by school type was junior high school (1.62%), senior high school (4.14%), comprehensive school (9.08%), vocational high school (14.03%), and night school (41.09%).
In general, male students (5.33%) had a higher rate of sexual intercourse than female students (4.53%) (Table 1). When stratified by school type, male students in senior high school had a significantly higher rate of sexual intercourse (4.92%) than female students (3.4%) ($p = 0.0352$). There was a borderline difference in sexual intercourse rate among students at vocational high school between both genders ($p = 0.0613$). However, when the sexual intercourse rates were further stratified by grade and school type, the rates of sexual intercourse between both genders did not differ significantly (Figure 2).

**Table 1.** Rates of ever having had sexual intercourse, condom use at first and last sex among adolescents in Taiwan from 2012 to 2016, by gender

|                     | Male (%) | Female (%) | $p$  |
|---------------------|----------|------------|------|
| **Sexual intercourse** |          |            |      |
| Grades 7-9          |          |            |      |
| Junior High school  | 156/9027 (1.73%) | 125/8286 (1.51%) | 0.2534 |
| Grades 10-12        |          |            |      |
| Senior high school  | 74/1505 (4.92%) | 53/1559 (3.4%) | 0.0352 * |
| Comprehensive school| 240/2518 (9.53%) | 157/1855 (8.46%) | 0.2245 |
| Vocational high school | 132/1048 (12.6%) | 170/1104 (15.4%) | 0.0613 |
| Night school        | 173/433 (39.95%) | 83/190 (43.68%) | 0.3836 |
| **Condom use at first sexual intercourse** |          |            |      |
| Total               | 384/688 (55.81%) | 332/549 (60.47%) | 0.3164 |
| Grades 7-9          |          |            |      |
| Junior High school  | 41/118 (34.75%) | 43/105 (40.95%) | 0.3397 |
| Grades 10-12        |          |            |      |
| Senior high school  | 343/570 (60.18%) | 279/444 (62.84%) | 0.3877 |
| Comprehensive school| 40/65 (61.54%) | 40/52 (76.92%) | 0.0754 |
| Vocational high school | 142/224 (63.39%) | 93/150 (62.00%) | 0.7847 |
| Night school        | 72/121 (59.50%) | 101/162 (62.35%) | 0.6276 |
| **Condom use at last sexual intercourse** |          |            |      |
| Total               | 186/725 (25.66%) | 146/566 (25.80%) | 0.9545 |
| Grades 7-9          |          |            |      |
| Junior High school  | 26/133 (19.55%) | 23/115 (20.00%) | 0.9291 |
| Grades 10-12        |          |            |      |
| Senior high school  | 160/592 (27.03%) | 123/451 (27.27%) | 0.9296 |
| Comprehensive school| 27/70 (38.57%) | 16/53 (30.19%) | 0.3343 |
| Vocational high school | 67/227 (29.52%) | 42/154 (27.27%) | 0.6345 |
| Night school        | 39/170 (22.94%) | 18/82 (21.95%) | 0.8603 |

$p$: $p$-values were obtained from Chi-square test.

*: $p$-values $< 0.05$
Condom use at first and last sexual intercourse

The overall condom use rate decreased from 57.07% at first sex to 25.72% at last sex (Figure 1). In terms of school type, the ascending order of the condom use rate was junior high school (first sex: 37.67%, last sex: 19.76%), night school (55.83%, 22.62%), vocational high school (61.13%, 25.78%), comprehensive school (62.83%, 28.61%), and senior high school (68.38%, 34.96%). Moreover, the condom use rates at both first and last sex were not statistically different between male and female adolescents (Table 1).

When investigating the decrease in the condom use rate, we observed that adolescents who used condoms at first sex (58.16%) mostly switched to using a non-condom contraceptive method at last sex (33.97%). In contrast, those who did not use any contraception (24.28%) and those who used non-condom contraception (17.56%) at first sex mostly did not change their method of birth control at last sex, regardless of the number of lifetime sexual partners (1 vs. > 1) (Table 2).

### Table 2. Inconsistent use of condom at first and last sexual intercourse among adolescents in Taiwan from 2012 to 2016, by number of lifetime sexual partner

| First sexual intercourse | Last sexual intercourse | Total | No contraception | Condom | Other methods | p     |
|--------------------------|------------------------|-------|------------------|--------|--------------|-------|
|                          | Total                  |       |                  |        |              |       |
| Overall                  | 1207                   | 241 (19.97%) | 316 (26.18%) | 650 (53.85%) | <.0001 |
| No contraception         | 293 (24.28%)           | 178 (14.75%) | 25 (2.07%)     | 90 (7.46%)    |       |
| Condom                   | 702 (58.16%)           | 28 (2.32%)  | 264 (21.87%)   | 410 (33.97%)  |       |
| Other methods            | 212 (17.56%)           | 35 (2.9%)   | 27 (2.24%)     | 150 (12.43%)  |       |

| No. of lifetime sexual partners >1 | Total | No contraception | Condom | Other methods | p     |
|-----------------------------------|-------|------------------|--------|--------------|-------|
| Overall                           | 598   | 131 (21.91%)     | 124 (20.74%) | 343 (57.36%) | <.0001 |
| No contraception                  | 158 (26.42%) | 93 (15.55%) | 15 (2.51%)   | 50 (8.36%)    |       |
| Condom                            | 326 (54.52%) | 18 (3.01%)   | 96 (16.05%)  | 212 (35.45%)  |       |
| Other methods                      | 114 (19.06%) | 20 (3.34%)   | 13 (2.17%)   | 81 (13.55%)   |       |

| One lifetime sexual partner       | Total | No contraception | Condom | Other methods | p     |
|-----------------------------------|-------|------------------|--------|--------------|-------|
| Overall                           | 606   | 109 (17.99%)     | 192 (31.68%) | 305 (50.33%) | <.0001 |
| No contraception                  | 134 (22.11%) | 85 (14.03%) | 10 (1.65%)   | 39 (6.44%)    |       |
| Condom                            | 374 (61.72%) | 9 (1.49%)   | 168 (27.72%) | 197 (32.51%)  |       |
| Other methods                      | 98 (16.17%)  | 15 (2.48%)   | 14 (2.31%)   | 69 (11.39%)   |       |

p: p-values were obtained from McNemar’s test.

Percentages in Table 2 are total percentages.
The overall total (1207) does not equal to the total (598+606=1204) at the lower half of the table because subjects who did not respond to the questions about

i) the number of lifetime sexual partners,

ii) the method of contraception use at first and last sexual intercourse

were not included in McNemar’s test.

In addition, we noted that the condom use rate at first and last sex among those with one lifetime sexual partner was statistically significantly higher than that of those with multiple lifetime sexual partners. At first sex, the condom use rate among those with one sexual partner and multiple lifetime sexual partners was 61.72% and 54.2% (p = 0.0113), respectively. At last sex, the condom use rate among those with a single sexual partner (31.68%) was higher than that of those with multiple lifetime sexual partners (20.74%) (p < .0001). Regarding consistency in condom use, students with one sexual partner were more likely to use condoms at first and last sex (27.72%) than those with multiple sexual lifetime partners (16.05%) (p < .0001).
### Table 3. Univariate and multivariate analysis of condom use at first and last sexual intercourse among adolescents in Taiwan, 2012-2016

|                | Univariate |          |          |          | Multivariate |          |          |
|----------------|------------|----------|----------|----------|--------------|----------|----------|
|                |            | Condom (1st sex) | Condom (last sex) | Condom (1st sex) | Condom (last sex) |          |          |
|                | Yes (%) | p       | Yes (%) | p       | AOR (95% CI) | p       | AOR (95% CI) | p       |
| **Total**      | 706/1237 (57.07%) | -- | 332/1291 (25.72%) | -- | -- | -- | -- |
| **Gender**     |          |         |         |         |               |         |         |         |
| Male           | 384/688 (55.81%) | 0.3164 | 186/725 (25.66%) | 0.9545 | NS | NS | NS |
| Female         | 322/549 (58.65%) |         | 146/566 (25.8%) |         |       |       |       |
| **School type**|          |         |         |         |               |         |         |         |
| Junior         | 84/223 (37.67%) | <.0001 | 49/248 (19.76%) | 0.0111 | NS | NS | NS |
| Senior         | 80/117 (68.38%) |         | 43/123 (34.96%) |         |       |       |       |
| Vocational     | 173/283 (61.13%) |         | 74/287 (25.78%) |         |       |       |       |
| Comprehensive  | 235/374 (62.83%) |         | 109/381 (28.61%) |         |       |       |       |
| Night          | 134/240 (55.83%) |         | 57/252 (22.62%) |         |       |       |       |
| **Sexual behaviors** | | | | | | | |
| **Age at 1st sex** |          | <.0001 | <.0001 | <.0001 | 0.0019 |          |          |
| ≤ 11 years old | 7/64 (10.94%) | 12/73 (16.44%) | Ref. | 4.17 (1.76 - 9.88) | 0.0011 | 0.86 (0.4 - 1.84) | 0.6968 |
| 12-13          | 53/144 (36.81%) | 23/160 (14.38%) | 9.24 (4.09 - 20.89) | <.0001 | 1.56 (0.81 - 3.02) | 0.1856 |
| 14-15          | 233/412 (56.55%) | 106/453 (24.31%) | 15.85 (7.05 - 35.66) | <.0001 | 2.00 (1.05 - 3.83) | 0.036 |
| ≥ 16           | 405/585 (61.23%) | 190/610 (31.15%) |           |           |       |       |       |
| **No. of lifetime sexual partner** |          | 0.0001 | <.0001 | NS | 0.0023 |          |          |
| 1              | 374/606 (61.72%) | 202/648 (31.17%) | 1.60 (1.23 - 2.07) | 0.0005 |       |       |       |
| > 1            | 326/607 (53.71%) | 130/639 (20.34%) |       |       |       |       |       |
| **Knowledge of sexually transmitted diseases** | | | | | | | |
| HPV & Pap smear |          | <.0001 | 0.6118 | 0.0047 | NS |          |          |
| Correct        | 483/779 (62%) | 218/812 (26.85%) | 2.61 (1.17 - 5.84) | 0.0196 |       |       |       |
| Incorrect      | 10/39 (25.64%) | 9/39 (23.08%) |       |       | Ref. |       |       |
| I do not know  | 194/373 (52.01%) | 97/397 (24.43%) | 1.85 (0.82 - 4.19) | 0.14 |       |       |       |
| **Substance use** | | | | | | | |
| Current smoker |          | 0.0013 | 0.0009 | NS | NS |          |          |
| No             | 412/671 (61.4%) | 207/701 (29.53%) |       |       |       |       |       |
| Yes            | 289/553 (52.26%) | 123/576 (21.35%) |       |       |       |       |       |
| Heavy alcohol use | | | | | | | |
| No             | 587/995 (58.99%) | 271/1038 (26.11%) |       |       |       |       |       |
| Yes (≥ 5 drinks/day) | 112/231 (48.48%) | 57/241 (23.65%) |       |       |       |       |       |

*P-values of univariate analysis were obtained by Chi-square test, while those of multivariate analysis were calculated by logistic regression with forward selection.

NS: non-significant; Ref.: reference group; AOR: adjusted odds ratio

Subjects who did not respond to the questions (i.e., missing data) were not included in Table 3.

At first sex, the number of missing data in the following questions: Age at 1st sex – 32, No. of lifetime sexual partner – 24, HPV & Pap smear – 46, Current smoker – 13, Heavy alcohol use – 11.

At last sex, the number of missing data in the following questions: Age at 1st sex – 12, No. of lifetime sexual partner – 4, HPV & Pap smear – 43, Current smoker – 14, Heavy alcohol use – 12.
In multivariate analysis of condom use at first sex, the following respondents were more likely to use condom at first sexual intercourse: those who first had sex at age 12-13 (adjusted odds ratio (AOR) 4.17, 95% confidence interval (C.I.)=1.76 - 9.88), age 14-15 (AOR 9.24, 95% C.I.=4.09 - 20.89) and age 16 or above (AOR 15.85, 95% C.I.=7.05 - 35.66) when compared with those who had sex at age 11 or younger; those who answered correctly in the question about HPV and Pap smear (AOR 2.61, 95% C.I.=1.17 - 5.84) when compared with those who gave incorrect answer (Table 3).

Regarding contraceptive use at last sex, the multivariate analysis indicated that adolescents who had one lifetime sexual partner (AOR 1.6, 95% C.I.=1.23 - 2.07) when compared with those who had more than one, and those who first had sex at age 16 or above (AOR 2, 95% C.I.=1.05 - 3.83) when compared with those who had sex at age 11 or younger were more likely to use condom at last sex (Table 3).

DISCUSSION

Sexual intercourse

This nationwide cross-sectional study revealed that the overall rate of ever having had sexual intercourse among adolescents (Grades 7–12) in Taiwan was 4.95% (5.33% of males and 4.53% of females) during 2012–2016. Our rates are similar to several studies in other Asian countries and regions, such as South Korea (Grades 7–12: 3.9% overall, opposite-sex intercourse; 5.5% of males, 2.2% of females),[11] Hong Kong (Grades 7–12: 5.2% overall, 5.6% of males, 4.7% of females),[12] and other South-East Asian countries.[13] On the other hand, our rates are considerably lower than those of developed Western countries.[14-15] For instance, in the United States, the sexual intercourse rate among Grades 9–12 students is 41.2% (43.2% of males and 39.2% of females).[15] Our rates are also lower than that of Australia, where it is geographically close to South-East Asian countries but culturally similar to that of Great Britain and the US. In Australia, the rates of anal or vaginal sex were 43.7% (male) and 48.5% (female) among Years 10–12 heterosexual students.[16] It is possible that Confucian culture plays an important role in adolescent sexual behaviors in Asian countries,[17] and this could potentially explain the discrepancy between our results and those obtained from Western countries.
More importantly, we observed that the rates of sexual intercourse varied greatly with different school types in Taiwan. Our analysis found that the sexual intercourse rate was lowest among junior high school students and that it generally increased with the grade. This was reasonable because more adolescents engaged in intimate sexual behaviors as they matured. Among the Grade 10–12 students, night schools had the highest sexual intercourse rate (41.09%), followed by vocational high school (14.03%), comprehensive school (9.08%), and senior high schools (4.14%). Night school students had the highest rate (41.09%) of sexual intercourse probably because some of them were married. As previously hypothesized,[6] the students’ educational and career aspirations and the school type may be associated with their sexual behaviors. Our findings highlight that academically oriented schools (e.g., senior high schools) tend to have lower sexual intercourse rates than those that place a heavier emphasis on vocational skill training (e.g., comprehensive and vocational high schools).

After stratifying by school type and grade, the difference in rates of sexual intercourse between both genders was statistically non-significant, although male students seemed to have a higher overall rate (5.33%) than female students (4.53%). This finding is inconsistent with previous reports, where male adolescents generally had a higher sexual intercourse rate than female adolescents.[17] In Confucian societies, where chastity is emphasized heavily, unmarried females engaging in sexual intercourse are highly stigmatized.[17] Meanwhile, countries (e.g., Taiwan) which were traditionally influenced by Confucianism are becoming westernized, possibly leading to increasing acceptance of premarital sexual behaviors among female adolescents.[18] Taken together, this might potentially explain our finding that male and female adolescents did not differ significantly in rates of sexual intercourse after stratifying by school type and grade. Nevertheless, the degree to which Western culture involved in shaping Taiwan adolescents’ sexual behaviors deserves further investigation.

Condom use and implications

Despite the low sexual intercourse rate, we found that the practice of protected sex (as indicated by the condom use rate) was not common among adolescents in Taiwan when compared with data obtained from Western[19-21] and South-East Asian countries.[13] In this study, only a quarter of sexually experienced respondents had used a condom at last sex (male: 25.66%, female: 25.80%), which was approximately half of those who used condoms at first sex (male: 55.81%,
female: 60.47%). In contrast, in Western countries such as the United States, the condom use rates at first sex among adolescents (age 15–17 years) are as high as 77% (male) and 74.6% (female)[20] and the rates at last sex (age 13–19 years) are 61% (male) and 47% (female).[19] In a study of nationwide surveys conducted in 33 countries from 2013 to 2014, developed Western countries, such as Great Britain, Denmark, Finland, France, Spain, and Switzerland, were found to typically have a condom use rate of over 40% at last sex among adolescents aged 14–16.[21] Moreover, countries participating in the GSHS in the South-East Asian and Western Pacific regions generally have a higher condom use rate (at last sex) than the rate (25.72%) we obtained.[13] For instance, the condom non-use rates at last sex among GSHS participants aged 12–15 years in Nepal, Bangladesh, Thailand, Cambodia, Laos, and Malaysia were estimated to be 52.6% (2015), 58.7% (2014), 33.8% (2015), 56.2% (2013), 46.7% (2015), and 66.8% (2012), respectively.[13] In Australia, despite being culturally Western but geographically proximal to South-East Asia, the rates of condom use were considerably higher than our rates. (In Australia, the condom use rates were 78.1% (male) and 77.5% (female) at first sex, and 65.1% (male) and 56.8% (female) at last sex.)[16] In summary, the above comparisons show that Taiwanese adolescents’ condom use (both at first and last sex) is not as prevalent as in Western developed countries and other countries participating in the GSHS.

Sex education is critical to the practice of protected sex among adolescents. Although the use of contraception is covered in Taiwan sex education, the importance of safe sex and correct use of condom are not emphasized, and abstinence-only sex education remains the mainstream of sex education in Taiwan.[22-23] In fact, condom vending machines and free condom programs are not available in high schools in Taiwan. This is probably because providing condom vending machines for students might be mistakenly seen as encouraging students to have sex. These reasons might have contributed to the relative low rate of condom use among adolescents in Taiwan when compared with the rates in Western and GSHS-participating countries.

In addition to cross-country comparisons, we investigated how school type and the students’ gender were associated with the condom use rate. Across school types, the condom use rate at first and last sex varied considerably. Notably, night schools had the highest sexual intercourse rate and the second lowest condom use rate at both first and last sex. Moreover, despite having the lowest sexual intercourse rate, sexually experienced junior high school students were the least likely to
use condoms at first and last sex. Our multivariate analysis also revealed that adolescents who initiated sex at a younger age tended not to use condom. In fact, we found that age at first intercourse was the strongest predictor of condom use at first and last sex. This highlights the urgent need to instill a proper understanding of protected sex while adolescents are still in their formative years, especially in junior high schools.

Our study also showed that the students’ gender did not seem to influence the condom use rate at first and last sex. It has long been assumed that gender equality plays an important role in condom use.[21] Our study suggests that across all school types and grades, male and female adolescents in Taiwan are of equal standing in terms of condom use decisions, in contrast to studies conducted elsewhere.[24]

Apart from gender, substance use (i.e., being current smoker and heavy alcohol use) was not found to be associated with condom use at first and last sex (Table 3). This contrasts with previous studies, which reported adolescents who engaged in risky sexual behaviors were more likely to use substance.[25] This phenomenon is commonly attributed to the relative inadequate self-regulation capacity among adolescents who engaged in substance use and risky sexual behaviors.[25] Whether the association between condom use and substance use exists among adolescents across different cultures and countries deserves further research.

The decrease in the condom use rate and increase in the non-condom contraception rate at last sex was possibly due to the teenagers being more concerned about potential pregnancy than the contraction of STIs, as speculated in previous studies.[26] Our data support this hypothesis; most participants in our study who used condoms at first sex (58.16%) changed to using non-condom contraceptive methods at last sex (33.97%) (Table 2). In addition, our data reveal that condom use at sexual debut was associated with better knowledge about STIs (Table 3). Our results also suggest that adolescents with one lifetime sexual partner were more likely to use condoms at last sex than those with multiple sexual partners (Table 2-3). This might be because those who stayed with a single sexual partner were more likely to understand the importance of protected sex and the risk associated with having multiple sexual partners than those who did not. Nevertheless, adolescents with multiple sexual partners who did not use condoms could potentially pose a huge public health risk in Taiwan, since having multiple sexual partners and sexual intercourse without using condoms are associated with the susceptibility to STIs.[4]
Strengths and limitations

A strength of this study is that our analysis was based on a large nationally representative sample. The GSHS used in this study allows for a fair comparison of the sexual intercourse and condom use rates between Taiwan students and others. Moreover, no identifying information was collected in the survey to encourage honest response. However, there are several limitations to our study. First, sex is a sensitive issue in Taiwan; therefore, sexual behavior data collected by the GSHS might be underreported and susceptible to recall bias. Second, sexual intercourse was not defined explicitly, and the Taiwan GSHS did not ask about the sex of the participants’ sexual partner(s). Thus, ‘sexual intercourse’ might be misinterpreted as other forms of sex (e.g., oral sex and intercourse between heterosexuals only). Third, there was a large difference in the number of male and female participants in comprehensive and night schools. Since our data is a representative sample of Grades 10-12 students, having more male students than female students in comprehensive and night schools implied a real male predominance in these school types. This male predominance can be partially explained by the fact that males tend to be the main source of family income in Taiwan. Moreover, having more male students than female students in comprehensive and night schools may introduce selection bias. However, we believe that the selection bias should be at minimum because most of our results (i.e., the rates of sexual intercourse and condom use) were already stratified by school type. Fourth, the comparison of the condom use rate at first and last sex is insufficient for drawing definite conclusions regarding condom use consistency. Additionally, respondents might use condoms and other contraceptive methods simultaneously, leading to biased responses. Therefore, we recommend incorporating questions with a clear definition of sexual intercourse and questions about the frequency of condom use in future GSHS.

In conclusion, the finding of lower sexual intercourse and condom use rates at first and last sex than in many developed countries indicates that the practice of protected sex is not prevalent among Taiwanese adolescents. This is further supported by our findings that most adolescents who used condoms at first sex switched to non-condom contraception at last sex and that adolescents who initiated sex at younger age and with multiple sexual partners were less likely to use condoms.

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Contributors

WHSS designed the study, conducted data analysis and interpretation, and drafted the manuscript. PRL and LCS prepared the GSHS dataset, interpreted the data, and revised the manuscript. All authors read and approved the manuscript in its present form.

Competing interests

None declared.

Data availability statement

No data are available.

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REFERENCES

1. Chawla N, Sarkar S. Defining “high-risk sexual behavior” in the context of substance use. *Journal of Psychosexual Health* 2019;1:26-31.

2 Taiwan Centers for Disease Control. Statistics of HIV/AIDS [updated 22 Aug 2019]. https://www.cdc.gov.tw/En/Category/MPage/kt6yIoEGURtMQubQ3nQ7pA (accessed 11 Sept 2020).

3 Taiwan Centers for Disease Control. Epidemic trend and prevention effectiveness of HIV/AIDS. https://www.cdc.gov.tw/En/Professional/ProgramResultInfo/ppxd4Xu5zcYwcLHniXKk6w?programResultId=8XOWLPdD6J15pNt9p0zrKQ (accessed 6 Nov 2020).
4 Waage J, Banerji R, Campbell O, et al. The Millennium Development Goals: a cross-sectoral analysis and principles for goal setting after 2015. *Lancet* 2010;376:991–1023. doi:10.1016/S0140-6736(10)61196-8

5 Health Promotion Administration, Ministry of Health and Welfare, Taiwan. Statistical yearbook of health promotion 2016 [updated 28 Dec 2019]. https://www.hpa.gov.tw/EngPages/Detail.aspx?nodeid=3850&pid=10649 (accessed 6 Nov 2020).

6 Peterson AJ, Donze M, Allen E, et al. Effects of interventions addressing school environments or educational assets on adolescent sexual health: systematic review and meta-analysis. *Int Perspect Sex Reprod Health* 2018;44:111-31. doi: 10.1363/44e6818 [published Online First: 30 June 2019].

7 Health Promotion Administration, Ministry of Health and Welfare, Taiwan. Taiwan global school-based student health survey (GSHS) [updated 28 Dec 2016]. https://www.hpa.gov.tw/Pages/Detail.aspx?nodeid=1077&pid=6205 (accessed 11 Sept 2020).

8 Health Promotion Administration, Ministry of Health and Welfare, Taiwan. Health promotion administration annual report [updated 28 Dec 2016]. https://www.hpa.gov.tw/EngPages/List.aspx?nodeid=1070 (accessed 11 Sept 2020).

9 Jamal A, Gentzke A, Hu SS, et al. Tobacco use among middle and high school students - United States, 2011-2016. *MMWR Morb Mortal Wkly Rep* 2017;66:597-603. doi: 10.15585/mmwr.mm6623a1 [published Online First: 16 June 2017].

10 Noel JK. Associations between alcohol policies and adolescent alcohol use: a pooled analysis of GSHS and ESPAD data. *Alcohol Alcohol* 2019;54:639-46. doi: 10.1093/alcalc/agz068 [published Online First: 27 September 2019].

11 Kim GH, Ahn HS, Kim HJ. Type of sexual intercourse experience and suicidal ideation, plans, and attempts among youths: a cross-sectional study in South Korea. *BMC Public Health* 2016;16:1229. doi:10.1186/s12889-016-3895-y [published Online First: 7 December 2016].

12 Wong WCW, Choi EPH, Holroyd E, et al. Impact of household composition and satisfaction with family life on self-reported sexual health outcomes of high-school students in Hong Kong.
13 Smith L, Jackson SE, Vancampfort D, et al. Sexual behavior and suicide attempts among adolescents aged 12–15 years from 38 countries: a global perspective. Psychiatry Res 2020;287:112564. doi:10.1016/j.psychres.2019.112564 [published Online First: 7 September 2019].

14 Scott RH, Wellings K, Lindberg L. Adolescent sexual activity, contraceptive use, and pregnancy in Britain and the U.S.: a multidecade comparison. J Adolesc Health 2020;66:582–88. doi:10.1016/j.jadohealth.2019.11.310 [published Online First: 8 February 2020].

15 Kann L, McManus T, Harris WA, et al. Youth risk behavior surveillance—United States, 2015. MMWR Surveill Summ 2016;65:1–174.

16 Fisher CM, Kauer S, Mikolajczak G, et al. Prevalence rates of sexual behaviors, condom use, and contraception among Australian heterosexual adolescents. J Sex Med 2020;17:2313-21. doi: 10.1016/j.jsxm.2020.08.009 [published Online First: 20 September 2020].

17 Zuo X, Lou C, Gao E, et al. Gender differences in adolescent premarital sexual permissiveness in three Asian cities: effects of gender-role attitudes. J Adolesc Health 2012;50(Suppl 3):S18–25. doi:10.1016/j.jadohealth.2011.12.001 [published Online First: 1 March 2012].

18 Cheng Y, Lou C, Gao E, et al. The relationship between external contact and unmarried adolescents' and young adults' traditional beliefs in three East Asian cities: a cross-sectional analysis. J Adolesc Health 2012;50(3 Suppl):S4-11. doi: 10.1016/j.jadohealth.2011.12.011 [published Online First: 1 March 2012]

19 Koumans EH, Welch R, Warner DL. Differences in adolescent condom use trends by global region. J Adolescent Health 2020;66:S36–S37.

20 Holway GV, Brewster KL, Tillman KH. Condom use at first vaginal intercourse among adolescents and young adults in the United States, 2002–2017. J Adolesc Health 2020;67:606–08. doi:10.1016/j.jadohealth.2020.03.034 [published Online First: 16 May 2020].
This is clean copy (without tracked or highlighted changes)

21 de Looze M, Madkour AS, Huijts T, et al. Country-level gender equality and adolescents' contraceptive use in Europe, Canada and Israel: findings from 33 Countries. Perspect Sex Reprod Health 2019;51:43–53. doi:10.1363/psrh.12090 [published Online First: 28 February 2019].

22 Leung H, Shek DTL, Leung E, et al. Development of contextually-relevant sexuality education: lessons from a comprehensive review of adolescent sexuality education across cultures. Int J Environ Res Public Health 2019;16 doi: 10.3390/ijerph16040621 [published Online First: 23 February 2019].

23 Yang HC. Teaching sexual matters in Taiwan: the analytical framework for popular culture and youth sexuality education. Asia Pacific Journal of Education 2014;34:49-64. doi: 10.1080/02188791.2013.822790

24 Vasilenko SA, Kreager DA, Lefkowitz ES. Gender, contraceptive attitudes, and condom use in adolescent romantic relationships: a dyadic approach. J Res Adolesc 2015;25:51–62. doi:10.1111/jora.12091 [published Online First: 8 November 2013].

25 Khadr SN, Jones KG, Mann S, et al. Investigating the relationship between substance use and sexual behaviour in young people in Britain: findings from a national probability survey. BMJ Open 2016;6:e011961. doi: 10.1136/bmjopen-2016-011961 [published Online First: 2 July 2016].

26 Samkange-Zeeb FN, Spallek L, Zeeb H. Awareness and knowledge of sexually transmitted diseases (STDs) among school-going adolescents in Europe: a systematic review of published literature. BMC Public Health 2011;11:727. doi:10.1186/1471-2458-11-727 [published Online First: 25 September 2011].
Figure legends

**Figure 1.** Flow chart of analysis illustrating the overall rates of ever having had sexual intercourse and condom use among adolescents in Taiwan from 2012 to 2016

**Figure 2.** The rate of ever having had sexual intercourse of Taiwan adolescents from 2012 to 2016, by gender, school type and grade
**Figure 1.** Flow chart of analysis illustrating the overall rates of ever having had sexual intercourse and condom use among adolescents in Taiwan from 2012 to 2016

493x575mm (300 x 300 DPI)
Figure 2. The rate of ever having had sexual intercourse of Taiwan adolescents from 2012 to 2016, by gender, school type and grade

609x469mm (300 x 300 DPI)
ONLINE ONLY SUPPLEMENTARY MATERIAL

Contents

- **Table S1.** Taiwan GSHS Questions that were used to determine whether respondents had sexual intercourse and to evaluate the validity of responses
- **Table S2.** The variables in GSHS involved in data analyses
- **References**

**Tables S1-S2:** The questions in these tables were obtained from the Centers for Disease Control and Prevention of the United States. However, the questions were written in Chinese when presented to the subjects.

Table S1. Taiwan GSHS Questions that were used to determine whether respondents had sexual intercourse and to evaluate the validity of responses:

| Question                                                                 | Option                                                                 |
|-------------------------------------------------------------------------|------------------------------------------------------------------------|
| 1. Have you ever had sexual intercourse?                                | A. Yes                                                                |
|                                                                         | B. No                                                                  |
| 2. How old were you when you had sexual intercourse for the first time? | A. I have never had sexual intercourse                                 |
|                                                                         | B. 11 years old or younger                                            |
|                                                                         | C. 12 years old                                                        |
|                                                                         | D. 13 years old                                                        |
|                                                                         | E. 14 years old                                                        |
|                                                                         | F. 15 years old                                                        |
|                                                                         | * G. 16 or 17 years old                                                |
|                                                                         | * H. 18 years old or older                                             |
| 3. During your life, with how many people have you had sexual intercourse? | A. I have never had sexual intercourse                                 |
|                                                                         | B. 1 person                                                            |
|                                                                         | C. 2 people                                                            |
|                                                                         | D. 3 people                                                            |
|                                                                         | E. 4 people                                                            |
|                                                                         | F. 5 people                                                            |
|                                                                         | G. 6 or more people                                                    |
| 4. The first time you had sexual intercourse, what method of birth control did you use to prevent pregnancy? | A. I have never had sexual intercourse                                 |
|                                                                         | B. No method was used to prevent pregnancy                             |
|                                                                         | C. Birth control pills                                                 |
|                                                                         | D. Condoms                                                             |
|                                                                         | E. Depo-Provera (or any injectable birth control, Nuva Ring (or any birth control ring), Implanon (or any implant), or any IUD |
|                                                                         | F. Withdrawal                                                          |
|                                                                         | G. Some other method                                                   |
|                                                                         | H. Not sure                                                            |
| 5. The last time you had sexual intercourse, did you or your partner use a condom? | A. I have never had sexual intercourse                                 |
|                                                                         | B. Yes                                                                 |
|                                                                         | C. No                                                                  |
| 6. The last time you had sexual intercourse, did you or your partner use any other method of birth control, such as withdrawal, rhythm (safe time), birth control pills, or any other method to prevent pregnancy? | A. I have never had sexual intercourse                                 |
|                                                                         | B. Yes                                                                 |
|                                                                         | C. No                                                                  |
|                                                                         | D. I do not know                                                       |
| 7. After having sexual intercourse, have you or your partner ever used emergency after-sex contraceptive pills to prevent pregnancy? | A. I have never had sexual intercourse                                 |
|                                                                         | B. Yes                                                                 |
|                                                                         | C. No                                                                  |
|                                                                         | D. I do not know                                                       |
8. Have you or your sexual partner ever had an induced abortion?

A. I have never had sexual intercourse
B. Yes
C. No
D. I do not know

| No sexual intercourse: | Answered ‘No’ for Qn. 1 and ‘I have never had sexual intercourse’ for Qn. 2-8
| Had sexual intercourse: | Answered ‘Yes’ for Qn. 1 and other than ‘I have never had sexual intercourse’ for Qn. 2-8
| Invalid response: | Contradictory response such as answered ‘Yes’ for Qn. 1 and answered ‘I have never had sexual intercourse’ for any one of Qn. 2-8

*In 2012, option G became ‘16 years old or older’ without option ‘H. 18 years old or older’. However, starting from 2013, option G and H were ‘16 or 17 years old’ and ‘18 years old or older’ respectively. Therefore, in our analyses throughout this paper, we combined the data of option ‘G. 16 or 17 years old’ and ‘H. 18 years old or older’ into ‘16 years old or older’.

Table S2. The variables in GSHS involved in data analyses

| Variable | Question / Description | Option |
|----------|------------------------|--------|
| Demographics | What is your sex? | A. Male
| | | B. Female
| | How old are you? | A. 11 years old or younger
| | | B. 12 years old
| | | C. 13 years old
| | | D. 14 years old
| | | E. 15 years old
| | | F. 16 years old
| | | G. 17 years old
| | | H. 18 years old or older
| Degree of urbanization ** | In what grade are you? | A. Grade 1 *
| | | B. Grade 2 *
| | | C. Grade 3 *
| School type ** | Junior high school / Senior high school / Vocational high school / Comprehensive school / Night school
| Knowledge about sexually transmitted diseases | Do you agree with the following statement: “Even if they had received the cervical cancer vaccine, women still need to have a Pap smear regularly”? | A. Yes
| | | B. No
| | | C. I do not know
| Substance use | During the past 30 days, on how many days did you smoke cigarettes? | A. 0 days
| | | B. 1 or 2 days
| | | C. 3 to 5 days
| | | D. 6 to 9 days
| | | E. 10 to 19 days
| | | F. 20 to 29 days
| | | G. All 30 days
| | During the past 30 days, on the days you drank alcohol, how many drinks did you usually drink per day? | A. I did not drink alcohol during the past 30 days
| | | B. Less than one drink
| | | C. 1 drink
| | | D. 2 drinks
| | | E. 3 drinks
| | | F. 4 drinks
| | | G. 5 or more drinks
| Sexual behaviors | Have you ever had sexual intercourse? | A. Yes
| | | B. No
During your life, with how many people have you had sexual intercourse?

A. I have never had sexual intercourse  
B. 1 person  
C. 2 people  
D. 3 people  
E. 4 people  
F. 5 people  
G. 6 or more people

The first time you had sexual intercourse, what method of birth control did you use to prevent pregnancy?

A. I have never had sexual intercourse  
B. No method was used to prevent pregnancy  
C. Birth control pills  
D. Condoms  
E. Depo-Provera (or any injectable birth control), Nuva Ring (or any birth control ring), Implanon (or any implant), or any IUD  
F. Withdrawal  
G. Some other method  
H. Not sure

The last time you had sexual intercourse, did you or your partner use a condom?

A. I have never had sexual intercourse  
B. Yes  
C. No

The last time you had sexual intercourse, did you or your partner use any other method of birth control, such as withdrawal, rhythm (safe time), birth control pills, or any other method to prevent pregnancy?

A. I have never had sexual intercourse  
B. Yes  
C. No  
D. I do not know

* In 2012, option F was 16 years old or older. However, from 2013 to 2016, option F was changed to 16 years old and option G (17 years old) and option H (18 years old or older) were added.

** The data for ‘Degree of urbanization’ and ‘School type’ were entered by those who collected the data, they were not answered by students.

# Grade 1, 2 and 3 mean Grade 7, 8 and 9 when GSHS was conducted in 2012, 2014 and 2016. Grade 1, 2 and 3 mean Grade 10, 11 and 12 when GSHS was conducted in 2013 and 2015.

References

1. Taiwan - Global School-based Student Health Survey (GSHS) 2016 [Available from: https://www.cdc.gov/gshs/countries/westpacific/taiwan.htm accessed 2 Nov 2020.
| Item No | Recommendation | Page No |
|--------|----------------|---------|
| **Title and abstract** | (a) Indicate the study’s design with a commonly used term in the title or the abstract | 1 |
| | (b) Provide in the abstract an informative and balanced summary of what was done and what was found | 1 |
| **Introduction** | | |
| Background/rationale | Explain the scientific background and rationale for the investigation being reported | 1-2 |
| Objectives | State specific objectives, including any prespecified hypotheses | 1-2 |
| **Methods** | | |
| Study design | Present key elements of study design early in the paper | 3-4 |
| Setting | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | 3-4 |
| Participants | (a) Give the eligibility criteria, and the sources and methods of selection of participants | 3-4 |
| Variables | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | 3-4 |
| Data sources/measurement | 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 | 3-4 |
| Bias | Describe any efforts to address potential sources of bias | 3-4, 14 |
| Study size | Explain how the study size was arrived at | 3-4 |
| Quantitative variables | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | 3-4 |
| Statistical methods | (a) Describe all statistical methods, including those used to control for confounding | 3-4 |
| | (b) Describe any methods used to examine subgroups and interactions | 3-4 |
| | (c) Explain how missing data were addressed | 3-4 |
| | (d) If applicable, describe analytical methods taking account of sampling strategy | 3-4 |
| | (e) Describe any sensitivity analyses | 3-4 |
| **Results** | | |
| Participants | (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 | 5-10 |
| | (b) Give reasons for non-participation at each stage | 5-10 |
| | (c) Consider use of a flow diagram | 5-10 |
| Descriptive data | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders | 5-10 |
| | (b) Indicate number of participants with missing data for each variable of interest | 5-10 |
| Outcome data | Report numbers of outcome events or summary measures | 5-10 |
| Main results | (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make | 5-10 |
clear which confounders were adjusted for and why they were included.

(b) Report category boundaries when continuous variables were categorized.

(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period.

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| Other analyses | 17 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses | 5-10 |

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**Discussion**

| Key results | 18 | Summarise key results with reference to study objectives | 10-14 |
| 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 | 10-14 |
| Interpretation | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | 10-14 |
| Generalisability | 21 | Discuss the generalisability (external validity) of the study results | 10-14 |

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**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 | 15 |

*Give information separately for exposed and unexposed groups.

**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.
The rate of condom use among sexually active adolescents: A nationwide cross-sectional study in Taiwan from 2012 to 2016

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TITLE

The rate of condom use among sexually active adolescents: A nationwide cross-sectional study in Taiwan from 2012 to 2016

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Word count: 3,798

ABSTRACT

Objective: Adolescents’ sexual behaviors are associated with sexually transmitted infections (STIs) and unwanted pregnancies. This study aimed to estimate the sexual intercourse and condom use rates at first and last sex among Taiwanese adolescents in Grades 7–12.

Design: A secondary data analysis of the Taiwan Global School-Based Student Health Survey’s 2012–2016 data. The survey was anonymous, cross-sectional, and nationwide.

Setting: Taiwan high school students (Grades 7-12).

Participants: The sample comprised 27,525 students from junior high schools (Grades 7–9) and senior high schools, comprehensive schools, vocational high schools, and night schools (Grades 10–12).

Main outcome measures: The rate of ever having had sexual intercourse; the rates and factors of condom use at first and last sex.
Results: The sexual intercourse rate in each school type (in ascending order) was junior high school (1.62%), senior high school (4.14%), comprehensive school (9.08%), vocational high school (14.03%), and night school (41.09%). Condom use rate decreased from 57.07% (95% confidence interval [CI] = 54.31%–59.83%) at first sex to 25.72% (95% CI = 23.34%–28.10%) at last sex ($p < 0.0001$). The condom use rate (in ascending order) was junior high school (first sex: 37.67%, last sex: 19.76%), night school (55.83%, 22.62%), vocational high school (61.13%, 25.78%), comprehensive school (62.83%, 28.61%), and senior high school (68.38%, 34.96%). Older age at sexual debut predicted condom use at first and last sex, and having one sexual partner predicted condom use at last sex, as revealed by logistic regression analysis.

Conclusions: This study highlights an urgent need to instill a proper understanding of protected sex while adolescents are still in their formative years. Despite the low sexual intercourse rate (4.95%), there is lower condom use at last sex than at first sex, which indicates that many sexually active adolescents are not practicing protected sex, especially among junior high school students.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- The Taiwan Global School-Based Student Health Survey (GSHS) was cross-sectional and based on a large nationally representative sample.
- The survey was anonymous and therefore encouraged honest responses to sensitive questions (such as sexual behaviors) from participants.
- Cross-country comparisons of the rates of sexual intercourse and condom use among adolescents based on GSHS data should be cautious because of the following reasons:
  - ‘Sexual intercourse’ was not defined explicitly; therefore, its exact meaning is open to interpretation by the participants and varies across cultures.
  - Inadequate details about sexual behaviors and condom use, such as knowledge, attitude and frequency of the behaviors.

INTRODUCTION

Adolescent sexual behavior is an important public health issue because of its association with sexually transmitted infections (STIs) and teenage pregnancies. Adolescent sexual behavior refers to
sexual behaviors which put adolescents at risk of contracting STIs, unintended pregnancies, abortions, and subsequent psychological distress.[1] Examples of such behaviors include unprotected sexual intercourse, having sexual intercourse with multiple partners, and males who have sex with males (MSM).[1-2] In Taiwan, the number of newly reported cases of human immunodeficiency virus / acquired immunodeficiency syndrome (HIV/AIDS) increased from 2012–2016,[3] and about 66% of HIV cases occurred in adolescents and young adults (aged 15-34 years) from 2014-2016.[4] The estimated incidence rate of HIV among adolescents aged 13–24 years was about 20 per 100,000 population during this period.[5] Condoms are considered the most effective contraception to protect against STIs. Condom use at last high-risk sex is one of the indicators of the Millennium Development Goals’ monitoring that was established by the United Nations International Children’s Emergency Fund to tackle STIs.[6] In Taiwan, the sexual intercourse rates among adolescents aged 13–15 years increased from 2.2% (male) and 1.8% (female) in 2006 to 5.4% (male) and 5.3% (female) in 2016.[7] Furthermore, the contraception use rate among these adolescents increased from 56.2% (male) and 58.1% (female) in 2006 to 74.8% (male) and 77.7% (female) in 2016.[7] However, the predominant form of contraception was not reported. More importantly, whether sexually active adolescents in Taiwan actually practice protected sex (i.e., use condoms) remains unclear.

It has long been speculated that adolescent sexual behaviors are associated with school type and education programs.[8] In Taiwan, public education has been compulsory from primary school to junior high school since 1968. Since 2014, a full 12-year compulsory education program has been implemented. Junior high school students in Grade 9 take a high school entrance examination to continue their education, which is designed as a screening tool to assign students to various school programs for Grades 10–12. Students who aspire to receive higher education mostly attend regular senior high schools. Other educational opportunities include vocational high schools and comprehensive schools, which are workplace-oriented and emphasize vocational skills. Night school curricula vary, ranging from vocational to academic courses. Therefore, in this study, we aimed to estimate the sexual intercourse and condom use rates at first and last sex among Taiwanese adolescents across school types by using nationally representative data of Grade 7–12 students. To our knowledge, this study is the first to examine whether sexually active adolescents in Taiwan actually practice protected sex by using the data from a large nationally representative sample.
METHODS

We performed a secondary analysis of the 2012–2016 data of the Taiwan Global School-Based Student Health Survey (GSHS). The Taiwan GSHS is a nationwide cross-sectional study that surveys the health behaviors of Grade 7–9 (aged 12-15) and Grade 10–12 (aged 15-18) students every other year.[9]

The survey was conducted by the Health Promotion Administration (HPA), Ministry of Health and Welfare of Taiwan, in collaboration with the United States’ Centers for Disease Control and Prevention.[9] The Taiwan GSHS was translated into Chinese from the English version. The HPA first categorized schools into four geographic levels (i.e., big city, small city, urban town, and rural town) according to the population density of their locations. Next, the HPA used a two-step “probability proportional to size” method at each geographic level for sampling, where the sample schools were drawn before the sample classes.[9] They invited all students from the sample classes to participate. The survey was anonymous and no identifying information were collected. Additional details of the Taiwan GSHS’s methodology are reported elsewhere.[9]

From 2012–2016, there were 29,040 participants, and the response rates were 93.3% in 2012, 89.6% in 2013, 93.7% in 2014, 90.2% in 2015, and 92.6% in 2016.[10] Junior high school students were surveyed in 2012, 2014, and 2016, and Grade 10–12 students (including senior high school, comprehensive, vocational high school, and night school students) were surveyed in 2013 and 2015. As illustrated in Figure 1, this study included a total of 27,525 students, after excluding those who did not indicate their gender (n = 62) and those who gave contradictory answers to the eight survey questions (Table S1, online supplementary material) about sexual behaviors (n = 1,453).

We selected three sections of questions from the GSHS (Table S2): demographics, substance use, and sexual behaviors. The demographic variables included gender, age, degree of urbanization, school type, and grade. Regarding substance use, we looked into whether the participants were current smokers (defined as smoking cigarettes on at least one day during the past 30 days)[11] and current heavy alcohol users (defined as consuming ≥ 5 drinks of alcoholic beverages per day in the past 30 days).[12] The variables regarding sexual behaviors were ever having had sexual intercourse, number of sexual partners, condom use, and non-condom use at first sex and last sex. The outcome variables were ever having had sexual intercourse and condom use at first and last sex. However, since
questionnaires of Taiwan GSHS did not explicitly define “sexual intercourse”, its exact meaning was open to interpretation by the subjects.

We used the chi-square test to examine the association between the students’ gender and the outcome variables (sexual intercourse and condom use at first and last sex) in each school type. We conducted McNemar’s test to investigate the consistency of condom use at first and last sex for students who had one sexual partner and those who had more than one sexual partner. In univariate analysis, we used chi-square test to examine the association between demographics, risk/protective factors, and outcome variables (condom use at first and last sex). Regarding multivariate analysis, we used logistic regression with forward selection to locate important factors for condom use at first and last sex. The adjusted odds ratio (AOR) with 95% confidence interval (CI) shows the direction and magnitude of the association between demographics, risk/protective factors, and outcome variables (condom use at first and last sex). We conducted all analyses using SAS 9.4 (SAS Institute, Cary, NC, USA). The significance level was 0.05.

Ethics

The Institutional Review Board of the Chang Gung Medical Foundation approved this study and waived the requirement for informed consent for this anonymous survey (IRB number: 202001534B0).

Patient and public involvement

No patients were involved.

RESULTS

Sexual intercourse rate by gender, school type, and grade

Overall, the sexual intercourse rate was 4.95% (Figure 1). The ascending order of sexual intercourse rate by school type was junior high school (1.62%), senior high school (4.14%), comprehensive school (9.08%), vocational high school (14.03%), and night school (41.09%).

In general, male students (5.33%) seemed to have a higher rate of sexual intercourse than female students (4.53%) (Table 1). However, there was significant interaction between gender and
school type ($p = 0.0279$), which indicated that the apparent difference in rate of sexual intercourse between both genders depended on different school types, or vice versa. Therefore, the main effect of gender or that of school type on sexual intercourse was meaningless. When stratified by school type, male students in senior high school had a significantly higher rate of sexual intercourse (4.92%) than female students (3.4%) ($p = 0.0352$). There was a borderline difference in sexual intercourse rate among students at vocational high school between both genders ($p = 0.0613$). However, when the sexual intercourse rates were further stratified by grade and school type, the rates of sexual intercourse between both genders did not differ significantly (Figure 2).

Table 1. Rates of ever having had sexual intercourse, condom use at first and last sex among adolescents in Taiwan from 2012 to 2016, by gender

|                                | Male (%)                      | Female (%)                     | $p$  
|--------------------------------|-------------------------------|--------------------------------|------
| **Sexual intercourse**         |                               |                                |      
| Grades 7-9                     | 775/14531 (5.33%)             | 588/12994 (4.53%)              | †    
| Junior High school             | 156/9027 (1.73%)              | 125/8286 (1.51%)               | 0.2534 
| Grades 10-12                   |                               |                                |      
| Senior High school             | 74/1505 (4.92%)               | 53/1559 (3.4%)                 | 0.0352 * 
| Comprehensive school           | 240/2518 (9.53%)              | 157/1855 (8.46%)               | 0.2245 
| Vocational high school         | 132/1048 (12.6%)              | 170/1104 (15.4%)               | 0.0613 
| Night school                   | 173/433 (39.95%)              | 83/190 (43.68%)                | 0.3836 
| **Condom use at first sexual intercourse** |                               |                                |      
| Total                          | 384/688 (55.81%)              | 322/549 (58.65%)               | 0.3164 
| Grades 7-9                     |                               |                                |      
| Junior High school             | 41/118 (34.75%)               | 43/105 (40.95%)                | 0.3397 
| Grades 10-12                   |                               |                                |      
| Senior High school             | 343/570 (60.18%)              | 279/444 (62.84%)               | 0.3877 
| Comprehensive school           | 40/65 (61.54%)                | 40/52 (76.92%)                 | 0.0754 
| Vocational high school         | 142/224 (63.39%)              | 93/150 (62.00%)                | 0.7847 
| Night school                   | 72/121 (59.50%)               | 101/162 (62.35%)               | 0.6276 
| **Condom use at last sexual intercourse** |                               |                                |      
| Total                          | 186/725 (25.66%)              | 146/566 (25.80%)               | 0.9545 
| Grades 7-9                     |                               |                                |      
| Junior High school             | 26/133 (19.55%)               | 23/115 (20.00%)                | 0.9291 
| Grades 10-12                   |                               |                                |      
| Senior High school             | 160/592 (27.03%)              | 123/451 (27.27%)               | 0.9296 
| Comprehensive school           | 27/70 (38.57%)                | 16/53 (30.19%)                 | 0.3343 
| Vocational high school         | 67/227 (29.52%)               | 42/154 (27.27%)                | 0.6345 
| Night school                   | 27/125 (21.60%)               | 47/162 (29.01%)                | 0.1546 

$p$: $p$-values were obtained from chi-square test.
Condom use at first and last sexual intercourse

The overall condom use rate decreased from 57.07% at first sex to 25.72% at last sex (Figure 1). The condom use rates were not statistically different between male and female adolescents at both first and last sex, with $p=0.3164$ and $p=0.9545$, respectively (Table 1). In terms of school type, the ascending order of the condom use rate was junior high school (first sex: 37.67%, last sex: 19.76%), night school (55.83%, 22.62%), vocational high school (61.13%, 25.78%), comprehensive school (62.83%, 28.61%), and senior high school (68.38%, 34.96%) (Figure 1). Moreover, across all school types, condom use rates did not differ significantly between male and female students (Table 1).

Univariate analysis showed that school type, age at first sexual intercourse, number of sexual partner(s), being current smoker (in the past 30 days) were all significantly associated with condom use at first and last sex. We also noted that alcohol consumption was significantly associated with condom use at first sex ($p=0.0037$) but not at last sex ($p=0.4314$). Regarding number of sexual partner(s), the condom use rate at first and last sex among those with one sexual partner was statistically significantly higher than that of those with multiple sexual partners. At first sex, the condom use rate among those with one sexual partner and multiple sexual partners was 61.72% and 53.71% ($p = 0.0048$), respectively. At last sex, the condom use rate among those with one sexual partner (31.17%=202/648) was higher than that of those with multiple sexual partners (20.34%=130/639) ($p < 0.0001$) (Table 2).

In multivariate analysis of condom use at first sex, the following respondents were more likely to use condom at first sexual intercourse: those who first had sex at age 12-13 (adjusted odds ratio (AOR) 4.74, 95% confidence interval (CI)= 2.02 – 11.1), age 14-15 (AOR 10.6, 95% CI=4.72 - 23.8) and age 16 or above (AOR 18.3, 95% CI= 8.20 – 40.9) when compared with those who had sex at age 11 or younger (Table 2).

*: p-values < 0.05
†: The interaction between gender and school type is statistically significant ($p = 0.0279$) when tested with logistic regression (model: sexual intercourse = $\beta_0 + \beta_1$ school type + $\beta_2$ gender + $\beta_3$ school type*gender).
Regarding condom use at last sex, the multivariate analysis indicated that adolescents who had one sexual partner (AOR 1.60, 95% CI=1.23 - 2.07) when compared with those who had more than one, and those who first had sex at age 16 or above (AOR 2.00, 95% CI=1.05 - 3.83) when compared with those who had sex at age 11 or younger were more likely to use condom at last sex (Table 2).

Table 2. Univariate and multivariate analysis of condom use at first and last sexual intercourse among adolescents in Taiwan, 2012-2016

|                              | Condom (1st sex) | Condom (last sex) | Condom (1st sex) | Condom (last sex) |
|------------------------------|------------------|-------------------|------------------|-------------------|
|                              | Yes (%)          | p                 | Yes (%)          | p                 |
| Total                        | 706/1237 (57.07%)| --                | 332/1291 (25.72%)| --                |
| Gender                       |                  |                   |                  |                   |
| Male                         | 384/688 (55.81%) | 0.3164            | 186/725 (25.66%) | 0.9545            |
| Female                       | 322/549 (58.65%) |                    | 146/566 (25.8%)  |                   |
| School type                  |                  |                   |                  |                   |
| Junior                       | 84/223 (37.67%)  | <0.0001           | 49/248 (19.76%)  | 0.0111            |
| Senior                       | 80/117 (68.38%)  |                    | 43/123 (34.96%)  | NS                |
| Vocational                   | 173/283 (61.13%) |                    | 74/287 (25.78%)  | NS                |
| Comprehensive                | 235/374 (62.83%) |                    | 109/381 (28.61%) |                   |
| Night                        | 134/240 (55.83%) |                    | 57/252 (22.62%)  |                   |
| Sexual behaviors             |                  |                   |                  |                   |
| Age at 1st sex               |                  |                   |                  |                   |
| ≤ 11 years old               | 7/64 (10.94%)    | <0.0001           | 12/73 (16.44%)   | Ref.              |
| 12-13                        | 53/144 (36.81%)  |                    | 23/160 (14.38%)  | 4.74 (2.02 – 11.1) |
| 14-15                        | 233/412 (56.55%) |                    | 106/436 (24.31%) | 10.6 (4.72 – 23.8) |
| ≥ 16                         | 405/585 (69.23%) |                    | 190/610 (31.15%) | 18.3 (8.20 – 40.9) |
| No. of sexual partner        |                  |                   |                  |                   |
| 1                            | 374/606 (61.72%) | 0.0048            | 202/648 (31.17%) | NS                |
| > 1                          | 326/607 (53.71%) |                    | 130/639 (20.34%) | 1.60 (1.23 - 2.07) |
| Substance use                |                  |                   |                  |                   |
| Current smoker               |                  |                   |                  |                   |
| No                           | 412/671 (61.4%)  | 0.0013            | 207/701 (29.53%) | NS                |
| Yes                          | 289/553 (52.26%) |                    | 123/576 (21.35%) | NS                |
| Heavy alcohol use            |                  |                   |                  |                   |
| No                           | 587/995 (58.99%) | 0.0037            | 271/1038 (26.11%)| NS                |
| Yes (≥ 5 drinks/day)         | 112/231 (48.48%) |                    | 57/241 (23.65%)  | NS                |

*P-values of univariate analysis were obtained by chi-square test, while those of multivariate analysis were calculated by logistic regression with forward selection.

NS: non-significant; Ref.: reference group; AOR: adjusted odds ratio

Subjects who did not respond to the questions (i.e., missing data) were not included in this Table.

At first sex, the number of missing data in the following questions: Age at 1st sex – 32, No. of sexual partner – 24, Current smoker – 13, Heavy alcohol use – 11.
At last sex, the number of missing data in the following questions: Age at 1st sex – 12, No. of sexual partner – 4, Current smoker – 14, Heavy alcohol use – 12.

When investigating the decrease in the condom use rate, we observed that about two-thirds of adolescents who used condoms at first sex (n=702) switched to using a non-condom contraceptive method (410/702, 58.4%) or having no contraception (28/702, 4.0%) at last sex. In contrast, those who did not use any contraception (n=293) at first sex remained not using any contraception (178/293, 60.8%) at last sex, and those who used non-condom contraception (n=212) at first sex mostly did not change their method of birth control (150/212, 70.7%) at last sex. Moreover, students with one sexual partner were more likely to use condoms both at first and last sex (27.7%=168/606) than those with multiple sexual partners (16.0%=96/598) (p < 0.0001) (Table 3).

Table 3. Inconsistent use of condom at first and last sexual intercourse among adolescents in Taiwan from 2012 to 2016, by number of sexual partner

| First sexual intercourse | Last sexual intercourse | Total | No contraception | Condom | Other methods | p   |
|--------------------------|------------------------|-------|------------------|--------|---------------|-----|
| Overall                  |                        | 1207  | 241              | 316    | 650           | <0.0001 |
| No contraception         |                        | 293   | 178              | 25     | 90            |     |
| Condom                   |                        | 702   | 28               | 264    | 410           |     |
| Other methods            |                        | 212   | 35               | 27     | 150           |     |
| No. of sexual partners >1|                        | 598   | 131              | 124    | 343           | <0.0001 |
| No contraception         |                        | 158   | 93               | 15     | 50            |     |
| Condom                   |                        | 326   | 18               | 96     | 212           |     |
| Other methods            |                        | 114   | 20               | 13     | 81            |     |
| One sexual partner       |                        | 606   | 109              | 192    | 305           | <0.0001 |
| No contraception         |                        | 134   | 85               | 10     | 39            |     |
| Condom                   |                        | 374   | 9                | 168    | 197           |     |
| Other methods            |                        | 98    | 15               | 14     | 69            |     |

p: p-values were obtained from McNemar’s test.

The overall total (1207) does not equal to the total (598+606=1204) at the lower half of the table because subjects who did not respond to the questions about

i) the number of sexual partners,

ii) the method of contraception use at first and last sexual intercourse
were not included in McNemar’s test.

DISCUSSION

Sexual intercourse

This nationwide cross-sectional study revealed that the overall rate of ever having had sexual intercourse among adolescents (Grades 7–12) in Taiwan was 4.95% (5.33% of males and 4.53% of females) during 2012–2016. Our rates are similar to several studies in other Asian countries and regions, such as South Korea (Grades 7–12: 3.9% overall, opposite-sex intercourse; 5.5% of males, 2.2% of females),[13] Hong Kong (Grades 7–12: 5.2% overall, 5.6% of males, 4.7% of females),[14] and other South-East Asian countries.[15] On the other hand, our rates are considerably lower than those of developed Western countries.[16-17] For instance, in the United States, the sexual intercourse rate among Grade 9–12 students is 41.2% (43.2% of males and 39.2% of females).[17] Our rates are also lower than that of Australia, where it is geographically close to South-East Asian countries but culturally similar to that of Great Britain and the US. In Australia, the rates of anal or vaginal sex were 43.7% (male) and 48.5% (female) among Year 10–12 heterosexual students.[18] It is possible that Confucian culture plays an important role in adolescent sexual behaviors in Asian countries,[19] and this could potentially explain the discrepancy between our results and those obtained from Western countries.

More importantly, we observed that the rates of sexual intercourse varied greatly with different school types in Taiwan. Our analysis found that the sexual intercourse rate was lowest among junior high school students and that it generally increased with the grade. This was reasonable because more adolescents engaged in intimate sexual behaviors as they matured. Among the Grade 10–12 students, night schools had the highest sexual intercourse rate (41.09%), followed by vocational high school (14.03%), comprehensive school (9.08%), and senior high schools (4.14%). We speculated that the highest rate of sexual intercourse among night school students (41.09%) was probably because some of them were married. As previously hypothesized,[8] the students’ educational and career aspirations and the school type may be associated with their sexual behaviors. Our findings highlight that academically oriented schools (e.g., senior high schools) tend to have lower sexual intercourse rates
than those that place a heavier emphasis on vocational skill training (e.g., comprehensive and vocational high schools).

After stratifying by school type and grade, the difference in rates of sexual intercourse between both genders was statistically non-significant, although male students seemed to have a higher overall rate (5.33%) than female students (4.53%). This finding is inconsistent with previous reports, where male adolescents generally had a higher sexual intercourse rate than female adolescents.[19] In Confucian societies, where chastity is emphasized heavily, unmarried females engaging in sexual intercourse are highly stigmatized.[19] Meanwhile, countries (e.g., Taiwan) which were traditionally influenced by Confucianism are becoming westernized, possibly leading to increasing acceptance of premarital sexual behaviors among female adolescents.[20] Taken together, this might potentially explain our finding that male and female adolescents did not differ significantly in rates of sexual intercourse after stratifying by school type and grade. Nevertheless, the degree to which Western culture involved in shaping Taiwan adolescents’ sexual behaviors deserves further investigation.

Condom use and implications

Despite the low sexual intercourse rate, we found that the practice of protected sex (as indicated by the condom use rate) was not common among adolescents in Taiwan when compared with data obtained from Western[21-23] and South-East Asian countries.[15] In this study, only a quarter of sexually experienced respondents had used a condom at last sex (male: 25.66%, female: 25.80%), which was approximately half of those who used condoms at first sex (male: 55.81%, female: 60.47%). In contrast, in Western countries such as the United States, the condom use rates at first sex among adolescents (age 15–17 years) are as high as 77% (male) and 74.6% (female) [22] and the rates at last sex (age 13–19 years) are 61% (male) and 47% (female).[21] In a study of nationwide surveys conducted in 33 countries from 2013 to 2014, developed Western countries, such as Great Britain, Denmark, Finland, France, Spain, and Switzerland, were found to typically have a condom use rate of over 40% at last sex among adolescents aged 14–16.[23] Moreover, countries participating in the GSHS in the South-East Asian and Western Pacific regions generally have a higher condom use rate (at last sex) than the rate (25.72%) we obtained.[15] For instance, the condom non-use rates at last sex among GSHS participants aged 12–15 years in Nepal, Bangladesh, Thailand, Cambodia, Laos, and Malaysia were estimated to be 52.6% (2015), 58.7% (2014), 33.8% (2015), 56.2% (2013), 46.7% (2015), and 66.8% (2012), respectively.[15] In Australia, despite being culturally Western but
geographically proximal to South-East Asia, the rates of condom use were considerably higher than our rates. (In Australia, the condom use rates were 78.1% (male) and 77.5% (female) at first sex, and 65.1% (male) and 56.8% (female) at last sex.)[18] In summary, the above comparisons show that Taiwanese adolescents’ condom use (both at first and last sex) is not as prevalent as in Western developed countries and other countries participating in the GSHS.

Sex education is critical to the practice of protected sex among adolescents. Although the use of contraception is covered in Taiwan sex education, the importance of safe sex and correct use of condom are not emphasized, and abstinence-only sex education remains the mainstream of sex education in Taiwan.[24-25] In fact, condom vending machines and free condom programs are not available in high schools in Taiwan. This is probably because providing condom vending machines for students might be mistakenly seen as encouraging students to have sex. These reasons might have contributed to the relative low rate of condom use among adolescents in Taiwan when compared with the rates in Western and GSHS-participating countries.

In addition to cross-country comparisons, we investigated how school type and the students’ gender were associated with the condom use rate. Across school types, the condom use rate at first and last sex varied considerably. Notably, night schools had the highest sexual intercourse rate and the second lowest condom use rate at both first and last sex. Moreover, despite having the lowest sexual intercourse rate, sexually experienced junior high school students were the least likely to use condoms at first and last sex. Our multivariate analysis also revealed that adolescents who initiated sex at a younger age tended not to use condom. In fact, we found that age at first intercourse was the strongest predictor of condom use at first and last sex. This highlights the urgent need to instill a proper understanding of protected sex while adolescents are still in their formative years, especially in junior high schools.

Our study also showed that the students’ gender did not seem to influence the condom use rate at first and last sex. It has long been assumed that gender equality plays an important role in condom use.[23] Our study suggests that across all school types and grades, male and female adolescents in Taiwan are of equal standing in terms of condom use decisions, in contrast to studies conducted elsewhere.[26]

Apart from gender, substance use (i.e., being current smoker and heavy alcohol use) was not found to be associated with condom use at first and last sex in our multivariate analysis (Table 2).
This contrasts with previous studies, which reported adolescents who engaged in risky sexual behaviors were more likely to use substance.[27] There are many factors that are associated with both adolescent sexual behaviors and substance use, including mental disorders (especially attention-deficit/hyperactivity disorder), trauma, sexual abuse, etc.[2, 27-29] Therefore, whether the association between condom use and substance use exists among adolescents across different cultures and countries deserves further research.

The decrease in the condom use rate and increase in the non-condom contraception rate at last sex was possibly due to the teenagers being more concerned about potential pregnancy than the contraction of STIs, as speculated in previous studies.[30] Our data support this hypothesis; most participants in our study who used condoms at first sex (58.16%) changed to using non-condom contraceptive methods at last sex (33.97%) (Table 3). Our results also suggest that adolescents with one sexual partner were more likely to use condoms at last sex than those with multiple sexual partners (Table 2-3). This might be because those who stayed with a single sexual partner were more likely to understand the importance of protected sex and the risk associated with having multiple sexual partners than those who did not. Nevertheless, adolescents with multiple sexual partners who did not use condoms could potentially pose a huge public health risk in Taiwan, since having multiple sexual partners and sexual intercourse without using condoms are associated with the susceptibility to STIs.[4]

**Strengths and limitations**

A strength of this study is that our analysis was based on a large nationally representative sample. Moreover, no identifying information was collected in the survey to encourage honest response. The GSHS used in this study allows multi-national comparisons between the sexual intercourse and condom use rates of Taiwan students and those of others. However, there are several limitations to our study.

First, sex is a sensitive issue in Taiwan; therefore, sexual behavior data collected by the GSHS might be underreported and susceptible to recall bias. Second, since sexual intercourse was not defined explicitly, its exact meaning is open to interpretation by the participants. The GSHS did not ask about the gender of the participants’ sexual partner(s). Thus, ‘sexual intercourse’ might be misinterpreted as other forms of sex (e.g., oral sex and intercourse between heterosexuals only). Additionally,
researchers using GSHS data regarding sexual intercourse from different countries should be very cautious because interpretation of sexual intercourse varies across cultures. Third, there was a large difference in the number of male and female participants in comprehensive and night schools. Since our data is a representative sample of Grades 10-12 students, having more male students than female students in comprehensive and night schools implied a real male predominance in these school types. This male predominance can be partially explained by the fact that males tend to be the main source of family income in Taiwan. Moreover, having more male students than female students in comprehensive and night schools may introduce selection bias. However, we believe that the selection bias should be at minimum because most of our results (i.e., the rates of sexual intercourse and condom use) were already stratified by school type. Fourth, the GSHS questionnaires did not contain sufficient details of knowledge, attitude, and practice of condom use (and other sexual behaviors) among adolescents. Therefore, our comparison of the condom use rate at first and last sex is insufficient for drawing definite conclusions regarding condom use consistency. Additionally, respondents might use condoms and other contraceptive methods simultaneously, leading to biased responses. Fifth, the Taiwan GSHS did not have questions regarding the gender of the sexual partner(s) of the subjects. As a result, we were unable to analyze adolescent MSM sexual behaviors. To address these limitations, we recommend incorporating questions with a clear definition of sexual intercourse, questions about the frequency of condom use, and gender of sexual partner(s) in future GSHS.

In conclusion, the finding of lower sexual intercourse and condom use rates at first and last sex than in many developed countries indicates that the practice of protected sex is not prevalent among Taiwanese adolescents. This is further supported by our findings that most adolescents who used condoms at first sex switched to non-condom contraception at last sex and that adolescents who initiated sex at younger age and with multiple sexual partners were less likely to use condoms.

Acknowledgments

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Contributors
WHSS designed the study, conducted data analysis and interpretation, and drafted the manuscript. PRL and LCS prepared the GSHS dataset, interpreted the data, and revised the manuscript. All authors read and approved the manuscript in its present form.

**Competing interests**

None declared.

**Data availability statement**

No data are available.

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**REFERENCES**

1 Chawla N, Sarkar S. Defining “high-risk sexual behavior” in the context of substance use. *Journal of Psychosexual Health* 2019;1:26-31.

2 Grubb LK, Committee On Adolescence. Barrier protection use by adolescents during sexual activity. *Pediatrics* 2020;146: e2020007245. doi: 10.1542/peds.2020-007245 [published Online First: 22 July 2020]

3 Taiwan Centers for Disease Control. Statistics of HIV/AIDS [updated 22 Aug 2019]. https://www.cdc.gov.tw/En/Category/MPage/kt6yIoEGURtMQubQ3nQ7pA (accessed 11 Sept 2020).

4 Chu JH, Huang JH. A theory-based exploration of condomless anal intercourse intention among young men who have sex with men of different sexual roles in Taiwan. *Arch Sex Behav* 2018;47:2041-50. doi: 10.1007/s10508-017-1081-7 [published Online First: 1 December 2017]

5 Taiwan Centers for Disease Control. Epidemic trend and prevention effectiveness of HIV/AIDS. https://www.cdc.gov.tw/En/Professional/ProgramResultInfo/ppxd4Xu5zcYwcLHniXKk6w?programResultId=8XOWLPdD6JI5pNt9p0zrKQ (accessed 6 Nov 2020).
6 Waage J, Banerji R, Campbell O, et al. The Millennium Development Goals: a cross-sectoral analysis and principles for goal setting after 2015. *Lancet* 2010;376:991–1023. doi:10.1016/S0140-6736(10)61196-8

7 Health Promotion Administration, Ministry of Health and Welfare, Taiwan. Statistical yearbook of health promotion 2016 [updated 28 Dec 2019]. https://www.hpa.gov.tw/EngPages/Detail.aspx?nodeid=3850&pid=10649 (accessed 6 Nov 2020).

8 Peterson AJ, Donze M, Allen E, et al. Effects of interventions addressing school environments or educational assets on adolescent sexual health: systematic review and meta-analysis. *Int Perspect Sex Reprod Health* 2018;44:111-31. doi: 10.1363/44e6818 [published Online First: 30 June 2019].

9 Health Promotion Administration, Ministry of Health and Welfare, Taiwan. Taiwan global school-based student health survey (GSHS) [updated 28 Dec 2016]. https://www.hpa.gov.tw/Pages/Detail.aspx?nodeid=1077&pid=6205 (accessed 11 Sept 2020).

10 Health Promotion Administration, Ministry of Health and Welfare, Taiwan. Health promotion administration annual report [updated 28 Dec 2016]. https://www.hpa.gov.tw/EngPages/List.aspx?nodeid=1070 (accessed 11 Sept 2020).

11 Jamal A, Gentzke A, Hu SS, et al. Tobacco use among middle and high school students - United States, 2011-2016. *MMWR Morb Mortal Wkly Rep* 2017;66:597-603. doi: 10.15585/mmwr.mm6623a1 [published Online First: 16 June 2017].

12 Noel JK. Associations between alcohol policies and adolescent alcohol use: a pooled analysis of GSHS and ESPAD data. *Alcohol Alcohol* 2019;54:639-46. doi: 10.1093/alcalc/agz068 [published Online First: 27 September 2019].

13 Kim GH, Ahn HS, Kim HJ. Type of sexual intercourse experience and suicidal ideation, plans, and attempts among youths: a cross-sectional study in South Korea. *BMC Public Health* 2016;16:1229. doi:10.1186/s12889-016-3895-y [published Online First: 7 December 2016].

14 Wong WCW, Choi EPH, Holroyd E, et al. Impact of household composition and satisfaction with family life on self-reported sexual health outcomes of high-school students in Hong Kong. *BMJ Sex Reprod Health* 2020;46:184–91. doi:10.1136/bmjsrh-2019-200372 [published Online First: 21 November 2019].
15 Smith L, Jackson SE, Vancampfort D, et al. Sexual behavior and suicide attempts among adolescents aged 12–15 years from 38 countries: a global perspective. Psychiatry Res 2020;287:112564. doi:10.1016/j.psychres.2019.112564 [published Online First: 7 September 2019].

16 Scott RH, Wellings K, Lindberg L. Adolescent sexual activity, contraceptive use, and pregnancy in Britain and the U.S.: a multidecade comparison. J Adolesc Health 2020;66:582–88. doi:10.1016/j.jadohealth.2019.11.310 [published Online First: 8 February 2020].

17 Kann L, McManus T, Harris WA, et al. Youth risk behavior surveillance—United States, 2015. MMWR Surveill Summ 2016;65:1–174.

18 Fisher CM, Kauer S, Mikolajczak G, et al. Prevalence rates of sexual behaviors, condom use, and contraception among Australian heterosexual adolescents. J Sex Med 2020;17:2313-21. doi: 10.1016/j.jsxm.2020.08.009 [published Online First: 20 September 2020].

19 Zuo X, Lou C, Gao E, et al. Gender differences in adolescent premarital sexual permissiveness in three Asian cities: effects of gender-role attitudes. J Adolesc Health 2012;50(Suppl 3):S18–25. doi:10.1016/j.jadohealth.2011.12.001 [published Online First: 1 March 2012].

20 Cheng Y, Lou C, Gao E, et al. The relationship between external contact and unmarried adolescents' and young adults' traditional beliefs in three East Asian cities: a cross-sectional analysis. J Adolesc Health 2012;50(3 Suppl):S4-11. doi: 10.1016/j.jadohealth.2011.12.011 [published Online First: 1 March 2012]

21 Koumans EH, Welch R, Warner DL. Differences in adolescent condom use trends by global region. J Adolescent Health 2020;66:S36–S37.

22 Holway GV, Brewster KL, Tillman KH. Condom use at first vaginal intercourse among adolescents and young adults in the United States, 2002–2017. J Adolesc Health 2020;67:606–08. doi:10.1016/j.jadohealth.2020.03.034 [published Online First: 16 May 2020].

23 de Looze M, Madkour AS, Huijts T, et al. Country-level gender equality and adolescents' contraceptive use in Europe, Canada and Israel: findings from 33 Countries. Perspect Sex Reprod Health 2019;51:43–53. doi:10.1363/psrh.12090 [published Online First: 28 February 2019].

24 Leung H, Shek DTL, Leung E, et al. Development of contextually-relevant sexuality education: lessons from a comprehensive review of adolescent sexuality education across cultures. Int J
Environ Res Public Health 2019;16 doi: 10.3390/ijerph16040621 [published Online First: 23 February 2019].

25 Yang HC. Teaching sexual matters in Taiwan: the analytical framework for popular culture and youth sexuality education. Asia Pacific Journal of Education 2014;34:49-64. doi: 10.1080/02188791.2013.822790

26 Vasilenko SA, Kreager DA, Lefkowitz ES. Gender, contraceptive attitudes, and condom use in adolescent romantic relationships: a dyadic approach. J Res Adolesc 2015;25:51–62. doi:10.1111/jora.12091 [published Online First: 8 November 2013].

27 Khadr SN, Jones KG, Mann S, et al. Investigating the relationship between substance use and sexual behaviour in young people in Britain: findings from a national probability survey. BMJ Open 2016;6:e011961. doi: 10.1136/bmjopen-2016-011961 [published Online First: 2 July 2016].

28 Chen MH, Hsu JW, Huang KL, et al. Sexually transmitted infection among adolescents and young adults with attention-deficit/hyperactivity disorder: a nationwide longitudinal study. J Am Acad Child Adolesc Psychiatry 2018;57:48-53. doi: 10.1016/j.jaac.2017.09.438 [published Online First: 6 January 2018]

29 Thompson R, Lewis T, Neilson EC, et al. Child maltreatment and risky sexual behavior. Child Maltreat 2017;22:69-78. doi: 10.1177/1077559516674595 [published Online First: 26 October 2016]

30 Samkange-Zeeb FN, Spallek L, Zeeb H. Awareness and knowledge of sexually transmitted diseases (STDs) among school-going adolescents in Europe: a systematic review of published literature. BMC Public Health 2011;11:727. doi:10.1186/1471-2458-11-727 [published Online First: 25 September 2011].
Figure legends

Figure 1. Flow chart of analysis illustrating the overall rates of ever having had sexual intercourse and condom use among adolescents in Taiwan from 2012 to 2016

Figure 2. The rate of ever having had sexual intercourse of Taiwan adolescents from 2012 to 2016, by gender, school type and grade
Figure 1. Flow chart of analysis illustrating the overall rates of ever having had sexual intercourse and condom use among adolescents in Taiwan from 2012 to 2016.

493x575mm (300 x 300 DPI)
Figure 2. The rate of ever having had sexual intercourse of Taiwan adolescents from 2012 to 2016, by gender, school type and grade

609x469mm (300 x 300 DPI)
### ONLINE ONLY SUPPLEMENTARY MATERIAL

**Contents**

- **Table S1.** Taiwan GSHS Questions that were used to determine whether respondents had sexual intercourse and to evaluate the validity of responses
- **Table S2.** The variables in GSHS involved in data analyses
- **References**

**Tables S1-S2:** The questions in these tables were obtained from the Centers for Disease Control and Prevention of the United States. However, the questions were written in Chinese when presented to the subjects.

**Table S1.** Taiwan GSHS Questions that were used to determine whether respondents had sexual intercourse and to evaluate the validity of responses:

| Question                                                                 | Option                                                                 |
|-------------------------------------------------------------------------|------------------------------------------------------------------------|
| 1. Have you ever had sexual intercourse?                                 | A. Yes                                                                  |
|                                                                         | B. No                                                                   |
| 2. How old were you when you had sexual intercourse for the first time?  | A. I have never had sexual intercourse                                   |
|                                                                         | B. 11 years old or younger                                               |
|                                                                         | C. 12 years old                                                          |
|                                                                         | D. 13 years old                                                          |
|                                                                         | E. 14 years old                                                          |
|                                                                         | F. 15 years old                                                          |
|                                                                         | * G. 16 or 17 years old                                                 |
|                                                                         | * H. 18 years old or older                                               |
| 3. During your life, with how many people have you had sexual intercourse?| A. I have never had sexual intercourse                                   |
|                                                                         | B. 1 person                                                             |
|                                                                         | C. 2 people                                                             |
|                                                                         | D. 3 people                                                             |
|                                                                         | E. 4 people                                                             |
|                                                                         | F. 5 people                                                             |
|                                                                         | G. 6 or more people                                                     |
| 4. The first time you had sexual intercourse, what method of birth control did you use to prevent pregnancy? | A. I have never had sexual intercourse                                   |
|                                                                         | B. No method was used to prevent pregnancy                              |
|                                                                         | C. Birth control pills                                                  |
|                                                                         | D. Condoms                                                              |
|                                                                         | E. Depo-Provera (or any injectable birth control, Nuva Ring (or any birth control ring), Implanon (or any implant), or any IUD |
|                                                                         | F. Withdrawal                                                           |
|                                                                         | G. Some other method                                                    |
|                                                                         | H. Not sure                                                             |
| 5. The last time you had sexual intercourse, did you or your partner use a condom? | A. I have never had sexual intercourse                                   |
|                                                                         | B. Yes                                                                  |
|                                                                         | C. No                                                                   |
| 6. The last time you had sexual intercourse, did you or your partner use any other method of birth control, such as withdrawal, rhythm (safe time), birth control pills, or any other method to prevent pregnancy? | A. I have never had sexual intercourse                                   |
|                                                                         | B. Yes                                                                  |
|                                                                         | C. No                                                                   |
|                                                                         | D. I do not know                                                        |
| 7. After having sexual intercourse, have you or your partner ever used emergency after-sex contraceptive pills to prevent pregnancy? | A. I have never had sexual intercourse                                   |
|                                                                         | B. Yes                                                                  |
|                                                                         | C. No                                                                   |
|                                                                         | D. I do not know                                                        |
8. Have you or your sexual partner ever had an induced abortion?

A. I have never had sexual intercourse
B. Yes
C. No
D. I do not know

No sexual intercourse: Answered ‘No’ for Qn. 1 and ‘I have never had sexual intercourse’ for Qn. 2-8

Had sexual intercourse: Answered ‘Yes’ for Qn. 1 and other than ‘I have never had sexual intercourse’ for Qn. 2-8

Invalid response: Contradictory response such as answered ‘Yes’ for Qn. 1 and answered ‘I have never had sexual intercourse’ for any one of Qn. 2-8

* In 2012, option G became ‘16 years old or older’ without option ‘H. 18 years old or older’. However, starting from 2013, option G and H were ‘16 or 17 years old’ and ‘18 years old or older’ respectively. Therefore, in our analyses throughout this paper, we combined the data of option ‘G. 16 or 17 years old’ and ‘H. 18 years old or older’ into ‘16 years old or older’.

Table S2. The variables in GSHS involved in data analyses

| Variable | Question / Description | Option |
|----------|------------------------|--------|
| Demographics | What is your sex? | A. Male  
B. Female |
| | How old are you? | A. 11 years old or younger  
B. 12 years old  
C. 13 years old  
D. 14 years old  
E. 15 years old  
*F. 16 years old  
*G. 17 years old  
*H. 18 years old or older  |
| Degree of urbanization ** | In what grade are you? | A. Grade 1  
B. Grade 2  
C. Grade 3  |
| School type ** | | Junior high school / Senior high school / Vocational high school / Comprehensive school / Night school |
| Knowledge about sexually transmitted diseases | Do you agree with the following statement: “Even if they had received the cervical cancer vaccine, women still need to have a Pap smear regularly“? | A. Yes  
B. No  
C. I do not know |
| Substance use | During the past 30 days, on how many days did you smoke cigarettes? | A. 0 days  
B. 1 or 2 days  
C. 3 to 5 days  
D. 6 to 9 days  
E. 10 to 19 days  
F. 20 to 29 days  
G. All 30 days |
| | During the past 30 days, on the days you drank alcohol, how many drinks did you usually drink per day? | A. I did not drink alcohol during the past 30 days  
B. Less than one drink  
C. 1 drink  
D. 2 drinks  
E. 3 drinks  
F. 4 drinks  
G. 5 or more drinks |
| Sexual behaviors | Have you ever had sexual intercourse? | A. Yes  
B. No |
During your life, with how many people have you had sexual intercourse?

|   |   |
|---|---|
| A. | I have never had sexual intercourse |
| B. | 1 person |
| C. | 2 people |
| D. | 3 people |
| E. | 4 people |
| F. | 5 people |
| G. | 6 or more people |

The first time you had sexual intercourse, what method of birth control did you use to prevent pregnancy?

|   |   |
|---|---|
| A. | I have never had sexual intercourse |
| B. | No method was used to prevent pregnancy |
| C. | Birth control pills |
| D. | Condoms |
| E. | Depo-Provera (or any injectable birth control), Nuva Ring (or any birth control ring), Implanon (or any implant), or any IUD |
| F. | Withdrawal |
| G. | Some other method |
| H. | Not sure |

The last time you had sexual intercourse, did you or your partner use a condom?

|   |   |
|---|---|
| A. | I have never had sexual intercourse |
| B. | Yes |
| C. | No |

The last time you had sexual intercourse, did you or your partner use any other method of birth control, such as withdrawal, rhythm (safe time), birth control pills, or any other method to prevent pregnancy?

|   |   |
|---|---|
| A. | I have never had sexual intercourse |
| B. | Yes |
| C. | No |
| D. | I do not know |

* In 2012, option F was 16 years old or older. However, from 2013 to 2016, option F was changed to 16 years old and option G (17 years old) and option H (18 years old or older) were added.

** The data for ‘Degree of urbanization’ and ‘School type’ were entered by those who collected the data, they were not answered by students.

# Grade 1, 2 and 3 mean Grade 7, 8 and 9 when GSHS was conducted in 2012, 2014 and 2016. Grade 1, 2 and 3 mean Grade 10, 11 and 12 when GSHS was conducted in 2013 and 2015.

References

1. Taiwan - Global School-based Student Health Survey (GSHS) 2016 [Available from: https://www.cdc.gov/gshs/countries/westpacific/taiwan.htm accessed 2 Nov 2020.
| Item No | Recommendation | Page No |
|---------|----------------|---------|
| **Title and abstract**<br>1 | *(a) Indicate the study’s design with a commonly used term in the title or the abstract*<br>*(b) Provide in the abstract an informative and balanced summary of what was done and what was found* | 1-2 |
| **Introduction**<br>2 | Explain the scientific background and rationale for the investigation being reported | 2-3 |
| Objectives<br>3 | State specific objectives, including any prespecified hypotheses | 2-3 |
| **Methods**<br>4 | Present key elements of study design early in the paper | 4-5 |
| Setting<br>5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | 4-5 |
| Participants<br>6 | *(a) Give the eligibility criteria, and the sources and methods of selection of participants* | 4-5 |
| Variables<br>7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | 4-5 |
| Data sources/ measurement<br>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 | 4-5 |
| Bias<br>9 | Describe any efforts to address potential sources of bias | 13-14 |
| Study size<br>10 | Explain how the study size was arrived at | 4-5 |
| Quantitative variables<br>11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | 4-5 |
| Statistical methods<br>12 | *(a) Describe all statistical methods, including those used to control for confounding*<br>*(b) Describe any methods used to examine subgroups and interactions*<br>*(c) Explain how missing data were addressed*<br>*(d) If applicable, describe analytical methods taking account of sampling strategy*<br>*(e) Describe any sensitivity analyses* | 4-5 |
| **Results**<br>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*<br>*(b) Give reasons for non-participation at each stage*<br>*(c) Consider use of a flow diagram* | 5-10 |
| Descriptive data<br>14* | *(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders*<br>*(b) Indicate number of participants with missing data for each variable of interest* | 5-10 |
| Outcome data<br>15* | Report numbers of outcome events or summary measures | 5-10 |
| Main results<br>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* | 5-10 |
(b) Report category boundaries when continuous variables were categorized 5-10
(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period Not applicable

| Other analyses | 17 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses | 5-10 |

**Discussion**

| Key results | 18 | Summarise key results with reference to study objectives | 10-14 |
| 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 | 10-14 |
| Interpretation | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | 10-14 |
| Generalisability | 21 | Discuss the generalisability (external validity) of the study results | 10-14 |

**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 | 15 |

*Give information separately for exposed and unexposed groups.

**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.
The rate of condom use among sexually active adolescents: A nationwide cross-sectional study in Taiwan from 2012 to 2016

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ABSTRACT

Objective: Adolescents’ sexual behaviors are associated with sexually transmitted infections (STIs) and unwanted pregnancies. This study aimed to estimate the sexual intercourse and condom use rates at first and last sex among Taiwanese adolescents in Grades 7–12.

Design: A secondary data analysis of the Taiwan Global School-Based Student Health Survey’s 2012–2016 data. The survey was anonymous, cross-sectional, and nationwide.

Setting: Taiwan high school students (Grades 7-12).

Participants: The sample comprised 27,525 students from junior high schools (Grades 7–9) and senior high schools, comprehensive schools, vocational high schools, and night schools (Grades 10–12).

Main outcome measures: The rate of ever having had sexual intercourse; the rates and factors of condom use at first and last sex.
**Results:** The sexual intercourse rate in each school type (in ascending order) was junior high school (1.62%), senior high school (4.14%), comprehensive school (9.08%), vocational high school (14.03%), and night school (41.09%). Condom use rate decreased from 57.07% (95% confidence interval [CI] = 54.31%–59.83%) at first sex to 25.72% (95% CI = 23.34%–28.10%) at last sex ($p < 0.0001$). The condom use rate (in ascending order) was junior high school (first sex: 37.67%, last sex: 19.76%), night school (55.83%, 22.62%), vocational high school (61.13%, 25.78%), comprehensive school (62.83%, 28.61%), and senior high school (68.38%, 34.96%). Older age at sexual debut predicted condom use at first and last sex, and having one sexual partner predicted condom use at last sex, as revealed by logistic regression analysis.

**Conclusions:** This study highlights an urgent need to instill a proper understanding of protected sex while adolescents are still in their formative years. Despite the low sexual intercourse rate (4.95%), there is lower condom use at last sex than at first sex, which indicates that many sexually active adolescents are not practicing protected sex, especially among junior high school students.

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**STRENGTHS AND LIMITATIONS OF THIS STUDY**

- The Taiwan Global School-Based Student Health Survey (GSHS) was cross-sectional and based on a large nationally representative sample.
- The survey was anonymous and therefore encouraged honest responses to sensitive questions (such as sexual behaviors) from participants.
- Cross-country comparisons of the rates of sexual intercourse and condom use among adolescents based on GSHS data should be cautious because of the following reasons:
  - ‘Sexual intercourse’ was not defined explicitly; therefore, its exact meaning is open to interpretation by the participants and varies across cultures.
  - Inadequate details about sexual behaviors and condom use, such as knowledge, attitude and frequency of the behaviors.

**INTRODUCTION**

Adolescent sexual behavior is an important public health issue because of its association with the risk of contracting sexually transmitted infections (STIs), unintended pregnancies, abortions, non-
consensual encounters, co-use of illicit or dangerous substances, and subsequent psychological stress.[1] Examples of sexual behaviors include unprotected sexual intercourse, having sexual intercourse with multiple partners, and males who have sex with males (MSM).[1-2] In Taiwan, the number of newly reported cases of human immunodeficiency virus / acquired immunodeficiency syndrome (HIV/AIDS) increased from 2012–2016,[3] and about 29% of all new cases of HIV infection occurred in adolescents and young adults (aged 15-24 years) in 2016.[4] The estimated incidence rate of HIV among adolescents aged 13–24 years was about 20 per 100,000 population during this period.[5] Condoms are the most effective method to protect against STIs. Condom use at last high-risk sex is one of the indicators of the Millennium Development Goals’ monitoring that was established by the United Nations International Children’s Emergency Fund to tackle STIs.[6] In Taiwan, the sexual intercourse rates among adolescents aged 13–15 years increased from 2.2% (male) and 1.8% (female) in 2006 to 5.4% (male) and 5.3% (female) in 2016.[7] Furthermore, the contraception use rate among these adolescents increased from 56.2% (male) and 58.1% (female) in 2006 to 74.8% (male) and 77.7% (female) in 2016.[7] However, the predominant form of contraception was not reported. More importantly, whether sexually active adolescents in Taiwan actually practice protected sex (i.e., use condoms) remains unclear.

It has long been speculated that adolescent sexual behaviors are associated with school type and education programs.[8] In Taiwan, public education has been compulsory from primary school to junior high school since 1968. Since 2014, a full 12-year compulsory education program has been implemented. Junior high school students in Grade 9 take a high school entrance examination to continue their education, which is designed as a screening tool to assign students to various school programs for Grades 10–12. Students who aspire to receive higher education mostly attend regular senior high schools. Other educational opportunities include vocational high schools and comprehensive schools, which are workplace-oriented and emphasize vocational skills. Night school curricula vary, ranging from vocational to academic courses. Therefore, in this study, we aimed to identify the sexual intercourse and condom use rates at first and last sex among Taiwanese adolescents across school types by using nationally representative data of Grade 7-12 students. To our knowledge, this study is the first to examine the rate at which sexually active adolescents in Taiwan practice protected sex by using the data from a large nationally representative sample.
METHODS

We performed a secondary analysis of the 2012–2016 data of the Taiwan Global School-Based Student Health Survey (GSHS). The Taiwan GSHS is a nationwide cross-sectional study that surveys the health behaviors of Grade 7–9 (aged 12-15) and Grade 10–12 (aged 15-18) students every other year.[9]

The survey was conducted by the Health Promotion Administration (HPA), Ministry of Health and Welfare of Taiwan, in collaboration with the United States’ Centers for Disease Control and Prevention.[9] The Taiwan GSHS was translated into Chinese from the English version. The HPA first categorized schools into four geographic levels (i.e., big city, small city, urban town, and rural town) according to the population density of their locations. Next, the HPA used a two-step “probability proportional to size” method at each geographic level for sampling, where the sample schools were drawn before the sample classes.[9] They invited all students from the sample classes to participate. The survey was anonymous and no identifying information were collected. Additional details of the Taiwan GSHS’s methodology are reported elsewhere.[9]

From 2012–2016, there were 29,040 participants, and the response rates were 93.3% in 2012, 89.6% in 2013, 93.7% in 2014, 90.2% in 2015, and 92.6% in 2016.[10] Junior high school students were surveyed in 2012, 2014, and 2016, and Grade 10–12 students (including senior high school, comprehensive, vocational high school, and night school students) were surveyed in 2013 and 2015. As illustrated in Figure 1, this study included a total of 27,525 students, after excluding those who did not indicate their gender (\(n=62\)) and those who gave contradictory answers to the eight survey questions (Table S1, online supplementary material) about sexual behaviors (\(n=1,453\)).

We selected three sections of questions from the GSHS (Table S2): demographics, substance use, and sexual behaviors. The demographic variables included gender, age, degree of urbanization, school type, and grade. Regarding substance use, we looked into whether the participants were current smokers (defined as smoking cigarettes on at least one day during the past 30 days)[11] and current heavy alcohol users (defined as consuming \(\geq 5\) drinks of alcoholic beverages per day in the past 30 days).[12] The variables regarding sexual behaviors were ever having had sexual intercourse, number of sexual partners, condom use, and non-condom use at first sex and last sex. The outcome variables were ever having had sexual intercourse and condom use at first and last sex. However, since
questionnaires of Taiwan GSHS did not explicitly define “sexual intercourse”, its exact meaning was open to interpretation by the subjects.

We used the chi-square test to examine the association between the students’ gender and the outcome variables (sexual intercourse and condom use at first and last sex) in each school type. We conducted McNemar’s test to investigate the consistency of condom use at first and last sex for students who had one sexual partner and those who had more than one sexual partner. In univariate analysis, we used chi-square test to examine the association between demographics, risk/protective factors, and outcome variables (condom use at first and last sex). Regarding multivariate analysis, we used logistic regression with forward selection to locate important factors for condom use at first and last sex. The adjusted odds ratio (AOR) with 95% confidence interval (CI) shows the direction and magnitude of the association between demographics, risk/protective factors, and outcome variables (condom use at first and last sex). We conducted all analyses using SAS 9.4 (SAS Institute, Cary, NC, USA). The significance level was 0.05.

Ethics

The Institutional Review Board of the Chang Gung Medical Foundation approved this study and waived the requirement for informed consent for this anonymous survey (IRB number: 202001534B0).

Patient and public involvement

No patients were involved.

RESULTS

Sexual intercourse rate by gender, school type, and grade

Overall, the sexual intercourse rate was 4.95% (Figure 1). The ascending order of sexual intercourse rate by school type was junior high school (1.62%), senior high school (4.14%), comprehensive school (9.08%), vocational high school (14.03%), and night school (41.09%).

In general, male students reported higher rates of sexual intercourse (5.33%) than female students (4.53%) (Table 1). However, there was significant interaction between gender and school
type ($p = 0.0279$), which indicated that the apparent difference in rate of sexual intercourse between both genders depended on different school types, or vice versa. Therefore, the main effect of gender or that of school type on sexual intercourse was meaningless. When stratified by school type, male students in senior high school had a significantly higher rate of sexual intercourse (4.92%) than female students (3.4%) ($p = 0.0352$). There was a borderline difference in sexual intercourse rate among students at vocational high school between both genders ($p = 0.0613$). However, when the sexual intercourse rates were further stratified by grade and school type, the rates of sexual intercourse between both genders did not differ significantly (Figure 2).

Table 1. Rates of ever having had sexual intercourse, condom use at first and last sex among adolescents in Taiwan from 2012 to 2016, by gender

|                         | Male (%)                  | Female (%)                 | $p$   |
|-------------------------|---------------------------|----------------------------|-------|
| **Sexual intercourse**  |                           |                            |       |
| Grades 7-9              | 775/14531 (5.33%)         | 588/12994 (4.53%)          | †     |
| Junior High school      | 156/9027 (1.73%)          | 125/8286 (1.51%)           | 0.2534|
| Grades 10-12            |                           |                            |       |
| Senior high school      | 74/1505 (4.92%)           | 53/1559 (3.4%)             | 0.0352*|
| Comprehensive school    | 240/2518 (9.53%)          | 157/1855 (8.46%)           | 0.2245|
| Vocational high school  | 132/1048 (12.6%)          | 170/1104 (15.4%)           | 0.0613|
| Night school            | 173/433 (39.95%)          | 83/190 (43.68%)            | 0.3836|
| **Condom use at first sexual intercourse** |                   |                            |       |
| Total                   | 384/688 (55.81%)          | 322/549 (58.65%)           | 0.3164|
| Grades 7-9              |                           |                            |       |
| Junior High school      | 41/118 (34.75%)           | 43/105 (40.95%)            | 0.3397|
| Grades 10-12            |                           |                            |       |
| Senior high school      | 343/570 (60.18%)          | 279/444 (62.84%)           | 0.3877|
| Comprehensive school    | 40/65 (61.54%)            | 40/52 (76.92%)             | 0.0754|
| Vocational high school  | 142/224 (63.39%)          | 93/150 (62.00%)            | 0.7847|
| Night school            | 72/121 (59.50%)           | 101/162 (62.35%)           | 0.6276|
| **Condom use at last sexual intercourse** |                   |                            |       |
| Total                   | 186/725 (25.66%)          | 146/566 (25.80%)           | 0.9545|
| Grades 7-9              |                           |                            |       |
| Junior High school      | 26/133 (19.55%)           | 23/115 (20.00%)            | 0.9291|
| Grades 10-12            |                           |                            |       |
| Senior high school      | 160/592 (27.03%)          | 123/451 (27.27%)           | 0.9296|
| Comprehensive school    | 27/70 (38.57%)            | 16/53 (30.19%)             | 0.3343|
| Vocational high school  | 67/227 (29.52%)           | 42/154 (27.27%)            | 0.6345|
| Night school            | 27/125 (21.60%)           | 47/162 (29.01%)            | 0.1546|

$p$: $p$-values were obtained from chi-square test.
*: p-values < 0.05

†: The interaction between gender and school type is statistically significant (p = 0.0279) when tested with logistic regression (model: sexual intercourse = β₀ + β₁ school type + β₂ gender + β₃ school type*gender).

Condom use at first and last sexual intercourse

The overall condom use rate decreased from 57.07% at first sex to 25.72% at last sex (Figure 1). The condom use rates were not statistically different between male and female adolescents at both first and last sex, with p=0.3164 and p=0.9545, respectively (Table 1). In terms of school type, the ascending order of the condom use rate was junior high school (first sex: 37.67%, last sex: 19.76%), night school (55.83%, 22.62%), vocational high school (61.13%, 25.78%), comprehensive school (62.83%, 28.61%), and senior high school (68.38%, 34.96%) (Figure 1). Moreover, across all school types, condom use rates did not differ significantly between male and female students (Table 1).

Univariate analysis showed that school type, age at first sexual intercourse, number of sexual partner(s), being current smoker (in the past 30 days) were all significantly associated with condom use at first and last sex. We also noted that alcohol consumption was significantly associated with condom use at first sex (p= 0.0037) but not at last sex (p=0.4314). Regarding number of sexual partner(s), the condom use rate at first and last sex among those with one sexual partner was statistically significantly higher than that of those with multiple sexual partners. At first sex, the condom use rate among those with one sexual partner and multiple sexual partners was 61.72% and 53.71% (p = 0.0048), respectively. At last sex, the condom use rate among those with one sexual partner (31.17%=202/648) was higher than that of those with multiple sexual partners (20.34%=130/639) (p < 0.0001) (Table 2).

In multivariate analysis of condom use at first sex, the following respondents were more likely to use condom at first sexual intercourse: those who first had sex at age 12-13 (adjusted odds ratio (AOR) 4.74, 95% confidence interval (CI)= 2.02 – 11.1), age 14-15 (AOR 10.6, 95% CI=4.72 - 23.8) and age 16 or above (AOR 18.3, 95% CI= 8.20 – 40.9) when compared with those who had sex at age 11 or younger (Table 2).
Regarding condom use at last sex, the multivariate analysis indicated that adolescents who had one sexual partner (AOR 1.60, 95% CI=1.23 - 2.07) when compared with those who had more than one, and those who first had sex at age 16 or above (AOR 2.00, 95% CI=1.05 - 3.83) when compared with those who had sex at age 11 or younger were more likely to use condom at last sex (Table 2).

Table 2. Univariate and multivariate analysis of condom use at first and last sexual intercourse among adolescents in Taiwan, 2012-2016

|                        | Univariate | Multivariate |
|------------------------|------------|--------------|
|                        | Condom (1st sex) | Condom (last sex) | Condom (1st sex) | Condom (last sex) |
|                        | Yes (%)  | p            | Yes (%)  | p            | AOR (95% CI) | p            | AOR (95% CI) | p            |
| Total                  | 706/1237 (57.07%) | --          | 332/1291 (25.72%) | --          | --          | --          | --          | --          |
| Gender                 |           |              | Gender |              |             |             |             |             |
| Male                   | 384/688 (55.81%) | 0.3164      | 186/725 (25.66%) | 0.9545      | --          | --          | --          | --          |
| Female                 | 322/549 (58.65%) | --          | 146/566 (25.8%) | --          | --          | --          | --          | --          |
| School type            |           |              | School type |              |             |             |             |             |
| Junior                 | 84/223 (37.67%) | <0.0001      | 49/248 (19.76%) | 0.0111      | NS          | --          | NS          | --          |
| Senior                 | 80/117 (68.38%) | --          | 43/123 (34.96%) | --          | --          | --          | --          | --          |
| Vocational            | 173/283 (61.13%) | --          | 74/287 (25.78%) | --          | --          | --          | --          | --          |
| Comprehensive         | 235/374 (62.83%) | --          | 109/381 (28.61%) | --          | --          | --          | --          | --          |
| Night                 | 134/240 (55.83%) | --          | 57/252 (22.62%) | --          | --          | --          | --          | --          |
| Sexual behaviors       |           |              | Sexual behaviors |              |             |             |             |             |
| Age at 1st sex         |           |              | Age at 1st sex | <0.0001      | <0.0001     | <0.0001     | 0.0019      |             |
| ≤ 11 years old         | 7/64 (10.94%) | --          | 12/73 (16.44%) | Ref.        | Ref.        | Ref.        | Ref.        | Ref.        |
| 12-13                  | 53/144 (36.81%) | --          | 23/160 (14.38%) | 4.74 (2.02 – 11.1) | 0.0004 | 0.86 (0.401- 1.84) | 0.6968      |             |
| 14-15                  | 233/412 (56.55%) | --          | 106/436 (24.31%) | 10.6 (4.72 – 23.8) | <0.0001 | 1.56 (0.807 - 3.02) | 0.1856      |             |
| ≥ 16                   | 405/585 (69.23%) | --          | 190/610 (31.15%) | 18.3 (8.20 – 40.9) | <0.0001 | 2.00 (1.05 - 3.83) | 0.0360      |             |
| No. of sexual partner  |           |              | No. of sexual partner | <0.0001      | <0.0001     | NS          | --          | 0.0023      |
| 1                      | 374/606 (61.72%) | --          | 202/648 (31.17%) | Ref.        | 1.60 (1.23 - 2.07) | 0.0005      |             |
| > 1                    | 326/607 (53.71%) | --          | 130/639 (20.34%) | --          | --          | --          | --          | --          |
| Substance use          |           |              | Substance use | <0.0013      | 0.0009      | NS          | --          | NS          |
| Current smoker         |           |              | Current smoker |             |             |             |             |             |
| No                     | 412/671 (61.4%) | --          | 207/701 (29.53%) | --          | --          | --          | --          | --          |
| Yes                    | 289/553 (52.26%) | --          | 123/576 (21.35%) | --          | --          | --          | --          | --          |
| Heavy alcohol use      |           |              | Heavy alcohol use | <0.0037      | 0.4314      | NS          | --          | --          |
| No                     | 587/995 (58.99%) | --          | 271/1038 (26.11%) | --          | --          | --          | --          | --          |
| Yes (≥ 5 drinks/day)   | 112/231 (48.48%) | --          | 57/241 (23.65%) | --          | --          | --          | --          | --          |

*P-values of univariate analysis were obtained by chi-square test, while those of multivariate analysis were calculated by logistic regression with forward selection.

NS: non-significant; Ref.: reference group; AOR: adjusted odds ratio

Subjects who did not respond to the questions (i.e., missing data) were not included in this Table.

At first sex, the number of missing data in the following questions: Age at 1st sex – 32, No. of sexual partner – 24, Current smoker – 13, Heavy alcohol use – 11.
At last sex, the number of missing data in the following questions: Age at 1st sex – 12, No. of sexual partner – 4, Current smoker – 14, Heavy alcohol use – 12.

When investigating the decrease in the condom use rate, we observed that about two-third of adolescents who used condoms at first sex (n=702) switched to using a non-condom contraceptive method (410/702, 58.4%) or having no contraception (28/702, 4.0%) at last sex. In contrast, those who did not use any contraception (n=293) at first sex remained not using any contraception (178/293, 60.8%) at last sex, and those who used non-condom contraception (n=212) at first sex mostly did not change their method of birth control (150/212, 70.7%) at last sex. Moreover, students with one sexual partner were more likely to use condoms both at first and last sex (27.7%=168/606) than those with multiple sexual partners (16.0%=96/598) (p < 0.0001) (Table 3).

Table 3. Inconsistent use of condom at first and last sexual intercourse among adolescents in Taiwan from 2012 to 2016, by number of sexual partner

| First sexual intercourse | Last sexual intercourse | Total | No contraception | Condom | Other methods | p      |
|--------------------------|-------------------------|-------|------------------|--------|---------------|--------|
| Overall                  |                         |       |                  |        |               |        |
| Total                    | 1207                    | 241   | 316              | 650    | <0.0001       |
| No contraception         | 293                     | 178   | 25               | 90     |               |
| Condom                   | 702                     | 28    | 264              | 410    |               |
| Other methods            | 212                     | 35    | 27               | 150    |               |

| No. of sexual partners >1 |                         |       |                  |        |               |        |
| Total                    | 598                     | 131   | 124              | 343    | <0.0001       |
| No contraception         | 158                     | 93    | 15               | 50     |               |
| Condom                   | 326                     | 18    | 96               | 212    |               |
| Other methods            | 114                     | 20    | 13               | 81     |               |

| One sexual partner       |                         |       |                  |        |               |        |
| Total                    | 606                     | 109   | 192              | 305    | <0.0001       |
| No contraception         | 134                     | 85    | 10               | 39     |               |
| Condom                   | 374                     | 9     | 168              | 197    |               |
| Other methods            | 98                      | 15    | 14               | 69     |               |

p: p-values were obtained from McNemar’s test.

The overall total (1207) does not equal to the total (598+606=1204) at the lower half of the table because subjects who did not respond to the questions about

i) the number of sexual partners,

ii) the method of contraception use at first and last sexual intercourse
were not included in McNemar’s test.

DISCUSSION

Sexual intercourse

This nationwide cross-sectional study revealed that the overall rate of ever having had sexual intercourse among adolescents (Grades 7–12) in Taiwan was 4.95% (5.33% of males and 4.53% of females) during 2012–2016. Our rates are similar to several studies in other Asian countries and regions, such as South Korea (Grades 7–12: 3.9% overall, opposite-sex intercourse; 5.5% of males, 2.2% of females),[13] Hong Kong (Grades 7–12: 5.2% overall, 5.6% of males, 4.7% of females),[14] and other South-East Asian countries.[15] On the other hand, our rates are considerably lower than those of developed Western countries.[16-17] For instance, in the United States, the sexual intercourse rate among Grade 9–12 students is 41.2% (43.2% of males and 39.2% of females).[17] Our rates are also lower than that of Australia, where it is geographically close to South-East Asian countries but culturally similar to that of Great Britain and the US. In Australia, the rates of anal or vaginal sex were 43.7% (male) and 48.5% (female) among Year 10–12 heterosexual students.[18] It is possible that Confucian culture plays an important role in adolescent sexual behaviors in Asian countries,[19] and this could potentially explain the discrepancy between our results and those obtained from Western countries.

More importantly, we observed that the rates of sexual intercourse varied greatly with different school types in Taiwan. Our analysis found that the sexual intercourse rate was lowest among junior high school students and that it generally increased with the grade. This was reasonable because more adolescents engaged in intimate sexual behaviors as they matured. Among the Grade 10–12 students, night schools had the highest sexual intercourse rate (41.09%), followed by vocational high school (14.03%), comprehensive school (9.08%), and senior high schools (4.14%). We speculated that the highest rate of sexual intercourse among night school students (41.09%) was probably because some of them were married. As previously hypothesized,[8] the students’ educational and career aspirations and the school type may be associated with their sexual behaviors. Our findings highlight that academically oriented schools (e.g., senior high schools) tend to have lower sexual intercourse rates.
than those that place a heavier emphasis on vocational skill training (e.g., comprehensive and vocational high schools).

After stratifying by school type and grade, the difference in rates of sexual intercourse between both genders was statistically non-significant, although male students seemed to have a higher overall rate (5.33%) than female students (4.53%). This finding is inconsistent with previous reports, where male adolescents generally had a higher sexual intercourse rate than female adolescents.[19] In Confucian societies, where chastity is emphasized heavily, unmarried females engaging in sexual intercourse are highly stigmatized.[19] Meanwhile, countries (e.g., Taiwan) which were traditionally influenced by Confucianism are becoming westernized, possibly leading to increasing acceptance of premarital sexual behaviors among female adolescents.[20] Taken together, this might potentially explain our finding that male and female adolescents did not differ significantly in rates of sexual intercourse after stratifying by school type and grade. Nevertheless, the degree to which Western culture involved in shaping Taiwan adolescents’ sexual behaviors deserves further investigation.

Condom use and implications

Despite the low sexual intercourse rate, we found that the practice of protected sex (as indicated by the condom use rate) was not common among adolescents in Taiwan when compared with data obtained from Western[21-23] and South-East Asian countries.[15] In this study, only a quarter of sexually experienced respondents had used a condom at last sex (male: 25.66%, female: 25.80%), which was approximately half of those who used condoms at first sex (male: 55.81%, female: 60.47%). In contrast, in Western countries such as the United States, the condom use rates at first sex among adolescents (age 15–17 years) are as high as 77% (male) and 74.6% (female) [22] and the rates at last sex (age 13–19 years) are 61% (male) and 47% (female).[21] In a study of nationwide surveys conducted in 33 countries from 2013 to 2014, developed Western countries, such as Great Britain, Denmark, Finland, France, Spain, and Switzerland, were found to typically have a condom use rate of over 40% at last sex among adolescents aged 14–16.[23] Moreover, countries participating in the GSHS in the South-East Asian and Western Pacific regions generally have a higher condom use rate (at last sex) than the rate (25.72%) we obtained.[15] For instance, the condom non-use rates at last sex among GSHS participants aged 12–15 years in Nepal, Bangladesh, Thailand, Cambodia, Laos, and Malaysia were estimated to be 52.6% (2015), 58.7% (2014), 33.8% (2015), 56.2% (2013), 46.7% (2015), and 66.8% (2012), respectively.[15] In Australia, despite being culturally Western but
geographically proximal to South-East Asia, the rates of condom use were considerably higher than our rates. (In Australia, the condom use rates were 78.1% (male) and 77.5% (female) at first sex, and 65.1% (male) and 56.8% (female) at last sex.)[18] In summary, the above comparisons show that Taiwanese adolescents’ condom use (both at first and last sex) is not as prevalent as in Western developed countries and other countries participating in the GSHS.

Sex education is critical to the practice of protected sex among adolescents. Although the use of contraception is covered in Taiwan sex education, the importance of safe sex and correct use of condom are not emphasized, and abstinence-only sex education remains the mainstream of sex education in Taiwan.[24-25] In fact, condom vending machines and free condom programs are not available in high schools in Taiwan. This is probably because providing condom vending machines for students might be mistakenly seen as encouraging students to have sex. These reasons might have contributed to the relative low rate of condom use among adolescents in Taiwan when compared with the rates in Western and GSHS-participating countries.

In addition to cross-country comparisons, we investigated how school type and the students’ gender were associated with the condom use rate. Across school types, the condom use rate at first and last sex varied considerably. Notably, night schools had the highest sexual intercourse rate and the second lowest condom use rate at both first and last sex. Moreover, despite having the lowest sexual intercourse rate, sexually experienced junior high school students were the least likely to use condoms at first and last sex. Our multivariate analysis also revealed that adolescents who initiated sex at a younger age tended not to use condom. In fact, we found that age at first intercourse was the strongest predictor of condom use at first and last sex. This highlights the urgent need to instill a proper understanding of protected sex while adolescents are still in their formative years, especially in junior high schools.

Our study also showed that the students’ gender did not seem to influence the condom use rate at first and last sex. It has long been assumed that gender equality plays an important role in condom use.[23] Our study suggests that across all school types and grades, male and female adolescents in Taiwan are of equal standing in terms of condom use decisions, in contrast to studies conducted elsewhere.[26]

Apart from gender, substance use (i.e., being current smoker and heavy alcohol use) was not found to be associated with condom use at first and last sex in our multivariate analysis (Table 2).
This contrasts with previous studies, which reported adolescents who engaged in risky sexual behaviors were more likely to use substances.[27] There are many factors that are associated with both adolescent sexual behaviors and substance use, including mental disorders (especially attention-deficit/hyperactivity disorder), trauma, sexual abuse, etc.[2, 27-29] Therefore, whether the association between condom use and substance use exists among adolescents across different cultures and countries deserves further research.

The decrease in the condom use rate and increase in the non-condom contraception rate at last sex was possibly due to the adolescents being more concerned about potential pregnancy than the contraction of STIs, as speculated in previous studies.[30] Our data support this hypothesis; most participants in our study who used condoms at first sex (58.16%) changed to using non-condom contraceptive methods at last sex (33.97%) (Table 3). Our results also suggest that adolescents with one sexual partner were more likely to use condoms at last sex than those with multiple sexual partners (Table 2-3). This might be because those who stayed with a single sexual partner were more likely to understand the importance of protected sex and the risk associated with having multiple sexual partners than those who did not. Nevertheless, adolescents with multiple sexual partners who did not use condoms could potentially pose a huge public health risk in Taiwan, since having multiple sexual partners and sexual intercourse without using condoms are associated with the susceptibility to STIs.[31]

**Strengths and limitations**

A strength of this study is that our analysis was based on a large nationally representative sample. Moreover, no identifying information was collected in the survey to encourage honest response. The GSHS used in this study allows multi-national comparisons between the sexual intercourse and condom use rates of Taiwan students and those of others. However, there are several limitations to our study.

First, sex is a sensitive issue in Taiwan; therefore, sexual behavior data collected by the GSHS might be underreported and susceptible to recall bias. Second, since sexual intercourse was not defined explicitly, its exact meaning is open to interpretation by the participants. The GSHS did not ask about the gender of the participants’ sexual partner(s). Thus, ‘sexual intercourse’ might be misinterpreted as
other forms of sex (e.g., oral sex and intercourse between heterosexuals only). Additionally, researchers using GSHS data regarding sexual intercourse from different countries should be very cautious because interpretation of sexual intercourse varies across cultures. Third, there was a large difference in the number of male and female participants in comprehensive and night schools. Since our data is a representative sample of Grades 10-12 students, having more male students than female students in comprehensive and night schools implied a real male predominance in these school types. This male predominance can be partially explained by the fact that males tend to be the main source of family income in Taiwan. Moreover, having more male students than female students in comprehensive and night schools may introduce selection bias. However, we believe that the selection bias should be at minimum because most of our results (i.e., the rates of sexual intercourse and condom use) were already stratified by school type. Fourth, the GSHS questionnaires did not contain sufficient details of knowledge, attitude, and practice of condom use (and other sexual behaviors) among adolescents. Therefore, our comparison of the condom use rate at first and last sex is insufficient for drawing definite conclusions regarding condom use consistency. Additionally, respondents might use condoms and other contraceptive methods simultaneously, leading to biased responses. Fifth, the Taiwan GSHS did not have questions regarding the gender of the sexual partner(s) of the subjects. As a result, we were unable to analyze adolescent non-vaginal-penile sexual intercourse. To address these limitations, we recommend incorporating questions with a clear definition of sexual intercourse, questions about the frequency of condom use, and gender of sexual partner(s) in future GSHS.

In conclusion, the finding of lower sexual intercourse and condom use rates at first and last sex than in many developed countries indicates that the practice of protected sex is not prevalent among Taiwanese adolescents. This is further supported by our findings that most adolescents who used condoms at first sex switched to non-condom contraception at last sex and that adolescents who initiated sex at younger age and with multiple sexual partners were less likely to use condoms.

Acknowledgments

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Contributors
WHSS designed the study, conducted data analysis and interpretation, and drafted the manuscript. PRL and LCS prepared the GSHS dataset, interpreted the data, and revised the manuscript. All authors read and approved the manuscript in its present form.

Competing interests

None declared.

Data availability statement

No data are available.

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REFERENCES

1 Chawla N, Sarkar S. Defining “high-risk sexual behavior” in the context of substance use. *Journal of Psychosexual Health* 2019;1:26-31.

2 Grubb LK, Committee On Adolescence. Barrier protection use by adolescents during sexual activity. *Pediatrics* 2020;146: e2020007245. doi: 10.1542/peds.2020-007245 [published Online First: 22 July 2020]

3 Taiwan Centers for Disease Control. Statistics of HIV/AIDS [updated 22 Aug 2019]. https://www.cdc.gov.tw/En/Category/MPage/kt6yIoEGURtMQubQ3nQ7pA (accessed 11 Sept 2020).

4 Centers for Disease Control, Ministry of Health and Welfare, R.O.C.(Taiwan). CDC Annual Report 2017 [updated 24 Aug 2017]. https://www.cdc.gov.tw/En/InfectionReport/Info/BAkN3lDoa6hdrimSerBQyQ?infoId=0tix8qZHC6MEhPoOTMVDA (accessed 18 June 2021).

5 Taiwan Centers for Disease Control. Epidemic trend and prevention effectiveness of HIV/AIDS. https://www.cdc.gov.tw/En/Professional/ProgramResultInfo/ppxd4Xu5zcYwcLHniXKk6w?programResultId=8XOWLPdD6JI5pNt9p0zrKQ (accessed 6 Nov 2020).
6 Waage J, Banerji R, Campbell O, et al. The Millennium Development Goals: a cross-sectoral analysis and principles for goal setting after 2015. *Lancet* 2010;376:991–1023. doi:10.1016/S0140-6736(10)61196-8

7 Health Promotion Administration, Ministry of Health and Welfare, Taiwan. Statistical yearbook of health promotion 2016 [updated 28 Dec 2019]. https://www.hpa.gov.tw/EngPages/Detail.aspx?nodeid=3850&pid=10649 (accessed 6 Nov 2020).

8 Peterson AJ, Donze M, Allen E, et al. Effects of interventions addressing school environments or educational assets on adolescent sexual health: systematic review and meta-analysis. *Int Perspect Sex Reprod Health* 2018;44:111-31. doi: 10.1363/44e6818 [published Online First: 30 June 2019].

9 Health Promotion Administration, Ministry of Health and Welfare, Taiwan. Taiwan global school-based student health survey (GSHS) [updated 28 Dec 2016]. https://www.hpa.gov.tw/Pages/Detail.aspx?nodeid=1077&pid=6205 (accessed 11 Sept 2020).

10 Health Promotion Administration, Ministry of Health and Welfare, Taiwan. Health promotion administration annual report [updated 28 Dec 2016]. https://www.hpa.gov.tw/EngPages/List.aspx?nodeid=1070 (accessed 11 Sept 2020).

11 Jamal A, Gentzke A, Hu SS, et al. Tobacco use among middle and high school students - United States, 2011-2016. *MMWR Morb Mortal Wkly Rep* 2017;66:597-603. doi: 10.15585/mmwr.mm6623a1 [published Online First: 16 June 2017].

12 Noel JK. Associations between alcohol policies and adolescent alcohol use: a pooled analysis of GSHS and ESPAD data. *Alcohol Alcohol* 2019;54:639-46. doi: 10.1093/alcalc/agz068 [published Online First: 27 September 2019].

13 Kim GH, Ahn HS, Kim HJ. Type of sexual intercourse experience and suicidal ideation, plans, and attempts among youths: a cross-sectional study in South Korea. *BMC Public Health* 2016;16:1229. doi:10.1186/s12889-016-3895-y [published Online First: 7 December 2016].

14 Wong WCW, Choi EPH, Holroyd E, et al. Impact of household composition and satisfaction with family life on self-reported sexual health outcomes of high-school students in Hong Kong. *BMJ Sex Reprod Health* 2020;46:184–91. doi:10.1136/bmjsrh-2019-200372 [published Online First: 21 November 2019].
15 Smith L, Jackson SE, Vancampfort D, et al. Sexual behavior and suicide attempts among adolescents aged 12–15 years from 38 countries: a global perspective. Psychiatry Res 2020;287:112564. doi:10.1016/j.psychres.2019.112564 [published Online First: 7 September 2019].

16 Scott RH, Wellings K, Lindberg L. Adolescent sexual activity, contraceptive use, and pregnancy in Britain and the U.S.: a multidecade comparison. J Adolesc Health 2020;66:582–88. doi:10.1016/j.jadohealth.2019.11.310 [published Online First: 8 February 2020].

17 Kann L, McManus T, Harris WA, et al. Youth risk behavior surveillance—United States, 2015. MMWR Surveill Summ 2016;65:1–174.

18 Fisher CM, Kauer S, Mikolajczak G, et al. Prevalence rates of sexual behaviors, condom use, and contraception among Australian heterosexual adolescents. J Sex Med 2020;17:2313-21. doi: 10.1016/j.jsxm.2020.08.009 [published Online First: 20 September 2020].

19 Zuo X, Lou C, Gao E, et al. Gender differences in adolescent premarital sexual permissiveness in three Asian cities: effects of gender-role attitudes. J Adolesc Health 2012;50(Suppl 3):S18–25. doi:10.1016/j.jadohealth.2011.12.001 [published Online First: 1 March 2012].

20 Cheng Y, Lou C, Gao E, et al. The relationship between external contact and unmarried adolescents' and young adults' traditional beliefs in three East Asian cities: a cross-sectional analysis. J Adolesc Health 2012;50(3 Suppl):S4-11. doi: 10.1016/j.jadohealth.2011.12.011 [published Online First: 1 March 2012]

21 Koumans EH, Welch R, Warner DL. Differences in adolescent condom use trends by global region. J Adolescent Health 2020;66:S36–S37.

22 Holway GV, Brewster KL, Tillman KH. Condom use at first vaginal intercourse among adolescents and young adults in the United States, 2002–2017. J Adolesc Health 2020;67:606–08. doi:10.1016/j.jadohealth.2020.03.034 [published Online First: 16 May 2020].

23 de Looze M, Madkour AS, Huijts T, et al. Country-level gender equality and adolescents' contraceptive use in Europe, Canada and Israel: findings from 33 Countries. Perspect Sex Reprod Health 2019;51:43–53. doi:10.1363/psrh.12090 [published Online First: 28 February 2019].

24 Leung H, Shek DTL, Leung E, et al. Development of contextually-relevant sexuality education: lessons from a comprehensive review of adolescent sexuality education across cultures. Int J
25 Yang HC. Teaching sexual matters in Taiwan: the analytical framework for popular culture and youth sexuality education. *Asia Pacific Journal of Education* 2014;34:49-64. doi: 10.1080/02188791.2013.822790

26 Vasilenko SA, Kreager DA, Lefkowitz ES. Gender, contraceptive attitudes, and condom use in adolescent romantic relationships: a dyadic approach. *J Res Adolesc* 2015;25:51–62. doi:10.1111/jora.12091 [published Online First: 8 November 2013].

27 Khadr SN, Jones KG, Mann S, et al. Investigating the relationship between substance use and sexual behaviour in young people in Britain: findings from a national probability survey. *BMJ Open* 2016;6:e011961. doi:10.1136/bmjopen-2016-011961 [published Online First: 2 July 2016].

28 Chen MH, Hsu JW, Huang KL, et al. Sexually transmitted infection among adolescents and young adults with attention-deficit/hyperactivity disorder: a nationwide longitudinal study. *J Am Acad Child Adolesc Psychiatry* 2018;57:48-53. doi:10.1016/j.jaac.2017.09.438 [published Online First: 6 January 2018]

29 Thompson R, Lewis T, Neilson EC, et al. Child maltreatment and risky sexual behavior. *Child Maltreat* 2017;22:69-78. doi:10.1177/1077559516674595 [published Online First: 26 October 2016]

30 Samkange-Zeeb FN, Spallek L, Zeeb H. Awareness and knowledge of sexually transmitted diseases (STDs) among school-going adolescents in Europe: a systematic review of published literature. *BMC Public Health* 2011;11:727. doi:10.1186/1471-2458-11-727 [published Online First: 25 September 2011].

31 Chu JH, Huang JH. A theory-based exploration of condomless anal intercourse intention among young men who have sex with men of different sexual roles in Taiwan. *Arch Sex Behav* 2018;47:2041-50. doi:10.1007/s10508-017-1081-7 [published Online First: 1 December 2017]
Figure legends

Figure 1. Flow chart of analysis illustrating the overall rates of ever having had sexual intercourse and condom use among adolescents in Taiwan from 2012 to 2016

Figure 2. The rate of ever having had sexual intercourse of Taiwan adolescents from 2012 to 2016, by gender, school type and grade
Figure 1. Flow chart of analysis illustrating the overall rates of ever having had sexual intercourse and condom use among adolescents in Taiwan from 2012 to 2016

493x575mm (300 x 300 DPI)
Figure 2. The rate of ever having had sexual intercourse of Taiwan adolescents from 2012 to 2016, by gender, school type and grade

609x469mm (300 x 300 DPI)
ONLINE ONLY SUPPLEMENTARY MATERIAL

Contents

- Table S1. Taiwan GSHS Questions that were used to determine whether respondents had sexual intercourse and to evaluate the validity of responses
- Table S2. The variables in GSHS involved in data analyses
- References

Tables S1-S2: The questions in these tables were obtained from the Centers for Disease Control and Prevention of the United States.\(^1\) However, the questions were written in Chinese when presented to the subjects.

Table S1. Taiwan GSHS Questions that were used to determine whether respondents had sexual intercourse and to evaluate the validity of responses:

| Question                                                                 | Option                                                                 |
|------------------------------------------------------------------------|------------------------------------------------------------------------|
| 1. Have you ever had sexual intercourse?                                | A. Yes                                                                 |
|                                                                        | B. No                                                                  |
| 2. How old were you when you had sexual intercourse for the first time? | A. I have never had sexual intercourse                                 |
|                                                                        | B. 11 years old or younger                                            |
|                                                                        | C. 12 years old                                                        |
|                                                                        | D. 13 years old                                                        |
|                                                                        | E. 14 years old                                                        |
|                                                                        | F. 15 years old                                                        |
|                                                                        | * G. 16 or 17 years old                                                |
|                                                                        | * H. 18 years old or older                                             |
| 3. During your life, with how many people have you had sexual intercourse? | A. I have never had sexual intercourse                                 |
|                                                                        | B. 1 person                                                            |
|                                                                        | C. 2 people                                                            |
|                                                                        | D. 3 people                                                            |
|                                                                        | E. 4 people                                                            |
|                                                                        | F. 5 people                                                            |
|                                                                        | G. 6 or more people                                                    |
| 4. The first time you had sexual intercourse, what method of birth control did you use to prevent pregnancy? | A. I have never had sexual intercourse                                 |
|                                                                        | B. No method was used to prevent pregnancy                             |
|                                                                        | C. Birth control pills                                                 |
|                                                                        | D. Condoms                                                             |
|                                                                        | E. Depo-Provera (or any injectable birth control, Nuva Ring (or any birth control ring), Implanon (or any implant), or any IUD |
|                                                                        | F. Withdrawal                                                          |
|                                                                        | G. Some other method                                                   |
|                                                                        | H. Not sure                                                            |
| 5. The last time you had sexual intercourse, did you or your partner use a condom? | A. I have never had sexual intercourse                                 |
|                                                                        | B. Yes                                                                 |
|                                                                        | C. No                                                                  |
| 6. The last time you had sexual intercourse, did you or your partner use any other method of birth control, such as withdrawal, rhythm (safe time), birth control pills, or any other method to prevent pregnancy? | A. I have never had sexual intercourse                                 |
|                                                                        | B. Yes                                                                 |
|                                                                        | C. No                                                                  |
|                                                                        | D. I do not know                                                        |
| 7. After having sexual intercourse, have you or your partner ever used emergency after-sex contraceptive pills to prevent pregnancy? | A. I have never had sexual intercourse                                 |
|                                                                        | B. Yes                                                                 |
|                                                                        | C. No                                                                  |
|                                                                        | D. I do not know                                                        |
8. Have you or your sexual partner ever had an induced abortion?

A. I have never had sexual intercourse
B. Yes
C. No
D. I do not know

| No sexual intercourse: | Answered ‘No’ for Qn. 1 and ‘I have never had sexual intercourse’ for Qn. 2-8 |
| Had sexual intercourse: | Answered ‘Yes’ for Qn. 1 and other than ‘I have never had sexual intercourse’ for Qn. 2-8 |
| Invalid response: | Contradictory response such as answered ‘Yes’ for Qn. 1 and answered ‘I have never had sexual intercourse’ for any one of Qn. 2-8 |

* In 2012, option G became ‘16 years old or older’ without option ‘H. 18 years old or older’. However, starting from 2013, option G and H were ‘16 or 17 years old’ and ‘18 years old or older’ respectively. Therefore, in our analyses throughout this paper, we combined the data of option ‘G. 16 or 17 years old’ and ‘H. 18 years old or older’ into ‘16 years old or older’.

Table S2. The variables in GSHS involved in data analyses

| Variable | Question / Description | Option |
|----------|------------------------|--------|
| Demographics | What is your sex? | A. Male  
B. Female |
| | How old are you? | A. 11 years old or younger  
B. 12 years old  
C. 13 years old  
D. 14 years old  
E. 15 years old  
*F. 16 years old  
*G. 17 years old  
*H. 18 years old or older |
| Degree of urbanization ** | In what grade are you? | A. Grade 1 #  
B. Grade 2 #  
C. Grade 3 # |
| School type ** | Junior high school / Senior high school / Vocational high school / Comprehensive school / Night school |
| Knowledge about sexually transmitted diseases | Do you agree with the following statement: “Even if they had received the cervical cancer vaccine, women still need to have a Pap smear regularly”? | A. Yes  
B. No  
C. I do not know |
| Substance use | During the past 30 days, on how many days did you smoke cigarettes? | A. 0 days  
B. 1 or 2 days  
C. 3 to 5 days  
D. 6 to 9 days  
E. 10 to 19 days  
F. 20 to 29 days  
G. All 30 days |
| | During the past 30 days, on the days you drank alcohol, how many drinks did you usually drink per day? | A. I did not drink alcohol during the past 30 days  
B. Less than one drink  
C. 1 drink  
D. 2 drinks  
E. 3 drinks  
F. 4 drinks  
G. 5 or more drinks |
| Sexual behaviors | Have you ever had sexual intercourse? | A. Yes  
B. No |
During your life, with how many people have you had sexual intercourse?

- A. I have never had sexual intercourse
- B. 1 person
- C. 2 people
- D. 3 people
- E. 4 people
- F. 5 people
- G. 6 or more people

The first time you had sexual intercourse, what method of birth control did you use to prevent pregnancy?

- A. I have never had sexual intercourse
- B. No method was used to prevent pregnancy
- C. Birth control pills
- D. Condoms
- E. Depo-Provera (or any injectable birth control), NuvaRing (or any birth control ring), Implanon (or any implant), or any IUD
- F. Withdrawal
- G. Some other method
- H. Not sure

The last time you had sexual intercourse, did you or your partner use a condom?

- A. I have never had sexual intercourse
- B. Yes
- C. No

The last time you had sexual intercourse, did you or your partner use any other method of birth control, such as withdrawal, rhythm (safe time), birth control pills, or any other method to prevent pregnancy?

- A. I have never had sexual intercourse
- B. Yes
- C. No
- D. I do not know

* In 2012, option F was 16 years old or older. However, from 2013 to 2016, option F was changed to 16 years old and option G (17 years old) and option H (18 years old or older) were added.

** The data for ‘Degree of urbanization’ and ‘School type’ were entered by those who collected the data, they were not answered by students.

# Grade 1, 2 and 3 mean Grade 7, 8 and 9 when GSHS was conducted in 2012, 2014 and 2016. Grade 1, 2 and 3 mean Grade 10, 11 and 12 when GSHS was conducted in 2013 and 2015.

References

1. Taiwan - Global School-based Student Health Survey (GSHS) 2016 [Available from: https://www.cdc.gov/gshs/countries/westpacific/taiwan.htm accessed 2 Nov 2020.
STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

| Item No | Recommendation | Page No |
|---------|----------------|---------|
| **Title and abstract** | | |
| 1 | (a) Indicate the study’s design with a commonly used term in the title or the abstract | 1-2 |
| 1 | (b) Provide in the abstract an informative and balanced summary of what was done and what was found | 1-2 |
| **Introduction** | | |
| 2 | Explain the scientific background and rationale for the investigation being reported | 2-3 |
| 3 | State specific objectives, including any prespecified hypotheses | 2-3 |
| **Methods** | | |
| 4 | Present key elements of study design early in the paper | 4-5 |
| 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | 4-5 |
| 6 | (a) Give the eligibility criteria, and the sources and methods of selection of participants | 4-5 |
| 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | 4-5 |
| 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 | 4-5 |
| 9 | Describe any efforts to address potential sources of bias | 13-14 |
| 10 | Explain how the study size was arrived at | 4-5 |
| 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | 4-5 |
| 12 | (a) Describe all statistical methods, including those used to control for confounding | 4-5 |
| 12 | (b) Describe any methods used to examine subgroups and interactions | 4-5 |
| 12 | (c) Explain how missing data were addressed | 4-5 |
| 12 | (d) If applicable, describe analytical methods taking account of sampling strategy | 4-5 |
| 12 | (e) Describe any sensitivity analyses | 4-5 |
| **Results** | | |
| 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 | 5-10 |
| 13* | (b) Give reasons for non-participation at each stage | 5-10 |
| 13* | (c) Consider use of a flow diagram | 5-10 |
| 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders | 5-10 |
| 14* | (b) Indicate number of participants with missing data for each variable of interest | 5-10 |
| **Outcome data** | | |
| 15* | Report numbers of outcome events or summary measures | 5-10 |
| 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 | 5-10 |
(b) Report category boundaries when continuous variables were categorized.
(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period.

| Other analyses | 17 | Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses | 5-10 |
|----------------|----|------------------------------------------------------------------------------------------------|------|

Discussion

| Key results | 18 | Summarise key results with reference to study objectives | 10-14 |
|-------------|----|--------------------------------------------------------|------|
| 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 | 10-14 |
| Interpretation | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | 10-14 |
| Generalisability | 21 | Discuss the generalisability (external validity) of the study results | 10-14 |

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 | 15 |

*Give information separately for exposed and unexposed groups.

**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.