BMJ Open

Incidence of unintended pregnancy among female sex workers in low- and middle-income countries: a systematic review and meta-analysis

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2018-021779
Article Type:	Research
Date Submitted by the Author:	22-Jan-2018
Complete List of Authors:	Ampt, Frances; Burnet Institute; Monash University, Department of Epidemiology and Preventive Medicine Willenberg, Lisa; Burnet Institute Agius, Paul; Burnet Institute; La Trobe University, Judith Lumley Centre Chersich, Matthew; University of the Witwatersrand, Wits Reproductive Health and HIV Institute Luchters, Stanley; Burnet Institute; Universiteit Gent, Department of Obstetrics and Gynaecology Lim, Megan; Burnet Institute; Monash University, Department of Epidemiology and Preventive Medicine
Keywords:	PUBLIC HEALTH, REPRODUCTIVE MEDICINE, PREVENTIVE MEDICINE, EPIDEMIOLOGY, SEXUAL MEDICINE

Incidence of unintended pregnancy among female sex workers in low- and middle-income countries: a systematic review and meta-analysis

Frances H. Ampt[1,2], Lisa Willenberg[1], Paul A. Agius[1,3], Matthew Chersich[4], Stanley Luchters[1,2,5], Megan S.C. Lim[1,2,6]

Affiliations:

1. Burnet Institute, Melbourne, Australia
2. Department of Epidemiology and Preventive Medicine, Monash University, Melbourne, Australia
3. Judith Lumley Centre, La Trobe University, Melbourne, Australia
4. Wits Reproductive Health and HIV Institute, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa
5. International Centre for Reproductive Health, Department of Obstetrics and Gynaecology, Ghent University, Ghent, Belgium
6. Melbourne School of Global and Population Health, University of Melbourne, Melbourne, Australia

Corresponding author:

A/Prof Stanley Luchters

85 Commercial Rd Melbourne, VIC 3004, Australia

+613 8506 2378

stanley.luchters@burnet.edu.au

Word count: 4,933 (excluding title page, abstract, summary box, figures, tables, acknowledgements, author contributions, competing interests, funding, and references)

ABSTRACT

Objectives

To determine the incidence of unintended pregnancy among female sex workers (FSWs) in low- and middle-income countries (LMICs).

Design

We conducted a systematic review and meta-analysis, searching six online databases for papers published in English between 1 January 2000 and 20 January 2016. Meta-analysis was performed on the primary outcomes using random effects models, with sub-group analysis used to explore heterogeneity.

Participants

Eligible studies targeted FSWs aged 15-49 living or working in an LMIC.

Outcome measures

Studies were eligible if they provided data on one of the primary outcomes: incidence of unintended pregnancy (outcome 1) or pregnancy where intention is not specified (outcome 2). Secondary outcomes were also extracted when they were reported in included studies: incidence of induced abortion; incidence of birth; and correlates/predictors of pregnancy or unintended pregnancy.

Results

Twenty-five eligible studies were identified from 3,866 articles. Methodological quality was low overall. Unintended pregnancy incidence showed high heterogeneity (I^2>95%), ranging from 7.2 to 59.6 per 100 person-years across ten studies. Study design and duration were found to account for heterogeneity. On sub-group analysis, the three cohort studies in which no intervention was introduced had a pooled incidence of 27.1 per 100 person-years (95%CI=24.4-

29.8; I2=0%). Incidence of pregnancy (intention unspecified) was also highly heterogeneous, ranging from 2.0 to 23.4 per 100 person-years (15 studies).

Conclusions

Of the many studies examining FSWs' sexual and reproductive health in LMICs, very few measured pregnancy, and fewer assessed pregnancy intention. Incidence varied widely, likely due to differences in study design, duration and baseline population risk, but was high in most studies, representing a considerable concern for this key population. Evidence-based approaches that place greater importance on unintended pregnancy prevention need to be incorporated into existing sexual and reproductive health programs for FSWs.

Registration

The study protocol was registered with PROSPERO: CRD42016029185.

STRENGTHS AND LIMITATIONS OF THE STUDY

- This is the first study to systematically review and analyse the incidence of pregnancy or unintended pregnancy among female sex workers in low- and middle-income countries.
- Broad inclusion criteria mean that the review allowed for the inclusion of all studies that have collected data on pregnancy or unintended pregnancy rates in this population.
- However, limitations of broad inclusion criteria are that only one study had an *a priori* objective of measuring pregnancy incidence, and studies were highly varied in terms of their methodology, settings and populations.
- High heterogeneity prevented pooled analysis of all studies, but allowed for subgroup analysis for cohort studies, and for studies in which no intervention was introduced.
- Pregnancy rates among FSWs could not be compared to general population rates because of the lack of availability of those data.

INTRODUCTION

Unintended pregnancy affects a large number of women in low- and middle-income countries (LMICs), and can have significant impacts on maternal and child health.[1-3] Unintended pregnancy is a high priority issue for many female sex workers (FSWs),[4 5] who usually have dependents to support and for whom pregnancy may increase financial dependence on sex work and add to already high levels of stigmatisation.[5] This has been confirmed by consultation with FSWs in Kenya[i], and workshops with FSWs to inform development of a pregnancy prevention intervention[6]. Participants expressed considerable fear and anxiety about pregnancy, related personal and peer experiences of pregnancy scares, and emphasised the importance of improving knowledge of family planning in their community (unpublished qualitative data, Mombasa, Kenya).

FSWs can face elevated risks of unintended pregnancy due to high frequency of intercourse and high number of sexual partners.[7 8]Risks are exacerbated by concurrent paying and non-paying partnerships,[8] and by sexual and gender-based violence, gender inequalities and stigma towards sex work, which reduce women's power to negotiate within sexual relationships.[9-11] While gains have been made in terms of condom use with paying clients[12], rates of condom and other contraceptive use are consistently lower with emotional (non-paying) partners.[5 13 14] In many countries, particularly in sub-Saharan Africa, few FSWs use long-acting reversible contraceptives (intrauterine devices and implants), and methods such as injections, condoms and pills may be used inconsistently or incorrectly, rendering them less effective[5 15]. Limited knowledge and misconceptions, particularly in relation to contraceptive side effects and impacts on fertility, are significant demand-side barriers to contraceptive uptake.[5 16 17]

Family planning services are often neglected as part of FSW-specific service provision, which have focused largely on preventing HIV and other sexually-transmitted infections. [12 18-20] Stigma

[i]Our research group has worked closely with a local NGO (International Centre for Reproductive Health, Kenya) which has a long history of collaborating with and providing services for sex workers in Mombasa.

of health workers towards sex workers can also limit access to contraception.[21 22] FSWs have the same reproductive rights as all women, and their desires and needs in relation to pregnancy have often been neglected [23-25], similar to other marginalized populations, which have historically been subjected to reproductive coercion[26 27]. It is important that those who do desire pregnancy are provided with non-judgmental care, and that those who don't are given the opportunity and resources to prevent it.

Despite a clear rationale for addressing unintended pregnancy in this population, it is important to acknowledge that intention is a problematic concept, which is more accurately represented as a spectrum than a dichotomy.[3 28] Indeed, many women feel positive about pregnancy despite not intending to conceive, or may simultaneously desire both pregnancy and its avoidance, for different reasons. The degree to which women accept or welcome a pregnancy once it has occurred has been hypothesised to be a more important predictor of adverse outcomes than pre-pregnancy intentions.[28] Fertility preferences are also likely to be less stable over time in LMICs undergoing fertility transition compared to high-income countries.[3] FSWs' intentions also differ between types of partner, requiring them to adapt contraceptive use accordingly.[23] Furthermore, as a stigmatised group, FSWs may feel pressure not to disclose their intention. Despite these limitations, we have continued to use the term 'unintended pregnancy' in this paper for the sake of consistency with other literature, and the lack of a feasible alternative.

The primary objective of this study was to determine the pooled incidence of unintended pregnancy among FSWs in LMICs. Given the expected low number of eligible studies, we also aimed to determine the incidence of pregnancy where intention is not known. Secondary aims were to examine the correlates and predictors of pregnancy, and the incidence of induced abortion and birth in this population.

METHODS

All stages of this systematic review and meta-analysis have been reported in line with the PRISMA statement.[29] The protocol for this review was registered with the international prospective register of systematic reviews (PROSPERO): number CRD42016029185.

Inclusion and exclusion criteria

Studies were included if they met key criteria in terms of population, outcomes and study design. FSWs had to account for at least two thirds of the sample, unless data could be disaggregated by sex work status. We employed a broad definition of sex work, including women who self-identified as sex workers, those who engaged in transactional sex or part-time sex work, and communities of women known to practice commercial or transactional sex. Study participants had to live or work in an LMIC[30] and be of reproductive age (15-49 years). Studies targeting women with reduced fertility (e.g. women in the first six months post-partum, and those exclusively breastfeeding, or undergoing fertility treatment) were excluded.

Studies had to measure or report one of the following primary outcomes:

1. Cumulative incidence (proportion of women who became pregnant in a defined time period), or incidence rate (per person-time) of unintended pregnancy;
2. Cumulative incidence or incidence rate of pregnancy (where intention is not measured).

Unintended pregnancy was defined as any pregnancy considered by the woman to be not planned, intended or desired at the time of conception,[31] as reported either prior to pregnancy or retrospectively. Such pregnancies may be described by the authors as unintended, unwanted, undesired, unplanned or mistimed.

Any study design that was able to measure one or more of the primary outcomes was considered, including both observational and intervention studies. Case studies, ecological studies, qualitative studies, editorials, and commentaries were excluded. We planned to expand the inclusion criteria if insufficient studies measuring the primary outcomes were identified, to

include studies reporting prevalence of pregnancy in the previous 12 months. Cross-sectional studies were included in the initial screen for this purpose, but were subsequently excluded due to sufficient longitudinal studies measuring incidence.

Only studies published in English since 1 January 2000 were included.

Search strategy

A systematic electronic search of Medline, Embase, PsychINFO and Popline was undertaken to identify relevant peer-reviewed articles. Search syntax included, as both Subject Headings and keywords: synonyms for "sex work"; list of LMICs from the World Bank [30], and synonyms for "low- and middle-income"; and study design and descriptor terms, e.g. "cohort studies" or "controlled trials" (full search strategy in supplementary file).

A search for unpublished grey literature was also undertaken, including conference proceedings and abstracts (via Web of Science and Proquest databases), research theses, and the websites of relevant non-government organisations, including the Population Council, FHI 360 and Guttmacher Institute.

The last search was performed on 20 January 2016. Up to two attempts were made to contact authors when further information was required. Eligible studies recommended by contacted authors were also included.

Screening and data extraction

Screening of all abstracts, removal of duplicates, and selection of full text articles was conducted by one researcher, with a random selection of 10% screened in duplicate. Data from a random sample of 50% of included full text manuscripts were extracted in duplicate. Discrepancies in eligibility and data extraction were resolved by discussion, with a third researcher arbitrating when necessary.

Summary estimates were sought rather than individual subject data. Data were extracted relating to: eligibility criteria; study aims, population and methods; setting and participant

characteristics at baseline; primary and secondary outcome data for each time point reported; and quality assessment criteria. In addition to the primary outcomes, the following secondary outcomes were extracted: incidence of induced abortion (termination of pregnancy); incidence of birth; and correlates/predictors of pregnancy or unintended pregnancy.

Authors were contacted to provide data relating to the primary outcome when it was not reported in the paper; for example, the total person-years of exposure.

Quality assessment

Methodological quality of the included studies was assessed using a modified version of the Joanna Briggs Institute Prevalence Critical Appraisal Tool[32] (supplementary file). This tool was designed to assess studies measuring prevalence or incidence, and can be applied to multiple study designs. The tool was modified to address specific methodological concerns of our research question. Given measurement bias could result from infrequent or irregular pregnancy detection methods, items on these methods were specifically included. We also documented whether pregnancy incidence was an *a priori* study objective.

Quality assessment was undertaken in duplicate for 50% of studies, with discrepancies resolved by discussion. Studies were given a score out of 15 if they measured unintended pregnancy incidence, and out of 14 if they measured pregnancy incidence (the latter did not include an item on measurement of intention). Scores were then reported as percentages.

Analysis

We undertook a qualitative narrative synthesis of both primary and secondary outcomes, and quantitative analysis of primary outcomes using Stata version 13.1 (StataCorp LLC, USA).

Incidence rate (per 100 person-years) was taken as the unit of analysis. In studies reporting only cumulative incidence, we estimated person-time, censoring women at their first pregnancy, and assuming that they became pregnant halfway through the study.

The Mantel-Haenszel I-squared statistic was over 95% for both primary outcomes, so meta-analysis and meta-regression were not performed for all eligible studies, as anticipated. Instead, sources of heterogeneity were explored using sub-group analyses, and pooled incidence rates calculated using DerSimonian & Laird random effects models for sub-groups containing more than two studies and with I-squared of less than 75%. The explored sub-groups were geographic region, study duration, method of pregnancy measurement (measured regularly vs. only when indicated) and study design (cohort vs. randomised controlled trial (RCT), and intervention vs. non-intervention). Interventions included any introduced by the study with the aim of improving sexual and reproductive health, including contraceptive provision, and behavioural or biomedical interventions to prevent HIV/STIs.

We assessed study quality as a source of heterogeneity by examining scatter plots and Pearson correlation coefficients of quality score against incidence rate. We also qualitatively explored characteristics of different studies, including the following baseline population characteristics that may have impacted on pregnancy rates: age; contraceptive prevalence; consistent condom use; number of sex partners; coital frequency; sexually transmitted infection (STI) prevalence; indicators of gender-based violence; and alcohol and other drug use.

RESULTS

The initial search yielded 6,523 peer-reviewed and 118 grey literature articles, and 11 identified by hand-searching (e.g. due to recommendations from contacted authors). After removal of duplicates, this resulted in 3,866 articles (Figure 1). Based on title and abstracts, 750 manuscripts remained for full text screening. Authors were contacted regarding 97 papers, with responses received for 54, either to determine eligibility or obtain data required for calculation of incidence rates.

Pregnancy incidence was reported in 12 studies, and was obtained for a further 13 studies after contacting authors. These 25 studies were reported in 99 papers. Ten studies measured

unintended pregnancy (outcome 1), and 15 measured pregnancy *without specifying intention* (outcome 2); none measured both outcomes.

Fourteen cohort studies were included and eleven randomised controlled trials (table 1). Pregnancy incidence was not an *a priori* primary objective for any, but was a secondary objective for a Rwandan HIV incidence study.[33] The majority of studies aimed to test interventions to prevent HIV or STIs (n=11), or measure HIV incidence (n=8). Six undertook sub-studies in which they reported pregnancy incidence.[34-39] Thirteen studies included an intervention: three involved provision of diaphragms or female condoms [40-42] and ten were biomedical or behavioural interventions to prevent HIV/STIs (table 1). The latter included four studies that reported providing contraceptive counselling[37 38 43 44] and one which offered free contraception when needed[45].

Table 1: Characteristics of included studies

Study (first author, year)	Additional sources*	Country	Year commenced	Design	Aim	Population	N (FSWs) at baseline	Age (median)*	Current contraceptive use* (%)	Consistent condom use*	Number of sex partners/ frequency of sex*	GBV/ alcohol/ other risk factor	HIV/STI prevalence*
Outcome 1: Unintended pregnancy													
Behets 2005[1]		Madagascar	2004	Prospective cohort (with intervention)	Assess acceptability and feasibility of diaphragm use	FSWs who use condoms inconsistently	91	28	Any: 47% LARC or permanent: <1%	0% with clients in last month (inconsistent use was an inclusion criterion)	5 partners 6 sex acts	N/A	Vaginitis/ PID: 8% TP (RPR): 27%
Behets 2008[2]	Author Khan 2009[3] Penman-Aguilar 2011[4]	Madagascar	2005	RCT (pilot)	Assess acceptability and feasibility of diaphragm and microbicide use for STI prevention	Women with high-risk sex behaviours (sex work self-reported: 81% current, 100% ever)	192	29	Any (excl. condoms): 24%	0% in last 2/52 (inconsistent use was an inclusion criterion)	6 casual partners 10 sex acts	Ever violence from casual partner for suggesting condom: 21% Ever received more money for no condom: 38%	N/A
Braunstein 2011[5]	Braunstein 2011[6]	Rwanda	2006	Prospective cohort	Measure HIV incidence (secondary aims included measure pregnancy incidence)	HIV-uninfected women at high risk of exposure (94% reported current sex work)	397	24	Any: 91% LARC or permanent: 0%	21% with clients 18% with non-paying partners	90 partners in past 3 months 10 clients per week 40 vaginal sex acts in last month	Forced sex ever: 19% Alcohol before sex: 52%	CT: 5% GN: 12% TV: 17% TP (RPR+TPHA pos): 7% HSV2: 54%
Chersich 2014[7]	Author Luchters 2016[8]	Kenya (Mombasa)	2006	Prospective cohort	Assess HIV incidence and microbicide trial feasibility This sub-study: investigate links between alcohol use, and unsafe sex and incident HIV infection	FSWs without HIV	386	Mean 25.1	Any (incl. *consistent* condom use): 57.1% LARC: 3.0% Permanent: 0%	21.3% in last 3 months	N/A	Hazardous or harmful drinking: 26.8% Ever had abortion: 21%	N/A
Deschamps 2016[9]	Deschamps 2013[10]	Haiti, Puerto Rico, Dominican Republic	2009	Prospective cohort	Assess feasibility of establishing a high-risk cohort for HIV vaccine trials This sub-study: assess retention, HIV and pregnancy incidence and risk behaviours	FSWs without HIV	634	24 ¥	Permanent: 10.0% (excluded from pregnancy analysis) Others not reported	0.5% in last 6 months	447 partners in last 6/12 ¥	Forced sex by client in last 6m: 37.1% Heavy drinker: 38.8% Drug use: 14.0%	
Gaffoor 2013[11]	Author Skoler-Karpoff 2008[12]	South Africa (one site of a multisite trial)	2004	RCT (phase 3, double blind, placebo-controlled)	Test safety and efficacy of the microbicide Carraguard for	HIV-uninfected sexually active women (3% FSWs)	41	¶	¶	N/A	¶	N/A	¶

Study (first author, year)	Additional sources*	Country	Year commenced	Design	Aim	Population	N (FSWs) at baseline	Age (median)*	Current contraceptive use* (%)	Consistent condom use*	Number of sex partners/ frequency of sex*	GBV/ alcohol/ other risk factor	HIV/STI prevalence*
					HIV prevention This sub-study: describe the prevalence and associations of forced sex								
Lara 2009[13]	Author	Dominican Republic	2006	Prospective cohort (with intervention)	Assess acceptability of the female condom and diaphragm, determinants of use, and impact on unprotected sex	FSWs	243	58.8% aged 20-29	Any (excl. condoms): 22.2% Permanent: 0%	66% in last month	N/A	Ever had abortion: 70%	HIV: 1% CT: 13% GN: 2% TP (VDRL): 8%
McClelland 2008[14]	Author Martin 1998[15] McClelland 2008[16] McClelland 2009[17]	Kenya (Mombasa)	2003	RCT (placebo-controlled, nested in an open cohort study)	Test efficacy of monthly periodic presumptive antibiotic treatment at reducing incidence of vaginal infections and promoting vaginal Lactobacillus colonization	HIV-uninfected FSWs	310	32	Any (excl. condoms): 35.5% LARC: 3.6% Permanent: 2.9%	Median 100% coverage of sex acts in past week¥	1 partner 1 sex act ¥	N/A	GN: 0.3% TV: 1% Cervicitis (microscopy): 0.6% HSV-2: 74% BV: 34.5%
Peterson 2007[18]	Author Macqueen 2007[19]	Ghana, Cameroon, Nigeria	2004	RCT (phase 2, double blind, placebo-controlled)	Investigate safety and preliminary effectiveness of tenofovir disoproxil fumarate in preventing HIV infection	HIV-uninfected women who work in hotels, bars, markets in high HIV transmission areas (areas known for sex work)	936	Mean 23.6 ¥	Any (excl. condoms): 7.22% LARC: <2% Permanent: <2%	N/A	Mean 21 partners in 30 days Mean 12 coital acts per week	N/A	Any STI in last 6 months (self-reported): 41.2%
Watson-Jones 2008[20]	Author Ogutola 2012[21]	Tanzania	2004	RCT (double blind, placebo-controlled)	Determine whether HSV-2 suppressive therapy reduces the risk of HIV acquisition and genital shedding of HIV	Female workers at food and recreational facilities at risk of HIV (38% FSWs)	499	¶	¶	¶	¶	¶	¶
Outcome 2: Pregnancy (intention not specified)													
Bazzi 2015[22]	Author Syvertsen 2012[23]	Mexico	2010	Prospective cohort	Identify time varying risk factors for STI acquisition within FSWs' intimate	FSWs with drug use history, and their steady male partners	212	33	Any (excl. condoms): 53.3% LARC: 12.3% Permanent:	Often or always: 56%	N/A	In last year: Physical assault by partner: 41% Sexual coercion in relationship: 9%	HIV: 2.6% CT: 5.9% GN: 1.2% TP (active): 1.4%

Study (first author, year)	Additional sources*	Country	Year commenced	Design	Aim	Population	N (FSWs) at baseline	Age (median)*	Current contraceptive use* (%)	Consistent condom use*	Number of sex partners/ frequency of sex*	GBV/ alcohol/ other risk factor	HIV/STI prevalence*
					partnerships				25.5%			In last 6 months: Hazardous drinking: 23% IV drug use: 62%	Any STI 8%
Duff 2017[24]	Author Page 2013[25] Couture 2011[26]	Cambodia	2009	Prospective cohort	Estimate HIV and STI prevalence, incidence and associated factors This sub-study: describe contraceptive utilization and correlates of incident pregnancy	Young women who practice SW and/or have multiple partners (all those recruited had practiced SW)	220	60.3% aged 25-29	Any hormonal (not LARC): 10.8% LARC: <1.0%	N/A	4 partners in last month	In last year: Physical or sexual violence by client: 26.0% Intimate partner: 20.1% In last 3 months: Stimulant drug use: 27.0% Abortion: 11.3%	HIV: 16.2%
Feldblum 2007[27]	Feldblum 2005[28] Hoke 2007[29]	Madagascar	2001	RCT	Assess impact of two condom promotion interventions This sub-study: estimate pregnancy incidence rate and predictive factors	FSWs	935	Mean 28.3	Any highly effective (excl. condoms): 16.3%	No unprotected sex with any partners: 13.2%	Mean 5-6 partners	N/A	CT: 14.6% GN: 21.7% TV: 11.7% Any STI: 36.1% ¥
Kaewkungwal 2013[30]	Rerks-Ngarm 2009[31]	Thailand (2 provinces)	2003	RCT (multisite double blind placebo-controlled)	Assess the efficacy of 2 vaccines to prevent HIV This sub-study: determine the qualities and outcomes of women's participation	HIV-uninfected women (5% FSWs)	318	N/A	N/A	¶	N/A	¶	N/A
Kaul 2004[32]	Yadav 2005[33] Fox 2000[34]	Kenya (Nairobi)	1998	RCT (double blind placebo-controlled)	Assess impact of monthly PPT on HIV and STI incidence	HIV-uninfected FSWs	430	28.6 ¥	Any hormonal (not LARCs): 38.1%	17.2% with casual partner ¥	15.4 partners ¥	Daily alcohol: 47.6% Ever IV drug use: 4.1%	CT: 9.9% GN: 10.3% TV: 12.2% TP: 4.4% HSV2: 73.9% BV: 51.1%
Liu 2015[35]	Author	China	2009	Cluster-RCT	Assess the impact of a preventive intervention for FSWs on condom use with clients and partners	FSWs	750	Mean 27.8 ¥	LARC: 29.9%	43.6% in past month	Mean 8.3 clients ¥	N/A	CT: 14.0% GN: 3.3% TP: 1.3% Any STI: 16.9%
McClelland 2011[36]	Author Martin 1998[15]	Kenya (Mombasa)	1993	Open cohort	Assess HIV-1 incidence and relationships	HIV-infected FSWs	898	31	Any (excl. condoms): 43.0%	55% in past week	1 partner 2 sex acts	N/A	N/A

Study (first author, year)	Additional sources*	Country	Year commenced	Design	Aim	Population	N (FSWs) at baseline	Age (median)*	Current contraceptive use* (%)	Consistent condom use*	Number of sex partners/ frequency of sex*	GBV/ alcohol/ other risk factor	HIV/STI prevalence*
	McClelland 2010[37]				between hormonal contraception, STIs and HIV Ths sub-study: examine relationship between risk behaviour and biologic outcomes (STI, pregnancy, seminal fluid deposition) among HIV-positive FSWs				LARC: 2.34% Permanent: 2.67%				
Price 2012[38]	Author	Kenya (Nairobi, Kilifi)	2005	Prospective cohort	Describe populations at risk of HIV, including HIV incidence, in preparation for HIV trials	HIV-uninfected women and men at risk of HIV (75% of women were FSWs)	515	¶	N/A	N/A	N/A	¶	Any non-ulcerative STI: 9.1% Genital ulcers: 1.5% TP: 0.6% Any STI: 10.6%
Priddy 2011[39]		Kenya (Nairobi)	2008	Prospective cohort	Assess HIV risk behaviour & incidence, STI prevalence, vaginal practices, and retention	HIV-uninfected FSWs	200	Mean 28	Any non-barrier method: 52.0% LARC: 3.0% Permanent: 1.0%	N/A (only reported sometimes/always use)	Mean per day: 2.4 regular clients 1.9 casual clients	Sexual/physical violence related to SW in last month: 19.5% Sometimes/always paid more for no condom: 29.0% Sometimes/always has sex while intoxicated: 31.5%	CT: 5.5% GN: 6.0% TV: 9.0% TP: 2.5% HSV2 (antibody): 72.0% BV: 38.0%
Robb 2016[40]	Author Rono 2016[41]	Kenya, Tanzania, Uganda	2009	Prospective cohort	Describe the trajectory of acute HIV infection	HIV-uninfected women and men at high risk for HIV (64% FSWs)	1463	N/A	Any hormonal (incl. implant): 36.5% IUD: 0.5% Permanent: 0.5%	32.6% with clients 20.3% with non-paying partners	N/A	Abortion in last 3 months: 0.43%	N/A
Strathdee 2013[42]	Author Vera 2012[43] Gaines 2013[44]	Mexico	2008	RCT (four-arm factorial)	Determine effectiveness of two behavioural interventions to reduce sexual and injecting risk	HIV-uninfected FSWs who inject drugs	584	33	Any (excl. condoms): 39.3% LARC: 25.3% Permanent: 17.8%	14.9% with regular clients 11.7% with casual clients	30 clients per month 51 paid sex acts per month	N/A	CT:12.0% GN: 2.2% TV: 33.6% TP (active): 8.4%
Van Damme 2002[45]	Author Vandebosch 2004[46]	Benin, Cote d'Ivoire, South Africa,	1996	RCT (multisite triple blind placebo-	Determine effectiveness of nonoxynol-9	HIV-uninfected FSWs	892	26	N/A	N/A(only reported use of condom in >=50% of sex acts)	3 partners per day	N/A	CT: 4.4% GN: 5.1% TV: 3.5%

Study (first author, year)	Additional sources*	Country	Year commenced	Design	Aim	Population	N (FSWs) at baseline	Age (median)*	Current contraceptive use* (%)	Consistent condom use*	Number of sex partners/ frequency of sex*	GBV/ alcohol/ other risk factor	HIV/STI prevalence*
	Ramjee 2005[47]	Thailand		controlled; open cohort design i.e. continuous enrolment)	microbicide in prevention of HIV-1								TP: 11.2%
Van Loggerenberg 2008[48]	Author Naicker 2015[49]	South Africa (Durban)	2004	Prospective cohort	Understand HIV-1 subtype C acquisition, pathogenesis and disease progression This sub-study: describe cohort characteristics and HIV-incidence rates, and report challenges in establishing and maintaining the cohort	HIV-uninfected women who practice SW (79%) and/or have multiple partners	193	Mean 34.3	N/A	53.9% with casual partners 20.4% with steady partners	2 partners per week	N/A	Any STI (CT, GN, TV, MG, TP, HSV2): 31.3%
Vandepitte 2013[50]	Author Vandepitte 2011[51]	Uganda (urban slum)	2008	Prospective cohort	Understand dynamics of HIV and STI infections among FSWs This sub-study: investigate patterns of clearance and recurrence of untreated M. genitalium infection	FSWs	1027	Mean 26	N/A	59.8% in last month	At least daily sex for money: 50.5%	Problem drinking: 55.7%	MG: 14%
Vielot 2015[52]	Author	Kenya (Nairobi)	2009	Prospective cohort	Compare the duration of high risk HPV infection among FSWs by exposure to STIs using a highly sensitive biomarker assay	FSWs	350	28	LARC: 15.5% Permanent: 2.1%	Most of the time/always: 73.8% with clients 24.6% with non-paying partners	10 partners per week	N/A	HIV: 24.0% CT: 3.8% GN: 2.3% TV: 7.3% MG: 12.8%

*'Author' indicates additional data was obtained from the author. Other references listed here reported on the same study and were used for data extraction.
*Median unless specified
*Any = modern contraceptive method including condoms, unless specified; LARC = long-acting reversible contraception (implants or IUDs); Permanent = any method of permanent contraception, e.g. tubal ligation or hysterectomy
*Always uses condoms (unless specified)
*Median number per week unless specified. Sex partners may be paying, non-paying, regular or casual, unless specified.
*CT = Chlamydia trachomatis; NG = Neisseria gonorrhoeae; TV = Trichomonas vaginalis; TP = Treponema pallidum (syphilis); HSV2 = Herpes simplex virus type 2; BV = Bacterial vaginosis; MG = Mycoplasma genitalium
N/A: Not measured or reported, data not available from author
¶ Not disaggregated by sex work status
¥ Reported results segregated by sub-group; data presented are overall estimates

Most RCTs in this review required women to remain non-pregnant for continuation[38 41 43 45-49] and although only six RCTs specifically mentioned providing contraceptive counselling or methods, others may have offered a larger package of services that was not reported.

The majority of studies (n=19) took place in sub-Saharan Africa, most frequently in Kenya (n=8; table 1). There were also studies from the Americas (Mexico and the Caribbean), and East Asia (China, Thailand and Cambodia). All except three [38 45 50] took place in urban settings. The study areas were frequently informal housing settlements, low-income areas or environments known for sex work and/or drug use.

Sex work was mainly defined as exchange of sex for money or goods (n=12) or money alone (n=4). In five studies, sex workers were self-identified, in two they were members of communities or working in areas known for commercial sex work[38 47], and in two no definition was provided[49 51]. Eighteen studies involved FSWs exclusively; the remainder targeted women with high-risk sexual practices or at high risk of HIV. These studies either reported pregnancy incidence in the sex work sub-group,[38 43 45 52] or FSWs constituted more than two-thirds of the sample.[33 41 50 53] Fourteen studies were restricted to women without HIV at baseline, and one study to women living with HIV.[39]

Most studies (n=15) were conducted for one to two years, although they ranged from a one month pilot RCT[41] to a 15-year open cohort study.[39] The studies reporting pregnancy (intention undefined) tended to be of longer duration than those reporting unintended pregnancy (median duration 24 and 12 months, respectively; table 2).

Table 2: Results *(in ascending order of incidence)*

Study	Incidence rate (per 100py)	95% Confidence interval	Person-years of exposure	Duration (months)	Measurement of pregnancy	Frequency of measurement	Quality (%)
Unintended pregnancy							
McClelland 2008	7.2	4.5 – 10.9	305.4	12	Urine test	Monthly	40
Watson-Jones 2008	11.8	9.7 – 14.5	796	30	Urine test	Quarterly on suspicion only	53
Gaffoor 2013	13.4	6.1 – 25.4	67.2	24	Urine test	Quarterly	20
Behets 2008	20.7	4.3 – 60.5	14.5	1	Urine test	Weekly	27
Braunstein 2011	26.3	21.9 – 30.7	528.5	24	Serum test	6-monthly for 1 year + 1 measurement in 2nd year	60
Deschamps 2016	27.3	23.3 – 31.7	615.6	18	Test (unspecified)	6-monthly	67
Chersich 2014	28.0	22.6 – 34.3	335.8	12	Urine test	Quarterly	60
Peterson 2007	51.7	44.9 – 59.3	400	12	Urine test	Monthly	40
Behets 2005	53.0	21.0 – 110.0	13.2	2	Urine test	Monthly	40
Lara 2009	59.6	41.7 – 82.5	60.4	4	Urine test	Monthly	40
Pregnancy (intention not specified)							
Robb 2016	2.0	1.4 – 2.9	1619.6	24	Self-report	Quarterly on suspicion only	21
McClelland 2011	2.7	2.1 – 3.5	2259.3	15 year open cohort £	Urine test	Monthly on suspicion only	21
Bazzi 2015	3.3	1.4 – 5.2	359.6	24	Self-report	6-monthly	43
Strathdee 2013	5.9	4.1 – 8.4	540.1	12	Self-report	4-monthly	36
Van Loggerenberg 2008	8.5	5.6 – 11.5	376.5	24	Urine test	Monthly on suspicion only	36
Van Damme 2002	8.6	6.7 – 10.8	837.5	<=24£	Urine test	Quarterly	29
Vielot 2015	12.6	9.7 – 16.1	500.8	24	Urine test	Quarterly on suspicion only	50
Kaul 2004	13.5	11.3 – 16.1	968.0	<=48£	N/A	N/A	21
Priddy 2011	14.2	7.6 – 24.3	91.5	6	Urine test	Quarterly	36
Price 2012	14.5	12.0 – 17.5	784.0	48	Urine test	Quarterly	43
Liu 2015	15.2	10.4 – 21.5	210.3	6	Self-report	Quarterly	71
Kaewkungwal 2013	15.8	13.0 – 19.0	721.0Ω	42	Urine test	N/A	43
Vandepitte 2013	18.3	16.2 – 20.6	1467.0	>=24£	Urine test	N/A	50
Duff 2017	22.0	16.3 – 30.1	186.4	12	Self-report	Quarterly	50
Feldblum 2007	23.4	20.6 – 26.5	1067.5	18	Urine test	6-monthly on suspicion only	43

£ Duration varied for different participants

N/A: Not measured or reported, data not available from author

Ω Person-time estimated by:

Person-time = (n_FSWs * yrs * retention) - (n_preg * yrs/2)

Where: n_FSWs = number of FSWs enrolled; yrs = study duration in years; retention = retention rate; n_preg = number of women who became pregnant

We could not use the approach advocated by Vandenbrouke et al[53] as average follow up time among FSWs was not known.

Baseline population characteristics

Most study populations had a median of five to eight years of education, and the majority of women were supporting at least one financial dependent (table 1). Median duration in sex work was three to five years for most study populations, with one notable exception of 14 years in a study in Mexico.[44] Concurrent non-paying sex partners were common, reported by 30-100% of women in 12 studies.

Permanent and long-acting reversible contraceptive use was around one per cent in most studies in Africa, with only one study in Kenya reporting significantly higher coverage (17.5%).[51] By contrast, coverage was greater than 30% in China[54] and Mexico.[44 55] Consistent condom use was measured using diverse metrics, but was generally low, and very low with non-paying partners. Most studies reported frequent sex with multiple partners, and few reported a median of less than five partners per week.[36 39 46 53] High rates of gender-based violence were noted in all studies in which this was measured, as well as physical or financial pressure not to use condoms.[41 56]

While the factors described generally contributed to high baseline pregnancy risk, several studies included FSW with notably lower risk profiles. For example, two studies were part of a large Kenyan open cohort, in which participants had few partners and sex acts per work, older median age and lower STI prevalence than the other studies.[39 46] In addition, a number of studies provided insufficient information to assess population risk for pregnancy.

STIs, other than HIV, were prevalent with one study reporting up to 36% of the study population having at least one STI on biological testing.[37 57] HIV prevalence was reported in four studies and varied from 24% in Kenya[51] to less than 3% in Mexico[55] and Dominican Republic.[42]

Methodology and quality assessment

Quality scores, as percentages of the available total, are presented in table 2. The median quality score was 40% (inter quartile range (IQR)=36-50%). Four studies scored 60% or greater; three

of these measured unintended pregnancy[33-35] and one measured pregnancy (undefined).[54] Most studies scored poorly in the external validity and selection bias categories.

Measurement bias was an issue for some studies. Pregnancy was tested regularly in all but one[45] of the unintended pregnancy studies; in contrast, five pregnancy (undefined) studies only measured it if suspected by the clinician or participant. Five of the pregnancy (undefined) studies measured pregnancy using self-report rather than a biological test.

Incidence of pregnancy

Incidence rate was reported by 14 studies, and calculated for the remainder based on the available data, with the number of women who became pregnant as the numerator and person-years as the denominator. Women were censored at the time they became pregnant. The one exception was Deschamps et al,[34] who counted multiple pregnancies, and subtracted pregnancy time from total person-time.

Unintended pregnancy incidence rate (outcome 1) varied widely between studies, ranging from 7.2 to 59.6 pregnancies per 100 person-years (table 2; figure 2). The median rate of the 10 studies was 26.8, and seven reported a rate of greater than 20 per 100 person-years.

Incidence rate of pregnancy (intention not specified – outcome 2) also varied widely, but rates were lower overall than unintended pregnancy, ranging from 2.0 to 23.4 per 100 person-years (table 2). The median rate of the 15 studies was 13.5, and only two reported a rate of greater than 20 per 100 person-years.

Meta-analyses

Random effects meta-analyses were performed for the two primary outcomes. Heterogeneity was high, with I-squared statistic over 95% for both outcomes.

Incidence of unintended pregnancy

Sub-group analyses for incidence of unintended pregnancy showed that study design (RCT versus cohort as well as presence/absence of an intervention) and study duration were

important sources of heterogeneity. Geographical region and pregnancy measurement method did not explain the high heterogeneity.

The cohort studies were more homogenous than the RCTs (I-squared=63.9% and 96.8% respectively), and had higher pooled incidence of unintended pregnancy (figure 3).

Heterogeneity due to study design was further explained by examining whether or not the study provided an intervention. The three cohort studies that did not involve an intervention had very low heterogeneity (I-squared=0%), and the pooled estimate for these studies was 27.1 unintended pregnancies per 100 person-years (95%CI=24.4-29.8; figure 4). These three studies scored at least 60% on quality assessment (table 2).

Sub-group analysis was also performed for long versus short study duration. The three studies of less than one year duration were more homogenous (I-squared=59.1%), and had much higher incidence (44.5 per 100 person-years) than longer studies (figure 5).

Quality was not found to be a source of heterogeneity, as no relationship was demonstrated between study quality score and unintended pregnancy incidence rate (Pearson correlation coefficient 0.01; scatter plot not shown).

Incidence of pregnancy (intention not defined)

Sub-group analyses showed that study duration and geographic region were sources of heterogeneity for rates of pregnancy where intention was not known. Pregnancy measurement method and study design characteristics did not account for any heterogeneity for this outcome.

There were only two studies of less than one year duration[54 56] (I-squared 0%). As with the unintended pregnancy outcome, these studies had a higher pooled incidence than studies of more than one year duration (14.9 vs. 11.4 per 100 person-years).

A sub-analysis of geographic region showed that studies from Asia and the Americas (both in Mexico) were more homogenous (I-squared=29.8% and 68.1% respectively) than those from

sub-Saharan Africa (I-squared=98.3%). The pooled incidence of pregnancy was higher in Asia (16.8 per 100 person-years) and lower in Mexico (4.8 per 100 person-years; figure 6).

A scatter plot demonstrated a weak positive relationship between quality score and incidence rate (plot not shown; Pearson correlation coefficient 0.55).

Secondary outcomes

Three studies assessed pregnancy outcomes for FSWs (table 3). In two of the studies, outcomes were unknown for about 25% of pregnancies (in the Caribbean[34] and Madagascar,[37]) resulting in underestimates of birth and abortion incidence. Abortion accounted for less than 20% of pregnancies with known outcomes. In contrast, in the third study, a multi-country study, [49] over 85% of women who became pregnant (intention undefinfed) reported an abortion.

Study	Site	Outcome	Incidence of pregnancy	Incidence of birth	Incidence of abortion	Abortion (as proportion of pregnancies with known outcome)
Deschamps 2016	Haiti, Puerto Rico, Dominican Republic	Unintended pregnancy	27.3	15.1	3.1	16%
Feldblum 2007	Madagascar	Pregnancy (undefined)	23.4	11.9	3.0	17%
Van Damme 2002	Benin, Cote d'Ivoire, South Africa, Thailand	Pregnancy (undefined)	8.6	Not measured	7.4	>85%

Table 3: Incidence of abortion and birth

Four studies developed multivariate regression models to determine the predictors of pregnancy[37 39] or unintended pregnancy.[5 34] Common findings were that younger age was associated with higher pregnancy incidence,[5 34 37] and that highly effective contraceptive use[37] and consistent condom use[37 39] were protective; however one study in Kenya found that using condoms at the exclusion of other methods was a risk factor.[5] Having a main or emotional partner increased the odds of unintended pregnancy,[5 34] but not of pregnancy (undefined).[37 39]

Deschamps et al noted some additional associations, including recreational drug use and male partners having other sex partners being protective against pregnancy. Only one study assessed reproductive history and income,[5] and none considered HIV status, as potential predictors or confounders.

DISCUSSION

This review found that of the many studies examining FSWs' sexual and reproductive health in LMICs, very few have measured pregnancy, and even fewer have assessed pregnancy intention. While incidence varies widely between included studies, it is sufficiently high in most low- and middle-income contexts to constitute a significant health and social issue for FSWs.

Study design impacted on unintended pregnancy rates, with a lower rate seen in RCTs (20.8 per 100 person-years) than cohort studies (29.6 per 100 person-years). Most RCTs in this review required women to remain non-pregnant for continuation[38 41 43 45-49] and although only six RCTs specifically mentioned providing contraceptive counselling or methods, others may have offered a larger package of services that was not reported.

To better understand the influence of services provided by studies, we compared studies that provided any intervention with those that did not, and found that the three studies in the latter category had very low heterogeneity and high pooled unintended pregnancy incidence (27 per 100 person-years). As non-intervention cohort studies with quality scores of at least 60%, these were arguably the best designed to answer the review question and included the only study for which pregnancy incidence was a stated study objective.[33]

The included studies may have under-estimated population incidence of pregnancy, for several reasons. First, studies that only tested for pregnancy on suspicion could have missed early pregnancies or failed to ascertain the need to test. Second, pregnancies occurring between study visits and ending in spontaneous or induced abortion may have been missed. Third, social desirability bias is likely to influence self-reporting of pregnancy in studies using that measure.

Fourth, participants may have joined some studies in order to access services, potentially receiving superior family planning services than would otherwise be accessible. Finally, there may be selective loss to follow up among women who become pregnant, particularly in drug trials requiring women to remain non-pregnant for continuation.[38 41 43 45-49] It is possible that these factors were more prominent in the studies measuring pregnancy without defining intention, contributing to the surprising finding that this outcome had generally lower incidence rates than unintended pregnancy.

Some 'unintended' pregnancies may in fact have been intended, because women may have been unsure about their intention or it changed over time.[28] Only one study assessed intention repeatedly,[35] and none used a validated instrument designed to measure this complex latent construct.[58] Some participants may have wanted a pregnancy, but felt pressure to say otherwise, depending on the social environment, external and internal stigma, and the study design; for example, if they wanted to access HIV prevention services through the study, but inclusion was restricted to those not wanting to get pregnant.

Conversely, it is likely that most women in the unspecified category (outcome 2) who became pregnant may not have intended to do so. During recruitment for a pregnancy prevention intervention trial with FSWs in Kenya[6], less than 1% of those interested in taking part were planning to get pregnant in the next year (unpublished data). Similarly, in a cohort study included in this review, only 4% of participants expressed an intention to get pregnant at some point during the 12-month follow up[5 59]. A study in South Africa found a higher proportion (10%) wishing to conceive, but this is still a small minority of FSWs. While immediate pregnancy intentions may be low, however, future fertility preferences are likely to be comparable to other women[60], and several authors have highlighted the need for appropriate services that promote safe conception and address FSWs' need for different forms of protection with different partners[23-25 60].

Quality scores were low, but it is important to note that we were assessing how well the studies answered *our* research question, rather than their own stated objectives. However, there was a notable absence of well-described sampling and recruitment techniques, suggesting that study populations may have been poorly representative of local FSW populations. This may have underestimated pregnancy incidence, as more marginalised members of the population, who are at greater sexual risk, are harder to reach and recruit by convenience or snowball methods. Indeed, the only study to use a random sampling approach found moderately high incidence of pregnancy (undefined; 15 per 100 person-years), despite 30% IUD coverage in this population.[54] Furthermore, inclusion criteria limiting more than half of the studies to HIV negative women contributed to selection bias, particularly in sub-Saharan African studies, where HIV prevalence among FSWs is estimated at 37%.[61] This may partly explain the observation that pregnancy incidence in sub-Saharan Africa was lower than Asia, despite the fact that total population fertility rates are lower in Asia. Higher quality scores seen in the Asian studies may also account for this discrepancy.

Quantitative analysis identified study duration as a clear contributor to heterogeneity in both outcomes. Incidence decreased over time, both in the sub-analysis, and within studies that reported incidence at multiple time points.[33 37] This is due in part to the analytical approach, taken by all but one study,[34] of censoring women's person-time when they first become pregnant. As study subjects at highest risk fall pregnant early, they are censored early and cannot contribute additional pregnancies to the numerator. The remaining lower-risk women are less likely to experience the outcome. The same phenomenon has been observed in closed cohorts with the outcome of HIV incidence.[62] In addition, sexual risk behaviours often reduce over time in longitudinal studies, because of social desirability bias or health education from study participation,[34 38] or attrition bias,[63] which may have been a factor for twelve studies in this review with low or unreported retention rates among FSWs.

While measurement bias did not emerge as a significant source of heterogeneity, there was ambiguity in the reporting of pregnancy measurement, and it was often dependent on authors'

recollections. There was a weak positive association between study quality and incidence rates in the pregnancy (undefined) group. The lack of clear relationship may be because quality issues can result in either an under-or overestimate of incidence.

Limitations

This review had a number of limitations. Foremost was the inclusion of studies in which (unintended) pregnancy incidence was not an *a priori* objective, which was the case for all but one. This likely resulted in methodological issues affecting participant selection and pregnancy measurement.

We also adopted a broad approach to other inclusion criteria. Several studies conducted in the late 1990s and early 2000s were included, which may be problematic as family planning coverage has grown and fertility rates declined since that time. The heavy reliance on authors to provide unreported data was a limitation and may have introduced bias, and older data often could not be accessed.

We used a broad definition of sex work, which may have increased the heterogeneity of the outcomes. However, this definition reflects the reality that there are many reasons for women to sell sex, which depend on local laws, culture and economies, and to arbitrarily limit to full time sex workers, for example, may exclude studies of 'hidden' FSWs who are often especially vulnerable.[64 65]

Our analysis was limited by high heterogeneity, which prevented us from pooling overall rates or performing meta-regression to tease out the influence of different variables. Heterogeneity was not fully explained by sub-analyses, and may in part be due to the low number of studies, low quality (with two-thirds of studies scoring less than 50%), and incomplete data on risk factors. Variations in baseline population risk probably contributed significantly to heterogeneity, but these could not be quantified due to the incomplete and/or inconsistent measurement of risk factors between studies. Cultural, legal and economic contexts, such as cultural norms around motherhood and abortion law, also vary considerably between the

different settings in which studies took place, and influence fertility preferences, expression of pregnancy intention and access to prevention methods and abortion. These contextual factors could not be accounted for in our analysis.

Another limitation was that we were unable to directly compare rates of pregnancy between FSWs and other populations. Very high pregnancy incidence has been observed in HIV studies among women not categorised as sex workers,[66 67] however these women were at high risk for HIV for other reasons (e.g. multiple partners). Among the general population, unintended pregnancy incidence is estimated at 5.4 per 100 person-years in the developing world, and 8 in Africa, substantially lower than the rates among FSWs presented here. Of the three studies in this review which reported incidence for a broader study population as well as an FSW subgroup, two reported higher incidence[38 43] and one reported approximately equal incidence[45] in the FSW sub-group compared to the whole study population.

Conclusion

Ultimately, this review demonstrates a concerning lack of research on an issue which is a priority for many FSWs in low-resource settings. This is surprising, as we found many studies on HIV incidence and prevention in this population, for which unintended pregnancy is both relevant to the primary outcome and may indicate overall sexual risk. There has been a modest increase in family planning availability for women in many countries since the early 2000s,[68 69] however this has not been accompanied by research on whether additional services have reached FSW populations, or impacted on pregnancy rates. Access to family planning, particularly long-acting reversible contraceptives, may be improved by better targeting of FSWs through mobile outreach[70] and integration with existing FSW-specific HIV prevention services, and by careful training of health workers and community workers in contraceptive counselling and follow-up.[70]

This review found that studies measuring pregnancy incidence among FSWs were of low overall methodological quality and had highly varied results, but that unintended pregnancy incidence

was high overall and, based on available data, higher than the general population. There is an urgent need for quality research on unintended pregnancy incidence, the effectiveness of interventions to reduce it, and the best models of reproductive health service provision for this large and stigmatised population.

LIST OF FIGURES

SUPPLEMENTARY MATERIAL

"Supplementary file" contains:

1. Complete search strategy
2. Quality assessment tool

ACKNOWLEDGEMENTS

We would like to acknowledge the many study authors who responded to our queries, in particular the following who provided additional data (in alphabetical order): Daniela Abramovitz, Kathy Baisley, Frieda Behets, Liviana Calzavara, Putu Duff, Paul Feldblum, James Iveniuk, Rupert Kaul, Diana Lara, Qun Li, Kate MacQueen, R. Scott McClelland, Mark Milazzo, Kimberly Page, Matt Price, Barbra Richardson, Merlin L. Robb, Steffanie Strathdee, Douglas Taylor, Abigail Norris Turner, Lut Van Damme, Francois Van Loggerenberg, Judith Vandepitte, Nadja Alexandra Vielot, Handan Wand, Deborah Watson-Jones, and Helen Weiss.

We also thank senior librarian Lorena Romero at the Ian Potter library, who assisted with building the search strategy, and Professor Rory Wolfe, who provided additional statistical advice.

AUTHOR CONTRIBUTIONS

FHA, SL and MSCL conceived of and designed the study. All authors contributed to the protocol. FHA performed the search, screening, data extraction and analysis, and drafted the manuscript. MC advised on search strategy. LW performed duplicate screening and extraction. PA advised on analytical methods. All authors reviewed drafts and approved the final manuscript.

COMPETING INTERESTS

The authors declare that they have no competing interests.

FUNDING

This work was supported by the Australian National Health and Medical Research Council (NHMRC), which provided a Career Development Fellowship for S. Luchters and a Postgraduate Scholarship for F. Ampt.

DATA SHARING STATEMENT

There are no additional data available.

REFERENCES

1. Singh S, Darroch JE, Ashford LS. Adding it up: The costs and benefits of investing in sexual and reproductive health 2014. New York: Guttmacher Institute, 2014.

2. Hall JA, Benton L, Copas A, et al. Pregnancy Intention and Pregnancy Outcome: Systematic Review and Meta-Analysis. *Matern Child Health J* 2017;21(3):670-704. doi: 10.1007/s10995-016-2237-0 [published Online First: 2017/01/18]

3. Gipson JD, Koenig MA, Hindin MJ. The Effects of Unintended Pregnancy on Infant, Child, and Parental Health: A Review of the Literature. *Studies in Family Planning* 2008;39(1):18-38.

4. Khan MR, Turner AN, Pettifor A, et al. Unmet need for contraception among sex workers in Madagascar. *Contraception* 2009;79(3):221-7. doi: http://dx.doi.org/10.1016/j.contraception.2008.09.011

5. Luchters S, Bosire W, Feng A, et al. "A baby was an added burden": predictors and consequences of unintended pregnancies for female sex workers in Mombasa, Kenya: a mixed-methods study. *PLoS ONE* 2016;11(9):e0162871. doi: 10.1371/journal.pone.0162871 [published Online First: 2016/10/01]

6. Ampt FH, Mudogo C, Gichangi P, et al. WHISPER or SHOUT study: protocol of a cluster-randomised controlled trial assessing mHealth sexual reproductive health and nutrition interventions among female sex workers in Mombasa, Kenya. *BMJ Open* 2017;7(8):e017388. doi: 10.1136/bmjopen-2017-017388 [published Online First: 2017/08/20]

7. Morineau G, Neilsen G, Heng S, et al. Falling through the cracks: Contraceptive needs of female sex workers in Cambodia and Laos. *Contraception* 2011;84(2):194-98.

8. Scorgie F, Chersich MF, Ntaganira I, et al. Socio-demographic characteristics and behavioral risk factors of female sex workers in sub-saharan Africa: a systematic review. *AIDS and behavior* 2012;16(4):920-33. doi: 10.1007/s10461-011-9985-z

9. Okal J, Stadler J, Ombidi W, et al. Secrecy, disclosure and accidental discovery: perspectives of diaphragm users in Mombasa, Kenya. *Culture, health & sexuality* 2008;10(1):13-26. doi: 10.1080/13691050701519730 [published Online First: 2007/11/27]

10. Okal J, Chersich MF, Tsui S, et al. Sexual and physical violence against female sex workers in Kenya: a qualitative enquiry. *AIDS care* 2011;23(5):612-8. doi: 10.1080/09540121.2010.525605

11. Erickson M, Goldenberg SM, Ajok M, et al. Structural determinants of dual contraceptive use among female sex workers in Gulu, northern Uganda. *International Journal of Gynecology and Obstetrics* 2015;131(1):91-95.

12. Yam EA, Okal J, Musyoki H, et al. Kenyan female sex workers' use of female-controlled nonbarrier modern contraception: do they use condoms less consistently? *Contraception* 2016;93(3):222-25. doi: https://doi.org/10.1016/j.contraception.2015.11.010

13. Maher L, Mooney-Somers J, Phlong P, et al. Condom negotiation across different relationship types by young women engaged in sex work in Phnom Penh, Cambodia. *Global public health* 2013;8(3):270-83. doi: 10.1080/17441692.2013.767930

14. Chow EP, Muessig KE, Yuan L, et al. Risk behaviours among female sex workers in China: a systematic review and data synthesis. *PLoS One* 2015;10(3):e0120595. doi: 10.1371/journal.pone.0120595

15. Lim MSC, Zhang X-D, Kennedy E, et al. Sexual and Reproductive Health Knowledge, Contraception Uptake, and Factors Associated with Unmet Need for Modern

Contraception among Adolescent Female Sex Workers in China. *PLoS ONE* 2015;10(1):e0115435. doi: 10.1371/journal.pone.0115435

16. Williamson LM, Parkes A, Wight D, et al. Limits to modern contraceptive use among young women in developing countries: a systematic review of qualitative research. *Reproductive health* 2009;6:3. doi: 10.1186/1742-4755-6-3

17. Khan MR, Turner AN, Pettifor A, et al. Unmet need for contraception among sex workers in Madagascar. *Contraception* 2009;79(3):221-7. doi: 10.1016/j.contraception.2008.09.011

18. Dhana A, Luchters S, Moore L, et al. Systematic review of facility-based sexual and reproductive health services for female sex workers in Africa. *Globalization and health* 2014;10(1):46-46. doi: 10.1186/1744-8603-10-46

19. Moore L, Chersich MF, Steen R, et al. Community empowerment and involvement of female sex workers in targeted sexual and reproductive health interventions in Africa: a systematic review. *Globalization and Health* 2014;10(1):47. doi: 10.1186/1744-8603-10-47

20. Slabbert M, Venter F, Gay C, et al. Sexual and reproductive health outcomes among female sex workers in Johannesburg and Pretoria, South Africa: Recommendations for public health programmes. *BMC Public Health* 2017;17(3):442. doi: 10.1186/s12889-017-4346-0

21. Scorgie F, Nakato D, Harper E, et al. 'We are despised in the hospitals': sex workers' experiences of accessing health care in four African countries. *Culture, Health and Sexuality* 2013;15(4):450-65. doi: http://dx.doi.org/10.1080/13691058.2012.763187

22. Mtetwa S, Busza J, Chidiya S, et al. You are wasting our drugs: health service barriers to HIV treatment for sex workers in Zimbabwe. *BMC Public Health* 2013;13:698. doi: http://dx.doi.org/10.1186/1471-2458-13-698

23. Beckham SW, Shembilu CR, Brahmbhatt H, et al. Female sex workers' experiences with intended pregnancy and antenatal care services in southern Tanzania. *Stud Fam Plann* 2015;46(1):55-71. doi: 10.1111/j.1728-4465.2015.00015.x [published Online First: 2015/03/11]

24. Center for Health and Gender Equity. All women, all rights, sex workers included. Washington, DC: CHANGE, 2016.

25. Duff P, Shoveller J, Feng C, et al. Pregnancy intentions among female sex workers: recognising their rights and wants as mothers. *J Fam Plann Reprod Health Care* 2015;41(2):102-8. doi: 10.1136/jfprhc-2012-100532

26. Kendall T, Albert C. Experiences of coercion to sterilize and forced sterilization among women living with HIV in Latin America. *Journal of the International AIDS Society* 2015;18(1):19462. doi: 10.7448/IAS.18.1.19462

27. Zampas C, Lamackova A. Forced and coerced sterilization of women in Europe. *Int J Gynaecol Obstet* 2011;114(2):163-6. doi: 10.1016/j.ijgo.2011.05.002 [published Online First: 2011/06/21]

28. Aiken ARA, Borrero S, Callegari LS, et al. Rethinking the Pregnancy Planning Paradigm: Unintended Conceptions or Unrepresentative Concepts? *Perspectives on Sexual and Reproductive Health* 2016;48(3):147-51. doi: 10.1363/48e10316

29. Moher D, Liberati A, Tetzlaff J, et al. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *BMJ* 2009;339:b2535. doi: 10.1136/bmj.b2535

30. The World Bank Group. World Bank Country and Lending Groups 2016 [Available from: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519 accessed 10 January 2016.

31. Santelli J, Rochat R, Hatfield-Timajchy K, et al. The measurement and meaning of unintended pregnancy. *Perspectives on sexual and reproductive health* 2003;35(2):94-101. doi: 10.1363/3509403

32. Munn Z, Moola S, Riitano D, et al. The development of a critical appraisal tool for use in systematic reviews addressing questions of prevalence. *International Journal of Health Policy and Management* 2014;3:123-28.

33. Braunstein SL, Ingabire CM, Kestelyn E, et al. High human immunodeficiency virus incidence in a cohort of Rwandan female sex workers. *Sexually Transmitted Diseases* 2011;38(5):385-94.

34. Deschamps MM, Metch B, Morgan CA, et al. Feasibility of Identifying a Female Sex Worker Cohort at High Risk of HIV Infection in the Caribbean for HIV Vaccine Efficacy Trials: Longitudinal Results of HVTN 907. *Journal of Acquired Immune Deficiency Syndromes* 2016;71(1):70-77.

35. Chersich MF, Bosire W, King'ola N, et al. Effects of hazardous and harmful alcohol use on HIV incidence and sexual behaviour: a cohort study of Kenyan female sex workers. *Globalization and health* 2014;10:22.

36. Duff P, Evans J, Stein E, et al. High pregnancy incidence and low contraceptive use among a prospective cohort of female entertainment and sex workers in Phnom Penh, Cambodia: need for prioritization of sexual and reproductive health services. *BMC Pregnancy and Childbirth* 2017 (under review)

37. Feldblum PJ, Nasution MD, Hoke TH, et al. Pregnancy among sex workers participating in a condom intervention trial highlights the need for dual protection. *Contraception* 2007;76(2):105-10. doi: http://dx.doi.org/10.1016/j.contraception.2007.04.009

38. Kaewkungwal J, Pitisuttithum P, Rerks-Ngarm S, et al. Issues in women's participation in a phase III community HIV vaccine trial in Thailand. *AIDS Research and Human Retroviruses* 2013;29(11):1524-34.

39. McClelland RS, Richardson BA, Wanje GH, et al. Association between participant self-report and biological outcomes used to measure sexual risk behavior in human immunodeficiency virus-1-seropositive female sex workers in Mombasa, Kenya. *Sexually Transmitted Diseases* 2011;38(5):429-33.

40. Behets F, Norris Turner A, Van Damme K, et al. Acceptability and feasibility of continuous diaphragm use among sex workers in Madagascar. *Sexually Transmitted Infections* 2005;81(6):472-76.

41. Behets FM, Turner AN, Van Damme K, et al. Vaginal microbicide and diaphragm use for sexually transmitted infection prevention: a randomized acceptability and feasibility study among high-risk women in Madagascar. *Sex Transm Dis* 2008;35(9):818-26. doi: 10.1097/OLQ.0b013e318175d8ab

42. Lara DK, Grossman DA, Munoz JE, et al. Acceptability and use of the female condom and diaphragm among sex workers in Dominican Republic: Results from a prospective study. *AIDS Education and Prevention* 2009;21(6):538-51.

43. Gaffoor Z, Wand H, Daniels B, et al. High risk sexual behaviors are associated with sexual violence among a cohort of women in Durban, South Africa. *BMC Research Notes* 2013;6:532. doi: http://dx.doi.org/10.1186/1756-0500-6-532

44. Strathdee SA, Abramovitz D, Lozada R, et al. Reductions in HIV/STI Incidence and Sharing of Injection Equipment among Female Sex Workers Who Inject Drugs: Results from a Randomized Controlled Trial. *PLoS ONE* 2013;8 (6) (no pagination)(e65812)

45. Watson-Jones D, Weiss HA, Rusizoka M, et al. Effect of herpes simplex suppression on incidence of HIV among women in Tanzania. *New England Journal of Medicine* 2008;358(15):1560-71. doi: 10.1056/NEJMoa0800260

46. McClelland RS, Richardson BA, Hassan WM, et al. Improvement of vaginal health for Kenyan women at risk for acquisition of human immunodeficiency virus type 1: Results of a randomized trial. *Journal of Infectious Diseases* 2008;197(10):1361-68. doi: http://dx.doi.org/10.1086/587490

47. Peterson L, Taylor D, Roddy R, et al. Tenofovir Disoproxil Fumarate for Prevention of HIV Infection in Women: A Phase 2, Double-Blind, Randomized, Placebo-Controlled Trial. *PLoS Clinical Trials* 2007;2(5):e27. doi: 10.1371/journal.pctr.0020027

48. Kaul R, Kimani J, Nagelkerke NJ, et al. Monthly antibiotic chemoprophylaxis and incidence of sexually transmitted infections and HIV-1 infection in Kenyan sex workers: A randomized controlled trial. *Journal of the American Medical Association* 2004;291(21):2555-62.

49. Van Damme L, Ramjee G, Alary M, et al. Effectiveness of COL-1492, a nonoxynol-9 vaginal gel, on HIV-1 transmission in female sex workers: a randomised controlled trial.[Erratum appears in Lancet 2002 Dec 7;360(9348):1892]. *Lancet* 2002;360(9338):971-7.

50. Price MA, Rida W, Mwangome M, et al. Identifying at-risk populations in kenya and south africa: HIV incidence in cohorts of menwho report sex with men, sex workers, and youth. *Journal of Acquired Immune Deficiency Syndromes* 2012;59(2):185-93.

51. Vielot N, Hudgens MG, Mugo N, et al. The role of chlamydia trachomatis in high-risk human papillomavirus persistence among female sex workers in Nairobi, Kenya. *Sexually Transmitted Diseases* 2015;42(6):305-11.

52. Robb ML, Eller LA, Kibuuka H, et al. Prospective Study of Acute HIV-1 Infection in Adults in East Africa and Thailand. *New England Journal of Medicine* 2016;374(22):2120-30. doi: doi:10.1056/NEJMoa1508952

53. van Loggerenberg F, Mlisana K, Williamson C, et al. Establishing a cohort at high risk of HIV infection in South Africa: Challenges and experiences of the CAPRISA 002 Acute Infection Study. *PLoS One* 2008;3(4):e1954. doi: http://dx.doi.org/10.1371/journal.pone.0001954

54. Liu J, Calzavara L, Mendelsohn JB, et al. Impact evaluation of a community-based intervention to reduce risky sexual behaviour in female sex workers in Shanghai, China. *BMC Public Health* 2015;15:147. doi: http://dx.doi.org/10.1186/s12889-015-1439-5

55. Bazzi AR, Rangel G, Martinez G, et al. Incidence and predictors of HIV and sexually transmitted infections among female sex workers and their intimate male partners in northern Mexico: A longitudinal, multilevel study. *American Journal of Epidemiology* 2015;181(9):723-31.

56. Priddy FH, Wakasiaka S, Hoang TD, et al. Anal sex, vaginal practices, and HIV incidence in female sex workers in Urban Kenya: Implications for the development of intravaginal HIV prevention methods. *AIDS Research and Human Retroviruses* 2011;27(10):1067-72.

57. Feldblum PJ, Hatzell T, Van Damme K, et al. Results of a randomised trial of male condom promotion among Madagascar sex workers. *Sexually Transmitted Infections* 2005;81:166-73.

58. Hall J, Barrett G, Mbwana N, et al. Understanding pregnancy planning in a low-income country setting: validation of the London measure of unplanned pregnancy in Malawif. *Bmc Pregnancy and Childbirth* 2013;13 doi: 10.1186/1471-2393-13-200

59. Chersich MF, Bosire W, King'ola N, et al. Effects of hazardous and harmful alcohol use on HIV incidence and sexual behaviour: a cohort study of Kenyan female sex workers. *Globalization and health* 2014;10(1):22-22. doi: 10.1186/1744-8603-10-22

60. Rao A, Baral S, Phaswana-Mafuya N, et al. Pregnancy Intentions and Safer Pregnancy Knowledge Among Female Sex Workers in Port Elizabeth, South Africa. *Obstetrics & Gynecology* 2016;128(1):15-21. doi: 10.1097/aog.0000000000001471

61. Baral S, Beyrer C, Muessig K, et al. Burden of HIV among female sex workers in low-income and middle-income countries: a systematic review and meta-analysis. *The Lancet Infectious diseases* 2012;12(7):538-49. doi: 10.1016/S1473-3099(12)70066-X

62. Heyward WL, Osmanov S, Saba J, et al. Preparation for Phase III HIV vaccine efficacy trials: methods for the determination of HIV incidence. *AIDS* 1994;8(9):1285-91.

63. Graham SM, Raboud J, McClelland RS, et al. Loss to Follow-Up as a Competing Risk in an Observational Study of HIV-1 Incidence. *PLoS ONE* 2013;8 (3) (no pagination)(e59480)

64. Hawken MP, Dallabetta G, Temmerman M. Part time female sex workers in a suburban community in Kenya: a vulnerable hidden population. *Sexually Transmitted Infections* 2002;78(4):271-73. doi: 10.1136/sti.78.4.271

65. Manopaiboon C, Prybylski D, Subhachaturas W, et al. Unexpectedly high HIV prevalence among female sex workers in Bangkok, Thailand in a respondent-driven sampling survey. *International Journal of STD and AIDS* 2013;24(1):34-38.

66. Macqueen KM, Johnson L, Alleman P, et al. Pregnancy prevention practices among women with multiple partners in an HIV prevention trial. *Journal of Acquired Immune Deficiency Syndromes: JAIDS* 2007;46(1):32-8.

67. Halpern V, Lie CC, Feldblum P, et al. Predictors of pregnancy in microbicide trials. *Contraception* 2011;83(5):436-40. doi: 10.1016/j.contraception.2010.08.018

68. Wang W, Wang S, Pullum T, et al. How Family Planning Supply and the Service Environment Affect Contraceptive Use: Findings from Four East African Countries. *DHS Analytical Studies* 2012;26

69. Ross J, Smith E. Trends in national family planning programs, 1999, 2004 and 2009. *Int Perspect Sex Reprod Health* 2011;37(3):125-33. doi: 10.1363/3712511

70. Rees H, Pillay Y, Mullick S, et al. Strengthening implant provision and acceptance in South Africa with the 'Any woman, any place, any time' approach: An essential step towards reducing unintended pregnancies. *South African Medical Journal* 2017;107(11):939-44.

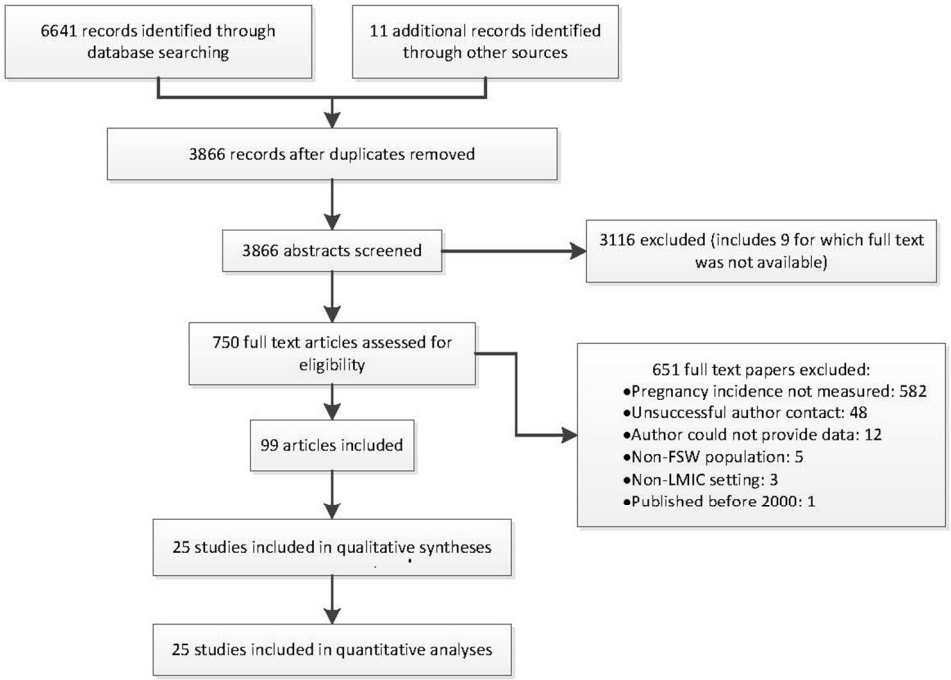

Figure 1: PRISMA flow diagram of search results and inclusion of studies after review

103x76mm (300 x 300 DPI)

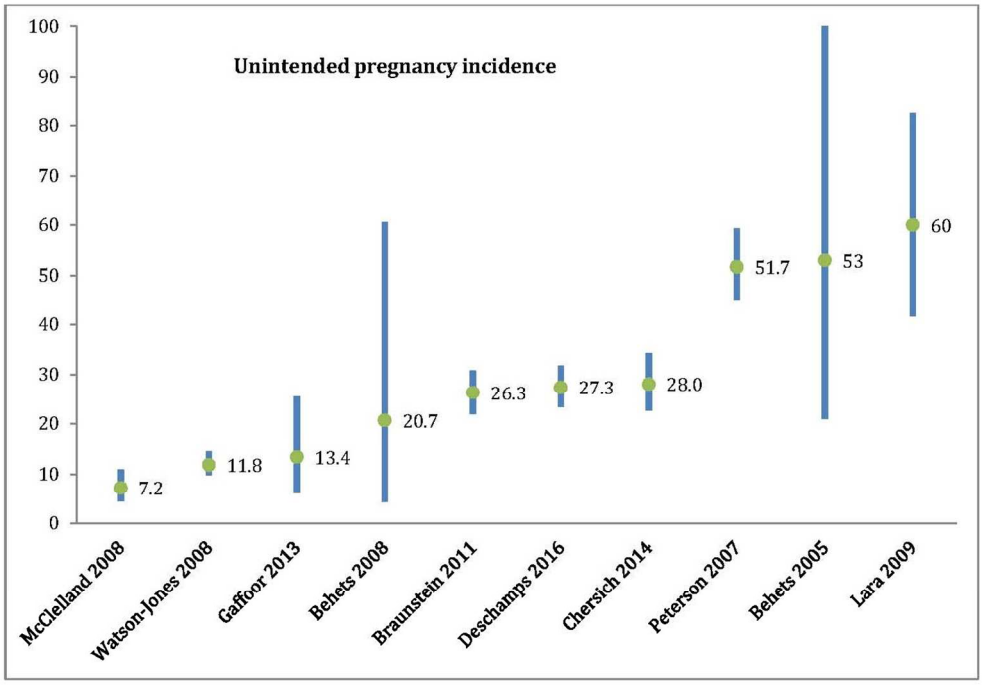

Figure 2: Incidence rates (per 100 person-years) for studies reporting unintended pregnancy

121x84mm (300 x 300 DPI)

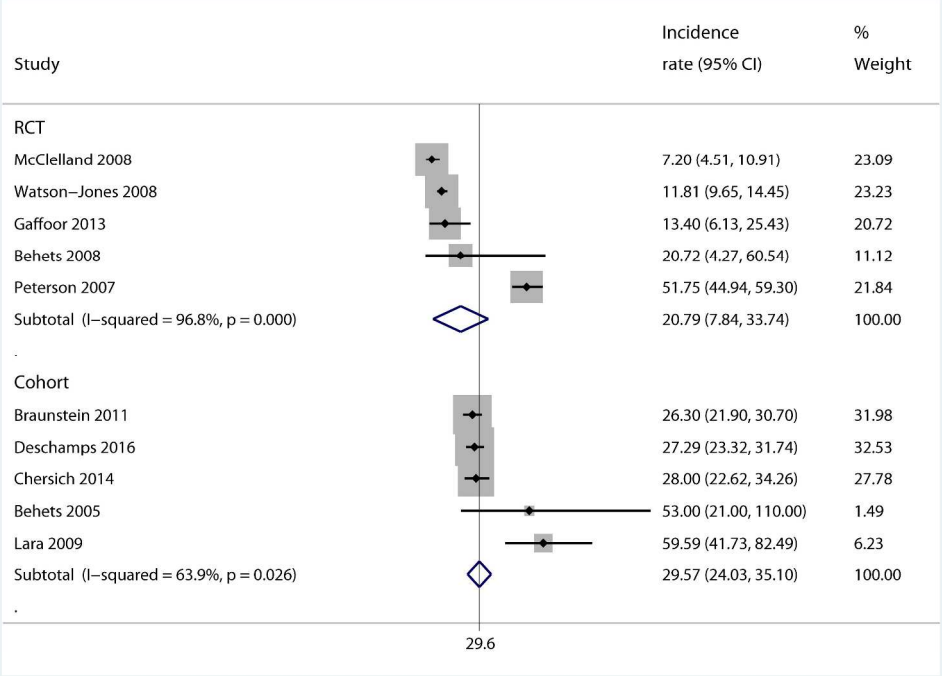

Figure 3: Forest plot showing sub-group analysis of unintended pregnancy incidence rates (per 100 person-years) by RCT vs. cohort study design

278x219mm (300 x 300 DPI)

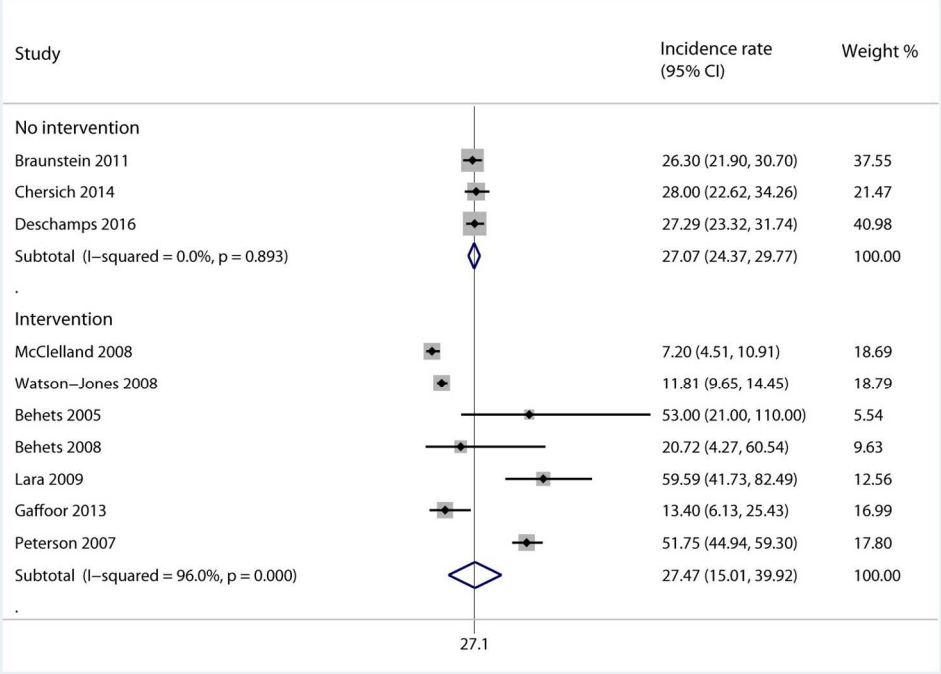

Figure 4: Forest plot showing sub-group analysis of unintended pregnancy incidence rates (per 100 person-years) by intervention vs. no intervention

139x103mm (300 x 300 DPI)

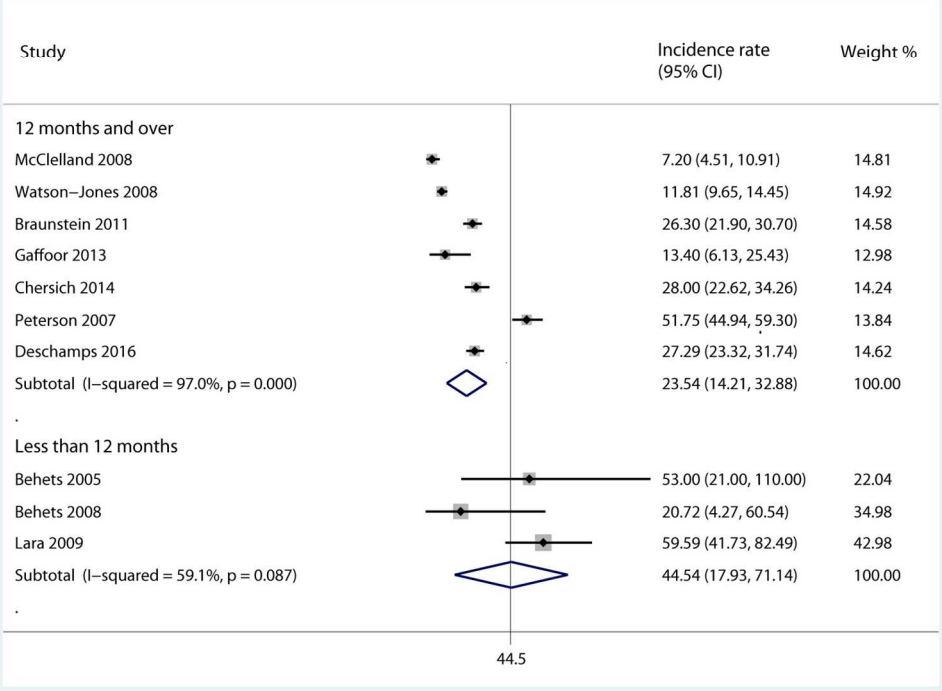

Figure 5: Forest plot showing sub-group analysis of unintended pregnancy incidence rates (per 100 person-years) by study duration (cut-off one year)

139x104mm (300 x 300 DPI)

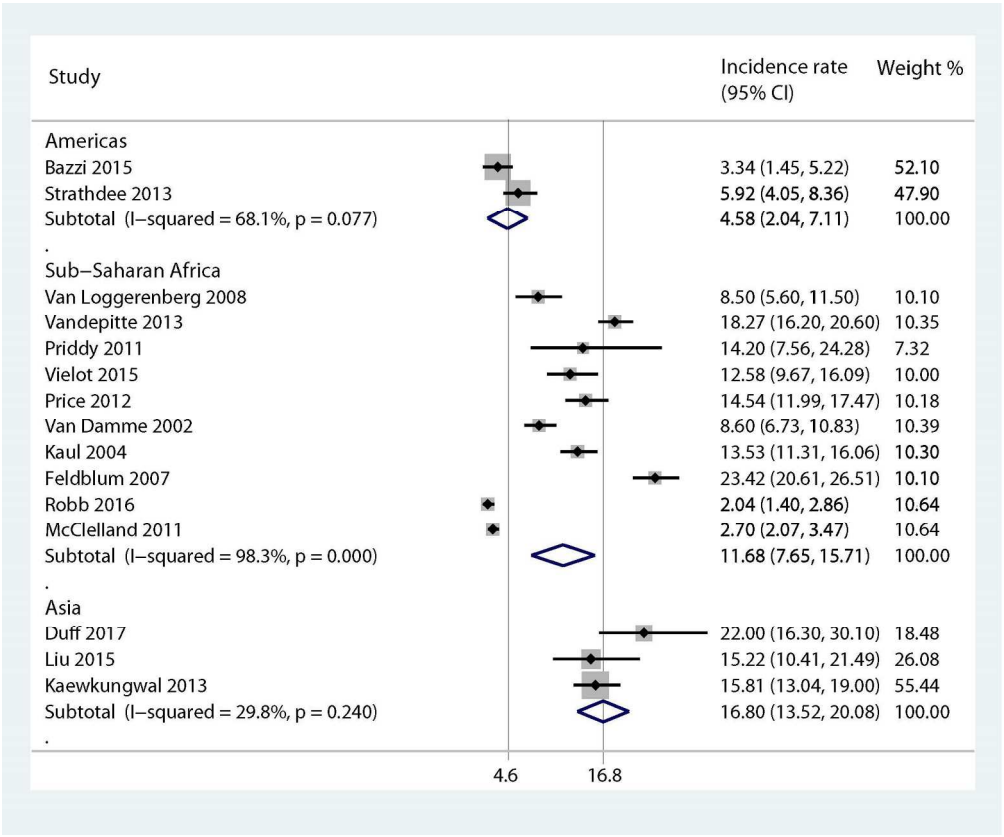

Figure 6: Forest plot showing sub-group analysis of pregnancy (undefined) incidence rates (per 100 person-years) by geographic region

185x154mm (300 x 300 DPI)

Supplementary File

Incidence of unintended pregnancy among female sex workers in low- and middle-income countries: a systematic review and meta-analysis

1. Complete search strategy

Medline search 19 Jan 2016

1. exp cohort studies/ or exp controlled before-after studies/ or exp cross-sectional studies/ or exp historically controlled study/ or exp interrupted time series analysis/ or exp feasibility studies/ or exp pilot projects/ or exp control groups/ or exp cross-over studies/ or exp double-blind method/ or exp random allocation/ or exp single-blind method/
2. exp clinical trial/ or exp observational study/ or exp comparative study/ or exp evaluation studies/ or exp multicenter study/
3. exp Sex Workers/
4. exp Prostitution/
5. prostitut*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
6. Commercial sex.mp.
7. sex work*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
8. (sex* adj2 (sell* or transact* or trade or trading)).mp.
9. 3 or 4 or 5 or 6 or 7 or 8
10. Developing Countries/
11. (Afghanistan* or Albania* or Algeria* or Angola* or Argentina* or Armenia* or Azerbaijan* or Bangladesh* or Belarus* or Beliz* or Benin* or Bhutan* or Bolivia* or Bosnia* or Herzegovin* or Botswan* or Brazil* or Bulgaria* or Burkina* or Burundi* or Cabo Verde* or Cape Verde* or Cambodia* or Cameroon* or Central African or Chad* or China or Chinese or Colombia* or Comor* or Congo* or Costa Rica* or Cote d'Ivoir* or Ivory Coast or Cuba* or Djibouti* or Dominica* or Ecuador* or Egypt* or El Salvador* or Eritrea* or Ethiopia* or Fiji* or Gabon* or Gambia* or Georgia* or Ghana* or Grenad* or Guatemala* or Guinea* or Guyan* or Haiti* or Hondura* or Hungar* or India* or Indonesia* or Iran* or Iraq* or Jamaica* or Jordan* or Kazakhstan* or Kenya* or Kiribati* or Korea* or Kosov* or Kyrgyz Republic or Lao* or Leban* or Lesotho* or Liberia* or Libya* or Macedonia* or Madagascar* or Malawi* or Malaysia* or Maldiv* or Mali* or Marshall Island* or Mauritania* or Mauriti* or Mexic* or Micronesia* or Moldova* or Mongolia* or Montenegr* or Morocc* or Mozambi* or Myanma* or Burmese or Namibia* or Nepal* or Nicaragua* or Niger* or Nigeria* or Pakistan* or Palau* or Panama* or Papua New Guinea* or Paraguay* or Peru* or Philippines or Filipino or Romania* or Rwanda* or Samoa* or Sao Tome* or Senegal* or Serbia* or Seychell* or Sierra Leon* or Solomon Island* or Somalia* or South Africa* or Sudan* or Sri Lanka* or St Lucia* or St Vincent or Grenadines or Surinam* or Swazi* or Syria* or Tajikistan* or Tanzania* or Thai* or Timor* or Togo* or Tonga* or Tunisia* or Turk* or Turkmenistan* or Tuvalu* or Uganda* or Ukrain* or Uzbekistan* or Vanuatu* or Venezuela* or Vietnam* or West Bank or Gaza or Yemen* or Zambia* or Zimbabwe*).mp.
12. exp africa/ or exp caribbean region/ or exp central america/ or latin america/ or exp south america/ or asia/ or exp asia, central/ or exp asia, southeastern/ or exp asia, western/ or exp indian ocean islands/ or pacific islands/ or exp melanesia/ or exp micronesia/ or exp west indies/
13. (africa* or asia* or caribbean or central america* or latin america* or south america* or melanesia* or micronesia* or polynesia*).mp.

14. (resource-limit* or resource-poor or low-resource* or limited-resource* or resource-constrain* or constrain*-resource* or under-resource* or poor*-resource* or resource-scarce* or scarce*-resource* or low-income or middle-income or lowincome or middleincome or LMIC*).mp.
15. ((developing or underdeveloped or under-developed or emerging or less-developed or least-developed or less-economically developed or least-economically developed or less-affluent or least-affluent) adj (country or countries or nation or nations or region or regions or economy or economies)).mp.
16. ((developing or underdeveloped or under-developed or less-developed or least-developed) adj world).mp.
17. (third-world* or thirdworld* or 3rd-world*).mp.
18. 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17
19. 9 and 18
20. Cohort analy*.mp.
21. ((doubl* or singl* or trebl* or tripl*) adj blind*).mp.
22. Cross sectional.mp.
23. ((random* or clinical or control*) adj (trial* or study or studies)).mp.
24. ((cohort or follow-up or followup or observational or prospective or retrospective or evaluation or intervention or comparative) adj (study or studies)).mp.
25. 1 or 2 or 20 or 21 or 22 or 23 or 24
26. 19 and 25
27. 26
28. limit 27 to (english language and yr="2000 -Current")

PsychInfo search 18 Jan 2016

1. Cohort analy*.mp.
2. ((doubl* or singl* or trebl* or tripl*) adj blind*).mp.
3. Cross sectional.mp.
4. ((random* or clinical or control*) adj (trial* or study or studies)).mp.
5. ((cohort or follow-up or followup or observational or prospective or retrospective or evaluation or intervention or comparative) adj (study or studies)).mp.
6. experimental design/ or exp between groups design/ or exp clinical trials/ or exp cohort analysis/ or exp followup studies/ or exp hypothesis testing/ or exp longitudinal studies/ or exp repeated measures/ or exp experiment controls/ or exp quasi experimental methods/
7. exp Evaluation/ or exp Program Evaluation/
8. exp observation methods/
9. "sampling (experimental)"/ or exp random sampling/
10. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9
11. exp Prostitution/
12. prostitut*.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]
13. Commercial sex.mp.
14. sex work*.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]
15. (sex* adj2 (sell* or transact* or trade or trading)).mp.
16. Developing Countries/
17. (Afghanistan* or Albania* or Algeria* or Angola* or Argentina* or Armenia* or Azerbaijan* or Bangladesh* or Belarus* or Beliz* or Benin* or Bhutan* or Bolivia* or Bosnia* or Herzegovin* or Botswan* or Brazil* or Bulgaria* or Burkina* or Burundi* or Cabo Verde* or Cape Verde* or Cambodia* or Cameroon* or Central African or Chad* or China or Chinese or Colombia* or Comor* or Congo* or Costa Rica* or Cote d'Ivoir* or Ivory Coast or Cuba* or Djibouti* or Dominica* or Ecuador* or Egypt* or El Salvador* or Eritrea* or Ethiopia* or Fiji* or Gabon* or Gambia* or Georgia* or Ghana* or Grenad* or Guatemala* or Guinea* or Guyan* or Haiti* or Hondura* or Hungar* or India* or Indonesia* or Iran* or Iraq* or Jamaica* or Jordan* or Kazakhstan* or Kenya* or Kiribati* or Korea* or Kosov* or Kyrgyz Republic or Lao* or Leban* or Lesotho*

or Liberia* or Libya* or Macedonia* or Madagascar* or Malawi* or Malaysia* or Maldiv* or Mali* or Marshall Island* or Mauritania* or Mauriti* or Mexic* or Micronesia* or Moldova* or Mongolia* or Montenegr* or Morocc* or Mozambi* or Myanma* or Burmese or Namibia* or Nepal* or Nicaragua* or Niger* or Nigeria* or Pakistan* or Palau* or Panama* or Papua New Guinea* or Paraguay* or Peru* or Philippines or Filipino or Romania* or Rwanda* or Samoa* or Sao Tome* or Senegal* or Serbia* or Seychell* or Sierra Leon* or Solomon Island* or Somalia* or South Africa* or Sudan* or Sri Lanka* or St Lucia* or St Vincent or Grenadines or Surinam* or Swazi* or Syria* or Tajikistan* or Tanzania* or Thai* or Timor* or Togo* or Tonga* or Tunisia* or Turk* or Turkmenistan* or Tuvalu* or Uganda* or Ukrain* or Uzbekistan* or Vanuatu* or Venezuela* or Vietnam* or West Bank or Gaza or Yemen* or Zambia* or Zimbabwe*).mp.
18. (africa* or asia* or caribbean or central america* or latin america* or south america* or melanesia* or micronesia* or polynesia*).mp.
19. (resource-limit* or resource-poor or low-resource* or limited-resource* or resource-constrain* or constrain*-resource* or under-resource* or poor*-resource* or resource-scarce* or scarce*-resource* or low-income or middle-income or lowincome or middleincome or LMIC*).mp.
20. ((developing or underdeveloped or under-developed or emerging or less-developed or least-developed or less-economically developed or least-economically developed or less-affluent or least-affluent) adj (country or countries or nation or nations or region or regions or economy or economies)).mp.
21. ((developing or underdeveloped or under-developed or less-developed or least-developed) adj world).mp.
22. (third-world* or thirdworld* or 3rd-world*).mp.
23. 16 or 17 or 18 or 19 or 20 or 21 or 22
24. 11 or 12 or 13 or 14 or 15
25. 10 and 23 and 24

Embase search 18 Jan 2016

1. (Afghanistan* or Albania* or Algeria* or Angola* or Argentina* or Armenia* or Azerbaijan* or Bangladesh* or Belarus* or Beliz* or Benin* or Bhutan* or Bolivia* or Bosnia* or Herzegovin* or Botswan* or Brazil* or Bulgaria* or Burkina* or Burundi* or Cabo Verde* or Cape Verde* or Cambodia* or Cameroon* or Central African or Chad* or China or Chinese or Colombia* or Comor* or Congo* or Costa Rica* or Cote d'Ivoir* or Ivory Coast or Cuba* or Djibouti* or Dominica* or Ecuador* or Egypt* or El Salvador* or Eritrea* or Ethiopia* or Fiji* or Gabon* or Gambia* or Georgia* or Ghana* or Grenad* or Guatemala* or Guinea* or Guyan* or Haiti* or Hondura* or Hungar* or India* or Indonesia* or Iran* or Iraq* or Jamaica* or Jordan* or Kazakhstan* or Kenya* or Kiribati* or Korea* or Kosov* or Kyrgyz Republic or Lao* or Leban* or Lesotho* or Liberia* or Libya* or Macedonia* or Madagascar* or Malawi* or Malaysia* or Maldiv* or Mali* or Marshall Island* or Mauritania* or Mauriti* or Mexic* or Micronesia* or Moldova* or Mongolia* or Montenegr* or Morocc* or Mozambi* or Myanma* or Burmese or Namibia* or Nepal* or Nicaragua* or Niger* or Nigeria* or Pakistan* or Palau* or Panama* or Papua New Guinea* or Paraguay* or Peru* or Philippines or Filipino or Romania* or Rwanda* or Samoa* or Sao Tome* or Senegal* or Serbia* or Seychell* or Sierra Leon* or Solomon Island* or Somalia* or South Africa* or Sudan* or Sri Lanka* or St Lucia* or St Vincent or Grenadines or Surinam* or Swazi* or Syria* or Tajikistan* or Tanzania* or Thai* or Timor* or Togo* or Tonga* or Tunisia* or Turk* or Turkmenistan* or Tuvalu* or Uganda* or Ukrain* or Uzbekistan* or Vanuatu* or Venezuela* or Vietnam* or West Bank or Gaza or Yemen* or Zambia* or Zimbabwe*).mp.
2. exp Africa/ or exp caribbean/ or exp caribbean islands/ or exp "South and Central America"/ or exp Asia/ or exp indian ocean/ or exp pacific ocean/
3. exp developing country/
4. (africa* or asia* or caribbean or central america* or latin america* or south america* or melanesia* or micronesia* or polynesia*).mp.
5. (resource-limit* or resource-poor or low-resource* or limited-resource* or resource-constrain* or constrain*-resource* or under-resource* or poor*-resource* or resource-scarce* or scarce*-resource* or low-income or middle-income or lowincome or middleincome or LMIC*).mp.

6. ((developing or underdeveloped or under-developed or emerging or less-developed or least-developed or less-economically developed or least-economically developed or less-affluent or least-affluent) adj (country or countries or nation or nations or region or regions or economy or economies)).mp.
7. ((developing or underdeveloped or under-developed or less-developed or least-developed) adj world).mp.
8. (third-world* or thirdworld* or 3rd-world*).mp.
9. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8
10. prostitut*.mp.
11. exp prostitution/ or exp transactional sex/
12. Commercial sex.mp.
13. sex work*.mp.
14. (sex* adj2 (sell* or transact* or trade or trading)).mp.
15. 10 or 11 or 12 or 13 or 14
16. ((cohort or follow-up or followup or observational or prospective or retrospective or evaluation or intervention or comparative) adj (study or studies)).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword]
17. ((random* or clinical or control*) adj (trial* or study or studies)).mp.
18. Cross sectional.mp.
19. ((doubl* or singl* or trebl* or tripl*) adj blind*).mp.
20. Cohort analy*.mp.
21. exp cohort analysis/ or exp control group/ or exp correlational study/ or exp cross-sectional study/ or exp crossover procedure/ or exp double blind procedure/ or exp "early termination of clinical trial"/ or exp experimental design/ or exp nonequivalent control group/ or exp parallel design/ or exp pretest posttest control group design/ or exp pretest posttest design/ or exp single blind procedure/ or exp triple blind procedure/
22. exp comparative study/ or exp experimental study/ or exp feasibility study/ or exp observational study/ or exp pilot study/ or exp prevention study/ or exp quasi experimental study/
23. exp time series analysis/
24. exp clinical trial/ or exp "clinical trial (topic)"/ or exp community trial/ or exp intervention study/ or exp longitudinal study/ or exp major clinical study/ or exp open study/ or exp postmarketing surveillance/ or exp prospective study/ or exp retrospective study/
25. exp evaluation study/
26. 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25
27. 9 and 15 and 26
28. limit 27 to (english language and yr="2000 -Current")

POPLINE search 20 Jan 2016

(((Keyword:SEX WORKERS) OR (Keyword:TRANSACTIONAL SEX))
OR
(("sex work*" OR "Commercial sex" OR prostitut* OR "sell sex*" OR "transact* sex*" OR "sex*transact*" OR "sex* trade" OR "sex* trading" OR "trade sex*" OR "trading sex*")))

AND

(((Keyword:COHORT ANALYSIS OR Keyword:CLINICAL TRIALS OR Keyword:CONTROL GROUPS OR Keyword:CROSS SECTIONAL ANALYSIS OR Keyword:DOUBLE-BLIND STUDIES OR Keyword:FOLLOW-UP STUDIES OR Keyword:PROSPECTIVE STUDIES OR Keyword:RETROSPECTIVE STUDIES OR Keyword:REPEATED ROUNDS OF SURVEY OR Keyword:LONGITUDINAL STUDIES OR Keyword:PILOT PROJECTS OR Keyword:HEALTH SERVICES EVALUATION OR Keyword:PRE-POST TESTS OR Keyword:FAMILY PLANNING PROGRAM EVALUATION OR Keyword:PERIOD ANALYSIS OR Keyword:PROGRAM EFFECTIVENESS))
OR

(((cohort OR follow\-up OR followup OR "follow up" OR observational OR prospective OR retrospective OR evaluation OR intervention OR comparative OR random* OR clinical OR control*) study ~0)
OR
((cohort OR follow\-up OR followup OR "follow up" OR observational OR prospective OR retrospective OR evaluation OR intervention OR comparative OR random* OR clinical OR control*) studies ~0)
OR
((random* OR clinical OR control*) trial~0) OR ((doubl* OR singl* OR trebl* OR tripl*) adj blind*) OR (cross\-sectional OR "cross sectional") OR ("cohort analy*")))

AND

(((Region/Country:Central America OR Region/Country:South America OR Region/Country:Caribbean OR Region/Country:Oceania OR Region/Country:Africa OR Region/Country:Europe Southeastern OR Region/Country:Asia Central OR Region/Country:Asia Southeastern OR Region/Country:Asia Southern OR Region/Country:Asia Southwestern OR Region/Country:China OR Region/Country:Democratic People's Republic of Korea OR Region/Country:Mongolia OR Region/Country:Belarus OR Region/Country:Moldova OR Region/Country:Ukraine OR Region/Country:Mexico OR Region/Country:Gaza OR Region/Country:Iran OR Region/Country:Iraq OR Region/Country:Jordan OR Region/Country:Lebanon OR Region/Country:Syria OR Region/Country:West Bank OR Region/Country:Yemen)))

AND ((Language:English) AND (Years:[2000 TO *]))

Conference abstracts: Web of Science 22 Jan 2016

#16	#15 AND #9 AND #3 DocType=All document types; Language=All languages;
#15	#14 OR #13 OR #12 OR #11 OR #10 DocType=All document types; Language=All languages;
#14	(TS=("Cross sectional")) AND LANGUAGE: (English) DocType=All document types; Language=All languages;
#13	(TS=("Cohort analy*")) AND LANGUAGE: (English) DocType=All document types; Language=All languages;
#12	(TS=((cohort OR "follow up" OR followup OR observational OR prospective OR retrospective OR evaluation OR intervention OR comparative) near/0 (study OR studies))) AND LANGUAGE: (English) DocType=All document types; Language=All languages;
#11	(TS=((random* OR clinical OR control*) near/0 (trial* OR study OR studies))) AND LANGUAGE: (English) DocType=All document types; Language=All languages;
#10	(TS=((doubl* OR singl* OR trebl* OR tripl*) near/0 (blind*))) AND LANGUAGE: (English) DocType=All document types; Language=All languages;
#9	#8 OR #7 OR #6 OR #5 OR #4 DocType=All document types; Language=All languages;
#8	(TS=(("developing" OR "underdeveloped" OR "under developed" OR "less developed" OR "least developed") NEAR/0 ("world"))) AND LANGUAGE: (English) DocType=All document types; Language=All languages;
#7	(TS=(("developing" or "underdeveloped" or "under-developed" or emerging or "less-developed "or "least-developed" or "less-economically developed" or "least-economically developed" or "less-affluent" or "least-affluent") near/0 (country or countries or nation or nations or region or regions or economy or economies))) AND LANGUAGE: (English)

	DocType=All document types; Language=All languages;
#6	(TS=("resource-limit*" or "resource-poor" or "low-resource*" or "limited-resource*" or "resource-constrain*" or "constrain*-resource*" or "under-resource*" or "poor*-resource*" or "resource-scarce*" or "scarce*-resource*" or "low-income" or "middle-income" or lowincome or middleincome or LMIC*)) AND LANGUAGE: (English) DocType=All document types; Language=All languages;
#5	(TS=(africa* or asia* or caribbean or "central america*" or "latin america*" or "south america*" or melanesia* or micronesia* or polynesia*)) AND LANGUAGE: (English) DocType=All document types; Language=All languages;
#4	(TS=(Afghanistan* or Albania* or Algeria* or Angola* or Argentina* or Armenia* or Azerbaijan* or Bangladesh* or Belarus* or Beliz* or Benin* or Bhutan* or Bolivia* or Bosnia* or Herzegovin* or Botswan* or Brazil* or Bulgaria* or Burkina* or Burundi* or "Cabo Verde*" or "Cape Verde*" or Cambodia* or Cameroon* or "Central African" or Chad* or China or Chinese or Colombia* or Comor* or Congo* or "Costa Rica*" or "Cote d'Ivoir*" or "Ivory Coast" or Cuba* or Djibouti* or Dominica* or Ecuador* or Egypt* or "El Salvador*" or Eritrea* or Ethiopia* or Fiji* or Gabon* or Gambia* or Georgia* or Ghana* or Grenad* or Guatemala* or Guinea* or Guyan* or Haiti* or Hondura* or Hungar* or India* or Indonesia* or Iran* or Iraq* or Jamaica* or Jordan* or Kazakhstan* or Kenya* or Kiribati* or Korea* or Kosov* or "Kyrgyz Republic" or Lao* or Leban* or Lesotho* or Liberia* or Libya* or Macedonia* or Madagascar* or Malawi* or Malaysia* or Maldiv* or Mali* or "Marshall Island*" or Mauritania* or Mauriti* or Mexic* or Micronesia* or Moldova* or Mongolia* or Montenegr* or Morocc* or Mozambi* or Myanma* or Burmese or Namibia* or Nepal* or Nicaragua* or Niger* or Nigeria* or Pakistan* or Palau* or Panama* or "Papua New Guinea*" or Paraguay* or Peru* or Philippines or Filipino or Romania* or Rwanda* or Samoa* or "Sao Tome*" or Senegal* or Serbia* or Seychell* or "Sierra Leon*" or "Solomon Island*" or Somalia* or "South Africa*" or Sudan* or "Sri Lanka*" or "St Lucia*" or "St Vincent" or Grenadines or Surinam* or Swazi* or Syria* or Tajikistan* or Tanzania* or Thai* or Timor* or Togo* or Tonga* or Tunisia* or Turk* or Turkmenistan* or Tuvalu* or Uganda* or Ukrain* or Uzbekistan* or Vanuatu* or Venezuela* or Vietnam* or "West Bank" or Gaza or Yemen* or Zambia* or Zimbabwe*)) AND LANGUAGE: (English) DocType=All document types; Language=All languages;
#3	#2 OR #1 DocType=All document types; Language=All languages;
#2	(TS=(sex* near/1 (sell* or transact* or trade or trading))) AND LANGUAGE: (English) DocType=All document types; Language=All languages;
#1	(TS=(prostitut* or "sex work*" or "commercial sex")) AND LANGUAGE: (English) DocType=All document types; Language=All languages;

Conference abstracts: Proquest 22 Jan 2016

(
(sex* NEAR/2 (sell* OR transact* OR trade OR trading)) OR prostitut* OR "Commercial sex" OR "sex work*"
)
AND
(
((doubl* OR singl* OR trebl* OR tripl*) PRE/0 blind*)
OR
((random* OR clinical OR control*) PRE/0 (trial* OR study OR studies))
OR
((cohort OR "follow up" OR followup OR observational OR prospective OR retrospective OR evaluation OR intervention OR comparative) PRE/0 (study OR studies))
OR
("Cohort analy*")
OR
("Cross sectional")
)
AND
(

(Afghanistan* OR Albania* OR Algeria* OR Angola* OR Argentina* OR Armenia* OR Azerbaijan* OR Bangladesh* OR Belarus* OR Beliz* OR Benin* OR Bhutan* OR Bolivia* OR Bosnia* OR Herzegovin* OR Botswan* OR Brazil* OR Bulgaria* OR Burkina* OR Burundi* OR Cabo Verde* OR Cape Verde* OR Cambodia* OR Cameroon* OR Central African OR Chad* OR China OR Chinese OR Colombia* OR Comor* OR Congo* OR Costa Rica* OR Cote d'Ivoir* OR Ivory Coast OR Cuba* OR Djibouti* OR Dominica* OR Ecuador* OR Egypt* OR El Salvador* OR Eritrea* OR Ethiopia* OR Fiji* OR Gabon* OR Gambia* OR Georgia* OR Ghana* OR Grenad* OR Guatemala* OR Guinea* OR Guyan* OR Haiti* OR Hondura* OR Hungar* OR India* OR Indonesia* OR Iran* OR Iraq* OR Jamaica* OR Jordan* OR Kazakhstan* OR Kenya* OR Kiribati* OR Korea* OR Kosov* OR Kyrgyz Republic OR Lao* OR Leban* OR Lesotho* OR Liberia* OR Libya* OR Macedonia* OR Madagascar* OR Malawi* OR Malaysia* OR Maldiv* OR Mali* OR Marshall Island* OR Mauritania* OR Mauriti* OR Mexic* OR Micronesia* OR Moldova* OR Mongolia* OR Montenegr* OR Morocc* OR Mozambi* OR Myanma* OR Burmese OR Namibia* OR Nepal* OR Nicaragua* OR Niger* OR Nigeria* OR Pakistan* OR Palau* OR Panama* OR Papua New Guinea* OR Paraguay* OR Peru* OR Philippines OR Filipino OR Romania* OR Rwanda* OR Samoa* OR Sao Tome* OR Senegal* OR Serbia* OR Seychell* OR Sierra Leon* OR Solomon Island* OR Somalia* OR South Africa* OR Sudan* OR Sri Lanka* OR St Lucia* OR St Vincent OR Grenadines OR Surinam* OR Swazi* OR Syria* OR Tajikistan* OR Tanzania* OR Thai* OR Timor* OR Togo* OR Tonga* OR Tunisia* OR Turk* OR Turkmenistan* OR Tuvalu* OR Uganda* OR Ukrain* OR Uzbekistan* OR Vanuatu* OR Venezuela* OR Vietnam* OR West Bank OR Gaza OR Yemen* OR Zambia* OR Zimbabwe*)
OR
((developing OR underdeveloped OR "under developed" OR "less developed" OR "least developed") PRE/0 (world))
OR
((developing OR underdeveloped OR "under developed" OR "less developed" OR "least developed" OR "less economically developed" OR "least economically developed" OR "less affluent" OR "least affluent") PRE/0 (country OR countries OR nation OR nations OR region OR regions OR economy OR economies))
OR
("third world*" OR thirdworld* OR "3rd-world*")
OR
("resource limit*" OR "resource poor" OR "low resource*" OR "limited resource*" OR "resource constrain*" OR "constrain* resource*" OR "under resource*" OR "poor* resource*" OR "resource scarce*" OR "scarce* resource*" OR "low income" OR "middle income" OR lowincome OR middleincome OR LMIC*)
OR
(africa* OR asia* OR caribbean OR "central america*" OR "latin america*" OR "south america*" OR melanesia* OR micronesia* OR polynesia*)
)

Open grey22 Jan 2016
lang:"en"
((sex* NEAR/2 (sell* OR transact* OR trade OR trading)) OR prostitut* OR "Commercial sex" OR "sex work*")
AND
(
(Afghanistan* OR Albania* OR Algeria* OR Angola* OR Argentina* OR Armenia* OR Azerbaijan* OR Bangladesh* OR Belarus* OR Beliz* OR Benin* OR Bhutan* OR Bolivia* OR Bosnia* OR Herzegovin* OR Botswan* OR Brazil* OR Bulgaria* OR Burkina* OR Burundi* OR Cabo Verde* OR Cape Verde* OR Cambodia* OR Cameroon* OR Central African OR Chad* OR China OR Chinese OR Colombia* OR Comor* OR Congo* OR Costa Rica* OR Cote d'Ivoir* OR Ivory Coast OR Cuba* OR Djibouti* OR Dominica* OR Ecuador* OR Egypt* OR El Salvador* OR Eritrea* OR Ethiopia* OR Fiji* OR Gabon* OR Gambia* OR Georgia* OR Ghana* OR Grenad* OR Guatemala* OR Guinea* OR Guyan* OR Haiti* OR Hondura* OR Hungar* OR India* OR Indonesia* OR Iran* OR Iraq* OR Jamaica* OR Jordan* OR Kazakhstan* OR Kenya*

OR Kiribati* OR Korea* OR Kosov* OR Kyrgyz Republic OR Lao* OR Leban* OR Lesotho* OR Liberia* OR Libya* OR Macedonia* OR Madagascar* OR Malawi* OR Malaysia* OR Maldiv* OR Mali* OR Marshall Island* OR Mauritania* OR Mauriti* OR Mexic* OR Micronesia* OR Moldova* OR Mongolia* OR Montenegr* OR Morocc* OR Mozambi* OR Myanma* OR Burmese OR Namibia* OR Nepal* OR Nicaragua* OR Niger* OR Nigeria* OR Pakistan* OR Palau* OR Panama* OR Papua New Guinea* OR Paraguay* OR Peru* OR Philippines OR Filipino OR Romania* OR Rwanda* OR Samoa* OR Sao Tome* OR Senegal* OR Serbia* OR Seychell* OR Sierra Leon* OR Solomon Island* OR Somalia* OR South Africa* OR Sudan* OR Sri Lanka* OR St Lucia* OR St Vincent OR Grenadines OR Surinam* OR Swazi* OR Syria* OR Tajikistan* OR Tanzania* OR Thai* OR Timor* OR Togo* OR Tonga* OR Tunisia* OR Turk* OR Turkmenistan* OR Tuvalu* OR Uganda* OR Ukrain* OR Uzbekistan* OR Vanuatu* OR Venezuela* OR Vietnam* OR West Bank OR Gaza OR Yemen* OR Zambia* OR Zimbabwe*)
OR
((developing OR underdeveloped OR "under developed" OR "less developed" OR "least developed" OR "less economically developed" OR "least economically developed" OR "less affluent" OR "least affluent") NEAR/0 (country OR countries OR nation OR nations OR region OR regions OR economy OR economies))
OR
((developing OR underdeveloped OR "under developed" OR "less developed" OR "least developed") NEAR/0 (world))
OR
("third world*" OR thirdworld* OR "3rd-world*")
OR
(“resource limit*" OR "resource poor" OR "low resource*" OR "limited resource*" OR "resource constrain*" OR "constrain* resource*" OR "under resource*" OR "poor* resource*" OR "resource scarce*" OR "scarce* resource*" OR "low income" OR "middle income" OR lowincome OR middleincome OR LMIC*)
OR
(africa* OR asia* OR caribbean OR "central america*" OR "latin america*" OR "south america*" OR melanesia* OR micronesia* OR polynesia*)
)

2. Quality assessment tool

Adapted from the Joanna Briggs Institute Prevalence Critical Appraisal Tool[1]. Modified version provided by the author (Munn) on 21/3/16. Adjustments as per Bowring 2016[2]. Further modifications specific to research question made by review authors.

DOMAIN 1: EXTERNAL VALIDITY ***Is the sample representative of the population of interest?***	
1.1 Was an appropriate sampling frame used?	
1	Enumeration/estimate of FSWs, or clear description of source population (demographics, location, and time period), and rationale for use
0	No sampling frame, or inappropriate population for research question
1.2 Was an appropriate sampling method used?	
1	Probability-based sample (including: simple random, systematic, stratified, cluster, two-stage and multi-stage sampling) RDS or properly described time-location/venue sampling (if analysed appropriately)
0	Non-random sample (including purposive, quota, convenience and snowball), or sampling not described
1.3 Were inclusion and exclusion criteria explicit and appropriate to the research question?	
1	Yes, e.g. women only, FSWs, all reproductive ages, etc
0	No: limited by HIV status or other characteristic that would affect generalisability

DOMAIN 2: SELECTION (NON-RESPONSE) BIAS ***Was there incomplete outcome data (due to non-response, refusal or exclusion), and how did it affect the outcome?***	
2.1 Were (FSW) study participants recruited and enrolled in an appropriate way?	
1	Well described methods of recruitment and enrolment; appropriate staff expertise/training; appropriate seed selection for RDS; appropriate venue/location coverage
0	Poorly described; potential source of bias due to recruitment methods
2.2 Was there selective participation in the study?	
1	>=80% of those invited to participate were screened <80% participation rate, but sociodemographic/sex work characteristics not significantly different between participants and non-participants
0	<80% participation rate and significantly different characteristics likely to affect outcome Participation rate not reported or differences not assessed
2.3 What was the retention rate? Closed cohort/RCT: what proportion of participants who commenced the study contributed data at the final follow up visit? (If choosing an earlier endpoint, use retention rate up to this point) Open cohort: what proportion attended at least one follow up visit, and was retention well described?	
2	>=80% and sociodemographic/sex work characteristics compared and not significantly different
1	>=80% and sociodemographic/sex work characteristics either significantly different or not compared
0	<80%

DOMAIN 3: MEASUREMENT BIAS	
3.1 Was a valid tool used for the identification of the condition (pregnancy)?	
1	Serum or urine test for beta HCG
0	Self-reported or observed by study personnel
3.2 Was the condition (pregnancy) measured in a standard, reliable way for all FSWs?	
1	Pregnancy measured systematically (eg every study visit); data collectors appropriately trained
0	Unclear/inconsistent methods; lack of training for data collectors; nonsystematic measurement or recording (eg pregnancy only tested on participant request or clinician suspicion)
3.3 Was pregnancy intention measured systematically using a valid tool?	
1	Prospective question about intention asked at appropriate intervals (at least every 12months); or LMUP
0	Intention assumed, infrequently measured or unreliable retrospective question
N/A	Intention not measured

DOMAIN 4: INTERNAL VALIDITY ***How likely could the result be due to chance? What is the level of precision?***	
4.1 Was the person-years of observation adequate for calculating pregnancy incidence?	
1	FSWs followed for at least 100 woman-years, or reasonable justification of smaller size
0	<100 woman-years
4.2 Was the study conducted for a sufficient period of time to calculate pregnancy incidence?	
1	Closed cohort or trial: at least 6 months' follow-up time Open cohort: median follow up time per participant >6 months?
0	Insufficient observation period, or not reported
4.3 Was there appropriate statistical analysis?	
1	Detailed statistical methods described Primarily consider the measure of risk that will be used in the meta-analysis – i.e. incidence rates, and/or incidence proportion if measured over 1 year For proportions (cumulative incidence): denominator and numerator explicitly reported and appropriate/justified For incidence rates: calculation of person-years, including estimate of conception date and approach to censoring of pregnancy, explicitly reported and appropriate/justified (should not count pregnant time towards total person-years) If calculated based on data from author: sufficient data provided for accurate calculation
0	Methods not sufficiently described; inappropriate technique

DOMAIN 5: OTHER ISSUES	
5.1 Was pregnancy incidence an objective of the study?	
1	Yes (consider objectives of overall study, not sub-study/specific paper)
0	No (e.g. cohort may have been originally designed to measure HIV incidence, but they also published a paper on incidental pregnancy incidence)
5.1 Were there any other issues that may have introduced bias or affected the validity of the estimates?	

1	No issues
0	Study design issues, e.g. highly variable/skewed follow up times in open cohort study; very long follow-up period during which true incidence in the population likely to have changed Selective use or reporting of data (e.g. only reporting pregnancy incidence in one subgroup or at one time point without justification) Intervention may impact on pregnancy incidence e.g. testing diaphragm use, or FP counselling (not just standard of care condom counselling)

Scoring

Studies that measure unintended pregnancy

Domain	**Raw score out of:**
External validity	3
Selection bias	4
Measurement bias	3
Internal validity	3
Other issues	2
Total	**15**

Studies that measure pregnancy (undefined)

Domain	**Raw score out of:**
External validity	3
Selection bias	4
Measurement bias	2
Internal validity	3
Other issues	2
Total	**14**

References

1. Munn Z, Moola S, Riitano D, Lisy K. The development of a critical appraisal tool for use in systematic reviews addressing questions of prevalence. *International Journal of Health Policy and Management* 2014; **3**: 123+.

2. Bowring AL, Veronese V, Doyle JS, Stoove M, Hellard M. HIV and Sexual Risk Among Men Who Have Sex With Men and Women in Asia: A Systematic Review and Meta-Analysis. *AIDS and Behavior* 2016: 1-23.

PRISMA 2009 Checklist: Ampt et al. Incidence of unintended pregnancy among female sex workers

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&3: Included in abstract and “Strengths and limitations” section
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	4-5: In introduction
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	5: Primary and secondary objectives given in last paragraph of introduction. 6-7: PICOS described in “Inclusion and exclusion criteria” section. Participants: “FSWs”; interventions and comparisons: not relevant as this is an incidence review; outcomes: “incidence of unintended pregnancy” and secondary outcomes; study design described at end of this section.
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.	3 (Abstract) and 6 (Methods)
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: All provided under sub-heading “Inclusion and exclusion criteria”
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.	7: Under sub-heading “Search strategy”
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Full strategy for multiple databases included in supplementary appendix

PRISMA 2009 Checklist: Ampt et al. Incidence of unintended pregnancy among female sex workers

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: Under sub-heading “Screening and data collection”
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.	7-8: Under sub-heading “Screening and data collection”
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	7-8: Under sub-heading “Screening and data collection”
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: Under sub-heading “Quality assessment”. Full quality assessment included in supplementary appendix
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	8: Incidence rate; in “Analysis” section
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.	9: Random effects models, I^2 statistic, sub-group analyses; in “Analysis” section

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).	8: Measurement bias, whether preg incidence was a primary objective; in “Quality assessment”. section
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	9: Sub-group analyses; in “Analysis” section
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.	9-10: In “Results”, displayed in 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.	10-18: In “Results” (p10 & 16), Table 1 (11-15), Table 2 (17), under sub-heading “Baseline population characteristics” (18)
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).	17-19: Table 2, under sub-headings “Methodology and quality assessment” & “Incidence of pregnancy”

PRISMA 2009 Checklist: Ampt et al. Incidence of unintended pregnancy among female sex workers

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.	Table 2 (p17), Figures 2-6
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	19: Under sub-heading “Meta-analysis”; results not presented due to very high heterogeneity
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	Table 2 (17), under sub-heading “Methodology and quality assessment” (18-19)
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	19-21: Sub-group analyses under sub-heading “Meta-analysis”, Figures 3-6 21-22: Secondary outcomes summary under sub-heading “Secondary outcomes”
DISCUSSION			
Summary of evidence	24	Summarize 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).	22-25: In “Discussion” 26-27: In “Conclusion”
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).	25-26: Under sub-heading “Limitations”
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	23-24: In “Discussion” 26-27: In “Conclusion
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.	28: In “Funding” section, as per BMJ Open guidelines. The funder had no role or interest in the conduct or outcome of this study.

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

For more information, visit: www.prisma-statement.org.

BMJ Open

Incidence of unintended pregnancy among female sex workers in low- and middle-income countries: a systematic review and meta-analysis

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2018-021779.R1
Article Type:	Research
Date Submitted by the Author:	14-May-2018
Complete List of Authors:	Ampt, Frances; Burnet Institute; Monash University, Department of Epidemiology and Preventive Medicine Willenberg, Lisa; Burnet Institute Agius, Paul; Burnet Institute; La Trobe University, Judith Lumley Centre Chersich, Matthew; University of the Witwatersrand, Wits Reproductive Health and HIV Institute Luchters, Stanley; Burnet Institute; Universiteit Gent, Department of Obstetrics and Gynaecology Lim, Megan; Burnet Institute; Monash University, Department of Epidemiology and Preventive Medicine
Primary Subject Heading:	Epidemiology
Secondary Subject Heading:	Global health, Public health, Reproductive medicine, Sexual health
Keywords:	PUBLIC HEALTH, REPRODUCTIVE MEDICINE, PREVENTIVE MEDICINE, EPIDEMIOLOGY, SEXUAL MEDICINE

Incidence of unintended pregnancy among female sex workers in low- and middle-income countries: a systematic review and meta-analysis

Frances H. Ampt[1,2], Lisa Willenberg[1], Paul A. Agius[1,3], Matthew Chersich[4], Stanley Luchters[1,2,5], Megan S.C. Lim[1,2,6]

Affiliations:

1. Burnet Institute, Melbourne, Australia
2. Department of Epidemiology and Preventive Medicine, Monash University, Melbourne, Australia
3. Judith Lumley Centre, La Trobe University, Melbourne, Australia
4. Wits Reproductive Health and HIV Institute, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa
5. International Centre for Reproductive Health, Department of Obstetrics and Gynaecology, Ghent University, Ghent, Belgium
6. Melbourne School of Global and Population Health, University of Melbourne, Melbourne, Australia

Corresponding author:

A/Prof Stanley Luchters

85 Commercial Rd Melbourne, VIC 3004, Australia

+613 8506 2378

stanley.luchters@burnet.edu.au

Word count abstract: 300

Word count: 5,055 (excluding title page, abstract, summary box, figures, tables, acknowledgements, author contributions, competing interests, funding, and references)

ABSTRACT

Objectives

To determine the incidence of unintended pregnancy among female sex workers (FSWs) in low- and middle-income countries (LMICs).

Design

We searched Medline, PsychInfo, Embase and Popline for papers published in English between January 2000 and January 2016, and Web of Science and Proquest for conference abstracts. Meta-analysis was performed on the primary outcomes using random effects models, with sub-group analysis used to explore heterogeneity.

Participants

Eligible studies targeted FSWs aged 15-49 years living or working in an LMIC.

Outcome measures

Studies were eligible if they provided data on one of two primary outcomes: incidence of unintended pregnancy; and incidence of pregnancy where intention is undefined. Secondary outcomes were also extracted when they were reported in included studies: incidence of induced abortion; incidence of birth; and correlates/predictors of pregnancy or unintended pregnancy.

Results

Twenty-five eligible studies were identified from 3,866 articles. Methodological quality was low overall. Unintended pregnancy incidence showed high heterogeneity (I^2>95%), ranging from 7.2 to 59.6 per 100 person-years across ten studies. Study design and duration were found to account for heterogeneity. On sub-group analysis, the three cohort studies in which no intervention was introduced had a pooled incidence of 27.1 per 100 person-years (95%CI=24.4-29.8; I2=0%). Incidence of pregnancy (intention undefined) was also highly heterogeneous, ranging from 2.0 to 23.4 per 100 person-years (15 studies).

Conclusions

Of the many studies examining FSWs' sexual and reproductive health in LMICs, very few measured pregnancy, and fewer assessed pregnancy intention. Incidence varied widely, likely due to differences in study design, duration and baseline population risk, but was high in most studies, representing a considerable concern for this key population. Evidence-based approaches that place greater importance on unintended pregnancy prevention need to be incorporated into existing sexual and reproductive health programs for FSWs.

Registration

The study protocol was registered with PROSPERO: CRD42016029185.

STRENGTHS AND LIMITATIONS OF THE STUDY

- This is the first study to systematically review and analyse the incidence of pregnancy or unintended pregnancy among female sex workers in low- and middle-income countries.
- Broad inclusion criteria meant that the review allowed for the inclusion of a large proportion of the studies that have collected data on pregnancy or unintended pregnancy rates in this population.
- However, limitations of broad inclusion criteria are that only one study had an *a priori* objective of measuring pregnancy incidence, and studies were highly varied in terms of their methodology, settings and study populations.
- High heterogeneity prevented pooled analysis of all studies, but allowed for subgroup analysis for cohort studies, and for studies in which no intervention was introduced.
- Pregnancy rates among FSWs could not be compared to the background general population rates because of the lack of availability of those data.

INTRODUCTION

Unintended pregnancy affects a large number of women in low- and middle-income countries (LMICs), and can have significant impacts on maternal and child health.[1-3] Unintended pregnancy is a high priority issue for many female sex workers (FSWs),[4 5] who usually have dependents to support and for whom pregnancy may increase financial dependence on sex work and add to already high levels of stigmatisation.[5] This has been confirmed by consultation with FSWs in Kenya[i], and workshops with FSWs to inform development of a pregnancy prevention intervention[6]. Participants expressed considerable fear and anxiety about pregnancy, related personal and peer experiences of pregnancy scares, and emphasised the importance of improving knowledge of family planning in their community (unpublished qualitative data, Mombasa, Kenya).

FSWs can face elevated risks of unintended pregnancy due to a high frequency of intercourse and a high number of sexual partners.[7 8]Risks are exacerbated by concurrent paying and non-paying partnerships,[8] and by sexual and gender-based violence, gender inequalities and stigma towards sex work, which reduce women's power to negotiate within sexual relationships.[9-11] While gains have been made in terms of condom use with paying clients,[12] rates of condom and other contraceptive use are consistently lower with emotional (non-paying) partners.[5 13 14] In many countries, particularly in sub-Saharan Africa, few FSWs use long-acting reversible contraceptives (intrauterine devices and implants), and methods such as injections, condoms and pills may be used inconsistently or incorrectly, rendering them less effective.[5 15] Limited knowledge and misunderstandings, particularly in relation to contraceptive side effects and impacts on fertility, are significant demand-side barriers to contraceptive uptake.[5 16 17]

Family planning services are often neglected as part of FSW-specific service provision, which have focused largely on preventing HIV and other sexually transmitted infections.[12 18-20] Stigma

[i]Our research group has worked closely with a local NGO (International Centre for Reproductive Health, Kenya) which has a long history of collaborating with and providing services for sex workers in Mombasa.

of health workers towards sex workers can also limit access to contraception.[21 22] FSWs have the same reproductive rights as all women, and their desires and needs in relation to pregnancy have often been neglected,[23-25] similar to other marginalized populations, which have historically been subjected to reproductive coercion.[26 27] It is important that those who do desire pregnancy are provided with non-judgmental care, and that those who don't are given the opportunity and resources to prevent it. Moreover, many FSWs who become pregnant may be reluctant to enter maternal health services, given their previous experiences of discrimination and abuse from health workers.[21] FSW programmes need to make concerted efforts to facilitate timely attendance of FSW at antenatal clinic and childbirth services. Importantly, FSWs often have remarkably high levels of HIV and maternal health services are a key entry point for them to access antiretroviral treatment, which secure their health and reduces HIV in infants.

Despite a clear rationale for addressing unintended pregnancy in this population, it is important to acknowledge that intention is a problematic concept, which is more accurately represented as a spectrum than a dichotomy.[3 28] Indeed, many women feel positive about pregnancy despite not intending to conceive, or may simultaneously desire both pregnancy and its avoidance, for different reasons. The degree to which women accept or welcome a pregnancy once it has occurred has been hypothesised to be a more important predictor of adverse outcomes than pre-pregnancy intentions.[28] Fertility preferences are also likely to be less stable over time in LMICs undergoing fertility transition compared to high-income countries.[3] FSWs' intentions also differ between types of partner, requiring them to adapt contraceptive use accordingly.[23] Furthermore, as a stigmatised group, FSWs may feel pressure not to disclose their intention. Despite these limitations, we have continued to use the term 'unintended pregnancy' in this paper for the sake of consistency with other literature, and the lack of a feasible alternative.

The primary objective of this study was to determine the pooled incidence of unintended pregnancy among FSWs in LMICs. Given the expected low number of eligible studies, we also aimed to determine the incidence of pregnancy where intention is not known. Secondary aims

were to examine the correlates and predictors of pregnancy, and the incidence of induced abortion and childbirth in this population.

METHODS

All stages of this systematic review and meta-analysis have been reported in line with the PRISMA statement.[29] The protocol for this review was registered with the international prospective register of systematic reviews (PROSPERO): number CRD42016029185.

Inclusion and exclusion criteria

Studies were included if they met key criteria in terms of population, outcomes and study design. FSWs had to account for at least two thirds of the sample, unless data could be disaggregated by sex work status. We employed a broad definition of sex work, including women who self-identified as sex workers, those who engaged in transactional sex or part-time sex work, and communities of women known to practice commercial or transactional sex. Study participants had to live or work in an LMIC[30] and be of reproductive age (15-49 years). Studies targeting women with reduced fertility (e.g. women in the first six months post-partum, and those exclusively breastfeeding, or undergoing fertility treatment) were excluded.

Studies had to measure or report one of the following primary outcomes:

1. Cumulative incidence (proportion of women who became pregnant in a defined time period), or incidence rate (per person-time) of unintended pregnancy;
2. Cumulative incidence or incidence rate of pregnancy (where intention is not measured).

Unintended pregnancy was defined as any pregnancy considered by the woman to be not planned, intended or desired at the time of conception,[31] as reported either prior to pregnancy or retrospectively. Such pregnancies may be described by the authors as unintended, unwanted, undesired, unplanned or mistimed.

Any study design that was able to measure one or more of the primary outcomes was considered, including both observational and intervention studies. Case studies, ecological

studies, qualitative studies, editorials, and commentaries were excluded. We planned to expand the inclusion criteria if insufficient studies measuring the primary outcomes were identified, to include studies reporting prevalence of pregnancy in the previous 12 months. Cross-sectional studies were included in the initial screen for this purpose, but were subsequently excluded as there were sufficient longitudinal studies measuring incidence. The addition of period-prevalence in the last 12 months as an outcome would have required additional sub-analyses; in addition, measurement of retrospective pregnancy intention in cross-sectional studies differs from prospective measurement as women may change their minds during the course of their pregnancy. Only studies published in English since 1 January 2000 were included.

Search strategy

A systematic electronic search of Medline, Embase, PsychINFO and Popline was undertaken to identify relevant peer-reviewed articles. Search syntax included, as both Subject Headings and keywords: synonyms for "sex work"; list of LMICs from the World Bank [30], and synonyms for "low- and middle-income"; and study design and descriptor terms, e.g. "cohort studies" or "controlled trials" (full search strategy in supplementary file).

A search for unpublished grey literature was also undertaken, including conference proceedings and abstracts (via Web of Science and Proquest databases), research theses, and the websites of relevant non-government organisations, including the Population Council, FHI 360 and Guttmacher Institute.

The last search was performed on 20 January 2016. Up to two attempts were made to contact authors when further information was required. Eligible studies recommended by contacted authors were also included.

Screening and data extraction

Screening of all abstracts, removal of duplicates, and selection of full text articles was conducted by one researcher, with a random selection of 10% screened in duplicate. Data from a random

sample of 50% of included full text manuscripts were extracted in duplicate. Discrepancies in eligibility and data extraction were resolved by discussion, with a third researcher arbitrating when necessary.

Summary estimates were sought rather than individual subject data. Data were extracted relating to: eligibility criteria; study aims, population and methods; setting and participant characteristics at baseline; primary and secondary outcome data for each time point reported; and quality assessment criteria. In addition to the primary outcomes, the following secondary outcomes were extracted: incidence of induced abortion (termination of pregnancy); incidence of birth; and correlates/predictors of pregnancy or unintended pregnancy. Authors were contacted to provide data relating to the primary outcome when it was not reported in the paper; for example, the total person-years of exposure.

Quality assessment

Methodological quality of the included studies was assessed using a modified version of the Joanna Briggs Institute Prevalence Critical Appraisal Tool[32] (supplementary file). This tool was designed to assess studies measuring prevalence or incidence, and can be applied to multiple study designs. The tool was modified to address specific methodological concerns of our research question. Given measurement bias could result from infrequent or irregular pregnancy detection methods, items on these methods were specifically included. We also documented whether pregnancy incidence was an *a priori* study objective.

Quality assessment was undertaken in duplicate for 50% of studies, with discrepancies resolved by discussion. Studies were given a score out of 15 if they measured unintended pregnancy incidence, and a score out of 14 if they measured pregnancy incidence (the latter did not include an item on measurement of intention). Scores were then reported as percentages.

Analysis

We undertook a qualitative narrative synthesis of both primary and secondary outcomes, and quantitative analysis of primary outcomes using Stata version 13.1 (StataCorp LLC, USA).

Incidence rate (per 100 person-years) was taken as the unit of analysis. In studies reporting only cumulative incidence, we estimated person-time, censoring women at their first pregnancy, and assuming that they became pregnant halfway through the study.

The Mantel-Haenszel I-squared statistic was over 95% for both primary outcomes, so meta-analysis and meta-regression were not performed for all eligible studies, as had been planned. Instead, sources of heterogeneity were explored using sub-group analyses, and pooled incidence rates calculated using DerSimonian & Laird random effects models for sub-groups containing more than two studies and with I-squared of less than 75%. The explored sub-groups were clustered as covariates that may explain heterogeneity (geographic region and intervention vs. non-intervention) and potential methodological explanations of heterogeneity: study design (cohort vs. randomised controlled trial (RCT); study duration; and frequency of pregnancy measurement (measured regularly vs. only when indicated). Interventions included any introduced by the study with the aim of improving sexual and reproductive health, including contraceptive provision, and behavioural or biomedical interventions to prevent HIV/STIs.

We assessed study quality as a source of heterogeneity by examining scatter plots and Pearson correlation coefficients of quality score against incidence rate. We also qualitatively explored characteristics of different studies, including the following baseline population characteristics that may have impacted on pregnancy rates: age; contraceptive prevalence; consistent condom use; number of sex partners; coital frequency; sexually transmitted infection (STI) prevalence; indicators of gender-based violence; and alcohol and other drug use.

Patient and public involvement

The research question and outcome measures were informed by previous qualitative work with female sex workers conducted by the International Centre for Reproductive Health, Kenya. This confirmed that unintended pregnancy was an important issue for this population group. Patients and members of the public were not otherwise involved in the design or conduct of this study.

RESULTS

The initial search yielded 6,523 peer-reviewed and 118 grey literature articles, and 11 identified by hand-searching (e.g. due to recommendations from contacted authors). After removal of duplicates, this resulted in 3,866 articles (Figure 1). Based on title and abstracts, 750 manuscripts remained for full text screening.

Pregnancy incidence was reported in 12 studies, and was obtained for a further 13 studies after contacting authors. These 25 studies were reported in 99 papers. Ten studies measured *unintended* pregnancy (outcome 1), and 15 measured pregnancy *without specifying intention* (outcome 2); none measured both outcomes.

Fourteen cohort studies were included and eleven randomised controlled trials (table 1). Pregnancy incidence was not an *a priori* primary objective for any, but was a secondary objective for a Rwandan HIV incidence study.[33] The majority of studies aimed to test interventions to prevent HIV or STIs (n=11), or measure HIV incidence (n=8). Six undertook sub-studies in which they reported pregnancy incidence.[34-39] Thirteen studies included any intervention: three involved provision of diaphragms or female condoms [40-42] and ten were biomedical or behavioural interventions to prevent HIV/STIs (table 1). The latter included four studies that reported providing contraceptive counselling[36 37 43 44] and one which offered free contraception when needed.[45]

Table 1: Characteristics of included studies

Study (first author, year)	Additional sources*	Country	Year commenced	Design	Aim	Population	N (FSWs) at baseline	Age (median)[b]	Current contraceptive use[c] (%)	Consistent condom use[d]	Number of sex partners/ frequency of sex[e]	GBV/ alcohol/ other risk factor	HIV/STI prevalence[f]
Outcome 1: Unintended pregnancy													
Behets 2005[40]		Madagascar	2004	Prospective cohort (with intervention)	Assess acceptability and feasibility of diaphragm use	FSWs who use condoms inconsistently	91	28	Any: 47% LARC or permanent: <1%	0% with clients in last month (inconsistent use was an inclusion criterion)	5 partners 6 sex acts	N/A	Vaginitis/PID: 8% TP (RPR): 27%
Behets 2008[41]	Author[a] Khan 2009[4] Penman-Aguilar 2011[46]	Madagascar	2005	RCT (pilot)	Assess acceptability and feasibility of diaphragm and microbicide use for STI prevention	Women with high-risk sex behaviours (sex work self-reported: 81% current, 100% ever)	192	29	Any (excl. condoms): 24%	0% in last 2 weeks (inconsistent use was an inclusion criterion)	6 casual partners 10 sex acts	Ever violence from casual partner for suggesting condom: 21% Ever received more money for no condom: 38%	N/A
Braunstein 2011[33]	Braunstein 2011[47]	Rwanda	2006	Prospective cohort	Measure HIV incidence (secondary aims included measure of pregnancy incidence)	HIV-uninfected women at high risk of HIV exposure (94% reported current sex work)	397	24	Any: 91% LARC or permanent: 0%	21% with clients 18% with non-paying partners	90 partners in past 3 months 10 clients per week 40 vaginal sex acts in last month	Forced sex ever: 19% Alcohol before sex: 52%	CT: 5% GN: 12% TV: 17% TP (RPR+TPHA pos): 7% HSV2: 54%
Chersich 2014[35]	Author[a] Luchters 2016[5]	Kenya (Mombasa)	2006	Prospective cohort	Assess HIV incidence and microbicide trial feasibility This sub-study: investigate links between alcohol use, and unsafe sex and incident HIV infection	HIV-uninfected FSWs	386	Mean 25.1	Any (incl. *consistent* condom use): 57.1% LARC: 3.0% Permanent: 0%	21.3% in last 3 months	N/A	Hazardous or harmful drinking: 26.8% Ever had abortion: 21%	N/A
Deschamps 2016[34]	Deschamps 2013[48]	Haiti, Puerto Rico, Dominican Republic	2009	Prospective cohort	Assess feasibility of establishing a high-risk cohort for HIV vaccine trials This sub-study: assess retention, HIV and pregnancy incidence and risk behaviours	HIV-uninfected FSWs	634	24 ¥	Permanent: 10.0% (excluded from pregnancy analysis) Others not reported	0.5% in last 6 months	447 partners in last 6 months ¥	Forced sex by client in last 6m: 37.1% Heavy drinker: 38.8% Drug use: 14.0%	N/A
Gaffoor 2013[43]	Author[a] Skoler-Karpoff 2008[49]	South Africa (one site of a multisite trial)	2004	RCT (phase 3, double blind, placebo-controlled)	Test safety and efficacy of the microbicide Carraguard for HIV prevention This sub-study: describe prevalence and associations of forced sex	HIV-uninfected sexually-active women (3% FSWs)	41	¶	¶	N/A	¶	N/A	¶
Lara 2009[42]	Author[a]	Dominican	2006	Prospective	Assess acceptability of the	FSWs	243	58.8%	Any (excl.	66% in last month	N/A	Ever had abortion:	HIV: 1%

Study (first author, year)	Additional sources*	Country	Year commenced	Design	Aim	Population	N (FSWs) at baseline	Age (median)[b]	Current contraceptive use[c] (%)	Consistent condom used[d]	Number of sex partners/ frequency of sex[e]	GBV/ alcohol/ other risk factor	HIV/STI prevalence[f]
		Republic		cohort (with intervention)	female condom and diaphragm, determinants of use, and impact on unprotected sex			aged 20-29	condoms): 22.2% Permanent: 0%			70%	CT: 13% GN: 2% TP (VDRL): 8%
McClelland 2008[50]	Author[a] Martin 1998[51] McClelland 2008[52] McClelland 2009[53]	Kenya (Mombasa)	2003	RCT (placebo-controlled, nested in an open cohort study)	Test efficacy of monthly periodic presumptive antibiotic treatment at reducing incidence of vaginal infections and promoting vaginal Lactobacillus colonization	HIV-uninfected FSWs	310	32	Any (excl. condoms): 35.5% LARC: 3.6% Permanent: 2.9%	Median 100% coverage of sex acts in past week¥	1 partner 1 sex act ¥	N/A	GN: 0.3% TV: 1% Cervicitis (microscopy): 0.6% HSV-2: 74% BV: 34.5%
Peterson 2007[54]	Author[a] Macqueen 2007[55]	Ghana, Cameroon, Nigeria	2004	RCT (phase 2, double blind, placebo-controlled)	Investigate safety and preliminary effectiveness of tenofovir disoproxil fumarate in preventing HIV infection	HIV-uninfected women who work in hotels, bars, markets in high HIV transmission areas (areas known for sex work)	936	Mean 23.6 ¥	Any (excl. condoms): 7.22% LARC: <2% Permanent: <2%	N/A	Mean 21 partners in 30 days Mean 12 coital acts per week	N/A	Any STI in last 6 months (self-reported): 41.2%
Watson-Jones 2008[45]	Author[a] Odutola 2012[56]	Tanzania	2004	RCT (double blind, placebo-controlled)	Determine whether HSV-2 suppressive therapy reduces the risk of HIV acquisition and genital shedding of HIV	Female workers at food and recreational facilities at risk of HIV (38% FSWs)	499	¶	¶	¶	¶	¶	¶
Outcome 2: Pregnancy (intention undefined)													
Bazzi 2015[57]	Author[a] Syvertsen 2012[58]	Mexico	2010	Prospective cohort	Identify time varying risk factors for STI acquisition within FSWs' intimate partnerships	FSWs with drug use history, and their steady male partners	212	33	Any (excl. condoms): 53.3% LARC: 12.3% Permanent: 25.5%	Often or always: 56%	N/A	In last year: Physical assault by partner: 41% Sexual coercion in relationship: 9% In last 6 months: Hazardous drinking: 23% IV drug use: 62%	HIV: 2.6% CT: 5.9% GN: 1.2% TP (active): 1.4% Any STI 8%
Page 2013[39]	Author[a] Duff 2018[59] Couture 2011[60]	Cambodia	2009	Prospective cohort	Estimate HIV and STI prevalence, incidence and associated factors This sub-study: describe contraceptive utilization and correlates of incident pregnancy	Young women who practice SW and/or have multiple partners (all those recruited had practiced SW)	220	60.3% aged 25-29	Any hormonal (not LARC): 10.8% LARC: <1.0%	N/A	4 partners in last month	In last year: Physical or sexual violence by client: 26.0% Intimate partner: 20.1% In last 3 months: Stimulant drug use: 27.0% Abortion: 11.3%	HIV: 16.2%
Feldblum 2007[36]	Feldblum 2005[61] Hoke	Madagascar	2001	RCT	Assess impact of two condom promotion	FSWs	935	Mean 28.3	Any highly effective (excl. condoms):	No unprotected sex with any partners:	Mean 5-6 partners	N/A	CT: 14.6% GN: 21.7% TV: 11.7%

Study (first author, year)	Additional sources*	Country	Year commenced	Design	Aim	Population	N (FSWs) at baseline	Age (median)[b]	Current contraceptive use[c] (%)	Consistent condom used[d]	Number of sex partners/ frequency of sex[e]	GBV/ alcohol/ other risk factor	HIV/STI prevalence[f]
	2007[62]				interventions This sub-study: estimate pregnancy incidence rate and predictive factors				16.3%	13.2%			Any STI: 36.1% ¥
Kaewkungwal 2013[37]	Rerks-Ngarm 2009[63]	Thailand (2 provinces)	2003	RCT (multisite double blind placebo-controlled)	Assess the efficacy of 2 vaccines to prevent HIV This sub-study: determine the qualities and outcomes of women's participation	HIV-uninfected women (5% FSWs)	318	N/A	N/A	¶	N/A	¶	N/A
Kaul 2004[64]	Yadav 2005[65] Fonck 2000[66]	Kenya (Nairobi)	1998	RCT (double blind placebo-controlled	Assess impact of monthly PPT on HIV and STI incidence	HIV-uninfected FSWs	430	28.6 ¥	Any hormonal (not LARCs): 39.1%	17.2% with casual partner ¥	15.4 partners ¥	Daily alcohol: 47.6% Ever IV drug use: 4.1%	CT: 9.9% GN: 10.3% TV: 12.2% TP: 4.4% HSV2: 73.9% BV: 51.1%
Liu 2015[67]	Author[a]	China	2009	Cluster-RCT	Assess the impact of a preventive intervention for FSWs on condom use with clients and partners	FSWs	750	Mean 27.8 ¥	LARC: 29.9%	43.6% in past month	Mean 8.3 clients ¥	N/A	CT: 14.0% GN: 3.3% TP: 1.3% Any STI: 16.9%
McClelland 2011[38]	Author[a] Martin 1998[51] McClelland 2010[68]	Kenya (Mombasa)	1993	Open cohort	Assess HIV-1 incidence and relationships between hormonal contraception, STIs and HIV This sub-study: examine relationship between risk behaviour and biologic outcomes (STI, pregnancy, seminal fluid deposition) among HIV-positive FSWs	HIV-infected FSWs	898	31	Any (excl. condoms): 43.0% LARC: 2.34% Permanent: 2.67%	55% in past week	1 partner 2 sex acts	N/A	N/A
Price 2012[69]	Author[a]	Kenya (Nairobi, Kilifi)	2005	Prospective cohort	Describe populations at risk of HIV, including HIV incidence, in preparation for HIV trials	HIV-uninfected women and men at risk of HIV (75% of women were FSWs)	515	¶	N/A	N/A	N/A	¶	Any non-ulcerative STI: 9.1% Genital ulcers: 1.5% TP: 0.6% Any STI: 10.6%
Priddy 2011[70]		Kenya (Nairobi)	2008	Prospective cohort	Assess HIV risk behaviour & incidence, STI prevalence, vaginal practices, and retention	HIV-uninfected FSWs	200	Mean 28	Any non-barrier method: 52.0% LARC: 3.0% Permanent: 1.0%	N/A (only reported sometimes/always use)	Mean per day: 2.4 regular clients 1.9 casual clients	Sexual/physical violence related to SW in last month: 19.5% Sometimes/always paid more for no condom: 29.0% Sometimes/always has sex while	CT: 5.5% GN: 6.0% TV: 9.0% TP: 2.5% HSV2 (antibody): 72.0% BV: 38.0%

Study (first author, year)	Additional sources*	Country	Year commenced	Design	Aim	Population	N (FSWs) at baseline	Age (median)[b]	Current contraceptive use[c] (%)	Consistent condom use[d]	Number of sex partners/ frequency of sex[e]	GBV/ alcohol/ other risk factor	HIV/STI prevalence[f]
												intoxicated: 31.5%	
Robb 2016[71]	Author[a] Rono 2010[72]	Kenya, Tanzania, Uganda	2009	Prospective cohort	Describe the trajectory of acute HIV infection	HIV-uninfected women and men at high risk for HIV (64% FSWs)	1463	N/A	Any hormonal (incl. implant): 36.5% IUD: 0.5% Permanent: 0.5%	32.6% with clients 20.3% with non-paying partners	N/A	Abortion in last 3 months: 0.43%	N/A
Strathdee 2013[44]	Author[a] Vera 2012[73] Gaines 2013[74]	Mexico	2008	RCT (four-arm factorial)	Determine effectiveness of two behavioural interventions to reduce sexual and injecting risk	HIV-uninfected FSWs who inject drugs	584	33	Any (excl. condoms): 39.3% LARC: 25.3% Permanent: 17.8%	14.9% with regular clients 11.7% with casual clients	30 clients per month 51 paid sex acts per month	N/A	CT:12.0% GN: 2.2% TV: 33.6% TP (active): 8.4%
Van Damme 2002[75]	Author[a] Vandebosch 2004[76] Ramjee 2005[77]	Benin, Cote d'Ivoire, South Africa, Thailand	1996	RCT (multisite triple blind placebo-controlled; open cohort design)	Determine effectiveness of nonoxynol-9 microbicide in prevention of HIV-1	HIV-uninfected FSWs	892	26	N/A	N/A(only reported use of condom in >=50% of sex acts)	3 partners per day	N/A	CT: 4.4% GN: 5.1% TV: 3.5% TP: 11.2%
Van Loggeren-berg 2008[78]	Author[a] Naicker 2015[79]	South Africa (Durban)	2004	Prospective cohort	Understand HIV-1 subtype C acquisition, pathogenesis and disease progression This sub-study: describe cohort characteristics and HIV-incidence rates, and report challenges in establishing and maintaining the cohort	HIV-uninfected women who practice SW (79%) and/or have multiple partners	193	Mean 34.3	N/A	53.9% with casual partners 20.4% with steady partners	2 partners per week	N/A	Any STI (CT, GN, TV, MG, TP, HSV2): 31.3%
Vandepitte 2013[80]	Author[a] Vandepitte 2011[81]	Uganda (urban slum)	2008	Prospective cohort	Understand dynamics of HIV and STI infections among FSWs This sub-study: investigate the risk of clearance and recurrence of untreated M. genitalium infection	FSWs	1027	Mean 26	N/A	59.8% in last month	At least daily sex for money: 50.5%	Problem drinking: 55.7%	MG: 14%
Vielot 2015[82]	Author[a]	Kenya (Nairobi)	2009	Prospective cohort	Compare the duration of high risk HPV infection among FSWs by exposure to STIs, using a highly sensitive biomarker assay	FSWs	350	28	LARC: 15.5% Permanent: 2.1%	Most of the time/always: 73.8% with clients 24.6% with non-paying partners	10 partners per week	N/A	HIV: 24.0% CT: 3.8% GN: 2.3% TV: 7.3% MG: 12.8%

[a]'Author' indicates additional data was obtained from the author. Other references listed here reported on the same study and were used for data extraction.

[b]Median unless specified

[c]Any = modern contraceptive method including condoms, unless specified; LARC = long-acting reversible contraception (implants or IUDs); Permanent = any method of permanent contraception, e.g. tubal ligation or hysterectomy

[d]Always uses condoms (unless specified)

[e]Median number per week unless specified. Sex partners may be paying, non-paying, regular or casual, unless specified.
[f]CT = Chlamydia trachomatis; NG = Neisseria gonorrhoeae; TV = Trichomonas vaginalis; TP = Treponema pallidum (syphilis); HSV2 = Herpes simplex virus type 2; BV = Bacterial vaginosis; MG = Mycoplasma genitalium
N/A: Not measured or reported, data not available from author
¶ Not disaggregated by sex work status
¥ Reported results segregated by sub-group; data presented are overall estimates

Most RCTs in this review required women to remain non-pregnant for continuation.[37 41 43 45 50 54 64 75] The majority of studies (n=19) took place in sub-Saharan Africa, most frequently in Kenya (n=8; table 1). There were also studies from the Americas (Mexico and the Caribbean), and East Asia (China, Thailand and Cambodia). All except three[37 45 69] took place in urban settings. The study areas were frequently informal housing settlements, low-income areas or environments known for sex work and/or drug use.

Sex work was mainly defined as exchange of sex for money or goods (n=12) or money alone (n=4). In five studies, sex workers were self-identified, in two they were members of communities or working in areas known for commercial sex work,[37 54] and in two no definition was provided.[75 82] Eighteen studies involved FSWs exclusively; the remainder targeted women with high-risk sexual practices or at high risk of HIV. These studies either reported pregnancy incidence in the sex work sub-group,[37 43 45 71] or FSWs constituted more than two-thirds of the sample.[33 41 69 78] Fourteen studies were restricted to women without HIV at baseline, and one study to women living with HIV.[38]

Most studies (n=15) were conducted for one to two years, although they ranged from a one month pilot RCT[41] to a 15-year open cohort study.[38] The studies reporting pregnancy (intention undefined) tended to be of longer duration than those reporting unintended pregnancy (median duration 24 and 12 months, respectively; table 2).

Table 2: Results of included studies reporting unintended pregnancy and pregnancy (intention undefined) in ascending order of incidence.

Study	Incidence rate (per 100py)	95% Confidence interval	Person-years of exposure	Duration (months)	Measurement of pregnancy	Frequency of measurement	Quality (%)
Unintended pregnancy							
McClelland 2008[52]	7.2	4.5 – 10.9	305.4	12	Urine test	Monthly	40
Watson-Jones 2008[45]	11.8	9.7 – 14.5	796	30	Urine test	Quarterly on suspicion only	53
Gaffoor 2013[43]	13.4	6.1 – 25.4	67.2	24	Urine test	Quarterly	20
Behets 2008[41]	20.7	4.3 – 60.5	14.5	1	Urine test	Weekly	27
Braunstein 2011[33]	26.3	21.9 – 30.7	528.5	24	Serum test	6-monthly for 1 year + 1 measurement in 2nd year	60
Deschamps 2016[34]	27.3	23.3 – 31.7	615.6	18	Test (unspecified)	6-monthly	67
Chersich 2014[35]	28.0	22.6 – 34.3	335.8	12	Urine test	Quarterly	60
Peterson 2007[54]	51.7	44.9 – 59.3	400	12	Urine test	Monthly	40
Behets 2005[40]	53.0	21.0 – 110.0	13.2	2	Urine test	Monthly	40
Lara 2009[42]	59.6	41.7 – 82.5	60.4	4	Urine test	Monthly	40
Pregnancy (intention undefined)							
Robb 2016[71]	2.0	1.4 – 2.9	1619.6	24	Self-report	Quarterly on suspicion only	21
McClelland 2011[38]	2.7	2.1 – 3.5	2259.3	15 year open cohort £	Urine test	Monthly on suspicion only	21
Bazzi 2015[57]	3.3	1.4 – 5.2	359.6	24	Self-report	6-monthly	43
Strathdee 2013[44]	5.9	4.1 – 8.4	540.1	12	Self-report	4-monthly	36
Van Loggerenberg 2008[78]	8.5	5.6 – 11.5	376.5	24	Urine test	Monthly on suspicion only	36
Van Damme 2002[75]	8.6	6.7 – 10.8	837.5	<=24£	Urine test	Quarterly	29
Vielot 2015[82]	12.6	9.7 – 16.1	500.8	24	Urine test	Quarterly on suspicion only	50
Kaul 2004[64]	13.5	11.3 – 16.1	968.0	<=48£	N/A	N/A	21
Priddy 2011[70]	14.2	7.6 – 24.3	91.5	6	Urine test	Quarterly	36
Price 2012[69]	14.5	12.0 – 17.5	784.0	48	Urine test	Quarterly	43
Liu 2015[67]	15.2	10.4 – 21.5	210.3	6	Self-report	Quarterly	71
Kaewkungwal 2013[37]	15.8	13.0 – 19.0	721.0Ω	42	Urine test	N/A	43
Vandepitte 2013[80]	18.3	16.2 – 20.6	1467.0	>=24£	Urine test	N/A	50
Page 2013[39]	22.0	16.3 – 30.1	186.4	12	Self-report	Quarterly	50
Feldblum 2007[36]	23.4	20.6 – 26.5	1067.5	18	Urine test	6-monthly on suspicion only	43

£ Duration varied for different participants

N/A: Not measured or reported, data not available from author

Ω Person-time estimated by:

Person-time = (n_FSWs * yrs * retention) - (n_preg * yrs/2)

Where: n_FSWs = number of FSWs enrolled; yrs = study duration in years; retention = retention rate; n_preg = number of women who became pregnant

We could not use the approach advocated by Vandenbrouke et al[83] as average follow up time among FSWs was not known.

Baseline population characteristics

Most study populations had a median of five to eight years of education, and the majority of women were supporting at least one financial dependent (data not shown). Median duration in sex work was three to five years for most study populations, with one notable exception of 14 years in a study in Mexico.[44] Concurrent non-paying sex partners were common, reported by 30-100% of women in 12 studies.

Permanent and long-acting reversible contraceptive use was around one per cent in most studies in Africa, with only one study in Kenya reporting significantly higher coverage (17.5%).[82] By contrast, coverage of these methods was greater than 30% in China[67] and Mexico.[44 57] Consistent condom use was measured using diverse metrics, but was generally low, and very low with non-paying partners. Most studies reported frequent sex with multiple partners, and few reported a median of less than five partners per week.[38 50 59 78] High rates of gender-based violence were noted in all studies in which this was measured, as well as physical or financial pressure not to use condoms.[41 70]

While the factors described generally contributed to high baseline pregnancy risk, several studies included FSW with notably lower risk profiles. For example, two studies were part of a large Kenyan open cohort, in which participants had few partners and sex acts per work, older median age and lower STI prevalence than the other studies.[38 50] In addition, a number of studies provided insufficient information to assess population risk for pregnancy.

STIs, other than HIV, were prevalent with one study reporting up to 36% of the study population having at least one STI on biological testing.[36 61] HIV prevalence was reported in four studies and varied from 24% in Kenya[82] to less than 3% in Mexico[57] and Dominican Republic.[42]

Methodology and quality assessment

Quality scores, as percentages of the available total, are presented in table 2. The median quality score was 40% (inter quartile range (IQR)=36-50%). Four studies scored 60% or greater; three

of these measured unintended pregnancy[33-35] and one measured pregnancy (undefined).[67] Most studies scored poorly in the external validity and selection bias categories.

Measurement bias was an issue for some studies. Pregnancy was tested regularly in all but one[45] of the unintended pregnancy studies; in contrast, five pregnancy (undefined) studies only measured it if suspected by the clinician or participant. Five of the pregnancy (undefined) studies measured pregnancy using self-report rather than a biological test.

Incidence of pregnancy

Incidence rate was reported by 14 studies, and calculated for the remainder based on the available data, with the number of women who became pregnant as the numerator and person-years as the denominator. Women were censored at the time they became pregnant. The one exception was Deschamps et al,[34] who counted multiple pregnancies, and subtracted pregnancy time from total person-time.

Unintended pregnancy incidence rate (outcome 1) varied widely between studies, ranging from 7.2 to 59.6 pregnancies per 100 person-years (table 2; figure 2). The median rate of the 10 studies was 26.8, and seven reported a rate of greater than 20 per 100 person-years.

Incidence rate of pregnancy (intention undefined – outcome 2) also varied widely, but rates were lower overall than unintended pregnancy, ranging from 2.0 to 23.4 per 100 person-years (table 2). The median rate of the 15 studies was 13.5, and only two reported a rate of greater than 20 per 100 person-years.

Meta-analyses

Random effects meta-analyses were performed for the two primary outcomes. Heterogeneity was high, with I-squared statistic over 95% for both outcomes.

Incidence of unintended pregnancy

Explored covariates which may explain the high heterogeneity of unintended pregnancy incidence showed that geographical region did not explain this, whereas presence/absence of

an intervention seemed important. The three cohort studies that did not involve an intervention had very low heterogeneity (I-squared=0%), and the pooled estimate for these studies was 27.1 unintended pregnancies per 100 person-years (95%CI=24.4-29.8; figure 3). These three studies scored at least 60% on quality assessment (table 2).

Assessment of potential methodological explanations showed that study design (RCT versus cohort), and study duration seemed important sources of heterogeneity, while pregnancy measurement method did not explain the high heterogeneity. The cohort studies were more homogenous than the RCTs (I-squared=63.9% and 96.8% respectively), and had higher pooled incidence of unintended pregnancy (figure 4). The three studies of less than one year duration were more homogenous (I-squared=59.1%), and had higher incidence (44.5 per 100 person-years) than longer studies (figure 5).

Quality was not found to be a source of heterogeneity, as no relationship was demonstrated between study quality score and unintended pregnancy incidence rate (Pearson correlation coefficient 0.01; scatter plot not shown).

Incidence of pregnancy (intention undefined)

Sub-group analyses showed that study duration and geographic region were sources of heterogeneity for rates of pregnancy where intention was not known. Pregnancy measurement method and study design characteristics did not account for any heterogeneity for this outcome.

There were only two studies of less than one year duration[67 70] (I-squared 0%). As with the unintended pregnancy outcome, these studies had a higher pooled incidence than studies of more than one year duration (14.9 vs. 11.4 per 100 person-years).

A sub-analysis of geographic region showed that studies from Asia and the Americas (both in Mexico) were more homogenous (I-squared=29.8% and 68.1% respectively) than those from sub-Saharan Africa (I-squared=98.3%). The pooled incidence of pregnancy was higher in Asia (16.8 per 100 person-years) and lower in Mexico (4.8 per 100 person-years; figure 6).

A scatter plot demonstrated a weak positive relationship between quality score and incidence rate (plot not shown; Pearson correlation coefficient 0.55).

Secondary outcomes

Three studies assessed pregnancy outcomes for FSWs (table 3). In two of the studies, outcomes were unknown for about 25% of pregnancies (in the Caribbean[34] and Madagascar,[36]) resulting in underestimates of birth and abortion incidence. Abortion accounted for less than 20% of pregnancies with known outcomes. In contrast, in the third study, a multi-country study,[75] 62 abortions were recorded as adverse events (author correspondence), compared to only 10 reported as withdrawing from the study due to pregnancy, suggesting that over 85% of the total women who became pregnant reported an abortion.

Table 3: Incidence of abortion and birth

Study	Site	Outcome	Incidence of pregnancy	Incidence of birth	Incidence of abortion	Abortion (as proportion of pregnancies with known outcome)
Deschamps 2016[34]	Haiti, Puerto Rico, Dominican Republic	Unintended pregnancy	27.3	15.1	3.1	16%
Feldblum 2007[36]	Madagascar	Pregnancy (intention undefined)	23.4	11.9	3.0	17%
Van Damme 2002[75]	Benin, Cote d'Ivoire, South Africa, Thailand	Pregnancy (intention undefined)	8.6	Not measured	7.4	>85%

Four studies developed multivariate regression models to determine the predictors of pregnancy[36 38] or unintended pregnancy.[5 34] Common findings were that younger age was associated with higher pregnancy incidence,[5 34 36] and that highly effective contraceptive use[36]

and consistent condom use[36 38] were protective; however one study in Kenya found that using condoms at the exclusion of other methods was a risk factor.[5] Having a main or emotional partner increased the odds of unintended pregnancy,[5 34] but not of pregnancy (intention undefined).[36 38] Deschamps et al noted some additional associations, including recreational drug use and male partners having other sex partners being protective against pregnancy. Only one study assessed reproductive history and income,[5] and none considered HIV status, as potential predictors or confounders.

DISCUSSION

This review found that of the many studies examining FSWs' sexual and reproductive health in LMICs, very few have measured pregnancy, and even fewer have assessed pregnancy intention. While incidence varies widely between the included studies, it is sufficiently high in most low- and middle-income contexts to constitute a significant health and social issue for FSWs.

Study design impacted on unintended pregnancy rates, with a lower rate seen in RCTs (20.8 per 100 person-years) than cohort studies (29.6 per 100 person-years). Most of the RCTs in this review required women to remain non-pregnant for continuation[37 41 43 45 50 54 64 75] and although only six RCTs specifically mentioned providing contraceptive counselling or methods, others may have offered a larger package of services that was not reported.

To better understand the influence of services provided by studies, we compared studies that provided any intervention with those that did not, and found that the three studies in the latter category had very low heterogeneity and high pooled unintended pregnancy incidence (27 per 100 person-years). As non-intervention cohort studies with quality scores of at least 60%, these were arguably the best designed to answer the review question.

The included studies may have under-estimated population incidence of pregnancy, for several reasons. First, studies that only tested for pregnancy on suspicion could have missed early pregnancies or failed to ascertain the need to test. Second, pregnancies occurring between study

visits and ending in spontaneous or induced abortion may have been missed. Third, social desirability bias is likely to influence self-reporting of pregnancy in studies using that measure. Fourth, participants may have joined some studies in order to access services, potentially receiving superior family planning services than would otherwise be accessible.[84] Finally, there may be selective loss to follow up among women who become pregnant, particularly in drug trials requiring women to remain non-pregnant for continuation.[37 41 43 45 50 54 64 75] It is possible that these factors were more prominent in the studies measuring pregnancy without defining intention, contributing to the surprising finding that this outcome had generally lower incidence rates than unintended pregnancy.

Some 'unintended' pregnancies may in fact have been intended, because women may have been unsure about their intention or it changed over time.[28] Only one study assessed intention repeatedly,[35] and none used a validated instrument designed to measure this complex latent construct.[85] Some participants may have wanted a pregnancy, but felt pressure to say otherwise, depending on the social environment, external and internal stigma, and the study design; for example, if they wanted to access HIV prevention and other services through the study, but inclusion was restricted to those not wanting to get pregnant.

Conversely, it is likely that most women in the undefined intention category (outcome 2) who became pregnant may not have intended to do so. During recruitment for a pregnancy prevention intervention trial with FSWs in Kenya,[6] less than 1% of those interested in taking part were planning to get pregnant in the next year (unpublished data). Similarly, in a cohort study included in this review, only 4% of participants expressed an intention to get pregnant at some point during the 12-month follow up.[5 35] A study in South Africa found a higher proportion (10%) wishing to conceive, but this is still a small minority of FSWs. While immediate pregnancy intentions may be low, however, future fertility preferences may be comparable to other women,[86] and several authors have highlighted the need for appropriate services that promote safe conception and address FSWs' need for different forms of protection with different partners.[23-25 86]

Quality scores were low, but it is important to note that we were assessing how well the studies answered *our* research question, rather than their own stated objectives. However, there was a notable absence of well-described sampling and recruitment techniques, suggesting that study populations may have been poorly representative of local FSW populations. This may have underestimated pregnancy incidence, as more marginalised members of the population, who are at greater sexual risk, are harder to reach and recruit by convenience or snowball methods. Indeed, the only study to use a random sampling approach found moderately high incidence of pregnancy (intention undefined; 15 per 100 person-years), despite 30% IUD coverage in this population.[67] Furthermore, inclusion criteria limiting more than half of the studies to HIV negative women contributed to selection bias, particularly in sub-Saharan African studies, where HIV prevalence among FSWs is estimated at 37%.[87] This may partly explain the observation that pregnancy incidence in sub-Saharan Africa was lower than Asia, despite the fact that total population fertility rates are lower in Asia. Higher quality scores seen in the Asian studies may also account for this discrepancy.

Quantitative analysis identified study duration as a clear contributor to heterogeneity in both outcomes. Incidence was lower in shorter studies, and decreased over time within studies that reported incidence at multiple time points.[33 36] This is due in part to the analytical approach, taken by all but one study,[34] of censoring women's person-time when they first become pregnant. As study subjects at highest risk fall pregnant early, they are censored early and cannot contribute additional pregnancies to the numerator. The remaining lower-risk women are less likely to experience the outcome. The same phenomenon has been observed in closed cohorts with the outcome of HIV incidence.[88] In addition, sexual risk behaviours often reduce over time in longitudinal studies, because of social desirability bias or health education from study participation,[34 37] or attrition bias,[89] which may have been a factor for twelve studies in this review with low or unreported retention rates among FSWs.

While measurement bias did not emerge as a significant source of heterogeneity, there was ambiguity in the reporting of pregnancy measurement, and it was often dependent on authors'

recollections. There was a weak positive association between study quality and incidence rates in the pregnancy (intention undefined) group. The lack of a clear relationship may be because quality issues can result in either an under-or overestimate of incidence.

Limitations

This review had a number of limitations. Foremost was the inclusion of studies in which (unintended) pregnancy incidence was not an *a priori* objective, which was the case for all but one. This likely resulted in methodological issues affecting participant selection and pregnancy measurement.

We also adopted a broad approach to other inclusion criteria. Several studies conducted in the late 1990s and early 2000s were included, which may be problematic as family planning coverage has grown and fertility rates declined since that time. The heavy reliance on authors to provide unreported data was a limitation and may have introduced bias, and older data often could not be accessed.

We used a broad definition of sex work, which may have increased the heterogeneity of the outcomes. However, this definition reflects the reality that there are many reasons for women to sell sex, which depend on local laws, culture and economies, and to arbitrarily limit to full time sex workers, for example, may exclude studies of 'hidden' FSWs who are often especially vulnerable.[90 91]

Our analysis was limited by high heterogeneity, which prevented us from pooling overall rates or performing meta-regression to tease out the influence of different variables. Heterogeneity was not fully explained by explorative sub-analyses, and may in part be due to the low number of studies, low quality, and incomplete data on risk factors. It should be noted that interpretation of these descriptive heterogeneity statistics require a certain level of caution, specifically where the number of cases is small. Variations in baseline population risk probably contributed significantly to heterogeneity, but these could not be quantified due to the incomplete and/or inconsistent measurement of risk factors between studies. Cultural, legal

and economic contexts, such as cultural norms around motherhood and abortion law, also vary considerably between the different settings in which the studies took place, and influence fertility preferences, expression of pregnancy intention and access to prevention methods and abortion. These contextual factors could not be accounted for in our analysis.

Another limitation was that we were unable to directly compare rates of pregnancy between FSWs and other populations. Very high pregnancy incidence has been observed in HIV studies among women not categorised as sex workers,[55 92] however these women were at high risk for HIV for other reasons (e.g. multiple partners). Among the general population, unintended pregnancy incidence is estimated at 5.4 per 100 person-years in the developing world, and 8 in Africa, substantially lower than the rates among FSWs presented here. Of the three studies in this review which reported incidence for a broader study population as well as an FSW subgroup, two reported higher incidence[37 43] and one reported approximately equal incidence[45] in the FSW sub-group compared to the whole study population.

Conclusion

Ultimately, this review demonstrates a concerning lack of research on an issue which is a priority for many FSWs in low-resource settings. This is surprising, as we found many studies on HIV incidence and prevention in this population, for which unintended pregnancy is both relevant to the primary outcome and may indicate overall sexual risk. There has been a modest increase in family planning availability for women in many countries since the early 2000s,[93 94] however this has not been accompanied by research on whether these additional services have reached FSW populations, or impacted on pregnancy rates. Access to family planning, particularly long-acting reversible contraceptives, may be improved by better targeting of FSWs through mobile outreach[95] and integration with existing FSW-specific HIV prevention services, and by careful training of health workers and community workers in contraceptive counselling and follow-up.[95] Also, it is important to make concerted efforts to link FSWs who become

pregnant with maternal health services, including services for antiretroviral treatment and preventing HIV transmission to infants.

This review found that studies measuring pregnancy incidence among FSWs were of low overall methodological quality and had highly varied results, but that unintended pregnancy incidence was high overall and, based on available data, higher than the general population. There is an urgent need for quality research on unintended pregnancy incidence, the effectiveness of interventions to reduce it, and the best models of reproductive health service provision for this large and stigmatised population.

LIST OF FIGURES

SUPPLEMENTARY MATERIAL

"Supplementary file" contains:

1. Complete search strategy

2. Quality assessment tool

ACKNOWLEDGEMENTS

We would like to acknowledge the many study authors who responded to our queries, in particular the following who provided additional data (in alphabetical order): Daniela Abramovitz, Kathy Baisley, Frieda Behets, Liviana Calzavara, Putu Duff, Paul Feldblum, James Iveniuk, Rupert Kaul, Diana Lara, Qun Li, Kate MacQueen, R. Scott McClelland, Mark Milazzo, Kimberly Page, Matt Price, Barbra Richardson, Merlin L. Robb, Steffanie Strathdee, Douglas Taylor, Abigail Norris Turner, Lut Van Damme, Francois Van Loggerenberg, Judith Vandepitte, Nadja Alexandra Vielot, Handan Wand, Deborah Watson-Jones, and Helen Weiss.

We also thank senior librarian Lorena Romero at the Ian Potter library, who assisted with building the search strategy, and Professor Rory Wolfe, who provided additional statistical advice.

AUTHOR CONTRIBUTIONS

FHA, SL and MSCL conceived of and designed the study. All authors contributed to the protocol. FHA performed the search, screening, data extraction and analysis, and drafted the manuscript. MC advised on search strategy. LW performed duplicate screening and extraction. PA advised on analytical methods. All authors reviewed drafts and approved the final manuscript.

COMPETING INTERESTS

The authors declare that they have no competing interests.

FUNDING

This work was supported by the Australian National Health and Medical Research Council (NHMRC), which provided funding for the study (Project Grant GNT 1087006), a Career Development Fellowship for S. Luchters and a Postgraduate Scholarship for F. Ampt.

DATA SHARING STATEMENT

There are no additional data available.

REFERENCES

1. Singh S, Darroch JE, Ashford LS. Adding it up: The costs and benefits of investing in sexual and reproductive health 2014. New York: Guttmacher Institute, 2014.

2. Hall JA, Benton L, Copas A, et al. Pregnancy Intention and Pregnancy Outcome: Systematic Review and Meta-Analysis. *Matern Child Health J* 2017;21(3):670-704. doi: 10.1007/s10995-016-2237-0 [published Online First: 2017/01/18]

3. Gipson JD, Koenig MA, Hindin MJ. The Effects of Unintended Pregnancy on Infant, Child, and Parental Health: A Review of the Literature. *Studies in Family Planning* 2008;39(1):18-38.

4. Khan MR, Turner AN, Pettifor A, et al. Unmet need for contraception among sex workers in Madagascar. *Contraception* 2009;79(3):221-7. doi: http://dx.doi.org/10.1016/j.contraception.2008.09.011

5. Luchters S, Bosire W, Feng A, et al. "A baby was an added burden": predictors and consequences of unintended pregnancies for female sex workers in Mombasa, Kenya: a mixed-methods study. *PLoS ONE* 2016;11(9):e0162871. doi: 10.1371/journal.pone.0162871 [published Online First: 2016/10/01]

6. Ampt FH, Mudogo C, Gichangi P, et al. WHISPER or SHOUT study: protocol of a cluster-randomised controlled trial assessing mHealth sexual reproductive health and nutrition

interventions among female sex workers in Mombasa, Kenya. *BMJ Open* 2017;7(8):e017388. doi: 10.1136/bmjopen-2017-017388 [published Online First: 2017/08/20]

7. Morineau G, Neilsen G, Heng S, et al. Falling through the cracks: Contraceptive needs of female sex workers in Cambodia and Laos. *Contraception* 2011;84(2):194-98.

8. Scorgie F, Chersich MF, Ntaganira I, et al. Socio-demographic characteristics and behavioral risk factors of female sex workers in sub-saharan Africa: a systematic review. *AIDS and behavior* 2012;16(4):920-33. doi: 10.1007/s10461-011-9985-z

9. Okal J, Stadler J, Ombidi W, et al. Secrecy, disclosure and accidental discovery: perspectives of diaphragm users in Mombasa, Kenya. *Culture, health & sexuality* 2008;10(1):13-26. doi: 10.1080/13691050701519730 [published Online First: 2007/11/27]

10. Okal J, Chersich MF, Tsui S, et al. Sexual and physical violence against female sex workers in Kenya: a qualitative enquiry. *AIDS care* 2011;23(5):612-8. doi: 10.1080/09540121.2010.525605

11. Erickson M, Goldenberg SM, Ajok M, et al. Structural determinants of dual contraceptive use among female sex workers in Gulu, northern Uganda. *International Journal of Gynecology and Obstetrics* 2015;131(1):91-95.

12. Yam EA, Okal J, Musyoki H, et al. Kenyan female sex workers' use of female-controlled nonbarrier modern contraception: do they use condoms less consistently? *Contraception* 2016;93(3):222-25. doi: https://doi.org/10.1016/j.contraception.2015.11.010

13. Maher L, Mooney-Somers J, Phlong P, et al. Condom negotiation across different relationship types by young women engaged in sex work in Phnom Penh, Cambodia. *Global public health* 2013;8(3):270-83. doi: 10.1080/17441692.2013.767930

14. Chow EP, Muessig KE, Yuan L, et al. Risk behaviours among female sex workers in China: a systematic review and data synthesis. *PLoS One* 2015;10(3):e0120595. doi: 10.1371/journal.pone.0120595

15. Lim MSC, Zhang X-D, Kennedy E, et al. Sexual and Reproductive Health Knowledge, Contraception Uptake, and Factors Associated with Unmet Need for Modern Contraception among Adolescent Female Sex Workers in China. *PLoS ONE* 2015;10(1):e0115435. doi: 10.1371/journal.pone.0115435

16. Williamson LM, Parkes A, Wight D, et al. Limits to modern contraceptive use among young women in developing countries: a systematic review of qualitative research. *Reproductive health* 2009;6:3. doi: 10.1186/1742-4755-6-3

17. Khan MR, Turner AN, Pettifor A, et al. Unmet need for contraception among sex workers in Madagascar. *Contraception* 2009;79(3):221-7. doi: 10.1016/j.contraception.2008.09.011

18. Dhana A, Luchters S, Moore L, et al. Systematic review of facility-based sexual and reproductive health services for female sex workers in Africa. *Globalization and health* 2014;10(1):46-46. doi: 10.1186/1744-8603-10-46

19. Moore L, Chersich MF, Steen R, et al. Community empowerment and involvement of female sex workers in targeted sexual and reproductive health interventions in Africa: a systematic review. *Globalization and Health* 2014;10(1):47. doi: 10.1186/1744-8603-10-47

20. Slabbert M, Venter F, Gay C, et al. Sexual and reproductive health outcomes among female sex workers in Johannesburg and Pretoria, South Africa: Recommendations for public health programmes. *BMC Public Health* 2017;17(3):442. doi: 10.1186/s12889-017-4346-0

21. Scorgie F, Nakato D, Harper E, et al. 'We are despised in the hospitals': sex workers' experiences of accessing health care in four African countries. *Culture, Health and Sexuality* 2013;15(4):450-65. doi: http://dx.doi.org/10.1080/13691058.2012.763187

22. Mtetwa S, Busza J, Chidiya S, et al. You are wasting our drugs: health service barriers to HIV treatment for sex workers in Zimbabwe. *BMC Public Health* 2013;13:698. doi: http://dx.doi.org/10.1186/1471-2458-13-698

23. Beckham SW, Shembilu CR, Brahmbhatt H, et al. Female sex workers' experiences with intended pregnancy and antenatal care services in southern Tanzania. *Stud Fam Plann* 2015;46(1):55-71. doi: 10.1111/j.1728-4465.2015.00015.x [published Online First: 2015/03/11]

24. Center for Health and Gender Equity. All women, all rights, sex workers included. Washington, DC: CHANGE, 2016.

25. Duff P, Shoveller J, Feng C, et al. Pregnancy intentions among female sex workers: recognising their rights and wants as mothers. *J Fam Plann Reprod Health Care* 2015;41(2):102-8. doi: 10.1136/jfprhc-2012-100532

26. Kendall T, Albert C. Experiences of coercion to sterilize and forced sterilization among women living with HIV in Latin America. *Journal of the International AIDS Society* 2015;18(1):19462. doi: 10.7448/IAS.18.1.19462

27. Zampas C, Lamackova A. Forced and coerced sterilization of women in Europe. *Int J Gynaecol Obstet* 2011;114(2):163-6. doi: 10.1016/j.ijgo.2011.05.002 [published Online First: 2011/06/21]

28. Aiken ARA, Borrero S, Callegari LS, et al. Rethinking the Pregnancy Planning Paradigm: Unintended Conceptions or Unrepresentative Concepts? *Perspectives on Sexual and Reproductive Health* 2016;48(3):147-51. doi: 10.1363/48e10316

29. Moher D, Liberati A, Tetzlaff J, et al. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *BMJ* 2009;339:b2535. doi: 10.1136/bmj.b2535

30. The World Bank Group. World Bank Country and Lending Groups 2016 [Available from: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519 accessed 10 January 2016.

31. Santelli J, Rochat R, Hatfield-Timajchy K, et al. The measurement and meaning of unintended pregnancy. *Perspectives on sexual and reproductive health* 2003;35(2):94-101. doi: 10.1363/3509403

32. Munn Z, Moola S, Riitano D, et al. The development of a critical appraisal tool for use in systematic reviews addressing questions of prevalence. *International Journal of Health Policy and Management* 2014;3:123-28.

33. Braunstein SL, Ingabire CM, Kestelyn E, et al. High human immunodeficiency virus incidence in a cohort of Rwandan female sex workers. *Sexually Transmitted Diseases* 2011;38(5):385-94.

34. Deschamps MM, Metch B, Morgan CA, et al. Feasibility of Identifying a Female Sex Worker Cohort at High Risk of HIV Infection in the Caribbean for HIV Vaccine Efficacy Trials: Longitudinal Results of HVTN 907. *Journal of Acquired Immune Deficiency Syndromes* 2016;71(1):70-77.

35. Chersich MF, Bosire W, King'ola N, et al. Effects of hazardous and harmful alcohol use on HIV incidence and sexual behaviour: a cohort study of Kenyan female sex workers. *Globalization and health* 2014;10:22.

36. Feldblum PJ, Nasution MD, Hoke TH, et al. Pregnancy among sex workers participating in a condom intervention trial highlights the need for dual protection. *Contraception* 2007;76(2):105-10. doi: http://dx.doi.org/10.1016/j.contraception.2007.04.009

37. Kaewkungwal J, Pitisuttithum P, Rerks-Ngarm S, et al. Issues in women's participation in a phase III community HIV vaccine trial in Thailand. *AIDS Research and Human Retroviruses* 2013;29(11):1524-34.

38. McClelland RS, Richardson BA, Wanje GH, et al. Association between participant self-report and biological outcomes used to measure sexual risk behavior in human immunodeficiency virus-1-seropositive female sex workers in Mombasa, Kenya. *Sexually Transmitted Diseases* 2011;38(5):429-33.

39. Page K, Stein E, Sansothy N, et al. Sex work and HIV in Cambodia: trajectories of risk and disease in two cohorts of high-risk young women in Phnom Penh, Cambodia. *BMJ Open* 2013;3(9):e003095. doi: 10.1136/bmjopen-2013-003095

40. Behets F, Norris Turner A, Van Damme K, et al. Acceptability and feasibility of continuous diaphragm use among sex workers in Madagascar. *Sexually Transmitted Infections* 2005;81(6):472-76.

41. Behets FM, Turner AN, Van Damme K, et al. Vaginal microbicide and diaphragm use for sexually transmitted infection prevention: a randomized acceptability and feasibility study among high-risk women in Madagascar. *Sex Transm Dis* 2008;35(9):818-26. doi: 10.1097/OLQ.0b013e318175d8ab

42. Lara DK, Grossman DA, Munoz JE, et al. Acceptability and use of the female condom and diaphragm among sex workers in Dominican Republic: Results from a prospective study. *AIDS Education and Prevention* 2009;21(6):538-51.

43. Gaffoor Z, Wand H, Daniels B, et al. High risk sexual behaviors are associated with sexual violence among a cohort of women in Durban, South Africa. *BMC Research Notes* 2013;6:532. doi: http://dx.doi.org/10.1186/1756-0500-6-532

44. Strathdee SA, Abramovitz D, Lozada R, et al. Reductions in HIV/STI Incidence and Sharing of Injection Equipment among Female Sex Workers Who Inject Drugs: Results from a Randomized Controlled Trial. *PLoS ONE* 2013;8 (6) (no pagination)(e65812)

45. Watson-Jones D, Weiss HA, Rusizoka M, et al. Effect of herpes simplex suppression on incidence of HIV among women in Tanzania. *New England Journal of Medicine* 2008;358(15):1560-71. doi: 10.1056/NEJMoa0800260

46. Penman-Aguilar A, Legardy-Williams J, Turner AN, et al. Effect of treatment assignment on intravaginal cleansing in a randomized study of the diaphragm with candidate microbicide. *Journal of Women's Health* 2011;20(2):187-95.

47. Braunstein SL, Ingabire CM, Geubbels E, et al. High burden of prevalent and recently acquired HIV among female sex workers and female HIV voluntary testing center clients in Kigali, Rwanda. *PLoS ONE* 2011;6(9):[10] p. doi: http://dx.doi.org/10.1371/journal.pone.0024321

48. Deschamps MM, Zorrilla CD, Morgan CA, et al. Recruitment of Caribbean female commercial sex workers at high risk of HIV infection. *Revista panamericana de salud publica = Pan American journal of public health* 2013;34(2):92-98.

49. Skoler-Karpoff S, Ramjee G, Ahmed K, et al. Efficacy of Carraguard for prevention of HIV infection in women in South Africa: a randomised, double-blind, placebo-controlled trial. *The Lancet* 2008;372(9654):1977-87. doi: http://dx.doi.org/10.1016/S0140-6736(08)61842-5

50. McClelland RS, Richardson BA, Hassan WM, et al. Improvement of vaginal health for Kenyan women at risk for acquisition of human immunodeficiency virus type 1: Results of a randomized trial. *Journal of Infectious Diseases* 2008;197(10):1361-68. doi: http://dx.doi.org/10.1086/587490

51. Martin HL, Nyange PM, Richardson BA, et al. Hormonal Contraception, Sexually Transmitted Diseases, and Risk of Heterosexual Transmission of Human Immunodeficiency Virus Type 1. *The Journal of Infectious Diseases* 1998;178(4):1053-59.

52. McClelland RS, Richardson BA, Graham SM, et al. A prospective study of risk factors for bacterial vaginosis in HIV-1-seronegative African women. *Sexually Transmitted Diseases* 2008;35(6):617-23. doi: http://dx.doi.org/10.1097/OLQ.0b013e31816907fa

53. McClelland RS, Richardson BA, Hassan WM, et al. Prospective study of vaginal bacteria flora and other risk factors for vulvovaginal candidiasis. *Journal of Infectious Diseases* 2009;199(12):1883-90.

54. Peterson L, Taylor D, Roddy R, et al. Tenofovir Disoproxil Fumarate for Prevention of HIV Infection in Women: A Phase 2, Double-Blind, Randomized, Placebo-Controlled Trial. *PLoS Clinical Trials* 2007;2(5):e27. doi: 10.1371/journal.pctr.0020027

55. Macqueen KM, Johnson L, Alleman P, et al. Pregnancy prevention practices among women with multiple partners in an HIV prevention trial. *Journal of Acquired Immune Deficiency Syndromes: JAIDS* 2007;46(1):32-8.

56. Odutola A, Baisley K, Hayes RJ, et al. Pregnancy and contraceptive use among women participating in an HIV prevention trial in Tanzania. *Sex Transm Infect* 2012;88(6):436-43. doi: 10.1136/sextrans-2011-050412

57. Bazzi AR, Rangel G, Martinez G, et al. Incidence and predictors of HIV and sexually transmitted infections among female sex workers and their intimate male partners in northern Mexico: A longitudinal, multilevel study. *American Journal of Epidemiology* 2015;181(9):723-31.

58. Syvertsen JL, Robertson AM, Abramovitz D, et al. Study protocol for the recruitment of female sex workers and their non-commercial partners into couple-based HIV research. *BMC Public Health* 2012;12(1):1-16. doi: 10.1186/1471-2458-12-136

59. Duff P, Evans JL, Stein ES, et al. High pregnancy incidence and low contraceptive use among a prospective cohort of female entertainment and sex workers in Phnom Penh, Cambodia. *BMC Pregnancy and Childbirth* 2018;18(1):128. doi: 10.1186/s12884-018-1768-3

60. Couture MC, Sansothy N, Sapphon V, et al. Young women engaged in sex work in Phnom Penh, Cambodia, have high incidence of HIV and sexually transmitted infections, and amphetamine-type stimulant use: new challenges to HIV prevention and risk. *Sexually Transmitted Diseases* 2011;38(1):33-39. doi: http://dx.doi.org/10.1097/OLQ.0b013e3182000e47

61. Feldblum PJ, Hatzell T, Van Damme K, et al. Results of a randomised trial of male condom promotion among Madagascar sex workers. *Sexually Transmitted Infections* 2005;81:166-73.

62. Hoke TH, Feldblum PJ, Van Damme K, et al. Temporal trends in sexually transmitted infection prevalence and condom use following introduction of the female condom to Madagascar sex workers. *International Journal of STD and AIDS* 2007;18(7):461-66. doi: http://dx.doi.org/10.1258/095646207781147175

63. Rerks-Ngarm S, Pitisuttithum P, Nitayaphan S, et al. Vaccination with ALVAC and AIDSVAX to Prevent HIV-1 Infection in Thailand. *New England Journal of Medicine* 2009;361(23):2209-20. doi: 10.1056/NEJMoa0908492

64. Kaul R, Kimani J, Nagelkerke NJ, et al. Monthly antibiotic chemoprophylaxis and incidence of sexually transmitted infections and HIV-1 infection in Kenyan sex workers: A randomized controlled trial. *Journal of the American Medical Association* 2004;291(21):2555-62.

65. Yadav G, Saskin R, Ngugi E, et al. Associations of sexual risk taking among Kenyan female sex workers after enrollment in an HIV-1 prevention trial. *Journal of Acquired Immune Deficiency Syndromes* 2005;38(3):329-34.

66. Fonck K, Kaul R, Kimani J, et al. A randomized, placebo-controlled trial of monthly azithromycin prophylaxis to prevent sexually transmitted infections and HIV-1 in Kenyan sex workers: study design and baseline findings. *International Journal of STD and AIDS* 2000;11(12):804-11.

67. Liu J, Calzavara L, Mendelsohn JB, et al. Impact evaluation of a community-based intervention to reduce risky sexual behaviour in female sex workers in Shanghai, China. *BMC Public Health* 2015;15:147. doi: http://dx.doi.org/10.1186/s12889-015-1439-5

68. McClelland R, Graham SM, Richardson BA, et al. Treatment with antiretroviral therapy is not associated with increased sexual risk behavior in Kenyan female sex workers. *Aids* 2010;24(6):891-97.

69. Price MA, Rida W, Mwangome M, et al. Identifying at-risk populations in kenya and south africa: HIV incidence in cohorts of menwho report sex with men, sex workers, and youth. *Journal of Acquired Immune Deficiency Syndromes* 2012;59(2):185-93.

70. Priddy FH, Wakasiaka S, Hoang TD, et al. Anal sex, vaginal practices, and HIV incidence in female sex workers in Urban Kenya: Implications for the development of intravaginal HIV prevention methods. *AIDS Research and Human Retroviruses* 2011;27(10):1067-72.

71. Robb ML, Eller LA, Kibuuka H, et al. Prospective Study of Acute HIV-1 Infection in Adults in East Africa and Thailand. *New England Journal of Medicine* 2016;374(22):2120-30. doi: doi:10.1056/NEJMoa1508952

72. Rono K, Sanga E, Sekiziyivu A, et al. RV 217: The early capture HIV cohort study (ECHO): A prospective study of acute HIV infection among high risk populations. *AIDS Research and Human Retroviruses* 2010;26 (10):A33.

73. Vera A, Abramovitz D, Lozada R, et al. Mujer Mas Segura (Safer Women): a combination prevention intervention to reduce sexual and injection risks among female sex workers who inject drugs. *BMC public health* 2012;12:653.

74. Gaines TL, Rudolph AE, Brouwer KC, et al. The longitudinal association of venue stability with consistent condom use among female sex workers in two Mexico-USA border cities. *International Journal of STD & AIDS* 2013;24(7):523-9.

75. Van Damme L, Ramjee G, Alary M, et al. Effectiveness of COL-1492, a nonoxynol-9 vaginal gel, on HIV-1 transmission in female sex workers: a randomised controlled trial.[Erratum appears in Lancet 2002 Dec 7;360(9348):1892]. *Lancet* 2002;360(9338):971-7.

76. Vandebosch A, Goetghebeur E, Ramjee G, et al. Acceptability of COL-1492, a vaginal gel, among sex workers in one Asian and three African cities. *Sexually Transmitted Infections* 2004;80(3):241-43.

77. Ramjee G, Williams B, Gouws E, et al. The impact of incident and prevalent herpes simplex virus-2 infection on the incidence of HIV-1 infection among commercial sex workers in South Africa. *Journal of Acquired Immune Deficiency Syndromes* 2005;39(3):333-39.

78. van Loggerenberg F, Mlisana K, Williamson C, et al. Establishing a cohort at high risk of HIV infection in South Africa: Challenges and experiences of the CAPRISA 002 Acute Infection Study. *PLoS One* 2008;3(4):e1954. doi: http://dx.doi.org/10.1371/journal.pone.0001954

79. Naicker N, Kharsany AB, Werner L, et al. Risk factors for HIV acquisition in high risk women in a generalised epidemic setting. *AIDS and Behavior* 2015;19(7):1305-16. doi: http://dx.doi.org/10.1007/s10461-015-1002-5

80. Vandepitte J, Weiss HA, Kyakuwa N, et al. Natural history of mycoplasma genitalium infection in a cohort of female sex workers in Kampala, Uganda. *Sexually Transmitted Diseases* 2013;40(5):422-27.

81. Vandepitte J, Bukenya J, Weiss HA, et al. HIV and other sexually transmitted infections in a cohort of women involved in high-risk sexual behavior in Kampala, Uganda. *Sexually Transmitted Diseases* 2011;38(4):316-23.

82. Vielot N, Hudgens MG, Mugo N, et al. The role of chlamydia trachomatis in high-risk human papillomavirus persistence among female sex workers in Nairobi, Kenya. *Sexually Transmitted Diseases* 2015;42(6):305-11.

83. Vandenbroucke JP, Pearce N. Incidence rates in dynamic populations. *International Journal of Epidemiology* 2012;41(5):1472-79. doi: 10.1093/ije/dys142

84. Stadler J, Scorgie F, van der Straten A, et al. Adherence and the Lie in a HIV Prevention Clinical Trial. *Med Anthropol* 2016;35(6):503-16. doi: 10.1080/01459740.2015.1116528

85. Hall J, Barrett G, Mbwana N, et al. Understanding pregnancy planning in a low-income country setting: validation of the London measure of unplanned pregnancy in Malawif. *Bmc Pregnancy and Childbirth* 2013;13 doi: 10.1186/1471-2393-13-200

86. Rao A, Baral S, Phaswana-Mafuya N, et al. Pregnancy Intentions and Safer Pregnancy Knowledge Among Female Sex Workers in Port Elizabeth, South Africa. *Obstetrics & Gynecology* 2016;128(1):15-21. doi: 10.1097/aog.0000000000001471

87. Baral S, Beyrer C, Muessig K, et al. Burden of HIV among female sex workers in low-income and middle-income countries: a systematic review and meta-analysis. *The Lancet Infectious diseases* 2012;12(7):538-49. doi: 10.1016/S1473-3099(12)70066-X

88. Heyward WL, Osmanov S, Saba J, et al. Preparation for Phase III HIV vaccine efficacy trials: methods for the determination of HIV incidence. *AIDS* 1994;8(9):1285-91.

89. Graham SM, Raboud J, McClelland RS, et al. Loss to Follow-Up as a Competing Risk in an Observational Study of HIV-1 Incidence. *PloS one* 2013;8 (3) (no pagination)(e59480)

90. Hawken MP, Dallabetta G, Temmerman M. Part time female sex workers in a suburban community in Kenya: a vulnerable hidden population. *Sexually Transmitted Infections* 2002;78(4):271-73. doi: 10.1136/sti.78.4.271

91. Manopaiboon C, Prybylski D, Subhachaturas W, et al. Unexpectedly high HIV prevalence among female sex workers in Bangkok, Thailand in a respondent-driven sampling survey. *International Journal of STD and AIDS* 2013;24(1):34-38.

92. Halpern V, Lie CC, Feldblum P, et al. Predictors of pregnancy in microbicide trials. *Contraception* 2011;83(5):436-40. doi: 10.1016/j.contraception.2010.08.018

93. Wang W, Wang S, Pullum T, et al. How Family Planning Supply and the Service Environment Affect Contraceptive Use: Findings from Four East African Countries. *DHS Analytical Studies* 2012;26

94. Ross J, Smith E. Trends in national family planning programs, 1999, 2004 and 2009. *Int Perspect Sex Reprod Health* 2011;37(3):125-33. doi: 10.1363/3712511

95. Rees H, Pillay Y, Mullick S, et al. Strengthening implant provision and acceptance in South Africa with the 'Any woman, any place, any time' approach: An essential step towards reducing unintended pregnancies. *South African Medical Journal* 2017;107(11):939-44.

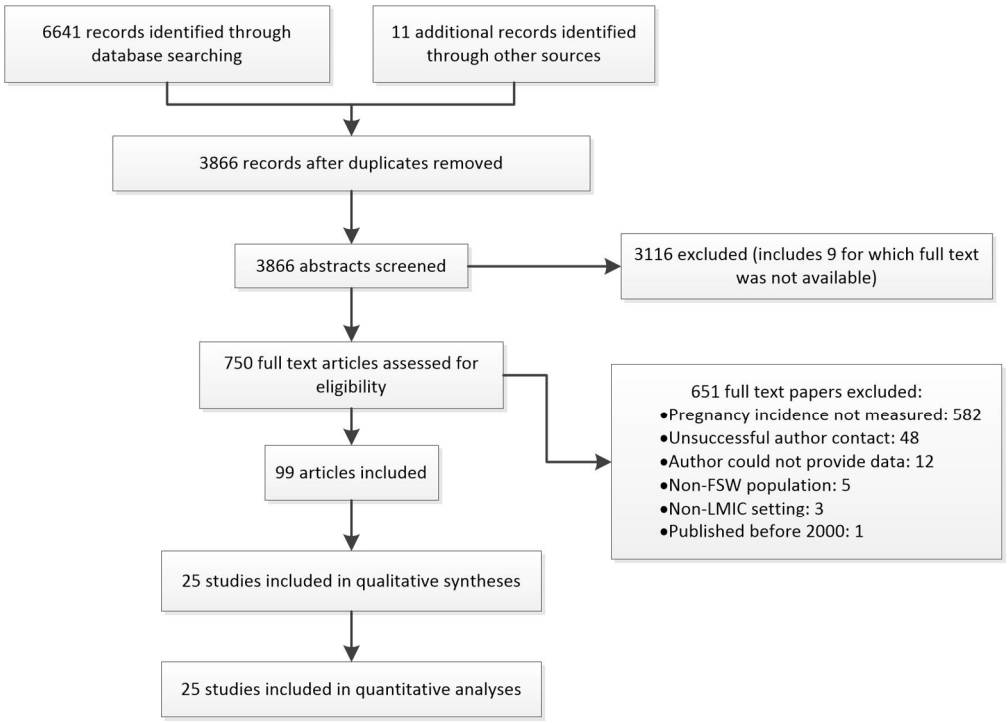

Figure 1: PRISMA flow diagram of search results and inclusion of studies after review

146x104mm (300 x 300 DPI)

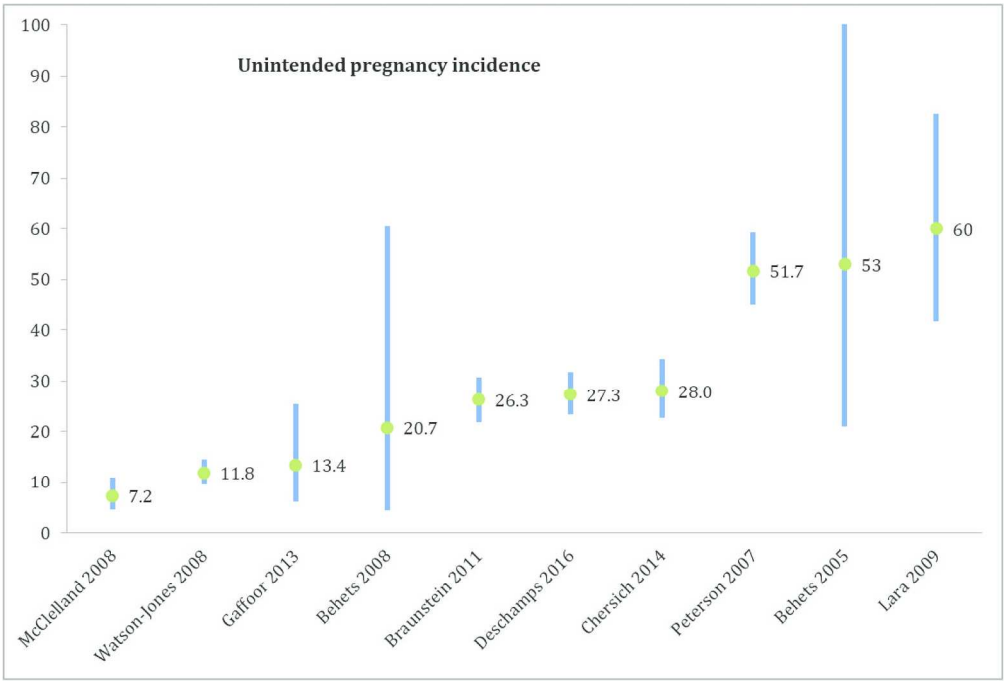

Figure 2: Incidence rates (per 100 person-years) for studies reporting unintended pregnancy

194x131mm (300 x 300 DPI)

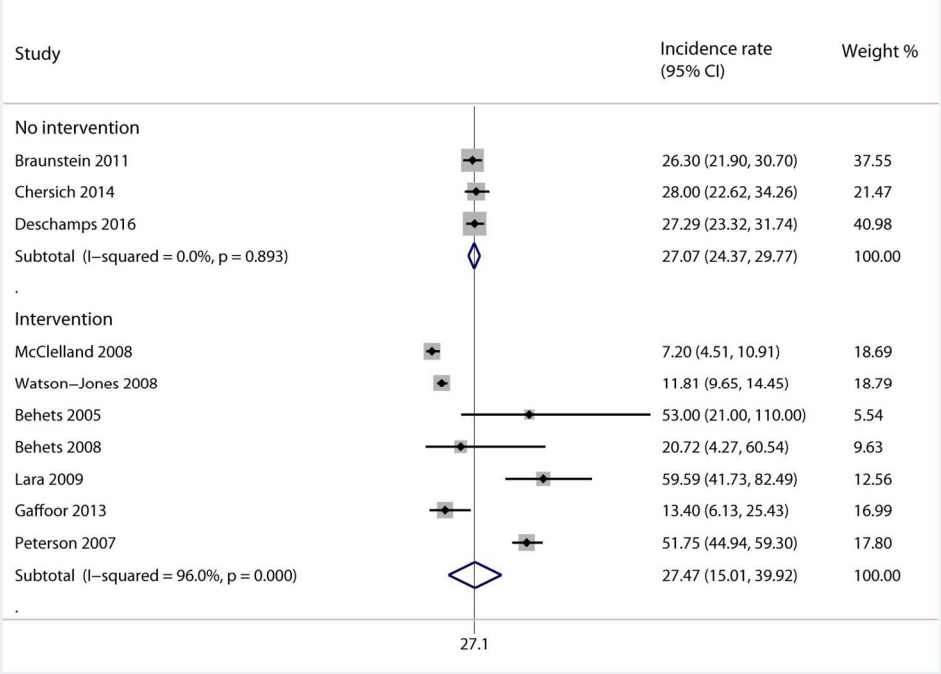

Figure 3: Forest plot showing sub-group analysis of unintended pregnancy incidence rates (per 100 person-years) by intervention vs. no intervention

139x103mm (300 x 300 DPI)

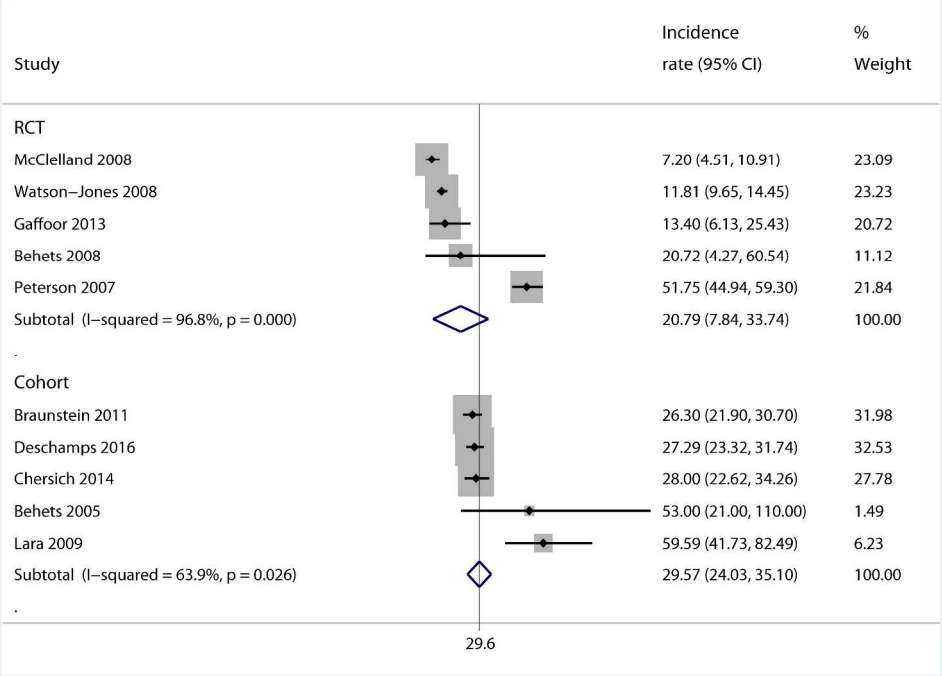

Figure 4: Forest plot showing sub-group analysis of unintended pregnancy incidence rates (per 100 person-years) by RCT vs. cohort study design

278x219mm (300 x 300 DPI)

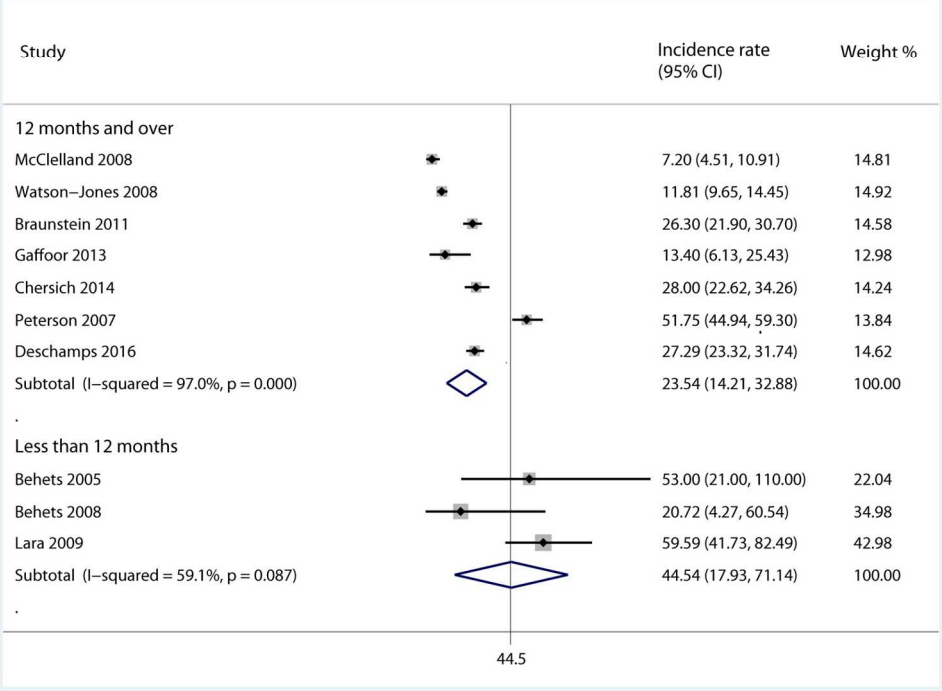

Figure 5: Forest plot showing sub-group analysis of unintended pregnancy incidence rates (per 100 person-years) by study duration (cut-off one year)

139x104mm (300 x 300 DPI)

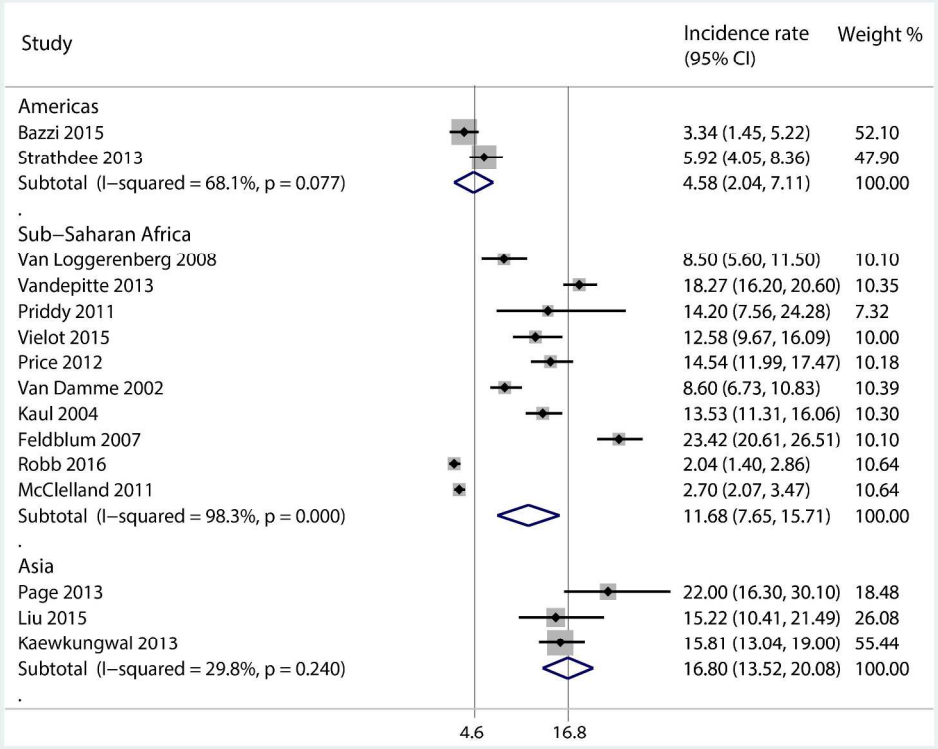

Figure 6: Forest plot showing sub-group analysis of pregnancy (intention undefined) incidence rates (per 100 person-years) by geographic region

282x244mm (300 x 300 DPI)

Supplementary File

Incidence of unintended pregnancy among female sex workers in low- and middle-income countries: a systematic review and meta-analysis

1. Complete search strategy

Medline search 19 Jan 2016

1. exp cohort studies/ or exp controlled before-after studies/ or exp cross-sectional studies/ or exp historically controlled study/ or exp interrupted time series analysis/ or exp feasibility studies/ or exp pilot projects/ or exp control groups/ or exp cross-over studies/ or exp double-blind method/ or exp random allocation/ or exp single-blind method/
2. exp clinical trial/ or exp observational study/ or exp comparative study/ or exp evaluation studies/ or exp multicenter study/
3. exp Sex Workers/
4. exp Prostitution/
5. prostitut*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
6. Commercial sex.mp.
7. sex work*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
8. (sex* adj2 (sell* or transact* or trade or trading)).mp.
9. 3 or 4 or 5 or 6 or 7 or 8
10. Developing Countries/
11. (Afghanistan* or Albania* or Algeria* or Angola* or Argentina* or Armenia* or Azerbaijan* or Bangladesh* or Belarus* or Beliz* or Benin* or Bhutan* or Bolivia* or Bosnia* or Herzegovin* or Botswan* or Brazil* or Bulgaria* or Burkina* or Burundi* or Cabo Verde* or Cape Verde* or Cambodia* or Cameroon* or Central African or Chad* or China or Chinese or Colombia* or Comor* or Congo* or Costa Rica* or Cote d'Ivoir* or Ivory Coast or Cuba* or Djibouti* or Dominica* or Ecuador* or Egypt* or El Salvador* or Eritrea* or Ethiopia* or Fiji* or Gabon* or Gambia* or Georgia* or Ghana* or Grenad* or Guatemala* or Guinea* or Guyan* or Haiti* or Hondura* or Hungar* or India* or Indonesia* or Iran* or Iraq* or Jamaica* or Jordan* or Kazakhstan* or Kenya* or Kiribati* or Korea* or Kosov* or Kyrgyz Republic or Lao* or Leban* or Lesotho* or Liberia* or Libya* or Macedonia* or Madagascar* or Malawi* or Malaysia* or Maldiv* or Mali* or Marshall Island* or Mauritania* or Mauriti* or Mexic* or Micronesia* or Moldova* or Mongolia* or Montenegr* or Morocc* or Mozambi* or Myanma* or Burmese or Namibia* or Nepal* or Nicaragua* or Niger* or Nigeria* or Pakistan* or Palau* or Panama* or Papua New Guinea* or Paraguay* or Peru* or Philippines or Filipino or Romania* or Rwanda* or Samoa* or Sao Tome* or Senegal* or Serbia* or Seychell* or Sierra Leon* or Solomon Island* or Somalia* or South Africa* or Sudan* or Sri Lanka* or St Lucia* or St Vincent or Grenadines or Surinam* or Swazi* or Syria* or Tajikistan* or Tanzania* or Thai* or Timor* or Togo* or Tonga* or Tunisia* or Turk* or Turkmenistan* or Tuvalu* or Uganda* or Ukrain* or Uzbekistan* or Vanuatu* or Venezuela* or Vietnam* or West Bank or Gaza or Yemen* or Zambia* or Zimbabwe*).mp.
12. exp africa/ or exp caribbean region/ or exp central america/ or latin america/ or exp south america/ or asia/ or exp asia, central/ or exp asia, southeastern/ or exp asia, western/ or exp indian ocean islands/ or pacific islands/ or exp melanesia/ or exp micronesia/ or exp west indies/
13. (africa* or asia* or caribbean or central america* or latin america* or south america* or melanesia* or micronesia* or polynesia*).mp.

14. (resource-limit* or resource-poor or low-resource* or limited-resource* or resource-constrain* or constrain*-resource* or under-resource* or poor*-resource* or resource-scarce* or scarce*-resource* or low-income or middle-income or lowincome or middleincome or LMIC*).mp.
15. ((developing or underdeveloped or under-developed or emerging or less-developed or least-developed or less-economically developed or least-economically developed or less-affluent or least-affluent) adj (country or countries or nation or nations or region or regions or economy or economies)).mp.
16. ((developing or underdeveloped or under-developed or less-developed or least-developed) adj world).mp.
17. (third-world* or thirdworld* or 3rd-world*).mp.
18. 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17
19. 9 and 18
20. Cohort analy*.mp.
21. ((doubl* or singl* or trebl* or tripl*) adj blind*).mp.
22. Cross sectional.mp.
23. ((random* or clinical or control*) adj (trial* or study or studies)).mp.
24. ((cohort or follow-up or followup or observational or prospective or retrospective or evaluation or intervention or comparative) adj (study or studies)).mp.
25. 1 or 2 or 20 or 21 or 22 or 23 or 24
26. 19 and 25
27. 26
28. limit 27 to (english language and yr="2000 -Current")

PsychInfo search 18 Jan 2016

1. Cohort analy*.mp.
2. ((doubl* or singl* or trebl* or tripl*) adj blind*).mp.
3. Cross sectional.mp.
4. ((random* or clinical or control*) adj (trial* or study or studies)).mp.
5. ((cohort or follow-up or followup or observational or prospective or retrospective or evaluation or intervention or comparative) adj (study or studies)).mp.
6. experimental design/ or exp between groups design/ or exp clinical trials/ or exp cohort analysis/ or exp followup studies/ or exp hypothesis testing/ or exp longitudinal studies/ or exp repeated measures/ or exp experiment controls/ or exp quasi experimental methods/
7. exp Evaluation/ or exp Program Evaluation/
8. exp observation methods/
9. "sampling (experimental)"/ or exp random sampling/
10. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9
11. exp Prostitution/
12. prostitut*.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]
13. Commercial sex.mp.
14. sex work*.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]
15. (sex* adj2 (sell* or transact* or trade or trading)).mp.
16. Developing Countries/
17. (Afghanistan* or Albania* or Algeria* or Angola* or Argentina* or Armenia* or Azerbaijan* or Bangladesh* or Belarus* or Beliz* or Benin* or Bhutan* or Bolivia* or Bosnia* or Herzegovin* or Botswan* or Brazil* or Bulgaria* or Burkina* or Burundi* or Cabo Verde* or Cape Verde* or Cambodia* or Cameroon* or Central African or Chad* or China or Chinese or Colombia* or Comor* or Congo* or Costa Rica* or Cote d'Ivoir* or Ivory Coast or Cuba* or Djibouti* or Dominica* or Ecuador* or Egypt* or El Salvador* or Eritrea* or Ethiopia* or Fiji* or Gabon* or Gambia* or Georgia* or Ghana* or Grenad* or Guatemala* or Guinea* or Guyan* or Haiti* or Hondura* or Hungar* or India* or Indonesia* or Iran* or Iraq* or Jamaica* or Jordan* or Kazakhstan* or Kenya* or Kiribati* or Korea* or Kosov* or Kyrgyz Republic or Lao* or Leban* or Lesotho*

or Liberia* or Libya* or Macedonia* or Madagascar* or Malawi* or Malaysia* or Maldiv* or Mali* or Marshall Island* or Mauritania* or Mauriti* or Mexic* or Micronesia* or Moldova* or Mongolia* or Montenegr* or Morocc* or Mozambi* or Myanma* or Burmese or Namibia* or Nepal* or Nicaragua* or Niger* or Nigeria* or Pakistan* or Palau* or Panama* or Papua New Guinea* or Paraguay* or Peru* or Philippines or Filipino or Romania* or Rwanda* or Samoa* or Sao Tome* or Senegal* or Serbia* or Seychell* or Sierra Leon* or Solomon Island* or Somalia* or South Africa* or Sudan* or Sri Lanka* or St Lucia* or St Vincent or Grenadines or Surinam* or Swazi* or Syria* or Tajikistan* or Tanzania* or Thai* or Timor* or Togo* or Tonga* or Tunisia* or Turk* or Turkmenistan* or Tuvalu* or Uganda* or Ukrain* or Uzbekistan* or Vanuatu* or Venezuela* or Vietnam* or West Bank or Gaza or Yemen* or Zambia* or Zimbabwe*).mp.
18. (africa* or asia* or caribbean or central america* or latin america* or south america* or melanesia* or micronesia* or polynesia*).mp.
19. (resource-limit* or resource-poor or low-resource* or limited-resource* or resource-constrain* or constrain*-resource* or under-resource* or poor*-resource* or resource-scarce* or scarce*-resource* or low-income or middle-income or lowincome or middleincome or LMIC*).mp.
20. ((developing or underdeveloped or under-developed or emerging or less-developed or least-developed or less-economically developed or least-economically developed or less-affluent or least-affluent) adj (country or countries or nation or nations or region or regions or economy or economies)).mp.
21. ((developing or underdeveloped or under-developed or less-developed or least-developed) adj world).mp.
22. (third-world* or thirdworld* or 3rd-world*).mp.
23. 16 or 17 or 18 or 19 or 20 or 21 or 22
24. 11 or 12 or 13 or 14 or 15
25. 10 and 23 and 24

Embase search 18 Jan 2016

1. (Afghanistan* or Albania* or Algeria* or Angola* or Argentina* or Armenia* or Azerbaijan* or Bangladesh* or Belarus* or Beliz* or Benin* or Bhutan* or Bolivia* or Bosnia* or Herzegovin* or Botswan* or Brazil* or Bulgaria* or Burkina* or Burundi* or Cabo Verde* or Cape Verde* or Cambodia* or Cameroon* or Central African or Chad* or China or Chinese or Colombia* or Comor* or Congo* or Costa Rica* or Cote d'Ivoir* or Ivory Coast or Cuba* or Djibouti* or Dominica* or Ecuador* or Egypt* or El Salvador* or Eritrea* or Ethiopia* or Fiji* or Gabon* or Gambia* or Georgia* or Ghana* or Grenad* or Guatemala* or Guinea* or Guyan* or Haiti* or Hondura* or Hungar* or India* or Indonesia* or Iran* or Iraq* or Jamaica* or Jordan* or Kazakhstan* or Kenya* or Kiribati* or Korea* or Kosov* or Kyrgyz Republic or Lao* or Leban* or Lesotho* or Liberia* or Libya* or Macedonia* or Madagascar* or Malawi* or Malaysia* or Maldiv* or Mali* or Marshall Island* or Mauritania* or Mauriti* or Mexic* or Micronesia* or Moldova* or Mongolia* or Montenegr* or Morocc* or Mozambi* or Myanma* or Burmese or Namibia* or Nepal* or Nicaragua* or Niger* or Nigeria* or Pakistan* or Palau* or Panama* or Papua New Guinea* or Paraguay* or Peru* or Philippines or Filipino or Romania* or Rwanda* or Samoa* or Sao Tome* or Senegal* or Serbia* or Seychell* or Sierra Leon* or Solomon Island* or Somalia* or South Africa* or Sudan* or Sri Lanka* or St Lucia* or St Vincent or Grenadines or Surinam* or Swazi* or Syria* or Tajikistan* or Tanzania* or Thai* or Timor* or Togo* or Tonga* or Tunisia* or Turk* or Turkmenistan* or Tuvalu* or Uganda* or Ukrain* or Uzbekistan* or Vanuatu* or Venezuela* or Vietnam* or West Bank or Gaza or Yemen* or Zambia* or Zimbabwe*).mp.
2. exp Africa/ or exp caribbean/ or exp caribbean islands/ or exp "South and Central America"/ or exp Asia/ or exp indian ocean/ or exp pacific ocean/
3. exp developing country/
4. (africa* or asia* or caribbean or central america* or latin america* or south america* or melanesia* or micronesia* or polynesia*).mp.
5. (resource-limit* or resource-poor or low-resource* or limited-resource* or resource-constrain* or constrain*-resource* or under-resource* or poor*-resource* or resource-scarce* or scarce*-resource* or low-income or middle-income or lowincome or middleincome or LMIC*).mp.

6. ((developing or underdeveloped or under-developed or emerging or less-developed or least-developed or less-economically developed or least-economically developed or less-affluent or least-affluent) adj (country or countries or nation or nations or region or regions or economy or economies)).mp.
7. ((developing or underdeveloped or under-developed or less-developed or least-developed) adj world).mp.
8. (third-world* or thirdworld* or 3rd-world*).mp.
9. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8
10. prostitut*.mp.
11. exp prostitution/ or exp transactional sex/
12. Commercial sex.mp.
13. sex work*.mp.
14. (sex* adj2 (sell* or transact* or trade or trading)).mp.
15. 10 or 11 or 12 or 13 or 14
16. ((cohort or follow-up or followup or observational or prospective or retrospective or evaluation or intervention or comparative) adj (study or studies)).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword]
17. ((random* or clinical or control*) adj (trial* or study or studies)).mp.
18. Cross sectional.mp.
19. ((doubl* or singl* or trebl* or tripl*) adj blind*).mp.
20. Cohort analy*.mp.
21. exp cohort analysis/ or exp control group/ or exp correlational study/ or exp cross-sectional study/ or exp crossover procedure/ or exp double blind procedure/ or exp "early termination of clinical trial"/ or exp experimental design/ or exp nonequivalent control group/ or exp parallel design/ or exp pretest posttest control group design/ or exp pretest posttest design/ or exp single blind procedure/ or exp triple blind procedure/
22. exp comparative study/ or exp experimental study/ or exp feasibility study/ or exp observational study/ or exp pilot study/ or exp prevention study/ or exp quasi experimental study/
23. exp time series analysis/
24. exp clinical trial/ or exp "clinical trial (topic)"/ or exp community trial/ or exp intervention study/ or exp longitudinal study/ or exp major clinical study/ or exp open study/ or exp postmarketing surveillance/ or exp prospective study/ or exp retrospective study/
25. exp evaluation study/
26. 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25
27. 9 and 15 and 26
28. limit 27 to (english language and yr="2000 -Current")

POPLINE search 20 Jan 2016

(((Keyword:SEX WORKERS) OR (Keyword:TRANSACTIONAL SEX))
OR
(("sex work*" OR "Commercial sex" OR prostitut* OR "sell sex*" OR "transact* sex*" OR "sex*transact*" OR "sex* trade" OR "sex* trading" OR "trade sex*" OR "trading sex*")))

AND

(((Keyword:COHORT ANALYSIS OR Keyword:CLINICAL TRIALS OR Keyword:CONTROL GROUPS OR Keyword:CROSS SECTIONAL ANALYSIS OR Keyword:DOUBLE-BLIND STUDIES OR Keyword:FOLLOW-UP STUDIES OR Keyword:PROSPECTIVE STUDIES OR Keyword:RETROSPECTIVE STUDIES OR Keyword:REPEATED ROUNDS OF SURVEY OR Keyword:LONGITUDINAL STUDIES OR Keyword:PILOT PROJECTS OR Keyword:HEALTH SERVICES EVALUATION OR Keyword:PRE-POST TESTS OR Keyword:FAMILY PLANNING PROGRAM EVALUATION OR Keyword:PERIOD ANALYSIS OR Keyword:PROGRAM EFFECTIVENESS))
OR

(((cohort OR follow\-up OR followup OR "follow up" OR observational OR prospective OR retrospective OR evaluation OR intervention OR comparative OR random* OR clinical OR control*) study ~0)
OR
((cohort OR follow\-up OR followup OR "follow up" OR observational OR prospective OR retrospective OR evaluation OR intervention OR comparative OR random* OR clinical OR control*) studies ~0)
OR
((random* OR clinical OR control*) trial~0) OR ((doubl* OR singl* OR trebl* OR tripl*) adj blind*) OR (cross\-sectional OR "cross sectional") OR ("cohort analy*")))

AND

(((Region/Country:Central America OR Region/Country:South America OR Region/Country:Caribbean OR Region/Country:Oceania OR Region/Country:Africa OR Region/Country:Europe Southeastern OR Region/Country:Asia Central OR Region/Country:Asia Southeastern OR Region/Country:Asia Southern OR Region/Country:Asia Southwestern OR Region/Country:China OR Region/Country:Democratic People's Republic of Korea OR Region/Country:Mongolia OR Region/Country:Belarus OR Region/Country:Moldova OR Region/Country:Ukraine OR Region/Country:Mexico OR Region/Country:Gaza OR Region/Country:Iran OR Region/Country:Iraq OR Region/Country:Jordan OR Region/Country:Lebanon OR Region/Country:Syria OR Region/Country:West Bank OR Region/Country:Yemen)))

AND ((Language:English) AND (Years:[2000 TO *]))

Conference abstracts: Web of Science 22 Jan 2016

#16	#15 AND #9 AND #3 DocType=All document types; Language=All languages;
#15	#14 OR #13 OR #12 OR #11 OR #10 DocType=All document types; Language=All languages;
#14	(TS=("Cross sectional")) AND LANGUAGE: (English) DocType=All document types; Language=All languages;
#13	(TS=("Cohort analy*")) AND LANGUAGE: (English) DocType=All document types; Language=All languages;
#12	(TS=((cohort OR "follow up" OR followup OR observational OR prospective OR retrospective OR evaluation OR intervention OR comparative) near/0 (study OR studies))) AND LANGUAGE: (English) DocType=All document types; Language=All languages;
#11	(TS=((random* OR clinical OR control*) near/0 (trial* OR study OR studies))) AND LANGUAGE: (English) DocType=All document types; Language=All languages;
#10	(TS=((doubl* OR singl* OR trebl* OR tripl*) near/0 (blind*))) AND LANGUAGE: (English) DocType=All document types; Language=All languages;
#9	#8 OR #7 OR #6 OR #5 OR #4 DocType=All document types; Language=All languages;
#8	(TS=(("developing" OR "underdeveloped" OR "under developed" OR "less developed" OR "least developed") NEAR/0 ("world"))) AND LANGUAGE: (English) DocType=All document types; Language=All languages;
#7	(TS=(("developing" or "underdeveloped" or "under-developed" or emerging or "less-developed "or "least-developed" or "less-economically developed" or "least-economically developed" or "less-affluent" or "least-affluent") near/0 (country or countries or nation or nations or region or regions or economy or economies))) AND LANGUAGE: (English)

	DocType=All document types; Language=All languages;
#6	(TS=("resource-limit*" or "resource-poor" or "low-resource*" or "limited-resource*" or "resource-constrain*" or "constrain*-resource*" or "under-resource*" or "poor*-resource*" or "resource-scarce*" or "scarce*-resource*" or "low-income" or "middle-income" or lowincome or middleincome or LMIC*)) AND LANGUAGE: (English) DocType=All document types; Language=All languages;
#5	(TS=(africa* or asia* or caribbean or "central america*" or "latin america*" or "south america*" or melanesia* or micronesia* or polynesia*)) AND LANGUAGE: (English) DocType=All document types; Language=All languages;
#4	(TS=(Afghanistan* or Albania* or Algeria* or Angola* or Argentina* or Armenia* or Azerbaijan* or Bangladesh* or Belarus* or Beliz* or Benin* or Bhutan* or Bolivia* or Bosnia* or Herzegovin* or Botswan* or Brazil* or Bulgaria* or Burkina* or Burundi* or "Cabo Verde*" or "Cape Verde*" or Cambodia* or Cameroon* or "Central African" or Chad* or China or Chinese or Colombia* or Comor* or Congo* or "Costa Rica*" or "Cote d'Ivoir*" or "Ivory Coast" or Cuba* or Djibouti* or Dominica* or Ecuador* or Egypt* or "El Salvador*" or Eritrea* or Ethiopia* or Fiji* or Gabon* or Gambia* or Georgia* or Ghana* or Grenad* or Guatemala* or Guinea* or Guyan* or Haiti* or Hondura* or Hungar* or India* or Indonesia* or Iran* or Iraq* or Jamaica* or Jordan* or Kazakhstan* or Kenya* or Kiribati* or Korea* or Kosov* or "Kyrgyz Republic" or Lao* or Leban* or Lesotho* or Liberia* or Libya* or Macedonia* or Madagascar* or Malawi* or Malaysia* or Maldiv* or Mali* or "Marshall Island*" or Mauritania* or Mauriti* or Mexic* or Micronesia* or Moldova* or Mongolia* or Montenegr* or Morocc* or Mozambi* or Myanma* or Burmese or Namibia* or Nepal* or Nicaragua* or Niger* or Nigeria* or Pakistan* or Palau* or Panama* or "Papua New Guinea*" or Paraguay* or Peru* or Philippines or Filipino or Romania* or Rwanda* or Samoa* or "Sao Tome*" or Senegal* or Serbia* or Seychell* or "Sierra Leon*" or "Solomon Island*" or Somalia* or "South Africa*" or Sudan* or "Sri Lanka*" or "St Lucia*" or "St Vincent" or Grenadines or Surinam* or Swazi* or Syria* or Tajikistan* or Tanzania* or Thai* or Timor* or Togo* or Tonga* or Tunisia* or Turk* or Turkmenistan* or Tuvalu* or Uganda* or Ukrain* or Uzbekistan* or Vanuatu* or Venezuela* or Vietnam* or "West Bank" or Gaza or Yemen* or Zambia* or Zimbabwe*)) AND LANGUAGE: (English) DocType=All document types; Language=All languages;
#3	#2 OR #1 DocType=All document types; Language=All languages;
#2	(TS=(sex* near/1 (sell* or transact* or trade or trading))) AND LANGUAGE: (English) DocType=All document types; Language=All languages;
#1	(TS=(prostitut* or "sex work*" or "commercial sex")) AND LANGUAGE: (English) DocType=All document types; Language=All languages;

Conference abstracts: Proquest 22 Jan 2016

(
(sex* NEAR/2 (sell* OR transact* OR trade OR trading)) OR prostitut* OR "Commercial sex" OR "sex work*"
)
AND
(
((doubl* OR singl* OR trebl* OR tripl*) PRE/0 blind*)
OR
((random* OR clinical OR control*) PRE/0 (trial* OR study OR studies))
OR
((cohort OR "follow up" OR followup OR observational OR prospective OR retrospective OR evaluation OR intervention OR comparative) PRE/0 (study OR studies))
OR
("Cohort analy*")
OR
("Cross sectional")
)
AND
(

(Afghanistan* OR Albania* OR Algeria* OR Angola* OR Argentina* OR Armenia* OR Azerbaijan* OR Bangladesh* OR Belarus* OR Beliz* OR Benin* OR Bhutan* OR Bolivia* OR Bosnia* OR Herzegovin* OR Botswan* OR Brazil* OR Bulgaria* OR Burkina* OR Burundi* OR Cabo Verde* OR Cape Verde* OR Cambodia* OR Cameroon* OR Central African OR Chad* OR China OR Chinese OR Colombia* OR Comor* OR Congo* OR Costa Rica* OR Cote d'Ivoir* OR Ivory Coast OR Cuba* OR Djibouti* OR Dominica* OR Ecuador* OR Egypt* OR El Salvador* OR Eritrea* OR Ethiopia* OR Fiji* OR Gabon* OR Gambia* OR Georgia* OR Ghana* OR Grenad* OR Guatemala* OR Guinea* OR Guyan* OR Haiti* OR Hondura* OR Hungar* OR India* OR Indonesia* OR Iran* OR Iraq* OR Jamaica* OR Jordan* OR Kazakhstan* OR Kenya* OR Kiribati* OR Korea* OR Kosov* OR Kyrgyz Republic OR Lao* OR Leban* OR Lesotho* OR Liberia* OR Libya* OR Macedonia* OR Madagascar* OR Malawi* OR Malaysia* OR Maldiv* OR Mali* OR Marshall Island* OR Mauritania* OR Mauriti* OR Mexic* OR Micronesia* OR Moldova* OR Mongolia* OR Montenegr* OR Morocc* OR Mozambi* OR Myanma* OR Burmese OR Namibia* OR Nepal* OR Nicaragua* OR Niger* OR Nigeria* OR Pakistan* OR Palau* OR Panama* OR Papua New Guinea* OR Paraguay* OR Peru* OR Philippines OR Filipino OR Romania* OR Rwanda* OR Samoa* OR Sao Tome* OR Senegal* OR Serbia* OR Seychell* OR Sierra Leon* OR Solomon Island* OR Somalia* OR South Africa* OR Sudan* OR Sri Lanka* OR St Lucia* OR St Vincent OR Grenadines OR Surinam* OR Swazi* OR Syria* OR Tajikistan* OR Tanzania* OR Thai* OR Timor* OR Togo* OR Tonga* OR Tunisia* OR Turk* OR Turkmenistan* OR Tuvalu* OR Uganda* OR Ukrain* OR Uzbekistan* OR Vanuatu* OR Venezuela* OR Vietnam* OR West Bank OR Gaza OR Yemen* OR Zambia* OR Zimbabwe*)
OR
((developing OR underdeveloped OR "under developed" OR "less developed" OR "least developed") PRE/0 (world))
OR
((developing OR underdeveloped OR "under developed" OR "less developed" OR "least developed" OR "less economically developed" OR "least economically developed" OR "less affluent" OR "least affluent") PRE/0 (country OR countries OR nation OR nations OR region OR regions OR economy OR economies))
OR
("third world*" OR thirdworld* OR "3rd-world*")
OR
("resource limit*" OR "resource poor" OR "low resource*" OR "limited resource*" OR "resource constrain*" OR "constrain* resource*" OR "under resource*" OR "poor* resource*" OR "resource scarce*" OR "scarce* resource*" OR "low income" OR "middle income" OR lowincome OR middleincome OR LMIC*)
OR
(africa* OR asia* OR caribbean OR "central america*" OR "latin america*" OR "south america*" OR melanesia* OR micronesia* OR polynesia*)
)

Open grey22 Jan 2016
lang:"en"
((sex* NEAR/2 (sell* OR transact* OR trade OR trading)) OR prostitut* OR "Commercial sex" OR "sex work*")
AND
(
(Afghanistan* OR Albania* OR Algeria* OR Angola* OR Argentina* OR Armenia* OR Azerbaijan* OR Bangladesh* OR Belarus* OR Beliz* OR Benin* OR Bhutan* OR Bolivia* OR Bosnia* OR Herzegovin* OR Botswan* OR Brazil* OR Bulgaria* OR Burkina* OR Burundi* OR Cabo Verde* OR Cape Verde* OR Cambodia* OR Cameroon* OR Central African OR Chad* OR China OR Chinese OR Colombia* OR Comor* OR Congo* OR Costa Rica* OR Cote d'Ivoir* OR Ivory Coast OR Cuba* OR Djibouti* OR Dominica* OR Ecuador* OR Egypt* OR El Salvador* OR Eritrea* OR Ethiopia* OR Fiji* OR Gabon* OR Gambia* OR Georgia* OR Ghana* OR Grenad* OR Guatemala* OR Guinea* OR Guyan* OR Haiti* OR Hondura* OR Hungar* OR India* OR Indonesia* OR Iran* OR Iraq* OR Jamaica* OR Jordan* OR Kazakhstan* OR Kenya*

OR Kiribati* OR Korea* OR Kosov* OR Kyrgyz Republic OR Lao* OR Leban* OR Lesotho* OR Liberia* OR Libya* OR Macedonia* OR Madagascar* OR Malawi* OR Malaysia* OR Maldiv* OR Mali* OR Marshall Island* OR Mauritania* OR Mauriti* OR Mexic* OR Micronesia* OR Moldova* OR Mongolia* OR Montenegr* OR Morocc* OR Mozambi* OR Myanma* OR Burmese OR Namibia* OR Nepal* OR Nicaragua* OR Niger* OR Nigeria* OR Pakistan* OR Palau* OR Panama* OR Papua New Guinea* OR Paraguay* OR Peru* OR Philippines OR Filipino OR Romania* OR Rwanda* OR Samoa* OR Sao Tome* OR Senegal* OR Serbia* OR Seychell* OR Sierra Leon* OR Solomon Island* OR Somalia* OR South Africa* OR Sudan* OR Sri Lanka* OR St Lucia* OR St Vincent OR Grenadines OR Surinam* OR Swazi* OR Syria* OR Tajikistan* OR Tanzania* OR Thai* OR Timor* OR Togo* OR Tonga* OR Tunisia* OR Turk* OR Turkmenistan* OR Tuvalu* OR Uganda* OR Ukrain* OR Uzbekistan* OR Vanuatu* OR Venezuela* OR Vietnam* OR West Bank OR Gaza OR Yemen* OR Zambia* OR Zimbabwe*)
OR
((developing OR underdeveloped OR "under developed" OR "less developed" OR "least developed" OR "less economically developed" OR "least economically developed" OR "less affluent" OR "least affluent") NEAR/0 (country OR countries OR nation OR nations OR region OR regions OR economy OR economies))
OR
((developing OR underdeveloped OR "under developed" OR "less developed" OR "least developed") NEAR/0 (world))
OR
("third world*" OR thirdworld* OR "3rd-world*")
OR
(“resource limit*" OR "resource poor" OR "low resource*" OR "limited resource*" OR "resource constrain*" OR "constrain* resource*" OR "under resource*" OR "poor* resource*" OR "resource scarce*" OR "scarce* resource*" OR "low income" OR "middle income" OR lowincome OR middleincome OR LMIC*)
OR
(africa* OR asia* OR caribbean OR "central america*" OR "latin america*" OR "south america*" OR melanesia* OR micronesia* OR polynesia*)
)

2. Quality assessment tool

Adapted from the Joanna Briggs Institute Prevalence Critical Appraisal Tool[1]. Modified version provided by the author (Munn) on 21/3/16. Adjustments as per Bowring 2016[2]. Further modifications specific to research question made by review authors.

DOMAIN 1: EXTERNAL VALIDITY ***Is the sample representative of the population of interest?***	
1.1 Was an appropriate sampling frame used?	
1	Enumeration/estimate of FSWs, or clear description of source population (demographics, location, and time period), and rationale for use
0	No sampling frame, or inappropriate population for research question
1.2 Was an appropriate sampling method used?	
1	Probability-based sample (including: simple random, systematic, stratified, cluster, two-stage and multi-stage sampling) RDS or properly described time-location/venue sampling (if analysed appropriately)
0	Non-random sample (including purposive, quota, convenience and snowball), or sampling not described
1.3 Were inclusion and exclusion criteria explicit and appropriate to the research question?	
1	Yes, e.g. women only, FSWs, all reproductive ages, etc
0	No: limited by HIV status or other characteristic that would affect generalisability

DOMAIN 2: SELECTION (NON-RESPONSE) BIAS ***Was there incomplete outcome data (due to non-response, refusal or exclusion), and how did it affect the outcome?***	
2.1 Were (FSW) study participants recruited and enrolled in an appropriate way?	
1	Well described methods of recruitment and enrolment; appropriate staff expertise/training; appropriate seed selection for RDS; appropriate venue/location coverage
0	Poorly described; potential source of bias due to recruitment methods
2.2 Was there selective participation in the study?	
1	>=80% of those invited to participate were screened <80% participation rate, but sociodemographic/sex work characteristics not significantly different between participants and non-participants
0	<80% participation rate and significantly different characteristics likely to affect outcome Participation rate not reported or differences not assessed
2.3 What was the retention rate? Closed cohort/RCT: what proportion of participants who commenced the study contributed data at the final follow up visit? (If choosing an earlier endpoint, use retention rate up to this point) Open cohort: what proportion attended at least one follow up visit, and was retention well described?	
2	>=80% and sociodemographic/sex work characteristics compared and not significantly different
1	>=80% and sociodemographic/sex work characteristics either significantly different or not compared
0	<80%

DOMAIN 3: MEASUREMENT BIAS	
3.1 Was a valid tool used for the identification of the condition (pregnancy)?	
1	Serum or urine test for beta HCG
0	Self-reported or observed by study personnel
3.2 Was the condition (pregnancy) measured in a standard, reliable way for all FSWs?	
1	Pregnancy measured systematically (eg every study visit); data collectors appropriately trained
0	Unclear/inconsistent methods; lack of training for data collectors; nonsystematic measurement or recording (eg pregnancy only tested on participant request or clinician suspicion)
3.3 Was pregnancy intention measured systematically using a valid tool?	
1	Prospective question about intention asked at appropriate intervals (at least every 12months); or LMUP
0	Intention assumed, infrequently measured or unreliable retrospective question
N/A	Intention not measured

DOMAIN 4: INTERNAL VALIDITY ***How likely could the result be due to chance? What is the level of precision?***	
4.1 Was the person-years of observation adequate for calculating pregnancy incidence?	
1	FSWs followed for at least 100 woman-years, or reasonable justification of smaller size
0	<100 woman-years
4.2 Was the study conducted for a sufficient period of time to calculate pregnancy incidence?	
1	Closed cohort or trial: at least 6 months' follow-up time Open cohort: median follow up time per participant >6 months?
0	Insufficient observation period, or not reported
4.3 Was there appropriate statistical analysis?	
1	Detailed statistical methods described Primarily consider the measure of risk that will be used in the meta-analysis – i.e. incidence rates, and/or incidence proportion if measured over 1 year For proportions (cumulative incidence): denominator and numerator explicitly reported and appropriate/justified For incidence rates: calculation of person-years, including estimate of conception date and approach to censoring of pregnancy, explicitly reported and appropriate/justified (should not count pregnant time towards total person-years) If calculated based on data from author: sufficient data provided for accurate calculation
0	Methods not sufficiently described; inappropriate technique

DOMAIN 5: OTHER ISSUES	
5.1 Was pregnancy incidence an objective of the study?	
1	Yes (consider objectives of overall study, not sub-study/specific paper)
0	No (e.g. cohort may have been originally designed to measure HIV incidence, but they also published a paper on incidental pregnancy incidence)
5.1 Were there any other issues that may have introduced bias or affected the validity of the estimates?	

1	No issues
0	Study design issues, e.g. highly variable/skewed follow up times in open cohort study; very long follow-up period during which true incidence in the population likely to have changed Selective use or reporting of data (e.g. only reporting pregnancy incidence in one subgroup or at one time point without justification) Intervention may impact on pregnancy incidence e.g. testing diaphragm use, or FP counselling (not just standard of care condom counselling)

Scoring

Studies that measure unintended pregnancy

Domain	**Raw score out of:**
External validity	3
Selection bias	4
Measurement bias	3
Internal validity	3
Other issues	2
Total	**15**

Studies that measure pregnancy (undefined)

Domain	**Raw score out of:**
External validity	3
Selection bias	4
Measurement bias	2
Internal validity	3
Other issues	2
Total	**14**

References

1. Munn Z, Moola S, Riitano D, Lisy K. The development of a critical appraisal tool for use in systematic reviews addressing questions of prevalence. *International Journal of Health Policy and Management* 2014; **3**: 123+.

2. Bowring AL, Veronese V, Doyle JS, Stoove M, Hellard M. HIV and Sexual Risk Among Men Who Have Sex With Men and Women in Asia: A Systematic Review and Meta-Analysis. *AIDS and Behavior* 2016: 1-23.

PRISMA 2009 Checklist: Ampt et al. Incidence of unintended pregnancy among female sex workers

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&3: Included in abstract and “Strengths and limitations” section
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	4-5: In introduction
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	5: Primary and secondary objectives given in last paragraph of introduction. 6-7: PICOS described in “Inclusion and exclusion criteria” section. Participants: “FSWs”; interventions and comparisons: not relevant as this is an incidence review; outcomes: “incidence of unintended pregnancy” and secondary outcomes; study design described at end of this section.
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.	3 (Abstract) and 6 (Methods)
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: All provided under sub-heading “Inclusion and exclusion criteria”
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.	7: Under sub-heading “Search strategy”
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Full strategy for multiple databases included in supplementary appendix

PRISMA 2009 Checklist: Ampt et al. Incidence of unintended pregnancy among female sex workers

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: Under sub-heading “Screening and data collection”
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.	7-8: Under sub-heading “Screening and data collection”
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	7-8: Under sub-heading “Screening and data collection”
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: Under sub-heading “Quality assessment”. Full quality assessment included in supplementary appendix
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	8: Incidence rate; in “Analysis” section
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.	9: Random effects models, I^2 statistic, sub-group analyses; in “Analysis” section

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).	8: Measurement bias, whether preg incidence was a primary objective; in “Quality assessment”. section
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	9: Sub-group analyses; in “Analysis” section
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.	9-10: In “Results”, displayed in 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.	10-18: In “Results” (p10 & 16), Table 1 (11-15), Table 2 (17), under sub-heading “Baseline population characteristics” (18)
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).	17-19: Table 2, under sub-headings “Methodology and quality assessment” & “Incidence of pregnancy”

PRISMA 2009 Checklist: Ampt et al. Incidence of unintended pregnancy among female sex workers

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.	Table 2 (p17), Figures 2-6
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	19: Under sub-heading “Meta-analysis”; results not presented due to very high heterogeneity
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	Table 2 (17), under sub-heading “Methodology and quality assessment” (18-19)
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	19-21: Sub-group analyses under sub-heading “Meta-analysis”, Figures 3-6 21-22: Secondary outcomes summary under sub-heading “Secondary outcomes”
DISCUSSION			
Summary of evidence	24	Summarize 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).	22-25: In “Discussion” 26-27: In “Conclusion”
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).	25-26: Under sub-heading “Limitations”
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	23-24: In “Discussion” 26-27: In “Conclusion
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.	28: In “Funding” section, as per BMJ Open guidelines. The funder had no role or interest in the conduct or outcome of this study.

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

For more information, visit: www.prisma-statement.org.