Manuscript title

The effectiveness of combined alcohol and sexual risk taking reduction interventions on the sexual behaviour of teenagers and young adults: A Systematic Review

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Highlights

- Comprehensive health service models for teenagers and young adults are gaining importance.
- During adolescence and early adulthood risky sexual behaviour is linked with alcohol consumption.
- Interventions to reduce both risky sexual behaviour and alcohol are vital and effective.
- Intervention design, delivery method, and follow-up are important aspects to ensure success of intervention programmes.

Abstract

Objectives: To conduct a systematic review to summarise currently implemented interventions investigating their effectiveness in reducing alcohol use and sexual risk taking behaviour in teenagers and young adults.

Study design: Systematic review

Methods: Studies published in English language with both, alcohol and sexual risky behaviour reduction interventions were searched using five electronic database platforms. All review tasks such as study screening, selection, data extraction, quality rating, and synthesis were performed in accordance with systematic review guidelines.

Results: The review included 18 studies. Fifteen studies were RCTs, while three were interventional studies having pre and post intervention analysis. Overall study duration ranged from 6 months to 24 months. The retention rate decreased with an increase in study duration and ranged from 60% to 80% for majority of studies, while some studies particularly planned for a shorter period had a higher retention rate (≥ 90%). Study site showed a range of patterns (in schools/college= 5, at family level/home environment= 3, web based= 2, sexual health clinics=2, mental health clinics= 1, community level = 1, and juvenile detention facility= 4). The study quality assessment showed that most studies were of medium to high quality. Evidence from this systematic review suggests that following interventions young people are less likely, to engage in risky sexual behaviour and choose harmful alcohol drinking. The major factors influencing individuals during adolescence and early adulthood include local cultural norms, acceptability of casual sex, and binge drinking trends in the teenage and young communities. It was also observed that study setting and target population determine the type of intervention required and impacts on outcomes.

Conclusions: This reviews suggests that interventions to reduce risky sexual behaviour and alcohol consumption work in teenagers and young adults. However, selection of appropriate intervention type/design, delivery methods, and follow-up plans are key elements to ensure both uptake and success of such intervention projects.

Keywords: Sexual Health, Alcohol, Adolescents, Young adults, Risky behaviour, Sexual behaviour

Background

Adolescence and early adulthood are important stages of personality and health development. In the modern world - changing social norms and perspectives towards life are also changing swiftly that can present a number of challenges for adolescents. The timespan during late adolescence (15 to 18 years) and young adulthood (19 to 25 years) is often a time of risk taking behaviour, such as alcohol, drug abuse, unsafe risky sexual behaviour, and tobacco smoking, , which can affect the health of young people (1) (2). Findings from national surveys from the US demonstrated that illicit drug use, alcohol consumption including binge drinking, and also substance misuse prevalence are serious public health concerns, and are very commonly seen across the country (1).

Patterns and occurrences of sexual and non-sexual behaviours are often influenced by elements such as alcohol (3). For example, a study among 18 to 24 year old adults found that young hazardous male drinkers had unprotected sex and regretted such sex, while female hazardous drinkers experienced unwanted sexual advances (4), resulting in risky sexual behaviours. It is also important to note that unwanted sexual contact may lead to unintended pregnancy, which further hampers the health of girls at a young age with long term consequences. This can likely to impact on education opportunities, career development and also on overall health developments.

The onset of such risky behaviours is thought to materialise prior to sexual debut. A European study found that individuals (less than 16 years of age) are three times more likely to have sex if they consumed alcohol (5). The study findings also showed that alcohol was predominantly used to facilitate a sexual encounter, and

was also associated with sexual risky behaviours in young participants who were also unlikely to seek required health services to investigate any sexually transmitted infections (STIs) (5).

STIs are most common in adolescents and young adults than older people due to a mix of behavioural, social, and age-related factors. This higher risk may exist due to the number of sexual partners, unprotected sex, and an increased likelihood to have a partner with an active STI(s) (6) include both viral (HIV, Hepatitis) and bacterial (Syphilis, Chlamydia, Gonorrhoea) infections. The behavioural influences related to higher prevalence of STIs among teenagers are predominantly peer predisposed (6). Moreover, alcohol misuse is known to be associated with high-risk sexual behaviour such as early sexual debut, emergency contraception use, unprotected sex with multiple partners, and STIs (2).

Alcohol consumption is commonly given as a reason for lack of condom use among high-risk adolescents (2). In the UK, binge (harmful) drinking among adolescents and young adults is a common problem (7), and poses immediate sexual risks (8), necessitating the involvement of primary health care services to provide integrated alcohol and sexual health interventions. Studies report a clustering of behaviours in the early and the late teenage years specifically drinking and risky sexual behaviour especially among girls and recommended a holistic approach integrating risk behaviours and its determinants (9).

With an understanding of existing public health situations and health service challenges, there is an opportunity and need to investigate the integrated service delivery approach aimed at promoting sexual health including multiple risky behaviours and disorders in adolescents and young adults (3, 5, 10). However,

most research often focuses on substance misuse alone and screening of comorbidities only prescribed for those with substance use disorders. For example, adolescents with alcohol use disorders (AUDs) evaluated for others comorbidities such as mental disorders and risky sexual behaviour (11). In order to improve services for adolescents and young adults to reduce sexual related behaviour resulting from alcohol use, it is important that the existing evidence base on interventions is systematically reviewed to inform future practice. There has been a growing recognition of the need to provide services and interventions that address health behaviours of teenagers and young adults more holistically. Part of this drive has been a growth in designing and evaluating interventions to address alcohol and sexual behaviour in a combined manner. Therefore, this systematic review was conducted to summarise currently implemented interventions to analyse their effectiveness in reducing either alcohol use, sexual risk taking or both.

Methods

Data sources and search strategy

One researcher (RT) searched for articles in English language published until February 2017, and each online search outcome was confirmed by an additional author (MH verified the online search results generated by RT). The literature search was conducted using the following electronic databases: MEDLINE, EBSCOHost (CINHAL, ERIC, PcyshInfo), Cochrane, ClinicalTrials.gov and Web of Science. Search terms were developed and reviewed by several authors to ensure their relevance to the review objectives (MH and RT). Search terms used in the electronic searches and the strategy are attached with the paper (Supplementary 1). Reference list of selected articles were also scrutinised to identify additional eligible papers. In addition, author search using the Google Scholar service was performed to check for any missed papers.

Inclusion criteria

1. Type of study: The systematic review considered intervention studies including randomised control trials where sexual health or behaviour and alcohol use were primary study objectives.
2. Type of intervention: Studies were deemed eligible only if both outlined components (sexual health/behaviour and alcohol use) were presented in the intervention model. Intervention at school level, community level, family level, within justice system, mental health facility, or at an individual level were eligible for inclusion.

3. Study population: The review aimed at teenage and young adult population in the following age group: 11 years to 25 years. The upper limit of 25 years was agreed in the team considering the review objective, published literature (1), scope of this review which was primarily to cover teenagers and young adults only.

Exclusion criteria

1. Studies with no interventions targeted towards both components (sexual health/behaviour and alcohol) were excluded.

Review selection

Two authors examined titles and abstracts against the inclusion criteria (RT and JJ, or RT and MH). Full-text analyses of eligible articles were performed and agreed at least between two authors (RT and MH, RT and JJ, RT and JW, AA and JW). Any disagreements were resolved through discussions, and wherever required advice from an additional author was obtained (JJ/MH/JW/AA).

Quality assessment

Study quality was assessed using the Critical Appraisal Skill Programme (CASP) checklist for RCTs, and Cochrane guidelines covering type of study, intervention, methodology robustness, reporting of results and study biases from recruitment, blinding, treatment of participants, assessments and presentation of data (12, 13). The quality assessment was conducted at first instances by one of the research team members (RT), and was discussed and verified by a senior author (MH). The

papers were rated 5 or High if they scored highly, and 1 or Low if they were marred by bias and avoidable measurement errors. The score ranged from scale 1 to 5.

Data extraction

A data extraction form was used to record study findings (See Supplementary 2 for more information). The form was developed and reviewed prior to its application. Initially all data extraction were completed by RT, and were validated by another author independently (JJ or JW or MH or AA).

Analysis

No statistical or meta-analysis was performed as the review was designed to provide narrative synthesis on interventions targeted at adolescents and young people. Synthesis was conducted to construct the review in explaining type of intervention, intervention setting, quality of each study, limitations, outcomes and challenges to present published evidence on interventions implemented on the two components: sexual health/behaviour and alcohol use.

The review is presented in accordance with the PRISMA reporting guidelines for systematic reviews (Supplementary 3 PRISMA checklist). The study protocol was drafted and revised followed by an agreement within the team members, however it was not registered on any external platforms.

Results

Electronic search outcomes

Electronic searches identified 889 articles in total, and after eliminating duplicates, 423 were eligible for title and abstract analysis. Forty-one articles were then eligible for full-text analysis. Of which, 23 were excluded mainly due to the absence of a combined intervention model having the two components of this review (sexual health/behaviour and alcohol use). The review included 18 articles. During this process consultation with a third author was obtained for 10 studies out of 41. The final inclusion of 18 studies was agreed in the team (JJ/MH/RT/JW/ASA). No papers were identified through reference and Google Scholar checks. The search results are presented using the PRISMA flow diagram (Figure 1, and Supplementary 2). The characteristics of the included studies are summarised in the table 1. Of 18 studies, 14 were conducted in the USA, 2 in the UK, and one study in South Africa and Namibia.

Overview of included studies

Overall, all included studies addressed the review objectives clearly. The majority of studies had teens from middle adolescence stage (12 to 14 years), and late adolescence (15 to 19 years), with the exception of only one study from the USA which involved young children from an elementary to high school in the programme (14). Fifteen studies were RCTs, while three were intervention studies having pre and post intervention analysis. Of the 15 randomised studies, four did not explain details on the randomisation techniques used in the study. There was no consistency on managing blinding issues as a variety of blinding approaches were

used in the studies. Few studies blinded participants at baseline, others blinded researchers or data analysis staff. One study indicated that clinicians involved in the project could not be blinded (15), which may be due to the nature of the study having clinical referrals being in the hospital setting. Similarly, two other studies reported that the blinding was not feasible, which may be due to their study design, setting, or methodological limitations (16, 17). Overall study duration ranged from 6 months to 24 months (2 years). The retention rate decreased with an increase in study duration. Overall retention rate ranged from 60% to 80% for majority of studies, while some studies particularly planned for a shorter period had a higher retention rate (90% ≤). The retention rate appeared to be influenced by study environment (school/community), change of location of study participants (family move), and change of institute for high school or further college/university studies.

Intervention quality and sustainability were largely affected by timeline/duration of the intervention, method, peer influence, contamination, study setting, and circle of friends (18). Generally, long-term interventions appeared more effective; however, there was no consistency of such effects across the included studies. Intervention effects were poorly reported in some studies such as a lack of odds ratio, p value, resulting in limited opportunities to evaluate benefits of such programmes. Recall bias was common particularly in studies where follow-up was required at fixed intervals (such as at 3, 6, 9, 12 months), or further longer intervals over the project duration. The study quality assessment showed that most studies were of medium to high quality (scored 4 or 5), with exception of only two studies scoring low to medium (scored 2 or 3). Additional information on the study design, interventions for each included study are described in the table 1.

Intervention types and outcomes

The intervention approach was mainly determined by study location. Study site showed a range of patterns (in schools/college= 5, at family level/home environment= 3, web based= 2, sexual health clinics=2, mental health clinics= 1, community level = 1, and juvenile detention facility= 4). Because of the study environment, intervention model varied. Social learning and cognitive theoretical approaches were used across the studies with some using motivational, integrated approaches while designing the interventions. Information on intervention types and outcomes is given below for each study setting.

i. Studies conducted in educational infrastructure

Schools/college based studies used training cum teaching sessions as a collective method. The intervention duration ranged from as short as 2 sessions (2 hours) in total, to an annual programme where the intervention was integrated within the school curriculum (140 lessons/35 hours per year) (14). Overall school training emphasis included a variety of topics consisting of substance misuse prevention, alcohol harm, negotiating relationships, managing peer pressure, reproductive biology, HIV risks and prevention. McNeal et al (19) showed that, school based interventions were more successful when trainings were delivered by their regular school teacher. In other studies, no such effects were reported. Dermen et al (20) demonstrated a reduction in alcohol intake and sexual risk taking behaviours (including decrease in unprotected sex). The follow-up work continued for 15 months in this study. Findings by Karnell et al (21) suggested that alcohol reduction may need longer interventions and follow-up support to demonstrate positive effects. Two studies; Stanton et al (22) and Robertson et al (17) suggested that girls

are likely to acquire more benefits to reduce their sexual risky behaviours and alcohol intake than boys from school based educational interventions. However, other studies did not report any gender specific differences.

ii. Studies conducted in family environment

Studies conducted in a family setting (23, 24, 34) demonstrated an improved relationship between parents and child using such model. The educational material was delivered using audio CD in one study (24), and the other used in-person counselling session (23). Alcohol intake and sexual risk behaviours were reduced, and parents reported improved communication with their child following the home based intervention programme (23).

iii. Web based studies

Both web based intervention studies had older participants (18 to 25 years) attending university/college studies (25) (18). The interventions were computerised and delivered using online platforms (such as education websites, and online surveys). Patrick et al (18) applied internet based graphic feedback, and tailored it to baseline responses using computer algorithms. The follow-up period was up to 6 months in one study (18), and the second study (25) had an immediate post-intervention follow-up. Findings by Lewis et al (25) reported that the alcohol intake was significantly reduced compared to the control group. Results also showed a minor reduction in alcohol related risky sexual behaviour. Analysis in the other study showed a change in perceived norms, and interventions helped to develop awareness around the harms of alcohol and risky behaviours (18).

iv. Studies in a healthcare facility

A sexual health clinic setting was used to provide a brief advice during routine consultations (15) (16). The duration of interventions ranged from brief advice (up to 5 minutes), to an individually tailored consultation. Harmful alcohol intake was reduced during the study period, but there was no evidence of an effect on sex related behaviours (16). Limited time was one of the identified challenges to provide such interventions in a clinical/hospital location. Esposito-Smythers et al (26) studied adolescents receiving treatment in a mental health facility comprised of 12 hours of workshops delivered over two consecutive weekends. Young people with their parents were involved in the discussions. Additionally 2 hours of an individual booster session was provided. The study reported a reduction in binge drinking, greater odds of refusing sex to avoid STIs, and some effect on alcohol reduction. Overall, the study reported improvements in behaviour, and enhanced communication ties with parents on such issues, which may help in reducing risky behaviour following release from the facility.

v. Studies in community environment

A study to support homeless young people used 8 sessions on health, substance misuse, life goals, and those were conveyed using video recordings with follow-up booster sessions (23). Reduction in alcohol intake and risky sexual behaviours was reported, although high attrition was a major limitation in the study.

vi. Studies in detention centres

Four studies were conducted in juvenile detention facilities. Interventions were based on motivational and behavioural modification concepts. Bryan et al (28) reported a lower number of alcohol related problems at 12 months; however, no effect was seen on the original mental health condition(s). Other issues such as

sexual behaviours, contraception usage did not display any improvements. Similar results were described in the other study where the intervention resulted in less alcohol use, and young people reported to have more knowledge on HIV and related conditions (29). Magnan et al (30) investigated links between genetics and alcohol/risky behaviours using a randomised control design. The intervention was planned to include sexual risks, alcohol reduction, and used motivational enhancement therapy approach. Findings revealed low genetic risk scores were associated with lower alcohol related sexual risky behaviours. Results suggested that peer norms significantly influence sexual risk behaviour along with the genetic trends. Robertson et al (17) investigated an intervention with 18 sessions on a number of subject areas, and young people were followed up for 9 months. Findings showed higher contraception use, and girls showed a reduction in sexual risk taking activities.

Discussion

Summary

Findings from the included studies suggest that following interventions young people appear less likely to engage in risky sexual behaviour and choose harmful alcohol drinking. However, it is also important to note not all interventions outlined in the review were completely successful, demonstrating limitations. The major factors influencing adolescents and young adults include local cultural norms, acceptability of casual sex, and binge drinking trends in the young community. It was also observed that study setting and target population determine the type of intervention required and impacts on outcomes. Therefore, evidence from this review suggests that selecting target population appropriate interventions, delivery methods and a follow-up plan are primary elements to be considered during project design and developments. We also understand that these aspects of the programme should be also checked periodically through stakeholder and target population involvement to ensure that the intervention model is flexible and adaptable across its life cycle. Such approaches would help to ensure uptake and also increase the success of intervention projects.

Synthesis on intervention impact and effectiveness

i. Intervention delivery opportunities

Negative behaviours are likely to occur simultaneously, they are linked (14), and one may give rise to another type of behaviour, which then develops into a pattern of risky behaviours. Thus, identification of positive behaviours at a young age is a stepping-stone to a long term pattern of positive practices. The process could be

achieved at school or home through interactive programmes, which are likely to result in added benefits (14). Impact of interventions may be influenced by numerous factors as described earlier. Based on the evidence presented in the included studies, it appears that a targeted group approaches, project setting, duration of interventions, and delivery methods are major components influencing the effectiveness of the overall programme. For example, a school based project would benefit from the involvement of teachers, as they can be engaged in promoting positive behaviours on a regular basis (14), and help in monitoring adolescents during their schooling period. In juvenile detention centres, the challenges of implementing such programmes are greater, thus demand a different strategy compared to school based initiatives. Detention centres provide facilitated access to the most vulnerable and needy young people, to address their sexual health issues with an opportunity to improve overall behaviours. Such adolescents are likely to come from marginalised communities and disadvantaged families (29). Risks of substance misuse is increased among juvenile offenders (28), therefore it requires specific planning while designing the intervention model. Subject specific training on positive attitudes, concept of healthy living, negotiations with risky behaviours, knowledge on STDs, alcohol misuse are crucial themes (17) (29). Early recruitment helps to engage adolescents for a longer period, however following the release from a facility; it needs reinforcement by parents, social workers or other relevant personnel to support juvenile offenders to avoid negative behaviours in the near future.

ii. Use of existing healthcare infrastructure

Sexual health clinics offer a platform to connect with young people. Evidence reports that providing brief advice on alcohol reduction may not result in significant effects (15). There are other alternatives such as displaying health messages, access to free information using leaflets, which may initiate a thought process among young visitors and promote self-questioning on their behaviours and choices related to sexual activities and alcohol consumption. College students/young adults are common visitors of sexual health clinics. A study reports that on an average a college student has two new sexual partners every year (31). Simultaneously, during the same age period exposure to alcohol, peer pressure on decision making, and experience seeking characteristics hamper positive behavioural norms, thus comprehensive programme structure is essential. Evidence strongly demonstrates that a reduction in alcohol intake reduces risky sexual behaviours (32). This indicates a requirement to implement both alcohol and sexual risk prevention strategies in a combined model especially for teenagers and young adults.

iii. Delivery techniques

Intervention delivery is at the core of success of any intervention programme. Basic reasons for project failure include insufficient content, inappropriate mediators and ineffective delivery (33). Data suggest that more benefits are achievable when interventions are delivered by a specialist (19). This suggests a necessity to recruit trained staff with the requisite capacity, knowledge and skills to deliver interventions effectively.

iv. Follow-up monitoring

Data collection during follow-up is vital to assess effectiveness of interventions. Collecting data on both positive and negative behaviours is one of the viable options. Self-reporting could be implemented with a weekly diary model to minimise recall biases, and helps an individual to track their own behavioural patterns to design suitable approach for constant improvements. There is also a scope to develop biological parameters to assess effectiveness of such interventions (27). This will allow confirmation of the absence of alcohol misuse, or risky sexual contact while evaluating benefits of intervention programmes. Such tools could be used to verify self-reported data, but could be expensive to implement at community level.

v. Scope for integration of modern technology in intervention delivery

As outlined in our review, a number of studies used self-reporting method to collect post-intervention data. It is important to understand non-response or false reporting on sexual activity, alcohol and related questions essentially due to embarrassment involved in recording such behaviours/actions (29). Therefore, to avoid potentially serious data flaws computer technology should be explored. This will allow the collection of anonymous data using software or survey programmes on a periodic basis, which participants can complete using smart phones or laptop/computer devices (18). The technology could be used in range of situations such as but not limited to school, home, detention/justice system, sexual health clinics and also in the community to collect data from large number of individuals. It is also vital to understand use of computer technology to deliver interventions, which appears to be feasible where target groups have access to phone/computer. This is likely to be

cost-effective option (25), and will allow constant monitoring on an individual basis across follow-up duration. Additional advantages include contacting participants after their address change, school/family move, transfer for higher education, and may help reduce programme costs. An additional major benefit is to establish a direct contact with an individual to provide constant access to online interventions, and essential support services.

vi. Sustainability of interventions

Long lasting effects of intervention was one of the challenges observed in the studies (21) (26). The follow-up period ranged up to two years in some studies, however particularly during adolescence age risk factors continue to appear, such as change of friend circle, altering influence on one's personal choices. To address this, family involvement is a practical option, through which parents could be trained to provide support to their children during difficult times (23, 24, 27, 34). Low parental monitoring is linked with high substance misuse or risky behaviour (35), thus parental involvement is instrumental. Such involvement also helps in enhancing parental-child relationship and communication (34). This was clearly seen as an added advantage in family based intervention models. This presents an opportunity to find such a support workforce in other study settings, for example teachers in schools, nurses in mental health institutes, social workers in juvenile offender facilities, counsellors in colleges, and community workers for field-based projects. However, it is also important to note that such parental support may not be available particularly in those who face vulnerable situations at home such as

financial difficulties, presence of addiction in one of the parents/guardian, thus the sustainability approach should be tailored based on individual circumstances.

Evidence suggest a genetic link with risky behavioural pattern (30), which provides scope for research into application of biological variables into prevention research and treatment outcomes (30). The genetic risk remained significant in this study (30) even after adjusting for peer influence; therefore, this is an important area for future research to plan sustainable and effective interventions to reduce alcohol use and risky sexual behaviour(s).

Strengths and limitations

This systematic review provided collective information on published interventions, which will be useful for policy makers, public health specialists and also for government and non-government agencies working to improve health of teenagers and young adults. We understand that these findings will be useful in the future, and should be considered from very initial stages of programme developments in order to formulate suitable intervention design through involvement of stakeholders and also target population. However, our study had some limitations. The online search was restricted to papers published in English. Further, we had to exclude large number of studies mainly due to the absence of clear information on the review components, or where the information was presented, it was not feasible from the published data to extrapolate information on alcohol or sexual behaviour related factors. Due to limited resources and ethical issues, it was not possible to contact authors of such publications requesting segregated data to isolate alcohol or sexual behaviour from other substance misuse or behaviour types respectively. On another

note, this review focused on alcohol but not illicit drug use. We acknowledge that alcohol and drug use may co-exist especially in young people. Considering available resources (time and funds) it was not feasible to extend the review beyond alcohol. The complexity of drugs and drug use would have increased the scope of this work substantially and also limited the specificity of the findings. .. Furthermore, three studies included in the review had adolescents or adults up to 25 years and also had general adult population (15, 16, 20). As part of these studies had eligible population, those were considered in the review; however, it was not possible to separate information for those less than 25 years in given literature. We perceive that it is unlikely, that the exclusion of this would change the review findings considering the narrative synthesis and structure of this review.

Conclusion

Interventions to reduce alcohol consumption and risky sexual behaviour are essential to deliver at a young age to reduce the risk of sexually transmitted diseases, and alcohol related illnesses. Such interventions can be also useful to minimise unwanted pregnancy, and thus will have direct benefits to improve health and wellbeing of young girls and women. Our review findings suggest that intervention type/model, delivery method, duration and follow-up services should be rigorously reviewed and revised to meet requirements of target population to ensure maximum benefits. Overall findings suggest that comprehensive intervention model helps to improve adolescent health outcomes, however sustainability is an important challenge to address where parental or other relevant persons' involvement must be planned to support young people on a longer term. Computer technology opens up a new platform to reach a large number of individuals and can help in intervention monitoring processes. Understanding project setting is another crucial step. The type of intervention and delivery tools should be studied, and thoroughly revised with local community norms and cultural requirements. Focus group discussions during intervention development is one of the ways to increase an overall success of an intervention model, and also acceptability of such project. Only two studies came from the developing world, and the majority of studies are from the USA, therefore, it is imperative to understand application of these interventions, associated challenges, and modifications in the interventions to make it tolerable in other high and middle to low income countries.

Along with public health and education programmes, government policy and advocacy support is vital to create a favourable environment especially for teenagers and young people to reduce risky behaviours. This includes recent

introduction of the minimum alcohol pricing policy in the UK that may benefit a number of areas including but not limited to reduction in hospital burden, preventable accidents/deaths, and access to more public funds to improve health systems (36). Research and advocacy in the recent two decades have helped to tighten legislation on alcohol advertisement (36) creating a supportive environment to engage more individuals in health promotion activities. Overall, the ongoing developments would allow health providers, policy makers, government officials and researchers to improve intervention programmes, and conduct evaluations to engage young people comprehensively in public health promotion and healthcare delivery schemes.

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Figure 1: Flow diagram of study selection

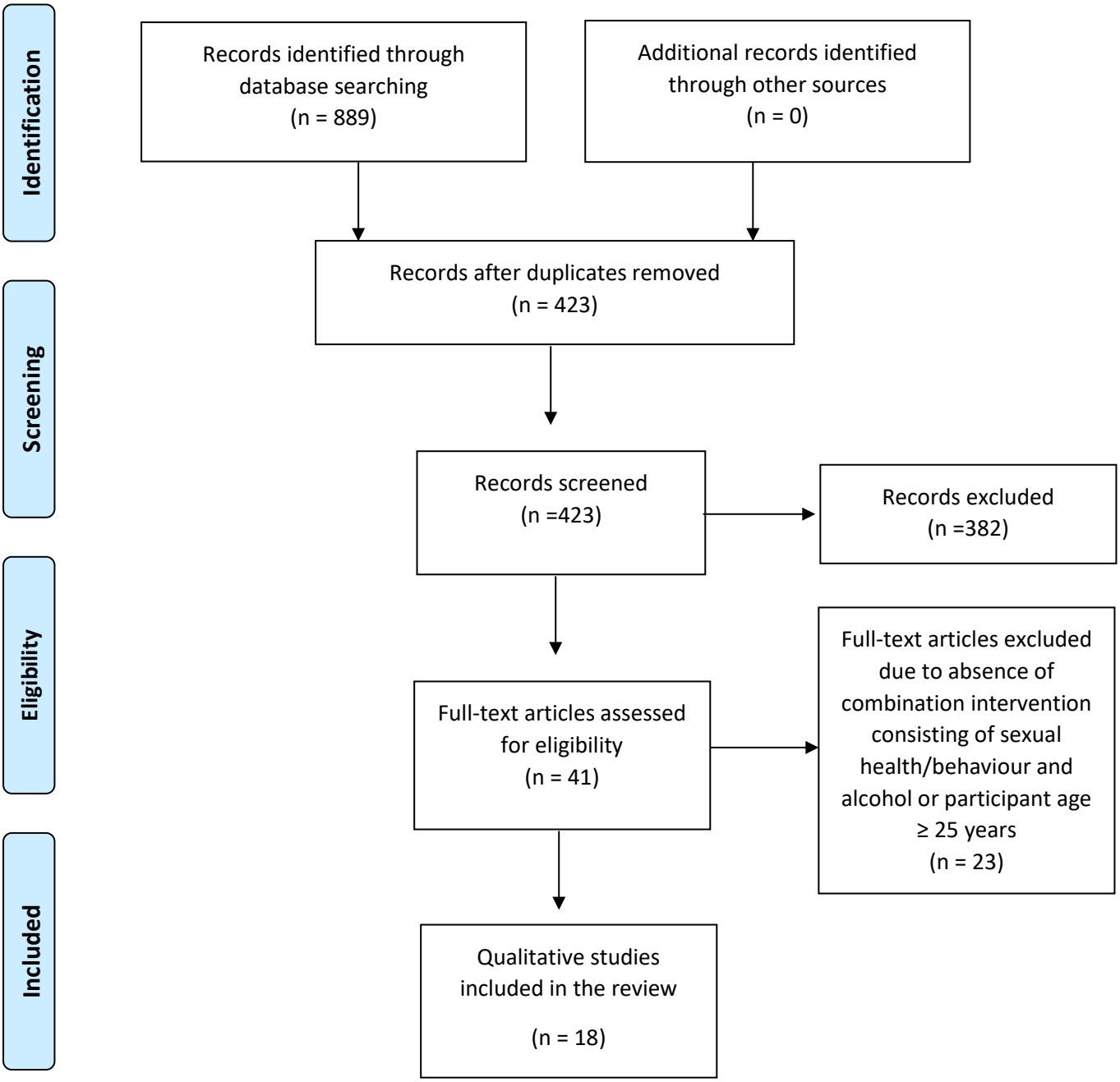

Table 1: Table of included studies (N=18)

No	Author, Title and Journal	Setting of the intervention and study population	Study design/model	Country and Programme/Intervention	Study description
1	Beets MW et al 2009 (14) Use of a social and character development program to prevent substance use, violent behaviors, and sexual activity among elementary-school students in Hawaii American Journal of Public Health	School based intervention programme involving children from kindergarten to fifth or sixth grade	Matched-pair cluster-RCT with 10 intervention and 10-control schools in a 5-year comprehensive school based 'Positive action' programme to prevent substance use, violent behaviours and sexual activity. Report effects on substance use and violent behaviours and sexual activity. Lower lifetime substance use (Rate ratio 0.41, 95% CI: 0.25 to 0.66), and sexual activity prevalence rates among intervention students (Rate ratio 0.24, 95% CI 0.08 to 0.66). Significant treatment effect with self-reported substance use but not sexual activity. Also dose-response trend across behaviours with those receiving 3-4 years of intervention showing lower reports across 3 outcomes.	Hawaii, USA Positive Action Program uses social and character development (personality development) initiatives in elementary school children	Study is on prevention of substance use (Alcohol and drugs), violent behaviours and sexual activity. Alcohol use outcomes reported and only one sexual health behaviour reported as sexual activity

2	Bryan AD et al 2009 (28) HIV risk reduction among detained adolescents: A randomized controlled trial Pediatrics	Interventions in juvenile detention facility for 14 to 17 years old adolescents	Theory based sexual and alcohol risk-reduction intervention in juvenile detention facilities. Evidence supports that theory based interventions are feasible and effective at reducing risky sex but there are limited evidences on reducing alcohol use considering such intervention.	USA Group psychosocial intervention [GPI] + group motivational enhancement therapy [GMET]); (group information-only intervention [GINFO)	Trial focussed on sexual and alcohol risk reduction among juvenile detained adolescents (condom use, and reduced alcohol use measures).
3	Crawford MJ et al 2014 (15) The clinical effectiveness and cost-effectiveness of brief intervention for excessive alcohol consumption among people attending sexual health clinics: a randomised controlled trial (SHEAR) Health Technology Assessment	Intervention through sexual health clinics for young adults more than 19 years of age	A 2-arm parallel single blind RCT of participants ≥19 years excessive alcohol drinkers (M-SASQ) randomised to a brief intervention using FRAME. Screening and brief intervention to reduce alcohol use advice in sexual health clinic does not result in the reduction of alcohol consumption and is not a cost effective use of resources.	UK Brief intervention in SHEAR study to reduce alcohol consumption	The study examined effects and cost-effectiveness of brief alcohol intervention aimed to reduce excessive alcohol consumption in sexual clinic setting.
4	Dermen KH et al 2011 (20) Randomized controlled trial of brief interventions to reduce college	Intervention through education institute for those between 18 and 30 years of age	RCT among 154 heavy drinking college students at high sexual risk randomised to motivational interviewing-based intervention, and followed up to 15 months. Intervention participants showed reduced alcohol intake but no sexual	USA Intervention to minimise alcohol intake to reduce risky sexual behaviour	Intervention to reduce alcohol use and sexual health risky behaviours. 3 arm groups, using motivational

	students' drinking and risky sex Psychology of Addictive Behaviors		behaviour differences. Interventions targeting alcohol only have no effect on sexual behaviour.		interview technique to reduce alcohol, to reduce HIV risky behaviours and to reduce both, vs controls.
5	Donenberg GR et al 2015 (29) HIV-risk reduction with juvenile offenders on probation Journal of Child and Family Studies	Interventions in juvenile detention facility for 13 to 17 year old adolescents	Explores change in sexual activity, drug/alcohol use, theoretical mediators of risk taking following intervention among 13-17 year old (N=54) teens on probation. There were moderate changes in sexual behaviour and less on alcohol consumption.	USA Preventing HIV/AIDS among teens (PHAT Life)	Intervention with before and after measures for sexual risk, alcohol use and mental health. Findings of pilot study, PHAT life measures baseline and 3 months outcomes, 2 weeks interventions involving 8 sessions.
6	Esposito-Smythers C et al 2017 (26) Randomized pilot trial of a cognitive-behavioural alcohol, self-harm, and HIV prevention program for teens in mental health treatment	Intervention in mental health services for 13 to 17 year old adolescents	ASH-P is an adolescent prevention programme for multiple high-risk behaviours. RCT of a cognitive-behavioural, family-based, alcohol, self-harm, and HIV Prevention (ASH-P) with assessment only control condition for adolescents in mental healthcare.	USA ASH-P is a cognitive-behavioural pilot trial programme.	Study segregates measures for alcohol use and HIV risk behaviours. Focussed on interactions on the 3 issues and mental health.

	Behaviour Research and Therapy		41 adolescents to intervention and 40 controls, age 13 to 18 years, with assessments at 1, 6, and 12 months post enrolment.		Randomised to intervention and control arms, and follow-up time up to 12 months post-intervention.
7	Estrada Y et al 2015 (34) Efficacy of a Brief Intervention to Reduce Substance Use and Human Immunodeficiency Virus Infection Risk Among Latino Youth Journal of Adolescent Health	Family based intervention project for adolescents (age range 14 to 16 years), and their primary caregivers	160 adolescents were randomised, and were surveyed at 6, 12, 24 months post-intervention. Youths who received interventions had lowed sexual initiation rate compared to the control group. Unsafe sex and substance abuse showed decreased initiation rates in intervention group. However, in adolescents 15 years and older sexual interventions were less effective.	USA Familias Unidas (family based) type of intervention is shortened to 6 weeks from 12 and was used in the project following its validation.	Familias Unidas focussed on family cohesion and substance use, and sexual behaviours of Hispanic adolescents in the USA. Study measured both alcohol and sexual behaviours.
8	Karnell AP et al 2006 (21) Efficacy of an American Alcohol and HIV Prevention Curriculum Adapted for Use in South Africa: Results of a Pilot Study in Five Township Schools	School based intervention programme for adolescents (mean reported age was 14.6 years)	Pre-post quasi-experimental study in 5 schools (3 intervention, 2 controls). Pre-post 5 months. Intervention was 4 fictional monologue recordings administered in class followed by a discussion and group assignments. 10 units of curriculum delivered over 8 weeks, 30 minutes each containing alcohol and HIV related issues. Effect on HIV-related behaviour but not for alcohol. Intervention group more	South Africa An adapted American Alcohol and HIV Prevention Curriculum investigated in developing country environment.	Our times, our choices curriculum focussed on alcohol and HIV risk prevention in a pre-post study. Alcohol and sexual behaviour outcomes were reported.

	AIDS Education and Prevention		likely to use a condom, less drinking before sex and higher female sex refusal, self-efficacy. Intervention models developed in western countries seem adaptable in different cultural set up.		
9	Lewis MA et al 2014 (25) Randomized controlled trial of a web-delivered personalized normative feedback intervention to reduce alcohol-related risky sexual behaviour among college students Journal of Consulting & Clinical Psychology	Intervention through computer technology/web based platform for young people 18 to 25 years	Trial of 480 sexually active college students randomised to four interventions arms. There was reduction in alcohol consumption, and alcohol related risky behaviour outcomes compared to controls. Combined alcohol and alcohol related risky sexual behaviour intervention was the only effective arm at reducing both.	USA Personalised Normative Feedback (PNF) on college student alcohol related risky sexual behaviour	Trial includes alcohol only, sexual health only, and combination alcohol and sexual health arms in intervention. Outcome measures were reported on both.
10	Magnan RE et al 2013 (30) Evaluating an integrative theoretical framework for HIV sexual risk among juvenile justice involved adolescents	Interventions for individuals involved in juvenile justice system from 14 to 18 years old	Evaluation of an RCT- project SHARP provided support for an integrative translational model to predict alcohol-related sexual risk behaviour among justice-involved adolescents. The study randomised population group based sexual risk + alcohol intervention or group based information only.	USA Project SHARP was developed through an integrative approach considering neurocognitive structure/function, genetic factors into bio psychological approach.	Adolescents given intervention focussed on psychology and genetics to prevent alcohol related risk taking and sexual behaviours.

	Journal of AIDS and Clinical Research		Interventions are more effective if utilises a bio psychological approach.		Various outcomes were reported for both conditions/risks.
11	McNeal RB et al 2004 (19) How All Stars Works: an examination of program effects on mediating variables Health Education and Behaviour	School based intervention programme for middle school children (majority of them were from 11 to 13 year of age group).	11 to 13 year olds (n=1,822) from 14 middle schools assigned to 3 conditions: 5 schools to all stars by specialists, 3 to all stars by their teachers, and 6 schools as controls. There were no overall effect at slowing alcohol drinking, or engaging in sexual activity, but positive effects for other substances such as inhalant use, marijuana and cigarette smoking. All stars delivered by teachers showed lower alcohol levels, cigarette and inhalant use than control. No effect on sexual activity and effects by specialist intervention group were not significant.	USA All Stars programme designed to deter adolescent drug use, sexual behaviour and violence through change in mediating variables.	Focus on prevention of adolescent risky behaviours specifically substance use, sexual risk. Outcomes were measured and reported.

12	Milburn NG et al 2012 (23) A family intervention to reduce sexual risk behaviour, substance use, and delinquency among newly homeless youth Journal of Adolescent Health	Community based intervention model for 12 to 17 year old homeless adolescents	Trial of 151 families with homeless adolescents, 12 to 17 years old. Randomly assigned to intervention or standard care. Significant reductions in sexual risk behaviour, alcohol use, and hard drug use and delinquent behaviours in intervention arm over 12 months.	USA Project STRIVE offered a minimum 5 sessions with parents by a trained facilitator required for behavioural change.	Outcome measures include sexual behaviour and alcohol but intervention appears to be family cohesion and no mention of these behaviours except for HIV-risk.
13	O'Donnell L et al 2010 (24) Especially for daughters: parent education to address alcohol and sex-related risk taking among urban young adolescent girls Health Promotion Practice	Family based intervention project for adolescent girls (11 to 13 years were involved in the study) and their parents	268 families recruited in the 'Especially for Daughters' parent focussed intervention. Intervention was a set of audio CDs vs printed material vs controls. Fewer sexual risks and less drinking among intervention girls. Increased self-efficacy with parents to address alcohol and sex communication.	USA Especially for Daughters was a unique programme developed through community participation/engagement to create awareness involving young girls and their families to reduce risks caused following alcohol and sexual behaviour.	Focus and outcomes included both alcohol other drugs and sexual behaviours.
14	Patrick ME et al 2014 (18) Web-based intervention to change perceived norms of college student alcohol use and	Intervention through computer technology/web based for 18 to 21 year old college students	Spring break intervention to reduce alcohol use and sexual behaviour among 18-21 year old college students. No effect on alcohol use or sexual behaviour during spring breaks. Intervention reduced in perceived social norms for spring break drinking and risky sexual behaviour.	USA Web-based multi-component personalised feedback intervention	Targets alcohol use and sexual behaviour. Intervention offered personalised feedback on both components in

	sexual behaviour on spring break Addictive Behaviors				18-21 years college students
15	Robertson AA et al 2011 (17) Comparison of health education and STD risk reduction intervention for incarcerated adolescent females Health Education & Behavior	Interventions for individuals involved in juvenile justice system between 12 and 17 years of age	Randomised block design: Cohort of 246 incarcerated adolescents. Evaluation of sexual risk reduction longitudinal follow-up intervention for 12 to 17 year old female detainees. Participants randomised to either STD risk reduction or health education interventions, and followed up post intervention and 9 months after. Findings reported decreased frequency of unprotected sex and sex while under the influence of alcohol and drugs in both intervention groups. Girls from STD risk reduction group showed more emphasis on their skills and developed ability to apply the skills during simulations at post intervention.	USA The study had two groups (Health education and STD risk reduction) facilitating comparison between two types of intervention methods. Both groups received 18, 60-minute group session and on individual goal-setting session provided by a trained staff who are not part of the correction facility.	Focus on girls, 12 to 17 year old. Intervention and outcome measures were on alcohol and sexual behaviours and risks.

16	Roderick P et al 2016 (16) Assessing feasibility and acceptability of a brief intervention for risky alcohol consumption in sexual health clinic attendees: a randomised controlled trial. Journal of Family Planning and Reproductive Health Care	Intervention through sexual health clinics for young adults more than 16 years of age	2 parallel-arm RCT with qualitative component. Participants aged ≥ 16 years attending sexual health clinics screened using AUDIT-C method and study questionnaire looking at alcohol and sexual behaviours. Alcohol misuse common among sexual health attendees, screening and information appeared to influence drinking and sexual behaviour. Follow-up rates were 54% and 47% at 6 weeks and 6 months, respectively. Intervention was feasible and acceptable.	UK Systematic assessment and brief intervention for alcohol misuse in sexual health clinic setting. Brief intervention utilised the FRAMES approach, integrated into sexual clinic service.	Evaluation of brief intervention focussed on alcohol drinking and linking current sexual health problem to alcohol. Measures various alcohol use and sexual behaviour outcomes.
17	Stanton BF et al 1998 (22) Increased protected sex and abstinence among Namibian youth following a HIV risk-reduction intervention: a randomized, longitudinal study. AIDS	School based intervention programme for 15 to 18 year old adolescents	In total, 515 youths were randomly assigned to cases and control groups and findings were evaluated at baseline, immediately post-intervention, and at 6 months and 12 months post-intervention. Positive outcomes related to condom use, and alcohol use in intervention compared to controls when results focussed on baseline young people who did not experience sex prior to the project interventions. Intervention appear to be effective among 15 to 18 year old youths reducing risk of HIV, and other risky behaviours.	Namibia My Future Is My Choice RCT of 14-session face-to-face abstinence and safe sex intervention among 515 secondary school youths.	Sexual health focussed interventions that includes alcohol use as secondary outcomes and embedded within the 14 sessions. Clear measures on both included and segregated.

18	Stanton B et al 2004 (27) Randomized trial of a parent intervention: parents can make a difference in long-term adolescent risk behaviours, perceptions, and knowledge. Archives Pediatrics and Adolescent Medicine	School based intervention programme for adolescents between 13 to 16 years of age at baseline	The randomised controlled longitudinal trial included 35 low-income urban community sites. Focus on kids (FOK) had 13 sites, FOK + ImPACT had 11 sites, and FOK+IMPACT+boosters had 11 sites. Age 13 to 16 year old There were differences across behaviours with ImPACT adding protective effects. Positive behaviours included condom use, birth control, and decrease in alcohol use. Findings suggest that ImPACT initiatives where parents are involved helps in sustaining intervention benefits.	USA ImPACT is Informed Parents and Children Together project among 13 to 16 year old African American youth to reduce truancy, substance abuse and sexual risk behaviours.	Intervention addresses alcohol and other substance disorder, sexual and other risky behaviours. Outcome measures were reported.

Table 1 footnotes: Please note that study details such as published paper title, publisher are spelled as it is. While providing narrative details on each study in the table and also in the manuscript standard UK English spellings were used. Please refer to the main reference section for additional publication details.

Supplementary 1: Electronic search strategy

A search strategy was initially prepared by RT, and was confirmed following inputs by MH. The details of the process are outlined below.

The search was conducted on the following databases - MEDLINE, EBSCOHost (CINHAL, ERIC, PcyshInfo), Cochrane, ClinicalTrials.gov and Web of Science.
Wherever applicable, medical subject headings ('MeSH terms') for the population, exposure, and the outcome were used. These were customised as per the databases resources/requirements. Key signs ($ and *) were used wherever required such as sexual behav*, teen*, adolescen*, intervention*, strateg*, program*. The first four sets were used to ensure that search terms are relevant and appropriate for use in this review, and then they were combined to generate relevant studies.

Set A- Population
(title, original title, abstract, subject heading word)
OR Teen
OR Teenage
OR Adolescent
OR Young

Set B- Exposure
(title, original title, abstract, subject heading word)
OR Sexual
OR Reproductive health
OR Relationship
OR Behaviour
OR Sexually transmitted infection
OR STI

Set C- Exposure
(title, original title, abstract, subject heading word)
Alcohol

Set D- Outcome
(title, original title, abstract, subject heading word)
OR Intervention
OR Strategies
OR Programmes
OR RCT
OR Clinical trial
OR Cohort
OR trial

The outlined sets were combined using AND option to generate relevant articles. The studies were limited to English language as outlined in the paper.

Supplementary 2: Data extraction checklist/form

Focus

- Sexual behaviour and alcohol (could be secondary)
- Age range: 11 to 25 years. Any subcategories of age group made in given age range.
- Study type: Intervention: treatment, evaluation; RCT: randomisation, control
- Recruitment: Generalizable, Representative, Special characteristics
- Theory /model used
- Limitations
- Conclusions

Detailed Checklist to extract from papers

Type of study Outcome measures: definition, measurement Intervention offered Population
Methodology • Focus • Age group • Outcomes (sexual behaviours and alcohol use) • Randomised assignment to treatments- procedures, blinded or not; exposure groups for cohorts. • Comparability of intervention and control groups (if not, controlled for in results) • Researchers or level of blinding: recruitment, interventionists, study researchers • Similarity of groups at baseline: age, sex, socioeconomic status, location. • Equal treatment of study arms (outside the intervention). Procedures • Attrition. Analysis in initial groups or not • Complete follow-up of subject? How long for, what differences with those not followed up? Who left?
Results • What outcomes were measured and are reported: measurement methods similar across groups, • Primary and secondary outcomes reported? What results for each outcome? • Measurement of treatment effect, limits, significance, how large? • Evidence of selective reporting of outcomes? (example- over controlling to get a significant p-value?) confounding variables? • Applicability on other or local contexts • Were all clinically important outcomes considered? • What else could have been reported on?
Others • Do you believe the results? Bias? Chance? • Flaws? Plausibility of results?
Bias checklist (Low or high risk) • Random sequence (selection bias) • Allocation concealment • Blinding of participants and personnel (performance bias) • Blinding outcome assessment (detection bias) • Incomplete outcome (attrition bias)

Supplementary 3: PRISMA Checklist

Page numbers from the manuscript submission are reported in the table below.

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3-5
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4-5
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	8
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	6-7
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	6
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Supplementary 1

Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	7,8
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	8
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	8
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	8
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	Not applicable
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	Not applicable

Section/topic	#	Checklist item	Reported on page
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	9
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	Not applicable
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	9 and Figure 1
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	9-14, Table 1 & references
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	10-15
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	10-15, and Table 1. No reporting on statistics

Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	Not applicable
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	10-12
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	Not applicable
DISCUSSION			
Summary of evidence	24	Summarise the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	15-20
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	20-21
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	22
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	2

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

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