fortune Journals

Research Article

ARCHIVES OF
CLINICAL AND
BIOMEDICAL RESEARCH

ISSN: 2572-5017

Sexually Transmitted Infections among Key Populations in India: Systematic Review with Spatiotemporal Distribution

Mihir Bhatta[1]*, Bhumika Tumkur Venkatesh[2], Utsha Ghosh[1], Santhakumar Aridoss[3], Subrata Biswas[1], Papiya Banerjee[1], Piyali Ghosh[1], Pankaj Khan[1], Abhishek Royal[4], Nibedita Das[5], Agniva Majumdar[1], Debjit Chakraborty[1], Falguni Debnath[1], Alok Kumar Deb[1], Protim Ray[6], Bhavani Shankara Bagepally[3], Lahari Saikia[7], Probal Goswami[8], Turlapati Narsimha Prasad[9], Gajendra Kumar Medhi[10], Chiranjeev Bhattacharjya[11], Shanta Dutta[1] and Rajatasubhra Adhikary[12].

Abstract

In the developing world, sexually transmitted infections (STIs) are among the key sources of health and financial adversities, contributing significantly to morbidity, death, and stigma. Goal of the current systematic review is to identify the geographic distribution and current of STIs among the Indian key population. A protocol was prepared and registered in the PROSPERO, with the registration number CRD42022357425 and published as a Systematic Review Protocol. The data on frequency and prevalence of four treatable STIs— syphilis, chlamydia, gonorrhea and trichomoniasis, focused on the MSM (men sex with men) and FSW (female sex workers) populations, followed by H/TG (Hijras with Transgenders) and PWID (those who inject drugs), was gathered and analyzed from different geographical regions in India. However, it was found that most of the research used aetiological diagnosis to report prevalence and were belongs to the western and southern regions of India. Few studies from the northern and north eastern regions were also being found. In the light of present findings and with the identified limitations, it can be concluded that existing HIV surveillance system under NACP (National AIDS Control Programme) in India, can be utilized with additional bio-specimen collection to determine STI prevalence among high risk populations.

Keywords: Sexually transmitted infections; Key population; Syphilis; Gonorrhea; Chlamydia; Trichomoniasis; India

Introduction

In the developing parts of the world, sexually transmitted infections (STIs) are among the key sources of health, and financial adversities, causing extensive morbidity, mortality and stigma [1]. A remarkable variation of frequency and prevalence of the four curable STIs, which are syphilis, chlamydia, gonorrhea and trichomoniasis are observed with the spatiotemporal variation [2]. Studies suggest that the prevalence of these four STIs among general people has a range of 0-3.9% in India [3], but the STI burden is considerably higher among key populations having high-risk behaviour like men who have sex with men (MSM), female sex worker (FSW) hijras with transgender, and people who inject drugs (PWID). However, there are inadequate literature till date to report STI burden in Indian key populations and all of the information have not been unified to enlighten the general spatiotemporal tendencies of STI infections in various

Affiliation:

1. ICMR - National Institute for Research in Bacterial Infections, Kolkata, India; 2. Campbell Collaboration, South Asia; 3. ICMR-National Institute of Epidemiology (ICMR-NIE), Chennai, India; 4. Independent Technical expert (STI); 5. Institute of Serology, Kolkata, India; 6. Durbar Mahila Samanwaya Committee, Kolkata, India; 7. Assam Medical College and Hospital, Dibrugarh, India; 8. Independent expert (analysis) 9. Independent expert (HIV and STI); 10. North Eastern Indira Gandhi Regional Institute of Health & Medical Sciences (NEIGRIHMS), Shillong, India; 11. United Nations Development Programme (UNDP); 12 World Health Organization (WHO).

***Corresponding author:**
Dr. Mihir Bhatta, ICMR - National Institute for Research in Bacterial Infections, P-33, CIT Road, Scheme-XM, Beleghata, Kolkata, West Bengal, India.

Citation: Mihir Bhatta, Bhumika Tumkur Venkatesh, Utsha Ghosh, Santhakumar Aridoss, Subrata Biswas, Papiya Banerjee, Piyali Ghosh, Pankaj Khan, Abhishek Royal, Nibedita Das, Agniva Majumdar, Debjit Chakraborty, Falguni Debnath, Alok Kumar Deb, Protim Ray, Bhavani Shankara Bagepally, Lahari Saikia, Probal Goswami, Turlapati Narsimha Prasad, Gajendra Kumar Medhi, Chiranjeev Bhattacharjya, Shanta Dutta, Rajatasubhra Adhikary. Sexually transmitted infections among key populations in India: systematic review with spatiotemporal distribution. Archives of Clinical and Biomedical Research 9 (2025): 135-155.

Received: March 06, 2025
Accepted: March 28, 2025
Published: April 15, 2025

key or high-risk population. To gain insight of the status of the prevalence and spatiotemporal distribution of four STIs viz. syphilis (by Treponema pallidum), gonorrhea (by Neisseria gonorrhoeae or NG), chlamydia (by Chlamydia trachomatis or CT), and trichomoniasis (by Trichomonas vaginalis or TV) among different key populations such are, men who have sex with men (MSM), female sex workers (FSW), hijras with transgenders (H/TG) and people who inject drugs (PWID) in India, present systematic review has been initiated using existing published evidence [3-4].

Materials and Methods

A study protocol was developed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines. All available peer reviewed published articles are extracted using suitable search terms [5] in PUBMED, MEDLINE, EMBASE, Cochrane Library, Science Direct, Google Scholar and Psychinfo along with published re-ports (as grey literature) from reliable sources, comprising all studies from January 2000 to December 2023.

A protocol for the systematic review was prepared and registered in the PROSPERO, having the registration number CRD42022357425 and published subsequently [5].

Evaluation of the methodological quality

Evaluation of selected studies was performed through title, text and abstract prior to the accumulation of it into the decisive analysis. Evaluation was performed with the help of modified Newcastle - Ottawa Quality Assessment tool [6]. Evaluation was completed be-fore collection of information.

Geographical distribution with spatiotemporal attributes

Geographical distributions of previously mentioned STIs in Indian key population were presented using heat map and choropleth maps, generated with the help of Quantum GIS (Ver. 3.18 Zurich) [7]. An administrative map of India containing the latest information of states and union territories is georeferenced and the resulting polygon was used as the base map layer. State-level STI prevalence data were added as comma delimited layers. Prevalence data from accepted studies were added as spatiotemporal attributes in separate layers respectively. Finally, maps were generated for overall included studies for each key population with prevalence of four curable STIs in histogram format in a separate layer. Multiple points were used to generate heat map of STI prevalence. Data based on regional distribution of STIs among key population has been entered into the newly pre-pared maps as non-spatial attributes [8].

Results

The present findings would be vital to understand the STI status among key population and to design evidence-based strategies for STI prevention in key population in India. There are total of 8919 publications are selected initially. The abstract and titles were screened for eligibility and duplicates were removed. A total of forty articles were included from peer reviewed journals. Among the 70 reports (grey literature)-excluding Sankalak Reports (two documents), published by several competent national, international, and state agencies, any reports could not be included based on the screening tool. Details of the inclusion and exclusion criteria, along with the, number of each category of articles are described through PRISMA flow Diagram [Figure 1].

Search of relevant databases (PUBMED. Google Scholar, Mendeley, Cochrane Library, Scopus, Science Direct and EMBASE) yielded 40 articles which met the inclusion criteria set in the protocol for the present systematic review. However, it is found that published articles were not available from all geographical regions in India. Most of the studies were conducted in southern and western part. However, four studies were also reported from north-eastern part of India. A few studies form northern India was also conducted in Del-hi and Lucknow (Figure 2).

Maximum numbers of studies reported on STI prevalence, were belongs to MSM and FSW population followed by H/TG and PWID and mostly based on syphilis seroprevalence. Data on chlamydia and gonorrhea were less available, trichomoniasis was least reported STI. While synthesizing data, articles which included more than one key population was counted separately. Eighteen articles reported STI prevalence among FSWs [1-4,8-23]. These eighteen articles included twenty-six different studies based on prevalence data of different STIs, different FSW subgroups and diverse geographical region. All data related to FSW was presented through two different diagnostic methods, aetiological [1-4,8-20] (Table 1) and syndromic [20,23] (Table 2). STI prevalence among MSM was reported in nineteen articles [3,15,24-40]. Based on different STIs and geographical regions total forty studies were recorded for this review. Relevant extracted data on MSM was recorded un-der aetiological diagnosis [3,15,24-40] (Table 3) and syndromic [33,40] (Table 4) diagnosis. Four articles on H/TG included four studies on STI prevalence among H/TG based on different STI and geographical region [18,29,31,41]. Data on H/TG under aetiological diagnosis was presented in Table 5. There was no data available for syndromic diagnosis. Two articles [15,42] were available for STI prevalence among PWID. These two articles comprise six studies on prevalence of different STIs among PWID population in India (Table 6).

Citation: Mihir Bhatta, Bhumika Tumkur Venkatesh, Utsha Ghosh, Santhakumar Aridoss, Subrata Biswas, Papiya Banerjee, Piyali Ghosh, Pankaj Khan, Abhishek Royal, Nibedita Das, Agniva Majumdar, Debjit Chakraborty, Falguni Debnath, Alok Kumar Deb, Protim Ray, Bhavani Shankara Bagepally, Lahari Saikia, Probal Goswami, Turlapati Narsimha Prasad, Gajendra Kumar Medhi, Chiranjeev Bhattacharjya, Shanta Dutta, Rajatasubhra Adhikary. Sexually transmitted infections among key populations in India: systematic review with spatiotemporal distribution. Archives of Clinical and Biomedical Research. 9 (2025): 135-155.

Bhatta M, et al., Arch Clin Biomed Res 2025
DOI:10.26502/acbr.50170446

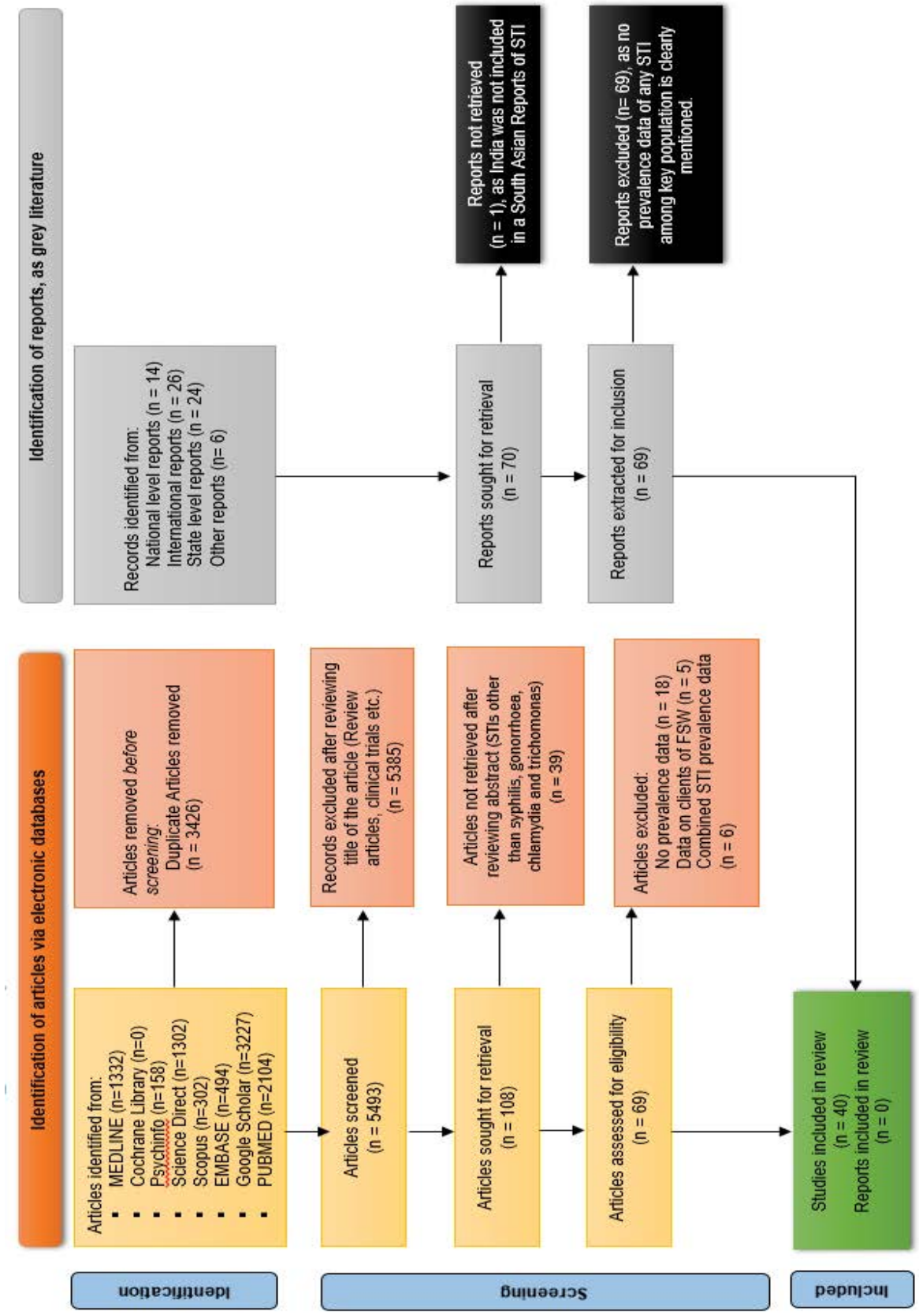

Figure 1: PRISMA Flow Diagram.

Citation: Mihir Bhatta, Bhumika Tumkur Venkatesh, Utsha Ghosh, Santhakumar Aridoss, Subrata Biswas, Papiya Banerjee, Piyali Ghosh, Pankaj Khan, Abhishek Royal, Nibedita Das, Agniva Majumdar, Debjit Chakraborty, Falguni Debnath, Alok Kumar Deb, Protim Ray, Bhavani Shankara Bagepally, Lahari Saikia, Probal Goswami, Turlapati Narsimha Prasad, Gajendra Kumar Medhi, Chiranjeev Bhattacharjya, Shanta Dutta, Rajatasubhra Adhikary. Sexually transmitted infections among key populations in India: systematic review with spatiotemporal distribution. Archives of Clinical and Biomedical Research. 9 (2025): 135-155.

Bhatta M, et al., Arch Clin Biomed Res 2025
DOI:10.26502/acbr.50170446

Table 1: Aetiological diagnosis and prevalence of four curable STIs among FSW from available published articles from different parts of India.

Study	Study period	Study design	Location	FSW Sub group	Sample size	Study setting	Sampling Technique	Specimen	Specimen source	Syphilis		Gonorrhoea		Chlamydia		Trichomoniasis	
										Methods of diagnosis	Prevalence	Methods of diagnosis	Prevalence	Methods of diagnosis	Prevalence	Methods of diagnosis	Prevalence
Reza-Paul et al. [1]	2004-2006	CS	Mysore	NR	429	Facility	TLC	Blood for Syphilis and urine for remaining three	NR	RPR + TPHA	24.7	PCR	5.4	PCR	10.8	PCR	32.9
Shethwala et al. [2]	2005-2006	CS	Surat	NR	300	Community	NR	Blood for syphilis and chlamydia, cervix-swab for Trichomoniasis	NR	RPR + TPHA	6.66	NR	NR	NR	NR	Wet mount microscopy	2
Gutierrez et al. [3]	2003-2007	CS	Andhra Pradesh	NR	1750	Facility	NR	Blood	NR	NA	13	NR	NR	NR	NR	NR	NR
Ramesh et al. [4]	2004-2006	CS	Karnataka	NR	2312	Community	CCS	Blood for Syphilis and urine for gonorrhoea, chlamydia	NR	NR	10.2	NAAT	3.5	NAAT	6.5	NR	NR
Hemalatha et al. [9]	Dec. 2005-Oct. 23006	CS	Andhra Pradesh	NR	3223	Community	CCS	Urine	NR	NR	NR	NAAT	2	NAAT	3.4	NR	NR
Das et al. [10]	Oct. 2008-May 2009	CS	Mumbai & Hyderabad	NR	416	Facility	NR	Blood	NR	RPR + TPHA	10.1	NA	NA	NA	NA	NA	NA
					417			Swab	Cervix	NA	NA	NAAT	14.1	NAAT	16.1	NA	NA
					399							NA	NA	NA	NA	PCR	31.1
Gupte et al. [11]	Dec.2007-Feb.2008	CH	Mumbai	Brothel	2858	Community	NR	Blood	NR	RPR	6.6	NR	NR	NR	NR	NR	NR
Gupte et al. [11]	Dec.2007-Feb.2008	CH	Mumbai	Bar	9296	Community	NR	Blood	NR	RPR	1.3	NR	NR	NR	NR	NR	NR
Gupte et al. [11]	Dec.2007-Feb.2008	CH	Mumbai	Street	1199	Community	NR	Blood	NR	RPR	2.9	NR	NR	NR	NR	NR	NR

Citation: Mihir Bhatta, Bhumika Tumkur Venkatesh, Utsha Ghosh, Santhakumar Aridoss, Subrata Biswas, Papiya Banerjee, Piyali Ghosh, Pankaj Khan, Abhishek Royal, Nibedita Das, Agniva Majumdar, Debjit Chakraborty, Falguni Debnath, Alok Kumar Deb, Protim Ray, Bhavani Shankara Bagepally, Lahari Saikia, Probal Goswami, Turlapati Narsimha Prasad, Gajendra Kumar Medhi, Chiranjeev Bhattacharjya, Shanta Dutta, Rajatasubhra Adhikary. Sexually transmitted infections among key populations in India: systematic review with spatiotemporal distribution. Archives of Clinical and Biomedical Research. 9 (2025): 135-155.

Gupte et al. [11]	Dec.2007-Feb.2008	CH	Mumbai	Home	4512	Community	NR	Blood	NR	RPR	1.8	NR	NR	NR	NR	NR	NR
Mainkar et al. [12]	Mar.2006-Dec 2006	CS	Maharashtra	NR	2525	Facility	RDS	Blood for Syphilis and urine for gonorrhoea, chlamydia	NR	RPR + TPHA	15.8	NAAT	7.4	NAAT	8	NR	NR
Rachakulla et al. [14]	Nov 2005-Dec 2006	CS	Andhra Pradesh	NR	3271	Facility	Cluster	Blood for Syphilis and urine for gonorrhoea, chlamydia	NR	RPR + TPHA	10.8	NAAT	2.2	NAAT	3.5	NR	NR
Ghosh et al. [15]	NR	CS	West Bengal	NR	45	Facility	NR	Blood for syphilis and chlamydia, cervix-swab for Trichomoniasis	NR	VDRL +TPHA	28.8	NR	NR	Serological	15.5	Kupferburges culture	17.7
Medhi et al. [16]	Feb. 2006 - Apr. 2006	CS	Nagaland	NR	423	Community	RDS	Blood for Syphilis and urine for gonorrhoea, chlamydia	NR	RPR + TPHA	15.3	NAAT	4.2	NAAT	22.2	NR	NR
Das et al. [17]	Oct 2008-Nov 2009	CH	Mumbai & Hyderabad	NR	417	Facility	NR	Blood for syphilis and Cervix-swab for remaining three	NR	RPR + TPHA	5.8	NAAT	14.2	NAAT	16.1	NAAT	31.2
Boily et al. [18]	Aug. 2004-Feb 2005	CS	Mysore	NR	429	Facility	TLC	Blood	NR	RPR + TPHA	24.9	NR	5.4	NR	10.8	NR	NR
Boily et al. [18]	Aug.2005-Aug. 2006	CS	Shimogga	NR	393	Facility	TLC	Blood	NR	RPR + TPHA	4	NR	1.3	NR	5.6	NR	NR
Boily et al. [18]	Nov. 2005-May 2007	CS	Belgaum	NR	366	Facility	TLC	Blood	NR	RPR + TPHA	8	NR	4.7	NR	6.5	NR	NR
Boily et al. [18]	Nov. 2005-Feb 2007	CS	Bellari	NR	423	Facility	TLC	Blood	NR	RPR +TPHA	5.2	NR	2.7	NR	4.1	NR	NR
Boily et al. [18]	Jul.2006-Jun. 2007	CS	Bangalore	NR	673	Facility	TLC	Blood	NR	RPR + TPHA	12.6	NR	3.6	NR	6.5	NR	NR

Citation: Mihir Bhatta, Bhumika Tumkur Venkatesh, Utsha Ghosh, Santhakumar Aridoss, Subrata Biswas, Papiya Banerjee, Piyali Ghosh, Pankaj Khan, Abhishek Royal, Nibedita Das, Agniva Majumdar, Debjit Chakraborty, Falguni Debnath, Alok Kumar Deb, Protim Ray, Bhavani Shankara Bagepally, Lahari Saikia, Probal Goswami, Turlapati Narsimha Prasad, Gajendra Kumar Medhi, Chiranjeev Bhattacharjya, Shanta Dutta, Rajatasubhra Adhikary. Sexually transmitted infections among key populations in India: systematic review with spatiotemporal distribution. Archives of Clinical and Biomedical Research. 9 (2025): 135-155.

Bhatta M, et al., Arch Clin Biomed Res 2025
DOI:10.26502/acbr.50170446

Jayaraman et al. [19]	Jul.2006-Jun. 2007	CS	Bangalore	NR	673	Facility	TLC	Blood	NR	RPR + TPHA	12.6	NAAT	NR	NAAT	NR	NR	NR
Sarna et al. [20]	Jan 2010 -Dec 2010	CH	Nellore	NR	529	Community	RDS	Blood for syphilis and Cervix-swab for remaining three	NR	RPR + TPPA	2.8	PCR	0.7	PCR	2.2	Pap Smear	15.5
Beksinska et al. [22]	July and August 2011	CS	Karnataka	NR	1092	Community	CCS	Blood	NR	RPR + TPHA	3.2	NR	NR	NR	NR	NR	NR

CH- Cohort study; CS- Cross-sectional study; TLC- Time Location Cluster, CCS- Conventional Cluster Sampling, NR- Not Reported; TPHA- Treponema Pallidum Heamagglutination Test, RPR Rapid Plasma Reagin; NAAT- Nucleic Acid Amplification Test

Table 2: Syndromic diagnosis and prevalence of four curable STIs among FSW from available published articles from different parts of India.

Study	Study period	Study design	Location	FSW Sub group	Sample size	Study setting	Sampling method	Urethral discharge	Genital Ulc Herpetic	Cervical discharge	Genital Ulcer Non Herpetic	PSSw	Inguinal Bubo	Vaginal discharge	Ano-rectal discharge
Sarna et al. [20]	Jan 2010 -Dec 2010	C1H	Nellore	NR	529	Community	RDS	NR	NR	5.3	NR	NR	NR	50.7	NR
Shukla et al. [23]	Aug 2012-Jul.2013	CS	Lucknow	Street based	83	Community	Random	NR	10.8	30.1	2.4	NR	1.2	30.1	0
Shukla et al. [23]	Aug 2012-Jul.2013	CS	Lucknow	Home based	205	Community	Random	NR	1.5	20.5	1.5	NR	1	20.5	1.5

CH- Cohort study; CS- Cross-sectional study; NR- Not reported; TLC- Time Location Cluster, RDS- Respondent Driven Sampling

Table 3: Aetiological diagnosis and prevalence of four curable STIs among MSM from available published articles from different parts of India.

Study	Study period	Study design	Location	MSM Sub group	Sample size	Study setting	Sampling Technique	Specimen	Syphilis		Gonorrhoea		Chlamydia		Trichomoniasis	
									Methods of diagnosis	Prevalence	Methods of diagnosis	Prevalence	Methods of diagnosis	Prevalence	Methods of diagnosis	Prevalence
Setia et al. [24]	2001	CS	Mumbai	NR	122	Facility	CCS	Blood	TPHA	17.2	NR	NR	NR	NR	NR	NR
Gupta et al. [25]	1998-2002	CH	Pune	NR	708	Facility	NR	Blood for syphilis and glans penis swab for gonorrhoea	RPR + TPHA	3	Gram Stain	4.1	NR	NR	NR	NR

Citation: Mihir Bhatta, Bhumika Tumkur Venkatesh, Utsha Ghosh, Santhakumar Aridoss, Subrata Biswas, Papiya Banerjee, Piyali Ghosh, Pankaj Khan, Abhishek Royal, Nibedita Das, Agniva Majumdar, Debjit Chakraborty, Falguni Debnath, Alok Kumar Deb, Protim Ray, Bhavani Shankara Bagepally, Lahari Saikia, Probal Goswami, Turlapati Narsimha Prasad, Gajendra Kumar Medhi, Chiranjeev Bhattacharjya, Shanta Dutta, Rajatasubhra Adhikary. Sexually transmitted infections among key populations in India: systematic review with spatiotemporal distribution. Archives of Clinical and Biomedical Research. 9 (2025): 135-155.

Gupta et al. [25]	1993-1997	CH	Pune	NR	708	Facility	NR	Blood for syphilis and glans penis swab for gonorrhoea	RPR + TPHA	8.2	Gram Stain	4.5	NR	NR	NR	NR
Brahmam et al. [26]	Mar.2006- Apr.2007	CS	Tamilnadu	NR	2025	Facility	TLC	Blood for syphilis and urine for gonorrhoea and chlamydia	RPR	14	NAAT	0.1	NAAT	0.6	NR	NR
Brahmam et al. [26]	Mar.2006- Apr.2007	CS	AAndhra Pradesh	NR	1621	Facility	TLC	Blood for syphilis and urine for gonorrhoea and chlamydia	RPR	13	NAAT	0.6	NAAT	1.6	NR	NR
Brahmam et al. [26]	Mar.2006- Apr.2007	CS	Karnataka	NR	298	Facility	TLC	Blood for syphilis and urine for gonorrhoea nd chlamydia	RPR	11.9	NAAT	0.6	NAAT	1.6	NR	NR
Brahmam et al. [26]	Mar.2006- Apr.2007	CS	Maharashtra	NR	653	Facility	TLC	Blood for syphilis and urine for gonorrhoea and chlamydia	RPR	8.4	NAAT	0.3	NAAT	4	NR	NR
Gutierrez et al. [3]	2003-2007	CS	Andhra Pradesh	NR	1106	Facility	NR	Blood	NR	20	NR	NR	NR	NR	NR	NR
Kumta et al. [27]	Jan.2003-Dec. 2004	CH	Mumbai	NR	831	Facility	NR	Blood	VDRL	6.5	NR	NR	NR	NR	NR	NR
Solomon et al. [28]	Oct 2008- Nov 2008	CS	Tamil Nadu	NR	721	Community	RDS	Blood	RPR, TPPA	8.04	NR	NR	NR	NR	NR	NR
Sahastrabuddhe et al. [29]	1993-2002	CS	Pune	NR	641	Facility	RDS	Blood	TPHA	5.8	NR	NR	NR	NR	2rrrr	NR
Ghosh et al. [15]	NR	CS	West Bengal	NR	26	Facility	NR	Blood	TPHA	7.7	NR	NR	NR	NR	NR	NR
Narayanan et al. [30]	2008-2009	CS	Mumbai and Hyderabad	NR	149	Facility	NR	Blood for syphilis and rectal swab for gonorrhoea and chlamydia	TPHA, RPR	4	PCR	14.8	PCR	4.7	NR	NR

Citation: Mihir Bhatta, Bhumika Tumkur Venkatesh, Utsha Ghosh, Santhakumar Aridoss, Subrata Biswas, Papiya Banerjee, Piyali Ghosh, Pankaj Khan, Abhishek Royal, Nibedita Das, Agniva Majumdar, Debjit Chakraborty, Falguni Debnath, Alok Kumar Deb, Protim Ray, Bhavani Shankara Bagepally, Lahari Saikia, Probal Goswami, Turlapati Narsimha Prasad, Gajendra Kumar Medhi, Chiranjeev Bhattacharjya, Shanta Dutta, Rajatasubhra Adhikary. Sexually transmitted infections among key populations in India: systematic review with spatiotemporal distribution. Archives of Clinical and Biomedical Research. 9 (2025): 135-155.

Subramanian et al. [31]	2006	CS	Tamilnadu	NR	1621	Community	TLC	Blood for syphilis and urine for gonorrhoea and chlamydia	RPR + TPHA	14.3	NR	0.07	NAAT	0.68	NR	NR
Goswami et al. [32]	2006	CS	Andhra Pradesh	NR	1218	Facility	TLC	Blood for syphilis and urine for gonorrhoea and chlamydia	RPR + TPHA	8.1	NAAT	0.3	NAAT	1.1	NR	NR
Nagarajan et al. [33]	2005-2007	CS	Andhra Pradesh, Maharashtra and Tamilnadu	NR	3895	Community	TLC	Blood for syphilis and urine for gonorrhoea and chlamydia	RPR + TPHA	12.8	NAAT	1.2	NAAT	0.3	NR	NR
Ramanathan et al. [34]	Jan. 2005-Mar. 2009	CS	Maharashtra	NR	653	Community	TLC	Blood for syphilis and urine for gonorrhoea and chlamydia	RPR + TPHA	8.8	NAAT	0.3	NAAT	3.7	NR	NR
Solomon et al. [35]	Sep.2012-Jun. 2013	CS	Hyderabad	NR	998	Community	RDS	Blood	TPHA	3.9	NR	NR	NR	NR	NR	NR
Solomon et al. [35]	Sep.2012-Jun. 2013	CS	Vijaywada	NR	1000	Community	RDS	Blood	TPHA	4.4	NR	NR	NR	NR	NR	NR
Solomon et al. [35]	Sep.2012-Jun. 2013	CS	Vizag	NR	1000	Community	RDS	Blood	TPHA	2.1	NR	NR	NR	NR	NR	NR
Solomon et al. [35]	Sep.2012-Jun. 2013	CS	Bangalore	NR	1000	Community	RDS	Blood	TPHA	4	NR	NR	NR	NR	NR	NR
Solomon et al. [35]	Sep.2012-Jun. 2013	CS	Belgaum	NR	1003	Community	RDS	Blood	TPHA	0.8	NR	NR	NR	NR	NR	NR
Solomon et al. [35]	Sep.2012-Jun. 2013	CS	Mangalore	NR	1000	Community	RDS	Blood	TPHA	1.4	NR	NR	NR	NR	NR	NR

Citation: Mihir Bhatta, Bhumika Tumkur Venkatesh, Utsha Ghosh, Santhakumar Aridoss, Subrata Biswas, Papiya Banerjee, Piyali Ghosh, Pankaj Khan, Abhishek Royal, Nibedita Das, Agniva Majumdar, Debjit Chakraborty, Falguni Debnath, Alok Kumar Deb, Protim Ray, Bhavani Shankara Bagepally, Lahari Saikia, Probal Goswami, Turlapati Narsimha Prasad, Gajendra Kumar Medhi, Chiranjeev Bhattacharjya, Shanta Dutta, Rajatasubhra Adhikary. Sexually transmitted infections among key populations in India: systematic review with spatiotemporal distribution. Archives of Clinical and Biomedical Research. 9 (2025): 135-155.

Solomon et al. [35]	Sep.2012-Jun. 2013	CS	Chennai	NR	1000	Community	RDS	Blood	TPHA	1.1	NR	NR	NR	NR	NR	NR
Solomon et al. [35]	Sep.2012-Jun. 2013	CS	Coimbatore	NR	1000	Community	RDS	Blood	TPHA	3	NR	NR	NR	NR	NR	NR
Solomon et al. [35]	Sep.2012-Jun. 2013	CS	Madurai	NR	1001	Community	RDS	Blood	TPHA	1.8	NR	NR	NR	NR	NR	NR
Solomon et al. [35]	Sep.2012-Jun. 2013	CS	Bhopal	NR	998	Community	RDS	Blood	TPHA	1.3	NR	NR	NR	NR	NR	NR
Solomon et al. [35]	Sep.2012-Jun. 2013	CS	Delhi	NR	997	Community	RDS	Blood	TPHA	3.5	NR	NR	NR	NR	NR	NR
Solomon et al. [35]	Sep.2012-Jun. 2013	CS	Lucknow	NR	1000	Community	RDS	Blood	TPHA	4.1	NR	NR	NR	NR	NR	NR
Mayer et al. [36]	NR	CS	Mumbai	NR	307	Community	RDS	Blood for syphilis , oro pharyngeal + rectal swab and urine for gonorrhoea and chlamydia	RPR, TPHA	4.02	Gen Probe	3.26	Gen Probe	17	NR	NR
Ramakrishnan et al. [37]	2009-2010	CS	Andhra Pradesh, Maharashtra and Tamilnadu	MSMO	2396	Community	TLC	Blood	RPR + TPHA	5.5	NR	NR	NR	NR	NR	NR

Citation: Mihir Bhatta, Bhumika Tumkur Venkatesh, Utsha Ghosh, Santhakumar Aridoss, Subrata Biswas, Papiya Banerjee, Piyali Ghosh, Pankaj Khan, Abhishek Royal, Nibedita Das, Agniva Majumdar, Debjit Chakraborty, Falguni Debnath, Alok Kumar Deb, Protim Ray, Bhavani Shankara Bagepally, Lahari Saikia, Probal Goswami, Turlapati Narsimha Prasad, Gajendra Kumar Medhi, Chiranjeev Bhattacharjya, Shanta Dutta, Rajatasubhra Adhikary. Sexually transmitted infections among key populations in India: systematic review with spatiotemporal distribution. Archives of Clinical and Biomedical Research. 9 (2025): 135-155.

Ramakrishnan et al. [37]	2009-2010	CS	Andhra Pradesh, Maharashtra and Tamilnadu	MSMW	1343	Community	TLC	Blood	RPR + TPHA	7	NR	NR	NR	NR	NR	NR
Prabahar et al. [38]	Jun.2015-May 2016	CH	Chennai	NR	1215	Facility	NR	Blood	VDRL + TPHA	4.53	NR	NR	NR	NR	NR	NR
Safren et al. [39]	NR	CS	Chennai	NR	304	Facility	NR	Blood for syphilis and urine +rectal and oro-pharyngeal swab for gonorrhoea and chlamydia	TPHA	16.1	NAAT	8.3	NAAT	11.3	NR	NR
Safren et al. [39]	NR	CS	Mumbai	NR	304	Facility	NR	Blood for syphilis and urine +rectal and oro-pharyngeal swab for gonorrhoea and chlamydia	TPHA	14.8	NAAT	16	NAAT	18.2	NR	NR
Swamiappan et al. [40]	July 2016- Jun. 2019	CH	Chennai	NR	489	Facility	NR	Blood	RPR	8.8	NR	NR	NR	NR	NR	NR

CH- Cohort study; CS- Cross-sectional study; TLC- Time Location Cluster, NR- Not Reported; TPHA- Treponema Pallidum Heamagglutination Test, RPR Rapid Plasma Reagin; NAAT- Nucleic Acid Amplification Test

Table 4: Syndromic diagnosis and prevalence of four curable STIs among MSMs from available published articles from different parts of India.

Study	Study period	Study design	Location	MSM sub group	Sample size	Study setting	Sampling method	Urethral discharge	Genital Ulcer Herpetic	Genital Ulcer Non-Herpetic	PSSw	Inguinal Bubo	Ano-rectal discharge
Nagarajan et al. [33]	2005-2007	CS	Andhra Pradesh, Maharashtra and Tamilnadu	NR	3895	Community	TLC	0.1	NR	NR	0.3	NR	NR
Swamiappan et al. [40]	July 2016-Jun. 2019	CH	Chennai	NR	489	Facility	NR	2	3.1	2	NR	NR	NR

CH- Cohort study; CS- Cross-sectional study; NR- Not Reported,, ; TLC- Time Location Cluster, PSSw- Painful Scrotal Swelling

Citation: Mihir Bhatta, Bhumika Tumkur Venkatesh, Utsha Ghosh, Santhakumar Aridoss, Subrata Biswas, Papiya Banerjee, Piyali Ghosh, Pankaj Khan, Abhishek Royal, Nibedita Das, Agniva Majumdar, Debjit Chakraborty, Falguni Debnath, Alok Kumar Deb, Protim Ray, Bhavani Shankara Bagepally, Lahari Saikia, Probal Goswami, Turlapati Narsimha Prasad, Gajendra Kumar Medhi, Chiranjeev Bhattacharjya, Shanta Dutta, Rajatasubhra Adhikary. Sexually transmitted infections among key populations in India: systematic review with spatiotemporal distribution. Archives of Clinical and Biomedical Research. 9 (2025): 135-155.

Bhatta M, et al., Arch Clin Biomed Res 2025
DOI:10.26502/acbr.50170446

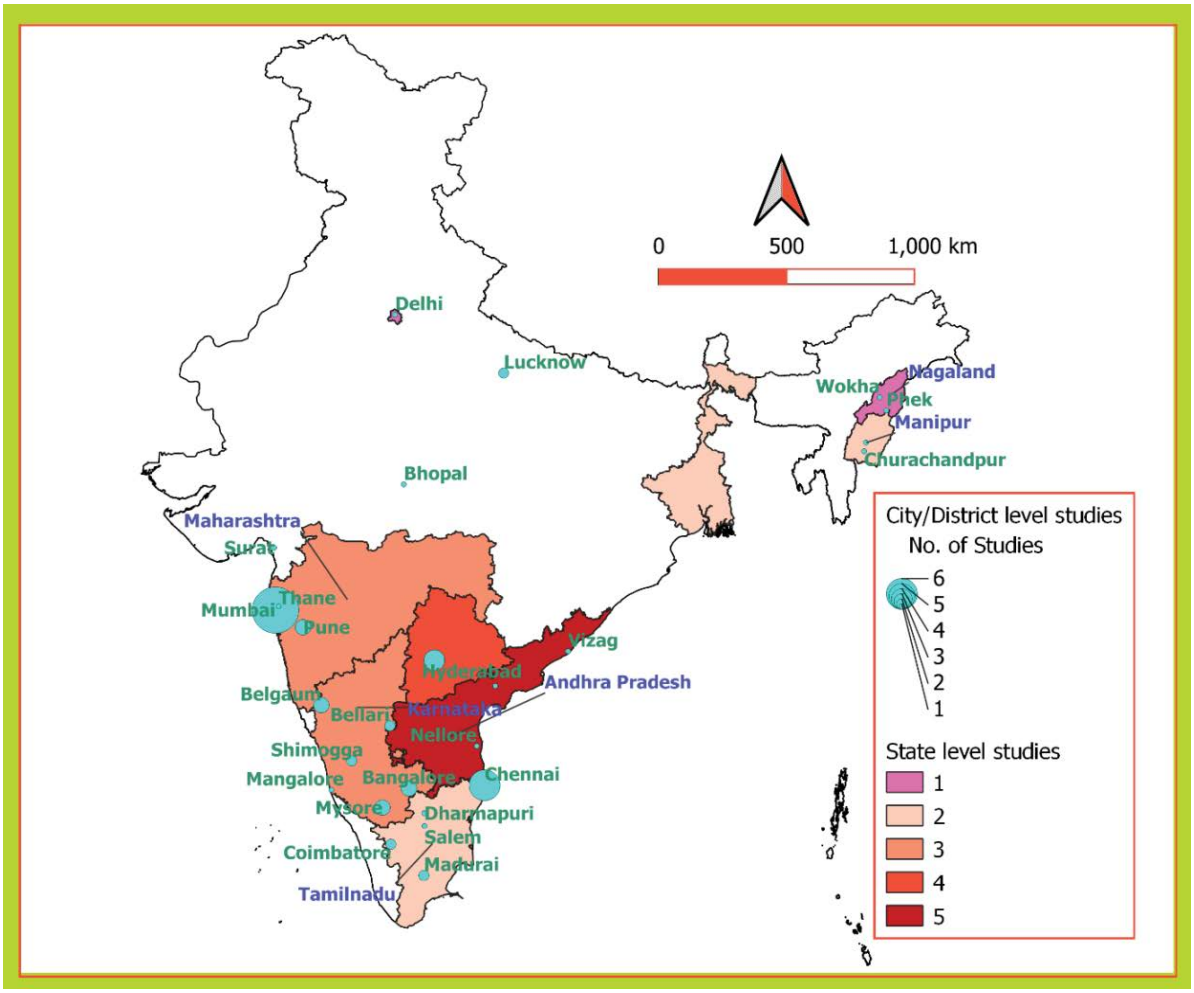

Figure 2: Map of India indicating the regions where included studies were conducted.

Findings among FSW

As per the search, there are eighteen articles comprises of twenty-six studies, which were find out, tell us out about the different STIs among FSW (Table 1 and 2), most of these studies were conducted in Andhra Pradesh, Telangana, Karnataka, Maharashtra, Uttar Pradesh, West Bengal, and Nagaland. Almost half of the studies were conducted in facilities like STI clinics or tertiary care hospitals (Figure 2). Out of 26 studies, most of the studies reported prevalence through aetiological diagnosis (Table 1). Most of the studies reported on single STI, namely syphilis. Among the published articles, an article from Beksinska et al. was published in 2018 [22], however, the study period was 2011. There was very little published article on STI prevalence estimation among FSW after 2011. This cross-sectional study on syphilis among FSW performed in Karnataka and the estimated prevalence was 3.2. Screening was done through RPR followed by TPHA.

Out of all available studies on FSW, a facility level cross-sectional study with a little lower sample size of 45, estimated very high syphilis prevalence (28.8) in West-Bengal [15]. A study conducted in Mumbai during the period of 2007- 2008. [11] and published in 2011, estimate prevalence of syphilis among two groups of sex workers, brothel based FSW had highest syphilis prevalence of 6.6 and the bar-based sex workers had lowest prevalence of 1.3. Trichomoniasis was the least examined and hence least reported STI among FSW (Figure. 3). A study, which based on syndromic diagnosis, was conducted in Nellore, Andhra Pradesh during the period of January to December, 2011, unveiled genital herpetic and non-herpetic ulcer, cervical discharge, Inguinal buboes vaginal discharge and ano-rectal discharge in FSWs (Table 2). The highest reported symptom was vaginal discharge (50.7%) [20]. There was a single reported study each from Nagaland, West Bengal, and Maharashtra, two from Karnataka and Tamil Nadu and three studies from Andhra Pradesh. Most of the district level studies were reported from Karnataka and Andhra Pradesh. Four district level or small studies were reported from Mumbai and two each from Bangalore and Mysore (Figure 3).

Citation: Mihir Bhatta, Bhumika Tumkur Venkatesh, Utsha Ghosh, Santhakumar Aridoss, Subrata Biswas, Papiya Banerjee, Piyali Ghosh, Pankaj Khan, Abhishek Royal, Nibedita Das, Agniva Majumdar, Debjit Chakraborty, Falguni Debnath, Alok Kumar Deb, Protim Ray, Bhavani Shankara Bagepally, Lahari Saikia, Probal Goswami, Turlapati Narsimha Prasad, Gajendra Kumar Medhi, Chiranjeev Bhattacharjya, Shanta Dutta, Rajatasubhra Adhikary. Sexually transmitted infections among key populations in India: systematic review with spatiotemporal distribution. Archives of Clinical and Biomedical Research. 9 (2025): 135-155.

Bhatta M, et al., Arch Clin Biomed Res 2025
DOI:10.26502/acbr.50170446

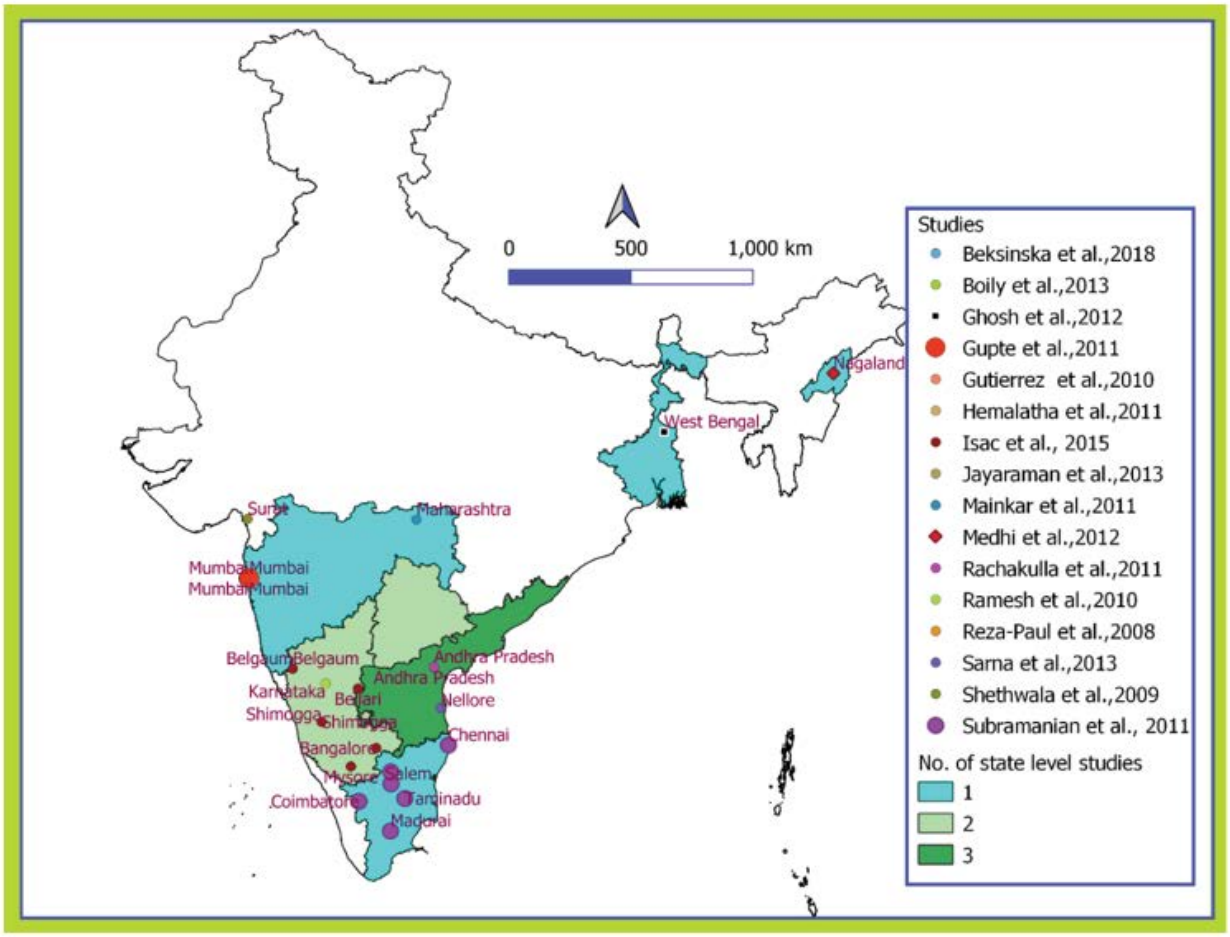

Figure 3: Representation of published articles on four curable STIs among FSWs in India.

Findings among MSM

Nineteen articles [3,15,24-40] on MSM were find out through literature search. Most of them were conducted in Tamil Nadu, West Bengal, Andhra Pradesh, Telangana, Karnataka, and Maharashtra (Figure 5). Almost half of the studies reported from facility level such as STI clinics or tertiary care hospitals. Most of the studies reported prevalence through aetiological diagnosis (Table 3). The most recent available publication reported through literature search, was by Swamiappan et al. [40] and by Safren et al. [39] and both published in 2020. The study conducted in Chennai during July 2016 to June 2019 [40] was reported prevalence of syphilis (8.8) through RPR without mentioning any confirmatory test. Along with the aetiological diagnosis, this study [40] reported symptoms of Urethral Discharge (2%), Genital herpetic Ulcer (3.1%) and Non-herpetic Ulcer (2%). Another cross-sectional study conducted in Mumbai and Chennai without specifying any study period (Table 4), reported prevalence of syphilis, gonorrhoea, and chlamydia as 16.1, 8.3 and 11.3 respectively in Chennai and 14.8, 16, 18.2 respectively in Mumbai [39]. Most of the studies reported Syphilis as none of the studies reported Trichomoniasis. Gonorrhoea and chlamydia were also examined by many of these studies. For aetiological diagnosis RPR screening test followed by TPHA confirmatory test were administered for syphilis and PCR and NAAT for gonorrhoea and chlamydia. Similarly, a cross-sectional community-based study [3] in Andhra Pradesh, estimate a very high syphilis prevalence of 20.0, during the study period of 2003 to 2007. In the same state, Andhra Pradesh a cross-sectional study was conducted in Vijayawada and Vizag, during 2012-2013 and had estimated prevalence of 4.4, and 2.1 respectively [28]. As per the literature search, there are single study from each state of Karnataka, West Bengal and Maharashtra was reported whereas; two studies were reported from Andhra Pradesh and Tamil Nadu. A considerable number of studies were reported from Mumbai, Chennai, and Pune. A few sporadic studies were also evident from Delhi, Lucknow, Bhopal, and Hyderabad. There \was no published article from North-eastern India. Studies from Mumbai, Chennai and Pune showed higher STI prevalence. Similar to FSW population, prevalence of syphilis was reported in most of the studies, whereas a fewer study reported studies on trichomonas (Figure 4).

Citation: Mihir Bhatta, Bhumika Tumkur Venkatesh, Utsha Ghosh, Santhakumar Aridoss, Subrata Biswas, Papiya Banerjee, Piyali Ghosh, Pankaj Khan, Abhishek Royal, Nibedita Das, Agniva Majumdar, Debjit Chakraborty, Falguni Debnath, Alok Kumar Deb, Protim Ray, Bhavani Shankara Bagepally, Lahari Saikia, Probal Goswami, Turlapati Narsimha Prasad, Gajendra Kumar Medhi, Chiranjeev Bhattacharjya, Shanta Dutta, Rajatasubhra Adhikary. Sexually transmitted infections among key populations in India: systematic review with spatiotemporal distribution. Archives of Clinical and Biomedical Research. 9 (2025): 135-155.

Bhatta M, et al., Arch Clin Biomed Res 2025
DOI:10.26502/acbr.50170446

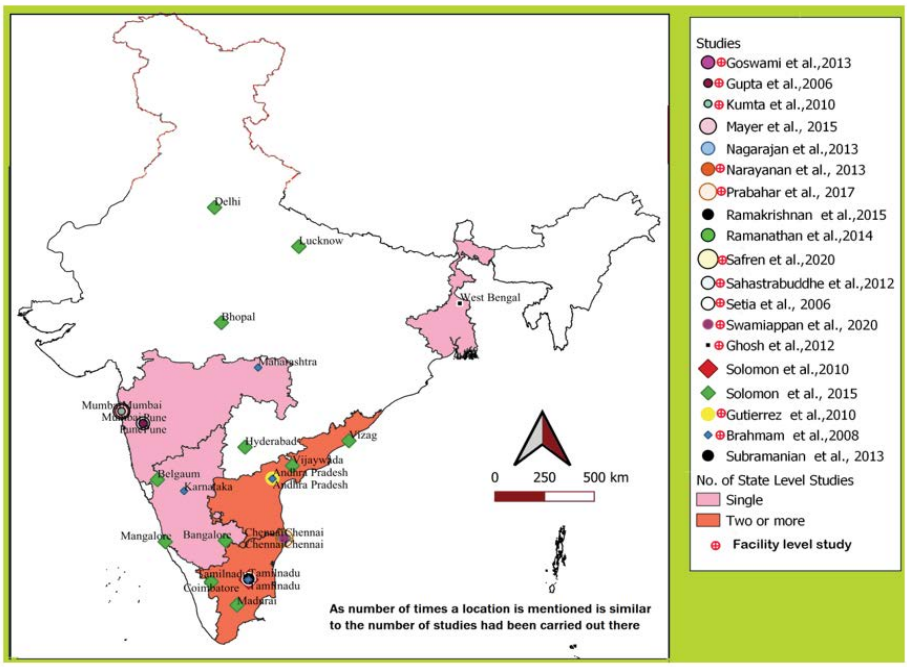

Figure 4: Representation of published articles on four curable STIs among MSMs in India.

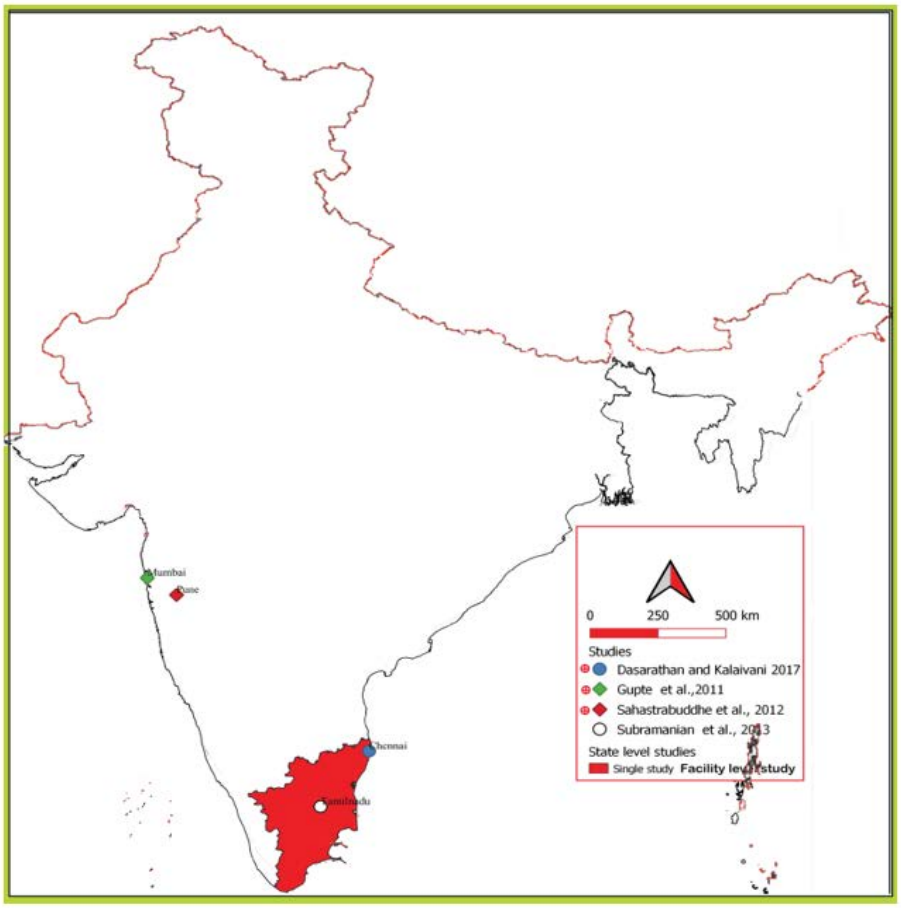

Figure 5: Geographical representation of published four curable STIs among H/TGs in India.

Citation: Mihir Bhatta, Bhumika Tumkur Venkatesh, Utsha Ghosh, Santhakumar Aridoss, Subrata Biswas, Papiya Banerjee, Piyali Ghosh, Pankaj Khan, Abhishek Royal, Nibedita Das, Agniva Majumdar, Debjit Chakraborty, Falguni Debnath, Alok Kumar Deb, Protim Ray, Bhavani Shankara Bagepally, Lahari Saikia, Probal Goswami, Turlapati Narsimha Prasad, Gajendra Kumar Medhi, Chiranjeev Bhattacharjya, Shanta Dutta, Rajatasubhra Adhikary. Sexually transmitted infections among key populations in India: systematic review with spatiotemporal distribution. Archives of Clinical and Biomedical Research. 9 (2025): 135-155.

Bhatta M, et al., Arch Clin Biomed Res 2025
DOI:10.26502/acbr.50170446

Table 5: Aetiological diagnosis and prevalence of four curable STIs among H/TG people from available published articles from different parts of India.

Study	Study period	Study design	Location	Sample size	Study setting	Sampling Technique	Specimen	Syphilis		Gonorrhoea		Chlamydia		Trichomoniasis	
								Methods of diagnosis	Prevalence	Methods of diagnosis	Prevalence	Methods of diagnosis	Prevalence	Methods of diagnosis	Prevalence
Gupte et al. [11]	Dec.2007-Feb.2008	CH	Mumbai	620	Facility	NR	Blood	RPR	13.1	NR	NR	NR	NR	NR	NR
Sahastrabuddhe et al. [29]	1993-2002	CS	Pune	68	Facility	RDS	Blood	TPHA	10.3	NR	NR	NR	NR	NR	NR
Subramanian et al. [31]	2006	CS	Tamilnadu	404	Community	CCS	Blood for syphilis and urine for gonorrhoea and chlamydia	RPR + TPHA	16.6	NAAT	0	NAAT	0	NR	NR
Dasarathan and Kalaivani [41]	2011-2014	CH	Chennai	82	Facility	RDS	Blood	VDRL + TPHA	20.7	NR	NR	NR	NR	NR	NR

CH- Cohort study; CS- Cross-sectional study; TLC- Time Location Cluster, NR- Not Reported; TPHA- Treponema Pallidum Heamagglutination Test, RPR Rapid Plasma Reagin; NAAT- Nucleic Acid Amplification Test

Findings among H/TG

From the literature search it was revealed that among the all STIs, syphilis was only re-ported among H/TGs in India. Present search finds out. four articles [11,29,31,41]. The recent published article on facility level study [41], which was conducted in a cohort of a sub group of males to female transgenders estimates prevalence of syphilis was 20.7 (Figure 5). Other four studies reveal from the present search, are reported from Tamilnadu, Mumbai, Chennai, and Pune. Although current finding shows a poor regional representation of H/TG on STI prevalence (Table 5).

Findings among PWID

There were only four articles reported STI prevalence among PWID [11,42-44], found chlamydia in India. A cross-

Citation: Mihir Bhatta, Bhumika Tumkur Venkatesh, Utsha Ghosh, Santhakumar Aridoss, Subrata Biswas, Papiya Banerjee, Piyali Ghosh, Pankaj Khan, Abhishek Royal, Nibedita Das, Agniva Majumdar, Debjit Chakraborty, Falguni Debnath, Alok Kumar Deb, Protim Ray, Bhavani Shankara Bagepally, Lahari Saikia, Probal Goswami, Turlapati Narsimha Prasad, Gajendra Kumar Medhi, Chiranjeev Bhattacharjya, Shanta Dutta, Rajatasubhra Adhikary. Sexually transmitted infections among key populations in India: systematic review with spatiotemporal distribution. Archives of Clinical and Biomedical Research. 9 (2025): 135-155.

Bhatta M, et al., Arch Clin Biomed Res 2025
DOI:10.26502/acbr.50170446

Table 6: Aetiological diagnosis and prevalence of four curable STIs among PWID from available published articles from different parts of India.

Study	Study period	Study design	Location	Sample size	Study setting	Sampling Technique	Specimen	Syphilis		Gonorrhoea		Chlamydia		Trichomoniasis	
								Methods of diagnosis	Prevalence	Methods of diagnosis	Prevalence	Methods of diagnosis	Prevalence	Methods of diagnosis	Prevalence
Mahanta et al. [42]	NR	CS	Bishnupur	420	Community	RDS	Blood	RPR + TPHA	5.7	NR	0.3	NR	1.7	NR	NR
Mahanta et al. [42]	NR	CS	Churachand	419	Community	RDS	Blood	RPR + TPHA	0.9	NA	NA	NA	NA	NR	NR
				417			Urine	NA	NA	NR	0	NR	2.1		
Mahanta et al. [42]	NR	CS	Phek	440	Community	RDS	Blood	RPR + TPHA	7.4	NA	NA	NA	NA	NR	NR
				430			Urine	NA	NA	NR	0.6	NR	11.4		
Mahanta et al. [42]	NR	CS	Wokha	420	Community	RDS	Blood	RPR + TPHA	19.5	NA	NA	NA	NA	NR	NR
				409			Urine	NA	NA	NR	1.6	NR	11		
Mahanta et al. [42]	NR	CS	Mumbai & Thane	355	Community	RDS	Blood	RPR + TPHA	4.9	NR	NR	NR	NR	NR	NR
				373			Urine	NA	NA			NR	0.7		
Ghosh et al. [15]	NR	CS	West Bengal	58	Facility	NR	Blood	TPHA	0	NR	NR	NR	NR	NR	NR
Armstrong et al. [43]	2009	CS	Nagaland	1705	Community	RDS	Blood for syphilis, urine for chlamydia	RPR+TPHA	13.4	NR	NR	NAAT	9.1	NR	NR
Armstrong et al. [43]	2009	CS	Manipur	1657	Community	RDS	Blood for syphilis, urine for chlamydia	RPR+TPHA	3.9	NR	NR	NAAT	1.8	NR	NR
Goswami et al. [44]	2014	CS	Manipur	1657	Community	RDS	Blood for syphilis, urine for chlamydia	RPR+TPHA	4	NR	NR	NAAT	0.2	NR	NR
Goswami et al. [44]	2014	CS	Nagaland	1705	Community	RDS	Blood for syphilis, urine for chlamydia	RPR+TPHA	13	NR	NR	NAAT	1	NR	NR

CH- Cohort study; CS- Cross-sectional study; TLC- Time Location Cluster, NR- Not Reported; TPHA- Treponema Pallidum Heamagglutination Test, RPR Rapid Plasma Reagin; NAAT- Nucleic Acid Amplification Test

Citation: Mihir Bhatta, Bhumika Tumkur Venkatesh, Utsha Ghosh, Santhakumar Aridoss, Subrata Biswas, Papiya Banerjee, Piyali Ghosh, Pankaj Khan, Abhishek Royal, Nibedita Das, Agniva Majumdar, Debjit Chakraborty, Falguni Debnath, Alok Kumar Deb, Protim Ray, Bhavani Shankara Bagepally, Lahari Saikia, Probal Goswami, Turlapati Narsimha Prasad, Gajendra Kumar Medhi, Chiranjeev Bhattacharjya, Shanta Dutta, Rajatasubhra Adhikary. Sexually transmitted infections among key populations in India: systematic review with spatiotemporal distribution. Archives of Clinical and Biomedical Research. 9 (2025): 135-155.

Bhatta M, et al., Arch Clin Biomed Res 2025
DOI:10.26502/acbr.50170446

sectional study on PWID published on 2008 carried out in Manipur, Nagaland and Maharashtra (Mumbai, and Thane), which reported seroprevalence of syphilis and gonorrhea as 19.5% and 1.6 respectively at Wokha, and 11.4% as chlamydia for 0Phek Nagaland [42]. without mentioning any specific study period. Another article comprised of data from North-eastern India viz. Phek, Wokha, Churachandpur, Bishnupur along with Mumbai-Thane [43] reported on prevalence of syphilis and chlamydia. Representation from North-eastern region was reported during present literature search (Figure 6), but no STI prevalence was reported from West Bengal. The data also implied a weak regional representation of STI prevalence among PWID (Table 6) in India.

Key findings

Forty articles were included in this systematic review after screening for inclusion criteria. Ghosh et al., 2012 reported a very high syphilis prevalence is 28.8 among FSW in West Bengal for a very small sample size of 45. A very low syphilis prevalence 0.8 was reporte [28] among MSM in Belgaum, where the sample size was 1003. A facility based cross-sectional study was conducted in Mumbai and Hyderabad for a sample size of 149 [30] reported a very high prevalence for Gonorrhea (14.8) among MSM. However, a community based cross sectional study conducted in Tamilnadu [31] reported a very low gonorrhea prevalence (0.07) among MSM with the sample size of 1621.Only nine articles reported Chlamydia among key population. A very high chlamydia prevalence (22.2) was reported by Medhi et al. [16] a community based cross-sectional study conducted on FSW in Nagaland with a sample size of 423. A similar community based cross-sectional study conducted in Tamilnadu [33] reported a very low chlamydia prevalence, 0.3 for MSM, Trichomoniasis was reported only by 1/10th [n=40] of the reviewed articles. From the available data of the included studies, it was found that STI prevalence was high when samples were taken from facility setting irrespective of region and key populations.

Quality of the selected studies

The modified Newcastle - Ottawa Quality Assessment Scale was applied to determined quality of included studies and the result was presented pictorially (Figure 7). Here, it must be noted that, quality of all the included studies calculated and presented here is only to accomplish the demands of present systematic review, except this author have no purposeful intention (Figure 7).

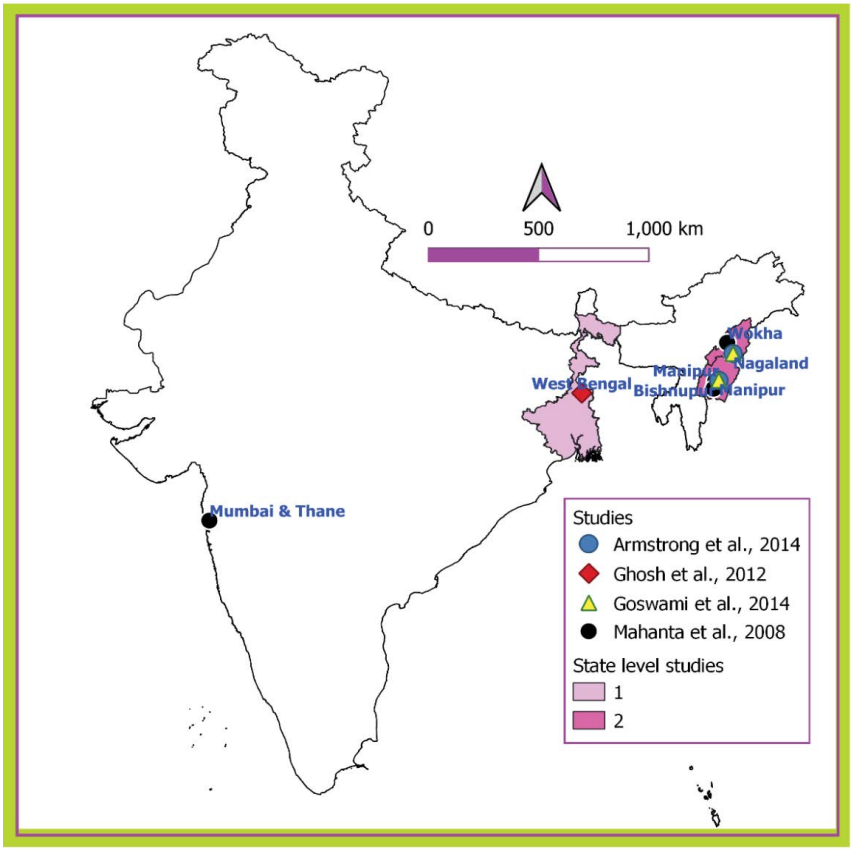

Figure 6: Representation of published articles on four curable STIs among PWIDs in India.

Citation: Mihir Bhatta, Bhumika Tumkur Venkatesh, Utsha Ghosh, Santhakumar Aridoss, Subrata Biswas, Papiya Banerjee, Piyali Ghosh, Pankaj Khan, Abhishek Royal, Nibedita Das, Agniva Majumdar, Debjit Chakraborty, Falguni Debnath, Alok Kumar Deb, Protim Ray, Bhavani Shankara Bagepally, Lahari Saikia, Probal Goswami, Turlapati Narsimha Prasad, Gajendra Kumar Medhi, Chiranjeev Bhattacharjya, Shanta Dutta, Rajatasubhra Adhikary. Sexually transmitted infections among key populations in India: systematic review with spatiotemporal distribution. Archives of Clinical and Biomedical Research. 9 (2025): 135-155.

Bhatta M, et al., Arch Clin Biomed Res 2025
DOI:10.26502/acbr.50170446

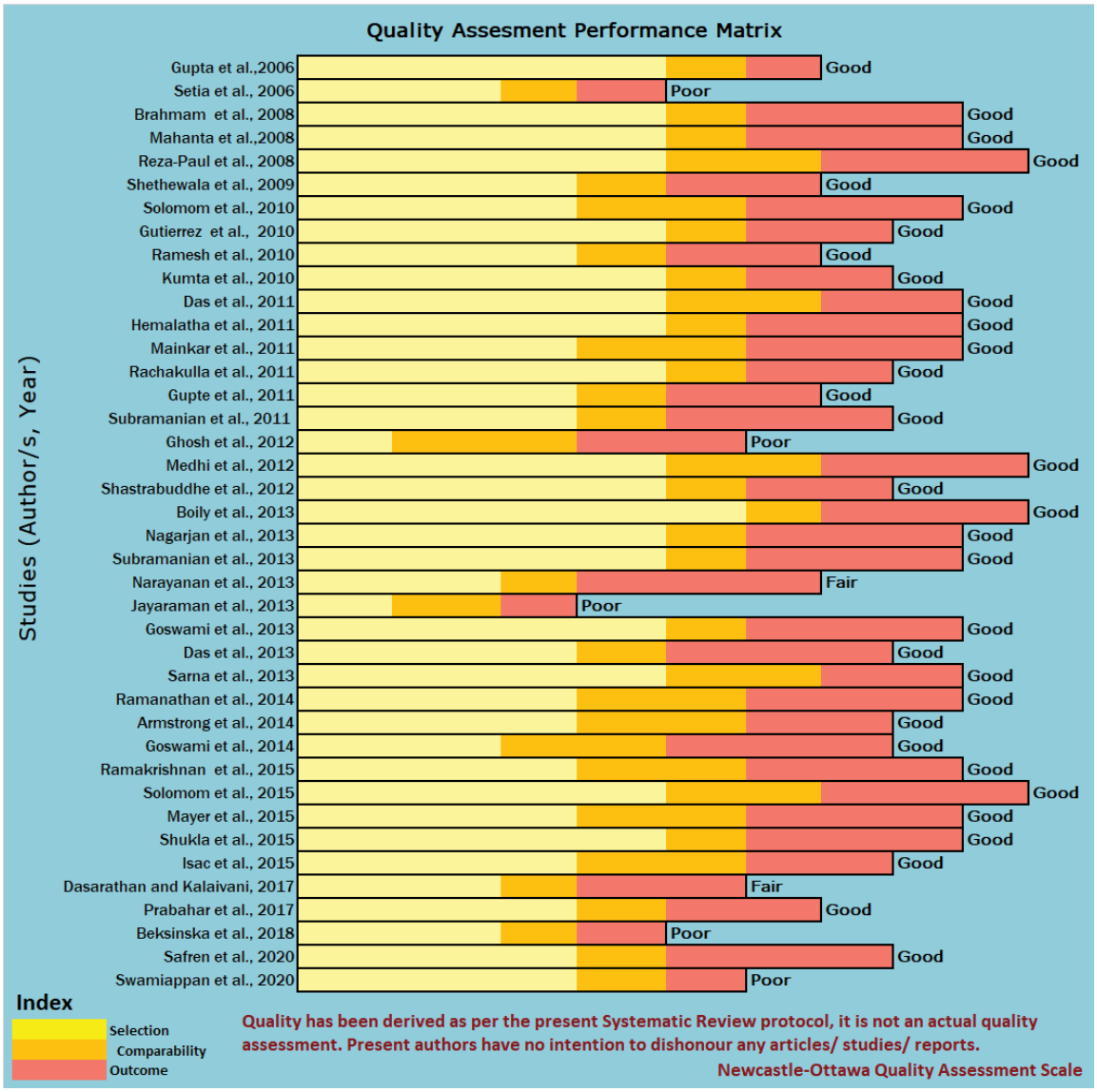

Figure 7: Quality Assessment Performance Matrix.

Strength and limitations

The prevalence of STIs shows considerable heterogeneity by geographical setting and key population group. At the same time, limited numbers of study reported STI prevalence, sampling heterogeneity across studies prevent definite conclusions and how the prevalence of STIs varies among key populations. All the included studies in the present systematic review used probability-based sampling and both in facility as well as community-based setting. However, there were limited data points from all regions in India. The variation among included studies highlights a limitation of the present review, as the findings can vary based on the electronic databases and selected search terms. However, present article summarizes of all study that allows pre-defined acceptance criteria and qualify the quality assessment tool (Tables 1-6).

Discussion

Forty articles were included in this systematic review after screening for inclusion criteria. State- wise distribution revealed that Tamilnadu, Andhra Pradesh, Karnataka, Maharashtra were study locations for 3/4th of the included articles [n=40]. Two articles determined prevalence of the four STIs among PWID in Manipur and Nagaland. Three articles with the prevalence of STIs among FSW and MSM in the cities of central and Northern India. One article was found from West Bengal. There were three articles that reported aetiological as well as syndromic prevalence among key population. One article reported only syndromic prevalence for FSW. Remaining articles reported the prevalence of four STIs among key populations through aetiological diagnosis. RPR and TPHA tests were con-ducted for diagnosing

Citation: Mihir Bhatta, Bhumika Tumkur Venkatesh, Utsha Ghosh, Santhakumar Aridoss, Subrata Biswas, Papiya Banerjee, Piyali Ghosh, Pankaj Khan, Abhishek Royal, Nibedita Das, Agniva Majumdar, Debjit Chakraborty, Falguni Debnath, Alok Kumar Deb, Protim Ray, Bhavani Shankara Bagepally, Lahari Saikia, Probal Goswami, Turlapati Narsimha Prasad, Gajendra Kumar Medhi, Chiranjeev Bhattacharjya, Shanta Dutta, Rajatasubhra Adhikary. Sexually transmitted infections among key populations in India: systematic review with spatiotemporal distribution. Archives of Clinical and Biomedical Research. 9 (2025): 135-155.

syphilis; NAAT or Gen Probe APTIMA were used for diagnosing gonorrhoea and chlamydia; kupferburges culture, wet mount microscopy tests were con-ducted for diagnosing trichomoniasis. Over the last two decades, the National AIDS Control Program of India (NACP) implemented by National AIDS Control Organization (NACO) which, undertakes prevention of STI as one of the key strategies. NACO through its network of designated STI or RTI (reproductive tract infection) clinics (situated at government health care facilities located mostly at the district level and above) is providing free standardized STI/RTI services. These clinics have been branded as "Suraksha Clinics" and provide sexual and reproductive health services [45]. Function of these Centre is to provide validation of syndromic case management by doing etiologic testing, antibiotic susceptibility testing for Gonococci, EQAS for syphilis, and conducting operations re-search providing evidence to the programme. [46]. Still, there is a limited literature till date to report pooled prevalence among key populations across India and these data have not been integrated to inform the overall geographical and temporal trends of STI infections among various key populations in India.

Conclusion

The present systemic review had generated on the prevalence and spatiotemporal distribution of the four STIs in Indian key population. Prevalence of STIs showed extensive het-erogeneity through spatiotemporal setting and people practicing high-risk beheviour in India. A national STI surveillance cum prevention programme is essential among key populations in India. In the light of present findings and with the identified limitations, it can be concluded that existing HIV surveillance system under NACP, can be utilized with additional bio-specimen collection to determine STI prevalence among high risk populations. However, in future, with the availability of the comparable data from most of the regions in India, it will be possible to conduct a systemic review with pooled prevalence on the spatiotemporal distribution of the four curable STIs in the general population of India.

Supplementary Materials:

The following supporting information can be downloaded at: www.mdpi.com/xxx/s1, Table S1: search terms and search strategy; Table S2 PRISMA chart.

Author Contributions:

MB, SB, AR, BTV, BSB, TLNP, LS, ND and SD Conceptualize and design the study. Data curation was done by MB, UG, PG, PB, and SB. Investigation MB, UG, PG, PB, SA, and SB. Methodology MB, UG, PB, SA, SB, AKD, DC, CB, GKM, BSB, FD and SD. Formal analysis UG, PG, MB, PGG, PK, BSB, GKM and PB. Funding acquisition AR, RA, and SD. Project admin-istration MB, TLNP, LS, ND, SB, RA, and SD. Supervised by BTV, TLNP, LS, MB, ND, PR, CB, RA, AKD, GKM and DC. Resources DC, AKD, AR, RA, and FD. Writing – original draft MB, UG, PK, PB, and SB; and Writing – review & editing MB, AM, TLNP, PR, PK, PGG, BSB, SA, SB, and SD. All authors read the manuscript before they have given the final approval for publication.

Funding:

Fund for this research is provided by World Health Organization (Reg. No. 2024/1456501). Moreover, the funders had no role in the study design, data collection, analysis, the decision to publish, or the preparation of the manuscript.

Data Availability Statement: No separate datasets were generated or analyzed during the cur-rent study. All relevant data from this study are available with the present article.

Acknowledgments: Authors are acknowledging all the technical, administrative officials of ICMR-NIRBI, Kolkata. Cochrane, London UK; NACO, Ministry of Health and Family Welfare, Govt. of India, and World Health Organization.

Conflicts of Interest: The authors have declared that no competing interests exist.

References

1. Reza-Paul S, Beattie T, Syed HUR, et al. Declines in risk behaviour and sexually transmitted infection prevalence following a community-led HIV preventive intervention among female sex workers in Mysore, India. AIDS 22 (2008): S91-S100.
2. Shethwala N, Mulla S, Kosambiya J, et al. Sexually transmitted infections and reproductive tract infections in female sex workers. Indian J Pathol. Microbiol 52 (2009): 198.
3. Gutierrez JP, McPherson S, Fakoya A, et al. Community-based prevention leads to an increase in condom use and a reduction in sexually transmit-ted infections (STIs) among men who have sex with men (MSM) and female sex workers (FSW): The Frontiers Prevention Project (FPP) evaluation results. BMC Public Health 10 (2010): 497.
4. Ramesh BM, Beattie TSH, Shajy I, et al. Changes in risk behaviours and prevalence of sexually trans-mitted infections following HIV preventive interventions among female sex workers in five districts in Karnataka state, south India. Sexually Transmitted Infections 86 (2010): i17-i24.
5. Bhatta M, Majumdar A, Ghosh U, eta l. Sexually

transmitted infections among key populations in India: A protocol for systematic review. Plos one 18 (2023): e0279048.

6. Luchini C, Stubbs B, Solmi M, et al. Assessing the quality of studies in meta-analyses: Advantages and limitations of the Newcastle Ottawa Scale. World J Meta-Anal 5 (2017): 80-84.
7. Gil J, Varoudis T, Karimi K, et al. The space syntax toolkit: Integrating depth map X and exploratory spatial analysis workflows in QGIS. In: SSS 2015-10th International Space Syntax Symposium, Space Syntax Laboratory, The Bartlett School of Architecture, UCL (University College London) 10 (2015).
8. Oxoli D, Prestifilippo G, Bertocchi D. Enabling spatial autocorrelation mapping in QGIS: The hotspot analysis Plugin. Geoingegneria Ambientale e Minerorio, Anno Livn. 2, Agosto (2017): 45-50.
9. Hemalatha R, Kumar RH, Venkaiah K, et al. Prevalence of & knowledge, attitude & practices towards HIV & sexually transmitted infections (STIs) among female sex workers (FSWs) in Andhra Pradesh. Indian J Med Res 6 (2011).
10. Das A, Prabhakar P, Narayanan P, et al. Prevalence and Assessment of Clinical Management of Sexually Transmitted Infections among Female Sex Workers in Two Cities of India. Infectious Diseases in Obstetrics and Gynecology (2011): 1-8.
11. Gupte S, Daly C, Agarwal V, et al. Introduction of Rapid Tests for Large-Scale Syphilis Screening Among Female, Male, and Transgender Sex Workers in Mumbai, India. Sexually Transmitted Diseases 38 (2011): 499-502.
12. Mainkar MM, Pardeshi DB, Dale J, et al. Targeted interventions of the Avahan program and their association with intermediate outcomes among female sex workers in Maharashtra, India. BMC Public Health 11 (2011): S2.
13. Thilakavathi S, Boopathi K, Girish Kumar CP, et al. Assessment of the scale, coverage and outcomes of the Avahan HIV pre-vention program for female sex workers in Tamil Nadu, India: is there evidence of an effect?. BMC Public Health 11 (2011): 1-14.
14. Rachakulla HK, Kodavalla V, Rajkumar H, et al. Condom use and prevalence of syphilis and HIV among female sex workers in Andhra Pradesh, India – following a large-scale HIV pre-vention intervention. BMC Public Health 11 (2011): S1.
15. Ghosh I, Ghosh P, Bharti AC, et al. Prevalence of Human Papillomavirus and Co-Existent Sexually Transmitted Infections among Female Sex Workers, Men having Sex with Men and Injectable Drug abusers from Eastern India. Asian Pacific Journal of Cancer Prevention 13 (2012): 799-802.
16. Medhi GK, Mahanta J, Kermode M, et al. Factors associated with history of drug use among female sex workers (FSW) in a high HIV prevalence state of India. BMC Public Health 12 (2012): 273.
17. Das A, Pathni AK, Narayanan P, et al. High rates of reinfection and incidence of bacterial sexually transmitted infections in a cohort of female sex workers from two Indian cities: need for different STI control strategies? Sex Transm Infect 89 (2013): 5-10.
18. Boily MC, Pickles M, Lowndes CM, et al. Positive impact of a large-scale HIV prevention programme among female sex workers and clients in South India. AIDS 27 (2013): 1449-1460.
19. Jayaraman GC, Kumar S, Isac S, et al. Demographic changes and trends in risk behaviours, HIV and other sexually transmitted infections among female sex workers in Bangalore, India involved in a focused HIV preventive intervention. Sex Transm Infect 89 (2013): 635-641.
20. Sarna A, Friedland BA, Srikrishnan AK, et al. Sexually transmitted infections and reproductive health morbidity in a cohort of female sex workers screened for a microbicide feasibility study in Nellore, India. GJHS 5 (2013): 139.
21. Isac S, Ramesh BM, Rajaram S, et al. Changes in HIV and syphilis prevalence among female sex workers from three serial cross-sectional surveys in Karnataka state, South India. BMJ Open 5 (2015): e007106.
22. Beksinska A, Prakash R, Isac S, et al. Violence experience by perpetrator and associations with HIV/STI risk and infection: a cross-sectional study among female sex workers in Karnataka, south India. BMJ Open 8 (2018): e021389.
23. Shukla P, Masood J, Singh J, et al. Predictors of Sexually Transmitted Infections among Female Sex Workers (FSWs) in a City of Northern India. Indi-an J Community Med 40 (2015): 121.
24. Setia M, Lindan C, Jerajani H, et al. Men who have sex with men and transgenders in Mumbai, In-dia: An emerging risk group for STIs and HIV. Indian J Dermatol VenereolLeprol 72 (2006): 425.
25. Gupta A, Mehta S, Godbole SV, et al. Same-Sex Behavior and High Rates of HIV Among Men Attending Sexually Transmitted In-fection Clinics in Pune, India (1993-2002).

Citation: Mihir Bhatta, Bhumika Tumkur Venkatesh, Utsha Ghosh, Santhakumar Aridoss, Subrata Biswas, Papiya Banerjee, Piyali Ghosh, Pankaj Khan, Abhishek Royal, Nibedita Das, Agniva Majumdar, Debjit Chakraborty, Falguni Debnath, Alok Kumar Deb, Protim Ray, Bhavani Shankara Bagepally, Lahari Saikia, Probal Goswami, Turlapati Narsimha Prasad, Gajendra Kumar Medhi, Chiranjeev Bhattacharjya, Shanta Dutta, Rajatasubhra Adhikary. Sexually transmitted infections among key populations in India: systematic review with spatiotemporal distribution. Archives of Clinical and Biomedical Research. 9 (2025): 135-155.

Journal of Acquired Immune Deficiency Syndromes 43 (2006): 483-490.

26. Brahmam GN, Kodavalla V, Rajkumar H, et al. Sexual practic-es, HIV and sexually transmitted infections among self-identified men who have sex with men in four high HIV prevalence states of India. AIDS 22 (2008): S45-S57.

27. Kumta S, Lurie M, Weitzen S, et al. Bisexuality, Sexual Risk Taking, and HIV Prevalence Among Men Who Have Sex with Men Accessing Voluntary Counseling and Testing Services in Mumbai, India. JAIDS Journal of Acquired Immune Deficiency Syndromes 53 (2010): 227-233.

28. Solomon SS, Srikrishnan AK, Sifakis F, et al. The Emerging HIV Epidemic among Men Who have Sex with Men in Tamil Nadu, India: Geographic Diffusion and Bisexual Concur-rency. AIDS Behav 14 (2010): 1001-1010.

29. Sahastrabuddhe S, Gupta A, Stuart E, et al. Sexually Transmitted Infections and Risk Behaviors Among Transgender Persons (Hijras) of Pune, India. Journal of Acquired Immune Deficiency Syndromes 59 (2012): 72-78.

30. Narayanan P, Das A, Morineau G, et al. An exploration of elevated HIV and STI risk among male sex workers from India. BMC Public Health 13 (2013): 1059.

31. Subramanian T, Ramakrishnan L, Aridoss S, et al. Increasing condom use and declining STI prevalence in high-risk MSM and TGs: evaluation of a large-scale prevention program in Tamil Nadu, India. BMC Public Health 13 (2013): 1-14.

32. Goswami P, Rachakulla HK, Ramakrishnan L, et al. An assessment of a large-scale HIV prevention programme for high-risk men who have sex with men and transgenders in Andhra Pradesh, India: using data from routine programme moni-toring and repeated cross-sectional surveys. BMJ Open 3 (2013): e002183.

33. Nagarajan K, Godbole S, Ramakrishnan L, et al. Self-Report of STI Symptoms, Inconsistent Condom use and Condom Nonuse are Poor Predictors of STI Prevalence among Men who have Sex with Men. J AIDS Clin Res 04 (2013).

34. Ramanathan S, Deshpande S, Gautam A, et al. Increase in condom use and decline in prevalence of sexually transmitted infections among high-risk men who have sex with men and transgender persons in Maharashtra, India: Avahan, the India AIDS Initiative. BMC Public Health 14 (2014): 784.

35. Solomon SS, Mehta SH, Srikrishnan AK, et al. High HIV prevalence and incidence among MSM across 12 cities in India. AIDS 29 (2015): 723-731.

36. Mayer KH, Gangakhedkar R, Sivasubramanian M, et al. Differing Identities but Comparably High HIV and Bacterial Sexually Transmitted Disease Burdens Among Married and Unmar-ried Men Who Have Sex with Men in Mumbai, India. Sexually Transmitted Diseases 42 (2015): 629-633.

37. Ramakrishnan L, Ramanathan S, Chakrapani V, et al. Comparison of Sexual Risk, HIV/STI Prevalence and Intervention Exposure Among Men Who Have Sex with Men and Women (MSMW) and Men Who Have Sex with Men Only (MSMO) in India: Implications for HIV Prevention. AIDS Be-hav 19 (2015): 2255-2269.

38. Prabahar P, Ranganathan T, Vijayabhaskar C, et al. Sexually transmitted infections among men who have sex with men: a retrospective study in a tertiary care hospital. Int J Res Med Sci 5 (2017): 3222.

39. Safren SA, Devaleenal B, Biello KB, et al. Geo-graphic and behavioral differences associated with sexually transmitted infection prevalence among Indian men who have sex with men in Chennai and Mumbai. Int J STD AIDS 32 (2020): 144-151.

40. Swamiappan M, Jagannathan M, Abdulla A. Sexual risk behaviour and sexually transmitted infections in men who have sex with men. Int J Res Dermatol 6 (2020): 178.

41. Dasarathan S, Kalaivani S. Study of prevalence of sexually transmitted infec-tions/human immunodeficiency virus and condom use among male-to-female transgender: A retrospective analysis from a tertiary care hospital in Chennai. Indian J Sex Transm Dis 38 (2017): 43.

42. Mahanta J, Medhi GK, Paranjape RS, et al. Injecting and sexual risk behaviours, sexually transmitted infections and HIV prevalence in injecting drug users in three states in India. AIDS 22 (2008): S59-S68.

43. Armstrong G, Nuken A, Medhi GK, et al. Injecting drug use in Manipur and Nagaland, Northeast India: injecting and sexual risk behaviours across age groups. Harm Reduction Journal 11 (2014): 1-10.

44. Goswami P, Medhi GK, Armstrong G, et al. An assessment of an HIV prevention intervention among people who inject drugs in the states of Manipur and Nagaland, India. International Journal of Drug Policy 25 (2014): 853-864.

45. National AIDS Control Organisation. Country scenario during NACP-IV. Ministry of Health and Family Welfare: New Delhi (2015).

Citation: Mihir Bhatta, Bhumika Tumkur Venkatesh, Utsha Ghosh, Santhakumar Aridoss, Subrata Biswas, Papiya Banerjee, Piyali Ghosh, Pankaj Khan, Abhishek Royal, Nibedita Das, Agniva Majumdar, Debjit Chakraborty, Falguni Debnath, Alok Kumar Deb, Protim Ray, Bhavani Shankara Bagepally, Lahari Saikia, Probal Goswami, Turlapati Narsimha Prasad, Gajendra Kumar Medhi, Chiranjeev Bhattacharjya, Shanta Dutta, Rajatasubhra Adhikary. Sexually transmitted infections among key populations in India: systematic review with spatiotemporal distribution. Archives of Clinical and Biomedical Research. 9 (2025): 135-155.

46. World Health Organization. Global progress report on HIV, viral hepatitis and sexually transmitted infections. Accountability for the global health sector strategies 2016–2021 Ge-neva: World Health Organization.

Citation: Mihir Bhatta, Bhumika Tumkur Venkatesh, Utsha Ghosh, Santhakumar Aridoss, Subrata Biswas, Papiya Banerjee, Piyali Ghosh, Pankaj Khan, Abhishek Royal, Nibedita Das, Agniva Majumdar, Debjit Chakraborty, Falguni Debnath, Alok Kumar Deb, Protim Ray, Bhavani Shankara Bagepally, Lahari Saikia, Probal Goswami, Turlapati Narsimha Prasad, Gajendra Kumar Medhi, Chiranjeev Bhattacharjya, Shanta Dutta, Rajatasubhra Adhikary. Sexually transmitted infections among key populations in India: systematic review with spatiotemporal distribution. Archives of Clinical and Biomedical Research. 9 (2025): 135-155.