
# Feasibility and Impact of School-Based Online Comprehensive Sexuality Education on Vocational High School Students: A Cluster-Randomized Controlled Trial

| | |
|---|---|
| Journal: | *The Journal of Sex Research* |
| Manuscript ID | 24-459.R1 |
| Manuscript Type: | Original Article |
| Keywords: | Longitudinal < METHODS USED:, Other categorical analyses (latent class analysis, log-linear analysis, etc) < STATISTICAL ANALYSES USED:, School-based interventions < SEX EDUCATION / INTERVENTIONS, Adolescents < Age Group of Participants: < PARTICIPANT CHARACTERISTICS: |
| | |

# Feasibility and Impact of School-Based Online Comprehensive Sexuality Education on Vocational High School Students: A Cluster-Randomized Controlled Trial

To assess the effect of an online comprehensive sexuality education (CSE) package for vocational high school students in China's developed and less-developed regions, a parallel, unblinded, cluster, randomized controlled trial was conducted. The study included 3,415 tenth-grade students from 29 mixed-gender vocational high schools who had not previously received CSE. The intervention group participated in weekly classes over two months, totaling 360 minutes of online CSE. For the primary outcomes, the intervention group exhibited improvements in sexuality knowledge and attitude post-intervention and one year later. However, after one year, the positive effects are less than post-intervention. In addition, the intervention group's growth rate of sexuality knowledge and attitude is not limited by the initial baseline level. In the secondary outcomes, compared with the control group, the online CSE resulted in a higher frequency of penetrative sexual events, harassment coping self-efficacy in both post-intervention and one year later, and school bully perception only in post-intervention. No significant between-group differences were observed in the trajectory of STD symptom changes, contraceptive usage, unintended pregnancy rates, or self-efficacy. Finally, curriculum progress positively impacts the slope of sexuality knowledge and attitude. Results suggest that more sustained CSE is necessary for vocational high school students in China. Online CSE presents a feasible solution to enhance sexuality knowledge and attitude and bridge the gap in developmental and sexuality education levels. However, behaviors and well-being outcomes did not yield consistent positive results.

## Introduction

Significant gaps and inadequacies have long marked China's sexual education. Despite growing public awareness of sexual health issues in recent years, the nationwide implementation of comprehensive sexuality education (CSE) remains challenging and inconsistent (Z. Zou et al., 2023).

Firstly, there is a shortage of qualified sexuality education teachers in China, many of whom hold traditional, conservative views on sexuality or face external pressures that influence their teaching (Zhao et al., 2020). Furthermore, pre-service teacher education programs in China tend to focus on knowledge while often neglecting practical teaching skills (Xiong et al., 2020). Schools also lack standardized teaching materials and guidelines (Ji & Reiss, 2022), leading to superficial courses primarily focusing on physiology. The psychosexual and sociosexual aspects are often downplayed to align with biosexual norms that reflect traditional cultural values (Liang et al., 2017). In many cases, sexuality education is merged with physiology courses taught by untrained teachers (Liu, 2022; Z. Zou et al., 2023). Moreover, traditional Chinese culture, deeply influenced by puritanical Confucian norms (Ho et al., 2018; Li et al., 2009), further contributes to unclear standards for sexuality education. Teachers may discourage any form of sexual contact, warning students that it leads to moral corruption (Liu, 2022) and in some cases, even promote sexual abstinence (W. Zou et al., 2023). This lack of comprehensive education fails to adequately prepare adolescents to understand sexual health and rights or to navigate the complexities of adolescence. These culturally and contextually relevant factors have led to the situation where traditional sexual education in China is unstandardized, scattered, lacking a systematic approach, unclear in its effectiveness, undervalued, even stigmatized, and accompanied by the risk of misinformation.

Adolescence is a critical period associated with increased risks of problematic behaviors such as pornography use (Chen, 2022), sexting (Steinberg et al., 2019), condomless sex (Szucs et al., 2020), and multiple sexual partners (Huang et al., 2011; Rossi et al., 2017). A study conducted in China, including 109,754 students from 18 provinces in grades 10 to 12, found that 4.8% of adolescents reported having had penetrative sexual events, with 32.8% of them experiencing forced sex (Song & Ji, 2010).

Notably, the prevalence of penetrative sexual events among vocational school students was twice as high compared to students in regular and elite high schools[1] (Song & Ji, 2010). Similar trends were reported in Beijing (10.4% for vocational vs. 4% for regular) (Song et al., 2006), Guangdong (10.1% for vocational vs. 4.8% for regular vs. 3.1% for elite) (Nie et al., 2007), and Xinjiang (8.7% for vocational vs. 3.0% for regular vs. 4.2% for elite) (Wang et al., 2009).

### *Challenges Faced by Vocational High School Students*

Vocational school students lack sexuality knowledge and exhibit negative attitudes toward sexuality (Yu, 2012), which increases their risk of sexually transmitted diseases (Liang et al., 2019; Zhang et al., 2022). However, institutional discrimination and stratification within China's education system pose challenges to promoting CSE in vocational high schools (Fang et al., 2022; Liu, 2022).

Vocational high schools in China have long been marginalized and face systematic discrimination (Schulte, 2013; Zeng, 2024). Students often come from disadvantaged socioeconomic backgrounds, and parents may lack the resources or knowledge to provide adequate sexual education (Liu et al., 2011; Wang & Guo, 2019). Additionally, these schools have fewer resources than regular schools, leading to a more severe shortage of qualified teachers. Vocational students are affected by both educational resource deficiencies and social discrimination, creating more significant barriers to acquiring sexual health knowledge and developing healthy sexual attitudes.

[1] Vocational high schools focus on vocational training, with students typically having weaker academic backgrounds. Regular high schools offer a more balanced academic curriculum, while key high schools cater to academic elites. These three types of schools differ significantly in terms of social perception, resource allocation, and student development opportunities.

Moreover, institutional discrimination labels vocational high school students as "low-quality" and "cheap labor" within society (Ling, 2015). As a result, many schools and educational institutions neglect the necessity of providing these students with comprehensive and systematic sexuality education. This institutionalized disregard further exacerbates the lack of sexual education among vocational high school students, leaving them even more vulnerable.

Additionally, bullying is rampant in Chinese vocational high schools. A study involving 95,873 students from 85 vocational schools found that 30.4% reported being bullied, 2.9% admitted to bullying others, and 21.7% experienced both (Xu et al., 2020). Another study across 28 schools in seven provinces showed that bullying incidents in vocational schools were 1.19 times higher than in regular schools, with low academic performance worsening the bullying problem (Han et al., 2017). Due to the lack of sexual education, many students are unable to recognize behaviors like sexual harassment or discrimination, often dismissing them as jokes. The silence of victims, inadequate school management, and weak legislation have normalized such behaviors (Fei et al., 2022).

These factors marginalize sexuality education in vocational high school curriculums, resulting in students' low interest in learning about sexuality knowledge and poor classroom participation (Liu, 2022). This issue is especially pronounced among lower socioeconomic status groups (Zou et al., 2022) and adolescents in rural areas of western China (Ji et al., 2018; Yu, 2012). Despite the existence of 7,294 vocational high schools in China, with an enrollment of 13.12 million students—representing 33.49% of secondary education students (Ministry of Education, 2023)—this group is often overlooked. Therefore, the primary aim of this study is to focus on vocational high school students by implementing comprehensive sexuality education.

### *Model of Attitudes and Behavioral Practices and Social Cognitive Theory*

This study adopts the Model of Attitudes and Behavioral Practices (MAP) as the theoretical foundation (Albarracín, 2021). The MAP highlights the critical role of external messages (e.g., CSE educational content), and prior experience (e.g., previous sexual education experiences) in shaping knowledge, attitude, and behavior.

In the MAP, knowledge serves as the cognitive foundation of behavior, forming beliefs that directly shape attitudes and, subsequently, behavioral intentions and actions. The CSE acts as pivotal message arguments, enhancing students' cognitive awareness and understanding of behavioral consequences. This process promotes positive attitudes, which, in turn, enhance behavioral intentions and behavior. Notably, the MAP suggests reciprocal relationships between these variables: while knowledge[2] guide attitudes, the reinforcement of attitudes can, in turn, influence knowledge, thereby sustaining and deepening the impact of educational interventions over time. This insight guided our view of the relationship between attitude and knowledge as correlational rather than causal.

Moreover, this study is grounded in Social Cognitive Theory (SCT), which posits that human behavior is shaped by the dynamic interplay of personal, behavioral, and environmental factors. SCT emphasizes the importance of self-efficacy—an individual's belief in their ability to successfully perform a behavior—as a central driver of motivation and behavior change (Warner & Schwarzer, 2025). According to Bandura's theory, efficacy beliefs can be enhanced through verbal persuasion, and higher levels of self-efficacy increase an individual's persistence and resilience in the face of challenges, facilitating lasting behavior change (Bandura, 2011; Warner & Schwarzer, 2025). In the context of CSE,

[2] In the literature, the term "belief" is commonly used; however, as noted in Chapter 2, "Beliefs" (p. 45), the distinction between belief and knowledge can be ambiguous.

enhancing students' general self-efficacy, particularly in coping sexual harassment situations, is crucial to empowering them to act in alignment with the knowledge and attitudes acquired through the education.

***Comprehensive sexuality education and Internet-based medium***

CSE is a curriculum-based theoretical framework to equip adolescents with sexuality knowledge, skills, and values, promoting their health, well-being, dignity, respectful relationships, mindful choices, and protecting their rights throughout their lives. (Herat et al., 2018). CSE is increasingly recognized as essential for promoting sexual health and well-being. In 2018, UNESCO and UNFPA launched the Chinese edition of the revised International Technical Guidance on Sexuality Education (ITGSE), which provides evidence-based recommendations for implementing effective CSE programs for learners aged 5 to 18+. Although voluntary, the guidance reflects international best practices and offers a framework adaptable to various national contexts for implementing sexuality education (UNESCO, 2018).

In China, CSE has led to improved knowledge and more positive attitudes toward sexual minorities among college students (Chi et al., 2015). High school students also benefit from CSE, gaining more accurate sexual knowledge, stronger support for nontraditional gender roles, and a greater rejection of sexual double standards immediately after the intervention (Chi et al., 2015; Sa et al., 2021). Additionally, middle school students demonstrate enhanced sexual knowledge, skills, positive attitudes, and self-efficacy following CSE (Jin et al., 2021; Kaidbey et al., 2023; Zhu et al., 2022). However, all these studies focus on the immediate effects of the intervention. Even international studies typically assess post-intervention effects after 3 or 9 months (Manlove et al., 2021; Pinandari et al., 2023), leaving the long-term impact of CSE unclear.

The computer and internet-based approach has become the primary channel through which students acquire sexual knowledge (Jiang & Ha, 2020; Vamos et al., 2020; Yu, 2012). The inherent transparency and openness of this medium challenge China's sexual repression and promote a more tolerant attitude towards sex (Liu et al., 2020). Although without the framework of CSE, prior research indicates that online platforms for delivering sexual education can enhance knowledge and attitudes toward sexuality (Guse et al., 2012; Lou et al., 2006; Wadham et al., 2019), as well as influencing contraceptive usage, sexual transmission infection testing (Swanton et al., 2015; Widman et al., 2018), and various aspects of sexual self-efficacy (Nurgitz et al., 2021; Roth et al., 2023; Strauss Swanson & Szymanski, 2022). However, these findings often fail to account for adherence to school-based CSE and overlook the progress achieved through online curriculum delivery. Thus, in response to calls for reform and standardization of sexual health education courses (Ferrand, 2023), the aim of this study is to investigate the effects of standardized online school-based CSE on knowledge, attitude, behavioral and well-being outcomes.

The *You and Me* package, developed by Marie Stopes International China (MSIC)[3] based on the ITGSE (UNESCO & WHO, 2018), provides free, standardized online comprehensive sexuality education (OCSE) for adolescents. The program includes eight teacher-facilitated sessions covering topics such as understanding gender, the reproductive system and puberty, pregnancy and contraception, relationships and values, media literacy and well-being skills, disease prevention and behavior, sexual violence, and love and

[3] Marie Stopes International China (MSIC) is a non-profit organization, delivering relevant, informative, cost effective and sustainable sexual and reproductive health services and education to improve the health and well-being of youth (age 13-24).

marriage. The Xi'an Guangyuan Assistance Charity Centre, in collaboration with MSIC, was responsible for implementing the project.

As of September 2018, 21,039 students from 24 schools have participated in the *You and Me*. However, there has been a lack of quantifiable assessment of the outcomes. We aimed to address whether the *You and Me* program effectively enhances sexuality knowledge and promotes more positive sexuality attitude in the short- and long-term among vocational high school students compared to traditional sexual education (RQ1). Additionally, considering regional and sexual experience differences, we explored whether *You and Me* mitigates rather than exacerbates disparities in economic and sexual education levels across regions (RQ2). Recognizing that changes in knowledge and attitudes alone are insufficient, we further investigated whether the program leads to healthier behavioral outcomes and improved well-being (RQ3). Given the competition for curriculum time with core subjects, the incomplete provision of sexual education, and regular instances of student absenteeism, we also examined how the implementation progress of online courses affects the program's effectiveness (RQ4). To address these questions, we conducted a large-scale cluster randomized controlled trial (RCT) to evaluate the impact of online comprehensive sexuality education (OCSE) on the sexual and reproductive health and rights outcomes of tenth-grade vocational high school students immediately post-intervention and one year later. A nested study was also conducted to assess influencing factors and monitor implementation progress.

## Methods

### *Study design and Participants*

A two-arm, parallel-group cluster randomized trial was conducted in Guangdong and Yunnan provinces, China, to evaluate the effectiveness of the *You and Me OCSE* program. In the

intervention group, OCSE was provided, while the control group maintained their previous sexual education implementation plans, which were nearly non-existent. Due to regional differences and the unstructured and fragmented nature of traditional sex education across schools, we did not standardize it. Moreover, since traditional sexual education in China can sometimes be flawed or even harmful, it was not feasible to implement an equivalent duration of traditional sex education to control for time and attention effects.

The intervention was delivered between April 2019 and June 2019, focusing on the general practices of the *You and Me* education program in Zhongshan City (Guangdong Province) and Kunming City (Yunnan Province), two regions with significant economic and sexuality educational disparities. Yunnan Province exhibited a lagging attitude, inadequate education, and consistently lower knowledge levels than the national average. In 2022, Guangdong province had a population of 127 million and a GDP exceeding 12.95 trillion yuan, maintaining its position as the top-ranked province among the 34 provinces in China for 34 consecutive years, with the second-highest increment in the nation. In contrast, Yunnan lagged with a population of 47 million and a GDP of 2.86 trillion yuan, ranking 18th nationwide (National Bureau of Statistics, 2024). A survey on sexuality knowledge, attitudes, and practices conducted in five regions revealed notable disparities between Guangdong and Yunnan provinces. This includes the prevalence of sexually transmitted diseases (2.5% in Guangdong vs. 3.2% in Yunnan vs. 3.0% average), opposition to premarital sexual activity (54.7% in Guangdong vs. 68.2% in Yunnan vs. 61.2% average), correct identification of HIV/AIDS transmission routes (74.9% in Guangdong vs. 63.5% in Yunnan vs. 73.0% average), and peer acceptance of studying in the same class with HIV/AIDS-infected individuals (36.7% in Guangdong vs. 25.1% in Yunnan vs. 29.0% average; see Sun, 2001). The trial targeted mixed-gender vocational high schools in March 2019, which were public institutions with more than 100 grade ten students. Schools that had already implemented a

CSE program or had plans to do so in the upcoming year were excluded. Participants without informed consent from their guardians were also excluded from the study. A total of 29 clusters were involved, with ten vocational high schools from Guangdong province and 19 from Yunnan province (see Figure 1). The baseline survey was conducted in April 2019, followed by a post-intervention survey in June 2019. The long-term effects were measured during a follow-up in June 2020.

### *Ethical approval statement*

All study procedures adhered to the 1964 Helsinki Declaration and its later amendments or by applying comparable ethical standards. Approval was obtained from the Tsinghua University Institutional Review Board (Project No: 20,190,009), and the trial was duly registered with the Chinese Clinical Trial Registry (Registration No: ChiCTR1900021582). Written informed consents were obtained from schools and students. For students under the age of 18, written consent was provided by their legal guardians. All data were anonymized under a waiver of consent as per data sharing and ethical approval agreements.

### *Cluster Randomization and Blinding*

Randomization was at the school and class levels. School clusters were the unit of randomization. Twenty-nine schools were randomly allocated to the *You and Me* OCSE or control groups with an equal allocation ratio after being stratified by borough. At the class level, two to four classes were randomly chosen in each selected school as the smallest unit for the intervention to be delivered.

A masked statistician (KT) generated randomization through a computerized process utilizing a random number generator and oversaw the development of the statistical analysis plan but did not conduct any analyses. Blinding is not appropriate to this study as it involves

education. Throughout the trial, researchers remained unaware of cluster allocation. Statisticians conducting analyses (HC) were blinded to allocation and were only unmasked after data collection and analyses were completed. Non-site-specific study ID numbers were used on all schools and data collection forms to maintain blinding.

***Procedure***

Xi'an Guangyuan Assistance Charity Centre provided a day and a half of training to at least two teachers from each school in the intervention groups following the ITGSE guidelines. To familiarize teachers with the *You and Me* OCSE content and improve their teaching skills, video recordings of trained educators delivering each session were made available as references. The education bureaus in each city supervised the training process. At least two teachers from each school underwent the training, ensuring every class had trained teachers. Under the supervision of the Family Planning Association (FPA) in Kunming and the Health and Hygiene Institute for Primary and Secondary Schools in Zhongshan (HHIPSS), Tsinghua University Vanke School of Public Health evaluated the knowledge levels of the trained teachers through interviews based on the ITGSE framework. Teachers who did not meet the standards underwent additional half-day training until passing the assessment. Control groups had no systematic CSE program but may have been exposed to regular sexuality education.

Outcomes were evaluated by trained health researchers from Tsinghua University and Peking University under the supervision of local FPA or HHIPSS representatives. People collecting questionnaire data were independent of the intervention implementation team and masked the allocation of communes to trial groups. Data were collected in three waves: at baseline, post-intervention (after eight weeks of education), and first follow-up (12 months since post-intervention).

The baseline survey was conducted in April 2019. All students used their mobile phones to complete a self-administered baseline questionnaire, which took approximately 20 minutes. For students without mobile phones, the research team provided alternative devices. Half of the students were moved to another classroom to provide more privacy during the questionnaire completion, with approximately two desks' distance between every two students. The questionnaire domains encompassed socio-demographic information, lifestyle, family, education, and students' sexual and reproductive knowledge, attitudes, and behaviors. All questionnaire data were directly stored in the backend database.

From April 2019 to June 2019, the *You and Me* program was delivered once a week for 45 minutes each session, totaling eight sessions and 360 minutes. Each session included approximately 30 minutes of autonomous learning through computer-mediated education, supplemented by 2-3 participatory activities. These activities involved teacher-led interactive elements, such as scenario simulations for sexual harassment and condom use demonstrations. Teachers addressed questions from students and were encouraged to follow the provided manual to ensure standardized instruction. After each class, teachers were required to document the classroom dynamics and report on the session. Each school reported fixed class times, and the FPA and the HHIPSS randomly inspected the implementation of the courses.

Instances of absenteeism and non-compliance with the standard class procedures were documented and cross-referenced with students' self-reported teaching situations to assess the quality of OCSE implementation. The post-intervention follow-up was conducted in June 2019, with most schools completing the *You and Me* program. In addition to completing the basic questionnaire, students were asked about the program's progress.

Trained health researchers conducted 30-minute semi-structured interviews with teaching staff in the intervention group. Additionally, in each school of the intervention

group, 5-10 students were randomly selected to participate in focus group interviews to understand the experiences and suggestions of the *You and Me* OCSE. The second follow-up was conducted in June 2020, using the same questionnaire to assess the long-term impact.

### *Outcomes*

The primary outcomes were sexuality knowledge and sexuality attitude. To the best of our knowledge, there is no validated scale for assessing Chinese adolescent sexuality knowledge and sexuality attitude based on CSE. Existing scales such as The Sex Knowledge and Attitudes Test - Adolescents (SKAT-A) and Global Early Adolescent Study do not cover all CSE content. They are lengthy and do not align with the Chinese context, causing confusion among high school students during pre-testing. Therefore, we followed the guidelines in the Reproductive Health Epidemiology (Centers for Disease Control and Prevention, 2003). ITGSE was used as a reference to construct dimensions, and SRHR experts ultimately designed the sexuality knowledge and attitude scales. The scales were pre-tested in junior high school to ensure the localization (Jin et al., 2021), and based on feedback from pre-test focus group interviews of vocational high school teachers and students, six questions were added to both sexuality knowledge and attitude. The sexuality knowledge questionnaire comprised 20 true-or-false questions on the reproductive system and puberty, pregnancy and contraception, disease and behavior, and sexual violence. Participants received one point for each correct answer. Kuder-Richardson Formula 20 = 0.7678 (Kuder & Richardson, 1937).

Sexuality attitude were assessed by a 20-item Likert scale on understanding gender, relationship and value, media literacy and well-being skills, sexual violence, love and marriage. Each item had seven response options, ranging from strongly disagree to strongly agree. The Cronbach's alpha of sexuality attitude = 0.79.

The secondary outcomes assessed were related to sexual and reproductive health and rights. Based on NHS and WHO standards, we measured explicit symptoms of sexually transmitted diseases (STDs) at baseline and one year after the intervention (NHS, 2018; WHO, 2020). The total score ranges between 1 and 4. Students were asked whether they had experienced the following symptoms in the last year: (a) itching and redness in the genital area and anal itching, soreness, or bleeding, (b) sores or warts on the genital area, (c) unusual discharge or abnormal odor from the penis or vagina, and (d) painful or frequent urination. The responses had been counted.

The frequency of penile-vaginal intercourse was measured at three points. Students were asked to report the number of times they had engaged in penetrative sexual events.

Contraceptive usage was measured at baseline and one year after the intervention. Students reported the percentage of time they and their partners used condoms or short-acting birth control pills in the past year. The total score ranges between 1 (50% or less) and 4 (100%), with a higher score indicating a higher contraceptive usage ratio.

Unintended pregnancy was measured three times. Female students were asked, "How many times have you been pregnant?" Male students were asked, "How many times has your sexual partner been pregnant?"

Self-efficacy was measured three times using the general self-efficacy scale (Schwarzer & Jerusalem, 1995), validated in China (Zeng et al., 2022). The total score ranges between 10 and 40, with a higher score indicating greater self-efficacy. This scale consists of 10 items, each with four response options, ranging from not at all (1) to absolutely right (4). Harassment coping self-efficacy was measured three times. Due to the absence of a suitable scale to measure sexual harassment coping, a custom questionnaire was developed. Students were asked to rate their confidence in coping effectively if they were to encounter forced

sexual activity or sexual harassment. Responses ranged from 1 (no coping confidence) to 5 (full coping confidence).

School bullying perception was measured three times. Students reported the frequency of classmates' sexual bullying or harassment behavior on a scale from 1 (not at all) to 7 (very often). The total score ranged from 1 to 5, with higher scores indicating a greater perception of bullying.

Curriculum progress was measured in the post-intervention. The total score ranges between 0 and 8, with a higher score indicating more content has been taught. The students in the intervention group were asked which specific lessons they attended in the past two months as part of the course package. The responses had been counted.

Demographic information includes age, sex[4], ethnicity, location, and parental divorce. Sexual experiences, baseline school bully perception, and sexuality education experiences were entered as covariates to explore the better way to accomplish the series sexuality education. Because of the complexity of sexuality education experience, it has been measured in different ways (Table 1).

### *Sample Size and Power*

Based on previous studies in China (Chi et al., 2015; Lou et al., 2006; Lyu et al., 2020), we assumed an intraclass correlation coefficient (ICC) of 0.10, correct response rates of 50% (with a standard deviation of 20%), a detection power of 80%, and an α value of 0.05, the

[4]Due to cultural constraints and the fact that participants from underdeveloped regions did not fully understand concepts like gender and sexual orientation, we only measured the sex recorded on their ID cards. All instances of "sex" mentioned in the paper refer to biological sex. Same-sex behavior specifically refers to men who have sex with men or women who engage in sexual activity with women.

minimum detectable difference between population means was set at 10%. Given that there are approximately 60 students per vocational high school class, 120 students per cluster, we determined that a minimum of eight clusters would be required in each arm. We oversampled for each arm to increase statistical power and account for the possibility of schools dropping out. Based on our baseline data, we can detect a minimum difference in sexuality knowledge of 0.30 (M = 8.55, SD = 3.76, ICC = 0.06) and sexuality attitude of 0.37 (M = 94.38, SD = 12.51, ICC = 0.10).

***Statistical Analysis***

Data analysis occurred from March 2022 to December 2023. To answer RQ1, we performed a multigroup parallel process latent growth model (PP-LGM) with freely estimated slopes (Figure 2). PP-LGM is a method for modeling repeated measures as latent variables composed of a random intercept and random slopes that can evaluate the interindividual difference and intraindividual changes over time (Cheong et al., 2003; Cheung & Lau, 2017). Intercept refers to the initial sexuality knowledge and attitude, while the slope represents the growth rate. When estimated freely, trajectories are not constrained to a linear trend, which illustrates the effect of intervention. For a theory-based intervention, PP-LGM provides an efficient way to assess and interpret the relationships of longitudinal effects for intervention studies. Correlations between the latent factors are also included to improve model fit (Cheong et al., 2003). Multigroup is used to compare differences between two groups. Thus, the method was appropriate in this study. To answer RQ2 and RQ4, covariates are included in the PP-LGM.

The mixed effect model (MEM) uses group and time as the main effects to examine secondary outcomes to solve RQ3. A pairwise comparison with Bonferroni correction was performed to compare the differences between the intervention groups whenever a

group and time interaction effect was observed. MEM was conducted using SPSS 26 and modeling analysis using Mplus 8.3. Missing data were treated with pairwise deletion for the MEM and the full information maximum likelihood method for PP-LGM. Statistical significance was defined at a 2-tailed α level of 0.05.

## Results

### *Participant Characteristics*

As shown in Table 2, the baseline sample included 3,415 students from 29 schools, aged 14 to 22, collected from March 23, 2019, to March 31, 2019. The mean age of participants was 16.10 (SD = 0.85), and 1,877 (54.96%) were male. A total of 2,889 (84.60%) adolescents completed the two-month follow-up, and 2,816 (82.46%) completed the one-year follow-up. Attrition occurred due to students being absent on the survey day, failing to remember their usernames and passwords to complete the survey online, or answering fewer than 80% of the items on any scale. There were no significant differences between students who only participated at baseline and those who completed at least one follow-up assessment in either the intervention or control groups on any of the outcome measures (sexuality knowledge: $F$ (3,413) = 0.053, $p$ = 0.261; sexuality attitude: $F$ (3,413) = 0.391, $p$ = 0.514).

At baseline, the average score for sexuality knowledge was 8.55 ($SD$ = 3.76), with 60.26% of individuals scoring below 10 points. The average score for sexuality attitude was 94.38 ($SD$ = 12.51). Regarding sexual experiences, 68.46% of the students reported being in love, but only 13.01% had experienced penetrative sexual events. Additionally, 19.57% of students reported encountering sexual harassment. Only 51.70% of the adolescents reported receiving sexuality education, with an average duration of 2.50 ($SD$ = 1.74) lessons, totaling approximately 112.50 minutes, and covering an average of 5.14 ($SD$ = 2.34) topics. Less than one-third of the students had ever received education on abortion, pregnancy and

contraception, sexual behaviors, sexual violence, and love and marriage. Notably, 32.83% of students (1,121) had received sexuality education during only one stage of their schooling.

***Primary Outcome***

Trajectory analyses showed an excellent model fit for PP-LGM (Appendix Table 1). In response to RQ1, the intervention group exhibited distinct and steeper growth trajectories compared to the control group (sexuality knowledge unstandardized coefficient, control group: $b = 0.27$ [95% CI, 0.12 to 0.41], $p < 0.001$ vs intervention group: $b = 4.19$ [95% CI, 4.00 to 4.37], $p < 0.001$; sexuality attitude, control group: $b = 1.27$ [95% CI, 0.75 to 1.78], $p < 0.001$ vs intervention group: $b = 6.09$ [95% CI, 5.55 to 6.63], $p < 0.001$). Both groups exhibited individual differences at the baseline level and growth of sexuality knowledge and sexuality attitude (Appendix Table 1). Furthermore, the intervention group's sexuality knowledge and sexuality attitude remained higher than those of the control group even after one year (sexuality knowledge short-term difference: 3.97 [95% CI, 3.69 to 4.25], $p < 0.001$; long-term difference: 2.23 [95% CI, 1.93 to 2.53], $p < 0.001$; sexuality attitude short-term difference: 4.06 [95% CI, 3.07 to 5.04], $p < 0.001$; long-term difference: 1.61 [95% CI, 0.53 to 2.69], $p = 0.003$). However, compared to two months after the intervention, both sexuality knowledge and sexuality attitude decreased (Table 3).

Interrelationships between slopes and intercepts of sexuality knowledge and sexuality attitude are described in Table 4. Positive correlations were found between the growth rate of sexuality knowledge and sexuality attitude in both the control group ($r = 0.58$, $p < 0.001$) and the intervention group ($r = 0.74$, $p < 0.001$). Notably, in the intervention group, a higher initial level of sexuality knowledge was associated with a greater increase in sexuality attitude ($r = 0.23$, $p = 0.003$). In the control group, higher initial levels are associated with slower growth, evident in sexuality knowledge ($r = -0.20$, $p = 0.046$) and sexuality attitude ($r$

= -0.22, $p$ = 0.012). However, under OCSE, the growth rate is not significantly affected by the initial level.

***Secondary Outcomes***

In our analysis of RQ2, we found significant interaction effects for penetrative sexual intercourse frequency, harassment coping self-efficacy, and perception of school bullying. Compared to the control group, at post-intervention or one-year follow-up, the intervention group showed an increase in penetrative sexual frequency both post-intervention and at the one-year follow-up (mean [SE] post-intervention 0.44 [0.02] vs 0.37 [0.03]; mean difference [MD] = 0.07; 95% CI 0.01–0.14; Bonferroni-corrected $p$ = 0.048; one-year follow-up 0.58 [0.02] vs 0.50 [0.03]; MD = 0.08; 95% CI 0.00–0.15; Bonferroni-corrected $p$ = 0.038), harassment coping self-efficacy (post-intervention 3.47 [0.03] vs 3.28 [0.03]; MD = 0.20; 95% CI 0.12–0.27; Bonferroni-corrected $p$ < 0.001; one-year follow-up 3.45 [0.02] vs 3.37 [0.02]; MD = 0.08; 95% CI 0.00–0.16; Bonferroni-corrected $p$ = 0.054), and school bullying perception (post-intervention 1.55 [0.03] vs 1.46 [0.03]; MD = 0.09; 95% CI 0.02–0.17; Bonferroni-corrected $p$ = 0.017; one-year follow-up 1.32 [0.02] vs 1.28 [0.02]; MD = 0.04; 95% CI -0.02–0.10; Bonferroni-corrected $p$ = 0.185). There were no differences in growth between the groups in the number of STD symptoms, contraceptive measures, unintended pregnancy, or general self-efficacy (Table 5).

***Demographic Information and Outcomes***

The coefficients of covariates on the intercepts and slopes of sexuality knowledge and attitude were presented in Appendix Tables 2 and 3. In the OCSE group, we identified that females had higher initial sexuality knowledge ($b$ = 0.80 [95% CI, 0.48 to 1.12], $p$ < 0.001) and sexuality attitude ($b$ = 6.78 [95% CI, 5.72 to 7.84], $p$ < 0.001), as well as higher growth

rates in sexuality knowledge ($b$ = 1.28 [95% CI, 0.91 to 1.65], $p < 0.001$) and sexuality attitude ($b$ = 3.21 [95% CI, 2.09 to 4.33], $p < 0.001$). Students living in the undeveloped region of Yunnan had lower initial sexuality knowledge ($b$ = -0.86 [95% CI, -1.26 to -0.47], $p < 0.001$) and sexuality attitude ($b$ = -3.99 [95% CI, -5.29 to -2.70], $p < 0.001$). However, after receiving OCSE, they showed steeper increases in sexuality knowledge ($b$ = 0.73 [95% CI, 0.29 to 1.18], $p < 0.001$) and sexuality attitude ($b$ = 1.82 [95% CI, 0.52 to 3.12], $p = 0.006$).

### *Sexuality Education Experiences and Outcomes*

Students who had received more sessions in previous sexuality education demonstrated higher levels of sexuality knowledge and attitudes in both the intervention group ($b$ = 0.13, $p$ = 0.002; $b$ = 0.50, $p < 0.001$) and the control group ($b$ = 0.21, $p < 0.001$; $b$ = 0.49, $p$ = 0.004). However, the duration of previous education did not significantly affect growth in sexual attitudes. Sensitivity analysis revealed that education experiences at different stages consistently had a positive influence on initial sexuality knowledge (Primary school: $b$ = 0.50, $p$ = 0.064; Junior High School: b = 0.47, p = 0.007; Vocational High School: $b$ = 0.49, $p$ = 0.011) but not on sexuality attitude. Moreover, sexuality education during junior high school influenced the growth rate of both sexuality knowledge ($b$ = -0.45, $p$ = 0.021) and sexuality attitude ($b$ = 1.43, $p$ = 0.016) in the OCSE group (Appendix Tables 2 and 3).

Separate models for the intervention group addressed RQ4. The curriculum progress did not significantly alter other coefficients in the PP-LGM for the intervention. However, it did show that curriculum progress positively impacted the slope of sexuality knowledge ($b$ = 0.45, $p < 0.001$, $\Delta R^2 = 0.16$) and sexuality attitude ($b$ = 1.01, $p < 0.001$, $\Delta R^2 = 0.16$; Appendix Table 1).

## Discussion

Our study investigated the implementation of *You and Me* OCSE in two district provinces and found that most students had insufficient and sporadic sexuality education experience.

### *Effectiveness of Comprehensive Sexuality Education*

Our findings on the impact of OCSE on sexuality knowledge and attitudes are consistent with prior research across different student stages, but they provide more detailed theoretical insights. Overall, the implementation of the *You and Me* program among vocational high school students led to a more rapid increase in both sexuality knowledge and attitude, proving more effective in the short and long term compared to traditional sexual education. In the control group, given the absence of standalone sexual education courses in China, a gradual short-term increase can be attributed to the broad safety education offered upon enrollment or peer interactions (Behler, 2017). Notably, students with higher initial levels of sexuality knowledge and attitudes in the control group exhibited slower growth, reflecting the limitations of informal sexual education in China. However, in the OCSE group, growth was not constrained by the initial level. This underscores the limitations of traditional informal sexual education in China, where, once basic information such as physiological knowledge is conveyed, there is no additional source of knowledge for vocational high school students. In contrast, CSE offers more comprehensive information, with initial levels—primarily physiological knowledge accumulated in a sexually repressive culture—forming only a small part, thus not limiting the positive growth in sexuality knowledge and attitude.

Secondly, OCSE mitigated the disadvantages of sexuality education faced by students in impoverished areas. Despite having lower initial levels of sexuality knowledge and attitudes, students in these regions exhibited faster growth than their peers in more developed areas. This highlights the program's effectiveness in addressing the intersectional challenges

posed by cultural barriers, economic and educational disparities, and discrimination faced by students.

Thirdly, our findings highlight the necessity of continuous sexuality education (Goldfarb & Lieberman, 2021). While OCSE consistently surpasses traditional Chinese sexual education, its effectiveness diminishes after a two-month period, indicating a decline in impact one year later. Therefore, sustained sexuality education across various school stages is crucial for maintaining long-term benefits.

Additionally, the thorough implementation of the curriculum is critical. Students who received more sessions of sexuality education, rather than longer sessions, had higher initial levels of knowledge and attitudes. This suggests that the current Chinese sexuality education curriculum might contain a considerable amount of ineffective content. Moreover, curriculum progress significantly influences the growth rate of sexuality knowledge and attitudes. This expands the theoretical framework of CSE to its implementation phase, emphasizing that comprehensive implementation of CSE is critical. Although the importance of CSE integrity was highlighted in the early stages of the ITGSE Chinese version (UNESCO, 2018), it remains insufficient in practice today.

### *Gaps in the Translation of Knowledge and Attitudes*

Our study found higher harassment-coping self-efficacy, which is consistent with previous research (Roth et al., 2023). However, our findings are inconsistent with earlier studies, which indicated that the OCSE group had a higher frequency of penetrative sexual intercourse (Swanton et al., 2015; Bordogna et al., 2023) Additionally, general self-efficacy did not show a significant increase (Sa et al., 2021). Furthermore, compared to the results of a meta-analysis on CSE implementation in the U.S. (Bordogna et al., 2023), we found no significant between-group differences in the trajectories of STD symptom changes

(consistent), contraceptive use (opposite), or unintended pregnancy rates (opposite).

The increase in the frequency of penetrative sexual intercourse following CSE implementation may be attributed to China's past abstinence-oriented policies, which historically led to low rates of penetrative sexual intercourse. (Li et al., 2009). Therefore, it is necessary to consider the translation of sexuality knowledge and sexuality attitude into behavior and habit, with key factors including the accessibility of contraceptive tools and the sexual inclusivity of the environment (Albarracín et al., 2024). Achieving these goals is difficult in undeveloped areas in China.

According to the MAP (Albarracín, 2021), the implementation of CSE is influenced by students' ability and motivation to process information. Specifically, under conditions of high cognitive elaboration (e.g., when educational content is perceived as relevant and engaging), students are more likely to form robust beliefs and attitudes through logical pathways. Therefore, the translation from attitude to behavior may be limited by ability and motivation. Under low elaboration conditions, the impact of the intervention may depend more on emotional resonance or habit formation to drive behavioral change (Albarracín, 2021). However, in the context of sexual repression and stigmatization, students may find it difficult to experience emotional resonance. Short-term interventions without supervision or access to health resources are also unlikely to lead to habit formation. This dual-pathway approach emphasizes the importance of designing interventions that not only enhance cognitive engagement but also leverage emotional and social influences, such as peer modeling and teacher support, to amplify educational outcomes.

A deeper underlying reason, according to SCT, is that self-efficacy can directly or indirectly influence behavior (Bandura, 2011). Although harassment coping self-efficacy and school bullying perception were enhanced, they did not correlate with contraceptive use, unintended pregnancies, or symptoms of STDs. The insignificance of general self-efficacy

likely explains the weak behavioral translation. According to the Theory of Normative Social Behavior (Rimal & Lapinski, 2015; Rimal & Yilma, 2022), behaviors are driven by descriptive norms, with self-efficacy moderating the impact of these norms (Jang et al., 2013; Stout et al., 2020; Zhao et al., 2018). China's deeply rooted cultural factors, such as the obsession with academic results, the tradition of sexual repression, and the stigmatization of sexuality, form descriptive, injunctive, and collective norms (Rimal & Yilma, 2022) that influence high school students' receptiveness to the curriculum. Given that most students are over the age of 15, the social stigma surrounding sexuality hinders their full engagement in the classroom. Therefore, teacher training is crucial, as educators must present the material in a serious yet approachable manner, rather than conveying compromise or conservatism, which hinders desensitization efforts (Zhao et al., 2020).

Moreover, awareness and understanding of sexual orientation and self-identity remain limited. Baseline findings revealed confusion among some students regarding these concepts, which led to revisions in the questionnaire, including the use of same-sex behaviors as behavioral indicators. Future research should take students' levels of acceptance into account. Additionally, OCSE must be adapted to local dialects, as regional variations, such as those in Guangdong and Yunnan, pose challenges. Teacher training can help address these regional language differences. Finally, although *You and Me* follows a standardized procedure and we supervised the progress, OCSE was still not fully implemented in schools, particularly in underdeveloped areas. The absence of sessions significantly impacted its effectiveness. This highlights the necessity for continuous and institutionalized CSE. Strong supervision alone cannot ensure the comprehensive implementation of the curriculum; legal frameworks and policy support are essential (Albarracín et al., 2024).

## Limitations

Several limitations need to be acknowledged. First, due to variations in school size, ranging from approximately 400 to 18,000 students, the two groups were not equal. Second, questionnaire-based self-report data may be influenced by social desirability bias. Given that the outcomes of CSE involve a combination of true/false questions for knowledge and Likert-scale items for attitudes, the diverse item formats and multidimensional nature of the scales make psychometric validation challenging. More comprehensive and valid assessments are needed in the future. Third, the three measurements constrain the interpretability of the model. Future longitudinal studies, including intensive longitudinal research, are essential for more granularly demonstrating the translation of CSE into knowledge, attitudes, intentions, behavior, and maintenance.

## Conclusions

The findings of this cluster randomized trial revealed that the CSE in China's vocational high schools is insufficient. The *You and Me* OCSE proved to be a feasible solution, leading to faster increase in sexuality knowledge and sexuality attitude, especially in undeveloped areas both post-intervention and 12 months later. Curriculum progress significantly impacted the growth of sexuality knowledge and attitude. However, *You and Me* is insufficient to alter sexual behaviors. Vocational high school students' behavioral outcomes and well-being did not produce consistent positive results. Therefore, vocational high school students require Long-term, comprehensive, and accurate support. This should include the provision of more sustained and thorough CSE, as well as establishing accessible contraceptive tools and healthcare channels.

## Consent for publication

Not applicable

## Availability of data and materials

De-identified individual participant data that underlie our study's results will be openly available for three years post-publication. Data is available to anyone upon a reasonable request.

## Competing of interests

The authors report that there are no competing interests to declare.

## Funding/Support:

This study was funded by the Kadoorie Charitable Foundation.

## Role of the Funder/Sponsor:

The funders had no role in the study design and conduct; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication. All authors had full access to the data and had final responsibility for the decision to submit for publication.

## List of abbreviations

OCSE: online comprehensive sexuality education package

CSE: comprehensive sexuality education

RCT: randomized controlled trial

GDP: Gross Domestic Product

ITGSE: International Technical Guidance on sexuality education

FPA: Family Planning Association

HHIPSS: Hygiene Institute for Primary and Secondary Schools in Zhongshan

SK: Sexuality knowledge

SA: Sexuality attitude

**Reference**

Albarracín, D. (2021). Definitions, Overview, Goals, and Principles of Cognitive Processing. In D. Albarracín (Ed.), *Action and Inaction in a Social World: Predicting and Changing Attitudes and Behavior* (pp. 3-42). Cambridge University Press. https://doi.org/DOI: 10.1017/9781108878357.002

Albarracín, D., Fayaz-Farkhad, B., & Granados Samayoa, J. A. (2024). Determinants of behaviour and their efficacy as targets of behavioural change interventions. *Nature Reviews Psychology*, *3*(6), 377-392. https://doi.org/10.1038/s44159-024-00305-0

Bandura, A. (2011). On the Functional Properties of Perceived Self-Efficacy Revisited. *Journal of Management*, *38*(1), 9-44. https://doi.org/10.1177/0149206311410606

Behler, R. L. (2017). You can't always get what you want: Network determinants of relationship inactualization in adolescence. *Social Science Research*, *61*, 181-194. https://doi.org/https://doi.org/10.1016/j.ssresearch.2016.06.012

Bordogna, A. L., Coyle, A. C., Nallamothu, R., Manko, A. L., & Yen, R. W. (2023). Comprehensive Sexuality Education to Reduce Pregnancy and STIs in Adolescents in the United States: A Systematic Review and Meta-Analysis. *American Journal of Sexuality Education*, *18*(1), 39-83. https://doi.org/10.1080/15546128.2022.2080140

Chen, L. (2022). Problematic Pornography Use in China. *Current Addiction Reports*, *9*(2), 80-85. https://doi.org/10.1007/s40429-022-00408-9

Cheong, J., MacKinnon, D. P., & Khoo, S. T. (2003). Investigation of Mediational Processes Using Parallel Process Latent Growth Curve Modeling. *Structural Equation Modeling: A Multidisciplinary Journal*, *10*(2), 238-262. https://doi.org/10.1207/S15328007SEM1002_5

Cheung, G. W., & Lau, R. S. (2017). Accuracy of Parameter Estimates and Confidence Intervals in Moderated Mediation Models:A Comparison of Regression and Latent

Moderated Structural Equations. *Organizational Research Methods*, *20*(4), 746-769. https://doi.org/10.1177/1094428115595869

Chi, X., Hawk, S. T., Winter, S., & Meeus, W. (2015). The Effect of Comprehensive Sexual Education Program on Sexual Health Knowledge and Sexual Attitude Among College Students in Southwest China. *Asia-Pacific Journal of Public Health*, *27*(2), NP2049-NP2066. https://doi.org/doi: 10.1177/1010539513475655

Fang, Y., Zheng, Y., Jin, Y., Yu, C., Zuo, X., Lian, Q., Lou, C., Li, L., Hong, P., & Tu, X. (2022). Sexual-Related Knowledge, School and Family Sexuality Education and Its Association with Experience of Sexual Intercourse among Vocational Secondary School Students in China. *Children*, *9*(8), 1206. https://www.mdpi.com/2227-9067/9/8/1206

Fei, G., Lihan, L., & Yingfei, S. (2022, 2022/07/11). Perceiving Sexual Harassment in Chinese Higher Education. Proceedings of the 2022 3rd International Conference on Mental Health, Education and Human Development (MHEHD 2022)

Ferrand, L. (2023). Reforming the sexual health education curriculum. *The Lancet Child & Adolescent Health*. https://doi.org/10.1016/S2352-4642(23)00233-X

Goldfarb, E. S., & Lieberman, L. D. (2021). Three Decades of Research: The Case for Comprehensive Sex Education. *Journal of Adolescent Health*, *68*(1), 13-27. https://doi.org/https://doi.org/10.1016/j.jadohealth.2020.07.036

Guse, K., Levine, D., Martins, S., Lira, A., Gaarde, J., Westmorland, W., & Gilliam, M. (2012). Interventions Using New Digital Media to Improve Adolescent Sexual Health: A Systematic Review. *Journal of Adolescent Health*, *51*(6), 535-543. https://doi.org/10.1016/j.jadohealth.2012.03.014

Han, Z., Zhang, G., & Zhang, H. (2017). School Bullying in Urban China: Prevalence and Correlation with School Climate. *International journal of environmental research and public health*, *14*(10).

Herat, J., Plesons, M., Castle, C., Babb, J., & Chandra-Mouli, V. (2018). The revised international technical guidance on sexuality education - a powerful tool at an important crossroads for sexuality education. *Reproductive Health*, *15*(1), 185. https://doi.org/10.1186/s12978-018-0629-x

Ho, P. S. Y., Jackson, S., Cao, S., & Kwok, C. (2018). Sex With Chinese Characteristics: Sexuality Research in/on 21st-Century China. *The Journal of Sex Research*, *55*(4-5), 486-521. https://doi.org/10.1080/00224499.2018.1437593

Huang, D. Y. C., Murphy, D. A., & Hser, Y.-I. (2011). Developmental Trajectory of Sexual Risk Behaviors From Adolescence to Young Adulthood. *Youth & Society*, *44*(4), 479-499. https://doi.org/10.1177/0044118X11406747

Jang, S. A., Rimal, R. N., & Cho, N. (2013). Normative Influences and Alcohol Consumption: The Role of Drinking Refusal Self-Efficacy. *Health Communication*, *28*(5), 443-451. https://doi.org/10.1080/10410236.2012.691455

Ji, Y., Xu, H., Zhang, Y., & Liu, Q. (2018). Heterogeneity of adolescent health risk behaviors in rural western China: A latent class analysis. *PloS one*, *13*(6), e0199286. https://doi.org/10.1371/journal.pone.0199286

Ji, Y., & Reiss, M. J. (2022). Cherish Lives? Progress and compromise in sexuality education textbooks produced in contemporary China. *Sex Education*, *22*(4), 496-519. https://doi.org/10.1080/14681811.2021.1955670

Jiang, W., & Ha, L. (2020). Smartphones or computers for online sex education? A contraception information seeking model for Chinese college students. *Sex Education*, *20*(4), 457-476. https://doi.org/10.1080/14681811.2019.1672041

Jin, Z., Guo, F., Wang, K., Zhang, H., Cao, W., Hee, J., Yuan, Y., Chen, M., & Tang, K. (2021). Effects of an Internet-Based and Teacher-Facilitated Sexuality Education Package: A Cluster-Randomized Trial. *Children*, *8*(10), 885. https://www.mdpi.com/2227-9067/8/10/885

Kaidbey, M., Zhen, S., Wong, S., Navchaa, S., & Junjian, G. (2023). The Effectiveness of Delivering Comprehensive Sexuality Education Through Live Streaming to Schools in Western China. *American Journal of Sexuality Education*, *18*(1), 115-148. https://doi.org/10.1080/15546128.2022.2064952

Kuder, G. F., & Richardson, M. W. (1937). The theory of the estimation of test reliability. *Psychometrika*, *2*(3), 151-160.

Li, L., King, M. E., & Winter, S. (2009). Sexuality education in China: the conflict between reality and ideology. *Asia Pacific Journal of Education*, *29*(4), 469-480. https://doi.org/10.1080/02188790903309066

Liang, M., Simelane, S., Fortuny Fillo, G., Chalasani, S., Weny, K., Salazar Canelos, P., Jenkins, L., Moller, A.-B., Chandra-Mouli, V., Say, L., Michielsen, K., Engel, D. M. C., & Snow, R. (2019). The State of Adolescent Sexual and Reproductive Health. *Journal of Adolescent Health*, *65*(6, Supplement), S3-S15. https://doi.org/https://doi.org/10.1016/j.jadohealth.2019.09.015

Liang, J. Y., Tan, S., & O'Halloran, K. (2017). Representing sexuality and morality in sex education picture books in contemporary China. *Social Semiotics*, *27*(1), 107-126. https://doi.org/10.1080/10350330.2016.1161117

Ling, M. (2015). "Bad Students Go to Vocational Schools!": Education, Social Reproduction and Migrant Youth in Urban China. *The China Journal*, *73*, 108-131. https://doi.org/10.1086/679271

Liu, C. (2022). Secondary Education and Class Stratification: Understanding the Hierarchy of Sexuality Education in a Chinese Vocational High School. *Children*, *9*(10), 1524. https://www.mdpi.com/2227-9067/9/10/1524

Liu, J., Cheng, M., Wei, X., & Yu, N. N. (2020). The Internet-driven sexual revolution in China. *Technological Forecasting and Social Change*, *153*, 119911. https://doi.org/https://doi.org/10.1016/j.techfore.2020.119911

Liu, W., Van Campen, K. S., Edwards, C. P., & Russell, S. T. (2011). Chinese Parents' Perspectives on Adolescent Sexuality Education. *International Journal of Sexual Health*, *23*(3), 224-236. https://doi.org/10.1080/19317611.2011.596256

Lou, C.-h., Zhao, Q., Gao, E.-S., & Shah, I. H. (2006). Can the Internet Be Used Effectively to Provide Sex Education to Young People in China? *Journal of Adolescent Health*, *39*(5), 720-728. https://doi.org/https://doi.org/10.1016/j.jadohealth.2006.04.003

Lyu, J., Shen, X., & Hesketh, T. (2020). Sexual Knowledge, Attitudes and Behaviours among Undergraduate Students in China—Implications for Sex Education. *International journal of environmental research and public health*, *17*(18), 6716. https://www.mdpi.com/1660-4601/17/18/6716

Manlove, J., Welti, K., Whitfield, B., Faccio, B., Finocharo, J., & Ciaravino, S. (2021). Impacts of Re:MIX—A School-Based Teen Pregnancy Prevention Program Incorporating Young Parent Coeducators. *Journal of School Health*, *91*(11), 915-927. https://doi.org/https://doi.org/10.1111/josh.13078

Ministry of Education, P. s. R. o. C. (2023). *The report on the development of vocational education in China (2012-2022)*. https://www.csdp.edu.cn/article/8940.html

Money, W. H., & Dean, B. P. (2019). Incorporating student population differences for effective online education: A content-based review and integrative model. *Computers*

*& Education*, *138*, 57-82. https://doi.org/https://doi.org/10.1016/j.compedu.2019.03.013

National Bureau of Statistics. (2024). *National data*. Retrieved September 8, 2024, from https://data.stats.gov.cn/easyquery.htm?cn=E0103

Nie S, Li H, Xu Y, Ma W, & Xu H. (2007). Analysis on sex-related behaviours of senior high school and professional technical school students in cities of Guangdong province. *China Preventive Medicine (in Chinese)* (05), 581-584. https://kns.cnki.net/kcms2/article/abstract?v=yXT3uqWUX__OlCejjiufDye7tTZJoXUWBCfZ7KDWpRp260vUMDaPPiI4lBiqrghMVYZa4zP3OGdl60P9eNGV-r2pPAdKbCQQPtHtuZQ8p-AWfW1Qncv0H48V0kUK2Q-onqhvllp8DSE=&uniplatform=NZKPT&language=CHS

NHS. (2018). *Sexually transmitted infections (STIs)*. Nhs.Uk. https://www.nhs.uk/conditions/sexually-transmitted-infections-stis/

Nurgitz, R., Pacheco, R. A., Senn, C. Y., & Hobden, K. L. (2021). The impact of sexual education and socialization on sexual satisfaction, attitudes, and self-efficacy. *The Canadian Journal of Human Sexuality*, *30*(2), 265-277. https://doi.org/10.3138/cjhs.2021-0028

Pinandari, A. W., Kågesten, A. E., Li, M., Moreau, C., van Reeuwijk, M., & Wilopo, S. A. (2023). Short-Term Effects of a School-Based Comprehensive Sexuality Education Intervention Among Very Young Adolescents in Three Urban Indonesian Settings: A Quasi-Experimental Study. *Journal of Adolescent Health*, *73*(1), S21-S32. https://doi.org/10.1016/j.jadohealth.2023.01.030

Centers for Disease Control and Prevention (2003). *Questionnaire design reproductive health Epidemiology series module 4*. chrome-extension://cdonnmffkdaoajfknoeeecmchibpmkmg/assets/pdf/web/viewer.html?file=h

ttps%3A%2F%2Frepository.dinus.ac.id%2Fdocs%2Fajar%2FEpi_Module_04_Questionnaire_Design.pdf

Ramírez-Villalobos, D., Monterubio-Flores, E. A., Gonzalez-Vazquez, T. T., Molina-Rodríguez, J. F., Ruelas-González, M. G., & Alcalde-Rabanal, J. E. (2021). Delaying sexual onset: outcome of a comprehensive sexuality education initiative for adolescents in public schools. *BMC Public Health*, *21*(1), 1439. https://doi.org/10.1186/s12889-021-11388-2

Rimal, R. N., & Lapinski, M. K. (2015). A Re-Explication of Social Norms, Ten Years Later. *Communication theory*, *25*(4), 393-409. https://doi.org/10.1111/comt.12080

Rimal, R. N., & Yilma, H. (2022). Descriptive, Injunctive, and Collective Norms: An Expansion of the Theory of Normative Social Behavior (TNSB). *Health Communication*, *37*(13), 1573-1580. https://doi.org/10.1080/10410236.2021.1902108

Rossi, E., Poulin, F., & Boislard, M.-A. (2017). Trajectories of Annual Number of Sexual Partners from Adolescence to Emerging Adulthood: Individual and Family Predictors. *Journal of Youth and Adolescence*, *46*(5), 995-1008. https://doi.org/10.1007/s10964-016-0571-6

Roth, D., Nellhaus, E., Ruley, M., Hess, A., Lamichhane, R., & Yoost, J. (2023). A virtual sex education tool improved reproductive health knowledge among adolescent girls. *Sex Education*, 1-11. https://doi.org/10.1080/14681811.2023.2203909

Sa, Z., Tian, L., & Wang, X. (2021). Evidence for a Comprehensive Sexuality Education Intervention that Enhances Chinese Adolescents' Sexual Knowledge and Gender Awareness and Empowers Young Women. *Sex Roles*, *85*(5), 357-370. https://doi.org/10.1007/s11199-021-01223-8

Schulte, B. (2013). Unwelcome stranger to the system: vocational education in early twentieth-century China. *Comparative Education*, *49*(2), 226-241. https://doi.org/10.1080/03050068.2012.713581

Schwarzer, R., & Jerusalem, M. (1995). Generalized Self-Efficacy scale. In J. Weinman, S. Wright, & M. Johnston, *Measures in health psychology: A user's portfolio. Causal and control beliefs* (pp. 35-37). Windsor, UK: NFER-NELSON.

Song, Y., & Ji, C.-Y. (2010). Sexual intercourse and high-risk sexual behaviours among a national sample of urban adolescents in China. *Journal of Public Health*, *32*(3), 312-321. https://doi.org/10.1093/pubmed/fdp123

Song S, Zhang Y, Zhou Y, Liu Y, & Xu S. (2006). Comparison on sex knowledge, attitude, behaviour, and demand between common high school students and occupational high school students. *Maternal and Child Health Care of China (in Chinese),* (04), 507-509.

Steinberg, D. B., Simon, V. A., Victor, B. G., Kernsmith, P. D., & Smith-Darden, J. P. (2019). Onset Trajectories of Sexting and Other Sexual Behaviors Across High School: A Longitudinal Growth Mixture Modeling Approach. *Archives of Sexual Behavior*, *48*(8), 2321-2331. https://doi.org/10.1007/s10508-019-1414-9

Stout, M. E., Christy, S. M., Winger, J. G., Vadaparampil, S. T., & Mosher, C. E. (2020). Self-efficacy and HPV Vaccine Attitudes Mediate the Relationship Between Social Norms and Intentions to Receive the HPV Vaccine Among College Students. *J Community Health*, *45*(6), 1187-1195. https://doi.org/10.1007/s10900-020-00837-5

Strauss Swanson, C., & Szymanski, D. M. (2022). Sexual Violence and Psychological Distress: The Roles of Coping Self-Efficacy, Self-Blame, Shame, Activism, and Feminism. *Sex Roles*, *87*(7), 419-434. https://doi.org/10.1007/s11199-022-01314-0

Swanton, R., Allom, V., & Mullan, B. (2015). A meta-analysis of the effect of new-media interventions on sexual-health behaviours. *Sexually Transmitted Infections*, *91*(1), 14-20. https://doi.org/10.1136/sextrans-2014-051743

Sun J, Ma Y, Chen H, Chen J , Song Y, Yu X, Zhang B, Si K, Ji H. (2001). The status quo of the dangerous behavior of middle school students in 5 provinces and cities in China (1) -The knowledge attitude and behavior of AIDS and sexual behavior. *Chinese school hygiene(in Chinese),* (03), 202-204. https://kns.cnki.net/kcms2/article/abstract?v=3IEynGI71r_GVdRiju0fGrmBL6tiryk8a_Lig9B_VJZSFtLxXRWUe_cObEvem6CqDxv-z2jooQW6aonj0tB-EZzoxqiBMpJKMhAsF2nOdSFMFEHKhtFAfC8HY4PEGOx5I_PWrp_f5yo=&uniplatform=NZKPT&language=CHS

Szucs, L. E., Lowry, R., Fasula, A. M., Pampati, S., Copen, C. E., Hussaini, K. S., Kachur, R. E., Koumans, E. H., & Steiner, R. J. (2020). Condom and Contraceptive Use Among Sexually Active High School Students - Youth Risk Behavior Survey, United States, 2019. *MMWR Suppl*, *69*(1), 11-18. https://doi.org/10.15585/mmwr.su6901a2

UNESCO. (2018, June 20). Chinese language edition of the revised International Technical Guideline on Sexuality Education published. *UNESCO*. Retrieved September 9, 2024, from https://www.unesco.org/en/articles/chinese-language-edition-revised-international-technical-guideline-sexuality-education-published

UNESCO, UNAIDS, UNFPA, UNICEF, UN Women and WHO. (2018, July 18). *International technical guidance on sexuality education*. UNFPA China. https://china.unfpa.org/en/publications/international-technical-guidance-sexuality-education-0

Vamos, C. A., Thompson, E. L., Logan, R. G., Griner, S. B., Perrin, K. M., Merrell, L. K., & Daley, E. M. (2020). Exploring college students' sexual and reproductive health

literacy. *Journal of American College Health*, *68*(1), 79-88. https://doi.org/10.1080/07448481.2018.1515757

Wadham, E., Green, C., Debattista, J., Somerset, S., & Sav, A. (2019). New digital media interventions for sexual health promotion among young people: a systematic review. *Sexual Health*, *16*(2), 101-123. https://doi.org/https://doi.org/10.1071/SH18127

Wang, A., & Guo, D. (2019). Technical and vocational education in China: enrolment and socioeconomic status. *Journal of Vocational Education & Training*, *71*(4), 538-555. https://doi.org/10.1080/13636820.2018.1535519

Wang J, Yang X, & Liu Y. (2009). Investigation on AIDS knowledge, attitude and behaviour of high school students in Xinjiang Uygur autonomous. *Chinese Journal of Health Education (in Chinese)*, 25(05), 372-374.

Warner, L. M., & Schwarzer, R. (2025). Self-Efficacy and Health. In P. Liamputtong (Ed.), *Handbook of Concepts in Health, Health Behavior and Environmental Health* (pp. 1-26). Springer Nature Singapore. https://doi.org/10.1007/978-981-97-0821-5_15-1

World Health Organization: WHO. (2020, June 4). Sexually transmitted infections (STIs). *World Health Organization: WHO*. https://www.who.int/health-topics/sexually-transmitted-infections#tab=tab_2

Widman, L., Nesi, J., Kamke, K., Choukas-Bradley, S., & Stewart, J. L. (2018). Technology-Based Interventions to Reduce Sexually Transmitted Infections and Unintended Pregnancy Among Youth. *Journal of Adolescent Health*, *62*(6), 651-660. https://doi.org/https://doi.org/10.1016/j.jadohealth.2018.02.007

Xiong, Z., Warwick, I., & Chalies, S. (2020). Understanding novice teachers' perspectives on China's sexuality education: a study based on the national pre-service teacher education programme. *Sex Education*, *20*(3), 252-266. https://doi.org/10.1080/14681811.2019.1640113

Xu, S., Ren, J., Li, F., Wang, L., & Wang, S. (2020). School Bullying Among Vocational School Students in China: Prevalence and Associations With Personal, Relational, and School Factors. *Journal of Interpersonal Violence*, *37*(1-2), NP104-NP124. https://doi.org/10.1177/0886260520907360

Yu, J. (2012). Teenage sexual attitudes and behaviour in China: a literature review. *Health & Social Care in the Community*, *20*(6), 561-582. https://doi.org/https://doi.org/10.1111/j.1365-2524.2011.01054.x

Zeng, G., Fung, S.-f., Li, J., Hussain, N., & Yu, P. (2022). Evaluating the psychometric properties and factor structure of the general self-efficacy scale in China. *Current Psychology*, *41*(6), 3970-3980. https://doi.org/10.1007/s12144-020-00924-9

Zeng, L. (2024). An Analysis of Diploma Discrimination in Chinese Higher Vocational Education within the Context of a Knowledge-Based. *Transactions on Social Science, Education and Humanities Research*, *5*, 169-176. https://doi.org/10.62051/1wyfyy88

Zhang, J., Ma, B., Han, X., Ding, S., & Li, Y. (2022). Global, regional, and national burdens of HIV and other sexually transmitted infections in adolescents and young adults aged 10–24 years from 1990 to 2019: a trend analysis based on the Global Burden of Disease Study 2019. *The Lancet Child & Adolescent Health*, *6*(11), 763-776. https://doi.org/10.1016/S2352-4642(22)00219-X

Zhao, P., Liu, L., Zhang, Y., Cheng, H., Cao, B., Liu, C., Wang, C., Yang, B., Wei, C., Tucker, J. D., & Tang, W. (2018). The interaction between HIV testing social norms and self-efficacy on HIV testing among Chinese men who have sex with men: results from an online cross-sectional study. *BMC Infect Dis*, *18*(1), 541. https://doi.org/10.1186/s12879-018-3454-5

Zhao, P., Yang, L., Sa, Z., & Wang, X. (2020). Propriety, empowerment and compromise: challenges in addressing gender among sex educators in China. *Sex Education*, *20*(5), 552-567. https://doi.org/10.1080/14681811.2019.1705779

Zhu, F., Zhu, G., Jia, B., Wang, P., Zhao, T., Ma, Y., & Dong, B. (2022). The Influencing Factors of Comprehensive Sexuality Education Capacity and Its Correlation with Subjective Social Status among Chinese Junior High School Students. *Children*, *9*(8).

Zou, S., Cao, W., Jia, Y., Wang, Z., Qi, X., Shen, J., & Tang, K. (2022). Sexual and reproductive health and attitudes towards sex of young adults in China. *BMJ Sexual & Reproductive Health*, *48*(e1), e13-e21. https://doi.org/10.1136/bmjsrh-2020-200766

Zou, W., Zhang, X., & He, J. (2023). Making Sense of Jiese: An Interview Study of Members from a Porn-Free Self-Help Forum in China. *Archives of Sexual Behavior*, *52*(1), 385-397. https://doi.org/10.1007/s10508-022-02456-8

Zou, Z., Dong, Y., Song, Y., & Ma, J. (2023). Strengthening sexual and reproductive health education for children and adolescents in China. *The Lancet Child & Adolescent Health*, *7*(9), 603-605. https://doi.org/https://doi.org/10.1016/S2352-4642(23)00138-4

# Feasibility and Impact of School-Based Online Comprehensive Sexuality Education on Vocational High School Students: A Cluster-Randomized Controlled Trial

To assess the effect of an online comprehensive sexuality education (CSE) package for vocational high school students in China's developed and less-developed regions, a parallel, unblinded, cluster, randomized controlled trial was conducted. The study included 3,415 tenth-grade students from 29 mixed-gender vocational high schools who had not previously received CSE. The intervention group participated in weekly classes over two months, totaling 360 minutes of online CSE. For the primary outcomes, the intervention group exhibited improvements in sexuality knowledge and attitude post-intervention and one year later. However, after one year, the positive effects are less than post-intervention. In addition, the intervention group's growth rate of sexuality knowledge and attitude is not limited by the initial baseline level. In the secondary outcomes, compared with the control group, the online CSE resulted in a higher frequency of penetrative sexual events~~intercourse~~, harassment coping self-efficacy in both post-intervention and one year later, and school bully perception only in post-intervention. No significant between-group differences were observed in the trajectory of STD symptom changes, contraceptive usage, unintended pregnancy rates, or self-efficacy~~There were no significant between-group differences in the growth of STD symptoms, contraceptive usage, unintended pregnancy, and self-efficacy~~. Finally, curriculum progress positively impacts the slope of sexuality knowledge and attitude. Results suggest that more sustained CSE is necessary for vocational high school students in China. Online CSE presents a feasible solution to enhance sexuality knowledge and attitude and bridge the gap in developmental and sexuality education levels. However, behaviors and well-being outcomes did not yield consistent positive results.

## Introduction

Significant gaps and inadequacies have long marked China's ~~sex education~~sexual education. Despite growing public awareness of sexual health issues in recent years, the nationwide implementation of comprehensive sexuality education (CSE) remains challenging and

inconsistent (Z. Zou et al., 2023).

Firstly, there is a shortage of qualified sexuality education teachers in China, many of whom hold traditional, conservative views on sexuality or face external pressures that influence their teaching (Zhao et al., 2020). Furthermore, pre-service teacher education programs in China tend to focus on knowledge while often neglecting practical teaching skills (Xiong et al., 2020). Schools also lack standardized teaching materials and guidelines (Ji & Reiss, 2022), leading to superficial courses primarily focusing on physiology. The psychosexual and sociosexual aspects are often downplayed to align with biosexual norms that reflect traditional cultural values (Liang et al., 2017). In many cases, sexuality education is merged with physiology courses taught by untrained teachers (Liu, 2022; Z. Zou et al., 2023).

Moreover, traditional Chinese culture, deeply influenced by puritanical Confucian norms (Ho et al., 2018; Li et al., 2009), further contributes to unclear standards for sexuality education. Teachers may discourage any form of sexual contact, warning students that it leads to moral corruption (Liu, 2022) and in some cases, even promote sexual abstinence (W. Zou et al., 2023). This lack of comprehensive education fails to adequately prepare adolescents to understand sexual health and rights or to navigate the complexities of adolescence. These culturally and contextually relevant factors have led to the situation where traditional sexual education in China is unstandardized, scattered, lacking a systematic approach, unclear in its effectiveness, undervalued, even stigmatized, and accompanied by the risk of misinformation.

Adolescence is a critical period associated with increased risks of problematic behaviors such as pornography use (Chen, 2022), sexting (Steinberg et al., 2019), condomless sex (Szucs et al., 2020), and multiple sexual partners (Huang et al., 2011; Rossi et al., 2017).

A study conducted in China, including 109,754 students from 18 provinces in grades 10 to 12, found that 4.8% of adolescents reported having had penetrative sexual events~~sexual intercourse~~, with 32.8% of them experiencing forced sex (Song & Ji, 2010).

Notably, the prevalence of penetrative sexual events~~sexual intercourse~~ among vocational school students was twice as high compared to students in regular and elite high schools[1] (Song & Ji, 2010). Similar trends were reported in Beijing (10.4% for vocational vs. 4% for regular) (Song et al., 2006), Guangdong (10.1% for vocational vs. 4.8% for regular vs. 3.1% for elite) (Nie et al., 2007), and Xinjiang (8.7% for vocational vs. 3.0% for regular vs. 4.2% for elite) (Wang et al., 2009).

### *Challenges Faced by Vocational High School Students*

Vocational school students lack sexuality knowledge and exhibit negative attitudes toward sexuality (Yu, 2012), which increases their risk of sexually transmitted diseases (Liang et al., 2019; Zhang et al., 2022). However, institutional discrimination and stratification within China's education system pose challenges to promoting CSE in vocational high schools (Fang et al., 2022; Liu, 2022).

Vocational high schools in China have long been marginalized and face systematic discrimination (Schulte, 2013; Zeng, 2024). Students often come from disadvantaged socioeconomic backgrounds, and parents may lack the resources or knowledge to provide adequate ~~sex education~~sexual education (Liu et al., 2011; Wang & Guo, 2019). Additionally, these schools have fewer resources than regular schools, leading to a more severe shortage of

[1] Vocational high schools focus on vocational training, with students typically having weaker academic backgrounds. Regular high schools offer a more balanced academic curriculum, while key high schools cater to academic elites. These three types of schools differ significantly in terms of social perception, resource allocation, and student development opportunities.

qualified teachers. Vocational students are affected by both educational resource deficiencies and social discrimination, creating more significant barriers to acquiring sexual health knowledge and developing healthy sexual attitudes.

Moreover, institutional discrimination labels vocational high school students as "low-quality" and "cheap labor" within society (Ling, 2015). As a result, many schools and educational institutions neglect the necessity of providing these students with comprehensive and systematic sexuality education. This institutionalized disregard further exacerbates the lack of sexual education among vocational high school students, leaving them even more vulnerable.

Additionally, bullying is rampant in Chinese vocational high schools. A study involving 95,873 students from 85 vocational schools found that 30.4% reported being bullied, 2.9% admitted to bullying others, and 21.7% experienced both (Xu et al., 2020). Another study across 28 schools in seven provinces showed that bullying incidents in vocational schools were 1.19 times higher than in regular schools, with low academic performance worsening the bullying problem (Han et al., 2017). Due to the lack of ~~sex education~~sexual education, many students are unable to recognize behaviors like sexual harassment or discrimination, often dismissing them as jokes. The silence of victims, inadequate school management, and weak legislation have normalized such behaviors (Fei et al., 2022).

These factors marginalize sexuality education in vocational high school curriculums, resulting in students' low interest in learning about sexuality knowledge and poor classroom participation (Liu, 2022). This issue is especially pronounced among lower socioeconomic status groups (Zou et al., 2022) and adolescents in rural areas of western China (Ji et al., 2018; Yu, 2012). Despite the existence of 7,294 vocational high schools in China, with an enrollment of 13.12 million students—representing 33.49% of secondary education students

(Ministry of Education, 2023)—this group is often overlooked. Therefore, the primary aim of this study is to focus on vocational high school students by implementing comprehensive sexuality education.

***Model of Attitudes and Behavioral Practices and Social Cognitive Theory***

This study adopts the Model of Attitudes and Behavioral Practices (MAP) as the theoretical foundation (Albarracín, 2021). The MAP highlights the critical role of external messages (e.g., CSE educational content), and prior experience (e.g., previous sexual education experiences) in shaping knowledge, attitude, and behavior.

In the MAP, knowledge serves as the cognitive foundation of behavior, forming beliefs that directly shape attitudes and, subsequently, behavioral intentions and actions. The CSE acts as pivotal message arguments, enhancing students' cognitive awareness and understanding of behavioral consequences. This process promotes positive attitudes, which, in turn, enhance behavioral intentions and behavior. Notably, the MAP suggests reciprocal relationships between these variables: while knowledge[2] guide attitudes, the reinforcement of attitudes can, in turn, influence knowledge, thereby sustaining and deepening the impact of educational interventions over time. This insight guided our view of the relationship between attitude and knowledge as correlational rather than causal.

Moreover, this study is grounded in Social Cognitive Theory (SCT), which posits that human behavior is shaped by the dynamic interplay of personal, behavioral, and environmental factors. SCT emphasizes the importance of self-efficacy—an individual's belief in their ability to successfully perform a behavior—as a central driver of motivation

[2] In the literature, the term "belief" is commonly used; however, as noted in Chapter 2, "Beliefs" (p. 45), the distinction between belief and knowledge can be ambiguous.

and behavior change (Warner & Schwarzer, 2025). According to Bandura's theory, efficacy beliefs can be enhanced through verbal persuasion, and higher levels of self-efficacy increase an individual's persistence and resilience in the face of challenges, facilitating lasting behavior change (Bandura, 2011; Warner & Schwarzer, 2025). In the context of CSE, enhancing students' general self-efficacy, particularly in coping sexual harassment situations, is crucial to empowering them to act in alignment with the knowledge and attitudes acquired through the education.

***Comprehensive sexuality education and Internet-based medium***

CSE is a curriculum-based theoretical framework to equip adolescents with sexuality knowledge, skills, and values, promoting their health, well-being, dignity, respectful relationships, mindful choices, and protecting their rights throughout their lives. (Herat et al., 2018). CSE is increasingly recognized as essential for promoting sexual health and well-being. In 2018, UNESCO and UNFPA launched the Chinese edition of the revised International Technical Guidance on Sexuality Education (ITGSE), which provides evidence-based recommendations for implementing effective CSE programs for learners aged 5 to 18+. Although voluntary, the guidance reflects international best practices and offers a framework adaptable to various national contexts for implementing sexuality education (UNESCO, 2018).

In China, CSE has led to improved knowledge and more positive attitudes toward sexual minorities among college students (Chi et al., 2015). High school students also benefit from CSE, gaining more accurate sexual knowledge, stronger support for nontraditional gender roles, and a greater rejection of sexual double standards immediately after the intervention (Chi et al., 2015; Sa et al., 2021). Additionally, middle school students demonstrate enhanced sexual knowledge, skills, positive attitudes, and self-efficacy following

CSE (Jin et al., 2021; Kaidbey et al., 2023; Zhu et al., 2022). However, all these studies focus on the immediate effects of the intervention. Even international studies typically assess post-intervention effects after 3 or 9 months (Manlove et al., 2021; Pinandari et al., 2023), leaving the long-term impact of CSE unclear.

The computer and internet-based approach has become the primary channel through which students acquire sexual knowledge (Jiang & Ha, 2020; Vamos et al., 2020; Yu, 2012). The inherent transparency and openness of this medium challenge China's sexual repression and promote a more tolerant attitude towards sex (Liu et al., 2020). Although without the framework of CSE, prior research indicates that online platforms for delivering sexual education can enhance knowledge and attitudes toward sexuality (Guse et al., 2012; Lou et al., 2006; Wadham et al., 2019), as well as influencing contraceptive usage, sexual transmission infection testing (Swanton et al., 2015; Widman et al., 2018), and various aspects of sexual self-efficacy (Nurgitz et al., 2021; Roth et al., 2023; Strauss Swanson & Szymanski, 2022). However, these findings often fail to account for adherence to school-based CSE and overlook the progress achieved through online curriculum delivery. Thus, in response to calls for reform and standardization of sexual health education courses (Ferrand, 2023), the aim of this study is to investigate the effects of standardized online school-based CSE on knowledge, attitude, behavioral and well-being outcomes.

The *You and Me* package, developed by Marie Stopes International China (MSIC)[3] based on the ITGSE (UNESCO & WHO, 2018), provides free, standardized online comprehensive sexuality education (OCSE) for adolescents. The program includes eight

[3] Marie Stopes International China (MSIC) is a non-profit organization, delivering relevant, informative, cost effective and sustainable sexual and reproductive health services and education to improve the health and well-being of youth (age 13-24).

teacher-facilitated sessions covering topics such as understanding gender, the reproductive system and puberty, pregnancy and contraception, relationships and values, media literacy and well-being skills, disease prevention and behavior, sexual violence, and love and marriage. The Xi'an Guangyuan Assistance Charity Centre, in collaboration with MSIC, was responsible for implementing the project.

As of September 2018, 21,039 students from 24 schools have participated in the *You and Me*. However, there has been a lack of quantifiable assessment of the outcomes. We aimed to address whether the *You and Me* program effectively enhances sexuality knowledge and promotes more positive sexuality attitude in the short- and long-term among vocational high school students compared to traditional sexual education (RQ1). Additionally, considering regional and sexual experience differences, we explored whether *You and Me* mitigates rather than exacerbates disparities in economic and sexual education levels across regions (RQ2). Recognizing that changes in knowledge and attitudes alone are insufficient, we further investigated whether the program leads to healthier behavioral outcomes and improved well-being (RQ3). Given the competition for curriculum time with core subjects, the incomplete provision of sexual education, and regular instances of student absenteeism, we also examined how the implementation progress of online courses affects the program's effectiveness (RQ4). To address these questions, we conducted a large-scale cluster randomized controlled trial (RCT) to evaluate the impact of online comprehensive sexuality education (OCSE) on the sexual and reproductive health and rights outcomes of tenth-grade vocational high school students immediately post-intervention and one year later. A nested study was also conducted to assess influencing factors and monitor implementation progress.

## Methods

### *Study design and Participants*

A two-arm, parallel-group cluster randomized trial was conducted in Guangdong and Yunnan provinces, China, to ~~compare~~ evaluate the effectiveness of the *You and Me OCSE* program ~~with traditional Chinese sexuality education as the control~~. In the intervention group, OCSE was provided, while the control group maintained their previous sexual education implementation plans, which were nearly non-existent. Due to regional differences and the unstructured and fragmented nature of traditional sex education across schools, we did not standardize it. Moreover, since traditional sexual education in China can sometimes be flawed or even harmful, it was not feasible to implement an equivalent duration of traditional sex education to control for time and attention effects.

The intervention was delivered between April 2019 and June 2019, focusing on the general practices of the *You and Me* education program in Zhongshan City (Guangdong Province) and Kunming City (Yunnan Province), two regions with significant economic and sexuality educational disparities. Yunnan Province exhibited a lagging attitude, inadequate education, and consistently lower knowledge levels than the national average. In 2022, Guangdong province had a population of 127 million and a GDP exceeding 12.95 trillion yuan, maintaining its position as the top-ranked province among the 34 provinces in China for 34 consecutive years, with the second-highest increment in the nation. In contrast, Yunnan lagged with a population of 47 million and a GDP of 2.86 trillion yuan, ranking 18th nationwide (National Bureau of Statistics, 2024). A survey on sexuality knowledge, attitudes, and practices conducted in five regions revealed notable disparities between Guangdong and Yunnan provinces. This includes the prevalence of sexually transmitted diseases (2.5% in Guangdong vs. 3.2% in Yunnan vs. 3.0% average), opposition to premarital sexual activity

(54.7% in Guangdong vs. 68.2% in Yunnan vs. 61.2% average), correct identification of HIV/AIDS transmission routes (74.9% in Guangdong vs. 63.5% in Yunnan vs. 73.0% average), and peer acceptance of studying in the same class with HIV/AIDS-infected individuals (36.7% in Guangdong vs. 25.1% in Yunnan vs. 29.0% average; see Sun, 2001). The trial targeted mixed-gender vocational high schools in March 2019, which were public institutions with more than 100 grade ten students. Schools that had already implemented a CSE program or had plans to do so in the upcoming year were excluded. Participants without informed consent from their guardians were also excluded from the study. A total of 29 clusters were involved, with ten vocational high schools from Guangdong province and 19 from Yunnan province (see Figure 1). The baseline survey was conducted in April 2019, followed by a post-intervention survey in June 2019. The long-term effects were measured during a follow-up in June 2020.

### *Ethical approval statement*

All study procedures adhered to the 1964 Helsinki Declaration and its later amendments or by applying comparable ethical standards. Approval was obtained from the Tsinghua University Institutional Review Board (Project No: 20,190,009), and the trial was duly registered with the Chinese Clinical Trial Registry (Registration No: ChiCTR1900021582). Written informed consents were obtained from schools and students. For students under the age of 18, written consent was provided by their legal guardians. All data were anonymized under a waiver of consent as per data sharing and ethical approval agreements.

### *Cluster Randomization and Blinding*

Randomization was at the school and class levels. School clusters were the unit of randomization. Twenty-nine schools were randomly allocated to the *You and Me* OCSE or

control groups with an equal allocation ratio after being stratified by borough. At the class level, two to four classes were randomly chosen in each selected school as the smallest unit for the intervention to be delivered.

A masked statistician (KT) generated randomization through a computerized process utilizing a random number generator and oversaw the development of the statistical analysis plan but did not conduct any analyses. Blinding is not appropriate to this study as it involves education. Throughout the trial, researchers remained unaware of cluster allocation. Statisticians conducting analyses (HC) were blinded to allocation and were only unmasked after data collection and analyses were completed. Non-site-specific study ID numbers were used on all schools and data collection forms to maintain blinding.

***Procedure***

Xi'an Guangyuan Assistance Charity Centre provided a day and a half of training to at least two teachers from each school in the intervention groups following the ITGSE guidelines. To familiarize teachers with the *You and Me* OCSE content and improve their teaching skills, video recordings of trained educators delivering each session were made available as references. The education bureaus in each city supervised the training process. At least two teachers from each school underwent the training, ensuring every class had trained teachers. Under the supervision of the Family Planning Association (FPA) in Kunming and the Health and Hygiene Institute for Primary and Secondary Schools in Zhongshan (HHIPSS), Tsinghua University Vanke School of Public Health evaluated the knowledge levels of the trained teachers through interviews based on the ITGSE framework. Teachers who did not meet the standards underwent additional half-day training until passing the assessment. Control groups had no systematic CSE program but may have been exposed to regular sexuality education.

Outcomes were evaluated by trained health researchers from Tsinghua University and Peking University under the supervision of local FPA or HHIPSS representatives. People collecting questionnaire data were independent of the intervention implementation team and masked the allocation of communes to trial groups. Data were collected in three waves: at baseline, post-intervention (after eight weeks of education), and first follow-up (12 months since post-intervention).

The baseline survey was conducted in April 2019. All students used their mobile phones to complete a self-administered baseline questionnaire, which took approximately 20 minutes. For students without mobile phones, the research team provided alternative devices. Half of the students were moved to another classroom to provide more privacy during the questionnaire completion, with approximately two desks' distance between every two students. The questionnaire domains encompassed socio-demographic information, lifestyle, family, education, and students' sexual and reproductive knowledge, attitudes, and behaviors. All questionnaire data were directly stored in the backend database.

From April 2019 to June 2019, the *You and Me* program was delivered once a week for 45 minutes each session, totaling eight sessions and 360 minutes. Each session included approximately 30 minutes of autonomous learning through computer-mediated education, supplemented by 2-3 participatory activities. These activities involved teacher-led interactive elements, such as scenario simulations for sexual harassment and condom use demonstrations. Teachers addressed questions from students and were encouraged to follow the provided manual to ensure standardized instruction. After each class, teachers were required to document the classroom dynamics and report on the session. Each school reported fixed class times, and the FPA and the HHIPSS randomly inspected the implementation of the courses.

Instances of absenteeism and non-compliance with the standard class procedures were documented and cross-referenced with students' self-reported teaching situations to assess the quality of OCSE implementation. The post-intervention follow-up was conducted in June 2019, with most schools completing the *You and Me* program. In addition to completing the basic questionnaire, students were asked about the program's progress.

Trained health researchers conducted 30-minute semi-structured interviews with teaching staff in the intervention group. Additionally, in each school of the intervention group, 5-10 students were randomly selected to participate in focus group interviews to understand the experiences and suggestions of the *You and Me* OCSE. The second follow-up was conducted in June 2020, using the same questionnaire to assess the long-term impact.

***Outcomes***

The primary outcomes were sexuality knowledge and sexuality attitude. To the best of our knowledge, there is no validated scale for assessing Chinese adolescent sexuality knowledge and sexuality attitude based on CSE. Existing scales such as The Sex Knowledge and Attitudes Test - Adolescents (SKAT-A) and Global Early Adolescent Study do not cover all CSE content. They are lengthy and do not align with the Chinese context, causing confusion among high school students during pre-testing. Therefore, we followed the guidelines in the Reproductive Health Epidemiology (Centers for Disease Control and Prevention, 2003). ITGSE was used as a reference to construct dimensions, and SRHR experts ultimately designed the sexuality knowledge and attitude scales. The scales were pre-tested~~underwent validity verification~~ in junior high school to ensure the localization (Jin et al., 2021), and based on feedback from pre-test focus group interviews of vocational high school teachers and students, six questions were added to both sexuality knowledge and attitude. The sexuality knowledge questionnaire comprised 20 true-or-false questions on the reproductive

system and puberty, pregnancy and contraception, disease and behavior, and sexual violence. Participants received one point for each correct answer. Kuder-Richardson Formula 20 = 0.7678 (Kuder & Richardson, 1937).

Sexuality attitude were assessed by a 20-item Likert scale on understanding gender, relationship and value, media literacy and well-being skills, sexual violence, love and marriage. Each item had seven response options, ranging from strongly disagree to strongly agree. The Cronbach's alpha of sexuality attitude = 0.79.

The secondary outcomes assessed were related to sexual and reproductive health and rights. Based on NHS and WHO standards, we measured explicit symptoms of sexually transmitted diseases (STDs) at baseline and one year after the intervention (NHS, 2018; WHO, 2020). The total score ranges between 1 and 4. Students were asked whether they had experienced the following symptoms in the last year: (a) itching and redness in the genital area and anal itching, soreness, or bleeding, (b) sores or warts on the genital area, (c) unusual discharge or abnormal odor from the penis or vagina, and (d) painful or frequent urination. The responses had been counted.

The frequency of penile-vaginal intercourse was measured at three points. Students were asked to report the number of times they had engaged in penetrative sexual events~~sexual intercourse~~.

Contraceptive usage was measured at baseline and one year after the intervention. Students reported the percentage of time they and their partners used condoms or short-acting birth control pills in the past year. The total score ranges between 1 (50% or less) and 4 (100%), with a higher score indicating a higher contraceptive usage ratio.

Unintended pregnancy was measured three times. Female students were asked, "How many times have you been pregnant?" Male students were asked, "How many times has your sexual partner been pregnant?"

Self-efficacy was measured three times using the general self-efficacy scale (Schwarzer & Jerusalem, 1995), validated in China (Zeng et al., 2022). The total score ranges between 10 and 40, with a higher score indicating greater self-efficacy. This scale consists of 10 items, each with four response options, ranging from not at all (1) to absolutely right (4).

Harassment coping self-efficacy was measured three times. Due to the absence of a suitable scale to measure sexual harassment coping, a custom questionnaire was developed. Students were asked to rate their confidence in coping effectively if they were to encounter forced sexual activity or sexual harassment. Responses ranged from 1 (no coping confidence) to 5 (full coping confidence).

School bullying perception was measured three times. Students reported the frequency of classmates' sexual bullying or harassment behavior on a scale from 1 (not at all) to 7 (very often). The total score ranged from 1 to 5, with higher scores indicating a greater perception of bullying.

Curriculum progress was measured in the post-intervention. The total score ranges between 0 and 8, with a higher score indicating more content has been taught. The students in the intervention group were asked which specific lessons they attended in the past two months as part of the course package. The responses had been counted.

Demographic information includes age, sex[4], ethnicity, location, and parental divorce. Sexual experiences, baseline school bully perception, and sexuality education experiences were entered as covariates to explore the better way to accomplish the series sexuality

[4]Due to cultural constraints and the fact that participants from underdeveloped regions did not fully understand concepts like gender and sexual orientation, we only measured the sex recorded on their ID cards. All instances of "sex" mentioned in the paper refer to biological sex. Same-sex behavior specifically refers to men who have sex with men or women who engage in sexual activity with women.

education. Because of the complexity of sexuality education experience, it has been measured in different ways (Table 1).

### *Sample Size and Power*

Based on previous studies in China (Chi et al., 2015; Lou et al., 2006; Lyu et al., 2020), we assumed an intraclass correlation coefficient (ICC) of 0.10, correct response rates of 50% (with a standard deviation of 20%), a detection power of 80%, and an α value of 0.05, the minimum detectable difference between population means was set at 10%. Given that there are approximately 60 students per vocational high school class, 120 students per cluster, we determined that a minimum of eight clusters would be required in each arm. We oversampled for each arm to increase statistical power and account for the possibility of schools dropping out. Based on our baseline data, we can detect a minimum difference in sexuality knowledge of 0.30 (M = 8.55, SD = 3.76, ICC = 0.06) and sexuality attitude of 0.37 (M = 94.38, SD = 12.51, ICC = 0.10).

### *Statistical Analysis*

Data analysis occurred from March 2022 to December 2023. To answer RQ1, we performed a multigroup parallel process latent growth model (PP-LGM) with freely estimated slopes (Figure 2). PP-LGM is a method for modeling repeated measures as latent variables composed of a random intercept and random slopes that can evaluate the interindividual difference and intraindividual changes over time (Cheong et al., 2003; Cheung & Lau, 2017). Intercept refers to the initial sexuality knowledge and attitude, while the slope represents the growth rate. When estimated freely, trajectories are not constrained to a linear trend, which illustrates the effect of intervention. For a theory-based intervention, PP-LGM provides an efficient way to assess and interpret the relationships of longitudinal effects for intervention

studies. Correlations between the latent factors are also included to improve model fit (Cheong et al., 2003). Multigroup is used to compare differences between two groups. Thus, the method was appropriate in this study. To answer RQ2 and RQ4, covariates are included in the PP-LGM.

The mixed effect model (MEM) uses group and time as the main effects to examine secondary outcomes to solve RQ3. A pairwise comparison with Bonferroni correction was performed to compare the differences between the intervention groups whenever a group and time interaction effect was observed. MEM was conducted using SPSS 26 and modeling analysis using Mplus 8.3. Missing data were treated with pairwise deletion for the MEM and the full information maximum likelihood method for PP-LGM. Statistical significance was defined at a 2-tailed α level of 0.05.

## Results

### *Participant Characteristics*

As shown in Table 2, the baseline sample included 3,415 students from 29 schools, aged 14 to 22, collected from March 23, 2019, to March 31, 2019. The mean age of participants was 16.10 (SD = 0.85), and 1,877 (54.96%) were male. A total of 2,889 (84.60%) adolescents completed the two-month follow-up, and 2,816 (82.46%) completed the one-year follow-up. Attrition occurred due to students being absent on the survey day, failing to remember their usernames and passwords to complete the survey online, or answering fewer than 80% of the items on any scale. There were no significant differences between students who only participated at baseline and those who completed at least one follow-up assessment in either the intervention or control groups on any of the outcome measures (sexuality knowledge: $F$ (3,413) = 0.053, $p$ = 0.261; sexuality attitude: $F$ (3,413) = 0.391, $p$ = 0.514).

At baseline, the average score for sexuality knowledge was 8.55 (*SD* = 3.76), with 60.26% of individuals scoring below 10 points. The average score for sexuality attitude was 94.38 (*SD* = 12.51). Regarding sexual experiences, 68.46% of the students reported being in love, but only 13.01% had experienced penetrative sexual events~~sexual intercourse~~. Additionally, 19.57% of students reported encountering sexual harassment. Only 51.70% of the adolescents reported receiving sexuality education, with an average duration of 2.50 (*SD* = 1.74) lessons, totaling approximately 112.50 minutes, and covering an average of 5.14 (*SD* = 2.34) topics. Less than one-third of the students had ever received education on abortion, pregnancy and contraception, sexual behaviors, sexual violence, and love and marriage. Notably, 32.83% of students (1,121) had received sexuality education during only one stage of their schooling.

***Primary Outcome***

Trajectory analyses showed an excellent model fit for PP-LGM (Appendix Table 1). In response to RQ1, the intervention group exhibited distinct and steeper growth trajectories compared to the control group (sexuality knowledge unstandardized coefficient, control group: $b = 0.27$ [95% CI, 0.12 to 0.41], $p < 0.001$ vs intervention group: $b = 4.19$ [95% CI, 4.00 to 4.37], $p < 0.001$; sexuality attitude, control group: $b = 1.27$ [95% CI, 0.75 to 1.78], $p < 0.001$ vs intervention group: $b = 6.09$ [95% CI, 5.55 to 6.63], $p < 0.001$). Both groups exhibited individual differences at the baseline level and growth of sexuality knowledge and sexuality attitude (Appendix Table 1). Furthermore, the intervention group's sexuality knowledge and sexuality attitude remained higher than those of the control group even after one year (sexuality knowledge short-term difference: 3.97 [95% CI, 3.69 to 4.25], $p < 0.001$; long-term difference: 2.23 [95% CI, 1.93 to 2.53], $p < 0.001$; sexuality attitude short-term difference: 4.06 [95% CI, 3.07 to 5.04], $p < 0.001$; long-term difference: 1.61 [95% CI, 0.53

to 2.69], $p = 0.003$). However, compared to two months after the intervention, both sexuality knowledge and sexuality attitude decreased (Table 3).

Interrelationships between slopes and intercepts of sexuality knowledge and sexuality attitude are described in Table 4. Positive correlations were found between the growth rate of sexuality knowledge and sexuality attitude in both the control group ($r = 0.58$, $p < 0.001$) and the intervention group ($r = 0.74$, $p < 0.001$). Notably, in the intervention group, a higher initial level of sexuality knowledge was associated with a greater increase in sexuality attitude ($r = 0.23$, $p = 0.003$). In the control group, higher initial levels are associated with slower growth, evident in sexuality knowledge ($r = -0.20$, $p = 0.046$) and sexuality attitude ($r = -0.22$, $p = 0.012$). However, under OCSE, the growth rate is not significantly affected by the initial level.

***Secondary Outcomes***

In our analysis of RQ2, we found significant interaction effects for penetrative sexual intercourse~~intercourse~~ frequency, harassment coping self-efficacy, and perception of school bullying. Compared to the control group, at post-intervention or one-year follow-up, the intervention group showed an increase in penetrative sexual ~~intercourse~~ frequency both post-intervention and at the one-year follow-up (mean [SE] post-intervention 0.44 [0.02] vs 0.37 [0.03]; mean difference [MD] = 0.07; 95% CI 0.01–0.14; Bonferroni-corrected $p = 0.048$; one-year follow-up 0.58 [0.02] vs 0.50 [0.03]; MD = 0.08; 95% CI 0.00–0.15; Bonferroni-corrected $p = 0.038$), harassment coping self-efficacy (post-intervention 3.47 [0.03] vs 3.28 [0.03]; MD = 0.20; 95% CI 0.12–0.27; Bonferroni-corrected $p < 0.001$; one-year follow-up 3.45 [0.02] vs 3.37 [0.02]; MD = 0.08; 95% CI 0.00–0.16; Bonferroni-corrected $p = 0.054$), and school bullying perception (post-intervention 1.55 [0.03] vs 1.46 [0.03]; MD = 0.09; 95% CI 0.02–0.17; Bonferroni-corrected $p = 0.017$; one-year follow-up 1.32 [0.02] vs 1.28 [0.02];

MD = 0.04; 95% CI -0.02–0.10; Bonferroni-corrected $p = 0.185$). There were no differences in growth between the groups in the number of STD symptoms, contraceptive measures, unintended pregnancy, or general self-efficacy (Table 5).

***Demographic Information and Outcomes***

The coefficients of covariates on the intercepts and slopes of sexuality knowledge and attitude were presented in Appendix Tables 2 and 3. In the OCSE group, we identified that females had higher initial sexuality knowledge ($b = 0.80$ [95% CI, 0.48 to 1.12], $p < 0.001$) and sexuality attitude ($b = 6.78$ [95% CI, 5.72 to 7.84], $p < 0.001$), as well as higher growth rates in sexuality knowledge ($b = 1.28$ [95% CI, 0.91 to 1.65], $p < 0.001$) and sexuality attitude ($b = 3.21$ [95% CI, 2.09 to 4.33], $p < 0.001$). Students living in the undeveloped region of Yunnan had lower initial sexuality knowledge ($b = -0.86$ [95% CI, -1.26 to -0.47], $p < 0.001$) and sexuality attitude ($b = -3.99$ [95% CI, -5.29 to -2.70], $p < 0.001$). However, after receiving OCSE, they showed steeper increases in sexuality knowledge ($b = 0.73$ [95% CI, 0.29 to 1.18], $p < 0.001$) and sexuality attitude ($b = 1.82$ [95% CI, 0.52 to 3.12], $p = 0.006$).

***Sexuality Education Experiences and Outcomes***

Students who had received more sessions in previous sexuality education demonstrated higher levels of sexuality knowledge and attitudes in both the intervention group ($b = 0.13$, $p = 0.002$; $b = 0.50$, $p < 0.001$) and the control group ($b = 0.21$, $p < 0.001$; $b = 0.49$, $p = 0.004$). However, the duration of previous education did not significantly affect growth in sexual attitudes. Sensitivity analysis revealed that education experiences at different stages consistently had a positive influence on initial sexuality knowledge (Primary school: $b = 0.50$, $p = 0.064$; Junior High School: b = 0.47, p = 0.007; Vocational High School: $b = 0.49$, $p = 0.011$) but not on sexuality attitude. Moreover, sexuality education during junior high

school influenced the growth rate of both sexuality knowledge ($b$ = -0.45, $p$ = 0.021) and sexuality attitude ($b$ = 1.43, $p$ = 0.016) in the OCSE group (Appendix Tables 2 and 3).

Separate models for the intervention group addressed RQ4. The curriculum progress did not significantly alter other coefficients in the PP-LGM for the intervention. However, it did show that curriculum progress positively impacted the slope of sexuality knowledge ($b$ = 0.45, $p < 0.001$, $\Delta R^2 = 0.16$) and sexuality attitude ($b$ = 1.01, $p < 0.001$, $\Delta R^2 = 0.16$; Appendix Table 1).

## Discussion

Our study investigated the implementation of *You and Me* OCSE in two district provinces and found that most students had insufficient and sporadic sexuality education experience.

### *Effectiveness of Comprehensive Sexuality Education*

Our findings on the impact of OCSE on sexuality knowledge and attitudes are consistent with prior research across different student stages, but they provide more detailed theoretical insights. Overall, the implementation of the *You and Me* program among vocational high school students led to a more rapid increase in both sexuality knowledge and attitude, proving more effective in the short and long term compared to traditional ~~sex education~~sexual education. In the control group, given the absence of standalone ~~sex education~~sexual education courses in China, a gradual short-term increase can be attributed to the broad safety education offered upon enrollment or peer interactions (Behler, 2017). Notably, students with higher initial levels of sexuality knowledge and attitudes in the control group exhibited slower growth, reflecting the limitations of informal ~~sex education~~sexual education in China. However, in the OCSE group, growth was not constrained by the initial level. This underscores the limitations of traditional informal ~~sex education~~sexual education in China,

where, once basic information such as physiological knowledge is conveyed, there is no additional source of knowledge for vocational high school students. In contrast, CSE offers more comprehensive information, with initial levels—primarily physiological knowledge accumulated in a sexually repressive culture—forming only a small part, thus not limiting the positive growth in sexuality knowledge and attitude.

Secondly, OCSE mitigated the disadvantages of sexuality education faced by students in impoverished areas. Despite having lower initial levels of sexuality knowledge and attitudes, students in these regions exhibited faster growth than their peers in more developed areas. This highlights the program's effectiveness in addressing the intersectional challenges posed by cultural barriers, economic and educational disparities, and discrimination faced by students.

Thirdly, our findings highlight the necessity of continuous sexuality education (Goldfarb & Lieberman, 2021). While OCSE consistently surpasses traditional Chinese ~~sex education~~sexual education, its effectiveness diminishes after a two-month period, indicating a decline in impact one year later. ~~Therefore, sustained sexuality education across various school stages is crucial for maintaining long-term benefits.~~ Additionally, in line with the MAP, implementing sexuality education at various stages positively influences both initial levels and subsequent growth in sexuality knowledge and attitudes. This suggests that while non-CSE sexuality education in China does have an impact, it is still not the optimal approach. ~~Implementing sexuality education at multiple stages positively affects both initial levels and subsequent growth in sexuality knowledge and attitudes.~~ Therefore, sustained sexuality education across various school stages is crucial for maintaining long-term benefits.

Additionally, the thorough implementation of the curriculum is critical. Students who received more sessions of sexuality education, rather than longer sessions, had higher initial levels of knowledge and attitudes. This suggests that the current Chinese sexuality education

curriculum might contain a considerable amount of ineffective content. Moreover, curriculum progress significantly influences the growth rate of sexuality knowledge and attitudes. This expands the theoretical framework of CSE to its implementation phase, emphasizing that comprehensive implementation of CSE is critical. Although the importance of CSE integrity was highlighted in the early stages of the ITGSE Chinese version (UNESCO, 2018), it remains insufficient in practice today.

***Gaps in the Translation of Knowledge and Attitudes***

Our study found higher harassment-coping self-efficacy, which is consistent with previous research (Roth et al., 2023). However, our findings are inconsistent with earlier studies, which indicated that the OCSE group had a higher frequency of penetrative sexual intercourse ~~Our study found an increase in the frequency of intercourse, improved self-efficacy in coping with harassment, and an elevated perception of school bullying. While higher harassment-coping self-efficacy is consistent with studies (Roth et al., 2023), our findings are inconsistent with previous studies, indicating that the OCSE group had a higher frequency of sexual intercourse~~ (Swanton et al., 2015; Bordogna et al., 2023) Additionally, general self-efficacy did not show a significant increase (Sa et al., 2021). Furthermore, compared to the results of a meta-analysis on CSE implementation in the U.S. ~~, and general self-efficacy did not exhibit a significant increase (Sa et al., 2021).~~ (Bordogna et al., 2023), we found no significant between-group differences in the trajectories of STD symptom changes (consistent), contraceptive use (opposite), or unintended pregnancy rates (opposite).

~~-~~The increase in the frequency of penetrative sexual intercourse following CSE implementation may be attributed to China's past abstinence-oriented policies, which historically led to low rates of penetrative sexual intercourse. (Li et al., 2009). ~~Furthermore, while Ramírez-Villalobos et al. (2021) suggest that CSE can delay the onset of sexual activity~~

~~and increase contraceptive use, our study did not observe significant differences in contraceptive use or unintended pregnancies among vocational high school students in China.~~ Therefore, it is necessary to consider the translation of sexuality knowledge and sexuality attitude into behavior and habit, with key factors including the accessibility of contraceptive tools and the sexual inclusivity of the environment (Albarracín et al., 2024). Achieving these goals is difficult in undeveloped areas in China. ~~This underscores the need for more sustained sexuality education.~~

According to the MAP (Albarracín, 2021), the implementation of CSE is influenced by students' ability and motivation to process information. Specifically, under conditions of high cognitive elaboration (e.g., when educational content is perceived as relevant and engaging), students are more likely to form robust beliefs and attitudes through logical pathways. Therefore, the translation from attitude to behavior may be limited by ability and motivation. Under low elaboration conditions, the impact of the intervention may depend more on emotional resonance or habit formation to drive behavioral change (Albarracín, 2021). However, in the context of sexual repression and stigmatization, students may find it difficult to experience emotional resonance. Short-term interventions without supervision or access to health resources are also unlikely to lead to habit formation. This dual-pathway approach emphasizes the importance of designing interventions that not only enhance cognitive engagement but also leverage emotional and social influences, such as peer modeling and teacher support, to amplify educational outcomes.

A deeper underlying reason, according to SCT, is that self-efficacy can directly or indirectly influence behavior (Bandura, 2011). Although harassment coping self-efficacy and school bullying perception were enhanced, they did not correlate with contraceptive use, unintended pregnancies, or symptoms of STDs. The insignificance of general self-efficacy likely explains the weak behavioral translation. According to the Theory of Normative Social

Behavior (Rimal & Lapinski, 2015; Rimal & Yilma, 2022), behaviors are driven by descriptive norms, with self-efficacy moderating the impact of these norms (Jang et al., 2013; Stout et al., 2020; Zhao et al., 2018). China's deeply rooted cultural factors, such as the obsession with academic results, the tradition of sexual repression, and the stigmatization of sexuality, form descriptive, injunctive, and collective norms (Rimal & Yilma, 2022) that influence high school students' receptiveness to the curriculum. Given that most students are over the age of 15, the social stigma surrounding sexuality hinders their full engagement in the classroom. Therefore, teacher training is crucial, as educators must present the material in a serious yet approachable manner, rather than conveying compromise or conservatism, which hinders desensitization efforts (Zhao et al., 2020).

Moreover, awareness and understanding of sexual orientation and self-identity remain limited. Baseline findings revealed confusion among some students regarding these concepts, which led to revisions in the questionnaire, including the use of same-sex behaviors as behavioral indicators. Future research should take students' levels of acceptance into account. Additionally, OCSE must be adapted to local dialects, as regional variations, such as those in Guangdong and Yunnan, pose challenges. Teacher training can help address these regional language differences. Finally, although *You and Me* follows a standardized procedure and we supervised the progress, OCSE was still not fully implemented in schools, particularly in underdeveloped areas. The absence of sessions significantly impacted its effectiveness. This highlights the necessity for continuous and institutionalized CSE. Strong supervision alone cannot ensure the comprehensive implementation of the curriculum; legal frameworks and policy support are essential (Albarracín et al., 2024).

**Limitations**

Several limitations need to be acknowledged. First, due to variations in school size, ranging

from approximately 400 to 18,000 students, the two groups were not equal. Second, questionnaire-based self-report data may be influenced by social desirability bias. Given that the outcomes of CSE involve a combination of true/false questions for knowledge and Likert-scale items for attitudes, the diverse item formats and multidimensional nature of the scales make psychometric validation challenging. More comprehensive and valid assessments are needed in the future. –Third, the three measurements constrain the interpretability of the model. Future longitudinal studies, including intensive longitudinal research, are essential for more granularly demonstrating the translation of CSE into knowledge, attitudes, intentions, behavior, and maintenance.

## Conclusions

The findings of this cluster randomized trial revealed that the CSE in China's vocational high schools is insufficient. The *You and Me* OCSE proved to be a feasible solution, leading to faster increase in sexuality knowledge and sexuality attitude, especially in undeveloped areas both post-intervention and 12 months later. Curriculum progress significantly impacted the growth of sexuality knowledge and attitude. However, *You and Me* is insufficient to alter sexual behaviors. Vocational high school students' behavioral outcomes and well-being did not produce consistent positive results. Therefore, vocational high school students require Long-term, comprehensive, and accurate support. This should include the provision of more sustained and thorough CSE, as well as establishing accessible contraceptive tools and healthcare channels.

## Consent for publication

Not applicable

## Availability of data and materials

De-identified individual participant data that underlie our study's results will be openly available for three years post-publication. Data is available to anyone upon a reasonable request.

## Competing of interests

The authors report that there are no competing interests to declare.

## Funding/Support:

This study was funded by the Kadoorie Charitable Foundation.

## Role of the Funder/Sponsor:

The funders had no role in the study design and conduct; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication. All authors had full access to the data and had final responsibility for the decision to submit for publication.

## List of abbreviations

OCSE: online comprehensive sexuality education package

CSE: comprehensive sexuality education

RCT: randomized controlled trial

GDP: Gross Domestic Product

ITGSE: International Technical Guidance on sexuality education

FPA: Family Planning Association

HHIPSS: Hygiene Institute for Primary and Secondary Schools in Zhongshan

SK: Sexuality knowledge

SA: Sexuality attitude

**Reference**

Albarracín, D. (2021). Definitions, Overview, Goals, and Principles of Cognitive Processing. In D. Albarracín (Ed.), *Action and Inaction in a Social World: Predicting and Changing Attitudes and Behavior* (pp. 3-42). Cambridge University Press. https://doi.org/DOI: 10.1017/9781108878357.002

Albarracín, D., Fayaz-Farkhad, B., & Granados Samayoa, J. A. (2024). Determinants of behaviour and their efficacy as targets of behavioural change interventions. *Nature Reviews Psychology*, *3*(6), 377-392. https://doi.org/10.1038/s44159-024-00305-0

Bandura, A. (2011). On the Functional Properties of Perceived Self-Efficacy Revisited. *Journal of Management*, *38*(1), 9-44. https://doi.org/10.1177/0149206311410606

Behler, R. L. (2017). You can't always get what you want: Network determinants of relationship inactualization in adolescence. *Social Science Research*, *61*, 181-194. https://doi.org/https://doi.org/10.1016/j.ssresearch.2016.06.012

Bordogna, A. L., Coyle, A. C., Nallamothu, R., Manko, A. L., & Yen, R. W. (2023). Comprehensive Sexuality Education to Reduce Pregnancy and STIs in Adolescents in the United States: A Systematic Review and Meta-Analysis. *American Journal of Sexuality Education*, *18*(1), 39-83. https://doi.org/10.1080/15546128.2022.2080140

Chen, L. (2022). Problematic Pornography Use in China. *Current Addiction Reports*, *9*(2), 80-85. https://doi.org/10.1007/s40429-022-00408-9

Cheong, J., MacKinnon, D. P., & Khoo, S. T. (2003). Investigation of Mediational Processes Using Parallel Process Latent Growth Curve Modeling. *Structural Equation Modeling: A Multidisciplinary Journal*, *10*(2), 238-262. https://doi.org/10.1207/S15328007SEM1002_5

Cheung, G. W., & Lau, R. S. (2017). Accuracy of Parameter Estimates and Confidence Intervals in Moderated Mediation Models:A Comparison of Regression and Latent

Moderated Structural Equations. *Organizational Research Methods*, *20*(4), 746-769. https://doi.org/10.1177/1094428115595869

Chi, X., Hawk, S. T., Winter, S., & Meeus, W. (2015). The Effect of Comprehensive Sexual Education Program on Sexual Health Knowledge and Sexual Attitude Among College Students in Southwest China. *Asia-Pacific Journal of Public Health*, *27*(2), NP2049-NP2066. https://doi.org/doi: 10.1177/1010539513475655

Fang, Y., Zheng, Y., Jin, Y., Yu, C., Zuo, X., Lian, Q., Lou, C., Li, L., Hong, P., & Tu, X. (2022). Sexual-Related Knowledge, School and Family Sexuality Education and Its Association with Experience of Sexual Intercourse among Vocational Secondary School Students in China. *Children*, *9*(8), 1206. https://www.mdpi.com/2227-9067/9/8/1206

Fei, G., Lihan, L., & Yingfei, S. (2022, 2022/07/11). Perceiving Sexual Harassment in Chinese Higher Education. Proceedings of the 2022 3rd International Conference on Mental Health, Education and Human Development (MHEHD 2022)

Ferrand, L. (2023). Reforming the sexual health education curriculum. *The Lancet Child & Adolescent Health*. https://doi.org/10.1016/S2352-4642(23)00233-X

Goldfarb, E. S., & Lieberman, L. D. (2021). Three Decades of Research: The Case for Comprehensive Sex Education. *Journal of Adolescent Health*, *68*(1), 13-27. https://doi.org/https://doi.org/10.1016/j.jadohealth.2020.07.036

Guse, K., Levine, D., Martins, S., Lira, A., Gaarde, J., Westmorland, W., & Gilliam, M. (2012). Interventions Using New Digital Media to Improve Adolescent Sexual Health: A Systematic Review. *Journal of Adolescent Health*, *51*(6), 535-543. https://doi.org/10.1016/j.jadohealth.2012.03.014

Han, Z., Zhang, G., & Zhang, H. (2017). School Bullying in Urban China: Prevalence and Correlation with School Climate. *International journal of environmental research and public health*, *14*(10).

Herat, J., Plesons, M., Castle, C., Babb, J., & Chandra-Mouli, V. (2018). The revised international technical guidance on sexuality education - a powerful tool at an important crossroads for sexuality education. *Reproductive Health*, *15*(1), 185. https://doi.org/10.1186/s12978-018-0629-x

Ho, P. S. Y., Jackson, S., Cao, S., & Kwok, C. (2018). Sex With Chinese Characteristics: Sexuality Research in/on 21st-Century China. *The Journal of Sex Research*, *55*(4-5), 486-521. https://doi.org/10.1080/00224499.2018.1437593

Huang, D. Y. C., Murphy, D. A., & Hser, Y.-I. (2011). Developmental Trajectory of Sexual Risk Behaviors From Adolescence to Young Adulthood. *Youth & Society*, *44*(4), 479-499. https://doi.org/10.1177/0044118X11406747

Jang, S. A., Rimal, R. N., & Cho, N. (2013). Normative Influences and Alcohol Consumption: The Role of Drinking Refusal Self-Efficacy. *Health Communication*, *28*(5), 443-451. https://doi.org/10.1080/10410236.2012.691455

Ji, Y., Xu, H., Zhang, Y., & Liu, Q. (2018). Heterogeneity of adolescent health risk behaviors in rural western China: A latent class analysis. *PloS one*, *13*(6), e0199286. https://doi.org/10.1371/journal.pone.0199286

Ji, Y., & Reiss, M. J. (2022). Cherish Lives? Progress and compromise in sexuality education textbooks produced in contemporary China. *Sex Education*, *22*(4), 496-519. https://doi.org/10.1080/14681811.2021.1955670

Jiang, W., & Ha, L. (2020). Smartphones or computers for online sex education? A contraception information seeking model for Chinese college students. *Sex Education*, *20*(4), 457-476. https://doi.org/10.1080/14681811.2019.1672041

Jin, Z., Guo, F., Wang, K., Zhang, H., Cao, W., Hee, J., Yuan, Y., Chen, M., & Tang, K. (2021). Effects of an Internet-Based and Teacher-Facilitated Sexuality Education Package: A Cluster-Randomized Trial. *Children*, *8*(10), 885. https://www.mdpi.com/2227-9067/8/10/885

Kaidbey, M., Zhen, S., Wong, S., Navchaa, S., & Junjian, G. (2023). The Effectiveness of Delivering Comprehensive Sexuality Education Through Live Streaming to Schools in Western China. *American Journal of Sexuality Education*, *18*(1), 115-148. https://doi.org/10.1080/15546128.2022.2064952

Kuder, G. F., & Richardson, M. W. (1937). The theory of the estimation of test reliability. *Psychometrika*, *2*(3), 151-160.

Li, L., King, M. E., & Winter, S. (2009). Sexuality education in China: the conflict between reality and ideology. *Asia Pacific Journal of Education*, *29*(4), 469-480. https://doi.org/10.1080/02188790903309066

Liang, M., Simelane, S., Fortuny Fillo, G., Chalasani, S., Weny, K., Salazar Canelos, P., Jenkins, L., Moller, A.-B., Chandra-Mouli, V., Say, L., Michielsen, K., Engel, D. M. C., & Snow, R. (2019). The State of Adolescent Sexual and Reproductive Health. *Journal of Adolescent Health*, *65*(6, Supplement), S3-S15. https://doi.org/https://doi.org/10.1016/j.jadohealth.2019.09.015

Liang, J. Y., Tan, S., & O'Halloran, K. (2017). Representing sexuality and morality in sex education picture books in contemporary China. *Social Semiotics*, *27*(1), 107-126. https://doi.org/10.1080/10350330.2016.1161117

Ling, M. (2015). "Bad Students Go to Vocational Schools!": Education, Social Reproduction and Migrant Youth in Urban China. *The China Journal*, *73*, 108-131. https://doi.org/10.1086/679271

Liu, C. (2022). Secondary Education and Class Stratification: Understanding the Hierarchy of Sexuality Education in a Chinese Vocational High School. *Children*, *9*(10), 1524. https://www.mdpi.com/2227-9067/9/10/1524

Liu, J., Cheng, M., Wei, X., & Yu, N. N. (2020). The Internet-driven sexual revolution in China. *Technological Forecasting and Social Change*, *153*, 119911. https://doi.org/https://doi.org/10.1016/j.techfore.2020.119911

Liu, W., Van Campen, K. S., Edwards, C. P., & Russell, S. T. (2011). Chinese Parents' Perspectives on Adolescent Sexuality Education. *International Journal of Sexual Health*, *23*(3), 224-236. https://doi.org/10.1080/19317611.2011.596256

Lou, C.-h., Zhao, Q., Gao, E.-S., & Shah, I. H. (2006). Can the Internet Be Used Effectively to Provide Sex Education to Young People in China? *Journal of Adolescent Health*, *39*(5), 720-728. https://doi.org/https://doi.org/10.1016/j.jadohealth.2006.04.003

Lyu, J., Shen, X., & Hesketh, T. (2020). Sexual Knowledge, Attitudes and Behaviours among Undergraduate Students in China—Implications for Sex Education. *International journal of environmental research and public health*, *17*(18), 6716. https://www.mdpi.com/1660-4601/17/18/6716

Manlove, J., Welti, K., Whitfield, B., Faccio, B., Finocharo, J., & Ciaravino, S. (2021). Impacts of Re:MIX—A School-Based Teen Pregnancy Prevention Program Incorporating Young Parent Coeducators. *Journal of School Health*, *91*(11), 915-927. https://doi.org/https://doi.org/10.1111/josh.13078

Ministry of Education, P. s. R. o. C. (2023). *The report on the development of vocational education in China (2012-2022)*. https://www.csdp.edu.cn/article/8940.html

Money, W. H., & Dean, B. P. (2019). Incorporating student population differences for effective online education: A content-based review and integrative model. *Computers*

*& Education*, *138*, 57-82. https://doi.org/https://doi.org/10.1016/j.compedu.2019.03.013

National Bureau of Statistics. (2024). *National data*. Retrieved September 8, 2024, from https://data.stats.gov.cn/easyquery.htm?cn=E0103

Nie S, Li H, Xu Y, Ma W, & Xu H. (2007). Analysis on sex-related behaviours of senior high school and professional technical school students in cities of Guangdong province. *China Preventive Medicine (in Chinese)* (05), 581-584. https://kns.cnki.net/kcms2/article/abstract?v=yXT3uqWUX__OlCejjiufDye7tTZJoXUWBCfZ7KDWpRp260vUMDaPPiI4lBiqrghMVYZa4zP3OGdl60P9eNGV-r2pPAdKbCQQPtHtuZQ8p-AWfW1Qncv0H48V0kUK2Q-onqhvllp8DSE=&uniplatform=NZKPT&language=CHS

NHS. (2018). *Sexually transmitted infections (STIs)*. Nhs.Uk. https://www.nhs.uk/conditions/sexually-transmitted-infections-stis/

Nurgitz, R., Pacheco, R. A., Senn, C. Y., & Hobden, K. L. (2021). The impact of sexual education and socialization on sexual satisfaction, attitudes, and self-efficacy. *The Canadian Journal of Human Sexuality*, *30*(2), 265-277. https://doi.org/10.3138/cjhs.2021-0028

Pinandari, A. W., Kågesten, A. E., Li, M., Moreau, C., van Reeuwijk, M., & Wilopo, S. A. (2023). Short-Term Effects of a School-Based Comprehensive Sexuality Education Intervention Among Very Young Adolescents in Three Urban Indonesian Settings: A Quasi-Experimental Study. *Journal of Adolescent Health*, *73*(1), S21-S32. https://doi.org/10.1016/j.jadohealth.2023.01.030

Centers for Disease Control and Prevention (2003). *Questionnaire design reproductive health Epidemiology series module 4*. chrome-extension://cdonnmffkdaoajfknoeeecmchibpmkmg/assets/pdf/web/viewer.html?file=h

ttps%3A%2F%2Frepository.dinus.ac.id%2Fdocs%2Fajar%2FEpi_Module_04_Questionnaire_Design.pdf

Ramírez-Villalobos, D., Monterubio-Flores, E. A., Gonzalez-Vazquez, T. T., Molina-Rodríguez, J. F., Ruelas-González, M. G., & Alcalde-Rabanal, J. E. (2021). Delaying sexual onset: outcome of a comprehensive sexuality education initiative for adolescents in public schools. *BMC Public Health*, *21*(1), 1439. https://doi.org/10.1186/s12889-021-11388-2

Rimal, R. N., & Lapinski, M. K. (2015). A Re-Explication of Social Norms, Ten Years Later. *Communication theory*, *25*(4), 393-409. https://doi.org/10.1111/comt.12080

Rimal, R. N., & Yilma, H. (2022). Descriptive, Injunctive, and Collective Norms: An Expansion of the Theory of Normative Social Behavior (TNSB). *Health Communication*, *37*(13), 1573-1580. https://doi.org/10.1080/10410236.2021.1902108

Rossi, E., Poulin, F., & Boislard, M.-A. (2017). Trajectories of Annual Number of Sexual Partners from Adolescence to Emerging Adulthood: Individual and Family Predictors. *Journal of Youth and Adolescence*, *46*(5), 995-1008. https://doi.org/10.1007/s10964-016-0571-6

Roth, D., Nellhaus, E., Ruley, M., Hess, A., Lamichhane, R., & Yoost, J. (2023). A virtual sex education tool improved reproductive health knowledge among adolescent girls. *Sex Education*, 1-11. https://doi.org/10.1080/14681811.2023.2203909

Sa, Z., Tian, L., & Wang, X. (2021). Evidence for a Comprehensive Sexuality Education Intervention that Enhances Chinese Adolescents' Sexual Knowledge and Gender Awareness and Empowers Young Women. *Sex Roles*, *85*(5), 357-370. https://doi.org/10.1007/s11199-021-01223-8

Schulte, B. (2013). Unwelcome stranger to the system: vocational education in early twentieth-century China. *Comparative Education*, *49*(2), 226-241. https://doi.org/10.1080/03050068.2012.713581

Schwarzer, R., & Jerusalem, M. (1995). Generalized Self-Efficacy scale. In J. Weinman, S. Wright, & M. Johnston, *Measures in health psychology: A user's portfolio. Causal and control beliefs* (pp. 35-37). Windsor, UK: NFER-NELSON.

Song, Y., & Ji, C.-Y. (2010). Sexual intercourse and high-risk sexual behaviours among a national sample of urban adolescents in China. *Journal of Public Health*, *32*(3), 312-321. https://doi.org/10.1093/pubmed/fdp123

Song S, Zhang Y, Zhou Y, Liu Y, & Xu S. (2006). Comparison on sex knowledge, attitude, behaviour, and demand between common high school students and occupational high school students. *Maternal and Child Health Care of China (in Chinese),* (04), 507-509.

Steinberg, D. B., Simon, V. A., Victor, B. G., Kernsmith, P. D., & Smith-Darden, J. P. (2019). Onset Trajectories of Sexting and Other Sexual Behaviors Across High School: A Longitudinal Growth Mixture Modeling Approach. *Archives of Sexual Behavior*, *48*(8), 2321-2331. https://doi.org/10.1007/s10508-019-1414-9

Stout, M. E., Christy, S. M., Winger, J. G., Vadaparampil, S. T., & Mosher, C. E. (2020). Self-efficacy and HPV Vaccine Attitudes Mediate the Relationship Between Social Norms and Intentions to Receive the HPV Vaccine Among College Students. *J Community Health*, *45*(6), 1187-1195. https://doi.org/10.1007/s10900-020-00837-5

Strauss Swanson, C., & Szymanski, D. M. (2022). Sexual Violence and Psychological Distress: The Roles of Coping Self-Efficacy, Self-Blame, Shame, Activism, and Feminism. *Sex Roles*, *87*(7), 419-434. https://doi.org/10.1007/s11199-022-01314-0

Swanton, R., Allom, V., & Mullan, B. (2015). A meta-analysis of the effect of new-media interventions on sexual-health behaviours. *Sexually Transmitted Infections*, *91*(1), 14-20. https://doi.org/10.1136/sextrans-2014-051743

Sun J, Ma Y, Chen H, Chen J , Song Y, Yu X, Zhang B, Si K, Ji H. (2001). The status quo of the dangerous behavior of middle school students in 5 provinces and cities in China (1) -The knowledge attitude and behavior of AIDS and sexual behavior. *Chinese school hygiene(in Chinese),* (03), 202-204. https://kns.cnki.net/kcms2/article/abstract?v=3IEynGI71r_GVdRiju0fGrmBL6tiryk8a_Lig9B_VJZSFtLxXRWUe_cObEvem6CqDxv-z2jooQW6aonj0tB-EZzoxqiBMpJKMhAsF2nOdSFMFEHKhtFAfC8HY4PEGOx5I_PWrp_f5yo=&uniplatform=NZKPT&language=CHS

Szucs, L. E., Lowry, R., Fasula, A. M., Pampati, S., Copen, C. E., Hussaini, K. S., Kachur, R. E., Koumans, E. H., & Steiner, R. J. (2020). Condom and Contraceptive Use Among Sexually Active High School Students - Youth Risk Behavior Survey, United States, 2019. *MMWR Suppl*, *69*(1), 11-18. https://doi.org/10.15585/mmwr.su6901a2

UNESCO. (2018, June 20). Chinese language edition of the revised International Technical Guideline on Sexuality Education published. *UNESCO*. Retrieved September 9, 2024, from https://www.unesco.org/en/articles/chinese-language-edition-revised-international-technical-guideline-sexuality-education-published

UNESCO, UNAIDS, UNFPA, UNICEF, UN Women and WHO. (2018, July 18). *International technical guidance on sexuality education*. UNFPA China. https://china.unfpa.org/en/publications/international-technical-guidance-sexuality-education-0

Vamos, C. A., Thompson, E. L., Logan, R. G., Griner, S. B., Perrin, K. M., Merrell, L. K., & Daley, E. M. (2020). Exploring college students' sexual and reproductive health

literacy. *Journal of American College Health*, *68*(1), 79-88. https://doi.org/10.1080/07448481.2018.1515757

Wadham, E., Green, C., Debattista, J., Somerset, S., & Sav, A. (2019). New digital media interventions for sexual health promotion among young people: a systematic review. *Sexual Health*, *16*(2), 101-123. https://doi.org/https://doi.org/10.1071/SH18127

Wang, A., & Guo, D. (2019). Technical and vocational education in China: enrolment and socioeconomic status. *Journal of Vocational Education & Training*, *71*(4), 538-555. https://doi.org/10.1080/13636820.2018.1535519

Wang J, Yang X, & Liu Y. (2009). Investigation on AIDS knowledge, attitude and behaviour of high school students in Xinjiang Uygur autonomous. *Chinese Journal of Health Education (in Chinese)*, 25(05), 372-374.

Warner, L. M., & Schwarzer, R. (2025). Self-Efficacy and Health. In P. Liamputtong (Ed.), *Handbook of Concepts in Health, Health Behavior and Environmental Health* (pp. 1-26). Springer Nature Singapore. https://doi.org/10.1007/978-981-97-0821-5_15-1

World Health Organization: WHO. (2020, June 4). Sexually transmitted infections (STIs). *World Health Organization: WHO*. https://www.who.int/health-topics/sexually-transmitted-infections#tab=tab_2

Widman, L., Nesi, J., Kamke, K., Choukas-Bradley, S., & Stewart, J. L. (2018). Technology-Based Interventions to Reduce Sexually Transmitted Infections and Unintended Pregnancy Among Youth. *Journal of Adolescent Health*, *62*(6), 651-660. https://doi.org/https://doi.org/10.1016/j.jadohealth.2018.02.007

Xiong, Z., Warwick, I., & Chalies, S. (2020). Understanding novice teachers' perspectives on China's sexuality education: a study based on the national pre-service teacher education programme. *Sex Education*, *20*(3), 252-266. https://doi.org/10.1080/14681811.2019.1640113

Xu, S., Ren, J., Li, F., Wang, L., & Wang, S. (2020). School Bullying Among Vocational School Students in China: Prevalence and Associations With Personal, Relational, and School Factors. *Journal of Interpersonal Violence*, *37*(1-2), NP104-NP124. https://doi.org/10.1177/0886260520907360

Yu, J. (2012). Teenage sexual attitudes and behaviour in China: a literature review. *Health & Social Care in the Community*, *20*(6), 561-582. https://doi.org/https://doi.org/10.1111/j.1365-2524.2011.01054.x

Zeng, G., Fung, S.-f., Li, J., Hussain, N., & Yu, P. (2022). Evaluating the psychometric properties and factor structure of the general self-efficacy scale in China. *Current Psychology*, *41*(6), 3970-3980. https://doi.org/10.1007/s12144-020-00924-9

Zeng, L. (2024). An Analysis of Diploma Discrimination in Chinese Higher Vocational Education within the Context of a Knowledge-Based. *Transactions on Social Science, Education and Humanities Research*, *5*, 169-176. https://doi.org/10.62051/1wyfyy88

Zhang, J., Ma, B., Han, X., Ding, S., & Li, Y. (2022). Global, regional, and national burdens of HIV and other sexually transmitted infections in adolescents and young adults aged 10–24 years from 1990 to 2019: a trend analysis based on the Global Burden of Disease Study 2019. *The Lancet Child & Adolescent Health*, *6*(11), 763-776. https://doi.org/10.1016/S2352-4642(22)00219-X

Zhao, P., Liu, L., Zhang, Y., Cheng, H., Cao, B., Liu, C., Wang, C., Yang, B., Wei, C., Tucker, J. D., & Tang, W. (2018). The interaction between HIV testing social norms and self-efficacy on HIV testing among Chinese men who have sex with men: results from an online cross-sectional study. *BMC Infect Dis*, *18*(1), 541. https://doi.org/10.1186/s12879-018-3454-5

Zhao, P., Yang, L., Sa, Z., & Wang, X. (2020). Propriety, empowerment and compromise: challenges in addressing gender among sex educators in China. *Sex Education*, *20*(5), 552-567. https://doi.org/10.1080/14681811.2019.1705779

Zhu, F., Zhu, G., Jia, B., Wang, P., Zhao, T., Ma, Y., & Dong, B. (2022). The Influencing Factors of Comprehensive Sexuality Education Capacity and Its Correlation with Subjective Social Status among Chinese Junior High School Students. *Children*, *9*(8).

Zou, S., Cao, W., Jia, Y., Wang, Z., Qi, X., Shen, J., & Tang, K. (2022). Sexual and reproductive health and attitudes towards sex of young adults in China. *BMJ Sexual & Reproductive Health*, *48*(e1), e13-e21. https://doi.org/10.1136/bmjsrh-2020-200766

Zou, W., Zhang, X., & He, J. (2023). Making Sense of Jiese: An Interview Study of Members from a Porn-Free Self-Help Forum in China. *Archives of Sexual Behavior*, *52*(1), 385-397. https://doi.org/10.1007/s10508-022-02456-8

Zou, Z., Dong, Y., Song, Y., & Ma, J. (2023). Strengthening sexual and reproductive health education for children and adolescents in China. *The Lancet Child & Adolescent Health*, *7*(9), 603-605. https://doi.org/https://doi.org/10.1016/S2352-4642(23)00138-4

Table 1. Definitions of covariates

| Baseline covariate | Measurement | Description |
|---|---|---|
| Age | | |
| Sex | Binary variable | Students voluntarily providing their registered gender: 1 = female, 0 = male. |
| Ethnicity | Binary variable | Minority ethnicity = 1, Han ethnicity = 0 |
| Parental Divorce | Binary variable | Parents' divorce=1 |
| Romantic Relationship | Binary variable | Current involvement in a romantic relationship=1 |
| Sexual Experiences | Binary variable | Having had intercourse (sexual experience) =1 |
| Same Sex | Binary variable | Having had same-sex sexual experience =1 |
| School Bully Perception | The total score ranges between 1 and 5, with a higher score indicating more bully perception. | Classmates' sexual bullying/harassment behavior? 1=Not at all, 7=Very often |
| Sexual Education Experience | | |
| Time in Sexual Education Experience | Range: 0-5 | From the start of sexual education until now, students have attended how many lessons of sexuality education (each lasting 45 minutes). Students were asked to exclude knowledge taught by teachers, parents, and others during fragmented time.<br>1=1 lesson<br>2=2-3 lessons<br>3=4-5 lessons<br>4=6-7 lessons<br>5=8 or more lessons |
| Sessions Covered in Sexual Education Experience | Range: 0-9 | The number of sexuality education sessions among the nine topics the students have taken |
| Primary School Sexual Education Experience | Binary variable | Having had sexual education =1 |
| Junior High School Sexual Education Experience | Binary variable | Having had sexual education =1 |
| High School Sexual Education Experience | Binary variable | Having had sexual education =1 |

Table 2. Baseline characteristics of participants in each study group

| | Yunnan (N=2342) | | | | Guangdong (N=1073) | | | | Total (N=3415) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Intervention (N=1447) | | Control (N=895) | | Intervention (N=567) | | Control (N=506) | | Intervention (N=2014) | | Control (N=1401) | |
| | Mean (N) | SD (%) | Mean (N) | SD (%) | Mean (N) | SD (%) | Mean (N) | SD (%) | Mean (N) | SD (%) | Mean (N) | SD (%) |
| Age | 16.28 | 0.84 | 16.19 | 0.88 | 15.75 | 0.69 | 15.81 | 0.80 | 16.13 | 0.83 | 16.06 | 0.87 |
| Sex | | | | | | | | | | | | |
| Female | 630 | 43.54 | 399 | 44.58 | 282 | 49.74 | 227 | 44.86 | 912 | 45.30 | 626 | 44.68 |
| Male | 817 | 56.46 | 496 | 55.42 | 285 | 50.26 | 279 | 55.14 | 1102 | 54.70 | 775 | 55.32 |
| Ethnic Minority | 488 | 33.70 | 303 | 33.90 | 12 | 2.10 | 16 | 3.20 | 500 | 24.80 | 319 | 22.80 |
| School bully perception | 1.48 | 1.06 | 1.47 | 1.05 | 1.32 | 0.79 | 1.27 | 0.83 | 1.43 | 0.99 | 1.39 | 0.98 |
| Parental divorcee | 184 | 12.70 | 141 | 15.80 | 57 | 10.10 | 44 | 8.70 | 241 | 12.00 | 185 | 13.20 |
| Romantic relationship | 1101 | 76.09 | 690 | 77.09 | 301 | 53.09 | 246 | 48.62 | 1402 | 69.60 | 936 | 66.81 |
| Sexual Experience | 249 | 17.20 | 153 | 17.10 | 21 | 3.70 | 21 | 4.15 | 270 | 13.40 | 174 | 12.40 |
| Sexual Harassment | 267 | 18.50 | 190 | 21.20 | 114 | 20.11 | 99 | 19.57 | 381 | 18.90 | 289 | 20.60 |
| Same Sex | 67 | 4.60 | 36 | 4.02 | 17 | 3.00 | 18 | 3.56 | 84 | 4.20 | 54 | 3.85 |
| Sexuality Education Experience | | | | | | | | | | | | |
| Duration | 1.56 | 1.85 | 1.19 | 1.57 | 1.71 | 1.74 | 1.62 | 1.67 | 1.60 | 1.82 | 1.34 | 1.62 |
| Sessions Covered | 2.56 | 3.05 | 2.19 | 2.94 | 3.23 | 3.21 | 3.10 | 3.02 | 2.75 | 3.11 | 2.52 | 3.00 |
| Primary School | 100 | 6.90 | 46 | 5.10 | 102 | 18.00 | 84 | 16.60 | 202 | 10.03 | 130 | 9.28 |
| Junior High School | 571 | 39.50 | 314 | 35.10 | 275 | 48.50 | 239 | 47.23 | 846 | 42.00 | 553 | 39.50 |
| High School | 327 | 22.60 | 167 | 18.70 | 192 | 33.90 | 174 | 34.39 | 519 | 25.77 | 341 | 24.34 |
| Sessions Covered in Previous Sexuality Education | | | | | | | | | | | | |
| Sex and gender | 529 | 36.60 | 288 | 32.18 | 253 | 44.62 | 224 | 44.27 | 782 | 38.83 | 512 | 36.55 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reproductive System | 541 | 37.40 | 296 | 33.07 | 276 | 48.68 | 230 | 45.45 | 817 | 40.60 | 526 | 37.54 |
| Adolescence | 645 | 44.57 | 339 | 37.88 | 320 | 56.44 | 284 | 56.13 | 965 | 47.91 | 623 | 44.50 |
| Pregnancy and Contraception | 364 | 25.20 | 188 | 21.01 | 168 | 29.63 | 135 | 26.68 | 532 | 26.42 | 323 | 23.05 |
| Abortion | 166 | 11.47 | 86 | 9.61 | 103 | 18.17 | 64 | 12.65 | 269 | 13.40 | 150 | 10.70 |
| STDs | 0.38 | 0.70 | 0.35 | 0.67 | 0.26 | 0.60 | 0.29 | 0.62 | 0.35 | 0.68 | 0.33 | 0.65 |
| Sexual Behavior | 431 | 29.79 | 212 | 23.70 | 219 | 38.62 | 204 | 40.32 | 650 | 32.27 | 416 | 29.69 |
| Sexual Violence | 202 | 14.00 | 115 | 12.80 | 115 | 20.28 | 103 | 20.36 | 317 | 15.70 | 218 | 15.56 |
| Love and Marriage | 224 | 15.48 | 126 | 14.10 | 100 | 17.64 | 83 | 16.40 | 324 | 16.10 | 209 | 14.92 |
| Curriculum Progress | 6.32 | 2.90 | NA | NA | 6.88 | 2.41 | NA | NA | 6.48 | 2.78 | NA | NA |

Table 3. Sexuality knowledge and attitudes in different groups: differences in baseline, growth slope, post-intervention, and follow-up

| | | Intervention | | | Control | | | Difference | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **Estimate (95% CI)** | **SE** | ***p* value** | **Estimate (95% CI)** | **SE** | ***p* value** | **Estimate (95% CI)** | **SE** | ***p* value** |
| Baseline (intercept) | Knowledge | 8.56 (8.40 to 8.73) | 0.08 | ＜0.001 | 8.52 (8.32 to 8.71) | 0.10 | ＜0.001 | 0.05 (-0.20 to 0.30) | 0.13 | 0.72 |
| | Attitude | 94.05 (93.52 to 94.59) | 0.27 | ＜0.001 | 94.82 (94.15 to 95.49) | 0.34 | ＜0.001 | -0.77 (-1.63 to 0.01) | 0.44 | 0.08 |
| Growth (slope) | Knowledge | 4.19 (4.00 to 4.37) | 0.09 | ＜0.001 | 0.27 (0.12 to 0.41) | 0.07 | ＜0.001 | 3.92 (3.69 to 4.15) | 0.12 | ＜0.001 |
| | Attitude | 6.09 (5.55 to 6.63) | 0.28 | ＜0.001 | 1.27 (0.75 to 1.78) | 0.25 | ＜0.001 | 4.82 (4.07 to 5.58) | 0.37 | ＜0.001 |
| Post-intervention | Knowledge | 12.75 (12.56 to 12.94) | 0.10 | ＜0.001 | 8.78 (8.58 to 8.99) | 0.11 | ＜0.001 | 3.97 (3.69 to 4.25) | 0.14 | ＜0.001 |
| | Attitude | 100.15 (99.48 to 100.81) | 0.34 | ＜0.001 | 96.09 (95.38 to 96.80) | 0.37 | ＜0.001 | 4.06 (3.07 to 5.04) | 0.50 | ＜0.001 |
| follow-up | Knowledge | 11.24 (11.05 to 11.43) | 0.10 | ＜0.001 | 9.02 (8.79 to 9.24) | 0.12 | ＜0.001 | 2.23 (1.93 to 2.53) | 0.15 | ＜0.001 |
| | Attitude | 98.79 (98.12 to 99.47) | 0.35 | ＜0.001 | 97.18 (96.36 to 98.00) | 0.42 | ＜0.001 | 1.61 (0.53 to 2.69) | 0.54 | 0.003 |

Table 4. Interrelationships between slopes and intercepts of sexuality knowledge and attitude

| | **INTK** | **SLPK** | **INTA** | **SLPA** |
|---|---|---|---|---|
| INTK [a] | NA | -0.196* | 0.551*** | -0.015 |
| SLPK [b] | -0.159 | NA | 0.050 | 0.580*** |
| INTA [c] | 0.630*** | -0.005 | NA | -0.216* |
| SLPA [d] | 0.230** | 0.739*** | 0.317 | NA |

note: [a] INTK: intercept of the sexuality knowledge, [b] SLPK slope of the sexuality knowledge, [c] INTA: intercept of the sexuality attitude, [d] SLPA: slope of the sexuality attitude.
The correlation matrix above the diagonal represents the control group, while the correlation matrix below the diagonal represents the intervention group; * $p < .05$, ** $p < .01$, *** $p < .001$; NA: not applicable

Table 5. Mixed model and post hoc for repeated measures of secondary outcomes

| | Mean ( SE ) | | | | | | *p* | | |
|---|---|---|---|---|---|---|---|---|---|
| **Measurement** | **Baseline** | | **Post-Intervention** | | **Follow-up** | | **Interaction** | **Group effect** | **Time effect** |
| Intercourse time | | | | | | | 0.001 | 0.076 | ＜0.001 |
| IG[a] | 0.28 | 0.02 | 0.44 | 0.02 | 0.58 | 0.02 | | | |
| CG[b] | 0.27 | 0.02 | 0.37 | 0.03 | 0.50 | 0.03 | | | |
| STD symptoms | | | | | | | 0.220 | 0.072 | ＜0.001 |
| IG | 0.35 | 0.01 | NA | NA | 0.27 | 0.01 | | | |
| CG | 0.33 | 0.02 | NA | NA | 0.22 | 0.02 | | | |
| Contraceptive usage | | | | | | | 0.331 | 0.434 | 0.429 |
| IG | 2.45 | 0.08 | NA | NA | 2.46 | 0.07 | | | |
| CG | 2.45 | 0.10 | NA | NA | 2.31 | 0.09 | | | |
| Unintended pregnant | | | | | | | 0.596 | 0.517 | ＜0.001 |
| IG | 0.05 | 0.01 | 0.09 | 0.01 | 0.12 | 0.01 | | | |
| CG | 0.03 | 0.01 | 0.08 | 0.01 | 0.12 | 0.02 | | | |
| Self-efficacy | | | | | | | 0.718 | 0.002 | ＜0.001 |
| IG | 25.76 | 0.12 | 26.31 | 0.13 | 25.98 | 0.15 | | | |
| CG | 25.33 | 0.15 | 25.72 | 0.16 | 25.44 | 0.17 | | | |
| Harassment coping self-efficacy | | | | | | | ＜0.001 | ＜0.001 | ＜0.001 |
| IG | 3.24 | 0.03 | 3.47 | 0.03 | 3.45 | 0.03 | | | |
| CG | 3.18 | 0.03 | 3.28 | 0.03 | 3.37 | 0.03 | | | |
| School bully perception | | | | | | | 0.021 | ＜0.001 | 0.356 |
| IG | 1.43 | 0.02 | 1.55 | 0.03 | 1.32 | 0.02 | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| CG | 1.39 | 0.03 | 1.46 | 0.03 | 1.28 | 0.02 |

| | Post-Intervention | | | | Follow-up | | | |
|---|---|---|---|---|---|---|---|---|
| **Measurement** | **Mean dif** | **95%CI** | | ***p*** | **Mean dif** | **95%CI** | | ***p*** |
| Intercourse time | 0.07 | 0.01 | 0.14 | 0.048 | 0.08 | 0.00 | 0.15 | 0.038 |
| Harassment coping Self-efficacy | 0.20 | 0.12 | 0.27 | ＜0.001 | 0.08 | 0.00 | 0.16 | 0.054 |
| School bully perception | 0.09 | 0.02 | 0.17 | 0.017 | 0.04 | -0.02 | 0.10 | 0.185 |

Note: The Bonferroni correction was used in the mixed model. [a]IG: intervention group, [b]CG: control group

Figure 1: Trial profile

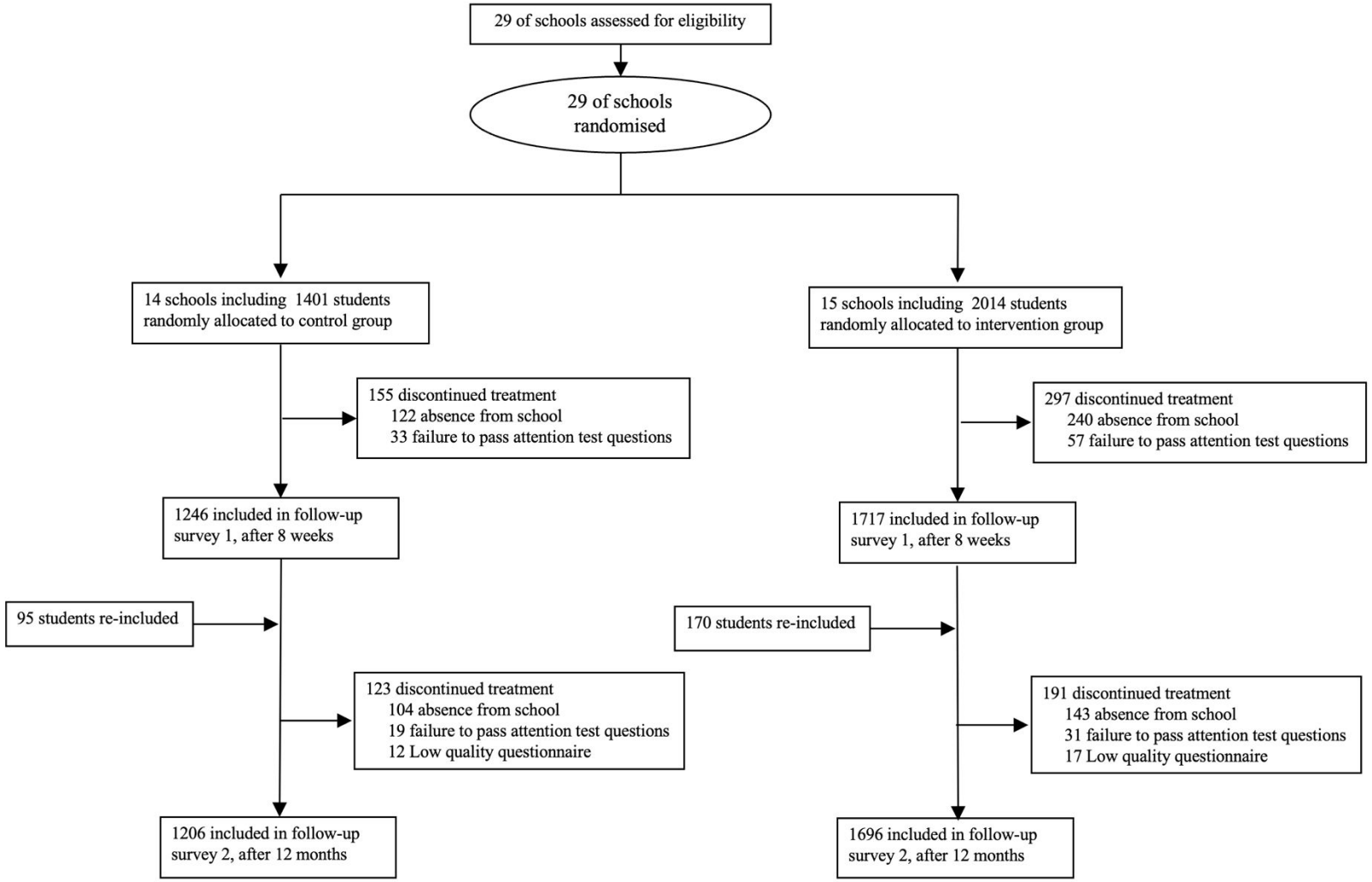
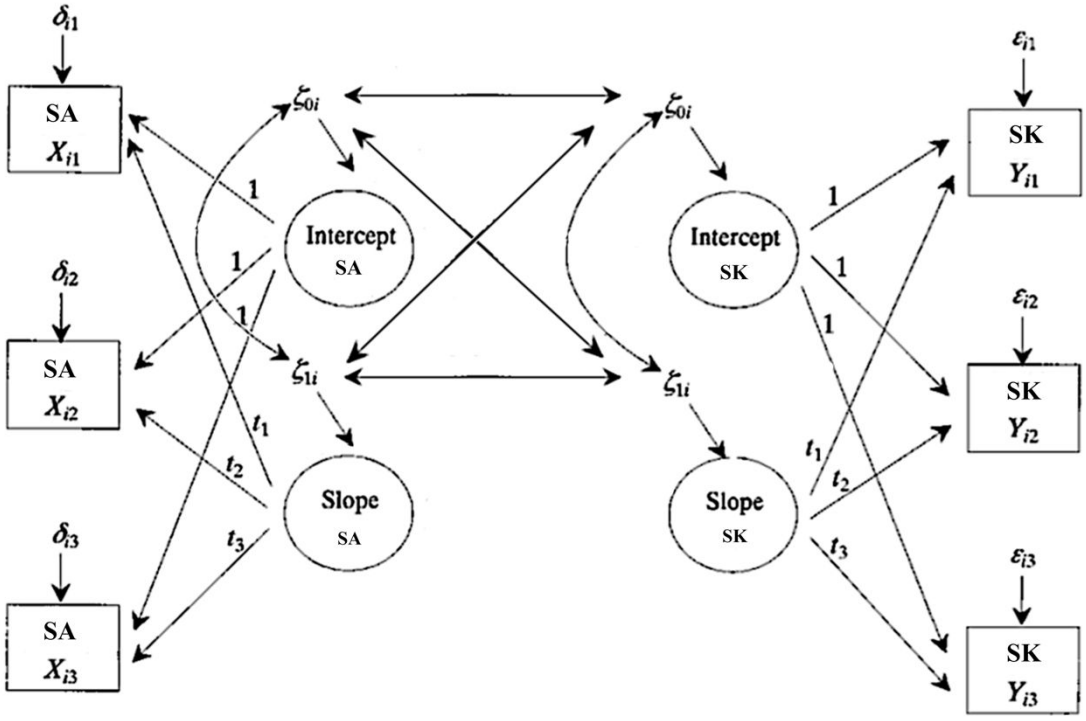


Figure 2: Parallel process latent growth model profile




SK: sexuality knowledge, SA: sexuality attitude.

Appendix Table 1. PP-LGM model fit for sexuality knowledge and attitude

| | PP-LGM (N = 3,415) | | | PP-LGM with covariate[a] (N = 3,415) | | | PP-LGM with covariate[b] (N = 3,415) | | | Intervention group PP-LGM (N = 2,014) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Residual Variances** | **Estimates** | **SE** | ***p* value** | **Estimates** | **SE** | ***p* value** | **Estimates** | **SE** | ***p* value** | **Estimates** | **SE** | ***p* value** |
| Intervention group | | | | | | | | | | | | |
| SK intercept | 8.98 | 0.73 | <0.001 | 8.16 | 0.72 | <0.001 | 8.30 | 0.73 | <0.001 | 8.13 | 0.74 | <0.001 |
| SK slope | 7.35 | 1.07 | <0.001 | 7.99 | 1.15 | <0.001 | 7.95 | 1.16 | <0.001 | 6.95 | 1.12 | <0.001 |
| SA intercept | 97.56 | 13.67 | <0.001 | 74.61 | 14.06 | <0.001 | 73.51 | 14.04 | <0.001 | 75.56 | 14.84 | <0.001 |
| SA slope | 37.45 | 17.34 | 0.031 | 29.92 | 18.94 | 0.114 | 27.12 | 19.00 | 0.153 | 26.13 | 19.29 | 0.176 |
| Control group | | | | | | | | | | | | |
| SK intercept | 11.68 | 0.85 | <0.001 | 9.76 | 0.77 | <0.001 | 10.00 | 0.79 | <0.001 | NA | NA | NA |
| SK slope | 1.31 | 0.56 | 0.02 | 1.03 | 0.67 | 0.122 | 0.99 | 0.7 | 0.159 | NA | NA | NA |
| SA intercept | 133.73 | 9.25 | <0.001 | 103.49 | 8.51 | <0.001 | 105.18 | 8.51 | <0.001 | NA | NA | NA |
| SA slope | 16.91 | 6.38 | 0.008 | 10.45 | 4.73 | 0.027 | 10.60 | 4.58 | 0.021 | NA | NA | NA |
| Model fit | | | | | | | | | | | | |
| RMSEA (90%CI) | 0.092 (0.080-0.106) | | | 0.017 (0.009-0.025) | | | 0.017 (0.009-0.024) | | | 0.021 (0.012-0.030) | | |
| CFI | 0.983 | | | 0.997 | | | 0.997 | | | 0.995 | | |
| TLI | 0.950 | | | 0.990 | | | 0.990 | | | 0.985 | | |
| SRMR | 0.033 | | | 0.012 | | | 0.013 | | | 0.013 | | |
| R-Squared | | | | | | | | | | | | |
| slope of the intervention group | | | | | | | | | | | | |
| SK | NA | NA | NA | 0.12 | 0.02 | <0.001 | 0.12 | 0.02 | <0.001 | 0.28 | 0.04 | <0.001 |
| SA | NA | NA | NA | 0.15 | 0.09 | 0.081 | 0.18 | 0.11 | 0.096 | 0.34 | 0.17 | 0.043 |
| slope of the control group | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SK | NA | NA | NA | 0.02 | 0.02 | 0.151 | 0.03 | 0.02 | 0.104 | NA | NA | NA |
| SA | NA | NA | NA | 0.12 | 0.04 | 0.002 | 0.14 | 0.04 | 0.002 | NA | NA | NA |

Note: SK: sexuality knowledge, SA: sexuality attitude. [a] Sexuality content and time were included in the model as covariates. [b] Sexuality education at different schooling stages was included in the model as covariates. NA: not applicable

Appendix Table 2. The effects of duration of education and sessions covered on the intercepts and slopes of sexuality knowledge and attitude

| | | SK Intercept | | | SK Slope | | | SA Intercept | | | SA Slope | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Estimate** | **SE** | ***p*** | **Estimate** | **SE** | ***p*** | **Estimate** | **SE** | ***p*** | **Estimate** | **SE** | ***p*** |
| Age | Intervention | 0.26 | 0.10 | 0.013 | -0.17 | 0.11 | 0.123 | -0.17 | 0.33 | 0.618 | -0.37 | 0.37 | 0.325 |
| | Control | 0.15 | 0.12 | 0.181 | -0.03 | 0.07 | 0.634 | -0.72 | 0.38 | 0.055 | -0.03 | 0.18 | 0.855 |
| Sex | Intervention | 0.84 | 0.16 | <0.001 | 1.26 | 0.19 | <0.001 | 6.72 | 0.53 | <0.001 | 3.20 | 0.56 | <0.001 |
| | Control | 0.66 | 0.20 | 0.001 | 0.15 | 0.12 | 0.208 | 6.48 | 0.68 | <0.001 | 2.06 | 0.49 | <0.001 |
| Minority | Intervention | -0.35 | 0.19 | 0.062 | -0.31 | 0.22 | 0.147 | -1.25 | 0.61 | 0.039 | -0.06 | 0.69 | 0.933 |
| | Control | -1.00 | 0.24 | <0.001 | 0.08 | 0.12 | 0.520 | -2.98 | 0.78 | <0.001 | -0.23 | 0.42 | 0.580 |
| School Bully Perception | Intervention | -0.21 | 0.08 | 0.007 | -0.34 | 0.09 | <0.001 | -1.15 | 0.26 | <0.001 | -0.60 | 0.34 | 0.073 |
| | Control | -0.32 | 0.09 | <0.001 | 0.00 | 0.05 | 0.928 | -1.20 | 0.38 | 0.002 | 0.07 | 0.20 | 0.726 |
| Location | Intervention | -0.90 | 0.20 | <0.001 | 0.82 | 0.22 | <0.001 | -3.98 | 0.65 | <0.001 | 1.78 | 0.65 | 0.006 |
| | Control | -0.36 | 0.23 | 0.126 | 0.01 | 0.14 | 0.957 | -1.53 | 0.74 | 0.039 | 0.26 | 0.37 | 0.484 |
| Romantic Relationship | Intervention | 0.57 | 0.18 | 0.002 | -0.53 | 0.20 | 0.009 | -0.02 | 0.59 | 0.975 | -0.46 | 0.63 | 0.464 |
| | Control | 0.21 | 0.22 | 0.339 | -0.13 | 0.14 | 0.368 | -0.79 | 0.73 | 0.280 | -0.12 | 0.35 | 0.728 |
| Sexual Experience | Intervention | 1.48 | 0.25 | <0.001 | -1.07 | 0.27 | <0.001 | 1.19 | 0.79 | 0.131 | -0.42 | 0.86 | 0.626 |
| | Control | 1.41 | 0.30 | <0.001 | -0.09 | 0.16 | 0.595 | 1.27 | 0.99 | 0.198 | -1.04 | 0.58 | 0.071 |
| Sexual Harassment | Intervention | 0.78 | 0.20 | <0.001 | -0.10 | 0.22 | 0.656 | 1.12 | 0.72 | 0.122 | 2.43 | 0.72 | 0.001 |
| | Control | 1.40 | 0.25 | <0.001 | -0.13 | 0.12 | 0.276 | 3.75 | 0.89 | <0.001 | 0.01 | 0.43 | 0.988 |
| Same Sex Intercourse | Intervention | 0.65 | 0.38 | 0.085 | -0.91 | 0.45 | 0.042 | 0.58 | 1.28 | 0.652 | -3.19 | 1.30 | 0.014 |
| | Control | 0.32 | 0.48 | 0.507 | -0.21 | 0.26 | 0.416 | -0.60 | 1.85 | 0.746 | -0.21 | 0.93 | 0.820 |
| Parent Divorce | Intervention | 0.60 | 0.24 | 0.012 | -0.19 | 0.27 | 0.477 | 2.29 | 0.75 | 0.002 | 1.21 | 0.77 | 0.117 |
| | Control | 0.09 | 0.28 | 0.755 | 0.18 | 0.13 | 0.172 | 0.54 | 1.00 | 0.587 | 0.53 | 0.49 | 0.280 |
| Duration of Sexuality | Intervention | 0.16 | 0.07 | 0.018 | -0.10 | 0.09 | 0.250 | -0.27 | 0.23 | 0.237 | 0.30 | 0.24 | 0.210 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Education Received | | | | | | | | | | | | | |
| | Control | 0.11 | 0.09 | 0.234 | -0.04 | 0.05 | 0.472 | 0.19 | 0.32 | 0.558 | -0.11 | 0.18 | 0.519 |
| Sessions Covered in Sexuality education | | | | | | | | | | | | | |
| Experience | Intervention | 0.13 | 0.04 | 0.002 | -0.09 | 0.05 | 0.062 | 0.50 | 0.14 | ＜0.001 | -0.10 | 0.14 | 0.506 |
| | Control | 0.21 | 0.05 | ＜0.001 | 0.00 | 0.03 | 0.998 | 0.49 | 0.17 | 0.004 | -0.07 | 0.09 | 0.460 |
| Curriculum Progress | Intervention | 0.09 | 0.03 | 0.001 | 0.45 | 0.04 | ＜0.001 | 0.28 | 0.09 | 0.002 | 1.01 | 0.12 | ＜0.001 |

Note: SK: sexuality knowledge, SA: sexuality attitude

Appendix Table 3. The effects of different sexual education periods on the intercepts and slopes of sexuality knowledge and attitude

| | | SK Intercept | | | SK Slope | | | SA Intercept | | | SA Slope | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Estimate** | **SE** | ***p*** | **Estimate** | **SE** | ***p*** | **Estimate** | **SE** | ***p*** | **Estimate** | **SE** | ***p*** |
| Age | Intervention | 0.25 | 0.11 | 0.018 | -0.17 | 0.11 | 0.135 | -0.22 | 0.33 | 0.503 | -0.34 | 0.37 | 0.363 |
| | Control | 0.17 | 0.12 | 0.148 | -0.03 | 0.07 | 0.634 | -0.68 | 0.38 | 0.073 | -0.03 | 0.18 | 0.857 |
| Sex | Intervention | 0.90 | 0.17 | ＜0.001 | 1.22 | 0.19 | ＜0.001 | 6.81 | 0.54 | ＜0.001 | 3.30 | 0.56 | ＜0.001 |
| | Control | 0.72 | 0.21 | ＜0.001 | 0.16 | 0.12 | 0.186 | 6.65 | 0.69 | ＜0.001 | 2.07 | 0.49 | ＜0.001 |
| Minority | Intervention | -0.36 | 0.19 | 0.061 | -0.32 | 0.22 | 0.140 | -1.29 | 0.61 | 0.034 | -0.05 | 0.69 | 0.947 |
| | Control | -1.04 | 0.24 | ＜0.001 | 0.07 | 0.12 | 0.526 | -3.09 | 0.78 | ＜0.001 | -0.21 | 0.42 | 0.622 |
| School Bully Perception | Intervention | -0.21 | 0.08 | 0.007 | -0.34 | 0.09 | ＜0.001 | -1.19 | 0.26 | ＜0.001 | -0.58 | 0.34 | 0.084 |
| | Control | -0.31 | 0.09 | ＜0.001 | -0.01 | 0.05 | 0.908 | -1.18 | 0.38 | 0.002 | 0.06 | 0.20 | 0.772 |
| Location | Intervention | -0.87 | 0.20 | ＜0.001 | 0.79 | 0.22 | ＜0.001 | -4.06 | 0.65 | ＜0.001 | 1.74 | 0.65 | 0.008 |
| | Control | -0.37 | 0.24 | 0.126 | -0.01 | 0.13 | 0.929 | -1.57 | 0.76 | 0.038 | 0.28 | 0.37 | 0.453 |
| Romantic Relationship | Intervention | 0.64 | 0.19 | 0.001 | -0.57 | 0.21 | 0.005 | 0.14 | 0.59 | 0.809 | -0.52 | 0.63 | 0.407 |
| | Control | 0.24 | 0.22 | 0.275 | -0.12 | 0.14 | 0.389 | -0.72 | 0.73 | 0.324 | -0.13 | 0.36 | 0.726 |
| Sexual Experience | Intervention | 1.56 | 0.25 | ＜0.001 | -1.10 | 0.28 | ＜0.001 | 1.49 | 0.79 | 0.060 | -0.50 | 0.86 | 0.565 |
| | Control | 1.51 | 0.31 | ＜0.001 | -0.08 | 0.16 | 0.609 | 1.48 | 0.98 | 0.132 | -1.09 | 0.58 | 0.059 |
| Sexual Harassment | Intervention | 0.83 | 0.21 | ＜0.001 | -0.12 | 0.22 | 0.588 | 1.34 | 0.72 | 0.063 | 2.35 | 0.71 | 0.001 |
| | Control | 1.42 | 0.26 | ＜0.001 | -0.12 | 0.12 | 0.299 | 3.79 | 0.89 | ＜0.001 | 0.03 | 0.43 | 0.954 |
| Same Sex Intercourse | Intervention | 0.71 | 0.38 | 0.062 | -0.97 | 0.45 | 0.033 | 0.56 | 1.30 | 0.667 | -3.24 | 1.32 | 0.014 |
| | Control | 0.24 | 0.48 | 0.623 | -0.22 | 0.26 | 0.389 | -0.80 | 1.86 | 0.666 | -0.21 | 0.94 | 0.824 |
| Parent Divorce | Intervention | 0.60 | 0.24 | 0.013 | -0.18 | 0.28 | 0.515 | 2.37 | 0.75 | 0.002 | 1.17 | 0.77 | 0.131 |
| | Control | 0.07 | 0.28 | 0.793 | 0.18 | 0.13 | 0.174 | 0.54 | 1.00 | 0.589 | 0.51 | 0.49 | 0.299 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Primary School | | | | | | | | | | | | | |
| Sexuality Education | Intervention | 0.50 | 0.27 | 0.064 | -0.50 | 0.29 | 0.089 | 0.88 | 0.94 | 0.347 | -1.31 | 0.95 | 0.168 |
| | Control | 0.72 | 0.36 | 0.045 | 0.08 | 0.17 | 0.640 | 1.49 | 1.27 | 0.242 | 1.10 | 0.62 | 0.075 |
| Junior High School | | | | | | | | | | | | | |
| Sexuality Education | Intervention | 0.47 | 0.17 | 0.007 | -0.45 | 0.19 | 0.021 | -0.28 | 0.55 | 0.617 | 1.43 | 0.59 | 0.016 |
| | Control | 0.69 | 0.22 | 0.002 | -0.10 | 0.17 | 0.539 | 2.04 | 0.69 | 0.003 | -0.74 | 0.37 | 0.044 |
| Vocational High School | | | | | | | | | | | | | |
| Sexuality Education | Intervention | 0.49 | 0.19 | 0.011 | -0.19 | 0.21 | 0.373 | 1.39 | 0.63 | 0.026 | -0.59 | 0.63 | 0.350 |
| | Control | 0.46 | 0.24 | 0.058 | -0.19 | 0.12 | 0.110 | 0.64 | 0.82 | 0.435 | -0.77 | 0.45 | 0.088 |
| Curriculum Progress | Intervention | 0.10 | 0.03 | 0.001 | 0.44 | 0.04 | ＜0.001 | 0.29 | 0.09 | 0.001 | 1.00 | 0.12 | ＜0.001 |

Note: SK: sexuality knowledge, SA: sexuality attitude

# Impact of school-based online comprehensive sexuality education on Vocational High School Students in China: a cluster randomized controlled trial

Note: This protocol adheres to the Consensus Statement for Protocols of Factorial Randomized Trials: Extension of the SPIRIT 2013 Statement [28], with some modifications.

## Administrative information

### *Trial registration*

Chinese Clinical Trial Registry (Registration No: ChiCTR1900021582)

### *Protocol version*

Version 2. 24 March 2019

### *Funding*

Kadoorie Charitable Foundation

### *Principal Investigator*

Vanke School of Public Health, Tsinghua University, No. 30, Shuangqing Road, Haidian District, Beijing, 100084, PR China. Tel: +86 13671129425 Email: tangk@mail.tsinghua.edu.cn

## Introduction

### *Background and rationale*

Reproductive health services encompass a series of effective interventions to prevent

the spread of sexually transmitted infections (STIs), ensure safe pregnancies, childbirth, or abortions, and avoid unintended pregnancies [1]. Sexually transmitted infections can lead to pelvic inflammatory disease, infertility, cervical cancer, and HIV infection. Maternal mortality and infant mortality are closely linked to pregnancy, childbirth, and abortion [2]. Unintended pregnancies increase the burden of child-rearing and have implications for maternal and child health, as well as economic and social impacts [3]. Since the 1990s, China has recognized and taken steps to address the reproductive health needs of young people. However, with the rapid development of society, issues related to adolescent sexual behaviors remain severe [4].

Over the past 30 years of rapid economic reforms and social development, sexual activity among Chinese adolescents has become increasingly prevalent [5]. A nationwide study in 2013 revealed that approximately 24.2% of the surveyed young people had engaged in premarital sexual activities before the age of 18 [6]. In China, including 109,754 students from 18 provinces in grades ten to twelve, 4.8% of students reported having experienced sexual intercourse, with 32.8% of them reporting instances of forced sex [7]. In a study conducted in seven Chinese cities, it was found that around 30-40% of young people did not use any contraception during their most recent sexual encounter. Among those who engaged in premarital sexual activities, about 20% admitted to experiencing unintended pregnancies, with the majority opting for termination through induced abortion [8]. Furthermore, the burden of sexually transmitted diseases, including HIV/AIDS, has surged, posing a high-risk health scenario for Chinese adolescents [9].

Adolescents lack sexuality knowledge and exhibit negative attitudes towards sexuality [10], especially those from vocational schools, which increase the risk of sexually

transmitted diseases (STDs) [11,12]. Students demonstrated a correct response rate of only 56.3% for safe sex information and 58.6% for HIV/AIDS information [13]. In another study, vocational high school students exhibited a 52.08% awareness rate regarding AIDS. In comparison, college students (OR: 1.44; 95% CI: 1.37–1.52) and undergraduate programs (OR: 3.18; 95% CI: 2.95–3.43) demonstrated higher awareness rates of HIV [14].

However, sexuality education in China is not comprehensive, particularly for lower socio-economic status groups. It lacks comprehensiveness, with reproductive and contraceptive information mentioned in less than one-third of school settings [19]. Institutional discrimination and stratification within China's education system pose challenges to the promotion of CSE in vocational high schools [20]. Firstly, pre-service teacher education programs in China tend to prioritize subject knowledge, often neglecting practical skills [21]. Moreover, schools lack standardized teaching materials and guidelines for CSE [20], and sexuality education courses are often merged with physiology courses conducted by untrained teachers [20, 22]. Thirdly, traditional Chinese culture led to the ambiguity of sexuality education standards for students and teachers. Teachers tell students that sexual contact will make them depraved [20], and even promotes sexual abstinence [23]. These factors result in vocational high school students having a low interest in learning about sexuality knowledge, leading to low classroom participation [20].

In addition, the urgent need for sexuality education is more pronounced in lower socio-economic status groups [24] and among adolescents in western rural areas [14,25]. Online comprehensive sexuality education (OCSE) is a potential solution to solve issues above. Therefore, the primary objective of this research is to assess the status of OCSE among

Chinese vocational high school students in less developed areas.

*You and Me* is a structured, standardized, and school-based course in China, aimed at providing opportunities to enhance sexuality education for children and adolescents in underdeveloped areas. It also aims to offer more targeted and standardized OCSE for vulnerable populations such as vocational school students. As of September 2018, 21,039 students from 24 schools and have participated in *You and Me*. However, there is a lack of quantifiable assessment of the outcomes.

***Objectives***

To assess the efficacy of OCSE in the future, a large-scale cluster randomized controlled trial (RCT) will be conducted to evaluate the enhancement of children's sexuality knowledge, attitude, self-efficacy, and sexual and reproductive health outcomes at grade ten.

***Trial design***

Two-arm parallel-group cluster RCT

**Methods**

***Study setting***

A two-arm parallel-group cluster RCT will be conducted in Guangdong and Yunnan provinces in China to compare the OCSE (*You and Me*) with usual sexuality education as a control. The *You and Me* package was developed by Marie Stopes International China according to the International technical guidance on sexuality education (ITGSE) and Sexuality Education Review and Assessment Tool (SERAT), used to provide free and standardized CSE to adolescents. *You and Me* contains a series of eight teacher-

assisted OCSE sessions, including understanding gender, reproductive system and puberty, pregnancy and contraception, relationship and value, media literacy and well-being skills, disease and behavior, sexual violence, love and marriage.

The intervention was delivered between April 2019 and June 2019, focusing on the general practices of the *You and Me* education program in Zhongshan city (Guangdong Province) and Kunming city (Yunnan Province), two regions in China with significant differences in both economic and sexuality education status. In 2022, Guangdong province had a population of 127 million and a GDP exceeding 12.95 trillion-yuan, maintaining its position as the top-ranked province among the 34 provinces in China for 34 consecutive years, with the second-highest increment in the nation. In contrast, Yunnan lagged behind with a population of 47 million and a GDP of 2.89 trillion-yuan, ranking 18th nationwide. A sexuality knowledge, attitudes, and practices survey conducted in five regions revealed notable disparities between Guangdong and Yunnan provinces. This includes the prevalence of sexually transmitted diseases (Guangdong vs. Yunnan vs. average: 2.5% vs 3.2% vs 3.0%), opposition to premarital sexual activity (54.7% vs 68.2% vs 61.2%), correct rate for HIV/AIDS transmission routes (74.9% vs 63.5% vs 73.0%), and peer acceptance of studying study in the same class with AIDS/HIV-infected individuals (36.7% vs 25.1% vs 29.0%) [29].

***Eligibility criteria***

The trial will target mixed-gender vocational high schools, which will be public institutions with more than 100 grade ten students. Schools that will have already implemented a CSE program or have plans to do so in the upcoming year will be excluded.

### *Intervention*

The *You and Me* package is a structured, standardized, and school-based course in China. It was developed by Marie Stopes International China according to the International technical guidance on sexuality education (ITGSE) and Sexuality Education Review and Assessment Tool (SERAT). The *You and Me* aimed at providing opportunities to enhance sexuality education for children and adolescents in underdeveloped areas. It also aims to offer more targeted and standardized OCSE for vulnerable populations such as vocational school students. *You and Me* contains a series of eight teacher-assisted OCSE sessions, including understanding gender, reproductive system and puberty, pregnancy and contraception, relationship and value, media literacy and well-being skills, disease and behavior, sexual violence, love and marriage. As of September 2018, 21,039 students from 24 schools and have participated in *You and Me*. However, there is a lack of quantifiable assessment of the outcomes.

Before the program, Xi'an Guangyuan Assistance Charity Centre will provide training to teachers in the intervention groups, following the International Technical Guidance on Sexuality Education (ITGSE). To acquaint teachers with the content of the *You and Me* OCSE and enhance their teaching skills, video recordings of trained educators conducting each session will be provided as references. The training process will be supervised by the education bureaus in each city. At least two teachers from each school will undergo the training, ensuring that every class has trained teachers. In Kunming city, under the supervision of the Family Planning Association (FPA) and the Health Care Center for Adolescents (HCCA) in Zhongshan, Tsinghua University's School of Public Health will assess the knowledge levels of the trained teachers through interviews based on the ITGSE. Teachers who do not meet the standards will undergo additional half-day training until passing the assessment. Control groups will have no

systematic CSE program but may be exposed to regular sexuality education.

Outcomes will be evaluated by trained health researchers from Tsinghua University and Peking University, all under the supervision of the local FPA or HCCA. People collecting questionnaire data will be independent of the intervention implementation team and masked to the allocation of communes to trial groups. Data will be collected in 3 waves: at baseline, in post-intervention (after 8 weeks of education), first follow-up (12 months since post-intervention).

From April 2019 to June 2019, the *You and Me* program will be conducted for OCSE group once a week for 45 minutes each session, totaling eight sessions and 360 minutes. Each session will include 2-3 participatory activities, involving teacher-led organization of interactive elements, such as scenario simulations for sexual harassment and demonstrations on the use of condoms. Teachers will address classroom questions and will be encouraged to adhere to the manual to maintain standardization. After class, teachers will be required to document the classroom situation. Each school will report a fixed class time, and the implementation of the courses will be randomly inspected by the FPA and the HHIPSS. Trained health researchers will conduct 30-minute semi-structured interviews with teaching staff in the intervention group. Additionally, in each school of the intervention group, 5-10 students will be randomly selected to participate in focus group interviews to understand the experiences and suggestions of the *You and Me* OCSE.

The post-intervention follow-up will be conducted in June 2019. The second follow-up was conducted in June 2020.

### *Measures*

*Primary Outcome Measures:*

To the best of our knowledge, there is no validated scale for assessing Chinese adolescent sexuality knowledge and sexuality attitudes based on CSE. Existing scales such as The Sex Knowledge and Attitudes Test - Adolescents (SKAT-A) and Global Early Adolescent Study do not cover all CSE content. They are lengthy and do not align with the Chinese context, causing confusion among high school students during pre-testing.

Therefore, the International technical guidance on sexuality education (ITGSE) and Sexuality Education Review and Assessment Tool (SERAT) were used as references to construct dimensions, and sexual and reproductive health and rights experts ultimately designed the sexuality knowledge and attitude scales.

**Sexuality knowledge:**

The sexuality knowledge questionnaire comprised 20 true-or-false questions on reproductive system and puberty, pregnancy and contraception, disease and behavior, sexual violence. Participants received one point for each correct answer.

Sexuality attitudes are assessed by a 20-item Likert scale on Understanding Gender, Relationship and Value, Media Literacy, and Well-being skills, Sexual Violence, Love, and Marriage. Each item has 7 response options, ranging from strongly disagree to strongly agree. The measurement is conducted three times. The total score ranges between 0 and 20, with a higher score indicating better sexuality knowledge.

**Sexuality attitude:**

Sexuality attitudes are assessed by a 20-item Likert scale on Understanding Gender, relationship and value, Media Literacy and Well-being skills, sexual violence, love and marriage. Each item has 7 response options, ranging from strongly disagree to strongly agree. The measurement is conducted three times. The total score ranges between 20 and 140, with a higher score indicating more positive sexuality attitude.

*Secondary Outcomes*

**Sexual intercourse**

Students will be asked how many times they had engaged in sexual intercourse.

**STD symptoms**

In accordance with the National Institutes of Health's classification of STD symptoms, we omit overly common symptoms such as abdominal pain and fever. Students will be asked whether they have experienced the following symptoms in the last year:

(a) Itching and redness in the genital area and anal itching, soreness, or bleeding

(b) Sores or warts on the genital area

(c) Unusual discharge or abnormal odor from the penis or vagina

(d) Painful or frequent urination

Due to the possibility of subtle changes in STD symptoms over two months, measurements will be taken at baseline and 14 months later, with a total of 2 assessments. The responses will be counted, and the total score ranges between 1 and 4.

**Contraceptive usage**

Students will be asked, “In the past year, what percentage of the time did you and your partner use condoms or short-acting birth control pills?”

4=100%

3=75% or more, less than 100%

2=50% or more, less than 75%

1=50% or less

**Unintended pregnant**

The measurement is conducted three times.

If students are female: “How many times have you been pregnant?”

If students are male: “How many times has your sexual partner been pregnant?”

**Self-efficacy**

The General Self-Efficacy Scale, validated in earlier research with China (Schwarzer et al., 1997), will be employed. It consists of 10 items, each offering four response options, ranging from not at all = 1 to absolutely right = 4. The measurement is conducted three times. The total score is calculated by finding the sum of all items. The total score ranges between 10 and 40, with a higher score indicating more self-efficacy.

**Harassment coping self-efficacy**

Students will be asked, “if they were to encounter forced sexual activity or sexual harassment, how confident are they in coping effectively?” Full coping confidence =5 No coping confidence =1. The total score ranges between 1 and 5, with a higher score indicating more harassment coping self-efficacy.

**School bully perception**

Students will be asked the frequency of Classmates’ sexual bullying/harassment

behavior. Not at all = 1, Very often = 7. The total score ranges between 1 and 5, with a higher score indicating more bully perception.

*Covariates*

Demographic information including age, sex, ethnicity, location, parental divorce. Sexual experiences, baseline school bully perception, curriculum progress and sexuality education experiences will be measured as covariates. Curriculum progress will be measured in the post-intervention. The students in the intervention group will be asked which lessons they attended in the past two months as part of the course package. The responses will be counted, and the total score will range between 0 and 8, with a higher score indicating that more content has been taught.

**Participant timeline**

Students will be recruited from March 23, 2019, to March 31, 2019. The baseline survey will conduct in April 2019. From April 2019 to June 2019, the *You and Me* program will be conducted once a week for 45 minutes each session, totalling eight sessions and 360 minutes. The post-intervention follow-up will be conducted in June 2019, with most schools completing the *You and Me* program. The second follow-up will be conducted in June 2020.

**Sample size**

The number of clusters and sample size were calculated with the CRTSize module in R (version 4.1.0). Based on previous studies in China [26,27], we assumed an allocation ratio of 1 and intraclass correlation coefficient (ICC) of 0.10, correct response rates of 50% for both Sexuality knowledge and attitude (with a standard deviation of 20%), a detection power of 80%, and an $\alpha$ value of 0.05, the minimum detectable difference

between population means was set at 10%. Given that there are approximately 60 students per vocational high school class, 120 students per cluster, we determined that a minimum of eight clusters, each with 120 students, would be required in intervention group and control group separately.

## Assignment of interventions

### *Sequence generation and Blinding*

Randomization will be at the level of school and class. School clusters will be the unit of randomization rather than individual practices as a key element of the intervention will be delivered at this level. Schools that meet the study inclusion criteria will be randomly allocated to the *You and Me* OCSE or control groups with an equal allocation ratio after being stratified by borough at Tsinghua University, Beijing, China. At the class level, two to four classes will be randomly chosen in each selected school as the smallest unit for the intervention to be delivered.

A masked statistician (KT) will generate randomization through a computerized process utilizing a random number generator and will oversee the development of the statistical analysis plan but will not conduct any analyses. Blinding will not be appropriate for this study as it involves education. Throughout the trial, researchers will remain unaware of cluster allocation. Statisticians conducting analyses (HC) will be blinded to allocation and will only be unmasked after the completion of data collection and analyses. Non-site-specific study ID numbers will be used on all schools and data collection forms to maintain blinding.

## Data Collection and Management

### *Data collection timeline*

Data collection for outcomes will occur at three specific timepoints: Baseline, 1-month Follow-up (post-intervention), and 12-month Follow-up. Participants who miss a session will be allowed to attend other sessions in the future.

***Data collection methods***

Each investigator will familiarize themselves with the questionnaire before data collection, understanding the purpose of each question to address students' inquiries during the survey.

Students will fill out the questionnaire via their mobile phones, and apart from research team members, no other local individuals (especially teachers) will be present during the questionnaire completion. The questionnaire filling process will be independently carried out by each student, and discussions will not be allowed. Prior to the commencement of the survey, students will be informed about the research content through written or oral communication. Research team members will clarify to students that they can choose not to participate in the questionnaire. However, emphasis will be placed on the completeness of questionnaire responses before the survey (as incomplete questionnaire information will be excluded from the study). Simultaneously, incomplete questionnaires will not be allowed to be submitted. To provide students with more privacy during the questionnaire completion process, half of the students will go to another classroom, with approximately 2 desks' distance between every two students. Students who are absent on the day of the questionnaire survey will fill out the questionnaire upon their return to school.

The study team will ensure adherence to the protocol and data confidentiality at each data collection point. Completed questionnaires will be handled by trained members of the study team who will have prior training on human subjects' ethical training.

***Investigator Workflow***

a. To ensure the questionnaire wording is appropriate and understandable for students, a pre-experiment will be conducted specifically for the questionnaire.

b. Teachers are requested to bring half of the students to another empty classroom, maintaining a distance of more than one desk between every two students.

c. Collect tablets corresponding to the number of students each is responsible for.

d. Upon entering the surveyed class, distribute the dedicated survey phones to the students.

e. Ask the teacher to leave the classroom.

f. Both the surveyors and students should turn off their private phones or put them on silent.

g. Introduce to the students [in a loud and friendly manner]: "Hello, everyone. We are researchers from Peking University. We are conducting a study on sexual education among Chinese adolescents. The purpose of this questionnaire is to understand adolescents' knowledge about reproduction, contraception, gender, and related topics. There are no right or wrong answers, and your responses will not affect your grades. The results of the questionnaire will contribute to the improvement of adolescent sexual education. Please answer independently. If you have any questions, feel free to ask me. Do not discuss or comment with each other, and do not look at others' questionnaires.

To protect your privacy, the answers written on this questionnaire will be sealed and kept confidential. No one, including school teachers, principals, or parents, except the researchers, will have access to the answers, and the researchers will not know your

name. We hope you can fill in the answers truthfully; providing false information may render the study invalid.

h. Guide students on how to use their phones and commence answering.

This questionnaire will be answered using mobile phones. Please click on the XX button on the desktop (specific description based on system settings) and fill out the questionnaire as instructed. When answering open-ended questions, use the tablet keyboard; for multiple-choice questions, select the "√" next to the option that best corresponds to your situation. If there are any issues during the skipping process or if there are technical problems such as tablet crashes, flashbacks, white screens, or lagging, please raise your hand, and I will help you. Students must click the "Submit" button to complete the survey, and you can only leave the classroom after the surveyor checks it.

i. Once students begin answering, ensure that no student feels that you can see their responses. You can stand on the podium. Only approach students if they raise their hands with questions, and avoid getting close to them otherwise.

j. When a student asks a question, hold a tablet and bring a blank questionnaire, inquire about the specific question in doubt without looking at their answers. Maintain an objective and neutral attitude when answering, avoiding hints or guiding them with personal opinions.

k. After the situation stabilizes, fill in the corresponding information on the record sheet.

l. Before allowing students to leave, check if the questionnaires have been submitted.

m. After collecting the tablets, return to the meeting room and regroup with other surveyors.

### *Data management*

These data consist of quantitative data generated from the survey and qualitative and quantitative data from process evaluations. The questionnaire will be administered using www.sojump.com, and the data will be promptly uploaded to thesojump database. After each baseline and follow-up assessment, data will be downloaded from the sojump software, cleaned, and stored in both Stata data file format and Excel spreadsheet format. We will collect data from approximately 30 schools (3000 individuals), and the data volume is estimated to be around 300MB. The data will be redundantly stored in three locations, including encrypted hard drives in secured offices at Peking University and Marie Stopes, as well as on a secure server at Peking University. All hard drives and files will be encrypted.

Data management will be jointly conducted by Peking University and the George Institute. Once the project is approved, a detailed data management plan will be formulated. Each participant will be assigned a unique identifier, which will be linked to identifiable personal information required for subsequent work. Identifiable personal information will be stored separately from other research information, with limited access granted only to authorized researchers for future research purposes. The data manager will regularly validate the data based on previously established principles and will issue inquiries to investigators who discover any issues. Once data collection is complete, all queries are resolved, data is cleaned, and the database is locked, statisticians will proceed with data analysis. To ensure data security and quality, the database will be temporarily locked between subsequent follow-up activities. Peking University provides secure storage space for each researcher in the long term. According to the data policies of Peking University and the George Institute, all electronic files will be securely stored using various physical and electronic security

controls.

Metadata includes descriptions of data, documentation of methods used to generate data, analysis and process information, documentation of data sources and their coding, and more. It also encompasses information about the approval and consent processes (including signed consent forms), quality assurance records demonstrating data validity, and compliance with protocols, collaboration agreements, management and agreements, and other relevant communications. All metadata will be recorded and saved in the forms of Word (.doc), PDF documents (.PDF), Excel (.xls), and Stata files (.dta). In addition to these formats, survey forms will be retained in their original form at the research institutions that generated these formats.

According to the policies of Peking University and the George Institute, all original research data and related materials will be retained for a minimum of 10 years from the date of publication. All research data will be securely stored in the offices of the research team, namely at Peking University and Marie Stopes International in China. At the end of the archival period, with approval from the MRC, the hard drives will be reused and/or all data will be overwritten.

**Relevant institutions, departments, or research data sharing and data security policies.**

| Policy | Link or Citation |
|---|---|
| Data Management Policy and Procedures | Data Ownership and Data Storage Policy, The George Institute for Global Health, 2013; Tsinghua University Data Management Protection Procedures, 2015 |
| Data Security Policy | Peking University Data Management Protection Procedures, 2015 |
| Data Sharing Policy | Data Access and Sharing Policy, The George Institute for Global Health, 2017 |

### *Data quality control*

Before the formal commencement of the trial, a pilot pre-testing and validation will be conducted on structured questionnaires, semi-structured group discussion outlines, and interview guides to ensure the effectiveness and feasibility of the data collection methods.

The survey questionnaires will be administered by the research team and local survey personnel. Local personnel will receive training and testing from the research team before the trial begins. Individuals with conflicts of interest, such as teachers, will be excluded from the classroom during the survey process. This ensures that students can answer questions without feeling nervous or hesitant, and each student has sufficient space and privacy. Inspectors will conduct regular data checks at each research site to ensure the accuracy of the data collection process and the quality of the data. At least 20% of the questionnaires at each location will be checked each time, and more if necessary. Separate group discussions for teachers and students will be used to obtain timely feedback. These will be facilitated by two trained surveyors, each with 8-10 participants. One surveyor will facilitate the group discussion, while the other will record the discussion and the process. All groups will use standardized and localized discussion outlines and prompts. After the discussions and interviews, new concepts will be extracted from the data to adjust subsequent discussion and interview outlines. Discussions and interviews will be discontinued when information reaches saturation. The collected data will be coded and analysed by two independent researchers using NVivo software. Any discrepancies in the coding process will be discussed to reach a consensus.

### *Statistical methods*

This stidy will perform a parallel multigroup latent growth model (LGM) with freely estimated slopes. LGM is a method for modeling repeated measures as latent variables composed of a random intercept and random slopes that will permit individual trajectories of change over time. The intercept refers to the initial sexuality knowledge and attitude, while the slope represents the growth rate. When estimated freely, trajectories will not be constrained to a linear trend, which will explicate the effect of the intervention. The parallel process will estimate the relationship between the sexuality knowledge and attitude growth factors. Multigroup analysis will be used to compare differences between two groups. Thus, it will be appropriate in this study. Before the LGM, we will conduct two separate unconditional LGMs to capture the trajectories. Second, intervention will employed to divide the multigroup. Then, we will add all covariates to the parallel process of latent growth curve modeling to examine their effect. We will finally add curriculum progress as predictors in the intervention group.

The mixed-effects model (MEM) will be employed to measure secondary outcomes in the future. It will allow both fixed and random effects, particularly useful when there is non-independence in the data. Due to the potential correlations among students resulting from class and regional factors, this method will be appropriate. It will use group and time as main effects to examine secondary outcomes. A pairwise comparison with Bonferroni correction will be performed to compare differences between the intervention groups whenever a group × time interaction effect is observed.

## Monitoring

### *Data monitoring*

An external data monitoring committee will not be recruited for this trial. The study team is comprised of psychologists and biostatisticians. These expert clinicians and biostatisticians will provide assessment of the data, safety, scientific validity, and integrity of the trial.

### *Harms*

To regulate and report adverse events during implementation, the study team will adapt emergency protocols which were developed for a previous study. These protocols provide guidelines for assessing risk if and when study participants report suicidal ideation or intent or cases of substance use, bullying or abuse. Supervisors will receive a course focused on these protocols during their training, while fellows will receive guidelines on how to respond to participants who report severe mental health distress and how to refer such participants to their supervisor. After a group leader's referral, the supervisor will use the emergency protocols to assess whether a participant is at risk. If a participant appears to be at risk, the supervisor will then set up individual follow-up sessions with the participant.

In instances of medium-risk and high-risk cases, the supervisors will work with the expert clinician in the study team to monitor the cases, and we will inform the school officials. In low-risk cases, supervisors will still work with the expert clinician to monitor the cases, however we will not inform the school. Our team will communicate all low-, medium- and high-risk cases to the Tsinghua University Ethics Review Committee.

### *Auditing*

All schools will undergo supervision from the FPA or the HCCA during teacher training and outcomes evaluation. Additionally, each school will be audited at least three times for the other aspects, including the school's acceptance of the project, participant recruitment, informed consent procedures, randomization processes, survey questionnaires, the implementation of the courses, follow-up inspections, and data analysis.

### Auditing list

Please evaluate the following aspects based on the actual situation, assigning scores from 1 to 5 for each item, where 1 represents very poor, 2 is fairly poor, 3 is average, 4 is fairly good, and 5 is very good.

| Supervision Phase | Supervision Content | Score | Stage Score |
|---|---|---|---|
| Participant Recruitment, Enrollment, Survey (50) | School's evaluation of the project | | |
| | School's acceptance of the project | | |
| | Proactiveness in school implementation | | |
| | Participants' compliance with the inclusion criteria in the experimental plan | | |
| | Consistency of the recruitment process with the experimental plan | | |
| | Consistency of recruitment numbers with the experimental plan | | |
| | Participants and their guardians signing informed consent forms, understanding the content fully | | |
| | Truthfulness and completeness of information in the survey questionnaire | | |
| | Participant understanding of the survey questionnaire content | | |
| | Undisturbed completion of the questionnaire by participants | | |
| Randomization (10) | Scientific and strict adherence to the randomization process according to the experimental plan | | |
| | Comparability between the intervention and control groups, with no significant differences in characteristics | | |
| Intervention | Adherence to the experimental plan in intervention implementation (including | | |

| | | | |
|---|---|---|---|
| Implementation (10) | intervention frequency and content) | | |
| | Confirmation that participants did not receive other sexual education during the project implementation (except for sexual education provided in biology classes or AIDS lectures) | | |
| Post-Intervention Survey (20) | Truthfulness and completeness of information in the survey questionnaire | | |
| | Participant understanding of the survey questionnaire content | | |
| | Undisturbed completion of the questionnaire by participants (free from interference by teachers, classmates, etc.) | | |
| | Assurance of privacy during questionnaire completion (conducted in separate classrooms) | | |
| Follow-up (15) | Establishment of a convenient WeChat group for follow-up | | |
| | Adherence to the follow-up survey timing according to the experimental plan | | |
| | Consistency of followed-up participants with the initial cohort | | |
| Data Analysis (10) | Timely saving and backup of data, ensuring security | | |
| | Rigorous, unbiased, and strict adherence to the experimental plan in the data analysis process | | |
| Total Score | | | |

## Ethics and dissemination

### *Research ethics approval*

Approval was obtained from Tsinghua University Institutional Review Board (Project No: 20,190,009), and the trial was duly registered with the Chinese Clinical Trial Registry (Registration No: ChiCTR1900021582).

### *Protocol amendments*

Any protocol amendments upon which the study team has agreed will be communicated to the Tsinghua University Ethics Review Committee via email. Such amendments will

also be added to our online ChiCTR trial registration. Amendments that are relevant to trial participants will be communicated via phone calls each school's contact person who will then inform the students in person.

***Consent or assent***

Written informed consents will be obtained from schools and students. For students under the age of 18, written consent will be provided by their legal guardians. All data will be under a waiver of consent as per data sharing and ethical approval agreements.

***Confidentiality***

In addition to all study team members receiving the human research protection training, additional training will be conducted on confidentiality and ethical considerations in the China's vocational high school context. School teachers will receive training on emergency case management prior to study implementation. This will ensure participants demonstrating distress can be assisted by clinical supervisors on site.

The questionnaires in this study will all be completed online using mobile phones. This study does not link identifiable information (name, birthday, etc.) to other data at any step. After enrolling and grouping the subjects, the researchers will collect student-identifiable information through the school and create a Non-site-specific ID number for each student. During the baseline and follow-up questionnaires, students are only required to fill in their own ID number without having to fill in any personally identifiable information. Baseline and follow-up data will be linked by the Non-site-specific ID number. The Non-site-specific ID number and corresponding personal identifiable information will be stored in the encrypted file cabinet in Tsinghua University School of Medicine. Researchers must have agreements from the whole team in order to open the cabinet and obtain the data. This identifiable information will be

destroyed within ten years of the end of the study. The data will be recorded on the ResMan platform. Additionally, only fully de-identified data will be used in the analysis and made public.

**Declaration of interests**

There are no competing interests to declare.

**Data sharing statement**

All researchers have full access to the data. De-identified individual participant data that underlie our study's results will be openly available for 3 years post-publication. Data is available to anyone upon a reasonable request.

**Reference**

1. Glasier A, Gülmezoglu AM, Schmid GP, Moreno CG, Van Look PF. Sexual and reproductive health: a matter of life and death. Lancet. 2006;368(9547):1595-1607.

2. Fang J, Kaufman J. Reproductive health in China: improve the means to the end. Lancet. 2008;372(9650):1619-1620.

3. Goto A, Yasumura S, Yabe J, Reich MR. Addressing Japan's fertility decline: influences of unintended pregnancy on child rearing. Reprod Health Matters. 2006;14(27):191-200.

4. Shah IH. Improving Sexual and Reproductive Health of Young People in China: Shaping the Future. Reproduction and contraception. 2004;15(1):1-8.

5. Zhou H, et al. Contraceptive knowledge, attitudes and behavior about sexuality among college students in Beijing, China. Chinese Medical Journal. 2012;125(6):1153-1157.

6. Zhou Y, et al. A blind area of family planning services in China: unintended pregnancy among unmarried graduate students. BMC Public Health. 2013;13(1):198.

7. Song Y, Ji C-Y. Sexual intercourse and high-risk sexual behaviors among a national sample of urban adolescents in China. Journal of Public Health. 2010;32(3):312-21.

8. Long L, et al. Association between college health services and contraceptive use among female students at five colleges in Wuhan, China: a cross-sectional study. BMC Public Health. 2016;16(1):929.

9. Zhang J, Ma B, Han X, Ding S, Li Y. Global, regional, and national burdens of HIV and other sexually transmitted infections in adolescents and young adults aged 10–24 years from 1990 to 2019: a trend analysis based on the Global Burden of Disease Study 2019. The Lancet Child & Adolescent Health. 2022;6(11):763-76.

10. Engel DMC, Paul M, Chalasani S, Gonsalves L, Ross DA, Chandra-Mouli V, et al. A Package of Sexual and Reproductive Health and Rights Interventions—What Does It Mean for Adolescents? Journal of Adolescent Health. 2019;65(6, Supplement):S41-S50.

11. Zhang J, Ma B, Han X, Ding S, Li Y. Global, regional, and national burdens of HIV and other sexually transmitted infections in adolescents and young adults aged 10-24 years from 1990 to 2019: a trend analysis based on the Global Burden of Disease Study 2019. The Lancet Child & Adolescent Health. 2022;6(11):763-76.

12. Liang M, Simelane S, Fortuny Fillo G, Chalasani S, Weny K, Salazar Canelos P, et al. The State of Adolescent Sexual and Reproductive Health. Journal of Adolescent Health. 2019;65(6, Supplement):S3-S15.

13. Cai Y, Ye X, Shi R, Xu G, Shen L, Ren J, et al. Predictors of consistent condom use based on the Information-Motivation-Behavior Skill (IMB) model among senior

high school students in three coastal cities in China. BMC Infectious Diseases. 2013;13(1):262.

14. Yu J. Teenage sexual attitudes and behavior in China: a literature review. Health & Social Care in the Community. 2012;20(6):561-82.

15. Education Mo. Text guideline for life safety and health education into primary and secondary school curriculum 2021 [Available from: https://hudong.moe.gov.cn/srcsite/A26/s8001/202111/t20211115_579815.html.

16. Herat J, Plesons M, Castle C, Babb J, Chandra-Mouli V. The revised international technical guidance on sexuality education - a powerful tool at an important crossroads for sexuality education. Reproductive Health. 2018;15(1):185.

17. Ramírez-Villalobos D, Monterubio-Flores EA, Gonzalez-Vazquez TT, Molina-Rodríguez JF, Ruelas-González MG, Alcalde-Rabanal JE. Delaying sexual onset: outcome of a comprehensive sexuality education initiative for adolescents in public schools. BMC Public Health. 2021;21(1):1439.

18. Goldfarb ES, Lieberman LD. Three Decades of Research: The Case for Comprehensive Sex Education. Journal of Adolescent Health. 2021;68(1):13-27.

19. Fang Y, Zheng Y, Jin Y, Yu C, Zuo X, Lian Q, et al. Sexual-Related Knowledge, School and Family Sexuality Education and Its Association with Experience of Sexual Intercourse among Vocational Secondary School Students in China. Children. 2022;9(8):1206.

20. Liu C. Secondary Education and Class Stratification: Understanding the Hierarchy of Sexuality Education in a Chinese Vocational High School. Children. 2022;9(10):1524.

21. Xiong Z, Warwick I, Chalies S. Understanding novice teachers' perspectives on China's sexuality education: a study based on the national pre-service teacher education programme. Sex Education. 2020;20(3):252-66.

22. Zou Z, Dong Y, Song Y, Ma J. Strengthening sexual and reproductive health education for children and adolescents in China. The Lancet Child & Adolescent Health. 2023;7(9):603-5.

23. Zou W, Zhang X, He J. Making Sense of Jiese: An Interview Study of Members from a Porn-Free Self-Help Forum in China. Archives of Sexual Behavior. 2023;52(1):385-97.

24. Zou S, Cao W, Jia Y, Wang Z, Qi X, Shen J, et al. Sexual and reproductive health and attitudes towards sex of young adults in China. BMJ Sexual & Reproductive Health. 2022;48(e1):e13-e21.

25. Ji Y, Xu H, Zhang Y, Liu Q. Heterogeneity of adolescent health risk behaviors in rural western China: A latent class analysis. PLOS ONE. 2018;13(6):e0199286.

26. Lyu J, Shen X, Hesketh T. Sexual Knowledge, Attitudes and Behaviors among Undergraduate Students in China—Implications for Sex Education. International Journal of Environmental Research and Public Health. 2020;17(18):6716.

27. Chi X, Hawk ST, Winter S, Meeus W. The Effect of Comprehensive Sexual Education Program on Sexual Health Knowledge and Sexual Attitude Among College Students in Southwest China. Asia-Pacific Journal of Public Health. 2015;27(2):NP2049-NP66.

28. Kahan BC, Hall SS, Beller EM, Birchenall M, Elbourne D, Juszczak E, et al. Consensus Statement for Protocols of Factorial Randomized Trials: Extension of the SPIRIT 2013 Statement. JAMA Network Open. 2023;6(12):e2346121-e.

29. Sun J, Ma Y, Chen H, et al. The status quo of the dangerous behavior of middle school students in 5 provinces and cities in China (1) -The knowledge attitude and behavior of AIDS and sexual behavior. *Chinese school hygiene(in Chinese).* 2001;(03):202-204.