

5-29-2026

## Determinants of Behavioral Intention to Change Sexual and Reproductive Health Practices Among Adolescents: A Hierarchical Multiple Linear Regression Analysis

Md Mizanur Rahman

*Universiti Malaysia Sarawak, Sarawak, rmmizanur@unimas.my*

Gerraint Gillan Ahi

*Universiti Malaysia Sarawak, Sarawak, gerraintgillan@gmail.com*

Rafazila Ramli

*Universiti Malaysia Sarawak, Sarawak, rafazilaramli@gmail.com*

Rasitasam Safii

*Universiti Malaysia Sarawak, Sarawak, razitasham@gmail.com*

Jacey Lynn Minoi

*Universiti Malaysia Sarawak, Sarawak, jacey@unimas.my*

Follow this and additional works at: <https://scholarhub.ui.ac.id/kesmas>



Part of the [Epidemiology Commons](#), [Public Health Education and Promotion Commons](#), and the [Women's Health Commons](#)

### Recommended Citation

Rahman MM , Ahi GG , Ramli R , et al. Determinants of Behavioral Intention to Change Sexual and Reproductive Health Practices Among Adolescents: A Hierarchical Multiple Linear Regression Analysis.

*Kesmas*. 2026; 21(2): 108-116

DOI: 10.7454/kesmas.v21i2.2691

Available at: <https://scholarhub.ui.ac.id/kesmas/vol21/iss2/5>

This Original Article is brought to you for free and open access by the Faculty of Public Health at UI Scholars Hub. It has been accepted for inclusion in Kesmas by an authorized editor of UI Scholars Hub.

---

# Determinants of Behavioral Intention to Change Sexual and Reproductive Health Practices Among Adolescents: A Hierarchical Multiple Linear Regression Analysis

## Authors

Md Mizanur Rahman, Gerraint Gillan Ahi, Rafazila Ramli, Rasitasam Safii, Jacey Lynn Minoi, Stephanie Chua Hui Li, Ahmad Sofian bin Shminan, and Lee Jun Choi

# Determinants of Behavioral Intention to Change Sexual and Reproductive Health Practices Among Adolescents: A Hierarchical Multiple Linear Regression Analysis

Md Mizanur Rahman<sup>1\*</sup>, Gerraint Gillan Ahi<sup>1</sup>, Rafazila Ramli<sup>1</sup>, Rasitasam Safii<sup>1</sup>, Jacey Lynn Minoi<sup>2</sup>, Stephanie Chua Hui Li<sup>2</sup>, Ahmad Sofian bin Shminan<sup>3</sup>, Lee Jun Choi<sup>3</sup>

<sup>1</sup>Department of Community Medicine and Public Health, Faculty of Medicine and Health Sciences, Universiti Malaysia Sarawak, Sarawak, Malaysia

<sup>2</sup>Faculty of Computer Science and Information Technology, Universiti Malaysia Sarawak, Sarawak, Malaysia

<sup>3</sup>Faculty of Cognitive Sciences and Human Development, Universiti Malaysia Sarawak, Sarawak, Malaysia

## Abstract

Conventional and web-based sexual and reproductive health (SRH) interventions are increasingly used with adolescents, yet their comparative effectiveness and underlying mechanisms remain unclear. This study compared the two formats and examined the Theory of Planned Behavior (TPB) constructs as predictors of changes in intention to adopt health-protective SRH practices (including contraceptive use, service utilization, and parent-child communication) among Malaysian adolescents. A randomized controlled trial allocated adolescents to conventional or web-based SRH education. Intention-to-change behavior towards sexual and reproductive health scores was assessed at baseline, 1 month, and 3 months; change scores were modeled using hierarchical linear regression, including intervention type, sociodemographic factors, and TPB-related changes in knowledge, attitude, subjective norm, control beliefs, perceived power, and perceived control. The conventional intervention produced significantly higher intention-to-change scores at 1 and 3 months, with moderate-to-large effects. In regression analyses (N = 209), Model 1 (type + demographics) significantly predicted change in intention (adjusted R<sup>2</sup> = .074), with only intervention type significant. Model 2 (adding TPB change scores) improved the fit (adjusted R<sup>2</sup> = .120; ΔR<sup>2</sup> = .069, p-value = .014), with perceived power positively and control beliefs inversely associated with change in intention; intervention type was no longer significant. Adolescents in the conventional group showed a larger and more sustained increase in intention to change their SRH behaviors than those in the web-based group, an effect that appeared to operate through changes in underlying psychosocial factors such as control beliefs and perceived power.

**Keywords:** adolescent, education, reproductive health, Theory of Planned Behavior

## Correspondence\*:

Md Mizanur Rahman,  
Faculty of Medicine  
and Health Sciences,  
Universiti Malaysia  
Sarawak, Malaysia  
[rmizanur@unimas.my](mailto:rmizanur@unimas.my);  
[aniqu@hotmail.com](mailto:aniqu@hotmail.com).

## Received:

February 10, 2026

## Accepted:

May 21, 2026

## Published:

May 29, 2026

## Section Editor:

Dewi Susanna  
Universitas Indonesia

## Reviewers:

Reviewer 1:

Anonymous

Reviewer 2:

Erni Astutik

Universitas Airlangga

## Introduction

Adolescence is a critical period when sexual and reproductive health (SRH) patterns are established. However, adolescents worldwide face significant SRH threats. The World Health Organization reports substantial burdens, including sexual coercion, unintended pregnancy, unsafe abortion, and sexually transmitted infections such as human immunodeficiency virus (HIV).<sup>1</sup> These are exacerbated by gender inequities and limited access to youth-friendly services. Global School-based Student Health Survey data from 2003-2017 show that 6.9% of adolescents aged 12-15 years report having sexual intercourse. More than half of sexually active adolescents report multiple partners. Only 58.1% used condoms during their last sexual encounter. Early sexual debut, multiple partnerships, and inconsistent condom use

contribute to poor SRH outcomes. These also lead to mental health problems and social disadvantages that persist into young adulthood.<sup>2</sup>

In Malaysia, sexuality education remains controversial, shaped by conservative cultural and religious views that prioritize tradition over expert guidance.<sup>3</sup> Sexuality is often taboo, restricting open discussion within families, schools, and communities.<sup>4</sup> A 2022 national survey found that 7-8% of school-enrolled adolescents aged 18-24 years reported sexual intercourse, with many not using condoms.<sup>5</sup> SRH service utilization is low: only 20.4% had ever received services, and just 8.4% used them in the previous year. Key barriers include shyness (77.3%), lack of privacy (57.5%), and limited awareness.<sup>4</sup> These findings reveal high rates of risky behaviors and inadequate SRH literacy

among adolescents. Current educational approaches face teacher discomfort, curriculum limitations, and time constraints.<sup>4</sup> Digital platforms offer anonymity, scalability, and flexibility aligned with adolescents' media habits. A systematic review of 11 randomized controlled trials (n = 7,876) found web-based SRH education showed moderate effects on knowledge (SMD = 0.59, 95% CI 0.20-0.98) and sexual behavior (OR = 0.75, 95% CI 0.60-0.94), small effects on attitudes (SMD = 0.16, 95% CI 0.11-0.22), and no significant effect on self-efficacy.<sup>6</sup> One trial showed face-to-face education produced larger knowledge gains (SMD = 1.79), though the evidence is of low certainty. A review of 27 digital studies found that purely digital interventions improved knowledge and attitudes but rarely changed behavior, while combined digital and face-to-face approaches demonstrated better outcomes.<sup>7</sup>

This study draws on the Theory of Planned Behavior (TPB) and Social Cognitive Theory (SCT). Ajzen's<sup>8</sup> TPB proposes intention as the most proximal behavior predictor, influenced by attitudes, subjective norms, and perceived behavioral control (PBC). PBC includes control beliefs (barrier perceptions) and perceived power (confidence in overcoming barriers). These constructs explain significant variance in adolescents' condom and contraception intentions, with PBC consistently emerging as a strong predictor.<sup>9,10</sup> Extended TPB models incorporating self-identity and parent-child communication explained 42-45% of variance in safe-sex intentions, with PBC and subjective norms as the most influential determinants.<sup>10</sup> TPB constructs mediate background variables' effects on intentions and condom use. The SCT positions self-efficacy as crucial, with elevated sexual self-efficacy linked to delayed sexual debut, enhanced refusal skills, and consistent contraceptive use.<sup>11,12</sup>

Combining TPB and SCT suggests interventions affect behavior change by altering cognitive precursors rather than delivery format alone. Web-based approaches increase knowledge and reduce barriers, while face-to-face interventions strengthen self-efficacy through interpersonal interaction.<sup>6,12</sup> Limited evidence exists from Southeast Asian countries such as Malaysia, where contexts differ from Western settings.<sup>13,14</sup> A significant gap remains regarding the relative impact of socio-demographic versus TPB/SCT psychological factors on Malaysian adolescents' SRH behavioral intentions.

This study investigated the factors that shape adolescents' intentions to change SRH behaviors following web-based or classroom-based education. It addresses three questions: how intervention type and sociodemographic characteristics influence behavioral intentions; how much additional insight is gained when TPB and SCT constructs (knowledge, attitudes, subjective norms, control beliefs, perceived power, and parent-child relationships) are incorporated; and which psychological factors emerge as the most important predictors. The central question examined how the mode of education and cognitive factors influence Malaysian adolescents' intentions to adopt safer SRH practices. This study compared web-based and classroom-based education and examined how attitudes, norms, perceived control, self-efficacy, and parent-child communication shape intentions in a conservative yet digitally evolving Malaysian context, addressing a critical gap in understanding how different SRH education forms guide young people's intentions in Southeast Asia.

## Method

This study employed a community-based randomized controlled trial with two parallel intervention arms (mobile/web-based vs. conventional face-to-face SRH education) among adolescents in Sarawak, Malaysia. The study population consisted of adolescents aged 16-19 years living in Kuching and Serian divisions, regardless of sex. Adolescents were eligible if they were aged 16-19 years (irrespective of sex and ethnicity), willing to participate and complete follow-up, had parental or guardian consent, and possessed a mobile phone with app support. Exclusion criteria included non-residents or guests, lack of app-supported mobile phones, and known mental health problems.

The sample size was calculated using cluster sampling with two arms. The calculation was based on a control group proportion of 0.53,<sup>15</sup> an intervention group proportion of 0.68, with a 15% difference,<sup>16</sup> a significance level of 0.05, a power of 0.8, a design effect of 1.7, and a non-response rate of 15%. These parameters yielded a minimum required sample of 554 adolescents. After adjusting for the 15% non-response rate, the total required sample was 637, with 319 adolescents per arm. This necessitated recruitment from 42 clusters (21 per intervention arm), with 15 adolescents selected from each cluster. The details of the sampling strategy are shown in the CONSORT flow chart (Figure 1).

**Web-based intervention.** The web-based program was an interactive, mobile-responsive SRH education platform covering reproductive anatomy, puberty, contraception, STIs/HIV, consent, relationships, and SRH services. Content included text, infographics, quizzes with immediate feedback, and scenario-based activities grounded in TPB and SCT. The design emphasized accurate information, interactive quizzes, reflective questions to elicit beliefs and perceived control, and strategies to enhance self-efficacy. Participants completed modules within one week with minimal supervision and could revisit materials during follow-up.

Facilitator-led SRH education sessions were delivered in community settings by trained health educators. The curriculum mirrored web-based content in scope and sequence, using didactic teaching, group discussions, role-plays, and question-and-answer sessions. Facilitators created supportive, non-judgmental environments and modeled communication and negotiation skills. The program was delivered over one or two half-day group sessions.

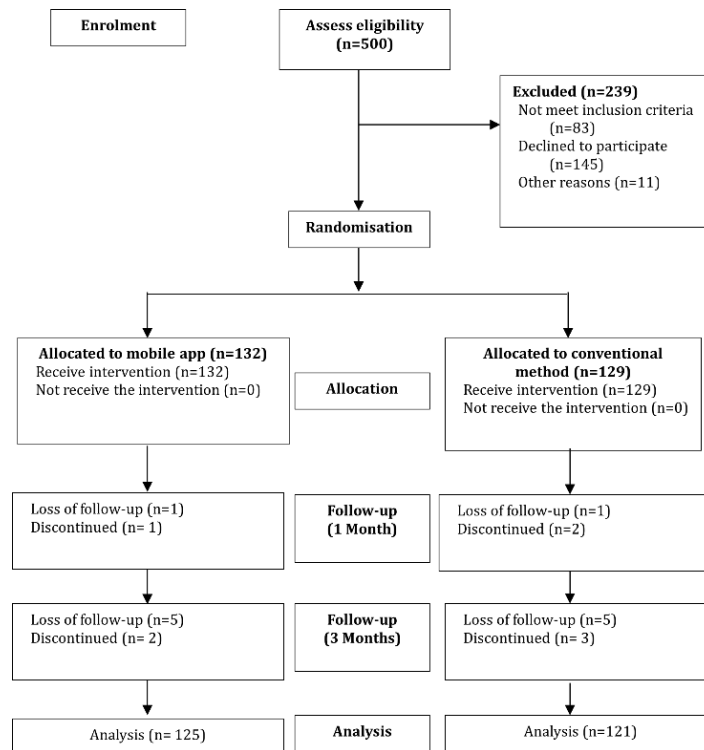


Figure 1. CONSORT Flow Chart

Adolescents' intention to change SRH behavior was measured using a multi-item scale evaluating intentions to use contraceptives regularly, seek SRH information, discuss SRH with parents, access SRH services and birth control, and attend SRH programs. Items were rated on a 1-5 Likert scale. Scores were summed and converted to percentiles (0-100), with higher scores indicating stronger behavioral intentions. The dependent variable was the change in behavioral intention over 3 months, calculated as the difference between 3-month and baseline scores. Positive values indicated greater intentions to engage in healthy SRH behaviors.

Independent variables were administered hierarchically in two blocks. Step 1 included sociodemographic predictors capturing structural and

contextual effects on SRH intentions without psychological factors: intervention type (web-based or conventional), age (16-19 years), sex (female or male), ethnicity (Malay, Sarawak Bumiputera, or Others), religion (Islam or Others), education level (primary, secondary, or pre-university), occupation (student, non-student, or informal), living status (with parents or others), family size (less than 6 or 6+ members based on median), parental education (no formal education, primary, secondary, or pre-university for each parent), and parental occupation. Fathers' occupations were classified as unemployed, non-professional, professional, or other. Mothers' occupation was coded as working or housekeeping.

Step 2 included process variables informed by TPB and SCT comprising six constructs: SRH knowledge was

measured using a multiple-choice test covering pregnancy, contraception, sexually transmitted infections, including HIV, and available services, scored as total correct answers. Attitude was measured on a 5-point Likert scale assessing favorable evaluation of protective SRH behaviors, with higher scores indicating positive attitudes. Subjective norms, measured on a 5-point Likert scale (strongly disagree to strongly agree), captured perceived approval from parents, peers, and others and were entered as a continuous variable. Control beliefs were measured on a 7-point Likert scale (less likely to most likely) for perceived barriers in performing protective behaviors, with composite scores averaged across items.

Hierarchical multiple linear regression was used to analyze how sociodemographic factors and TPB/SCT variables predicted changes in behavioral intention. This method evaluated additional variance explained by psychological constructs beyond demographics and intervention type. The dependent variable was the change in intention from baseline to the 3-month follow-up. Data were systematically cleaned with consistency checks. Missing data were minimal, mostly random, and excluded. Univariate (z-scores) and multivariate (Mahalanobis distance) outliers were identified, yielding an analytical sample of 209 adolescents. Regression assumptions were assessed with no substantial violations. Multicollinearity (Variance Inflation Factor), independence of residuals (Durbin-Watson), normality (Q-Q plots, histograms), and homoscedasticity (residuals versus fitted values) were within acceptable ranges, requiring no transformations.

Model 1 regressed the dependent variable on intervention type and sociodemographic variables. Model 2 added process variables simultaneously. This allowed analysis of changes in model fit ( $\Delta R^2$  and F-change) and in intervention-type coefficients, demonstrating whether psychological constructs had mediating effects. Mean-centered continuous predictors minimized multicollinearity; categorical variables were dummy-coded. Significance was tested at  $\alpha = 0.05$  (two-tailed). Model fit was summarized using  $R^2$ , adjusted  $R^2$ , F-statistics, and p-values. Each predictor was reported with standardized coefficients ( $\beta$ ), 95% confidence intervals, and p-values, interpreted using traditional benchmarks (small:  $R^2 = 0.02$ ; medium: 0.13; large: 0.26).

## Results

Baseline characteristics showed several differences between conventional and web-based intervention arms (Table 1). Age distribution differed at the trend level (p-value = 0.060), with more 17-year-olds in the conventional group (32.0% vs. 18.9%) and fewer 19-year-olds (10.2% vs. 17.4%). Sex was balanced, with no significant difference in females (52.3% vs. 59.8%; p-value = 0.223). Marked differences appeared for ethnicity and religion. The conventional arm had more Malay adolescents (12.5% vs. 0.8%), while the web-based arm had more "other" ethnicities (6.6% vs. 0%; p-value <0.001). Muslims were more common in the conventional group (12.5% vs. 3.0%; p-value = 0.004), though non-Muslims predominated in both arms.

Educational level did not differ significantly (p-value = 0.350), with most participants in secondary school (76% vs. 70%). Socioeconomic and family characteristics showed systematic imbalances. More conventional participants were students (82.0% vs. 68.9%; p-value = 0.014). Conventional adolescents more often lived with parents (98.4% vs. 89.4%; p-value = 0.002), while web-based participants more often lived with others (10.6% vs. 1.6%). Family size did not differ (p-value = 0.215). Parental education and occupation varied considerably. Fathers and mothers with no formal education were more common in the web-based group (15.2% vs. 4.4% for fathers, p-value = 0.021; 14.4% vs. 3.3% for mothers, p-value = 0.011). Fathers in the conventional arm were more often professionals (32.8% vs. 9.9%), whereas non-professional jobs were more common in the web-based group (73.5% vs. 38.3%; p-value <0.001). Mothers' employment showed a non-significant trend toward more working mothers in the web-based group (30.3% vs. 20.3%; p-value = 0.064).

At baseline, there was no significant difference in intention-to-change scores between adolescents in the web-based group (M = 62.10, SD = 12.66) and the conventional group (M = 63.21, SD = 15.04), p-value = 0.519, mean difference = -1.11, 95% CI [-4.51, 2.28], Cohen's d = -0.08, indicating a negligible effect size. By 1-month follow-up, the conventional group reported significantly higher intention-to-change scores (M = 71.54, SD = 7.25) than the web-based group (M = 64.04, SD = 15.08), p-value <0.001, mean difference = -7.50, 95% CI [-10.40, -4.59], Cohen's d = -0.63, reflecting a moderate effect favoring the conventional intervention.

**Table 1. Characteristics of the Participants (N = 260)**

Characteristics	Conventional Group (n=128)	Web-Based Group (n=132)	p-value
<b>Age (years)</b>			
16	38.3	40.2	
17	32.0	18.9	0.060
18	19.5	23.5	
19	10.2	17.4	
<b>Sex</b>			
Female	52.3	59.8	0.223
Male	47.7	40.2	
<b>Ethnicity</b>			
Malay	12.5	0.8	<0.001
Sarawak Bumi	87.5	92.4	
Others (Chinese, Indian, etc.)	0.0	6.8	
<b>Religion</b>			
Islam	12.5	3.0	0.004
Others (Christianity, Buddhism, etc.)	87.5	97.0	
<b>Education Level</b>			
Primary	14.1	14.4	0.350
Secondary	76.6	70.5	
Pre-university	9.4	15.2	
<b>Occupation</b>			
Student	82.0	68.9	0.014
Non-student, including an informal job	18.0	31.1	
<b>Living Status</b>			
Living with parents	98.4	89.4	0.002
Living with Others	1.6	10.6	
<b>Family Size</b>			
<6	46.1	53.8	0.215
6+	53.9	46.2	
<b>Father's Education</b>			
No formal education	4.7	15.2	
Primary	10.2	13.6	0.021
Secondary	75.0	64.4	
Pre-university	10.2	6.8	
<b>Mother's Education</b>			
No formal education	3.9	14.4	
Primary	12.5	17.4	0.011
Secondary	71.9	60.6	
Pre-university	11.7	7.6	
<b>Father's Occupation</b>			
Unemployed	25.0	16.7	
Non-professional	38.3	73.5	<0.001
Professional	32.8	9.1	
Others (housekeeping, small trade)	3.9	0.8	
<b>Mother's Occupation</b>			
Working	20.3	30.3	0.064
Housekeeping	79.7	69.7	

**Table 2. Group Differences in Intention to Change Scores at Baseline, 1-Month, and 3-Month Follow-ups**

Group	n	M	SD	p-value	Mean Diff	95% CI	Cohen's d
<b>Baseline</b>							
Web-based	132	62.10	12.66	0.519	-1.11	[-4.51, 2.28]	-0.08
Conventional	128	63.21	15.04				
<b>1-Month</b>							
Web-based	130	64.04	15.08	<0.001	-7.50	[-10.40, -4.59]	-0.63
Conventional	125	71.54	7.25				
<b>3-Month</b>							
Web-based	125	66.63	13.04	<0.001	-9.37	[-12.06, -6.68]	-0.87
Conventional	120	76.00	7.72				

Notes: M = mean, SD = standard deviation, Mean Diff = difference in means (conventional vs web-based group), p-values are two-sided. Effect sizes are Cohen's d with 95% confidence intervals.

This difference further increased at 3 months, with the conventional group maintaining higher intention scores (M = 76.00, SD = 7.72) than the web-based group (M = 66.63, SD = 13.04), p-value <0.001, mean difference = -9.37, 95% CI [-12.06, -6.68], Cohen's d = -0.87, indicating a large and sustained advantage of the

conventional intervention in enhancing adolescents' intention to change their SRH behaviors.

Changes in intention were examined using a two-step hierarchical linear regression model that included intervention type, sociodemographic variables, and TPB-related change scores. The final analytical sample

comprised 209 participants after excluding cases lost to follow-up and those identified as multivariate outliers.

Model 1 entered intervention type and demographics (age, sex, ethnicity, living status, family size, and occupation) and was statistically significant, explaining 11.9% of variance ( $R^2 = 0.119$ , adjusted  $R^2 = 0.074$ ). Conventional intervention participants showed a significantly greater increase in intention than web-based participants ( $B = 8.29$ ,  $SE = 1.87$ ,  $\beta = 0.69$ , 95% CI [3.84, 9.98],  $p$ -value  $< 0.001$ ), while sociodemographic covariates were non-significant (all  $p$ -values  $> 0.29$ ).

Model 2 added change scores for knowledge, attitude, subjective norm, control beliefs, perceived power, and perceived control. The final model remained significant ( $R = 0.43$ ,  $R^2 = 0.188$ , adjusted  $R^2 = 0.120$ ), explaining 18.8% of variance. TPB change

variables produced a significant variance increase ( $\Delta R^2 = 0.069$ ,  $F$ -change (6, 192) = 2.73,  $p$ -value = 0.014), but intervention type became non-significant ( $B = 4.15$ ,  $SE = 3.58$ ,  $\beta = 0.35$ , 95% CI [-2.43, 9.35],  $p$ -value = 0.248), suggesting the conventional intervention's advantage operates through psychosocial constructs.

In the fully adjusted model, only control beliefs and perceived power remained significant predictors. Larger increases in control beliefs associated with smaller intention increase ( $B = -0.19$ ,  $SE = 0.10$ ,  $\beta = -0.21$ , 95% CI [-0.42, -0.00],  $p$ -value = 0.047), while greater perceived power gains associated with larger intention increase ( $B = 0.21$ ,  $SE = 0.08$ ,  $\beta = 0.21$ , 95% CI [0.05, 0.37],  $p$ -value = 0.010). Changes in knowledge, attitude, subjective norm, and perceived behavioral control were not significant (all  $p$ -values  $> 0.18$ ).

**Table 3. Hierarchical Multiple Linear Regression Analysis Predicting Intention to Change Behavior (N = 209)**

Predictors	B	SE B	$\beta$	p-value	95% CI LL	95% CI UL
<b>Model 1</b>						
Intercept	-6.19	15.42	—	0.688	-36.57	24.18
Type (Conventional vs. Web-based)	8.29	1.87	0.69	<0.001	3.84	9.98
Sex (Male vs. Female)	1.76	1.66	0.15	0.291	-1.26	4.19
Ethnicity (Malay vs. Others)	1.25	6.05	0.10	0.837	-8.90	11.09
Ethnicity (Sarawak Bumi vs. Others)	1.85	4.30	0.15	0.668	-5.53	8.61
Living status (with parents vs. others)	-0.28	3.22	-0.02	0.932	-5.53	4.51
Family size (6+ vs. <6)	-0.50	1.66	-0.04	0.765	-3.14	2.31
Occupation (Unemployed vs. others)	5.87	6.08	0.49	0.335	-5.09	16.49
Occupation (Non-professional vs. others)	5.27	5.98	0.44	0.379	-5.43	16.42
Occupation (Professional vs. others)	1.68	6.10	0.14	0.784	-8.64	11.43
Age	0.24	0.76	0.02	0.755	-0.11	0.16
<b>Model 2</b>						
Intercept	-13.04	15.68	—	0.407	-44.00	17.91
Type (Conventional vs. Web-based)	4.15	3.58	0.35	0.248	-2.43	9.35
Sex (Male vs. Female)	0.35	1.70	0.03	0.836	-2.50	3.09
Ethnicity (Malay vs. Others)	-0.42	5.95	-0.04	0.943	-10.13	9.43
Ethnicity (Sarawak Bumi vs. Others)	2.01	4.20	0.17	0.633	-5.23	8.86
Living status (with parents vs. others)	0.23	3.22	0.02	0.942	-5.09	5.48
Family size (6+ vs. <6)	0.06	1.63	0.01	0.971	-2.64	2.27
Occupation (Unemployed vs. others)	6.58	6.09	0.55	0.282	-4.53	15.50
Occupation (Non-professional vs. others)	5.09	6.08	0.42	0.403	-5.75	14.24
Occupation (Professional vs. others)	1.62	6.13	0.13	0.792	-8.73	11.42
Age	0.59	0.75	0.05	0.431	-0.08	0.19
change in knowledge	0.04	0.04	0.07	0.315	-0.07	0.22
change in attitude	-0.07	0.11	-0.05	0.541	-0.20	0.11
change in subjective nor	0.01	0.09	0.01	0.891	-0.13	0.15
change in control beliefs	-0.19	0.10	-0.21	0.047	-0.42	-0.00
change in perceived power	0.21	0.08	0.21	0.010	0.05	0.37
change in perceived control	0.16	0.12	0.14	0.188	-0.07	0.34

Notes: B = unstandardized coefficient, SE B = standard error of B,  $\beta$  = standardized coefficient, CI = confidence interval, LL = lower limit, UL = upper limit. Model 1:  $R = 0.34$ ,  $R^2 = 0.12$ , adjusted  $R^2 = 0.07$ ,  $F(10,198) = 2.66$ ,  $p$ -value = 0.005. Model 2:  $R = 0.43$ ,  $R^2 = 0.19$ , adjusted  $R^2 = 0.12$ ,  $F(16,192) = 2.78$ ,  $p$ -value  $< 0.001$ ;  $\Delta R^2 = 0.07$ ,  $F$ -change (6, 192) = 2.73,  $p$ -value = 0.014. Dependent variable: change in intention to perform the behavior.

## Discussion

Conventional face-to-face SRH education produced larger, more sustained increases in adolescents' behavioral intentions than web-based delivery. Regression analyses showed this advantage operates through psychological mechanisms rather than sociodemographic. When TPB/SCT change scores were included, intervention type became non-

significant, while control beliefs and perceived power emerged as independent predictors. Effective SRH interventions reduce perceived barriers and increase confidence in acting, regardless of delivery mode.

Between-group comparisons showed that although both groups started with similar intention scores, adolescents receiving conventional face-to-face education developed stronger, more sustained

intentions to modify SRH behaviors than the web-based group, with effects growing from moderate at one month to large at three months.<sup>6,17</sup> This partly aligns with reviews reporting that online SRH education improves knowledge and, to a lesser extent, attitudes and behavior, but shows mixed results for changing intentions.<sup>6,18</sup> Real-time questioning, peer conversation, and direct facilitator encouragement likely fostered stronger engagement and commitment than self-guided web platforms, despite the value of digital tools' privacy and flexibility.<sup>19,20</sup> While web-based approaches remain promising for reaching adolescents at scale, traditional group sessions may be crucial for anchoring SRH behavioral intentions, particularly where face-to-face interaction and relational support are valued.<sup>17,19</sup>

Sociodemographic characteristics did not significantly influence changes in intention once intervention type was considered. Although the initial model included age, sex, ethnicity, living status, family size, and occupation, only intervention type predicted changes in intention, with modest explained variance. These results aligned with previous studies, indicating that while background factors affect exposure and structural risk, proximal cognitive factors (intentions, norms, self-efficacy) are stronger predictors of protective behaviors than sociodemographic factors alone.<sup>21-23</sup> Demographic influences are inconsistent when psychosocial factors are considered, implying interventions should target beliefs, perceived norms, and perceived behavioral control rather than demographic risk profiles.<sup>21</sup> Malaysian youth SRH studies emphasize norms, parental communication, and cognitive factors over demographics, supporting program design that prioritizes modifiable psychological determinants.<sup>19,24</sup>

Including TPB and SCT variables enhanced the model's explanatory power and clarified intervention effectiveness. Once changes in knowledge, attitudes, subjective norms, control beliefs, perceived power, and perceived control were incorporated, the model explained greater variance in intention, and intervention type became non-significant. This indicated that the conventional sessions' benefit was mediated by shifts in cognitive constructs rather than by delivery format. A previous study also showed that attitudes, norms, and perceived behavioral control are key drivers of intention.<sup>25</sup> Reviews and empirical studies show educational programs influence behavior primarily by improving attitudes, enhancing perceived

control or self-efficacy, and shaping norms.<sup>21,22</sup> Studies on TPB-based sexual health education indicate interventions targeting these constructs yield significant improvements in adolescent behavioral intentions, reinforcing that psychological content is as important as delivery mode.<sup>26,27</sup>

In the final model, perceived barriers and capability emerged as the main drivers of changes in intention. After accounting for all factors, only control beliefs and perceived power changes were associated with shifts in intention: greater perceived power predicted larger increases in intention, while stronger perceived barriers predicted smaller gains. This aligns with TPB's core premise that perceived behavioral control influences intention most strongly when adolescents perceive behaviors as difficult, and feeling capable despite obstacles is vital for forming intentions.<sup>8</sup> Studies on sexual self-efficacy show confident adolescents report stronger intentions and less risky behavior, whereas those foreseeing difficulties are less likely to sustain safer practices.<sup>28-30</sup> Interventions are most effective when helping adolescents identify and address specific barriers and practice skills that foster realistic capability for safer SRH behaviors.

Gains in knowledge, attitudes, subjective norms, and perceived behavioral control did not predict further changes in intention once other psychological factors were considered. This result indicated that strengthening adolescents' intentions over three months requires feeling capable of acting despite specific obstacles and believing one has the power to follow through, rather than merely acquiring knowledge or favorable views. Previous studies show knowledge alone rarely predicts sexual behavior, and attitudes and norms influence outcomes mainly when combined with strong behavioral skills and self-efficacy.<sup>6,31</sup> Studies on condom use self-efficacy show confidence in specific actions (buying condoms, negotiating use) more reliably predict intentions and behavior than general HIV awareness or broad attitudinal measures.<sup>30,32</sup> Adolescent sexual health programs should therefore focus explicitly on developing context-specific skills, reducing perceived barriers, and fostering realistic control to effectively influence intentions.

This trial had clear strengths. Random allocation supported causal interpretation of observed differences. Theory-based TPB measures explained how interventions worked, not just whether they worked. Hierarchical regression showed psychological

variables' contribution after accounting for background factors. Follow-up at baseline, one month, and three months assessed the durability of the effect. The sample of 209 participants provided adequate power for including the main predictors. Using change scores rather than only post-test values accounts for baseline imbalances between groups.

Several limitations exist. Differences in ethnicity, religion, and living arrangements persisted, and unmeasured factors might have influenced results. Nearly one-fifth of participants were lost to follow-up, potentially introducing bias. This study measured intention, not actual behavior. TPB could not account for all influences, such as structural barriers and access to services. Findings were based on adolescents in one Malaysian setting, limiting generalizability. The unexpected negative association between some beliefs and intention required further qualitative research. The study was not designed to test formal mediation, so causal claims about mechanisms are tentative. Long-term behavior change should be examined in future studies, and interventions should be tested in diverse cultural settings.

## Conclusion

Traditional face-to-face interventions significantly outperform web-based interventions in reinforcing adolescents' SRH behavioral intentions, with moderate-to-large effect sizes. Within the TPB framework, perceived power and control beliefs are identified as key predictors of changes in intention. In-person sexual health education should be prioritized in schools where feasible. Teachers should be trained to develop self-efficacy and agency alongside the delivery of knowledge. Web-based interventions should be enhanced with interactive barrier-management and problem-solving elements. Hybrid strategies combining brief in-person contact with web-based information should be developed.

## Abbreviations

SRH: sexual and reproductive health; HIV: human immunodeficiency virus; TPB: Theory of Planned Behavior; SCT: Social Cognitive Theory; PBC: Perceived Behavioural Control; SD: standard deviation; CI: confidence interval.

## Ethics Approval and Consent to Participate

This study received approval from the Universiti Malaysia Sarawak Ethics Committee (Ref # FME/23/58).

## Competing Interest

The authors declare no competing financial, professional, or personal interests that would affect the objectivity of this research. The funding authority, Universiti Malaysia Sarawak, had no involvement in study

design, data collection, analysis, interpretation, or publication decisions; all research was conducted independently.

## Availability of Data and Materials

Not applicable.

## Authors' Contribution

Study conceptualization and design were led by MMR, JLM, SCHL, ASS, and LJC. Project implementation and oversight were conducted by MMR, GGA, RR, and RS. Data were collected by MMR, GGA, and RR under the supervision of the principal investigator. Statistical analysis and data interpretation were performed by MMR and GGA. MMR and GGA drafted the manuscript. All authors critically reviewed, revised, and approved the final manuscript and accept full responsibility for the accuracy, completeness, and integrity of the work.

## Acknowledgment

The authors acknowledge financial support from Universiti Malaysia Sarawak (UNIMAS) through the Vice-Chancellor's High Impact Research Grant (Research ID: UNI/F05/VC-HIRG/85490/P05-01/2022). The authors thank UNIMAS authorities, the Faculty of Medicine and Health Sciences, and the UNIMAS Ethics Committee for ethical approval (Ref # FME/23/58). The authors appreciate the village headmen in the Kuching and Serian divisions for facilitating recruitment, and all 260 adolescent participants and their parents/guardians for their participation. The authors also acknowledge the data collection team, research assistants, and Faculty of Computer Science for developing the "RISES" mobile application, as well as school administrators, teachers, and health authorities for enabling trial completion.

## Declaration on the Use of Artificial Intelligence

The authors declare that artificial intelligence (AI) tools were utilized solely for language editing and grammatical refinement to improve the manuscript's clarity and readability. The specific AI tools used are Perplexity and Grammarly. AI was not involved in content generation, data analysis, interpretation, or any decision-making processes. All scientific content, interpretations, conclusions, and responsibilities related to the manuscript rest solely with the authors.

## References

1. World Health Organization. Sexual and Reproductive Health and Research (SRH): Adolescent sexual and reproductive health and rights. Geneva: World Health Organization; 2025.
2. Jing Z, Li J, Wang Y, et al. Prevalence and Trends of Sexual Behaviors Among Young Adolescents Aged 12 Years to 15 Years in Low and Middle-Income Countries: Population-Based Study. *JMIR Public Health Surveill.* 2023; 9: e45236. DOI: 10.2196/45236.
3. Ang PS, Taib F. Fear generation in the multimodal communication of sexual and reproductive health to Malaysian adolescents. *Visual Comm.* 2023; 22 (3): 449-468. DOI: 10.1177/14703572231163555.
4. Federation of Reproductive Health Associations Malaysia. Comprehensive Sexuality Education for Malaysian Adolescents: How Far Have We Come? Selangor Darul Ehsan: Federation of Reproductive Health Associations Malaysia; 2019.
5. John R, Salleh NAM, Farid NDN. Utilization of Sexual Reproductive Health Services Among Youths in Malaysia: A Cross-Sectional Study Applying Andersen's Behavioral Model of Healthcare Utilization. *Cureus.* 2024; 16 (5): e60230. DOI: 10.7759/cureus.60230.

6. Guo R, Xie H, Zhao W, et al. Web-based sexual and reproductive health education for adolescents aged 10–17 years: A systematic review and meta-analysis. *BMJ Paediatr*. 2025; 9: e003714. DOI: 10.1136/bmjpo-2025-003714.
7. Aguilar-Quesada A, Sierra-Yagüe A, González-Cano-Caballero M, et al. Effectiveness of digital interventions to reduce school-age adolescent sexual risks: A systematic review. *J Nurs Scholar*. 2024; 57 (2): 342-353. DOI: 10.1111/jnu.13015.
8. Ajzen I. The theory of planned behavior. *Org Behav Human Dec Pro*. 1991; 50: 179-211. DOI: 10.1016/0749-5978(91)90020-T
9. Ajzen I. Perceived Behavioral Control, Self-Efficacy, Locus of Control, and the Theory of Planned Behavior. *J Appl Soc Psychol*. 2022; 32: 665-683. DOI: 10.1111/j.1559-1816.2002.tb00236.x.
10. Tseng YH, Cheng CP, Kuo SH, et al. Safe Sexual Behaviors Intention Among Female Youth: The Construction on Extended Theory of Planned Behavior. *J Adv Nurs*. 2019; 76: 814-823. DOI: 10.1111/jan.14277.
11. Bandura A. Social Cognitive Theory: An Agentic Perspective. *Ann Rev Psychol*. 2001; 52: 1-26. DOI: 10.1146/annurev.psych.52.1.1.
12. Mitchell CM, Kaufman CE, Whitesell NR, et al. Self-Efficacy About Sexual Risk/Protective Behaviors: Intervention Impact Trajectories Among American Indian Youth. *J Res Adolesc*. 2017; 27 (3): 697-704. DOI: 10.1111/jora.12308.
13. Ja'afar S, Awang H, Rahman A. Level of Knowledge on Sexual and Reproductive Health Among Youths in Southern Region of Peninsular Malaysia. *Int J Human Health Sci*. 2021; 5 (3): 315-323. DOI: 10.31344/ijhhs.v5i3.281.
14. Low J, Nishikawa Y, Takahashi Y, et al. How Malaysian Adolescents Navigate Sexual Health Information on the Internet. *Asia Pac J Public Health*. 2025; 37 (1): 126-133. DOI: 10.1177/10105395241299919.
15. Nuwamanya E, Nalwanga R, Nuwasiima A, et al. Effectiveness of a mobile phone application to increase access to sexual and reproductive health information, goods, and services among university students in Uganda: A randomized controlled trial. *Contracept Reprod Med*. 2020; 5: 31. DOI: 10.1186/s40834-020-00134-5.
16. Onukwugha FI, Smith L, Kaseje D, et al. The effectiveness and characteristics of mHealth interventions to increase adolescent's use of Sexual and Reproductive Health services in Sub-Saharan Africa: A systematic review. *PLoS ONE*. 2022; 17 (1): e0261973. DOI: 10.1371/journal.pone.0261973.
17. Decker MJ, Gutmann-Gonzalez A, Borgen N, et al. Comparing In-Person and Online Sexual Health Education Program Delivery: Youth Perspectives and Short-Term Outcomes. *Health Promot Pract*. 2026; 0 (0). DOI: 10.1177/15248399251411256.
18. Meherali S, Hussain A, Rahim KA, et al. Digital knowledge translation tools for sexual and reproductive health information to adolescents: An evidence gap-map. *Ther Adv Reprod Health*. 2024; 18. DOI: 10.1177/26334941241307881.
19. Nik Farid ND, bin Mohd Arsyad MF, Yakub NA, et al. Improving Malaysian adolescent sexual and reproductive health: An Internet-based health promotion programme as a potential intervention. *Health Educ J*. 2018; 77: 837-848. DOI: 10.1177/0017896918778071
20. Abdul Hamid Alhassan RH, Haggerty CL, Fapohunda A, et al. Exploring the Use of Digital Educational Tools for Sexual and Reproductive Health in Sub-Saharan Africa: Systematic Review. *JMIR Public Health Surveill*. 2025; 11: e63309. DOI: 10.2196/63309.
21. Teye-Kwadjo E, Kagee A, Swart H. Predicting the Intention to Use Condoms and Actual Condom Use Behaviour: A Three-Wave Longitudinal Study in Ghana. *Appl Psychol Health Well Being*. 2017; 9 (1): 81-105. DOI: 10.1111/aphw.12082.
22. Eggers SM, et al. Sociocognitive Predictors of Condom Use and Intentions Among Adolescents in Three Sub-Saharan Sites. *Arch Sex Behav*. 2016; 45: 353-365. DOI: 10.1007/s10508-015-0525-1.
23. Espada JP, Morales A, Guillén-Riquelme A, et al. Predicting condom use in adolescents: A test of three socio-cognitive models using a structural equation modeling approach. *BMC Public Health*. 2016; 16: 35. DOI: 10.1186/s12889-016-2702-0.
24. George AJ, Waheed M. A Study on Factors Forming Sexual and Reproductive Health Information-seeking Intention. *Pertanika J Soc Sci Hum*. 2021; 29 (1): 509-526. DOI: 10.47836/pjssh.29.1.28.
25. Ajzen I. The theory of planned behavior: Frequently asked questions. *Human Behav Emerg Tech*. 2020; 2 (4): 314-324. DOI: 10.1002/hbe2.195.
26. Gibson LP, Gust CJ, Gillman AS, et al. Mechanisms of Action for Empirically Supported Interventions to Reduce Adolescent Sexual Risk Behavior: A Randomized Controlled Trial. *J Adolesc Health*. 2020; 67 (1): 53-60. DOI: 10.1016/j.jadohealth.2020.01.004.
27. Putri S, Devy S, Nurmala I, et al. Sexual Health Education Based on the Theory of Planned Behavior to Prevent Risky Sexual Behavior in Adolescents: A Systematic Review. *Indonesian J Glob Health Res*. 2024; 6: 4139-4148. DOI: 10.37287/ijghr.v6i6.4408.
28. Brar P, Dworkin J, Brady SS. Adolescent Women's Sexual Self-Efficacy: Associations with Personal and Perceived Partner Beliefs that Condoms Interfere with Pleasure. *Am J Sex Educ*. 2020; 15 (3): 336-356. DOI: 10.1080/15546128.2020.1763882.
29. Edison B, Bhochhibhoya S, Baumler ER, et al. Self-Efficacy to Refuse Sex Mediates the Relationship Between Dating Violence Victimization and Sexual Risk Behavior. *J Adolesc Health*. 2024; 74 (3): 531-536. DOI: 10.1016/j.jadohealth.2023.10.025.
30. Ritchwood TD, Penn D, Peasant C, et al. Condom Use Self-Efficacy Among Younger Rural Adolescents: The Influence of Parent-Teen Communication, and Knowledge of and Attitudes Toward Condoms. *J Early Adolesc*. 2017; 37 (2): 267-283. DOI: 10.1177/0272431615599065.
31. Torregosa M, Patricio O. The Mediating Role of Sexual Self-Efficacy on Protected Sex. *J Prim Care Community Health*. 2022; 13. DOI: 10.1177/21501319221129934.
32. Dana NR, Yulia DI. Self-efficacy mediates the relationship between sexual education and prevention of sexually-transmitted diseases awareness among secondary school students in padang city, Indonesia. *Afr J Infect Dis*. 2025; 19 (1): 57-63. DOI: 10.21010/Ajdiv19i1.7.