Journal of Adolescent Health 74 (2024) 644–656

ELSEVIER

JOURNAL OF ADOLESCENT HEALTH

www.jahonline.org

Review article

Interventions Promoting Condom Use Among Youth: A Systematic Review

Alcira de Vries, M.Sc. [a,*], Chantal den Daas, Ph.D. [b], Inge J. M. Willemstein, M.Sc. [a], John B. F. de Wit, Ph.D. [c], and Janneke C. M. Heijne, Ph.D. [a,d]

[a] *Centre for Infectious Disease Control, National Institute for Public Health and the Environment, Bilthoven, The Netherlands*
[b] *Health Psychology Group and Epidemiology Group, Institute of Applied Health Sciences, University of Aberdeen, Aberdeen, United Kingdom*
[c] *Department of Interdisciplinary Social Science, Utrecht University, Utrecht, The Netherlands*
[d] *Department of Social Medicine, Care and Public Health Research Institute (CAPHRI), Maastricht University, Maastricht, The Netherlands*

Article history: Received February 1, 2023; Accepted November 10, 2023
Keywords: Condoms; Safe sex; Young adult; Adolescent; Intervention; Health promotion; Systematic review

A B S T R A C T

In many European and other high-income, Western countries, condom use has been decreasing among youth. A variety of promotional strategies to increase condom use exists. Our systematic review aimed to identify effective elements in interventions aimed at increasing condom use in youth. We searched databases (2010–2021) for intervention studies promoting condom use among youth in Western, high-income countries. The primary outcome was condom use; the secondary outcome was sexually transmitted infection (STI) diagnoses. Effectiveness per intervention was defined based on the percentage of comparisons that showed significant increases in condom use and significant decreases in STIs. We compared the effectiveness of interventions for different participant-, intervention- and methodological characteristics. We included 74 papers describing 85 interventions in the review. Overall, the median intervention effectiveness was 33.3% (interquartile range = 0%–66.7%) for condom use and 0% (interquartile range = 0%–100%) for STI diagnoses. Intervention effectiveness for condom use was significantly higher in interventions tailored towards females and males specifically, compared with interventions applied to both sexes combined. Our findings show the difficulty in designing effective interventions to increase condom use among youth. Interventions aimed at either females or males were more effective in increasing condom use.

IMPLICATIONS AND CONTRIBUTION

This review contributes to research by providing a comprehensive overview of interventions aiming to improve condom use and which characteristics are related to the effectiveness of interventions. Findings imply that condom use is difficult to improve, and that interventions should take sex- and gender differences into account.

Condom use among youth has been decreasing over the past 10–15 years in many European countries, as well as in other Western, high-income countries [1–3]. In the Netherlands, the proportion of males (12–24 years) who used a condom during their last one-nightstand decreased from 74% in 2005 to 55% in 2017, for females this decreased from 85% to 61% [4,5]. In addition, young age is a risk factor of contracting sexually transmitted infections (STIs) compared with older people in many countries [6–8]. In the United States of America and Europe, the highest number of chlamydia diagnosis is among young people [6,7]. Also, the European Centre for Disease Prevention and Control has recently reported increases in gonorrhea diagnoses among young heterosexual populations [9]. This demonstrates the importance of improving condom use in this young population.

Conflicts of interest: The authors declared no potential conflicts.

* Address correspondence to: Alcira de Vries, M.Sc., National Institute of Public Health and the Environment, P.O. Box 1, 3720 BA, Bilthoven, The Netherlands.
E-mail address: Alcira.de.vries@rivm.nl (A. de Vries).

1054-139X/
https://doi.org/10.1016/j.jadohealth.2023.11.014

Numerous interventions have been developed to promote condom use among young people. Condom use may be influenced by many different determinants stemming from various behavioral theories, e.g. knowledge of condoms and/or STIs, beliefs about capabilities (i.e., self-efficacy), and intentions to use condoms [10–13]. Furthermore, condom use can be promoted using various different behavior change techniques [14]. Interventions promoting condoms use can also be delivered in many different settings (e.g., education-based) and through one of many methods of delivery (e.g., radio campaigns or text messages). Developments in the usage of social media and mobile devices over the last decade have yielded even more opportunities for health promotion. This results in a variety of interventions that may each target different determinants of condom use through different methods, but are all aiming to increase condom use.

Systematic reviews can act as valuable tools to gain an overview of the many different possible interventions and to assess their effectiveness. Previous reviews focused on condom use in low- and middle-income countries [15,16], or on the use of contraception [17–21] or dual protection [22,23], which, due to its focus on preventing pregnancy, differs from interventions aiming to improve condom use which address both risk for pregnancies and STIs. Furthermore, systematic reviews often included only specific study designs, mostly randomized controlled trials (RCTs) [24], behavioral interventions [25], specific subpopulations, e.g. college students [26], and above all, most have become outdated [27]. This limits their comprehensiveness and translatability to our current target population. To our knowledge, there currently is no recent systematic review on condom use interventions targeted at young people in Western, high-income countries. Therefore, we aim to provide an overview of interventions to increase condom use among youth in Western, high-income countries, and to identify effective elements in these interventions.

Methods

We conducted a systematic review. The corresponding registration number in PROSPERO is CRD42021253738. Our study is conducted and reported in accordance with the PRISMA guidelines. Study materials are available upon request.

Search strategy and criteria

We used the following electronic databases; Embase, PubMed, Scopus, PsycINFO and Web of Science. The search was conducted on the 13th of December, 2021. Our predefined Population, Intervention, Comparison, Outcome, Study designs guided the in- and exclusion criteria and were as follows: young people (population), interventions to increase condom use (intervention), compared to control conditions or over time (comparison), condom use and STI diagnoses (outcome) and all study designs (study designs).

We focused on interventions aimed at improving condom use specifically, or sexual health in general, such as sexual education programs at school. The search strategy focused on the combination of three main concepts, condom use, general young population, and interventions. The search strategy also contained explicit exclusion terms for certain geographical areas and for sexual minorities and other subgroups, as these subgroups were considered to be too specific to be applicable to the general population. These minorities may, however, still be present in the included studies as part of the general population. The full search strategy can be found in the Supplementary Material, Text 1.

We included experimental and observational studies with at least one comparison on the primary outcome condom use: this could either be between an intervention- and control group, or before and after the intervention in the same group. Observational studies often report on interventions in real-life settings, and therefore are of added value. We included studies from 2010 to 2021 performed in European high-income countries as defined by the United Nations, the Unites states of America, Canada, Australia and New Zealand [28]. Furthermore, the studies had to be focused on young people, defined as a reported age range, median or mean age between 16 and 25 year old. Studies with a broader age range were also eligible for inclusion when the intervention was targeted towards young people (e.g. college students) and a substantial proportion of included participants were between the ages 16 and 25.

Studies were excluded if the primary goal of the intervention was to improve any other health behavior than sexual behavior. For example, an intervention aiming to reduce binge drinking that also measured the effects of the binge drinking intervention on condom use would be excluded. Studies were also excluded if they reported intentions to use condoms rather than actual condom use or if the only available condom use measure combined condom use with condom fails or errors (e.g. breakage, slippage etc.).

Deduplication of the records was performed using EndNote and Rayyan, after which the screening was also performed using Rayyan. Two reviewers (JH and AdV) independently screened the titles and abstract for inclusion and categorized them into either include, exclude or maybe. All disagreements between the reviewers and records that were labeled at least once as maybe were discussed by the two reviewers: titles and abstracts were read again and discussed, after which a final decision was made. Records that were excluded were labeled with the reason for exclusion. We established a list of reasons on which records were excluded; region, population (e.g. incarcerated youth), topic/publication type (e.g. epidemiological reports), intervention (e.g. interventions to increase HPV vaccine uptake), outcome (e.g. condom use intention), study design (e.g. only a postintervention measure). If a study had multiple reasons for exclusion, the reason highest in the above list was selected. The full-text screening was performed by the same two reviewers in a similar fashion. Lastly, we performed a forward- and backward search and followed the same procedure for selection as the initial selection.

Data extraction

To extract the data, we created an extraction form in Qualtrics. Data were extracted independently by four reviewers in total and each paper was extracted by two reviewers to minimize potential errors and bias by the reviewers. In case of uncertainties regarding the data in a paper, the reviewers discussed and resolved the matter. If needed, we contacted the corresponding author of the paper for additional information to resolve uncertainties.

We extracted data on participant characteristics (e.g. mean age, sex) and intervention characteristics, including the name, setting, mode of delivery, duration, and, if stated in the paper, the behavioral model(s) used during intervention development. Extracted data on methodological characteristics included study

characteristics (e.g. study design) and outcome characteristics (e.g. type of outcome).

For each intervention, our primary outcome was self-reported condom use. We extracted data on the type of outcome variable (categorical or continuous) and descriptive measures (e.g. means, standard deviations) of the outcome at each time point (baseline/follow-up) and in each group (intervention/control). We also extracted data on each comparison of the outcome measurement, including the type of analysis, measure of effect, (un) adjusted effect size and variance and variables for which was adjusted and p values. We also assessed the secondary outcome STI diagnoses, if available. For STI outcomes, the same, abovementioned, data as for the condom outcomes were extracted.

Risk of bias assessment

To assess the risk of bias, we used the criteria as stated in the Cochrane risk of bias tools for RCTs, cluster RCTs and nonrandomized studies [29,30]. The assessed domains for RCTs were risk of bias in the randomization process, due to deviations from interventions, bias due to missing outcome data, bias in the selection of the reported results, and for cluster RCTs also bias due to timing of identification/recruitment of participants. For nonrandomized studied the domains were risk of confounding, bias in selection of participants, bias due to classification of interventions, bias due to deviations from intended interventions, bias due to missing outcome data and bias due to selection of the reported results. All risk of bias tools also contain a domain on risk of bias in measurement of the outcome. We did not assess this, since all included studies assessed self-reported condom use, and therefore no differences in bias in measurement of the outcome between studies was expected.

Judgements on the risk of bias for each domain were made based on the signaling questions as stated in the risk of bias tools. For (cluster) RCTs, we followed the algorithms as suggested in the risk of bias tools. For nonrandomized studies, we used the tables from the risk of bias to that were designed to reach a judgement for each domain. Disagreements in the risk of bias judgements were resolved by one author (AdV), who thoroughly examined the support/explanation given for the judgement, the criteria as stated in the tools and the information in the paper. If needed, uncertainties were discussed with the other authors.

Data synthesis

Data were cleaned and prepared for analyses using Microsoft Excel and STATA/SE 17. Preparations included combining the two files of extracted data per paper. Differences and possible mistakes in the extracted data between the two reviewers were resolved by analyzing the corresponding papers.

We synthesized each intervention's effectiveness. In case of multiple interventions in one paper, each intervention counted separately. Also, if a unique study was reported in multiple papers, we considered the papers as different follow-up measures of the same study and intervention. Intervention conditions that differed in their content or mode of delivery were considered unique interventions. The extracted data on intervention characteristics included a description of the intervention. During data synthesis, we further specified characteristics into the setting and different levels of the mode of delivery. Interventions were classified using the Setting Ontology and the Mode of Delivery Ontology [31,32]. In short, the setting could either be physical (e.g. group session) or nonphysical (e.g. text messages), and the facility of the setting could be a community-, educational-, health care- or residential facility. The mode of delivery was categorized into the persons it was delivered to (individual, pair or group), the direction of information (unidirectional or interactive) and the material of the intervention (electronic, human interactional, printed material, television/radio or visual information). The duration of the intervention was classified into single session/administration (one time intervention), short (up to six months) or long (six months or more). For interventions that had components of multiple categories, the most prominent category was selected, and therefore categories are mutually exclusive. Missing values in the information characteristics variables are due to the study not providing sufficient detail. Lastly, study designs were classified into RCT, cluster RCT or other. The category other consisted of all non-RCT study designs (e.g. randomized trials and longitudinal studies) that were grouped together as more specific subgroups would become too small.

Due to high levels of heterogeneity in measures of condom use, types of comparisons, effect measures and analyses, we were unable to perform meta-analyses. Meta-analyses would, thus include too few interventions per analysis to provide meaningful results. Therefore, we calculated an overall score of effectivity per intervention. Since condom use could be measured in multiple ways (e.g. different types of sex/partners) at different follow-up times per intervention, one intervention can have multiple comparisons. We first determined the effectiveness per comparison (i.e. statistical test determining the effectiveness of the intervention, thus a change in condom use over time or compared to a control condition). The extracted p values for each comparison of condom use were formed on the basis of which we determined intervention effectiveness per comparison (if $p < .05$). If the p values were unavailable, we based a statistical significant increase in condom use on confidence intervals (significant if the confidence intervals for odds ratio's and risk ratio's did not include the value 1, or 0 for other measures of effect) or on written texts stating that the association was (not) significant.

We then calculated the overall effectiveness score per intervention by dividing the number of effective comparisons by the total number of comparisons. For example, an intervention with only one comparison can have an effectiveness score of either 0% or 100%, whereas an intervention with 10 comparisons (i.e., five follow-up times for two condom measures (condom use with steady partners or with casual partners)) of which 6 effectively increased condom use has an effectiveness score of 60%. Interventions that showed a decrease in condom use were considered as no effect. As a high number of interventions with only one or two comparisons would consequently result in a high number of interventions with 0%, 50% or 100% effectiveness, the overall intervention effectiveness scores across interventions would not be normally distributed and median values are needed. Studies were eligible for synthesis when either p values or confidence intervals were available for comparisons between intervention- and control groups or premeasures and postmeasures.

To analyze characteristics related to the effective interventions, we performed Kruskal-Wallis tests, which test the equality of the medians. Statistical significance was set at $p \leq .05$. We compared effectiveness across interventions stratified by participant characteristics (region, age and sex), intervention

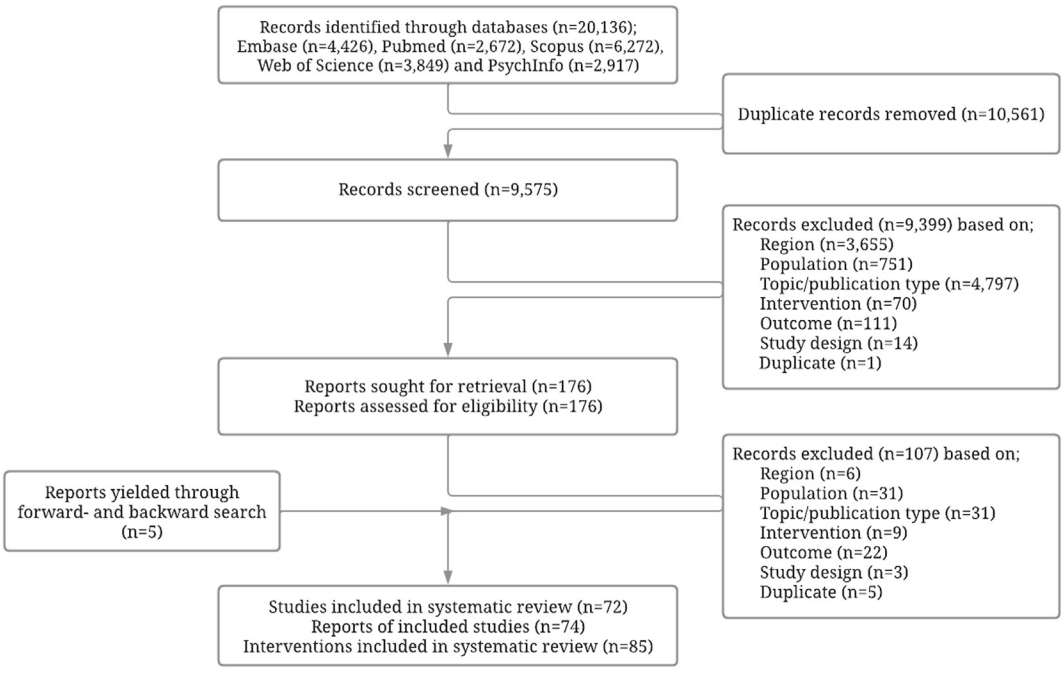

Figure 1. Flowchart of the paper selection and inclusion process.

characteristics (setting, mode of delivery, duration, and whether a behavioral model was used during intervention development). We also assessed methodological characteristics, consisting of study characteristics (design and sample size) and outcome characteristics (type of measure, period of follow-up, type of partner and type of sex). To assess the effect of behavioral models to interventions we also performed separate analyses in a subset of interventions per behavioral model for the models that were reported in $\geq$5 interventions. Sensitivity analyses were performed to analyze whether results were different for males and females and when using a subset of interventions that only reported multiple comparisons of the condom outcome. We did this to check for any possible bias as a result of the extensiveness of comparing the intervention's effect. All descriptive and statistical analyses were performed using STATA/SE 17.

Results

Study selection

We identified a total of 20,136 records, resulting in 9,575 records after deduplication (Figure 1). After screening titles and abstracts, 176 were selected to read in full text to assess eligibility, resulting in 74 papers of 72 unique studies included in the review (Figure 1). Some studies reported on multiple interventions. The included studies reported on 92 unique interventions. Of these interventions seven are only included in our descriptive- but not statistical analyses since they did not include statistical analyses, resulting in an ultimate sample of 85 interventions. The majority of studies were (cluster) RCTs (56.9%), had a sample size of 100–499 participants (37.8%), were published between 2014 and 2017 (41.9%) and were conducted in the United States (68.9%) (Table 1).

Primary outcome: condom use

Each unique intervention has its own effectiveness score, indicating the proportion (%) of comparisons in which condom use significantly increased (Table 1). A histogram of the non-normal distribution of these scores can be found in the Figure S1. Of the 85 interventions, 48 interventions (56.5%) reported one or more statistically significant increases in condom use. Overall, the median value of the effectiveness scores of the included interventions was 33.3% (interquartile range = 0.0%–66.7%) (Table 2). This means that the intervention with the median value of effectiveness significantly increased condom use in one of its three comparisons.

Starting with participant characteristics, no differences in median effectiveness were seen between interventions conducted in different geographical regions, or interventions targeted at young people with different ages (Table 2). However, differences in effectiveness were seen between interventions targeted to the different sexes of the study population (χ^2 = 13.62, p = .001). Stratified analyses revealed that interventions aimed at males only (χ^2 = 8.56, p = .003) and interventions aimed at females only (χ^2 = 7.44, p = .006) had a higher median effectiveness compared with interventions aimed at a population consisting of both males and females. For intervention characteristics (setting, mode of delivery, duration of intervention), we found no difference in the median value of effectiveness scores in increasing condom use (Table 2). Also, for using a theoretical behavioral model, there was no difference in the median value of effectiveness between interventions that either reported to have used a behavioral model or not. However, analyses per behavioral model revealed that interventions using the Theory of Gender and Power had a significantly higher median score of effectiveness (χ^2 = 6.75, p = .009) at increasing condom use compared with interventions that reported to have used a

Table 1
Study characteristics presented for the first intervention, intervention characteristics and effectiveness scores presented per intervention

Authors	Year	Design	Participants, n	Region	Age, mean	Sex	Name of intervention/ condition	Setting	Mode of delivery	Behavioral model(s)	Condom use			STI
											Comparisons, n	Follow-up[b]	Effectiveness	Effectiveness
Armstrong et al. [33]	2010	Other	174	USA	23	Males		health-care facility	human interactional		2	short	100%	
Aronson et al. [34]	2013	Other	57	USA	21	Males	Brothers Leading Healthy Lives (BLHL)	educational	human interactional	IMBSM, Big Man Little Man Complex	2	short	100%	
Ballester-Arnal et al. [35]	2017	Other	467	Europe	21	Both	B-PAPY (Brief Program for AIDS Prevention in Young)	educational	human interactional	behavioral change theories	25	both	8%	
Ballester-Arnal et al. [36]	2014	Other	239	Europe	21	Both	Talk[a]		human interactional	IMBSM	6	short	0%	
							Website[a]		electronic	IMBSM	6	short	0%	
							Attitude discussion[a]		human interactional	IMBSM	6	short	0%	
							Seropositive participant[a]		human interactional	IMBSM	6	short	0%	
							Fear-induction[a]		visual information	IMBSM	6	short	0%	
							Role-play[a]		human interactional	IMBSM	6	short	0%	
Bannink et al. [37]	2014	Cluster RCT	1,702	Europe	16	Both	E-Health4Uth	educational	electronic		3	short	67%	
							E-health4Uth + consult	educational	electronic		3	short	33%	
Berenson et al. [38]	2012	RCT	1,155	USA	20	Females	Clinic-based[a]	health-care facility	human interactional	HBM	1	long	0%	0%
							Clinic-based + phone call[a]	health-care facility	human interactional	HBM	1	long	100%	0%
Bull et al. [39,40]	2016, 2017	Cluster RCT	852	USA	15	Both	Youth All Engaged! (YAE)	educational	electronic	Integrated Theory of mHealth	4	both	50%	
Bull et al. [41]	2012	Cluster RCT	1,578	USA	20	Both	Just/Us		electronic		3	both	33%	
Calloway et al. [42]	2014	Other	129	USA	18	Both	Playing it Safe	educational	human interactional	HBM & SCT	1	short	0%	
Carey et al. [43]	2014	RCT	1,010	USA	29	Both		health-care facility	visual information	IMBSM, SDT & SLT	6	long	0%	33%
Carvalho et al. [44]	2016	RCT	347	Europe	20	Males	Motivational intervention[a]		electronic	HAPA	4	short	75%	
							Volitional intervention[a]		electronic	HAPA	5	short	80%	
Cordova et al. [45]	2020	RCT	50	USA	19	Both	Storytelling 4 Empowerment	health-care facility	electronic	ecodevelopmental and empowerment theories	2	short	0%	
Cornelius et al. [46]	2013	Other	40	USA	15	Both	Becoming A Responsible Teen (BART)		human interactional		1	short	0%	
Cunha-Oliveira et al. [47]	2017	Other	1,303	Europe	19	Both		educational	human interactional	ARRM& IMBSM	4	long	25%	
Daley et al. [48]	2019	Cluster RCT	4,789	USA	NA	Both	Teen Outreach Program (TOP)	educational	human interactional	positive youth development (PYD)	6	both	33%	
Dermen et al. [49]	2011	RCT	154	USA	21	Both	HIV[a]	educational	human interactional		1	long	100%	
							HIV + alcohol[a]	educational	human interactional		1	long	0%	
DiClemente et al. [50]	2014	RCT	701	USA	17	Females	HORIZONS	health-care facility	human interactional		6	long	100%	50%
DiClemente et al. [51]	2021	Other	560	USA	21	Females	HORIZONS + GMET	educational	human interactional	SCT	3	long	100%	0%
							HORIZONS	educational	human interactional	SCT	3	long	0%	0%
Escribano et al. [52]	2016	Other	716	Europe	15	Both	COMPAS	educational	human interactional	SLT & IMBSM	3	both	0%	
Escribano et al. [53]	2015	Other	626	Europe	15	Both	¡Cuidate!	educational	human interactional	SCT & theories of reasoned and planned action	8	both	25%	
Espada et al. [54]	2017	Cluster RCT	1,563	Europe	17	Both	COMPAS	educational	human interactional	SLT & IMBSM	1	long	0%	
							¡Cuidate!	educational	human interactional	SCT& TPB	1	long	0%	
Estrada et al. [55]	2015	RCT	160	USA	15	Both	Brief Familias Unidas	educational	human interactional		3	long	33%	
Estrada et al. [56]	2017	Cluster RCT	746	USA	14	Both	Familias Unidas	educational	human interactional		2	long	50%	
Ferrer et al. [57]	2011	Other	176	USA	NA	Both	Social-cognitive[a]	educational	human interactional	IMBSM	2	both	0%	
							Social-cognitive-emotional[a]	educational	human interactional	IMBSM	2	both	100%	
Francis et al. [58]	2018	Other	195	USA	20	Females		residential facility		integrative model of behavioral prediction, & TGP	3	short	67%	
Garcia-Retamero et al. [59]	2014	Other	700	Europe	19	Both	Positive framed[a]	educational	printed material		NA	NA	NA	
							Negative framed[a]	educational	printed material		NA	NA	NA	

Table 1
Continued

Authors	Year	Design	Participants, n	Region	Age, mean	Sex	Name of intervention/ condition	Setting	Mode of delivery	Behavioral model(s)	Condom use			STI
											Comparisons, n	Follow-up[b]	Effectiveness	Effectiveness
Garcia-Retamero et al. [60]	2015	Other	1,230	Europe	20	Both	Positive framed[a]	educational	human interactional		1	short	100%	
							Negative framed[a]	educational	human interactional		1	short	100%	
Gimenez-Garcia et al. [61]	2018	RCT	225	Europe	21	Both	Peer-led[a]	educational	human interactional	IMBSM & participatory learning	10	short	60%	
							Expert-led[a]	educational	human interactional	IMBSM & participatory learning	10	short	50%	
Gold et al. [62]	2011	RCT	7,606	Australia	NA	Both			electronic	Precaution Adoption Process model, ToPB & Bandura's concept of self-efficacy	5	short	33%	
Grycynski et al. [63]	2020	RCT	300	USA	16	Both	Nurse delivered[a]	health-care facility	human interactional		4	both	0%	
							Computer delivered[a]	health-care facility	electronic		4	both	0%	
Hadley et al. [64]	2016	Other	170	USA	15	Both	Work It Out Together		visual information	The Social-Personal Framework for HIV-Risk Behavior & SLT	1	short	0%	
Hennessy et al. [65]	2013	RCT	1,139	USA		Both	iMPPACS		television & radio		1	long	100%	
Howard et al. [66]	2011	Other	254	USA	NA	Females		health-care facility	electronic		1	short	100%	
Jackson et al. [67]	2016	Other	372	USA	19	Both	Sex 101		electronic	TRA & TTM	1	short	0%	
Jenner et al. [68]	2016	RCT	850	USA	15	Both	Becoming a Responsible Teen (BART)		human interactional		1	long	0%	
Jones et al. [69]	2012	Other	70	USA	NA	Both	Caryn Forya		electronic	HPM	NA	NA	NA	
Kelsey et al. [70]	2016	RCT	2,198	USA	14	Both	¡Cuidate!	educational	human interactional		3	long	0%	
Kelsey et al. [71]	2016	RCT	2,108	USA	17	Females	Safer Sex Intervention	health-care facility	human interactional	SCT & TTM	3	long	0%	
Kirby et al. [72]	2010	RCT	805	USA	NA	Females	Project Reach		electronic		2	long	0%	
Klein et al. [73]	2011	RCT	178	USA	16	Females	SiHLE	community facility	electronic	SCT & TGP	1	short	100%	
Kogan et al. [74]	2012	Other	502	USA	16	Both	The Strong African American Families-Teen (SAAF-T) program	community facility	human interactional		2	long	50%	
Levy et al. [75]	2021	RCT	149	Europe	21	Both		educational	electronic	social cognitive models	3	short	0%	
Lim et al. [76]	2011	RCT	994	Australia	NA	Both			electronic		4	long	0%	
Lohan et al. [77]	2018	Cluster RCT	831	Europe	15	Both	If I were Jack	educational	electronic		NA	NA	NA	
Marsiglia et al. [78]	2013	Other	358	USA	22	Both	HIV/AIDS: Science, Behavior, and Society course	educational	human interactional		1	short	0%	
Mevissen et al. [79]	2011	RCT	218	Europe	21	Both	Tailored[a]		electronic	ARRM, extended parallel process model	2	short	50%	
							Nontailored[a]		electronic	ARRM, extended parallel process model	2	short	50%	
Montanaro et al. [80]	2018	Other	317	USA	19	Both		educational	electronic	TPB	3	short	0%	
Morales et al. [81]	2020	Cluster RCT	699	Europe	15	Both	COMPAS	educational	human interactional	IMBSM, SLT& TPB	3	long	67%	
Morales et al. [82]	2015	Cluster RCT	1,030	Europe	16	Both	COMPAS	educational	human interactional	SLT & IMBSM	1	long	0%	
							¡Cuidate!	educational	human interactional	SCT & TPB	1	long	0%	
Morrison-Beedy et al. [83]	2013	RCT	738	USA	17	Females		health-care facility	human interactional	IMBSM	18	both	22%	
Nebot et al. [84]	2015	Other	181	Europe	NA	Both		community facility	human interactional	SCT	5	short	60%	
Negash et al. [85]	2020	RCT	271	USA		Both		educational	visual information	TPB	5	short	67%	
Nielsen et al. [86]	2019	RCT	433	Europe	20	Both	Skyddslaget ('protection team')		electronic	TTM & Integrated Behavioural Model	4	long	0%	0%
Norton et al. [87]	2012	Other	198	USA	19	Both		educational	visual information	IMBSM	8	short	0%	
Pakarinen et al. [88]	2019	Cluster RCT	683	Europe	NA	Both		educational	human interactional		1	short	0%	
Redding et al. [89]	2014	Other	828	USA	16	Females		health-care facility	electronic	TTM	7	long	29%	

(*continued on next page*)

Table 1
Continued

Authors	Year	Design	Participants, n	Region	Age, mean	Sex	Name of intervention/ condition	Setting	Mode of delivery	Behavioral model(s)	Condom use			STI
											Comparisons, n	Follow-up[b]	Effectiveness	Effectiveness
Reyna et al. [90]	2014	RCT	734	USA	16	Both	Reducing the risk (RTR)	educational	human interactional	fuzzy-trace theory, social learning, social inoculation, and cognitive behavior theories	3	long	33%	
Reyna et al. [90]							Reducing the risk+ (RTR+)	educational	human interactional	fuzzy-trace theory, social learning, social inoculation, and cognitive behavior theories	3	long	33%	
Rinehart et al. [91]	2019	RCT	244	USA	16	Females	Texting for Sexual Health Education and Empowerment (t4she)		electronic	HBM	2	both	0%	
Sapiano et al. [92]	2012	Other	615	USA	29	Females	Sisters Informing Sisters about Topics on Aids (SISTA)	community facility	human interactional	SCT & TGP	3	both	100%	
Serowoky et al. [93]	2015	Other	24	USA	16	Females	¡Cuidate!	health-care facility	human interactional	TRA	NA	short	NA	
Shafii et al. [94]	2019	RCT	272	USA	21	Both	e-KISS	health-care facility	electronic	IMBSM	3	short	33%	0%
Sieving et al. [95–97]	2011, 2013, 2014	RCT	253	USA	16	Females	Prime Time	health-care facility	human interactional	SCT & the resilience paradigm	1	long	80%	
Snitzman et al. [98]	2011	Other	1,383	USA	15	Both		community facility	television & radio		1	long	0%	
Snitzman et al. [99]	2011	Other	1,346	USA	15	Both		community facility	television & radio	Bandura's social cognitive theory of mass communication	1	long	0%	
Starosta et al. [100]	2016	RCT	422	USA	19	Females					4	short	25%	
Walsh-Buhi et al. [101]	2016	Cluster RCT	7,976	USA	15	Both	Teen Outreach Program (TOP)	educational	human interactional		54	short	17%	
Wingood et al. [102]	2011	RCT	135	USA	24	Females	SAHARA	health-care facility	electronic	SCT & TGP	2	short	50%	
Wingood et al. [103]	2013	RCT	848	USA	22	Females		health-care facility	human interactional	SCT & TGP	3	long	33%	67%
Yarber et al. [104]	2018	Other	67	USA	NA	Females	Kinsey Institute Home-based Exercises for Responsible Sex (KIHERS)	residential facility	printed material	sex therapy approach & IMBSM	1	short	100%	
Yoost et al. [105]	2016	Other	50	USA	16	Females		educational	electronic		1	long	100%	
Zellner et al. [106]	2015	Other	192	USA	20	Both		community facility	human interactional	Self-efficacy Model, the Theory of Change Model, & HBM	1	short	100%	

IMBSM = Information-motivation-behavior-Skills Model; HBM = Health Belief Model; SCT = Social Cognitive Theory; SLT = Social Learning Theory; SDT = Self-determination Theory; HAPA = Health Action Process Model; ARRM = AIDS Risk Reduction Model; TPA = Theory of Planned Action; TGP = Theory of Gender and Power; ToRA = Theory of Reasoned Action; HPM = Health Promotion model; TTM = Trans Theoretical Model; TPB = Theory of Planned Behavior.

[a] Names indicate the condition of the intervention in case of multiple intervention in one study.

[b] Short term was defined as <6 months, long term as ≥ 6 months.

Table 2
Analyses of median values of intervention's effectiveness scores in increasing condom use

	Total		Median	IQR		χ^2	*p* value
	n	%		Q1	Q3		
Total of interventions	85	100.0	33.3	0.0	66.7		
Participant characteristics							
Region							
Australia	2	2.4	16.7	0.0	33.3	1.26	.532
Europe	29	34.1	8.0	0.0	60.0		
USA	54	63.5	33.3	0.0	100.0		
Total	85		33.3	0.0	66.7		
Age[a]							
<20	48	60.8	26.8	0.0	55.0	1.21	.548
20–24	29	36.7	33.3	0.0	100.0		
25–29	2	2.5	50.0	0.0	100.0		
Total	79		33.3	0.0	66.7		
Sex							
Females	20	23.5	73.3	12.5	100.0	13.62	.001
Males	4	4.7	90.0	77.5	100.0		
Both	61	71.8	0.0	0.0	50.0		
Total	85		33.3	0.0	66.7		
Intervention characteristics							
Setting							
Nonphysical	12	14.1	12.5	0.0	41.7	0.68	.409
Physical	73	85.9	33.3	0.0	75.0		
Total	85		33.3	0.0	66.7		
Setting – facility[a]							
Community facility	7	11.1	60.0	0.0	100.0	3.68	.298
Educational facility	38	60.3	33.3	0.0	60.0		
Health-care facility	16	25.4	33.3	0.0	100.0		
Residential facility	2	3.2	83.3	66.7	100.0		
Total	63		33.3	0.0	100.0		
Mode of delivery - persons delivered to[a]							
Individual	40	48.2	33.3	0.0	90.0	1.06	.588
Pair	4	4.8	41.7	16.7	50.0		
Group	39	47.0	8.0	0.0	60.0		
Total	83		33.3	0.0	75.0		
Mode of delivery - direction of information							
Unidirectional	22	25.9	16.7	0.0	66.7	0.35	.553
Interactive	63	74.1	33.3	0.0	80.0		
Total	85		33.3	0.0	66.7		
Mode of delivery - material of interevention[a]							
Electronic	25	30.1	33.3	0.0	75.0	4.89	.299
Human interactional	49	59.0	33.3	0.0	66.7		
Printed material	1	1.2	100.0	100.0	100.0		
Television & radio	3	3.6	0.0	0.0	100.0		
Visual information	5	6.0	0.0	0.0	100.0		
Total	83		33.3	0.0	75.0		
Duration of intervention[a]							
Single session/administration	28	34.1	33.3	0.0	70.8	0.51	.774
Short (<6 months)	40	48.8	33.3	0.0	83.3		
Long (≥6 months)	14	17.1	22.6	0.0	50.0		
Total	82		33.3	0.0	66.7		
Behavioral model for intervention development							
Did not report a behavioral model	24	28.2	33.3	0.0	100.0	0.42	.516
Reported a behavioral model	61	71.8	33.3	0.0	66.7		
Total	85		33.3	0.0	66.7		
Methodological characteristics							
Study characteristics							
Study design							
Cluster RCT	13	15.3	33.3	0.0	50.0	0.43	.807
RCT	36	42.4	33.3	0.0	77.5		
Other[b]	36	42.4	16.5	0.0	100.0		
Total	85		33.3	0.0	66.7		
Sample size							
1–100	7	8.2	100.0	0.0	100.0	1.39	.708
101–500	38	44.7	29.2	0.0	75.0		
501–1000	19	22.4	33.3	0.0	50.0		
1000+	21	24.7	16.7	0.0	50.0		
Total	85		33.3	0.0	66.7		
Outcome characteristics[c]							
Type of measure							
Categorical	45	46.9	33.3	0.0	60.0	1.53	.465

(*continued on next page*)

Table 2
Continued

	Total		Median	IQR		χ^2	*p* value
	n	%		Q1	Q3		
Continuous	40	41.7	0.0	0.0	100.0		
Last sex	11	11.5	50.0	0.0	100.0		
Total	96		33.3	0.0	70.8		
Follow-up							
Short (<6 months)	56	55.0	33.3	0.0	90.0	2.10	.147
Long (≥6 months)	48	46.0	0.0	0.0	58.3		
Total	104		25.0	0.0	77.5		
Type of partner							
Casual	7	7.1	0.0	0.0	50.0	0.89	.641
Steady	6	6.1	26.7	0.0	100.0		
Unspecified	86	86.9	33.3	0.0	66.7		
Total	99		28.6	0.0	66.7		
Type of sex							
Vaginal	24	19.0	0.0	0.0	70.0	6.58	.254
Anal	4	3.2	10.0	0.0	40.0		
Oral	5	4.0	0.0	0.0	0.0		
Vaginal/anal	17	13.5	0.0	0.0	0.0		
Vaginal/anal/oral	7	5.6	0.0	0.0	0.0		
Unspecified	69	54.8	25.0	0.0	60.0		
Total	126		0.0	0.0	60.0		

IQR = Interquartile range.
[a] The number of outcomes in this variable is lower than the total due to missing data.
[b] Other designs include all studies that are not a (cluster) RCT.
[c] The total number of outcomes under the section outcome characteristics is higher than the total number of interventions, because studies could report more than one condom measure.

different behavioral model (Table 3). Finally, study characteristics (study design and sample size) and outcome characteristics (type of measure, follow-up period, type of partner, and type of sex) showed no significant differences in the median value of effectiveness scores in increasing condom use (Table 2). Additional information on the type of condom use measure can be found in Table S1. In short, eight different types of measure (e.g. condom use during the last sex act or a percentage indicating the consistency of condom use) were used, which did not significantly differ in the median value of effectiveness.

Secondary outcome: sexually transmitted infections

11 interventions from nine studies also assessed STI outcomes. Two only included descriptive analyses, leaving nine interventions for analyses. The assessed STIs were mainly chlamydia (n = 6) and gonorrhea (n = 5), but also included trichomoniasis (n = 4), syphilis (n = 1), HIV (n = 1), and high-risk HPV (n = 1). STI outcomes were assessed between 3 and 36 months postintervention, either as a part of the study or based on self-reported test outcomes. Of the nine interventions, three interventions reported statistically significant decreases in STIs and six reported no significant decreases in STIs (Table 4), resulting in a median value of the effectiveness score of 0%. Of the three effective interventions, one intervention significantly decreased high-risk HPV but not nonviral STIs (chlamydia, gonorrhea and trichomoniasis), one intervention decreased chlamydia infections, but not gonococcal infections, and one intervention decreased STIs (chlamydia, gonorrhea, trichomoniasis, syphilis or HIV) on the long term follow-ups (>7 months) but not on the short term follow-ups (≤7 months). Two of the three interventions that showed decreases in STIs also showed an significant increases in condom use. The small number of studies that measures STI outcomes hinder any statistical analyses.

Sensitivity analyses

To check for possible differences in intervention effectiveness for interventions that measured condom use in multiple ways (i.e., more comparisons), we repeated the main analyses of condom use among a subset of interventions that had two or more comparisons (73% of interventions) and three or more comparisons (54% of interventions). We also conducted the main analyses stratified by gender. This both did not change the findings (data not shown).

Risk of bias assessment

Risk of bias assessments revealed that 1% of all studies had a low overall risk of bias, 5% moderate, 92% high, and 1% critical risk of bias (Table S2). Since we included different types of study designs, the assessed domains of bias are different between study types. Each domain represents a specific aspect of a study in which bias may be introduced. For RCTs and cluster RCTs the domain with the highest proportion (94% and 50%, respectively) of studies with a high risk of bias was domain two; deviations from intended interventions (e.g. failures in implementing the intervention). The majority of high risk of bias judgments in this domain resulted from underreporting of adherence to the interventions. For other designs, domain one; confounding (65%) had the highest proportion of studies with a high risk of bias. The high number of studies with a high risk of bias meant that analyses excluding studies with a high risk of bias were not possible.

Discussion

Our review found low median values for intervention's effectiveness in improving condom use and reducing STI's among young people. Interventions conducted among each sex separately demonstrated a higher median value of effectiveness

Table 3
Univariate analyses of the effect of using a particular behavioral model compared to interventions that used another model, only including models used in ≥5 interventions

	Model reported	n	Median	Q1	Q3	%	χ^2	*p* value
Overall		61	33.3	0.0	66.7	100.0		
Behavioral model								
Social learning theory	No	53	33.3	0.0	75.0	86.9	1.97	.160
	Yes	8	0.0	0.0	33.3	13.1		
Information-motivation-behavior-skills model	No	40	33.3	0.0	77.5	65.6	1.36	.244
	Yes	21	0.0	0.0	50.0	34.4		
Theory of planned behavior	No	54	31.0	0.0	75.0	88.5	0.01	.934
	Yes	7	33.3	0.0	50.0	11.5		
Social-cognitive theory	No	49	28.6	0.0	50.0	80.3	0.93	.335
	Yes	12	46.7	0.0	100.0	19.7		
Theory of gender and power	No	56	16.5	0.0	55.0	91.8	6.75	.009
	Yes	5	100.0	66.7	100.0	8.2		

compared with interventions conducted among both sexes combined. We did not find a difference in effectiveness in increasing condom use between interventions that were either based on a behavioral model or not. However, analyses of the most frequently reported models showed that interventions that applied the Theory of Gender and Power had a significantly higher intervention effectiveness compared with interventions that reported applying other behavioral models.

The main strength of this systematic review is its broad scope. Our review provides a comprehensive overview of all study types on any intervention aimed at improving condom use among youth in Western, high-income countries. However, the broadness of the review also resulted in a high level of heterogeneity in reported measures for condom use (e.g. the type of sex and partner), types of comparisons (e.g. compared over time or between intervention- and control groups) and analyses to measure the effects on condom use (e.g. generalized estimating equations and analysis of variance). This heterogeneity hampered the performance of meta-analyses to assess the strength of intervention effectiveness. However, we did base our analyses on whether an intervention significantly increased condom use for each of the comparisons rather than the effect size of each comparison. As a result, interventions with a small but significant increase are treated the same way as interventions with a high increase in condom use. Another limitation is the variation in the duration of the interventions, specifically in the short category, as these interventions could range between a few hours and a few months. However, since majority of short interventions had a duration between 5 and 10 hours and were divided over multiple sessions in a time period of 2–3 months, we expect the variation to be of little influence on the findings. Another limitation is that in some categories the number of interventions was relatively small. This may have reduced the analyses' power in detecting differences between the groups. Also, we did not extract information on the levels of the Social-Ecological model that were targeted, which may be of interest to assess in future research. Last, we only focused on an increase in condom use and treated decreases in condom use as the intervention having no effect. However, only three interventions found negative effects or a significantly higher increase of condom use in the control condition. Reasons included a decrease in condom use among the full sample, or small subgroup analyses. We, therefore, expect the impact of such negative effects on our findings to be negligible. Last, based on the risk of bias assessment, some concerns may arise on the reliability of the results. However, this higher risk of bias is mostly inevitable due to the nature of the included interventions. For example, in RCT studies, one of the assessed topics that increased risk of bias was whether the participant is aware of the intervention. In our context this is inevitable and also less relevant than it would be in e.g. a drug trial. For this reason, we expect the assessed risk of bias to be an overestimation of the actual risk of bias. Additionally, since we did not find a difference in the effectiveness scores between (cluster) RCTs and other designs, we expect our results to be robust.

Table 4
Values of the effectiveness scores of interventions that measures STI outcomes, for both effectiveness in decreasing STI's and increasing condom use

Authors	Effectiveness scores	
	STIs	Condom use
Berenson et al. [38]	0%	0%
Berenson et al. [38]	0%	100%
Carey et al. [43]	33%	0%
DiClemente et al. [51]	0%	100%
DiClemente et al. [51]	0%	0%
DiClemente et al. [50]	50%	100%
Nielsen et al. [86]	0%	0%
Shafii et al. [94]	0%	33%
Wingood et al. [103]	67%	33%
Overall median	0%	33%

Our study found a low overall median value of intervention effectiveness scores. This means that overall, the majority of interventions showed improvements in condom use for only few of the comparisons. This is in line with previous literature that demonstrate mixed findings on the effectiveness of condom use interventions [15,16,19,24–26,107–109]. Altogether, this shows that condom use is a behavior that may be difficult to improve by interventions. However, it remains unknown to what extent an increase in condom use affects STI transmission. Small increases in condom use in a large population may already affect STI transmission and consequently positively impact sexual health. In our review we included STI outcomes, yet the low number of studies that measured this makes it difficult to form any conclusions. More research is needed how improvements in condom use affect the transmission of STIs.

However, we did find a difference in intervention effectiveness between the sexes to which the interventions were aimed. Interventions aimed at either females or males were more effective in increasing condom use than interventions aimed at both sexes combined, which suggests that sex-specific interventions may be more effective in improving condom use. This is in line with a systematic review of meta-analyses that found that behavioral interventions to promote condom use that are successful when tailored for example to gender [108].

Our review could not demonstrate a difference in effectiveness between interventions that were based on behavioral models compared with interventions that were not. This was unexpected, as research has demonstrated that interventions based on theoretical behavior models effectively improve condom use [19,108]. A possible explanation include that our review only included the reported behavioral models, but not to what extent the used behavior change techniques were actually in line with the constructs of the reported behavioral models as this is often not reported in publications. This would, therefore, be of interest for future research. However, when focusing only on studies that did report a behavioral model, we did find that interventions using the Theory of Gender and Power had a significantly higher effectiveness than interventions that used another behavioral model. In existing literature, this theory has been applied to HIV risk and demonstrates how different gender-specific factors, e.g. power imbalances, put females at a higher risk for HIV and presumably other STIs [110]. Though this theory mainly focuses on gender, some aspects of condom use may depend on biological sex, more specifically on genitalia. Power imbalances in a sexual context, for example, may exist as a result of gender, but also from having a penis as opposed to having receptive sex with a person with a penis. The latter involves both dependance on and convincing of the partner to use a condom. Effective interventions in our review aimed at females for example focused on communication-, relationship- and negotiation skills [73,92,102,103]. On the other hand, effective interventions aimed at males for example focused on information about sexual and reproductive health, STI transmission and condom use, personal and social motivations, responsibility, and the protection of partners [33,34].

Only recently has gender become less binary, and therefore research on condom use interventions among transgender and gender diverse persons is lacking. Since in most research, including interventions in our review, sex and gender are interwoven, it is unclear whether interventions should target aspects that are sex-specific or gender-specific. The higher effectiveness of sex- and/or gender-specific interventions do, however, illustrate that when improving condom use, one size may not fit all, and that both sex- and gender differences should be taken into account.

In conclusion, our systematic review suggests that condom use remains a behavior that is difficult to improve by interventions. More research is needed into how changes in condom use affect the transmission of STIs. Tailoring interventions to different genders and/or sex may increase an intervention's effectiveness, which is something future interventions should take into consideration.

Acknowledgments

This work is part of the project "The condom comeback: development of an appropriate, effective, and sustainable strategy to promote condom use and reduce STI disease burden among young people" (with project number 10150511910049) which is financed by the Netherlands Organisation for Health Research and Development (ZonMw).

Funding Sources

The funding source had no involvement in the in the study design, the writing of the report, or the decision to submit the article for publication.

Supplementary Data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jadohealth.2023.11.014.

References

[1] Koumans EH, Welch R, Warner DL. 70. Differences in adolescent condom use trends by global region. J Adolesc Health 2020;66(2, Supplement): S36–7.
[2] Vashishtha R, Pennay A, Dietze PM, Livingston M. Trends in adolescent alcohol and other risky health- and school-related behaviours and outcomes in Australia. Drug Alcohol Rev 2021;40:1071–82.
[3] Clark T, Lambert M, Tiatia-Seath J, et al. Youth19 rangatahi smart survey, initial findings: Sexual and reproductive health of New Zealand secondary school students. New Zealand: The Youth19 Research Group, The University of Auckland and Victoria University of Wellington; 2020.
[4] Hanneke de Graaf SM, Poelman J, Vanwesenbeeck I. Seks onder je 25e [in Dutch]. Delft: Rutgers; 2005.
[5] Hanneke de Graaf MVDB, Nikkelen S, Twisk D, Meijer S. Seks onder de 25e [in Dutch]. Available at: https://rutgers.nl/wp-content/uploads/2021/09/Onderzoeksboek-Seks-onder-je-25e-2017.pdf. Accessed November 18, 2022.
[6] Sexually transmitted disease surveillance 2021. 2022. Available at: https://www.cdc.gov/std/statistics/2021/default.htm. Accessed June 28, 2023.
[7] Chlamydia infection. Stockholm: European Centre for Disease Prevention and Control [ECDC]; 2022.
[8] Gonorrhoea. Stockholm: European Centre for Disease Prevention and Control [ECDC]; 2020.
[9] Communicable disease threats report, week 25, 18-24 June 2023. Solna, Sweden: European Centre for Disease Prevention and Control [ECDC]; 2023.
[10] Asare M. Using the theory of planned behavior to determine the condom use behavior among college students. Am J Health Stud 2015;30:43–50.
[11] Conner M, Norman P. Predicting and Changing Health Behaviour: Research and Practice with Social Cognition Models. 3rd ed. Maidenhead, Berkshire: Open University Press; 2015. Available at: http://search.ebscohost.com/login.aspx?direct=true&scope=site&db=nlebk&db=nlabk&AN=1099351. Accessed November 17, 2022.
[12] Albarracín D, Johnson BT, Fishbein M, Muellerleile PA. Theories of reasoned action and planned behavior as models of condom use: A meta-analysis. Psychol Bull 2001;127:142–61.
[13] 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.
[14] Michie S, Richardson M, Johnston M, et al. The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: Building an international consensus for the reporting of behavior change interventions. Ann Behav Med 2013;46:81–95.
[15] Fonner VA, Armstrong KS, Kennedy CE, et al. School based sex education and HIV prevention in low- and middle-income countries: A systematic review and meta-analysis. PLoS One 2014;9:e89692.
[16] Evans WD, Ulasevich A, Hatheway M, Deperthes B. Systematic review of peer-reviewed literature on global condom promotion programs. Int J Environ Res Public Health 2020;17:2262.
[17] Jawad A, Jawad I, Alwan NA. Interventions using social networking sites to promote contraception in women of reproductive age. Cochrane Database Syst Rev 2019;3:CD012521.
[18] Lopez LM, Bernholc A, Chen M, Tolley EE. School-based interventions for improving contraceptive use in adolescents. Cochrane Database Syst Rev 2016;6:1–17.
[19] Lopez LM, Grey TW, Chen M, et al. Theory-based interventions for contraception. Cochrane Database Syst Rev 2016;11:1–21.

[20] Lopez LM, Grey TW, Tolley EE, Chen M. Brief educational strategies for improving contraception use in young people. Cochrane Database Syst Rev 2016;3:1–17.
[21] Lopez LM, Tolley EE, Grimes DA, Chen-Mok M. Theory-based interventions for contraception. Cochrane Database Syst Rev 2011;3:1–13.
[22] Lopez LM, Stockton LL, Chen M, et al. Behavioral interventions for improving dual-method contraceptive use. Cochrane Database Syst Rev 2014;3:1–5.
[23] Lopez LM, Otterness C, Chen M, et al. Behavioral interventions for improving condom use for dual protection. Cochrane Database Syst Rev 2013;10:1–5.
[24] Free C, Roberts IG, Abramsky T, et al. A systematic review of randomised controlled trials of interventions promoting effective condom use. J Epidemiol Community Health 2011;65:100–10.
[25] Bailey JV, Murray E, Rait G, et al. Interactive computer-based interventions for sexual health promotion. Cochrane Database Syst Rev 2010;9:1–18.
[26] Whiting W, Pharr JR, Buttner MP, Lough NL. Behavioral interventions to increase condom use among college students in the United States: A systematic review. Health Educ Behav 2019;46:877–88.
[27] Albarracín D, Durantini MR, Earl A. Empirical and theoretical conclusions of an analysis of outcomes of HIV-prevention interventions. Curr Dir Psychol Sci 2006;15:73–8.
[28] World economic situation and prospects 2022. New York: United Nations; 2022.
[29] Sterne JA, Hernán MA, Reeves BC, et al. ROBINS-I: A tool for assessing risk of bias in non-randomised studies of interventions. BMJ 2016;355:i4919.
[30] Sterne JAC, Savović J, Page MJ, et al. RoB 2: A revised tool for assessing risk of bias in randomised trials. BMJ 2019;366:l4898.
[31] Norris E, Marques MM, Finnerty AN, et al. Development of an Intervention Setting Ontology for behaviour change: Specifying where interventions take place. Wellcome Open Res 2020;5:124.
[32] Marques MM, Carey RN, Norris E, et al. Delivering behaviour change interventions: Development of a mode of delivery Ontology. Wellcome Open Res 2020;5:125.
[33] Armstrong B, Kalmuss D, Franks M, et al. Creating teachable moments: A clinic-based intervention to improve young men's sexual health. Am J Mens Health 2010;4:135–44.
[34] Aronson RE, Rulison KL, Graham LF, et al. Brothers Leading Healthy Lives: Outcomes from the pilot testing of a culturally and contextually congruent HIV prevention intervention for black male college students. AIDS Educ Prev 2013;25(5):376–93.
[35] Ballester-Arnal R, Gil-Llario MD, Ruiz-Palomino E, Giménez-García C. Effectiveness of a brief multi-component intervention to HIV prevention among Spanish youth. AIDS Behav 2017;21(9):2726–35.
[36] Ballester-Arnal R, Gil-Llario MD, Giménez-García C, Kalichman SC. What works well in HIV prevention among spanish young people? An analysis of differential effectiveness among six intervention techniques. AIDS Behav 2015;19(7):1157–69.
[37] Bannink R, Broeren S, Joosten-van Zwanenburg E, van As E, van de Looij-Jansen P, Raat H. Effectiveness of a web-based tailored intervention (E-health4Uth) and consultation to promote adolescents' health: randomized controlled trial. J Med Internet Res 2014;16(5):e143.
[38] Berenson AB. A study of two interventions to increase adherence with oral contraceptives and condom use among adolescents and young adults. Diss Abstr Int 2013;73 (11-B(E)):No-Specified.
[39] Bull S, Devine S, Schmiege SJ, et al. Text messaging and teen sexual health behavior: Long-term follow-up of a cluster randomized trial. Comput Inform Nurs 2017;35:549–53.
[40] Bull S, Devine S, Schmiege SJ, et al. Text messaging, teen outreach program, and sexual health behavior: A cluster randomized trial. Am J Public Health 2016;106(S1):S117–24.
[41] Bull SS, Levine DK, Black SR, et al. Social media-delivered sexual health intervention: A cluster randomized controlled trial. Am J Prev Med 2012; 43:467–74.
[42] Calloway DS, Long-White DN, Corbin DE. Reducing the risk of HIV/AIDS in African American college students: An exploratory investigation of the efficacy of a peer educator approach. Health Promot Pract 2014;15:181–8.
[43] Carey MP, Senn TE, Walsh JL, et al. Evaluating a brief, video-based sexual risk reduction intervention and assessment reactivity with STI clinic patients: Results from a randomized controlled trial. AIDS Behav 2015;19: 1228–46.
[44] Carvalho T, Alvarez M-J, Pereira C, Schwarzer R. Stage-based computer-delivered interventions to increase condom use in young men. Int J Sex Health 2016;28:176–86.
[45] Cordova D, Munoz-Velazquez J, Mendoza Lua F, et al. Pilot study of a multilevel mobile health app for substance use, sexual risk behaviors, and testing for sexually transmitted infections and HIV among youth: Randomized controlled trial. JMIR Mhealth Uhealth 2020;8:e16251.
[46] Cornelius JB, Dmochowski J, Boyer C, et al. Text-messaging-enhanced HIV intervention for African American adolescents: A feasibility study. J Assoc Nurses AIDS Care 2013;24:256–67.
[47] Cunha-Oliveira A, Caramelo F, Patrício M, et al. Impact of an educational intervention program on the sexual behaviors of higher education students. Revista de Enfermagem Referência 2017;IV Série:71–82.
[48] Daley EM, Marhefka SL, Wang W, et al. Longitudinal evaluation of the teen outreach programme: Impacts of a health promotion programme on risky sexual behaviours. Health Educ J 2019;78:916–30.
[49] Dermen KH, Thomas SN. Randomized controlled trial of brief interventions to reduce college students' drinking and risky sex. Psychol Addict Behav 2011;25:583–94.
[50] DiClemente RJ, Wingood GM, Sales JM, et al. Efficacy of a telephone-delivered sexually transmitted infection/human immunodeficiency virus prevention maintenance intervention for adolescents: A randomized clinical trial. JAMA Pediatr 2014;168:938–46.
[51] DiClemente RJ, Rosenbaum JE, Rose ES, et al. Horizons and group motivational enhancement therapy: HIV prevention for alcohol-using young black women, a randomized experiment. Am J Prev Med 2021;60:629–38.
[52] Escribano S, Espada JP, Orgilés M, Morales A. Implementation fidelity for promoting the effectiveness of an adolescent sexual health program. Eval Program Plann 2016;59:81–7.
[53] Escribano S, Morales A, Orgilés M, Espada JP. Influence of fidelity of implementation in the efficacy of a program to promote sexual health with adolescents. Health Addict/Salud Drog 2015;15:103–14.
[54] Espada JP, Escribano S, Morales A, Orgilés M. Two-year follow-up of a sexual health promotion program for Spanish adolescents. Eval Health Prof 2017;40:483–504.
[55] Estrada Y, Rosen A, Huang S, et al. Efficacy of a brief intervention to reduce substance use and human immunodeficiency virus infection risk among latino youth. J Adolesc Health 2015;57:651–7.
[56] Estrada Y, Molleda L, Murray A, et al. eHealth Familias Unidas: Pilot study of an internet adaptation of an evidence-based family intervention to reduce drug Use and sexual risk behaviors among hispanic adolescents. Int J Environ Res Public Health 2017;14:264.
[57] Ferrer RA, Fisher JD, Buck R, Amico KR. Pilot test of an emotional education intervention component for sexual risk reduction. Health Psychol 2011;30:656–60.
[58] Francis DB, Noar SM, Fortune DA, Adimora AA. "Be straight up and so will He": Evaluation of a novel HIV prevention condom distribution and health communication intervention targeting young African American females. AIDS Educ Prev 2018;30:137–51.
[59] Garcia-Retamero R, Cokely ET. The influence of skills, message frame, and visual aids on prevention of sexually transmitted diseases. J Behav Decis Making 2014;27:179–89.
[60] Garcia-Retamero R, Cokely ET. Simple but powerful health messages for increasing condom use in young adults. J Sex Res 2015;52:30–42.
[61] Giménez-García C, Ballester-Arnal R, Gil-Llario MD, Salmerón-Sánchez P. Peer-led or expert-led intervention in HIV prevention efficacy? A randomized control trial among Spanish young people to evaluate their role. Health Promot Pract 2018;19:277–86.
[62] Gold J, Aitken CK, Dixon HG, et al. A randomised controlled trial using mobile advertising to promote safer sex and sun safety to young people. Health Educ Res 2011;26:782–94.
[63] Gryczynski J, Mitchell SG, Schwartz RP, et al. Computer- vs. nurse practitioner-delivered brief intervention for adolescent marijuana, alcohol, and sex risk behaviors in school-based health centers. Drug Alcohol Depend 2021;218:108423.
[64] Hadley W, Brown LK, Barker D, et al. Work it out together: Preliminary efficacy of a parent and adolescent DVD and workbook intervention on adolescent sexual and substance use attitudes and parenting behaviors. AIDS Behav 2016;20:1961–72.
[65] Hennessy M, Romer D, Valois RF, et al. Safer sex media messages and adolescent sexual behavior: 3-year follow-up results from project iMPPACS. Am J Public Health 2013;103:134–40.
[66] Howard MN, Davis JA, Mitchell ME. Improving low-income teen health behaviors with Internet-linked clinic interventions. Sex Res Soc Pol 2011; 8:50–7.
[67] Jackson DD, Ingram LA, Boyer CB, et al. Can technology decrease sexual risk behaviors among young people? Results of a pilot study examining the effectiveness of a mobile application intervention. Am J Sex Educ 2016;11:41–60.
[68] Jenner E, Jenner LW, Walsh S, et al. Impact of an intervention designed to reduce sexual health risk behaviors of African American adolescents: Results of a randomized controlled trial. Am J Public Health 2016;106(S1): S78–84.
[69] Jones K, Baldwin KA, Lewis PR. The potential influence of a social media intervention on risky sexual behavior and chlamydia incidence. J Community Health Nurs 2012;29:106–20.

[70] Kelsey M, Layzer C, Layzer J, et al. Replicating cuidate!: 6-month impact findings of a randomized controlled trial. Am J Public Health 2016;106-(Suppl 1):S70–7.
[71] Kelsey M, Walker JT, Layzer J, et al. Replicating the safer sex intervention: 9-month impact findings of a randomized controlled trial. Am J Public Health 2016;106(S1):S53–9.
[72] Kirby D, Raine T, Thrush G, et al. Impact of an intervention to improve contraceptive use through follow-up phone calls to female adolescent clinic patients. Perspect Sex Reprod Health 2010;42:251–7.
[73] Klein CH, Card JJ. Preliminary efficacy of a computer-delivered HIV prevention intervention for African American teenage females. AIDS Educ Prev 2011;23:564–76.
[74] Kogan SM, Yu T, Brody GH, et al. Integrating condom skills into family-centered prevention: Efficacy of the strong African American families-teen program. J Adolesc Health 2012;51:164–70.
[75] Levy E, Warner LM, Fleig L, et al. The effects of psychological inoculation on condom use tendencies and barriers; a randomized controlled trial. Psychol Health 2021;36:575–92.
[76] Lim MSC, Hocking JS, Aitken CK, et al. Impact of text and email messaging on the sexual health of young people: A randomised controlled trial. J Epidemiol Community Health 2012;66:69–74.
[77] Lohan M, Aventin A, Clarke M, et al. JACK trial protocol: A phase III multicentre cluster randomised controlled trial of a school-based relationship and sexuality education intervention focusing on young male perspectives. BMJ Open 2018;8:e022128.
[78] Marsiglia FF, Jacobs BL, Nieri T, et al. Effects of an undergraduate HIV/AIDS course on students' HIV risk. J HIV AIDS Soc Serv 2013;12:172–89.
[79] Mevissen FEF, Ruiter RAC, Meertens RM, et al. Justify your love: Testing an online STI-risk communication intervention designed to promote condom use and STI-testing. Psychol Health 2011;26:205–21.
[80] Montanaro EA, Kershaw TS, Bryan AD. Dismantling the theory of planned behavior: Evaluating the relative effectiveness of attempts to uniquely change attitudes, norms, and perceived behavioral control. J Behav Med 2018;41:757–70.
[81] Morales A, Orgilés M, Espada JP. Sexually unexperienced adolescents benefit the most from a sexual education program for adolescents: A longitudinal cluster randomized controlled study. AIDS Educ Prev 2020;32:493–511.
[82] Morales A, Espada JP, Orgilés M. A 1-year follow-up evaluation of a sexual-health education program for Spanish adolescents compared with a well-established program. Eur J Public Health 2016;26:35–41.
[83] Morrison-Beedy D, Jones SH, Xia Y, et al. Reducing sexual risk behavior in adolescent girls: Results from a randomized controlled trial. J Adolesc Health 2013;52:314–21.
[84] Nebot L, Díez E, Martín S, et al. [Effects of a contraceptive counselling intervention in adolescents from deprived neighbourhoods with a high proportion of immigrants]. Gac Sanit 2016;30:43–6.
[85] Negash S, Fincham F, Cui M, et al. Promoting sexual health on college campuses: Implementing brief sexual negotiation strategies. Coll Student J 2020;54:241–57.
[86] Nielsen AM, De Costa A, Gemzell-Danielsson K, et al. The MOSEXY trial: Mobile phone intervention for sexual health in youth-a pragmatic randomised controlled trial to evaluate the effect of a smartphone application on sexual health in youth in Stockholm, Sweden. Sex Transm Infect 2021;97:141–6.
[87] Norton WE, Fisher JD, Amico KR, et al. Relative efficacy of a pregnancy, sexually transmitted infection, or human immunodeficiency virus prevention-focused intervention on changing sexual risk behavior among young adults. J Am Coll Health 2012;60:574–82.
[88] Pakarinen M, Kylmä J, Helminen M, Suominen T. Vocational school students' self-evaluations of a sexual health promotion intervention. Scand J Caring Sci 2019;33:857–67.
[89] Redding CA, Prochaska JO, Armstrong K, et al. Randomized trial outcomes of a TTM-tailored condom use and smoking intervention in urban adolescent females. Health Educ Res 2015;30:162–78.
[90] Reyna VF, Mills BA. Theoretically motivated interventions for reducing sexual risk taking in adolescence: A randomized controlled experiment applying fuzzy-trace theory. J Exp Psychol Gen 2014;143:1627–48.
[91] Rinehart DJ, Leslie S, Durfee MJ, et al. Acceptability and efficacy of a sexual health texting intervention designed to support adolescent females. Acad Pediatr 2020;20:475–84.
[92] Sapiano TN, Moore A, Kalayil EJ, et al. Evaluation of an HIV prevention intervention designed for African American women: Results from the SISTA community-based organization behavioral outcomes project. AIDS Behav 2013;17:1052–67.
[93] Serowoky ML, George N, Yarandi H. Using the program logic model to evaluate cuidate!: A sexual health program for latino adolescents in a school-based health center. Worldviews Evid Based Nurs 2015;12:297–305.
[94] Shafii T, Benson SK, Morrison DM, et al. Results from e-KiSs: Electronic-KIOSK intervention for safer sex: A pilot randomized controlled trial of an interactive computer-based intervention for sexual health in adolescents and young adults. PLoS One 2019;14:e0209064.
[95] Sieving RE, McMorris BJ, Beckman KJ, et al. Prime time: 12-month sexual health outcomes of a clinic-based intervention to prevent pregnancy risk behaviors. J Adolesc Health 2011;49:172–9.
[96] Sieving RE, McRee AL, Secor-Turner M, et al. Prime time: Long-term sexual health outcomes of a clinic-linked intervention. Perspect Sex Reprod Health 2014;46:91–100.
[97] Sieving RE, McRee AL, McMorris BJ, et al. Prime time: Sexual health outcomes at 24 months for a clinic-linked intervention to prevent pregnancy risk behavior. JAMA Pediatr 2013;167:333–40.
[98] Sznitman S, Stanton BF, Vanable PA, et al. Long term effects of community-based STI screening and mass media HIV prevention messages on sexual risk behaviors of African American adolescents. AIDS Behav 2011;15:1755–63.
[99] Sznitman S, Vanable PA, Carey MP, et al. Using culturally sensitive media messages to reduce HIV-associated sexual behavior in high-risk African American adolescents: Results from a randomized trial. J Adolesc Health 2011;49:244–51.
[100] Starosta AJ, Cranston E, Earleywine M. Safer sex in a digital world: A web-based motivational enhancement intervention to increase condom use among college women. J Am Coll Health 2016;64:184–93.
[101] Walsh-Buhi ER, Marhefka SL, Wang W, et al. The impact of the teen outreach program on sexual intentions and behaviors: Erratum. J Adolesc Health 2016;59:607.
[102] Wingood GM, Card JJ, Er D, et al. Preliminary efficacy of a computer-based HIV intervention for African-American women. Psychol Health 2011;26:223–34.
[103] Wingood GM, DiClemente RJ, Robinson-Simpson L, et al. Efficacy of an HIV intervention in reducing high-risk human papillomavirus, nonviral sexually transmitted infections, and concurrency among African American women: A randomized-controlled trial. J Acquir Immune Defic Syndr 2013;63(SUPPL. 1):S36–43.
[104] Yarber WL, Milhausen RR, Beavers KA, et al. A pilot test of a self-guided, home-based intervention to improve condom-related sexual experiences, attitudes, and behaviors among young women. J Am Coll Health 2018;66:421–8.
[105] Yoost J, Starcher R, King-Mallory B, Gress T. Using telemedicine to teach reproductive health to rural at risk high school females. J Pediatr Adolesc Gynecol 2016;29:169.
[106] Zellner T, Trotter J, Lenoir S, et al. Color it real: A program to increase condom use and reduce substance Abuse and perceived stress. Int J Environ Res Public Health 2015;13:ijerph13010051.
[107] Noar SM. Behavioral interventions to reduce HIV-related sexual risk behavior: Review and synthesis of meta-analytic evidence. AIDS Behav 2008;12:335–53.
[108] von Sadovszky V, Draudt B, Boch S. A systematic review of reviews of behavioral interventions to promote condom use. Worldviews Evid Based Nurs 2014;11:107–17.
[109] Berendes S, Gubijev A, McCarthy OL, et al. Sexual health interventions delivered to participants by mobile technology: A systematic review and meta-analysis of randomised controlled trials. Sex Transm Infect 2021;97:190–200.
[110] Wingood GM, Scd, DiClemente RJ. Application of the theory of gender and power to examine HIV-related exposures, risk factors, and effective interventions for women. Health Educ Behav 2000;27:539–65.