AIDS and Behavior (2020) 24:3414–3435
https://doi.org/10.1007/s10461-020-02915-0

SUBSTANTIVE REVIEW

Systematic Review of Interventions to Reduce HIV Risk Among Men Who Purchase Sex in Low- and Middle-Income Countries: Outcomes, Lessons Learned, and Opportunities for Future Interventions

Luh Putu Lila Wulandari[1,2] · Rebecca Guy[1] · John Kaldor[1]

Published online: 28 May 2020

Abstract
Along with other partners of key population groups, men who purchase sex (MWPS) contributed to around 18% of new reported HIV cases in 2018 among people aged 15–49 years worldwide. A systematic review was performed to evaluate interventions conducted to reduce HIV risk among MWPS in low- and middle-income countries (LMICs). A comprehensive search of studies published in Embase, Medline, Global Health, Scopus, and Cinahl was performed. Among 32,115 studies found, 21 studies met the review's inclusion criteria. Only four studies recruited MWPS, while the rest recruited groups often used as proxy populations for MWPS. The interventions were made primarily to increase HIV-related knowledge or perceptions through education and to improve condom usage rates through promotion and distribution. Few studies evaluated the impact of interventions on HIV testing rates and none looked at HIV treatment. Given the important role of testing as a prevention gate, together with UNAIDS' 90-90-90 testing and treatment coverage goals for people infected with HIV, more studies which evaluate the impact of HIV testing and treatment provision among this group are needed.

Keywords Systematic review · Interventions · Human immunodeficiency virus—HIV · Men who purchase sex · Clients of sex workers

Introduction

In 2006, 9–10% of men globally were estimated to pay for sex with female sex workers (FSWs) [1], 11.8% of whom living in low- and middle-income countries (LMICs) were HIV-infected [2]. Many of those men were adolescents or young adults [3–13], and overlap with other key population groups such as men who have sex with men (MSM) [14, 15], people who inject drugs (PWIDs) [13, 16], and sex workers themselves [15]. Studies also report high numbers of sexual partners among this group, including multiple FSWs [17] as well as partners from low-risk groups [17], highlighting the importance of this group in bridging the onward HIV transmission from key to lower-risk populations. In 2018, UNAIDS estimated that 18% of global new HIV infections among people aged 15–49 years were among men who purchase sex (MWPS), and sexual partners of other key population groups [18].

Effective measures for HIV prevention are available. These include behavioural interventions and biomedical ones such as condoms, and HIV testing and treatments. UNAIDS recommends that key populations have access to combinations of such prevention services, and highlights the lack of interventions that combine measures [19]. However, there is limited information available to appraise and summarise interventions conducted to reduce the risk of HIV infection among MWPS in LMICs.

One systematic review of HIV interventions conducted among MWPS in LMICs did not particularize MWPS, but rather grouped them together with sex workers [20], with the result that none of the studies included focused solely on MWPS. It is, therefore, necessary to extend the previous systematic review study.

The current systematic review aims to extend the previous analysis to:

✉ Luh Putu Lila Wulandari
lwulandari@kirby.unsw.edu.au; putuwulandari@gmail.com

[1] The Kirby Institute, University of New South Wales, Level 6 Wallace Wurth Building, UNSW Kensington Campus, Sydney, NSW 2052, Australia

[2] Department of Public Health and Preventive Medicine, Faculty of Medicine, Udayana University, Bali, Indonesia

1. Map and characterize the HIV prevention interventions targeting MWPS in LMICs, and
2. Summarize the impact of such interventions on reducing the risk of HIV among MWPS and identify existing gaps and opportunities for future interventions.

Methods

The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement was used to guide the development of the report [21].

Information Search

Studies were included if they (1) evaluated interventions to reduce the risk of HIV infection either in: (a) MWPS or proxy populations used to represent MWPS, or (b) populations within which there was stratification by MWPS, (2) were conducted in LMICs, and (3) were published up until September 2016.

To assess programme effectiveness, studies were deemed eligible if they used either follow-up observations or parallel comparison groups within the same population, i.e. if they compared outcomes: (1) of serial surveys, including before-and-after interventions within the same population, or at baseline and follow-up surveys made at any time; or (2) between intervention and control groups.

A comprehensive search was conducted within Embase, Medline, Global Health, Scopus, and Cinahl databases. Search terms covered the main building blocks of HIV, FSWs, and MWPS. Because MWPS are also typically associated with particular occupation groups often used as proxies for MWPS, the building blocks were expanded to include other relevant terms. The search was then modified depending upon the terms and Boolean operators used in each database, as shown in Table 1.

All retrieved articles were exported into EndNote X7. Duplicates within and between databases were removed by using a command in EndNote X7, and by visual inspection for similarities among study characteristics such as titles, authors, and years. Articles were then excluded if they were letters to editors, commentary, or systematic review/review/meta-analysis studies, or not published in a peer-reviewed journal. All article titles or abstracts were then read to ascertain their relevance to our study aim, i.e. referring to HIV interventions among MWPS or proxy populations in LMICs. Full texts of potentially eligible articles were obtained and further assessed for final inclusion. These processes were conducted in two rounds. The inclusion/exclusion criteria were the same for each, with a focus on the detail of the review in the second round. Only studies with the full text in English were included in the analysis.

Table 1 Literature search strategy

Databases	Keywords and search terms
Embase Medline Global health	exp HIV/ or exp Acquired Immunodeficiency Syndrome/ or HIV.mp. or AIDS.mp. or Human Immunodeficiency virus.mp. or exp HIV Infections/ or exp HIV Seropositivity/ or exp HIV Seroprevalence/ or exp AIDS Serodiagnosis/ or Acquired Immunodeficiency Syndrome.mp AND exp sex workers/ or exp prostitution/ or sex work*.mp. or prostitut*.mp. or transact* sex.mp. or exchang* sex.mp. or sell* sex.mp. or sold sex.mp. or trad* sex.mp AND high risk men.mp. or exp Sexual Partners/ or sexual partner*.mp. or regular partner*.mp. or casual partner*.mp. or boyfriend*.mp. or husband*.mp. or exp Spouses/ or spouse*.mp. or client*.mp. or customer*.mp. or buy* sex.mp. or bought sex.mp. or purchas* sex.mp. or millitary personnel.mp. or truck driver*.mp. or taxi driver*.mp. or Mining/ or mining worker*.mp. or businessmen.mp. or Construction Industry/ or construction worker*.mp. or exp Construction Industry/ or construction worker*.mp. or military personnel.mp. or exp Military Personnel/ or exp Fisheries/ or fishermen.mp. or port worker*.mp. or dock worker*.mp. or exp Police/ or police officer*.mp. or army.mp
Scopus Cinahl	HIV or Acquired Immunodeficiency Syndrome or HIV or AIDS or Human Immunodeficiency virus or HIV Infections or HIV Seropositivity or HIV Seroprevalence or AIDS Serodiagnosis or Acquired Immunodeficiency Syndrome AND sex work* or prostitut* or transact* sex or exchang* sex or sell* sex or sold sex or trad* sex AND high risk m*n or sexual partner* or regular partner* or casual partner* or boyfriend* or husband* or spouse* or client* or customer* or buy* sex or bought sex or purchas* sex or military personnel or truck driver* or taxi driver* or Mining/ or mining worker* or businessmen or Construction Industry or construction worker* or Fisheries or fishermen or port worker* or dock worker* or Police or police officer* or army

To avoid double publication bias, only one article of studies published more than once was selected. However, if these studies published different outcomes or intervention strategies in each publication, both were included.

LPLW was responsible for the entire process, with referral to RG and JK to resolve queries.

Method of Extraction

Criteria for a systematic review of health promotion and public health interventions [22] were used to guide the requisite information to be extracted from the articles. For each article, we extracted information about study participants, descriptions of interventions, follow-up observation period, comparison group/s, and outcomes. Other data, relating to author/s, publication year, country, study design, study settings, sample size, sampling technique, and theoretical framework used was also extracted.

Results

32,115 studies were found; 7034 duplicates were excluded. After a reading of titles and/or abstracts, a further 24,957 studies were excluded due to the topic not referring to HIV interventions among MWPS or proxy populations, resulting in 124 studies being screened for the full text. Of those, 103 were excluded on the bases of study design, full text not in English/not available, no comparison groups or follow-up observations, duplication, no clear interventions, target groups, or outcomes, or high-income country settings. Ultimately, 21 studies were yielded for inclusion in the analysis (Fig. 1).

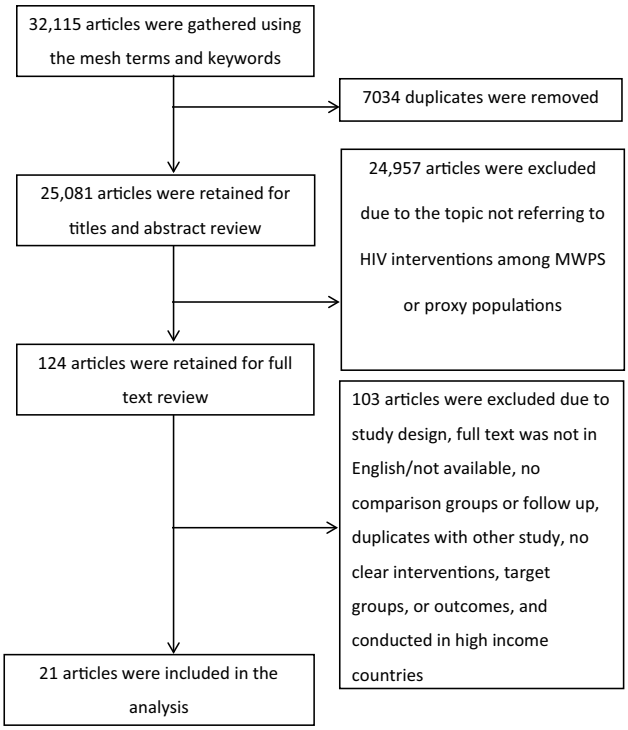

Fig. 1 Study selection

Study Characteristics

These 21 research reports were from 14 countries. India contributed four studies, the highest percentage of all countries in which studies were conducted. Studies were published between 1997 and 2015. Study designs encompassed trial, cohort study, and secondary analysis of routinely collected data or national surveys, with the majority being serial surveys. Only four studies recruited MWPS, while almost all others recruited mobile populations from particular occupation groups often used as proxies for MWPS, considered by the original authors (as reflected in their background sections) to be highly exposed to commercial sex contact. These populations included army and military personnel, mine workers, and truck company workers; most studies recruited truck drivers (10 studies). Study settings included clinics, military areas, sex work venues, transport terminals, immigration checkpoints, ports, and truck-stops (Table 2).

Intervention Characteristics

The content of the interventions varied, covering: (1) law enforcement, (2) community forums or social gatherings, (3) health education interventions, (4) condom promotion or distributions, (5) sexually transmitted infection (STI) testing provision, and 6) HIV testing provision. Health education interventions comprised the largest intervention type, and took the following forms: media campaigns, hotline services, distribution of outdoor printed promotional materials, posters, billboards, education sessions, and counselling, interpersonal communication, workshops, training, or peer education. Except for two studies which solely evaluated health education interventions, all other studies assessed programmes combining health education with other intervention types noted above. While condom promotion or distribution was also the largest intervention type (18 studies), provision of STI testing was evaluated in only eight studies; six studies assessed interventions involving HIV testing provision; and none addressed HIV treatment. The range of intervention settings included clinics, media platforms, occupational sites, sex venues, and transport hubs. Follow-up periods varied from two months to 5 years (Table 3).

The Effect of Interventions on HIV-Related Outcomes

To assess the impact of interventions, a range of behavioural and biological outcomes was reported. These included extent of HIV/STI-related knowledge and perceptions/beliefs/motivations (13 studies), rates of condom use (20 studies), number of FSW contacts or engagement with transactional sex (15 studies), number of visits to STI clinics (3 studies), HIV testing rates (6 studies), STI prevalence or incidence

Table 2 Study characteristics

Publication year	Authors	Country	Study design	Study settings	Study participants
1997	Jackson, D. J. et al. [47]	Kenya	Cohort study	Transportation companies	Trucking company workers
1998	Celentano, D. D. et al. [29]	Thailand	Cohort study	Military bases	Army
2000	Celentano, D. D. et al. [48]	Thailand	Non randomised trial	Military camps	Army
2000	Lau, J. T. et al. [49]	China	Serial survey	Immigration checkpoint	Travellers
2000	Laukamm-Josten, U. et al. [50]	Tanzania	Serial survey	Truck stops, bar/guest houses, sex-work venues, and transportation companies	Truck drivers and their assistants, women working at truck stops, bar/guest houses, and sex work venues
2000	Leonard, L. et al. [51]	Senegal	Cohort study	Terminal	Transportation park workers, including truck drivers, apprentices, and baggage handlers
2002	Bronfman, M. et al. [52]	Mexico	Before and after	Restaurants and boarding house	Truck drivers
2003	Tambashe, B. O. et al. [31]	Burkina Faso	Serial survey	Border areas	Truck drivers
2003	Williams, B. G. et al. [53]	South Africa	Serial survey	Gold mining complex	Mine workers, sex workers and adults in the community
2006	Ross, M. W. et al. [54]	Nigeria	RCT	Military unit	Military personnel
2007	Cornman, D. H. et al. [55]	India	RCT	Transportation companies	Truck drivers
2007	Lowndes, C.M. et al. [32]	Benin	Serial survey	Sex-work venues	MWPS and FSWs
2008	Bing, E.G. et al. [56]	Angola	Group RCT	Military bases	Military personnel
2008	Jewkes, R. et al. [46]	South Africa	Cluster RCT	School premises	Men and women residing in the village
2009	Lau, J.T. et al. [57]	China	Serial survey	Sex-work venues	MWPS
2010	Lafort, Y. et al. [58]	Mozambique	Secondary data analysis and qualitative interview	Clinics	Truck drivers
2010	Lau, J. T. et al. [59]	China	RCT	Immigration checkpoint	Truck drivers
2010	Lipovsek, V. et al. [30]	India	Serial survey	Sex-work venues	MWPS
2011	Pandey, A. et al. [60]	India	Secondary data analysis	Transhipment areas	Truck drivers
2012	Bai, R.L. et al. [61]	India	Serial survey	Sex-work venues	MWPS
2015	Himmich, H. et al. [62]	Morocco	Before and after	Transportation companies	Truck drivers

(12 studies), and HIV prevalence or incidence (7 studies). Some studies also reported programme coverage, including the number of people exposed to the interventions or the number of men reached by the activity (9 studies) (Table 3).

The impacts of interventions were measured by comparing these outcomes among comparison groups, or by follow-up observations. As Table 3 shows, in its comparison of study characteristics, some studies did not provide the p value to ascertain statistically significant differences, while others reported that value.

While interventions to improve knowledge or perceptions of HIV had mixed results, most (9 out of 13 studies which measured changes in knowledge/perceptions of HIV) reported statistically significant results in the expected direction, i.e. in favour of improving HIV-related knowledge and perceptions. A change in condom use behaviours was also an apparently easy-to-achieve outcome. Of 20 studies reporting changes in the rates of condom use, 13 reported a statistically significant increase in/higher rate of condom use in their follow-up observation or intervention groups. Among the 15 studies measuring the rates of engagement or contact with FSWs, seven reported a statistically significant decrease in/lower rate of FSWs contact in the follow-up observation or intervention group (Table 3).

Table 3 Intervention description, follow-up observation, comparison groups, and outcomes

Authors	Intervention description	Follow up observation	Comparison/control group	Outcome										
				Rate of program exposure	Level of HIV related knowledge and perception/beliefs/motivation	Rates of alcohol use	Rates of drug use	Rates of FSW contact/engagement with transactional sex	Numbers of sex partners	Condom use rates	HIV testing rates	Number of visits to STI clinics	STI prevalence/incidence	HIV prevalence / incidence
Jackson et al. [47]	Mobile health clinics were held each week in six largest trucking companies, targeting their employees. The program included group discussions or counselling, covering topics around condom use, partner reduction, and risk reduction counselling. The program also consisted of condom promotion and supply, distribution of health educational materials containing information on HIV and STI risk and prevention, condoms, and the need to reduce the number of sexual partners. Lastly, HIV and STI testing activities were included.	Baseline and follow up visit at 3-month intervals until at least 16 months period.	–					↓*	↓*	=			↓*	=

Table 3 (continued)

Authors	Intervention description	Follow up observation	Comparison/control group	Outcome										
				Rate of program exposure	Level of HIV related knowledge and perception/beliefs/motivation	Rates of alcohol use	Rates of drug use	Rates of FSW contact/engagement with transactional sex	Numbers of sex partners	Condom use rates	HIV testing rates	Number of visits to STI clinics	STI prevalence/incidence	HIV prevalence / incidence
Celentano et al. [29]	Intervention activities included television and radio campaigns promoting public awareness of the need to reduce high-risk sexual behaviours such as by avoiding commercial sex and using condoms in commercial sex transactions, targeting key population groups. Identification of commercial sex establishments, enforcement of compliance with condom recommendations, condom promotion and supply at commercial sex establishments, and periodic STI examination were also included.	Baseline, and follow up every 6 months for 2-year period.	–					↓*	↑*	↑*			↓*	↓*

Table 3 (continued)

Authors	Intervention description	Follow up observation	Comparison/control group	Outcome										
				Rate of program exposure	Level of HIV related knowledge and perception/beliefs/motivation	Rates of alcohol use	Rates of drug use	Rates of FSW contact/engagement with transactional sex	Numbers of sex partners	Condom use rates	HIV testing rates	Number of visits to STI clinics	STI prevalence/incidence	HIV prevalence / incidence
Celentano et al. [48]	Prevention activities conducted to promote consistent condom use, reduce alcohol consumption and brothel patronage, and improve sexual negotiation and condom skills were integrated into the curriculum of continuing education sessions mandatory for all military conscripts. HIV and AIDS health education sessions at basic training, and risk reduction counselling were also conducted every 6 months.	Baseline and follow up at 6-month intervals for a 2-year period	Men were divided into three groups based on military missions: 450 men comprised an intervention group, and 681 men a diffusion group (i.e. in barracks at the same base but not receiving the interventions); 414 men in distant camps were recruited as a control group.			=		↑*	=	=			↓*	=
Lau et al. [49]	Interventions included mass media awareness raising campaigns and condom promotion and distribution through government STI clinics, methadone clinics, and sex work venues.	Two survey rounds (16 months apart)	–		x			=	=	↓*			=	

Table 3 (continued)

Authors	Intervention description	Follow up observation	Comparison/control group	Outcome										
				Rate of program exposure	Level of HIV related knowledge and perception/beliefs/motivation	Rates of alcohol use	Rates of drug use	Rates of FSW contact/engagement with transactional sex	Numbers of sex partners	Condom use rates	HIV testing rates	Number of visits to STI clinics	STI prevalence/incidence	HIV prevalence / incidence
Laukamm-Josten et al. [50]	The interventions mainly included peer education and condom promotion by peer. The peers, who were mostly sex workers, delivered verbal messages to other sex workers and truck drivers, which were reinforced with posters, stickers, pamphlets, booklets, flip charts, audio-cassettes, dramas and video shows. Small group discussions and role plays to improve skills on condom negotiation were also conducted. Condoms were distributed in hotel bedrooms, bars, and company bathrooms.	Baseline, 18 months, and 24 months	–		↑*					↑*	↓*		↑	
Leonard et al. [51]	Peer educators selected from among the transport workers performed health education, distributed condoms and printed materials to their peers, and referred men with STI symptoms to STI clinics.	Baseline and 3 months following the intervention	–		↑*			↓*	↓*	↑*				

Table 3 (continued)

Authors	Intervention description	Follow up observation	Comparison/control group	Outcome										
				Rate of program exposure	Level of HIV related knowledge and perception/beliefs/motivation	Rates of alcohol use	Rates of drug use	Rates of FSW contact/engagement with transactional sex	Numbers of sex partners	Condom use rates	HIV testing rates	Number of visits to STI clinics	STI prevalence/incidence	HIV prevalence / incidence
Bronfman et al. [52]	Access to a national AIDS information hotline was provided; small group discussions were held in boarding houses and eating places, using flipcharts, brochures, posters and stickers containing information on STI/HIV transmission and prevention, and condom use.	Baseline and follow up, 14 months apart	Group 1 (selected before the intervention), group 2 (selected after the intervention and had been part of intervention), group 3 (selected after the intervention but had not been part of the intervention).		↑	=	=	↓	↓	↓				
Tambashe et al. [31]	The program included condom distributions and sales, peer education, the use of audio and video materials, and mass media communication for social marketing via billboards posted at major truck-stops along the intervention routes, and radio and television campaigns.	Baseline and follow-up, 3 years apart	–		↑*					↑*				

Table 3 (continued)

Authors	Intervention description	Follow up observation	Comparison/control group	Outcome										
				Rate of program exposure	Level of HIV related knowledge and perception/beliefs/motivation	Rates of alcohol use	Rates of drug use	Rates of FSW contact/engagement with transactional sex	Numbers of sex partners	Condom use rates	HIV testing rates	Number of visits to STI clinics	STI prevalence/incidence	HIV prevalence / incidence
Williams et al. [53]	In a peer education program, peers were recruited from among sex workers, mine workers and youth, and trained as peer educators. Condoms were provided free by the Department of Health and distributed by peer educators and through local clinics. In addition, a specific program targeted sex workers only, i.e. syndromic management of STI and a periodic presumptive STI treatment.	Two survey rounds (before and after, 2 years apart)	–		↑*	↓*			↓*	↑*	=		↑*	
Ross et al. [54]	A participatory action research-based training of trainers of Nigerian military health educators was conducted by one of the research teams. The trainers then conducted education interventions for risk behaviours using the training modules presented to groups of military personnel.	Baseline, and 6 and 12 months following the intervention	Intervention group (received the intervention) and control group (did not receive the intervention)		↑*	=	↓*			↑*				

Table 3 (continued)

Authors	Intervention description	Follow up observation	Comparison/control group	Outcome										
				Rate of program exposure	Level of HIV related knowledge and perception/beliefs/motivation	Rates of alcohol use	Rates of drug use	Rates of FSW contact/engagement with transactional sex	Numbers of sex partners	Condom use rates	HIV testing rates	Number of visits to STI clinics	STI prevalence/incidence	HIV prevalence / incidence
Cornman et al. [55]	In a workshop on information-motivation-behavioural (IMB) skills, the intervention group participated in several interactive activities to improve knowledge, motivation, and skills, including discussions among truck drivers about the transmission and prevention of HIV/AIDS and other STIs, aimed to motivate condom use with all partners, about the high prevalence of HIV among truck drivers, and about the importance of getting tested for HIV and STIs. The control group participated in a workshop which provided information about HIV transmission and prevention only, but no behavioural skills training or activities to increase motivation.	Baseline, soon after the intervention, and 10 months later	Intervention group, i.e. group receiving an intervention based on the IMB model compared with a control group, i.e. group receiving information only		x			↓*	x	↑*				

Table 3 (continued)

Authors	Intervention description	Follow up observation	Comparison/control group	Outcome										
				Rate of program exposure	Level of HIV related knowledge and perception/beliefs/motivation	Rates of alcohol use	Rates of drug use	Rates of FSW contact/engagement with transactional sex	Numbers of sex partners	Condom use rates	HIV testing rates	Number of visits to STI clinics	STI prevalence/incidence	HIV prevalence / incidence
Lowndes et al. [32]	HIV/STI preventive intervention focusing on condom promotion and STI care, targeting both FSWs and MWPS was conducted. It included a clinical screening algorithm which was applied at regular clinic visits, condom promotion, and activities aimed at capacity building and community development. In addition, outreach workers conducted specific activities targeting MWPS, which included outreach activities at sex-work venues and surrounding areas and setting up free STI clinics for men near these main areas. Men who visited the clinic were offered physical examinations, a test for urethritis, syndromic treatment, risk-reduction counselling, and education about STIs and condom use.	Three survey rounds (1998, 2002, 2005)	–					↓*	↓	↑*		↑	↓*	=

Table 3 (continued)

Authors	Intervention description	Follow up observation	Comparison/control group	Outcome										
				Rate of program exposure	Level of HIV related knowledge and perception/beliefs/motivation	Rates of alcohol use	Rates of drug use	Rates of FSW contact/engagement with transactional sex	Numbers of sex partners	Condom use rates	HIV testing rates	Number of visits to STI clinics	STI prevalence/incidence	HIV prevalence / incidence
Bing et al. [56]	A military-focused HIV prevention intervention which included training on HIV prevention and malaria was conducted. A monthly informal booster training session for a five-month period followed the completion of the training.	Baseline, and 3 and 6 months after the intervention	Intervention and control groups. Intervention group received 4.5 days' training for HIV prevention and 0.5 day's training on malaria. Control group received 0.5 day's training on HIV prevention and 4.5 days' training on malaria.		↑*	=		=	=	x				
Jewkes et al. [46]	Participatory learning approaches were used in 13 three-hour educational sessions, including critical reflection, role play and drama, to build knowledge, risk awareness, develop communication skills and stimulate critical reflection. This was followed by meetings of male and female peer groups and community meetings. The monthly community meetings were called by the village chiefs and, attended by a research team member who gave a brief presentation and prompted discussion with the community about many topics, including STI, HIV, safer sex and condom use.	Baseline, and 12 and 24 months after the intervention	Intervention and control groups. The intervention group received intervention as outlined in the intervention descriptions. The control group received a single three-hour session on HIV, safer sex, and condoms only.			↓*	=	↓*#	=	=			↓*	=

Table 3 (continued)

Authors	Intervention description	Follow up observation	Comparison/control group	Outcome										
				Rate of program exposure	Level of HIV related knowledge and perception/beliefs/motivation	Rates of alcohol use	Rates of drug use	Rates of FSW contact/engagement with transactional sex	Numbers of sex partners	Condom use rates	HIV testing rates	Number of visits to STI clinics	STI prevalence/incidence	HIV prevalence / incidence
Lau et al. [57]	Peer educators, consisting of MWPS, were trained by the local Centers for Disease Control and Prevention (CDC) to provide peer education at sex-work venues and promote condom use. Free condoms and printed education materials were disseminated. Social activities were organised periodically to maintain relationships among sex-work venue keepers and peer educators.	Baseline and follow-up, 8 months apart	–	↑*	↑*			↑*		↑*	↑*	↑*	↓*	
Lafort et al. [58]	An STI clinic was established targeting FSW and long-distance truck drivers. The clinic offered a range of services including free individual education and counselling, condom promotion and distribution, STI care, HIV testing, contraceptive services, and outreach peer education.	Clinic data across year (2004-2009)	–	↑							↑	↑		

Table 3 (continued)

Authors	Intervention description	Follow up observation	Comparison/control group	Outcome										
				Rate of program exposure	Level of HIV related knowledge and perception/beliefs/motivation	Rates of alcohol use	Rates of drug use	Rates of FSW contact/engagement with transactional sex	Numbers of sex partners	Condom use rates	HIV testing rates	Number of visits to STI clinics	STI prevalence/incidence	HIV prevalence / incidence
Lau et al. [59]	The intervention group was offered a voluntary HIV counselling session and testing along with information on HIV preventive behaviours and condom use (VCT-ID).	Baseline, 1 & 2 month follow up	Intervention group received VCT-ID intervention. Control group received information on HIV preventive behaviours and condom use (ID)-only.		↑*	↓*	=	=	=	↑*			↓*	
Lipovsek et al. [30]	As part of the AVAHAN project, this program involved communication campaigns across multiple media channels including outdoor education materials, e.g. posters, interpersonal communication, and mid-media activities in 100 hotspots. Condoms were distributed in more than 65,000 retail outlets. HIV and STI testing were also conducted.	Baseline and end-line, and comparison across five survey rounds in April 2006, December 2006, May 2007, February 2008, and November 2008	–			↓*		↓	↓	↑*				

Table 3 (continued)

Authors	Intervention description	Follow up observation	Comparison/control group	Outcome										
				Rate of program exposure	Level of HIV related knowledge and perception/beliefs/motivation	Rates of alcohol use	Rates of drug use	Rates of FSW contact/engagement with transactional sex	Numbers of sex partners	Condom use rates	HIV testing rates	Number of visits to STI clinics	STI prevalence/incidence	HIV prevalence / incidence
Pandey et al. [60]	Skilled community members were selected as peer educators to deliver health education activities via mid-media, mass media events, and monthly health camps at the intervention sites; distribution and social marketing of condoms were conducted; satellite STI clinics were established at truck halt points; community engagement and mobilization activities (including street plays, health games, truckers' festivals) were also undertaken.	Two survey rounds, 2 years apart	There were three comparison groups: the no-program exposure group if they had never heard of any HIV prevention services along their route; the less intensive exposure group if they had heard of HIV prevention intervention but either had not used the services in past 12 months, or received services only from non-Avahan project interventions; and the intensive exposure group, was assigned if the men had received any of the following services either from Avahan or from both Avahan and non-Avahan at least once in past 12 months: had contact with peer educators/outreach workers; had received condoms from peer educators or outreach workers; had visited the clinics or received counselling services on HIV/AIDS; or had participated in any community meetings or events organized by the clinics.	↑*				↓*		↑*			↓*	↓*

Table 3 (continued)

Authors	Intervention description	Follow up observation	Comparison/control group	Outcome										
				Rate of program exposure	Level of HIV related knowledge and perception/beliefs/motivation	Rates of alcohol use	Rates of drug use	Rates of FSW contact/engagement with transactional sex	Numbers of sex partners	Condom use rates	HIV testing rates	Number of visits to STI clinics	STI prevalence/incidence	HIV prevalence / incidence
Bai et al. [61]	Awareness program and mass media campaigns which were conducted by various donors and government agencies provided information about the importance of safe sex behaviours and condom use.	Four annual survey rounds	–	↑	=					↑	=			
Himmich et al. [62]	The interventions included community-based outreach educational intervention, peer education program, distribution of condoms and educational materials, referral to HIV/STI clinics, and care and support for those who were HIV/STI positive	Baseline and follow-up, 5 years apart	Three groups were assigned, one intervention and two control groups. The first control group was a historical control group, i.e. Individuals sampled before the intervention. The second control group comprised of individuals interviewed after the intervention period but who had not been exposed to the intervention.		↑*			↑*		↑*	↑*		=	

Notes:

↑Increased or higher rates on outcome in the follow-up observation or intervention group

↓Decreased or lower rates on outcome in the follow-up observation or intervention group

= Similar or no statistically significant difference on rates of outcome across the groups or across timeline

x Mixed result/s

#Effect disappeared in the subsequent follow up period

*Statistically significant

Only two of six studies measuring changes in HIV testing rates noted a significant increase in HIV testing rates in their follow-up groups, in the order of no more than 30% of the participants tested at the end of the interventions. Of the 12 studies which measured changes in STI rates, eight reported a significant decline in STI rates in their follow-up or intervention groups. Three of the four studies not reporting a significant decline in STI rates did not provide STI testing for the men, focusing instead on health education and or condom distribution. Among the seven studies measuring changes in HIV prevalence or incidence rates, only two noted a statistical reduction in HIV prevalence or incidence rates among their follow-up or intervention groups (Table 3).

Owing to the broad range of study participants, intervention types and combinations, follow-up periods, comparison groups, and outcomes of interests, a meta-analysis was not performed.

Assessment of Study Quality

The quality of all included studies was assessed using the STROBE checklist [23]. In accord with our inclusion criteria, only five studies used randomised controlled trial (RCT) designs (Table 2). Fourteen studies attempted to reduce bias by selecting their sample using a probability sampling method (Table 4). Six studies provided clear justifications for their sample size (Table 4). Eighteen studies reported on the statistical significance of their outcomes (Table 3).

Discussion

This review found a limited number [21] of studies matching its inclusion criteria. Among the 21 studies reviewed here, only four were conducted directly among MWPS. The paucity of studies in the published literature measuring the effectiveness of interventions to reduce the risk of HIV infection is at odds with the significant contribution of new HIV infections reported among this group to the overall number of new reported HIV cases globally [24]. The limited attention and effort to target MWPS could be explained by the clandestine nature of this population: the challenges of identifying this hard-to-reach group (1), let alone implementing interventions, are considerable. As an alternative, men from particular occupation groups thought to be highly exposed to commercial sex activities are often used as proxies for MWPS and sought for interventions targeting this population. Further, targeting these occupational groups may be less stigmatising than approaching men for HIV prevention programmes directly in the transactional sex context.

Programme coverage or uptake, i.e. the percentage of participants exposed to or receiving interventions prior to conclusions being drawn about the impact of an intervention [25], is an essential factor influencing programme effectiveness [26, 27]. A study of FSWs, for example, found a correlation between programme exposure and condom use and HIV testing rates [28]. Despite its importance, only nine studies in the current review provided any such information on uptake or coverage of interventions. This questions conclusions about, first, whether the inadequate outcomes noted in some studies was due to poor exposure to, or the inefficacy of the programme itself; or second, whether the reported success of some others was due to the public health intervention itself, or to other influencing factors, such as parallel interventions conducted in the same settings [29–32], a more widespread HIV culture [31], or the nature of epidemic phases [27]. Future interventions and studies should, therefore, report such possible factors so that proper conclusions about intervention effectiveness can be drawn.

UNAIDS has advocated for intensification of combined behavioural interventions and condom distribution along with HIV testing [33]. The current review observed that interventions which were combined to improve HIV-related knowledge or perceptions and rates of condom use have often resulted in a statistically significant improvement in both these indicators.

The goal of having 90% of people living with HIV know their HIV status is one of their global indicators set by UNAIDS for health sector response [34]. Their 90-90-90 fast-track target emphasises the importance of HIV status awareness and HIV treatment in curbing the HIV epidemic [35], yet only six of the studies reviewed indicated HIV testing rates as one of their outcomes, and none looked at HIV treatment. Of the studies including HIV testing rates as one of their results, only two found a statistically significant improvement in testing rates of no more than 30% of study participants tested at the end of the study period. The challenges entailed in increasing the rates of HIV testing noted in the current review supports the argument highlighted in a recent editorial which declares that "the last big shared challenge remaining is testing" [36]. This opens opportunities for future studies targeting MWPS to evaluate other potentially effective strategies to improve HIV testing rates. Since WHO guidelines recommend HIV self-testing as a means of increasing rates [37–39], and various studies note the potential of this strategy to improve the coverage of testing among MWPS [40–42], implementation and evaluations of this strategy are worthy of future consideration.

This review has several limitations. First, most of the studies included in the analysis used questionnaires to reveal cognitive and behavioural changes among their participants. Sexual behaviour and HIV/AIDS are widely felt to be sensitive matters, and social desirability bias might have influenced outcomes measured by self-report [43, 44]. Second,

Table 4 Target populations of interventions, sampling, and theoretical framework used

Authors	Target populations of interventions	Number of men included in the study	Calculation of sample size	Sampling technique	Theoretical framework used
Jackson, D. J. et al. [47]	Trucking company workers	556 men who returned for at least one follow-up visit	–	–	–
Celentano, D. D. et al. [29]	Key population groups	4086 men (2417 and 1669 conscripts in 1991 and 1993)	–	Probability	–
Celentano, D. D. et al. [48]	Army	1545 men (450 in experimental group, 681 men in diffusion group, 414 in control group)	Justified	Non- probability	+
Lau, J.T. et al. [49]	General population, including key population groups	1263 and 1448 men in 1997 and 1998 respectively	–	Probability	–
Laukamm-Josten, U. et al. [50]	Long-distance truck drivers and women working in bars and hotels at truck stops	425 men in 1990 (KAP1); 198 men in 1991 (KAP2); 305 (in 1993 (KAP 3)	Justified	Probability	–
Leonard, L. et al. [51]	Transport workers and FSWs	260 men completed both baseline and follow-up interviews	–	Probability	–
Bronfman, M. et al. [52]	Truck drivers	307 men before the intervention (group 1); 303 after the intervention, which comprised 2 groups; 67 (group 2, 23%) had been part of the intervention and 234 (Group 3, 77%) had not	–	Non-probability	–
Tambashe, B. O. et al. [31]	Truck drivers, seasonal workers, FSWs, and other women who sell goods to these truckers and who are, more often than not, covert or disguised sex workers	764 men at baseline in 1997, 1032 at follow up in 2000	–	Non-probability	+
Williams, B. G. et al. [53]	Mine workers, sex workers, and adults in the community	899 men in 1998, 769 in 2000	Justified	Probability	–
Ross, M. W. et al. [54]	Military personnel	1914 men (1055 in intervention group, 859 men in control group)	–	Probability	+
Cornman, D. H. et al. [55]	Truck drivers	250 men	Justified	Non-probability	+
Lowndes, C.M. et al. [32]	MWPS and FSWs	About 300–400 male clients took part in each round of the IBBS in and outside Cotonou, except in Cotonou in 2002, where 600 male clients took part	–	Probability	–
Bing, E.G. et al. [56]	Military personnel (soldiers)	568 male soldiers from the Angolan Armed Forces (280 participated in the HIV prevention intervention, 288 participated in the control intervention)	–	Probability	+
Jewkes, R. et al. [46]	Men and women in the village	1360 men (694 men at intervention group, 666 men at control group)	Justified	Probability	–
Lau, J.T. et al. [57]	MWPS	356 men at baseline in Sept 2005; 372 at evaluation survey in May 2006	–	Non-probability	–
Lafort, Y. et al. [58]	FSWs and truck drivers	–	–	–	–
Lau, J.T. et al. [59]	Truck drivers	301 men (147 in intervention group, 154 in control group)	–	Probability	–
Lipovsek, V. et al. [30]	Key population groups	2401 men at baseline; 1756 at round 2, 1741 at round 3, 1779 at round 4, and 2382 at endline	–	Probability	–

Table 4 (continued)

Authors	Target populations of interventions	Number of men included in the study	Calculation of sample size	Sampling technique	Theoretical framework used
Pandey, A. et al. [60]	Key population including FSWs, MSM, transgender, injecting drug users, and the potential clients of FSWs	2066 men in round 1; 2085 in round 2	–	Probability	–
Bai, R.L. et al. [61]	General population and key population groups	1497 men in 2005; 1418 in 2006; 2690 in 2007; 2772 in 2008	–	Probability	–
Himmich, H. et al. [62]	Truck drivers	484 men in 2007, 459 men in 2012	Justified	Probability	–

Notes: – not clear

only studies which measured changed outcomes against comparison or follow-up groups were included. There may have been studies that measured the effectiveness of interventions to reduce HIV risk among MWPS but, not meeting those criteria, they were not included in this review.

Challenges exist in comparing the effectiveness of interventions in relation to their outcomes because of the complexities of intervention packages and the scope of outcomes measured. Identifying the overall effectiveness of programmes is also problematic since data for other, possibly crucial factors that may have influenced reported outcomes, such as programme coverage or exposure was rarely included in studies. Follow-up timelines also varied significantly, making it difficult to estimate effect [45]. Different follow-up timelines might produce different outcomes, such as that noticed in the study by Jewkes et al. (2008). At that study's 12-month follow-up, a significantly lower proportion of men reported transactional sex compared to the control group. That effect had, however, disappeared by the 24-month follow-up [46]. Quite a few studies did not provide a significant value in their statistical testing measuring changes in their outcomes, which also qualifies the conclusions drawn. Last, but not least, since the current review included only those studies published in a peer-reviewed journal, thus excluding those in grey literature, studies with non-statistically significant findings may have been missed.

Conclusions

This systematic review is the first that aimed to map and characterise HIV interventions conducted among MWPS in LMICs and identify extant gaps. A considerable paucity of published studies measuring the effectiveness of HIV interventions to change HIV-related outcomes among this population was noted. Among the studies included, only a few recruited MWPS; the balance looked only at proxy groups for this population. Most of the interventions reviewed were made to increase HIV-related knowledge or perceptions through education, or to improve condom usage rates via promotion and distribution. Almost all studies evaluated interventions combining health education interventions with other intervention types. Despite the UNAIDS 90-90-90 target, few studies evaluated the impact of HIV testing, and none assessed HIV treatment.

Interventions to improve HIV-related knowledge or perceptions and rates of condom use have often resulted in statistically significant improvements in both indicators. However, only six studies included HIV testing rates as one of their outcomes, and only two of them noted statistically significant improvements in testing rates, i.e. no more than 30% of their participants were tested at the end of the study. This finding emphasises the enormity of the challenges of

testing asserted in a recent editorial [36]. In addition, the UNAIDS goal for 90% of all people living with HIV to know their HIV status indicates the necessity of sharper focus on HIV testing provision interventions to improve HIV testing uptake among MWPS. The HIV self-testing approach in particular, recommended by the WHO [39], and recently pilot trialled [42] is worth considering.

References

1. Carael M, Slaymaker E, Lyerla R, Sarkar S. Clients of sex workers in different regions of the world: hard to count. Sex Transm Infect. 2006;82(3):26–33.
2. Baral S, Beyrer C, Muessig K, Poteat T, Wirtz AL, Decker M, et al. Burden of HIV among female sex workers in low-income and middle-income countries: a systematic review and meta-analysis. Lancet Infect Dis. 2012;12(7):538–49.
3. Mulieri I, Santi F, Colucci A, Fanales-Belasio E, Gallo P, Luzi AM. Sex workers clients in Italy: results of a phone survey on HIV risk behaviour and perception. Annali dell'Istituto Superiore Sanita. 2014;50(4):363–8.
4. Goldenberg SM, Gallardo Cruz M, Strathdee SA, Nguyen L, Semple SJ, Patterson TL. Correlates of unprotected sex with female sex workers among male clients in Tijuana. Mexico Sex Transm Dis. 2010;37(5):319–24.
5. McClair TL, Hossain T, Sultana N, Burnett-Zieman B, Yam EA, Hossain S, et al. Paying for sex by young men who live on the streets in Dhaka city: compounded sexual risk in a vulnerable migrant community. J Adolesc Health. 2017;60(2):S29–S34.
6. Ng JYS, Wong M-L. Determinants of heterosexual adolescents having sex with female sex workers in Singapore. PLoS ONE. 2016;11(1):e0147110.
7. Xantidis L, McCabe MP. Personality characteristics of male clients of female commercial sex workers in Australia. Arch Sex Behav. 2000;29(2):165–76.
8. Ompad DC, Bell DL, Amesty S, Nyitray AG, Papenfuss M, Lazcano-ponce E, et al. Men who purchase sex, who are they? An interurban comparison. J Urban Health. 2013;90(6):1166–80.
9. Darling KE, Diserens EA, N'Garambe C, Ansermet-Pagot A, Masserey E, Cavassini M, et al. A cross-sectional survey of attitudes to HIV risk and rapid HIV testing among clients of sex workers in Switzerland. Sex Transm Infect. 2012;88(6):462–4.
10. Nadol P, Hoang TV, Le L, Nguyen TA, Kaldor J, Law M. High HIV prevalence and risk among male clients of female sex workers in Hanoi and Ho Chi Minh City, Vietnam. AIDS Behav. 2017. https://doi.org/10.1007/s10461-017-1751-4.
11. Reilly KH, Wang J, Zhu Z, Li SC, Yang T, Ding G, et al. HIV and associated risk factors among male clients of female sex workers in a Chinese border region. Sex Transm Dis. 2012;39(10):750.
12. Shaw SY, Parinita B, Isac S, Deering KN, Ramesh BM, Washington R, et al. A cross-sectional study of sexually transmitted pathogen prevalence and condom use with commercial and non-commercial sex partners among clients of female sex workers in Southern India. Sex Transm Dis. 2013;40(6):482–9.
13. Leng Bun H, Detels R, Heng S, Mun P. The role of sex worker clients in transmission of HIV in Cambodia. Int J STD AIDS. 2005;16(2):170–4.
14. Villarroel MA. Male clients of sex workers in the United States: correlates with STI/HIV risk behaviors and urbanization level. Sexually Transmitted Infections Conference: STI and AIDS World Congress. 2013;89.
15. Kolaric B. Croatia: still a low-level HIV epidemic?–seroprevalence study. Coll Antropol. 2011;35(3):861–5.
16. Wagner KD, Pitpitan EV, Valente TW, Strathdee SA, Rusch M, Magis-Rodriguez C, et al. Place of residence moderates the relationship between emotional closeness and syringe sharing among injection drug using clients of sex workers in the US-Mexico border region. AIDS Behav. 2015;19(6):987–95.
17. Niccolai LM, Odinokova VA, Safiullina LZ, Bodanovskaya ZD, Heimer R, Levina OS, et al. Clients of street-based female sex workers and potential bridging of HIV/STI in Russia: results of a pilot study. AIDS Care. 2012;24(5):665–72.
18. UNAIDS. Global AIDS update 2019—Communities at the centre. Geneva: UNAIDS; 2019.
19. UNAIDS. On the Fast-Track to end AIDS: UNAIDS Strategy 2016–2021 Geneva 2015.
20. Wariki WM, Ota E, Mori R, Koyanagi A, Hori N, Shibuya K. Behavioral interventions to reduce the transmission of HIV infection among sex workers and their clients in low- and middle-income countries. Cochrane Libr. 2012. https://doi.org/10.1002/14651858.CD005272.pub3.
21. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS Med. 2009;8(5):336–41.
22. Jackson N, Waters E. Criteria for the systematic review of health promotion and public health interventions. Health Promot Int. 2005;20(4):367–74.
23. Vandenbroucke JP, von Elm E, Altman DG, Gotzsche PC, Mulrow CD, Pocock SJ, et al. Strengthening the reporting of observational studies in epidemiology (STROBE): explanation and elaboration. Int J Surg. 2014;12(12):1500–24.
24. UNAIDS. UNAIDS Data 2017. UNAIDS; 2017.
25. Glasgow RE, Vogt TM, Boles SM. Evaluating the public health impact of health promotion interventions: the RE-AIM framework. Am J Public Health. 1989;89:1322–7.
26. Hargreaves JR, Delany-Moretlwe S, Hallett TB, Johnson S, Kapiga S, Bhattacharjee P, et al. The HIV prevention cascade: integrating theories of epidemiological, behavioural, and social science into programme design and monitoring. Lancet HIV. 2016;3(7):e318–e322322.
27. Hayes R, Kapiga S, Padian N, McCormack S, Wasserheit J. HIV prevention research: taking stock and the way forward. AIDS. 2010;24(Suppl 4):S81–S92.
28. Armstrong G, Medhi GK, Kermode M, Mahanta J, Goswami P, Paranjape RS. Exposure to HIV prevention programmes associated with improved condom use and uptake of HIV testing by female sex workers in Nagaland, Northeast India. BMC Public Health. 2013;13(1):476.
29. Celentano DD, Nelson KE, Lyles CM, Beyrer C, Eiumtrakul S, Go VFL, et al. Decreasing incidence of HIV and sexually transmitted diseases in young Thai men: evidence for success of the HIV/AIDS control and prevention program. AIDS. 1998;12(5):F29–F36.
30. Lipovsek V, Amajit M, Deepa N, Pritpal M, Aseem S, Roy KP. Increases in self-reported consistent condom use among male clients of female sex workers following exposure to an integrated behaviour change programme in four states in southern India. Sex Transm Infect. 2010;86(Suppl. 1):i25–i32.
31. Tambashe BO, Speizer IS, Amouzou A, Djangone AM. Evaluation of the PSAMAO "Roulez Protege" mass media campaign in Burkina Faso. Prevention du SIDA sur les Axes Migratoires de l'Afrique de l'Ouest. AIDS Educ Prev. 2003;15(1):33–48.
32. Lowndes C, Alary M, Labbe A, Gnintoungbe C, Belleau M, Mukenge L, et al. Interventions among male clients of female sex workers in Benin, West Africa: an essential component of targeted HIV preventive interventions. Sex Transm Infect. 2007;83:577–81.

33. Joint United Nations Programme on HIV/AIDS. Fast-tracking combination prevention: towards reducing new HIV infections to fewer than 500 000 by 2020. Geneva 2015.
34. World Health Organisation. Consolidated strategic information guidelines for HIV in the health sector. Geneva: World Health Organisation; 2015.
35. UNAIDS. 90-90-90 An ambitious treatment target to help end the AIDS epidemic: UNAIDS; 2014 [cited 2018 6 March]. Available from: https://www.unaids.org/sites/default/files/media_asset/90-90-90_en.pdf.
36. The Lancet HIV. Divergent paths to the end of AIDS. Lancet HIV. 2017;4(9):e375.
37. World Health Organisation. Consolidated guidelines on HIV testing services. Geneva: WHO; 2015.
38. World Health Organisation. Guidelines on HIV self-testing and partner notification: supplement to consolidated guidelines on HIV testing services. Geneva: World Health Organisation; 2016.
39. World Health Organisation. WHO recommends HIV self testing—evidence update and considerations for success. Geneva: World Health Organisation; 2019.
40. Thirumurthy H, Akello I, Murray K, Masters S, Maman S, Omanga E, et al. Acceptability and feasibility of a novel approach to promote HIV testing in sexual and social networks using HIV self-tests. J Int AIDS Soc. 2015;18:22–3.
41. Wulandari LPL, Kaldor J, Guy R. Brothel-distributed HIV self-testing by lay workers improves HIV testing rates among men who purchase sex in Indonesia. 2018 Australasian HIV&AIDS Conference; Sydney 2018.
42. Wulandari LPL, Kaldor J, Guy R. Uptake and acceptability of assisted and unassisted HIV self-testing among men who purchase sex in brothels in Indonesia: a pilot intervention study. BMC Public Health. 2020;20:730. https://doi.org/10.1186/s12889-020-08812-4.
43. Schick V, Calabrese SK, Herbenick D. Survey methods in sexuality research. Am Psychol Assoc. 2014. https://doi.org/10.1037/14193-004.
44. DiFranceisco W, McAuliffe TL, Sikkema KJ. Influences of survey instrument format and social desirability on the reliability of self-reported high risk sexual behavior. AIDS Behav. 1998;2(4):329–37.
45. Schaefer R, Gregson S, Fearon E, Hensen B, Hallett TB, Hargreaves JR. HIV prevention cascades: a unifying framework to replicate the successes of treatment cascades. Lancet HIV. 2019;6(1):e60–e6666.
46. Jewkes R, Nduna M, Levin J, Jama N, Dunkle K, Puren A, et al. Impact of Stepping Stones on incidence of HIV and HSV-2 and sexual behaviour in rural South Africa: cluster randomised controlled trial. BMJ. 2008;337(7666):391–5.
47. Jackson DJ, Rakwar JP, Richardson BA, Mandaliya K, Chohan BH, Bwayo JJ, et al. Decreased incidence of sexually transmitted diseases among trucking company workers in Kenya: results of a behavioral risk-reduction programme. Aids. 1997;11(7):903–9.
48. Celentano DD, Bond KC, Lyles CM, Eiumtrakul S, Go VF, Beyrer C, et al. Preventive intervention to reduce sexually transmitted infections: a field trial in the Royal Thai Army. Arch Intern Med. 2000;160(4):535–40.
49. Lau JT, Wong WS. Behavioural surveillance of sexually-related risk behaviours for the cross-border traveller population in Hong Kong: the evaluation of the overall effectiveness of relevant prevention programmes by comparing the results of two surveillance surveys. Int J STD AIDS. 2000;11(11):719–27.
50. Laukamm-Josten U, Mwizarubi BK, Outwater A, Mwaijonga CL, Valadez JJ, Nyamwaya D, et al. Preventing HIV infection through peer education and condom promotion among truck drivers and their sexual partners in Tanzania, 1990–1993. AIDS Care. 2000;12(1):27–40.
51. Leonard L, Ndiaye I, Asha K, Eisen G, Diop O, Mboup S, et al. HIV prevention among male clients of female sex workers in Kaolack, Senegal: results of a peer education program. AIDS Educ Prev. 2000;12(1):21–37.
52. Bronfman M, Leyva R, Negroni MJ. HIV prevention among truck drivers on Mexico's southern border. Cult Health Sex. 2002;4(4):475–88.
53. Williams BG, Taljaard D, Campbell CM, Gouws E, Ndhlovu L, Dam JV, et al. Changing patterns of knowledge, reported behaviour and sexually transmitted infections in a South African gold mining community. AIDS. 2003;17(14):2099–107.
54. Ross MW, Essien EJ, Ekong E, James TM, Amos C, Ogungbade GO, et al. The impact of a situationally focused individual human immunodeficiency virus/sexually transmitted disease risk-reduction intervention on risk behavior in a 1-year cohort of Nigerian military personnel. Mil Med. 2006;171(10):970–5.
55. Cornman DH, Schmiege SJ, Bryan A, Benziger TJ, Fisher JD. An information-motivation-behavioral skills (IMB) model-based HIV prevention intervention for truck drivers in India. Soc Sci Med. 2007;64(8):1572–84.
56. Bing EG, Cheng KG, Ortiz DJ, Ovalle-Bahamon RE, Ernesto F, Weiss RE, et al. Evaluation of a prevention intervention to reduce HIV Risk among Angolan soldiers. AIDS Behav. 2008;12(3):384–95.
57. Lau JTF, Wan SP, Yu XN, Cheng F, Zhang Y, Wang N, et al. Changes in condom use behaviours among clients of female sex workers in China. Sex Transm Infect. 2009;85(5):376–82.
58. Lafort Y, Geelhoed D, Cumba L, Lazaro C, Delva W, Luchters S, et al. Reproductive health services for populations at high risk of HIV: performance of a night clinic in Tete province, Mozambique. BMC Health Serv Res. 2010;10:144.
59. Lau JT, Tsui HY, Cheng S, Pang M. A randomized controlled trial to evaluate the relative efficacy of adding voluntary counseling and testing (VCT) to information dissemination in reducing HIV-related risk behaviors among Hong Kong male cross-border truck drivers. AIDS Care. 2010;22(1):17–28.
60. Pandey A, Mishra RM, Sahu D, Benara SK, Sengupta U, Paranjape RS, et al. Heading towards the Safer Highways: an assessment of the Avahan prevention programme among long distance truck drivers in India. BMC Public Health. 2011;11(6):S15.
61. Bai RL, Surya AV, Balasubramaniam R. Increasing awareness on prevention of HIV/AIDS in the clients of sex workers influencing their safe sexual practices. Int J BioSci Technol. 2012;5(13):67–75.
62. Himmich H, Ouarsas L, Hajouji FZ, Lions C, Roux P, Carrieri P. Scaling up combined community-based HIV prevention interventions targeting truck drivers in Morocco: effectiveness on HIV testing and counseling. BMC Infect Dis. 2015;15:208.