Original Article

Recent trends in HIV prevalence in a remote setting of southern India: Insights into arranging HIV control policies

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Abstract

Introduction: Constant vigilance of the dynamics of HIV prevalence is important in estimating, regulating, and implementing prevention programs. The objective of this study was to investigate the trend in the prevalence of HIV infection over six years among specific demographic groups in the remote district of southern India.

Methodology: All high-risk attendees of the Integrated Counseling and Testing Centre, Government Theni Medical College between April 2005 and December 2010 were included in this study. Characteristics including age, sex, place of residence, literacy, and HIV sero-status were collected as per the guidelines of the National AIDS Control Organization.

Results: A total of 50,043 data sets were analyzed; 3,282 (6.6%) tested positive for HIV infection. The prevalence of HIV infection among the ≤ 25 age group was significantly lower as compared to the elderly (4.4% vs. 6.9%; odds ratio 0.62; 95% confidence interval 0.55–0.71; p < 0.01). There was a decline in HIV prevalence among both age groups (P_{trend} < 0.01 for ≤ 25 year-old; – 82.3% and P_{trend} < 0.01 for > 25-year old, – 14.2%), males (P_{trend} < 0.01; – 50.9%), the urban population (P_{trend} < 0.01; – 45.9%), and illiterates (P_{trend} < 0.01; – 68%). The trend of HIV prevalence among females (P_{trend} = 0.48; +9.1%), the rural population (P_{trend} = 0.95; – 7.1%), and literate population (P_{trend} = 0.44; +28%) was statistically insignificant.

Conclusion: HIV prevalence is stable in the female population, while it is decreasing in male population, indicating that current interventions must be strengthened to reduce HIV prevalence among females.

Key words: HIV; prevalence; epidemiology; declining trend

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Introduction

The epidemiology of human immunodeficiency virus (HIV) infection in India has changed significantly since the early 1980s when it began as an epidemic predominantly among high-risk groups such as female sex workers and injecting drug users [1,4]. Today, HIV/acquired immune deficiency syndrome (AIDS) is a disease of far greater demographic diversity, affecting all ages, sexes, races, and income levels, involving multiple transmission risk behaviors. Hence, the HIV epidemic in India has moved more and more from urban to rural areas and from high-risk to general populations [1,3]. This epidemiologic diversity is important to understand in order to target the interventions needed for diagnosis and treatment and to potentially reduce virus transmission. India has a population of 1.1 billion people – one sixth of the world's population – and is currently home to 2.27 million people infected with HIV [3,4].

The first case of HIV infection in India was reported in 1987 [5] from Tamil Nadu, a state in southern India. Since then, the seroprevalence of HIV in Tamil Nadu and elsewhere in India has increased steadily. The total number of HIV-infected individuals in the country was estimated at 5.1 million at the end of 2003, and 5.7 million in 2006 [6]. Interestingly, the number of HIV infections in India has been reported to be 2.3 million in 2008 by the National AIDS Control Organization (NACO) [3]. This large variation is to the result of an over-projection of HIV estimates to the national population based on the surveillance data of high-prevalence areas. A later report provided more reliable data since the surveillance sites were equally distributed throughout the nation. United Nations AIDS (UNAIDS) recently indicated a significant decline in the global HIV infection rate. One of the UN's Millennium Development Goals is the halting of HIV infection by 2015 [4,7]. A declining trend of HIV prevalence was also observed in Africa, which is home

to the largest number of patients living with HIV/AIDS in the world [7]. Nevertheless, HIV remains an important cause of morbidity and mortality in India[7,8].

Since India is a highly populated country, and although the number of surveillance sites is expanding, the data on HIV prevalence may still be inadequate, as one percent variation in the projection would result in a significant variation in the actual number of cases [6,9]. Hence, it is necessary to investigate the prevalence of HIV infection in the local community to conceive and implement the necessary remedial programs [10,11]. Theni is one of the remote districts of Tamil Nadu, with a population size of about 1.1 million people [12]. Together, the states of Tamil Nadu and other south Indian states (Andhra Pradesh, Karnataka, and Maharashtra) account for 60% of HIV infections in India [3,4].

Recently, we have reported the prevalence of transfusion-transmissible infections in our region [13]. The present study aimed to investigate the risk of HIV infection among different population groups based on age, sex, residence, and literacy, and to identify the trend of HIV prevalence. This information could be useful for NACO to prioritize HIV prevention strategies and resource allocation [14].

Methodology

Setting

The current study was conducted in the Department of Microbiology, Government Theni Medical College, Theni District, Tamil Nadu state, a tertiary care referral hospital and a state reference laboratory for HIV/AIDS.

Participants and period of study

A retrospective analysis of data from the Integrated Counseling and Testing Centre (ICTC) attached to the tertiary care hospital was performed. The present study included data of all high-risk attendees between April 2005 and December 2010. Antenatal care participants of ICTC were excluded, since they were reflective of the general population. The patient population was categorized into two groups based on age, sex, place of residence, and literacy. Most of the ICTC attendees were recruited from Tamil Nadu state; a few from Kerala were recruited.

Specimens

Three mL of venous blood samples were collected in a sterile plain container and allowed to clot for 30 minutes at room temperature (25-30°C). The serum sample was separated after centrifugation and stored in a properly labeled sterile screw-capped container [15].

Serology

HIV antibodies were tested by one screening test (ELISA/Rapid) and two supplemental tests (ELISA/Rapid) as per the standard guidelines (strategy/algorithm III) published by NACO [15].

Statistical analysis

Statistical analyses of data were performed with GraphPad Prism version 5.03 (GraphPad Software Inc., San Diego, USA) using the chi-square test for trend; the statistical significance was set at $p < 0.05$.

Results

During the study period of six years, a total of 50,043 participants were enrolled in the ICTC. A total of 22,768 (45.5%) were males and 27,275 (54.5%) were females; 6,411 (12.8%) were 25 years of age or younger. Among them 3,282 (6.6%) were found to be positive for HIV infection [16]. The yearly prevalence of HIV infection in this cohort was observed to be declining in concordance with national and global estimate [3,4,7,17]. The prevalence of HIV infection among the ≤ 25 age group was found as 4.4%, and its counterpart, the > 25 age group, had an HIV prevalence of 6.9%. Therefore, the prevalence of HIV infection was documented to be 1.56 fold lower in the ≤ 25 age group when compared with the > 25 age group (4.4% vs. 6.9%, respectively; odds ratio [OR] 0.62; 95% confidence interval [CI] 0.55–0.71; $p < 0.01$) (Table 1). The analysis of the yearly prevalence of HIV infection revealed a declining trend among both study groups.

The prevalence of HIV infection among males was 8.9% and among females, 4.6% (OR 2.01; 95% CI 1.87–2.16; $p < 0.01$) (Table 2). Although the male population showed a high risk of acquiring HIV infection, the yearly analysis of HIV prevalence revealed a declining trend among the male population.

Among the study participants, 30,332 (60.6%) lived in a rural area. The prevalence of HIV infection among the people in rural and urban areas was similar (5.6%). Therefore, the place of residence was identified as not having any association with HIV prevalence (Table 3). However, the yearly analysis of HIV prevalence revealed a declining trend among the urban population, and the prevalence remained stable among the rural population.

Table 1: Age-based HIV prevalence among ICTC attendees in a remote area of southern India.

Year	Age ≤ 25 years		Age > 25 years		Odds Ratio (95% Confidence Interval)	p Value
	No. of Samples Tested	No. of Samples Positive for HIV (%)	No. of Samples Tested	No. of Samples Positive for HIV (%)		
2005	275	34 (12.36)	5300	373 (7.04)	1.86 (1.28 to 2.70)	< 0.01
2006	1061	64 (6.03)	8395	630 (7.50)	0.79 (0.61 to 1.03)	0.09
2007	1369	57 (4.16)	8779	614 (6.99)	0.57 (0.44 to 0.76)	< 0.01
2008	1379	61 (4.42)	8000	552 (6.9)	0.62 (0.48 to 0.82)	< 0.01
2009	1046	38 (3.63)	5311	357 (6.72)	0.52 (0.38 to 0.74)	< 0.01
2010	1281	28 (2.19)	7847	474 (6.04)	0.35 (0.24 to 0.51)	< 0.01
Total	**6411**	**282 (4.40)**	**43632**	**3000 (6.88)**	**0.62 (0.55 to 0.71)**	**< 0.01**

Table 2: Sex-based HIV prevalence among ICTC attendees in a remote area of southern India.

Year	Male		Female		Odds Ratio (95% Confidence Interval)	p Value
	No. of Samples Tested	No. of Samples Positive for HIV (%)	No. of Samples Tested	No. of Samples Positive for HIV (%)		
2005	2025	259 (12.79)	3550	148 (4.17)	3.37 (2.73 to 4.16)	< 0.01
2006	3728	416 (11.16)	5728	278 (4.85)	2.46 (2.10 to 2.88)	< 0.01
2007	4714	395 (8.38)	5434	276 (5.08)	1.71 (1.46 to 2)	< 0.01
2008	4848	393 (8.11)	4531	220 (4.86)	1.73 (1.46 to 2.05)	< 0.01
2009	2453	245 (9.99)	3904	150 (3.84)	2.78 (2.25 to 3.43)	< 0.01
2010	5000	314 (6.28)	4128	188 (4.55)	1.40 (1.17 to 1.69)	< 0.01
Total	**22768**	**2022 (8.88)**	**27275**	**1260 (4.62)**	**2.01 (1.87 to 2.16)**	**< 0.01**

Table 3: Residence-based HIV prevalence among ICTC attendees in a remote area of southern India.

Year	Rural residents		Urban residents		Odds Ratio (95% Confidence Interval)	p Value
	No. of Samples Tested	No. of Samples Positive for HIV (%)	No. of Samples Tested	No. of Samples Positive for HIV (%)		
2005	3723	264 (7.09)	1852	143 (7.72)	0.91 (0.74 to 1.13)	0.43
2006	5996	400 (6.67)	3460	294 (8.50)	0.77 (0.66 to 0.90)	< 0.01
2007	6470	386 (5.97)	3678	285 (7.75)	0.76 (0.64 to 0.89)	< 0.01
2008	5418	337 (6.22)	3961	276 (6.97)	0.89 (0.75 to 1.04)	0.16
2009	3706	271 (7.31)	2651	124 (4.68)	1.61 (1.29 to 2.00)	< 0.01
2010	5009	330 (6.59)	4119	172 (4.18)	1.61 (1.34 to 1.96)	< 0.01
Total	**30322**	**1988 (6.56)**	**19721**	**1294 (6.56)**	**1.00 (0.93 to 1.07)**	**0.99**

Table 4: Literacy-based HIV prevalence among ICTC attendees in a remote area of southern India.

Year	Illiterate		Literate		Odds Ratio (95% Confidence Interval)	p Value
	No. of Samples Tested	No. of Samples Positive for HIV (%)	No. of Samples Tested	No. of Samples Positive for HIV (%)		
2005	1362	286 (21.00)	4213	121 (2.87)	8.99 (7.19 to 11.23)	< 0.01
2006	6451	486 (7.53)	3005	208 (6.92)	1.10 (0.93 to 1.30)	0.31
2007	6843	401 (5.86)	3305	270 (8.17)	0.70 (0.60 to 0.82)	< 0.01
2008	6010	439 (7.30)	3369	174 (5.16)	1.45 (1.21 to 1.73)	< 0.01
2009	3710	216 (5.82)	2647	179 (6.76)	0.85 (0.69 to 1.05)	0.14
2010	5461	367 (6.72)	3667	135 (3.68)	1.89 (1.54 to 2.31)	< 0.01
Total	**29837**	**2195 (7.36)**	**20206**	**1087 (5.38)**	**1.40 (1.30 to 1.51)**	**< 0.01**

A total of 29,837 (59.6%) patients were illiterate. The prevalence of HIV infection among the illiterate study group was significantly higher (7.36% vs. 5.38%, respectively; OR 1.40; 95% CI 1.30–1.51; $p < 0.01$) (Table 4). Although the illiterate population showed a high risk of acquiring HIV infection, the yearly analysis of HIV prevalence revealed a declining trend; nevertheless, the prevalence remained stable among the literate population.

Trend analysis revealed a declining trend of HIV prevalence among both age groups ($P_{trend} < 0.01$ for age group ≤ 25 and $P_{trend} < 0.01$ for age group > 25), males ($P_{trend} < 0.01$), the urban population ($P_{trend} < 0.01$), and illiterates ($P_{trend} < 0.01$). The trend of HIV prevalence among females ($P_{trend} = 0.48$), the rural population ($P_{trend} = 0.95$), and literates ($P_{trend} = 0.44$) was statistically insignificant. Additionally, the overall analysis revealed that rural residence did not have any association with HIV prevalence when compared with urban residence.

Discussion

The results of this study demonstrate a significant decrease in HIV prevalence among the regional population between 2005 and 2010. This decrease mainly owed to a substantial decrease of HIV prevalence among individuals 25 years of age or younger, illiterates, and males.

The reduced HIV prevalence among the ≤ 25 age group during the study could be because of the intense health education and awareness campaign about HIV/AIDS among all adolescents at India's schools and colleges in addition to the effective prevention of mother-to-child transmission of HIV [3]. The relative reduction in the > 25 years age group was insignificant (< 33%). This observation could be because of the higher prevalence of HIV infection in older people, who do not have adequate awareness of HIV/AIDS and do not use condoms regularly [18]. The present study results corroborate national and global projections of HIV prevalence based on different age groups [3,7]. The adult HIV prevalence at the national level shows a steady decline from an estimated level of 0.45% in 2002, 0.36% in 2006, and 0.29% in 2008. All the high-prevalence states show a clear declining trend in adult HIV prevalence [3].

Recent estimates on the proportion of HIV infection among males (61%) and females (39%) [19] were similar to the rates found in the current study – 62% and 38%, respectively. According to a previously published report, the odds of HIV infection among males were 2.27 times higher than for females [20]; the current study showed that the odds of HIV infection were two times higher for males. Notably, the prevalence of HIV infection was constantly high among the male population [3,7]; however, the yearly analysis revealed a declining trend of HIV prevalence during the study period, which indicates that the current strategies helped to reduce the prevalence in the male population.

Intriguingly, among all the study groups analyzed, HIV prevalence was found to be stable in the female population, while other study groups revealed a decreasing HIV prevalence. The national adult prevalence was 0.26% among women and 0.38% among men in 2008, and 0.25% among women and 0.36% among men in 2009 [3]. There are several factors that can increase women's vulnerability to HIV infection, including early marriage, illiteracy, ignorance about risk factors, and gender inequalities, along with biological factors. As a consequence, many women are extremely vulnerable to HIV infection even though they do not practice high-risk behavior. Reportedly, there has been an increase in HIV infection among females in the recent past [1,21]. Notably, significant proportions of new infections are reported from monogamous women in stable marital relationships, which indicates that marriage itself is a risk [6]. The results of the present study indicate that the current intervention programs must be specifically strengthened to control HIV prevalence among women.

The present study revealed there is no relationship between HIV infection and place of residence; however, it was one of the important risk factors in early years, which might be overcome by effective campaigns and awareness programs.

In contrast to these data, previous studies involving rural populations from southern India and other developing parts of the world reported an increased or higher HIV prevalence [17,22,23]. A report from NACO and other recent studies have shown an increased susceptibility and vulnerability to HIV infection among rural communities, signaling a potential for a further escalating epidemic [1,3,23,27].

According to a UNAIDS report published in 2002, condom use among rural men was low [2]. In contrast, the scenario of HIV prevalence in Tamil Nadu [10,19] is greater in the urban population than in the rural population. On the other hand, the current study indicated that the place of residence does not have any impact on HIV prevalence. A similar observation was previously reported by Kumar *et al*. [22].

According to UNESCO [28], illiterates were highly vulnerable to HIV infection because of their lack of knowledge and engagement in unprotected sex. HIV prevalence was observed to be high among the illiterate population in early years; following the implementation of effective awareness programs, there was equilibrium and alternating peaks of HIV prevalence among the study populations. However, in 2010, HIV prevalence was observed to be 6.72% vs. 3.68% (OR 1.89, 95% CI 1.54 to 2.31). The prevalence rate must be monitored in the forthcoming years to determine the precise trend. The present study's results corroborated results from a recent report [22], in which the prevalence of HIV infection was higher in illiterates.

During early years of the study (2005), immediately after the initiation of ICTC (at the time VCTC – Voluntary Counseling and Testing Centre) in a remote setting of South India, participants were recruited based on voluntary participation. Notably, most of the attendees were reported to have multiple unprotected promiscuous sex exposures and were at extreme risk for sexually transmissible infection (STI). Conversely, the low-risk participants ignored the test due to stigma. Additionally, physicians often referred participants with clinical symptoms of HIV/AIDS in that period. During the later years (2007), the number of ICTC attendees increased, owing to the public awareness created by different media; also, the integration of the Revised National Tuberculosis Control Program (RNTCP) and STI clinic with ICTC increased the number of physician-referred participants. These factors might have contributed to a bias in patient selection during early years, being responsible for the higher prevalence of HIV in 2005. Another limitation of this study was not performing multiple logistic regression analysis for different variables analyzed. In univariate analysis, the influence of one variable on another variable is inevitable. The influence of other variables on rural residence might have prejudiced the insignificant association of rural residence with HIV infection – a contrasting statement from the existing literature. Additionally, this study excluded antenatal care participants of ICTC because it was reflective of the general population and might dilute the study participants and significantly decrease the prevalence of HIV among the high-risk group.

HIV testing, early diagnosis, and access to treatment are key strategies for HIV/AIDS prevention. Individuals unaware of their infection status are at high risk of transmitting infection to others [29], and of the progression of the disease since they cannot benefit from treatment. There is growing evidence that widespread access to treatment may reduce HIV prevalence by reducing viral load at the population level [30,31]. In addition, a meta-analysis showed that people diagnosed early are less likely to transmit the virus [32].

Conclusion

The trend of HIV prevalence among the population of a remote area in the southern Indian state of Tamil Nadu was found to be declining irrespective of age, residence, and literacy, indicating the effectiveness of NACP – III interventional programs. The stable HIV prevalence in the female population and the decrease in the male population indicates that the present interventions must be strengthened to control HIV prevalence with a special focus on females.

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