



Review

A systematic review and meta-analysis of the prevalence, trends, and geographical distribution of HIV among Chinese female sex workers (2000–2011): implications for preventing sexually transmitted HIV



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ARTICLE INFO

Article history:

Received 21 January 2015

Received in revised form 19 August 2015

Accepted 28 August 2015

Corresponding Editor: Eskild Petersen, Aarhus, Denmark

Keywords:

HIV
Epidemiology
Female sex workers
Risk behaviours
China

SUMMARY

Objective: The aim of this meta-analysis was to investigate temporal and geographical trends in the HIV epidemic among female sex workers (FSWs) recruited from various venues in China.

Methods: Chinese and English peer-reviewed articles published between January 2000 and February 2013 were systematically searched. Standard meta-analysis methods were used to calculate the pooled HIV prevalence, in accordance with the PRISMA guidelines.

Results: The national HIV prevalence among FSWs declined from 0.74% (95% confidence interval (CI) 0.37–1.49%) in 2000–2002 to 0.40% (95% CI 0.31–0.53%) in 2009–2011. All Chinese regions demonstrated significant declines in HIV prevalence, apart from the East and South Central regions, in which the epidemics stabilized at low/moderate levels. Despite a significant decline from 1.92% (95% CI 0.86–4.24%) to 0.87% (95% CI 0.65–1.18%) during 2000–2011, Southwest China still bore the greatest HIV disease burden. Nationwide, FSWs recruited from detention centres had the highest HIV prevalence (0.92%, 95% CI 0.46–1.88%), followed by voluntary counselling and testing sites (0.80%, 95% CI 0.46–1.67%) and entertainment venues (0.61%, 95% CI 0.47–0.79%). The prevalences among FSWs in high-, middle-, and low-tier entertainment venues were 0.59% (95% CI 0.32–1.45%), 0.92% (95% CI 0.50–1.77%), and 1.10% (95% CI 0.71–2.16%), respectively. High- and middle-tier FSWs had a significantly lower risk of HIV infection than lower-tier FSWs (high/low: odds ratio (OR) 0.48, 95% CI 0.40–0.59; middle/low: OR 0.49, 95% CI 0.37–0.66).

Conclusions: The HIV epidemic has shown a gradual declining or stabilizing trend among Chinese FSWs. Intervention efforts should be diverted to high-risk subgroups of FSWs, such as drug-using and low-tier FSWs. © 2015 The Authors. Published by Elsevier Ltd on behalf of International Society for Infectious Diseases. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Introduction

The Chinese Ministry of Health estimated that over 780 000 people were living with HIV in 2012.¹ HIV transmission in China

varies geographically and across population subgroups.^{2,3} As a typical Asian epidemic, needle-sharing among people who inject drugs (PWIDs) was the predominant mode of HIV transmission at the beginning of the epidemic.² However, the proportion of diagnosed HIV cases attributed to heterosexual transmission increased rapidly from 30.6% in 2006 to 62.6% in 2011, whereas the proportion attributed to the sharing of injection equipment among PWIDs fell from 34.1% to 16.9% during the same period,⁴

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indicating an important shift in the mode of HIV transmission from injection equipment sharing among PWIDs to sexual transmission.^{2,5}

Although nearly eliminated in China during the early 1950s, the commercial sex industry re-emerged following the economic reforms of the 1980s and has flourished alongside China's rapid economic growth.⁶ Commercial sex work is illegal and not accepted according to traditional Chinese social values.⁷ Regular police raids on female sex workers (FSWs) are more frequent in urban China, where commercial sex work is more prevalent.⁸ FSWs who are caught are sent to detention centres, where the availability of medical and harm reduction services is scarce.^{9,10} For FSWs in the community, community-based organizations may provide limited HIV interventions, subject to restraint from interference by the public security authorities.^{11,12} FSWs work in various venues and are classified as high-, middle-, and low-tier according to the type of sex venue where they sell sex.¹³ The sex work tier is often a key determinant of socio-economic status, work environment, type of client, and risk behavioural patterns of FSWs in China.¹⁴

The prevalence of sexually transmitted infections (STIs) among Chinese FSWs was high during the period of the present investigation and review (during 2000–2011: *Chlamydia trachomatis*, 17–46%;^{15–20} gonorrhoea, 8–39%;^{15–18,20} herpes simplex virus 2, 33–71%;^{15,19,21,22} syphilis, 4–16%^{15–17,20,23–26}).

In 2012, Baral et al. published a systematic review of HIV disease burden among FSWs across low- and middle-income countries, which estimated an HIV prevalence of 3% in Chinese FSWs based on 12 studies.²⁷ The small number of studies included in that review and the finding of a higher than average prevalence led to a debate on the review's accuracy.^{28,29} More recently, a meta-analysis of 190 studies reported a national HIV prevalence in FSWs of 0.04% in 2011,²⁶ which is unexpectedly even lower than the national HIV prevalence among pregnant women (0.10%⁴) and the overall general population (0.06%⁴) in China. Further, the study did not show a significant difference in risk of HIV infection between FSWs in the low-tier and middle/high-tier venues, leading to queries on the consistency of these prevalence estimates.

An accurate estimate of HIV trends and disease burden among FSWs, especially in the various tiers, is essential to provide informed and appropriate HIV prevention to the 4–10 million FSWs in China.^{1,30} The present study comprehensively integrated the findings of 456 studies on Chinese FSWs through a systematic review and meta-analysis. The aim was to examine (1) temporal trends and geographical patterns in the HIV epidemic among FSWs, and (2) the differences in risk of HIV infection of the various venues and tiers of FSWs during 2000–2011.

2. Methods

2.1. Search strategy

Two independent investigators (EPFC, WLY) conducted a systematic review of peer-reviewed research articles published during the period January 2000 to February 2013 by searching the following English and Chinese literature databases: PubMed, Chinese Scientific Journals Fulltext Database (CQVIP), China National Knowledge Infrastructure (CNKI), and Wanfang Data. Keywords used in the database search included (“HIV” OR “AIDS” OR “human immunodeficiency virus” OR “acquired immunodeficiency syndrome”) AND (“FSW” OR “female sex worker” OR “CSW” OR “commercial sex worker” OR “sex worker” OR “prostitute” OR “women who sell sex” OR “sex industry”) AND (“China” OR “Chinese”) AND (“prevalence” OR “infection” OR “associated risk” OR “infection status” OR “epidemic status” OR “surveillance”). A

manual search of the reference lists of published articles was also performed. This review was performed in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement issued in 2009 (Checklist S1).³¹

2.2. Study selection

Review articles, non-peer-reviewed local/government reports, conference abstracts, and presentations were excluded from the current study. Duplications were identified by comparing detailed study characteristics, including author names, study period, study location, the number of infection cases, and the sample size. If two publications were found to be from the same data source, only the earlier publication was included. If the same study data were published in both English and Chinese sources, the Chinese language version was excluded. In addition, as HIV prevalence was the key indicator, studies that did not report HIV prevalence and sample size were excluded. Studies had to explicitly state their HIV testing methodology, including both screening and confirmatory tests. The diagnosis of HIV was required to include both presumptive and confirmatory tests. Urine and saliva tests for HIV testing were excluded from the quantitative synthesis. Studies not reporting the study period/time and geographical location were excluded. Self-reported HIV infections were also excluded. Studies with a sample size less than 30 were excluded. Studies only on specific subgroups of FSWs (e.g., FSWs who use drugs) were excluded.

2.3. Quality assessment

Studies included in the review were considered high quality if they fulfilled the following criteria: (1) provided a clear description of demographic characteristics of the participants, such as age, marital status, education level, and recruitment location; (2) employed a probability sampling strategy (such as simple random, systematic, stratified, cluster, two-stage, or multi-stage sampling strategies); (3) reported inclusion and exclusion criteria for sample selection; (4) achieved an adequate response rate of 80%; (5) applied an identical HIV testing methodology to all respondents; (6) demonstrated reliability of measures, for example manufacturer's specifications for HIV testing kits were reported; (7) demonstrated validity of measures, for example testing method and/or agents were reported; and (8) conducted and reported appropriate statistical analyses (**Supplementary Material**, Table S3). Studies with a quality score between 0 and 2 were classified as low quality, those with a score between 3 and 5 as average quality, and those with a score between 6 and 8 as high quality.

2.4. Data abstraction

The following information was extracted from all eligible studies: first author and year published, study location, average age of FSW participants, study period, recruitment and sampling method, sample size, and laboratory testing method for HIV infection. Studies were categorized into one of six geographical locations according to the traditional Chinese administrative regions: East, Northeast, North, South Central, Northwest, and Southwest. Based on the availability of data, studies were further categorized into four 3-year time periods of data collection: 2000–2002, 2003–2005, 2006–2008, and 2009–2011.

2.5. Classification of venues

Demographic characteristics and socio-economic status varied substantially among FSWs. FSWs recruited in different venues may

show distinct differences in demographic and behavioural patterns that contribute to their risk of acquiring HIV. In China, FSWs were frequently recruited from entertainment venues, detention centres, voluntary counselling and testing (VCT) sites, and community and other venues (such as sexually transmitted disease (STD) clinics). The HIV sentinel surveillance system in China has designated sites for FSW recruitment that may include one or many of the aforementioned sites. Individual studies have often not separated these sites, but have generally referred to them as 'sentinel sites'.³²

'FSWs in the community' refers to those who were recruited through community-based organizations and referred by peers, rather than being directly sampled at the venues. Further, entertainment venues where FSWs solicit their clients can be classified into three social tiers: high-, middle-, and low-tier. This classification relies on the types of services provided and the price range of the venue. In the present study, these tiers were based on the original classification in the articles and at the discretion of the authors. However, a general consensus was observed across most papers. High-tier entertainment venues predominantly include hotels, night clubs, star-ranked hotels with spas/saunas, karaoke clubs, dance halls, and pubs.^{33–37} Middle-tier entertainment venues include massage parlours, beauty salons, spas/saunas, leisure centres, and tea houses.^{37–41} Low-tier entertainment venues include small hairdressing salons, street walkers, restaurants, temporary sublets, foot massage, unranked hostels, small hotels, and small pubs.^{38,42–46} In the present analysis, unclassified venues or mixed-tier venues were grouped as 'unspecific' entertainment venues.

2.6. Statistical analysis

Meta-analyses were carried out using Comprehensive Meta-Analysis software v. 2.0 (Biostat, Englewood, NJ, USA).⁴⁷ As an essential part of the analysis, meta-regression was conducted to investigate the contribution of key study factors to the heterogeneity of the effect outcome (HIV prevalence); these included study year, geographical region, study sample size, language of the paper, recruitment venue, sampling method, and quality score.

The analysis of heterogeneity was performed using the Cochran Q-test ($p < 0.10$ representing statistically significant heterogeneity) and the I^2 statistic. The effect rates of pooled HIV prevalence estimates and their corresponding 95% confidence intervals (CI) for each study were determined using either the fixed-effects or random-effects model.⁴⁸ The random-effects model was used if the I^2 statistic was ≥ 75 .⁴⁸

The presence of potential publication bias was measured using Begg and Mazumdar rank correlation.^{49,50} The result was considered to be significant if $p < 0.05$. To accommodate geographical publication bias, the national HIV prevalence was estimated as the average prevalence levels across the six Chinese regions weighted by the estimated population size of FSWs in each region. The most recent available literature reported 2.5 million FSWs in China, with the proportion from each region being as follows: East, 25.8%; North, 9.1%; Northeast, 6.1%; South Central, 38.7%; Southwest, 13.6%; Northwest, 6.7%.^{3,51}

The risk of infection between subgroups (determined as the odds ratio) was obtained by meta-regression.

3. Results

3.1. Trial flow/flow of included studies

The initial search criteria identified 2505 articles from the four electronic databases; 41 additional articles were identified through the reference lists of these articles. The abstracts of the

remaining 1344 articles were screened. Conference abstracts ($n = 168$), student theses ($n = 137$), review papers ($n = 104$), and other non-peer-reviewed articles ($n = 29$) were excluded. A total of 906 articles were eligible for full-text screening, and 450 were further excluded as they did not report HIV prevalence ($n = 129$), the HIV testing method ($n = 90$), or the study period ($n = 72$). Studies were also removed if they appeared to report duplicate data from the same data source ($n = 56$). Studies that were not conducted in Mainland China ($n = 42$), were irrelevant to the research topics ($n = 16$), and those published beyond the defined study period ($n = 45$) were excluded. The remaining 456 studies (23 in English, 433 in Chinese; [Figure 1](#)) were eligible for meta-analysis ([Supplementary Material](#), Table S1).

3.2. Study characteristics

The 456 eligible articles included in this study covered all 31 provinces of China ([Figure 2](#)). The sample size of the selected studies ranged from 31 to 16 845 (mean 696, 95% CI 603–789). A substantial proportion of studies recruited participants from entertainment establishments (58.0%), among which, high-tier venues accounted for 7.4%, middle-tier venues for 6.3%, low-tier venues for 11.9%, and unspecific entertainment venues for 32.4%. This was followed by sentinel sites (19.9%), detention centres (10.3%), VCT sites (8.7%), community sites (0.2%), and other venues (2.8%). The mean age of FSWs ranged from 14 to 50 years. Approximately two-thirds (approximately 64%) of FSWs were rural-to-urban migrants. More than one-third (approximately 35%) of FSWs were married.

3.3. Overall epidemic trends in HIV prevalence

The national HIV prevalence among FSWs declined significantly from 0.74% (95% CI 0.37–1.49%) in 2000–2002 to 0.40% (95% CI 0.31–0.53%) in 2009–2011 ($p < 0.001$; [Figure 3](#)). All regions demonstrated a significant decline in HIV prevalence in FSWs, apart from the East region (0.19%, 95% CI 0.12–0.32% in 2000–2002; 0.19%, 95% CI 0.15–0.24% in 2009–2011; $p = 0.546$) and South Central region (0.73%, 95% CI 0.39–1.38% in 2000–2002; 0.52%, 95% CI 0.43–0.64% in 2009–2011; $p = 0.123$), where the epidemics appeared to stabilize to moderate levels. Notably, despite a substantial decline in HIV prevalence from 1.92% (95% CI 0.86–4.24%) in 2000–2002 to 0.87% (95% CI 0.65–1.18%) in 2009–2011 ($p < 0.001$; [Figure 3](#)), Southwest China carried the greatest disease burden across all periods. The Northeast also demonstrated a significant decline in prevalence from 0.96% (95% CI 0.46–1.99%) in 2000–2002 to 0.03% (95% CI 0.01–0.12%) in 2009–2011.

3.4. HIV prevalence by sex work venue

Nationwide, HIV prevalence among FSWs recruited from detention centres was highest (0.92%, 95% CI 0.46–1.88%; [Figure 4a](#)), followed by VCT sites (0.80%, 95% CI 0.46–1.67%), entertainment venues (0.61%, 95% CI 0.47–0.79%), and the community (0.29%, 95% CI 0.03–2.78%). HIV sentinel surveillance sites surveyed from these venues showed a moderate level of HIV prevalence (0.48%, 95% CI 0.32–0.73%). However, this study did not show any significant difference in the risk of HIV infection across the recruitment venues ([Supplementary Material](#), Table S2). Similar to the geographical trends, Southwest China consistently demonstrated higher HIV prevalence across all venues. Notably, 2.91% (95% CI 1.20–6.90%) of FSWs in detention centres in Southwest China were HIV-positive, whereas HIV prevalence among FSWs recruited from entertainment venues reached 2.05% (95% CI 1.62–2.59%).

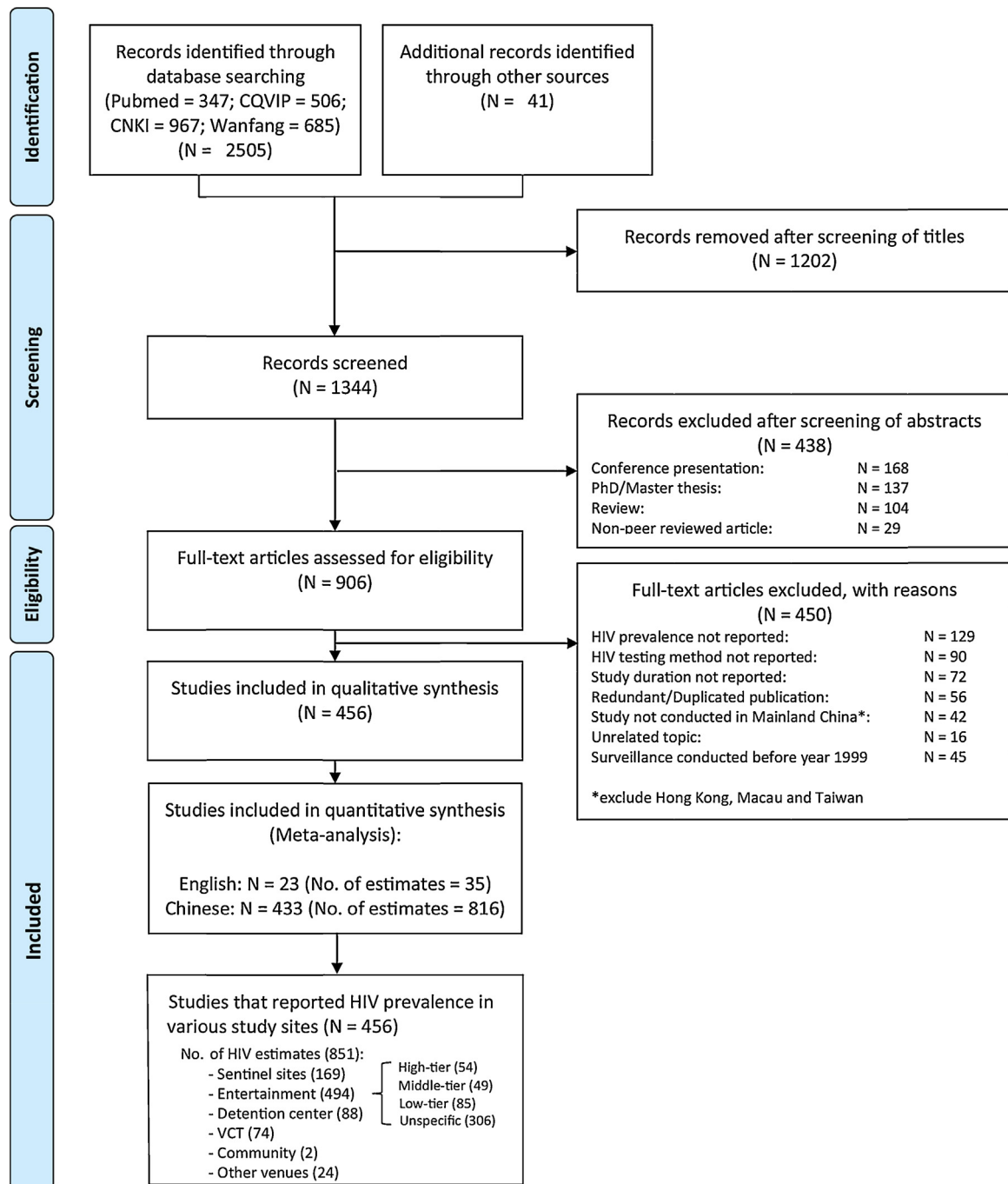


Figure 1. Flow chart showing the literature search and study selection process.

Further subgroup analysis for entertainment venues demonstrated substantial differences in HIV prevalence among FSWs recruited from high-, middle- and low-tier venues nationwide (high, 0.59%, 95% CI 0.32–1.45%; middle, 0.92%, 95% CI 0.50–1.77%; low, 1.10%, 95% CI 0.71–2.16%). Meta-analysis indicated heterogeneous patterns in the Southwest region ($I^2 = 89.96$, $p < 0.001$) and South Central region ($I^2 = 30.22$, $p = 0.027$), but not in the other Chinese regions (Figure 4a and b). In the South Central region, HIV prevalence among low-tier FSWs was 0.85% (95% CI 0.60–1.22%), which was substantially higher than rates in FSWs recruited from the middle- and high-tier venues. In the Southwest, prevalence rates in FSWs recruited from the low and middle tiers were comparable (3.71%, 95% CI 1.98–6.83% versus 4.18%, 95%

CI 2.10–8.14%), but significantly higher than that in FSWs recruited in high-tier venues (2.10%, 95% CI 1.34–3.29%). Among the 38 studies that reported matching prevalence levels across tiers, high-tier FSWs had a significantly lower risk of HIV infection than low-tier FSWs (odds ratio (OR) 0.48, 95% CI 0.40–0.59, $p < 0.001$; Figure 5a). A similar finding was also observed between the middle- and low-tier FSWs (OR 0.49, 95% CI 0.37–0.66, $p < 0.001$; Figure 5b).

3.5. Study quality assessment

Substantial publication bias was found across studies that reported HIV prevalence ($p < 0.001$). Among the 456 included studies, 10.75%, 73.90%, and 15.35% were considered low quality



Figure 2. The six Chinese geographical regions. The number in each province represents the number of publications reporting HIV prevalence among female sex workers ($n = 456$). The number in brackets represents the total number of HIV prevalence estimates identified ($n = 848$).

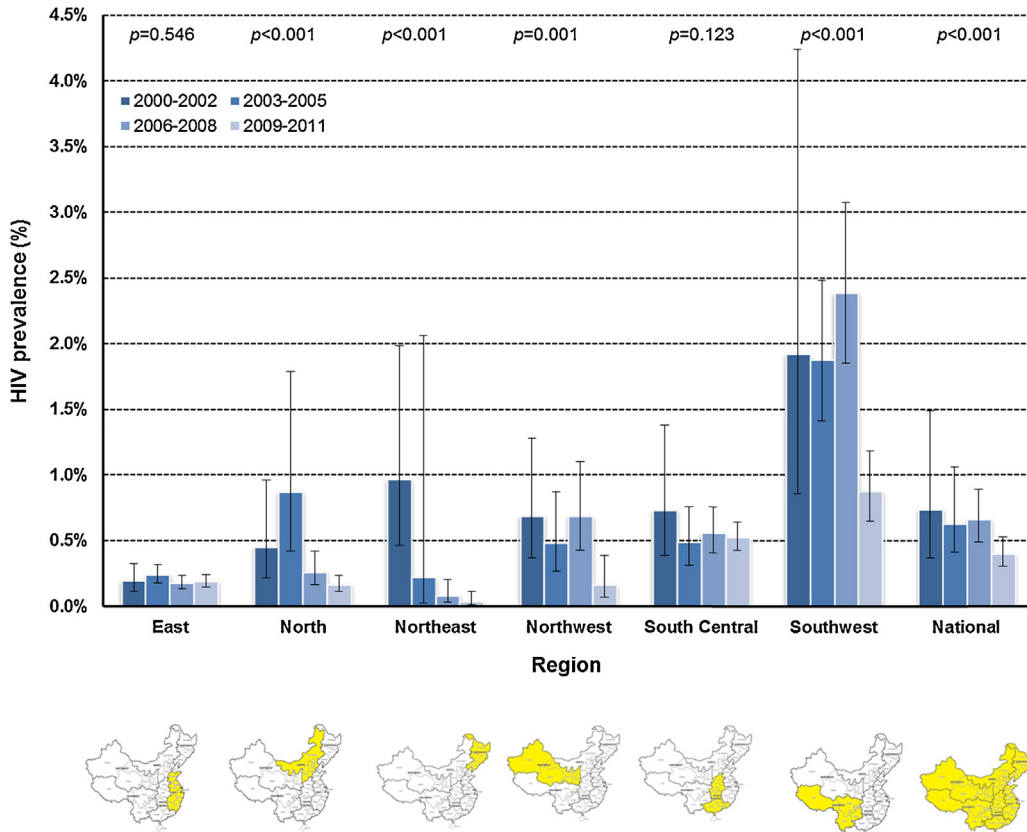


Figure 3. Estimated HIV prevalence among female sex workers across the six regions in China during 2000–2011.

(score 0–2), average quality (score 3–5), and high quality (score 6–8), respectively (**Supplementary Material**, Figure S1). Meta-regression indicated that the quality score made no significant contribution to the variations in HIV prevalence (**Supplementary Material**, Table S2; $p = 0.30$). All analyses were repeated after excluding low-quality studies; this resulted in no substantial changes in the key findings and conclusions.

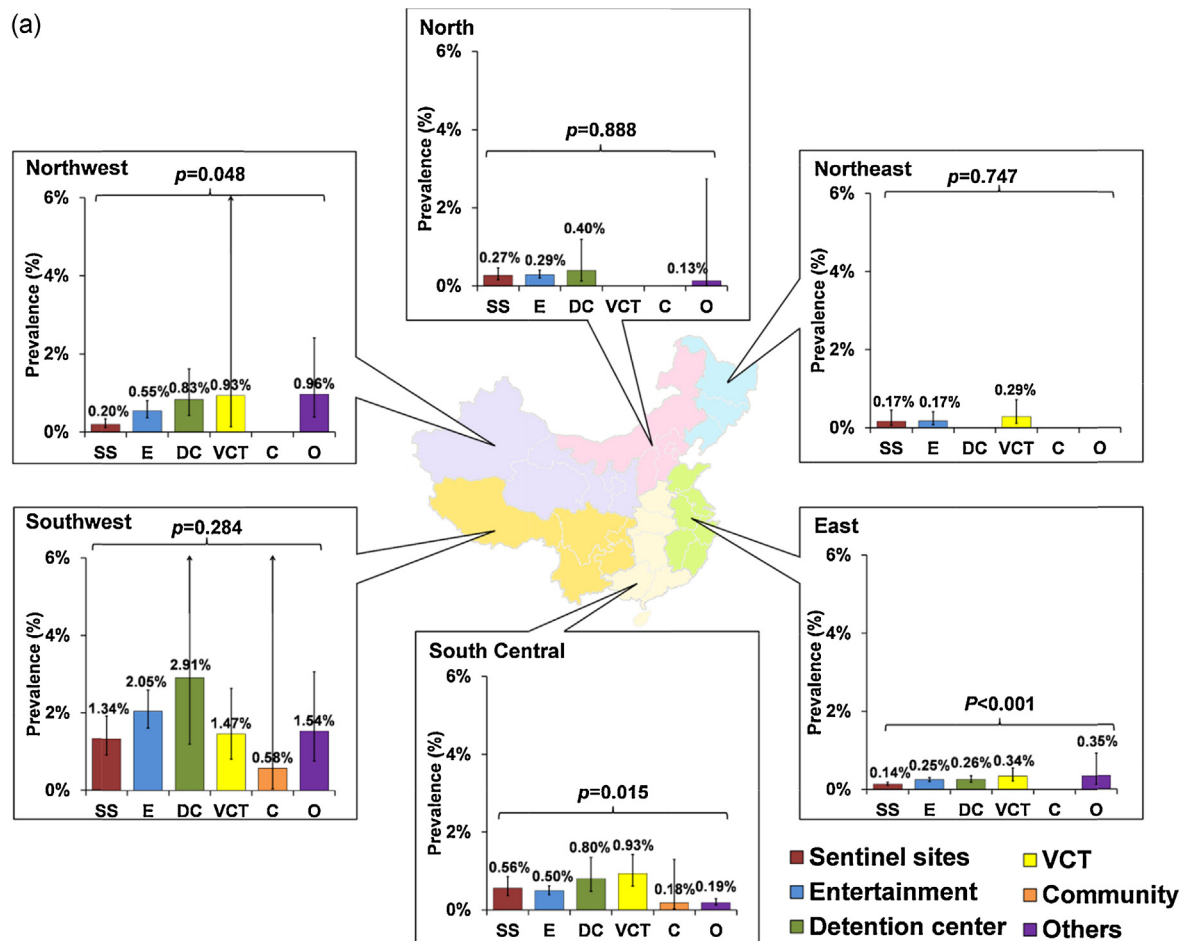
4. Discussion

An accurate understanding of HIV prevalence among FSWs is critical in order to tailor interventions and evaluate previously established programmes and services. The data from this study indicate a decreasing or stable HIV prevalence in most regions of China. However, a high burden of HIV infection was observed among FSWs in Southwest China. The higher HIV prevalence among FSWs at detention centres and low-tier entertainment centres demonstrates the need to provide tailored interventions to these key sub-populations.

This review improves on the two earlier systematic reviews^{26,27} by disaggregating the data according to recruitment venues and sex work tiers, with a more comprehensive integration of the data. In contrast to these previous reviews, the present study provides a

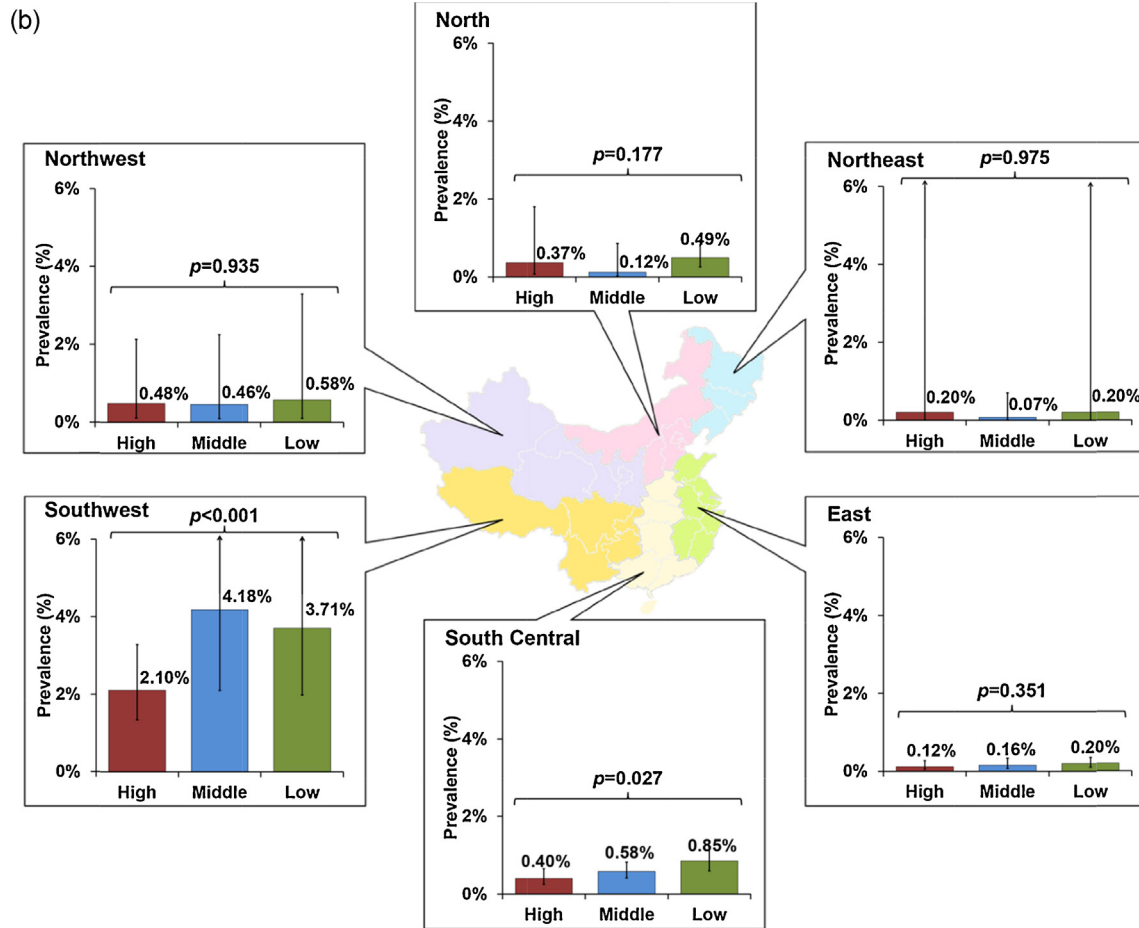
far more comprehensive integration of available data (456 publications) and more plausible HIV estimates (from 0.74% to 0.40% during 2000–2011). In particular, the 2011 national prevalence is of a similar order to a recent model estimate of 0.49–0.85%.³ This indicates a six- and four-fold higher risk of HIV infection than in the general Chinese population (0.06%) and pregnant women (0.10%), respectively.^{4,52} The HIV disease burden in FSWs in China is much lower than the corresponding levels in low- and middle-income country settings.^{27,53} The overall stabilizing trend may effectively be a result of the drastic scale-up of condom programmes and increased access to HIV testing and counselling services for Chinese FSWs.^{54,55} Both government institutions and non-governmental organizations have strongly promoted condom use and HIV testing programmes, which have significantly improved condom use (from 53.7% to 84.9%) and HIV testing coverage (from 3.2% to 48.0%) over the period 2000–2011.⁵⁶ However, it is also possible that a lack of access to optimal treatment and delayed linkage to care in the early 2000s contributed to high death rates among the earlier-infected women, which would remove them from future prevalence estimates.

In China, approximately 3% of FSWs are drug-users.⁵⁶ The disproportionately high HIV disease burden among FSWs in Southwest China is likely drug-related. The so-called ‘Golden



† HIV prevalence at the national level, stratified by recruitment venues, is: community 0.29% (0.03–2.78%); sentinel sites: 0.48% (0.32–0.73%); entertainment venues: 0.61% (0.47–0.79%); detention centre: 0.92% (0.46–1.88%); VCT: 0.80% (0.46–1.67%); other venues: 0.48% (0.23–1.25%).

Figure 4. (a) Comparison of HIV prevalence among the female sex workers at various recruitment venues in the six Chinese regions. (b) Comparison of HIV prevalence across the high-, middle- and low-social tier female sex workers in the six Chinese regions.



† HIV prevalence at the national level, stratified by tiers of entertainment venues, is: low-tier: 1.10% (0.71–2.16%); medium-tier: 0.92% (0.50–1.77%); high-tier: 0.59% (0.32–1.45%)

Figure 4 (Continued).

Triangle' is a well-known illicit drug manufacturing and trafficking region bordering Myanmar, Laos, Thailand, and Southwest China.⁵⁷ This region was home to the onset of the HIV epidemic among people who inject drugs in Southeast Asia and fuelled the subsequent transmission into other at-risk populations in China, such as FSWs. A high proportion of drug-using FSWs has also been reported in the Southwest region, and the potential overlapping commercial sex and drug use may have facilitated the rapid transmission of HIV in the region.^{24,58,59} Accumulated evidence has indicated that drug-using FSWs are highly at-risk. The frequency and intensity of drug use are associated with engagement in commercial sex, mostly due to addiction-related financial needs.⁶⁰ Drug-using FSWs are more likely to work in low-end sex venues, serve more clients, have a longer history of commercial sex work, and demonstrate riskier sexual behaviours.^{15,23,60} A high proportion of FSWs have sexual partners who use drugs.²³ STIs are reportedly common in FSWs who use drugs and may facilitate the transmission of HIV.¹⁹

This systematic review indicated a high prevalence of HIV among FSWs recruited from detention centres and VCT sites, both of which represent FSW sub-populations with risky commercial sex activities. The previous literature has reported that FSWs participating in frequent commercial and/or unprotected sex are more prone to police incarceration and likely to take up testing as a result of the higher risk of HIV infection.^{61,62} In entertainment venues, the sex work tier shapes the work environment, the types

of client, and behavioural patterns of FSWs. Overall, the likelihood of HIV infection when selling sex in a low-tier venue is double the risk of infection in middle- and high-tier venues. These differences in risk are more significant in the Southwest and South Central regions of China where the HIV disease burden is already moderate or high. These geographical differences are likely the result, in part, of greater openness to commercial sex brought about by economic development and also higher drug trafficking and usage in the southern Chinese regions. These significantly facilitate HIV transmission. In contrast, given the already low HIV prevalence in other Chinese regions, entertainment tiers and the associated risk behaviours in FSWs may affect HIV transmission to a lesser extent. In general, FSWs in low-tier entertainment venues reportedly have a low socio-economic status, low level of education, and poor hygiene practices.¹⁷ Due to financial needs, low-tier FSWs are required to provide services to more clients and are often not empowered to negotiate condom use during sexual intercourse,⁶³ substantially increasing the risk of HIV infection and transmission. The easy access to their venues and identifiable appearance has positioned them as obvious targets for frequent police crack-downs.¹⁰ This contributes to high mobility among low-tier FSWs,¹⁷ creating substantial barriers to health interventions among these women. STIs among low-tier FSWs are also more prevalent^{18,26} and may further facilitate heightened HIV transmission.

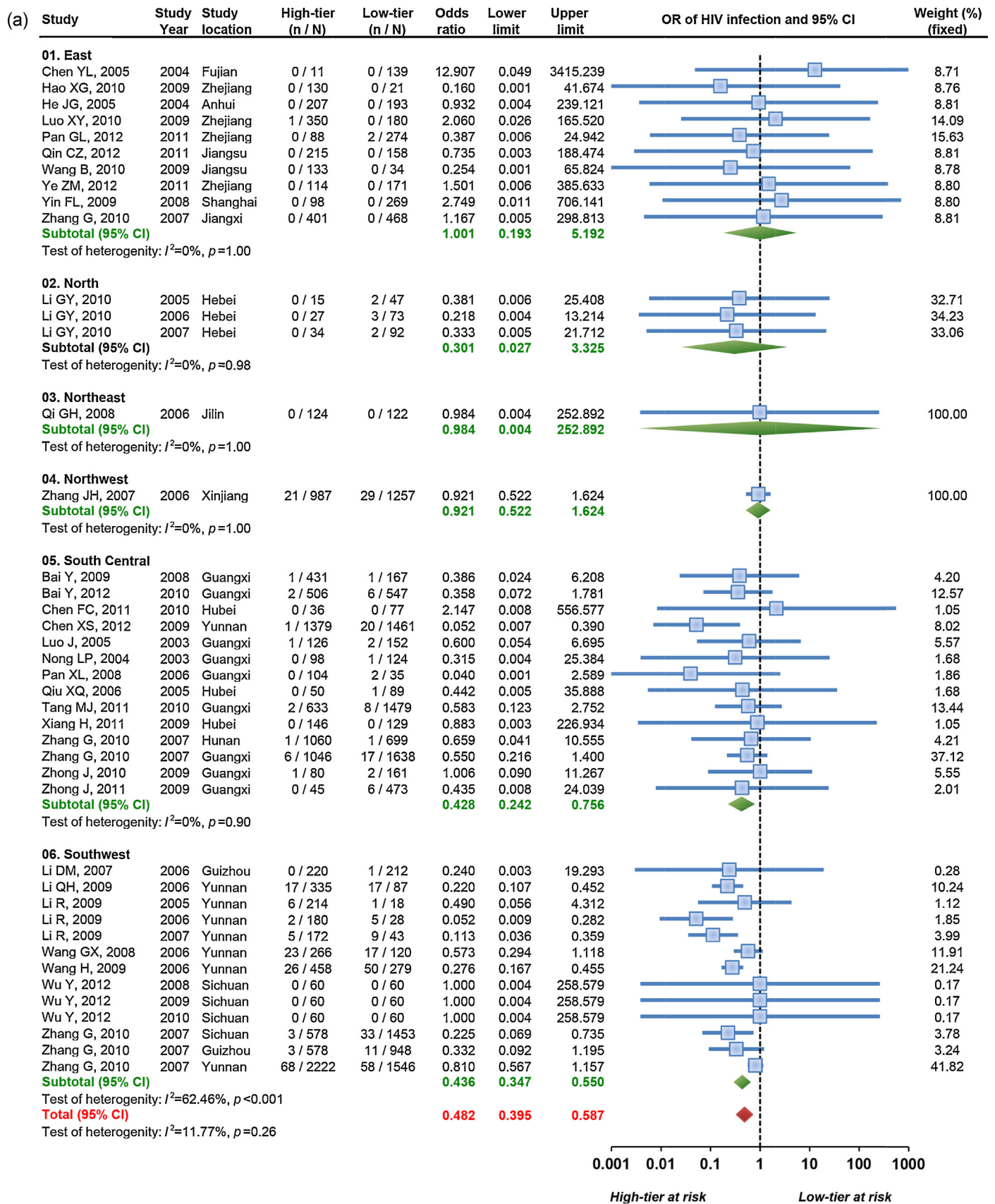


Figure 5. (a) Comparison of the risk of HIV infection between high- and low-tier female sex workers. (b) Comparison of the risk of HIV infection between middle- and low-tier female sex workers.

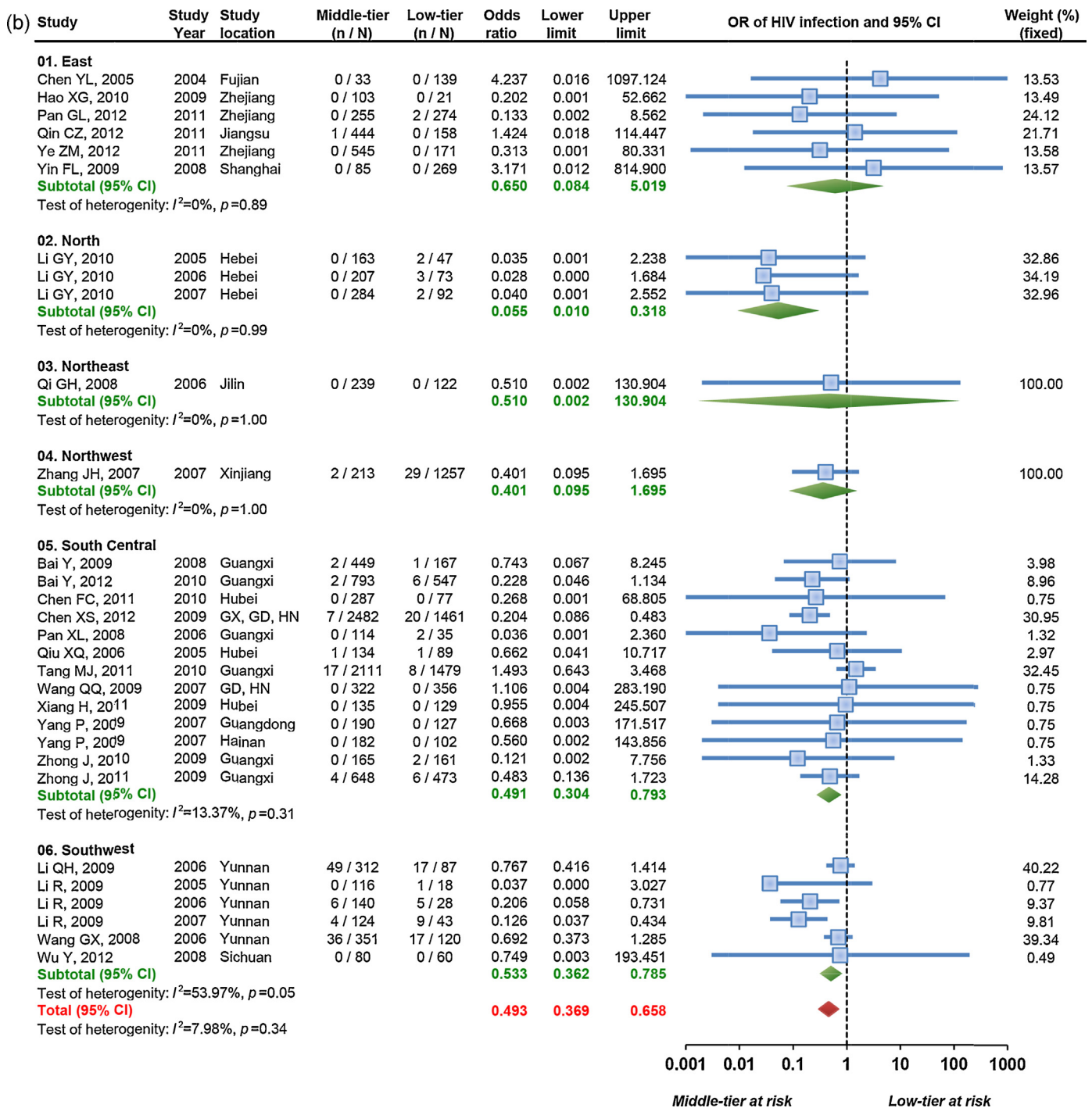


Figure 5 (Continued).

This study has several limitations. First, it was not possible to disaggregate data about FSWs among drug-using FSWs so these could not be analysed separately. Second, the methodological limitations of most research data lead to constraints on the inferences that can be made. Third, the marginalized nature of low-tier FSWs likely results in under-sampling from this key subpopulation. Fourth, the classification of various tiers of entertainment venues may vary temporarily and geographically, and may also be largely influenced by economic development. Fifth, venues defined in this analysis were the sites of recruitment and may not represent the location that the participants most often attended. Sixth, intrinsic heterogeneities exist in each Chinese administrative region and these could not be accounted for due to a lack of data in this study.

Comprehensive HIV prevention programmes have been effective at increasing knowledge and awareness of HIV and safe sexual practices among FSWs in China.⁶⁴ The rapidly expanding 100% condom use programme in China is consistent with the stabilizing trend in the HIV epidemic among FSWs. To achieve the best outcomes in terms of population impact, HIV prevention strategies should focus on the highest-risk subgroups of FSWs, such as drug-using and low-tier FSWs. In provinces where overlapping drug use and commercial sex activities are common, integration of condom programmes, needle and syringe exchange programmes, and other harm reduction programmes should be implemented together in order to further curb the epidemic. Interventions with a specific focus on low-tier FSWs, marked by their limited power to negotiate

condom use and high mobility, need to be scaled-up in cooperation with the Ministry of Public Security. Further investigations into how mobile and internet technologies may impact the pattern of commercial sex work may be necessary in the planning of future interventions for FSWs.

Authors' contribution

EPFC, WLY, XZ, KIL, KT, XS, RZ, PS, and LY, performed the literature search, quality assessment, data extraction, and data analysis. LZ wrote the first draft of this manuscript. LZ and JJ designed the study. EPFC, JDT, KEM, SS, and LZ assisted with data analysis and interpretation, and critically revised the manuscript for important intellectual content. All authors have reviewed and approved the final version of the manuscript.

Acknowledgement

This study was supported by a Global Infectious Diseases Training Grant (1D43TW009532–01). The funders had no role in the study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Conflict of interest: The authors have declared that no competing interests exist.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.ijid.2015.08.014>.

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