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ORIGINAL ARTICLE | HIV INFECTION

Identifying Risk Factors and Spatial Clustering of HIV Infection Among Female Sex Workers in India

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ABSTRACT

Background: The human immunodeficiency virus (HIV) epidemic in India is generally considered to be more concentrated, with the focus on high-risk groups including female sex workers (FSWs). The Integrated Biological and Behavioral Surveillance (IBBS), the first nationwide surveillance conducted during 2014-2015, collected many key indicators, including indicators related to HIV/STI transmission. The purpose of this study was to develop an index score for each domain surveyed and to identify focus areas for interventions among FSWs.

Methods: The study population consisted of 27,007 FSWs. Forty high-risk related covariates of HIV/STI transmission, demographic characteristics, sexual history, condom practices, knowledge of HIV/STI and biological variables were considered. The original data set was examined using the correlation matrix and was reduced to 15 highly-correlated factors using principal component analysis. The factors were further improved using varimax rotation and the percentage of variation was used as weights to obtain the initial score for each domain, which were then standardized for comparison. Bartlett's test of sphericity was examined before the factor extraction.

Results: Six factors were extracted, which together explained about 73% of the total variation. The factors were: (1) more number of clients; (2) younger FSW and started selling sex at younger age; (3) experiencing condom breakage; (4) having occasional clients and poor HIV/AIDS knowledge; (5) illiteracy; and (6) a longer period of sex work. Six domains with an index score of above 80, from the states of Maharashtra, Rajasthan, Arunachal Pradesh, Uttar Pradesh, and Jharkhand need greater intervention.

Conclusion and Implications for Translation: FSWs' current age, age at commencement of sex work, and the number of clients were the indicators most-associated with HIV infection. Therefore, program and policy interventions should focus on FSWs who are younger than <25 years, who started selling sex at <22 years, and who have >10 clients.

Key words: • Female Sex Worker • Kriged Map • Factor Analysis • Principle Component Analysis • HIV • Sexually Transmitted Infections

1. Introduction

The National AIDS Control Organization (NACO) estimates that around 2.1 million people in India are living with HIV, out of which 40.5% are females.[1] The epidemic in India is concentrated among high-risk group (HRG) populations, including female sex workers (FSW), men who have sex with other men, transgender people, and injection drug users. The infection is generally transmitted from HRGs to low-risk groups such as the general population through bridge populations such as migrants and truckers. Hence, containing the disease at the HRG level is considered effective in preventing the disease spread to the general population by advocating behavioral changes among HRGs. The National Integrated Biological and Behavioural Surveillance (IBBS),[2] was conducted in 2014-15, with a strategic focus of strengthening HIV surveillance among high-risk groups (HRG) and bridge population. It was the first nationwide community-based bio-behavioral surveillance, among HRG and bridge populations that collected information on many key parameters of programmatic importance. Apart from the basic socio-demographic profile, the dataset also included knowledge indicators related to HIV prevention, sexually transmitted infections (STI), condom usage, HIV/AIDS services, behavioral risk profile and practices, HIV testing, stigma, and discrimination as well as exposure to HIV/AIDS services and community mobilization. Since several HIV/STI transmission-related variables were collected during the IBBS surveillance, it would be beneficial to bring out the essence of all the highly correlated HIV risk-related variables. Hence, the aim of this study was to develop an index or a score for each domain surveyed, based on multiple and highly correlated risk-related variables of HIV/STI concurrently and to identify focus areas for interventions among FSWs.

2. Methods

2.1. Study Type

The National IBBS was a community-based cross-sectional survey designed using probability-based sampling. Numerous behavioral and biological variables of HIV/STI in India were collected. Blood specimens were collected using the Dried Blood Spot (DBS) method.

2.2. Study Population

Female sex workers were defined as any female, aged 15 years or older, who engaged in consensual sex in exchange for cash/payment in kind in the last month. The study population consisted of 27,007 FSWs from 73 randomly selected domains comprising 108 districts across 28 Indian states including Union territories, where the sizable number of FSWs are available (Appendix I).

2.3. Domain

A 'Domain' was defined as a continuous geographical unit for which the bio-behavioral estimates generated for a specific (FSW/MSM/IDU/TG) group. The domains surveyed in the study were selected based on the size of the FSWs available in a particular domain. Generally, a single district was the basic domain in National IBBS, called independent domains. However, if a single district did not have an adequate sample size, neighboring districts were grouped to form a 'Domain', called composite domains. A domain name was given to each domain, which was either the district name in the case of independent domains, or the name of the district with the highest number of HRG for composite domains. All the domains were prioritized for targeted interventions by NACO.

2.4. Sampling Strategy

The respondents were recruited through a two-stage cluster sampling procedure. A conventional cluster sampling approach was used for fixed locations like home-based venues and brothels,

A time-location cluster (TLC) sampling approach was used for dynamic clusters such as street-based FSWs. Each hotspot was divided into four clusters based on availability as follows: (1) Peak Day- Peak Time (peak days of operations, maximum FSW found at a particular time); (2) Peak Days - Lean Time (peak days of operations, minimum FSW found at a particular time); (3) Lean Day- Peak Time (lean days of operations, maximum FSW found at a particular time); (4) Lean Day- Lean Time (lean days of operations, minimum FSW found at a particular time). The TLCs were selected by systematic random sampling (without replacement) by probability proportional to the estimated measure of size (PPS) of FSWs.

The target sample size for the FSW group was 400 per domain. The sample size was less than 400 members in the case of fewer populations in the domain or when the refusal rate was high. The methodology, data collection, ethical consent, weighting procedure, laboratory methods, etc. are discussed in detail elsewhere.[2] The study period was for three months and varied for each site from October 2014 to November 2015.

2.5. Study Variables

Forty covariates of HIV/STI transmission for FSW based on demographic characteristics, sexual history, condom practices, knowledge, and awareness of HIV/STI and biological variables were explored.

2.6. Statistical Analysis

Principal component analysis (PCA) and factor analysis are data reduction techniques employed to reduce the dimension of the covariates; these methods are used to extract a relatively smaller subset of independent uncorrelated factors and to find the linear combination of standardized indicators.[3-5] In our study, these techniques were used to identify the underlying structure of the variables studied and to estimate the factor scores. All the estimates used in the analysis were weighted based on the inverse probability of selection. The original dataset of 40 high-risk related covariates was examined using the correlation matrix. The final data set used in the analysis was of size 73 (domains) x 15 variables (Appendix I). The PCA identified a smaller dimension of six (eigen value greater than one) uncorrelated factors. The six factors were improved using varimax rotation and their scores were acquired. Using percent variation as weights on factor scores, the initial score for each domain was then obtained and standardized for comparisons. To check for model adequacy, Bartlett's test of sphericity was done before factor extraction and was found to be suitable with $p<0.0001$. All the analyses were done using the SPSS (version 26) software.[6]

A geospatial interpolation technique called Kriging was used for points that were not physically sampled in the study area. The method of least squares was used, which estimates the values with the information surveyed and the spatial arrangement of the data set.[7] The standardized score (as a proportion) for each surveyed domain was expressed as $\beta(xi, yi)$, where (xi, yi) are the geographic coordinates (latitude and longitude). $\beta(xi, yi)$ were modeled using a semi-variogram and the kriged values were obtained using the ArcGIS software package.[8]

3. Results

The initial and standardized index scores of the domains are presented in Table 1. Twenty-six domain sites had an index score of above 50 (more than the average). Considering all the high-risk related variables in a multivariate set up, the domain of Jalna in Maharashtra state had the highest score followed by Kota and Ajmer in Rajasthan; West Siang in Arunachal Pradesh; Jhansi in Uttar Pradesh; Lathiar in Jharkhand; and Pune in Maharashtra. The distribution of the domains and levels of care required based on the standardized index score of the surveyed domains are presented in Figure 1. The domains in deep red indicate the need for greater care and interventions.

Bartlett's test of sphericity of high significance ($p<0.0001$) indicated that the selected variables were well-correlated, which is required for the factor analysis to be valid. The 15 variables with factor loadings greater than 0.6 are listed in Table 2. The six factors extracted together explained about 73% percent of the total variation. The six factors were: (1) having 10 or more regular clients in the past week, having 10 or more occasional clients in the past week, and having regular clients; (2) current

Table 1: The standardized index scores for the domains surveyed in India: IBBS 2014-2015

S.no#	State	Domain	Initial index	Standardized index	S.no#	State	Domain	Initial index	Standardized index
1	Maharashtra	Jalna	76.21	100.00	37	Arunachal Pradesh	Lohit	-5.42	40.84
2	Rajasthan	Kota	69.40	95.07	38	Andhra Pradesh	Nellore	-6.73	39.89
3	Rajasthan	Ajmer	59.69	88.03	39	Karnataka	Kolar	-7.11	39.61
4	Arunachal Pradesh	West siang	58.42	87.11	40	Uttarakhand	Hardwar	-7.31	39.47
5	Uttar Pradesh	Jhansi	51.46	82.06	41	Assam	Goalpara	-8.00	38.97
6	Jharkhand	Latihar	50.98	81.72	42	Andhra Pradesh	Chittoor	-8.02	38.95
7	Maharashtra	Pune	49.28	80.48	43	NCT Of Delhi	West	-8.37	38.69
8	NCT Of Delhi	Central	49.01	80.29	44	Chhattisgarh	Mahasamund	-9.12	38.15
9	West Bengal	Burdwan	48.91	80.22	45	Tripura	Dhalai	-11.06	36.74
10	Gujarat	Sabarkantha	47.89	79.47	46	Assam	Karimganj	-11.56	36.38
11	West Bengal	Jalpaiguri	40.59	74.18	47	Tamil Nadu	Madurai	-12.73	35.53
12	Andhra Pradesh	Adilabad	39.60	73.46	48	Manipur	Imphal East	-13.23	35.17
13	Manipur	Senapati	33.30	68.90	49	Haryana	Faridabad	-13.90	34.69
14	West Bengal	24 Paraganas (S)	30.08	66.56	50	Maharashtra	Nagpur	-14.25	34.44
15	Meghalaya	Jaintia Hills	27.29	64.54	51	Goa	South Goa	-14.61	34.17
16	Karnataka	Bagalkot	24.23	62.33	52	Kerala	Pathanamthitta	-17.01	32.43
17	Gujarat	Surat	22.92	61.38	53	Puducherry	Pondicherry	-17.12	32.35
18	Maharashtra	Nandurbar	21.81	60.57	54	Nagaland	Dimapur	-18.73	31.19
19	Chhattisgarh	Dantewada	15.12	55.72	55	Jharkhand	Dhanbad	-20.79	29.69
20	Jharkhand	Sahibganj	13.52	54.56	56	Karnataka	Raichur	-20.82	29.67
21	Haryana	Jind	12.76	54.01	57	Haryana	Kaithal	-22.91	28.16
22	Madhya Pradesh	Shivpuri	12.07	53.51	58	Chhattisgarh	Bilaspur	-24.62	26.92
23	Arunachal Pradesh	Papum Pare	11.54	53.13	59	Uttarakhand	Udham Singh Nagar	-26.07	25.86
24	Gujarat	Bhavnagar	9.69	51.79	60	Madhya Pradesh	Balaghat	-27.07	25.14
25	Rajasthan	Ganganagar	8.16	50.68	61	Tamil Nadu	Thiruvarur	-28.47	24.12
26	Jharkhand	PaschimSinghboom	7.34	50.09	62	Goa	North Goa	-28.75	23.92
27	Andhra Pradesh	Mahabubnagar	5.47	48.72	63	Himachal Pradesh	Shimla	-29.63	23.28
28	Madhya Pradesh	Indore	4.22	47.82	64	Mizoram	Aizwal	-30.67	22.53
29	Tamil Nadu	Erode	3.15	47.05	65	Orissa	Jajpur	-35.23	19.22

(*Contd...*)

Table 1: (*Continued*)

S.no#	State	Domain	Initial index	Standardized index	S.no#	State	Domain	Initial index	Standardized index
30	Tamil Nadu	Chennai	1.24	45.66	66	Haryana	Rohtak	-35.55	19.00
31	Kerala	Kozhikode	-0.36	44.50	67	Karnataka	Dakshina Kannada	-36.45	18.34
32	Kerala	Thrissur	-0.42	44.46	68	Assam	Jorhat	-41.55	14.64
33	Orissa	Nabarangpur	-0.96	44.07	69	Punjab	Punjab_All_FSW	-44.81	12.29
34	Uttar Pradesh	Kanpur Nagar	-3.19	42.45	70	Tripura	North Tripura	-52.69	6.57
35	Orissa	Sundargarh	-3.66	42.11	71	Himachal Pradesh	Una	-60.00	1.27
36	Uttar Pradesh	JyotibaPhule Nagar	-4.46	41.53	72	Uttar Pradesh	Gorakhpur	-60.20	1.12
					73	Chandigarh	Chandigarh	-61.75	0.00

#Serial number represents the serial number as well the rank obtained by the domains respectively

age of the FSW ≤ 25 and had started selling sex at age <22 years; (3) experiencing condom breakage, and wanted to use condoms but could not use in the past month; (4) having occasional clients, never heard of any other sexually transmitted diseases, and having misconceptions about AIDS transmission; (5) HIV prevalence, illiteracy, and never used a condom; and (6) duration of sex work for more than 5 years. The first factor was set as the proxy for HIV infection.

The map in Figure 2 depicts the best, unbiased representation of the essence of numerous HIV risk-related variables in the form of Kriged estimates. It represents the regional variations and the high-risk, HIV-concentrated regions (hot spots), and regions where FSW are at the greater risk of developing the HIV infection. The Kriged estimates identified the western part of central India that included Gujarat, and portions of Rajasthan, Madhya Pradesh, and Maharashtra as high-risk regions.

4. Discussion

IBBS was an extensive cross-sectional survey conducted across India among the HRGs that has resulted in a huge data resource of great importance to policymakers. Just by looking at the HIV prevalence estimates the domains of higher prevalence will seem to be of programmatic importance for future interventions, which may not necessarily be the actual case. For instance, the state of Karnataka had been a high prevalent state for FSW, owing to the practice of traditional sex work. Although the districts of Bagalkot, Raichur, and Kolar had HIV prevalence greater than 5%, these domains fall behind the domain of Jalna with a prevalence of 2.62%. Thus, the data reduction techniques, PCA and factor analysis, used in this study have optimally reduced the dimensionality of variables in a multivariate set up to derive an index for each domain, such that emerging hotspots and contributing factors are well-identified. Rather than just considering the prevalence of HIV/STI estimates, this technique helps to probe further into the behavioral factors to identify the key domains that require greater interventional care.[9]

At the individual level, age, sexual debut, duration of commercial sex, type and number of clients, illiteracy, STD knowledge, presence of STI symptoms,

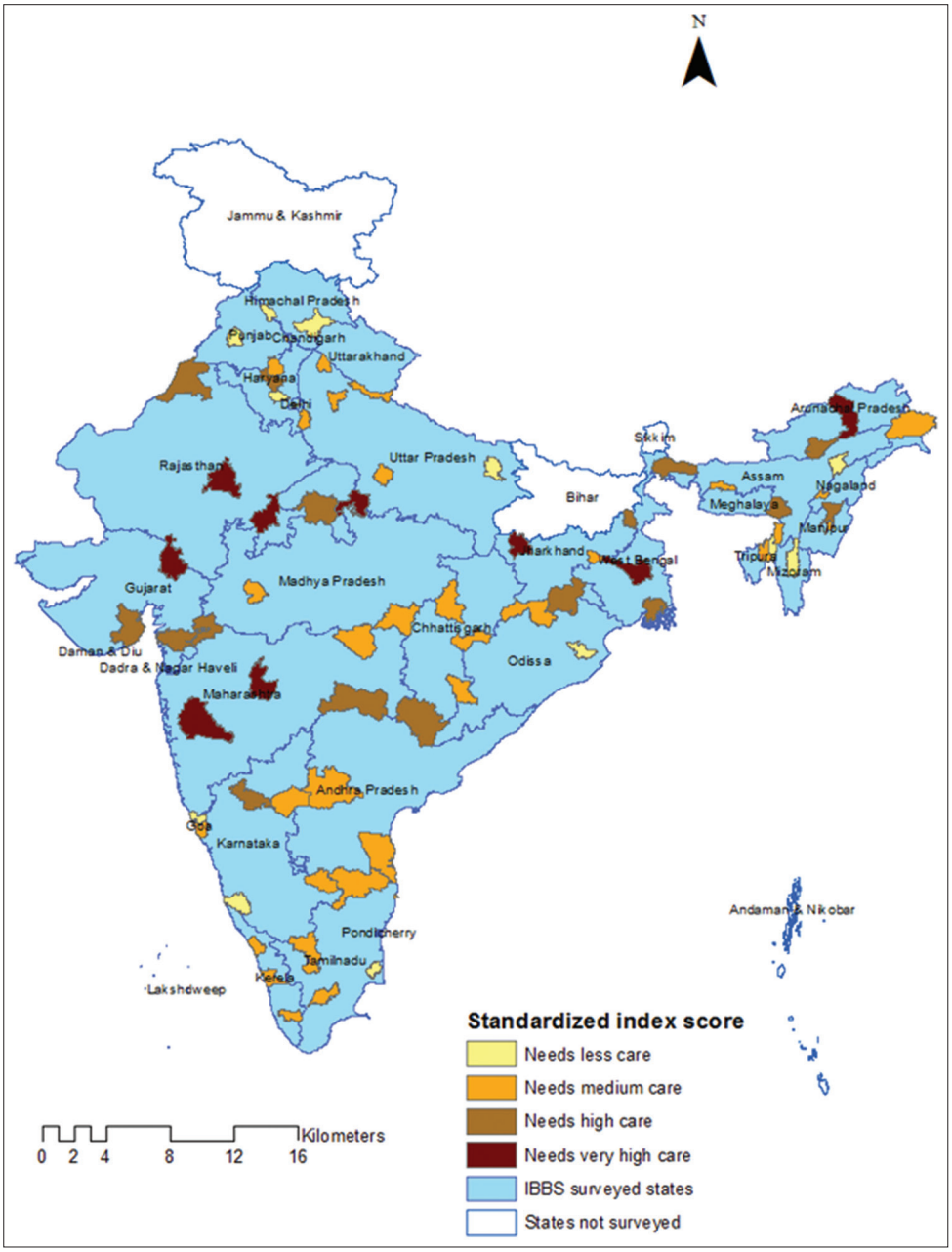

Figure 1: Map showing standardized scores of HIV risk-related factors among female sex workers (FSW) in India: IBBS 2014-2015

condom breakage or non-usage, misconceptions about HIV transmission, were the risk related factors. These factors, being associated with higher infection risk, have been well-established through numerous behavioral studies. According to the National AIDS Control Programme III, FSWs having several clients per day and FSWs having 100 or more clients in a month are found to be at most risk.[10] A study in the Indian district of Kolkata indicated that the odds of exposure of younger sex workers ≤ 20 years

Table 2: Principal component analysis - varimax rotation factor loadings

Variables	Component 1	Component 2	Component 3	Component 4	Component 5	Component 6	Communalities
HIV					0.645		0.447
Any STI							0.63
Cannot read & write					0.647		0.655
Current age<=25 years		0.881					0.946
Duration of sex work >5 years						0.89	0.888
Age at started selling sex <22 years.		0.92					0.909
Never used a condom					0.659		0.681
Experienced condom breakage last month			0.881				0.813
Wanted to use but did not past month			0.764				0.654
Have a regular client	-0.658						0.604
Have an occasional client				-0.641			0.764
10 or more clients in the past week - Occasional Male Clients	0.926						0.903
10 or more clients in the past week – Regular Male Clients	0.926						0.903
Never heard of any STI				0.664			0.629
Incorrect belief about AIDS transmission-global indicator				0.643			0.561

Component 1: Sex with More number of male clients (≥10) in a week (Regular or Occasional); *Component 2:* Younger FSWs (age ≤25 yrs.) and started sex at a younger age (<22yrs); *Component 3:* Condom usage (breakages and wanted but did not use); *Component 4:* Have occasional clients and improper knowledge of HIV/STI (not heard of STI & incorrect belief of about AIDS transmission); *Component 5:* Illiterate, HIV cases and never used a condom; *Component 6:* Duration of sex work for a longer period (≥ 5 yrs)

acquiring HIV were four times higher compared to the older age group.[11] Similarly, surveillance data in Nepal reported that a larger proportion of HIV-affected victims were young female sex workers than older ones.[12] Young FSW are more vulnerable to HIV than their older counterparts for reasons including a higher number of sexual partners, susceptibility to violence, and hence inability to negotiate condom use.[13] A higher rate of damage to the cervico-vaginal epithelium because of the relatively immature genital tract anatomy of adolescent FSW has also been reported to increase their susceptibility to infection.[11] Young age and duration of sex work are also associated with higher exposure risk, due to the probability of having higher number of sexual partners.

At the domain levels, the priority-domains reported having higher standardized index scores had a comparatively lower prevalence (< 3%) except Kota. On the other hand, the domains Mahabubnagar (Andhra Pradesh), Aizwal (Mizoram), Pune (Maharashtra), Kota (Rajasthan) and Imphal East (Manipur) had the highest HIV prevalence (> 10%) among FSW. This indicates that the

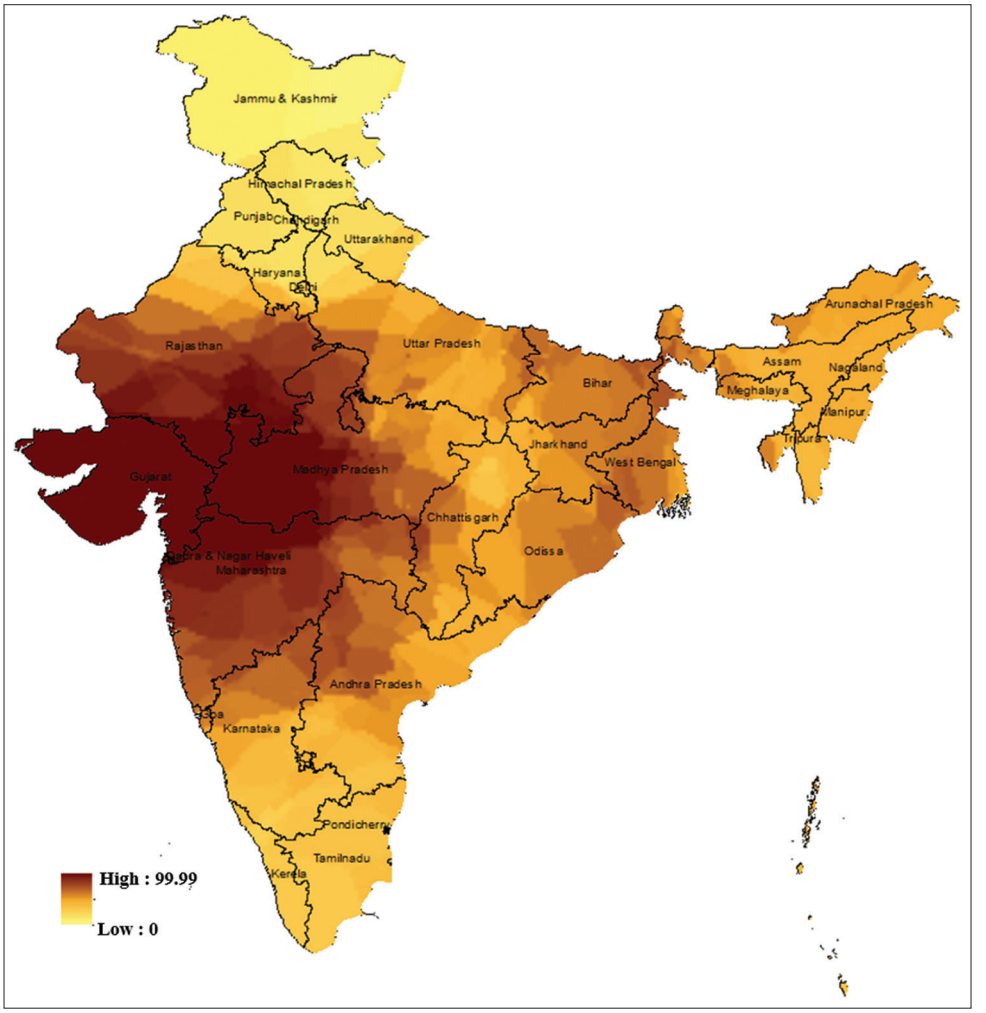

Figure 2: Kriged estimates of the standardized scores of FSW in India: IBBS 2014-2015

identified priority-domains were either emerging hotspots or increasing high-risk related behaviors among FSW. Accordingly, the proportion of FSW having 10 or more clients and misconceptions about HIV transmission was invariably much higher in the priority-domains as well as in the domains of Gujarat state indicating higher exposure risk.

Kriged estimates revealed that Western India including Gujarat and parts of Rajasthan, Maharashtra, and Madhya Pradesh as high-risk regions. Correspondingly, an increase in the number of HIV/AIDS related deaths has been reported in Gujarat.[14] High HIV prevalence was reported among females in Madhya Pradesh, with a larger proportion of affected being aged between 21 and 40 years.[15] The World Health Organization stated that Rajasthan was at higher risk of HIV transmission due to its geographical and occupational reasons such as tourism.[16] Our study identified hot spots in Maharashtra and Rajasthan.[10] HIV sentinel surveillance conducted in 2016-17 indicated an overall decline in HIV infection in India; however, Gujarat and Rajasthan reported a rising trend in HIV prevalence.[17] Similar analyses done earlier, showed 63 districts with consistently high HIV prevalence clustered in the South and the North-east regions of

India including some districts in Maharashtra.[18] Given its geographic and cultural diversity, an overall analysis of the cross-sectional survey might have masked certain regional high-risk factors. For instance, injection drug use (IDU) is a major cause of HIV transmission in North-East India; IDU practices among FSW have been reported in Northeast India[19, 20] that need to be considered for interventions in these regions. Our study reveals that the clustering has now shifted to the central regions of India. Continuous interventions at the previously identified high-risk regions had been instrumental in bringing about behavioral change among the FSW. Hence, it would be appropriate to target FSW and domains with increased HIV risk-related factors and prioritize interventional care.

4.1. Limitations

Though this surveillance was conducted during 2014-2015, this was the only latest available behavioral data to study the FSWs and their behaviors in India. Nonetheless, it is considered as relevant in the present scenario as the behaviors of HRGs hardly change within short period of time. In addition, migration and double counting are some of the major problems for any survey. These information were not collected in IBBS and may pose another source of limitation for the survey.

5. Conclusion and Implications For Translation

All 26 domains with a standardized score of 50 and above require priority care. The FSW at exposure risk, having limited knowledge about STI/HIV transmission and condom usage needs interventions for behavioral change. HIV estimates identify regions of high prevalence that need continued interventions. PCA and factor analysis revealed the factors that optimally contribute to higher infection risks and Kriged estimates identified hotspots of high-risk concentrated areas that need increased interventional care to prevent emerging infections. Globally, carrying out such studies at HIV epidemic regions will help to identify the target populations and emerging hotspots, thereby facilitating faster preventive measures.

Compliance With Ethical Standards

Conflicts of Interest: *The author(s) declared that no potential conflicts of interest concerning the research, authorship, and/or publication of this article.* ***Funding/Support:*** *The first author received funding from the National AIDS Control Organization for conducting the IBBS, especially in seven southern states of India. Permission also received for authorship and publication of this article. The publication of this article was partially supported by the Global Health and Education Projects, Inc. (GHEP) through the Emerging Scholars Grant Program (ESGP). The information, contents, and conclusions are those of theauthors' and should not be construed as the official position or policy of, nor should any endorsements be inferred by ESGP or GHEP.* ***Ethics Approval:*** *IBBS study was approved by NACO's Ethics Committee on 26-July-2013, Ref. No: T-11020/20/2008-NACO(R&D). Written informed consent was obtained from all the participants. Respondents were informed about their voluntary nature of participation and were given clear information regarding the risks and benefits of their participation. Consent process emphasized that the participation was voluntary and they can withdraw from the IBBS at any point of time during the survey, which will not affect any services they used to receive from the NGOs or clinics. Participants' time spent during the survey was compensated.* ***Acknowledgments:*** *The authors wish to thank the Project Directors of all the State AIDS Control Societies and Regional Institutes for their support in completing the surveillance activities on time. The authors also express their gratitude to the concerned Referral Laboratories, State Surveillance Team members, and sentinel site personnel. The authors also express their special gratitude to Dr. Sanjay Madhav Mehendale, former Additional Director General, Indian Council of Medical Research, New Delhi, for his technical inputs towards conducting the surveillance.* ***Disclaimer:*** *None*

Key Messages

- Female Sex Workers who are young, having higher exposure risk and having limited knowledge on STI/HIV transmission are more vulnerable to HIV/AIDS.
- The western part of central India, comprising of the state of Gujarat, a portion of Rajasthan, Madhya Pradesh and Maharashtra needs a greater interventional care.

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Appendix

Appendix 1: Percentage distribution of respondents by 15 variables: IBBS 2014-2015

State Name	Domain name	Total	HIV Prevalence (%)	Any STI#	Cannot read & write	Current age <=25 years	Duration of sex work >5 years	Age at started selling sex <22 years	Never used a condom	Experienced condom breakage in the last month	Wanted to use condoms but could not in the past month	Have regular clients	Have occasional clients	Had 10 or more occasional male clients in the past week	Had 10 or more regular male clients in the past week	Never heard of other STDs	Misconceptions about HIV/ AIDS transmission-global indicator
Andhra Pradesh	Adilabad	347	4.24	53.9	20.0	23.7	64.4	45.0	3.6	15.5	17.9	47.7	64.7	49.3	51.4	26.6	66.9
	Chittoor	391	6.64	39.7	40.4	22.6	55.7	32.7	14.2	10.0	8.5	72.0	74.0	4.4	1.5	7.2	33.8
	Mahabubnagar	384	15.85	34.6	50.1	9.5	63.6	29.0	16.2	12.2	23.3	91.1	82.0	13.4	10.0	9.3	84.5
	Nellore	371	0.32	39.8	35.8	20.0	68.2	48.9	9.4	17.9	22.8	81.8	79.6	11.1	12.8	9.0	42.3
Arunachal Pradesh	Lohit	389	0.19	28.2	10.8	46.4	42.6	62.2	1.4	27.1	8.7	91.1	84.8	10.8	7.3	20.6	53.3
	Papum Pare	386	0.00	63.4	12.2	40.9	61.3	44.2	4.9	11.2	29.2	84.5	67.7	14.6	19.9	22.4	90.8
	West siang*	398	0.00	20.2	13.2	29.9	35.0	20.7	2.5	19.8	23.8	52.7	78.4	86.8	69.1	34.9	71.3
Assam	Goalpara	403	0.00	36.8	24.1	47.2	37.3	57.8	5.9	14.0	6.7	96.2	70.9	1.4	1.4	5.0	63.8
	Jorhat*	408	0.00	28.8	11.6	19.7	30.7	22.4	0.9	13.5	1.4	97.2	88.6	9.0	9.8	6.6	63.8
	Karimganj*	402	0.82	87.8	20.4	42.7	60.6	69.6	2.4	7.0	1.3	88.4	67.9	6.4	20.8	10.3	61.1
Chandigarh	Chandigarh	396	0.00	57.7	12.4	14.2	45.1	28.0	0.5	8.9	21.7	99.7	62.3	0.7	0.0	1.2	42.3
Chhattisgarh	Bilaspur	386	0.91	35.8	23.8	36.4	55.3	57.1	7.6	10.1	29.5	96.0	91.5	2.5	0.3	3.5	34.3
	Dantewada	394	0.50	55.7	46.8	37.8	34.8	44.9	9.4	0.1	9.0	50.7	71.5	3.9	1.5	38.7	54.4
	Mahasamund	360	1.00	33.6	38.8	26.0	54.4	55.3	7.9	11.0	11.3	91.0	74.8	0.4	0.0	12.0	59.7
Goa	North Goa	372	1.20	57.3	36.0	22.2	53.8	30.3	1.2	7.4	6.9	70.6	79.8	13.2	5.3	17.8	35.4
	South Goa	394	0.93	59.9	36.5	16.0	84.5	65.3	9.7	10.9	11.7	98.3	95.5	6.8	5.5	7.9	56.2
Gujarat	Bhavnagar	398	0.00	73.5	13.9	7.0	68.9	23.4	4.2	27.0	27.9	89.1	88.8	58.4	47.7	9.5	66.9
	Sabarkantha	422	2.61	66.6	6.0	6.0	66.7	7.0	22.1	5.4	8.1	18.1	51.7	38.1	43.4	22.8	74.5
	Surat*	396	1.50	85.8	5.6	14.8	74.2	32.7	10.4	4.2	4.4	79.0	72.0	28.2	32.2	32.9	70.9
Haryana	Faridabad*	402	0.94	70.7	9.9	30.6	54.2	55.3	4.8	8.3	10.8	90.1	86.9	10.0	4.5	26.9	62.1
	Jind	283	0.69	51.0	13.1	32.2	71.4	69.4	1.1	25.3	22.5	94.3	83.0	22.2	21.8	21.9	77.0
	Kaithal	290	0.00	36.6	1.8	33.0	58.3	65.8	7.1	13.2	22.3	81.3	88.5	9.4	4.5	4.8	49.7
	Rohtak	393	0.42	86.6	19.1	23.6	58.3	39.3	1.4	10.1	11.3	60.8	89.4	20.6	6.9	11.0	13.3
Himachal Pradesh	Shimla*	406	0.00	54.2	9.9	15.5	61.7	48.6	2.3	8.6	9.5	96.0	67.6	15.1	8.3	5.4	69.3
	Una*	397	0.14	8.2	1.5	7.1	52.8	18.1	1.1	5.9	3.4	82.0	95.0	1.2	2.1	10.8	36.5

(*Contd...*)

Appendix 1: ***(Continued)***

State Name	Domain name	Total	HIV Prevalence (%)	Any STI#	Cannot read & write	Current age <=25 years	Duration of sex work >5 years	Age at started selling sex <22 years	Never used a condom	Experienced condom breakage in the last month	Wanted to use condoms but could not in the past month	Have regular clients	Have occasional clients	Had 10 or more occasional male clients in the past week	Had 10 or more regular male clients in the past week	Never heard of other STDs	Misconceptions about HIV/ AIDS transmission-global indicator
Jharkhand	Dhanbad	389	0.19	38.5	33.6	18.4	28.6	24.8	6.0	12.9	10.8	49.2	51.7	4.9	2.1	14.2	38.2
	Latihar*	327	0.60	21.8	43.7	43.1	30.7	49.7	15.1	18.8	8.0	98.0	53.6	0.0	0.0	25.9	57.3
	PaschimSinghboom*	281	0.14	84.0	35.7	68.6	38.8	79.0	0.7	23.3	40.5	95.1	74.7	0.7	2.2	24.9	50.8
	Sahibganj*	373	0.41	65.6	57.4	38.5	56.0	49.9	5.5	32.4	35.6	85.9	68.1	4.4	2.6	14.8	63.1
Karnataka	Bagalkot	380	9.15	50.4	70.9	19.8	95.0	79.6	21.1	16.2	13.0	79.4	98.4	11.9	4.5	4.3	34.4
	Dakshina Kannada	356	0.00	50.5	13.7	11.7	42.8	11.5	15.2	6.1	4.5	63.7	51.4	18.5	4.3	6.4	34.3
	Kolar	405	5.07	51.2	44.2	15.5	72.7	48.5	1.4	19.5	20.9	64.2	63.9	5.8	1.9	23.7	46.5
	Raichur	393	5.07	73.5	61.8	16.5	60.6	26.1	8.6	9.6	5.1	90.7	97.3	1.1	2.8	10.9	26.6
Kerala	Kozhikode	331	0.26	22.3	15.6	1.8	86.8	11.7	26.9	8.7	10.4	82.5	76.8	4.4	3.1	12.1	45.6
	Pathanamthitta	401	0.00	48.9	8.6	1.2	86.9	11.9	7.8	6.5	9.9	70.8	70.4	29.0	16.6	12.6	52.3
	Thrissur	139	2.65	26.0	29.3	2.2	79.3	10.7	13.5	22.0	23.5	83.3	74.7	5.3	0.1	23.7	58.8
Madhya Pradesh	Balaghat	396	0.70	60.0	31.7	19.8	54.4	28.7	3.3	17.5	22.9	97.0	74.5	3.3	2.1	10.5	65.1
	Indore*	401	0.91	43.5	30.8	30.8	67.8	64.9	3.0	22.5	41.9	90.3	86.2	30.7	19.6	11.0	32.5
	Shivpuri*	389	1.03	50.9	78.0	20.0	78.7	55.1	2.9	20.3	21.6	97.4	92.5	2.4	6.7	18.8	60.0
Maharashtra	Jalna	380	2.62	55.7	34.9	15.9	61.7	23.7	17.2	9.6	5.9	43.3	40.3	40.9	43.2	57.2	72.4
	Nagpur	411	1.33	62.0	19.9	28.2	67.9	54.6	4.5	11.5	2.5	91.6	92.7	23.2	16.3	10.9	53.2
	Nandurbar	165	8.55	73.3	43.9	36.7	57.5	56.2	10.4	17.9	7.5	64.6	75.1	13.2	17.0	23.6	40.8
	Pune	393	12.45	57.6	48.1	13.6	87.9	58.2	9.4	17.0	25.4	85.6	82.3	29.8	8.4	47.1	75.4
Manipur	Imphal East	285	11.39	68.8	38.3	30.7	23.4	24.0	3.7	26.9	31.5	89.6	74.2	15.9	8.0	14.9	44.7
	Senapati	290	0.69	70.4	21.2	46.8	22.1	43.6	10.9	14.3	32.7	89.9	76.3	8.6	4.5	59.4	80.3
Meghalaya	Jaintia Hills*	404	9.54	43.2	15.8	53.5	33.3	36.6	3.1	14.9	10.7	46.1	58.9	40.2	13.5	35.6	74.7
Mizoram	Aizwal*	354	13.31	30.3	0.0	46.5	21.7	47.8	12.9	7.5	9.8	73.9	76.9	3.3	0.4	2.1	26.2
Nagaland	Dimapur*	399	2.55	83.9	18.0	34.8	38.3	48.4	5.7	28.1	13.8	94.8	89.0	4.8	6.8	8.8	51.3
NCT of Delhi	Central	391	2.43	33.5	38.9	32.8	64.0	42.7	16.9	11.5	8.6	39.4	66.6	50.0	52.7	16.7	48.2
	West	409	0.00	73.5	21.3	35.2	58.3	56.0	3.7	19.3	18.5	79.8	84.8	27.3	24.2	7.1	29.1

(*Contd...*)

Appendix 1: ***(Continued)***

State Name	Domain name	Total	HIV Prevalence (%)	Any STI#	Cannot read & write	Current age <=25 years	Duration of sex work >5 years	Age at started selling sex <22 years	Never used a condom	Experienced condom breakage in the last month	Wanted to use condoms but could not in the past month	Have regular clients	Have occasional clients	Had 10 or more occasional male clients in the past week	Had 10 or more regular male clients in the past week	Never heard of other STDs	Misconceptions about HIV/ AIDS transmission-global indicator
Orissa	Jajpur*	407	0.54	92.3	39.5	42.1	16.6	35.9	5.2	22.2	32.4	99.6	99.5	1.0	1.8	1.1	30.5
	Nabarangpur*	396	1.13	76.2	50.3	42.4	55.2	72.4	6.0	6.9	30.0	92.6	95.2	10.5	14.4	3.1	36.4
	Sundargarh	395	0.21	7.5	14.1	78.9	29.4	93.0	4.7	2.5	4.1	94.6	95.4	4.5	7.4	13.1	31.7
Puducherry	Pondicherry*	389	0.84	23.5	11.0	7.8	48.0	10.5	18.4	30.9	23.2	71.0	88.1	3.0	1.2	15.4	29.5
Punjab	Punjab*	396	2.14	53.2	13.5	21.8	39.5	37.7	1.9	10.9	15.3	85.4	73.2	15.5	14.4	3.7	14.8
Rajasthan	Ajmer*	382	0.24	69.0	11.3	41.6	61.2	66.9	10.0	5.6	7.6	48.2	44.5	68.2	39.2	35.7	78.6
	Ganganagar	366	0.36	71.8	37.0	29.2	55.6	51.2	6.1	2.3	2.5	96.1	38.9	27.7	11.8	36.9	35.9
	Kota*	391	11.63	61.3	20.1	52.0	85.0	79.1	12.7	11.3	12.4	87.4	69.9	60.7	41.4	33.0	65.5
Tamil Nadu	Chennai	376	0.11	27.2	31.9	11.3	31.5	10.7	38.7	15.4	5.5	96.5	85.2	5.3	2.2	8.4	23.0
	Erode*	360	1.96	19.3	19.3	10.9	62.3	22.6	27.6	28.3	5.7	96.9	91.2	12.9	8.2	3.2	43.4
	Madurai	385	2.10	45.1	16.0	5.1	63.4	18.1	17.1	12.2	14.4	88.9	86.2	7.0	12.9	18.8	46.2
	Thiruvarur*	356	0.25	10.4	18.0	4.4	53.4	7.7	10.5	17.1	12.3	82.9	84.9	9.0	3.2	21.0	38.8
Tripura	Dhalai	280	4.30	25.0	23.4	20.4	32.0	13.2	12.3	8.5	6.5	97.5	41.6	5.3	3.2	7.3	60.7
	North Tripura	397	1.19	63.9	13.9	26.1	36.6	27.3	0.6	9.6	5.1	95.8	54.9	4.4	1.2	3.2	46.5
	Gorakhpur*	396	1.61	17.7	9.4	14.0	40.2	13.6	1.0	0.3	1.6	99.4	60.9	3.4	4.4	30.2	10.0
Uttar Pradesh	Jhansi*	394	0.00	32.0	46.2	24.5	44.7	28.8	11.9	8.5	7.8	60.8	41.5	44.4	31.2	26.6	45.3
	JyotibaPhule Nagar*	399	1.72	80.6	51.0	30.3	49.5	59.1	0.7	3.7	3.2	93.0	38.3	9.2	3.0	22.5	87.1
	Kanpur Nagar	397	0.00	26.8	17.4	24.2	60.5	42.4	4.5	20.0	8.7	86.1	68.3	26.3	18.0	19.1	36.4
Uttarakhand	Hardwar	380	0.11	92.5	27.2	26.0	71.7	40.2	2.7	31.4	35.0	91.7	96.6	2.8	3.4	18.3	68.0
	Udham Singh Nagar	390	0.51	63.0	32.7	25.6	47.0	29.4	0.9	30.4	18.9	86.6	69.1	7.4	5.1	6.8	42.3
West Bengal	24 Paraganas (S)	385	1.92	27.9	70.5	31.6	48.1	41.5	15.3	33.3	4.7	90.7	88.3	13.3	11.9	15.3	62.2
	Burdwan	382	0.74	52.5	61.3	37.1	56.7	64.0	13.3	40.4	3.3	86.0	88.6	22.8	12.9	12.2	88.8
	Jalpaiguri	198	4.55	41.9	72.2	30.3	63.7	67.2	17.2	20.7	6.6	90.4	94.9	19.1	12.8	29.8	45.5

***composite domain;** # Had at least one STI symptom during the past 12 months (Vaginal discharge/lower abdominal pain without diarrhea or menses/Genital ulcer or sores); STI – Sexually Transmitted infections, STD – Sexually Transmitted Diseases