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B.A.

Honors area (eg Molecular and Cellular Biology, English, Studio Art):

International studies

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The Impacts of Economic Development: An Analysis of HIV/AIDS in India by State/Territory

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THE IMPACTS OF ECONOMIC DEVELOPMENT:

AN ANALYSIS OF HIV/AIDS IN INDIA BY

STATE/TERRITORY

BY

ANIKET MAITRA

A Thesis Submitted to The Honors College

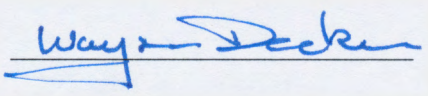
In Partial Fulfillment of the Bachelors Degree
With Honors in

International Studies

THE UNIVERSITY OF ARIZONA

DECEMBER 2013

Approved by:



Dr. Douglas Taren
Dr. Wayne Decker
International Studies Program

Abstract

This paper focuses on the relationships between economic development and the prevalence of HIV/AIDS in individual state with a particular focus on the years between 2005 and 2011. Data was collected from annual reports compiled by the National AIDS Control Organization in India, sentinel surveys, economic statistics published by the government of India and a few journalistic sources. This data was graphed in a variety of ways including bar graphs to show comparisons between states and scatter plots to determine several key relationships. While there has been overall economic growth in India, an increase in per capita income, an increase in income inequality in rural and urban areas, and a decrease in prevalence rates of HIV/AIDS, there is a substantial presence of HIV/AIDS in several states including Andhra Pradesh, Maharashtra, Manipur, Mizoram, Nagaland, and Karnataka. The greater prevalence rates in Manipur, Mizoram, and Nagaland are partly explained largely by the drug trade from Myanmar. High rates of in Andhra Pradesh, Maharashtra, and Karnataka are partly explained by a large commercial sex industry through South India, migration of individuals from northern to southern India in Andhra Pradesh, and intermittent drug use especially in states like Maharashtra.

Introduction

HIV/AIDS is a pandemic effecting the lives of the millions of people around the world. The United Nations estimates that over 28 million people have died from this disease and about 33 million people are currently infected.[1] It was first seen in the early 1980s with advances made in the next few years to come in naming the disease, finding its cause, and learning about its modes of transmission. In these crucial beginning years it was identified as a pandemic that had spread to Africa, Asia, and South America. Today, it is a disease largely impacting the developing world with an estimated 90%-95% of infections occurring in those particular regions of the world. It is estimated that the cost of drugs for treating AIDS including antiretroviral drugs is $12,000 or more per year but for many countries the figure is largely unaffordable.[2] One particular region heavily affected by the HIV/AIDS pandemic is South Asia. An estimated 60% of those living with HIV in Asia are living in India.[3] There are an approximate 2.4 million people living with HIV/AIDS in India today.[4]

HIV is the abbreviation for Human Immunodeficiency Virus, which can cause AIDS, Acquired Immunodeficiency Virus, if left untreated. People are usually defined as having AIDS in several ways including complications of a suppressed immune system, cancer in AIDS patients, or blood tests that show a dangerously weakened immune

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[1] Scott Freeman. *Biological Science* (Upper Sadle River: Prentice Hall, 2011), 677
[2] Nancy Harris. *AIDS In Developing Countries* (Farmington Hills: Greenhaven Press, 2003), 5
[3] Stephen Moses et al., *AIDS in South Asia: Understanding and Responding to a Heterogeneous Epidemic* (Washingon, D.C.: The World Bank, 2006), xvii
[4] "The World Factbook: India," United States Central Intelligence Agency, accessed November 28, 2013, https://www.cia.gov/library/publications/the-world-factbook/geos/in.html.

system. A continued progression of HIV without treatment usually leads to AIDS but might take years to develop.[5]

HIV is a retrovirus, a family of viruses that is encapsulated by a lipid membrane or protective protein shell which usually composed of fats and proteins. This envelope makes it easier for HIV to enter human cell and avoid detection by the immune system but makes HIV more sensitive to breakdown by detergents, heat and dry conditions (making it quite delicate and unable to survive well outside of humans).[6] HIV is particularly harmful as it targets and attacks specific cells in the human body. HIV specifically impacts helper T lymphocytes and macrophages, which are both critical to the body's immune system.[7] Helper T cells are important to the body's immune system as they do not directly participate in the destruction of pathogens but help in activating other lymphocytes (white blood cells) and macrophages. They tend to make up majority of T cells of the three types of T cells that help with the body's defenses. They are also the most abundant type of T cell constituting 60%-80% of the body's circulating T cells.[8] Macrophages are a type of white blood cell that are produced when monocytes gradually enlarge to become phagocytes.[9]

HIV attacks the body by specifically infecting a helper T lymphocyte or macrophage and reproduces inside those particular cells. It then kills the cells and spreads new virions, or particles of the virus, in order to infect more cells. The body responds by producing more helper T cells and macrophages but unfortunately cannot keep pace with

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[5] Sigall K. Bell, Kevin Shelby, Courtney L. McMickens, *AIDS* (Santa Barbara: Greenwood, 2011), 14
[6] Ibid, 19.
[7] Scott Freeman. *Biological Science* (Upper Sadle River: Prentice Hall, 2011), 676
[8] Lauralee Sherwood, *Fundamental of Human Physiology* (Belmont: Brooks/Cole, 2012), 326
[9] Ibid, 310-311.

the number that the HIV virus ends up destroying.[10] This process is assisted by a particular membrane protein known as CD4 which is how HIV is able to enter the helper T lymphocytes and macrophages.[11] As the process of the invading pathogen continues, the number of T cells drops and makes the body less effective at fighting off not only the virus but other invading pathogens such as bacteria. As a result of this, helper T lymphocytes and macrophages are unable to fight off foreign pathogens that end up multiplying unchecked leading to a process in which the infected individuals are killed indirectly by factors like pneumonia, eukaryotic parasites, and unusual types of cancer.[12]

History of HIV/AIDS in India

Signs of HIV/AIDS were first seen in the early 1980s. In 1986 it was reported that there were 20,000 cases of AIDS worldwide but there were no reported cases of HIV or AIDS in India.[13] Later that year, HIV was first seen in India and was diagnosed by Dr. Suniti Solmon amongst female sex workers in Chennai. During this time period, it is believed that contact with foreign visitors spread HIV among sex workers but there were no calls for visitors to be screened for the disease.[14]

In 1987, 135 cases of HIV/AIDS were discovered. Most of these cases had occurred through heterosexual sexual intercourse but by the late 1980s a substantial number of cases were observed among injecting drug users in Manipur, Mizoram, and Nagaland. During the same time period, the National AIDS Control Program (NACP) was created to include surveillance, blood screening, and health education. In the 1992,

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[10] Scott Freeman. *Biological Science* (Upper Sadle River: Prentice Hall, 2011), 677
[11] Ibid, 681.
[12] Ibid, 677.
[13] "HIV & AIDS in India", AVERT, accessed December 8, 2013, http://www.avert.org/hiv-aids-india.htm.
[14] Steve Sternberg, "HIV scars India's vast population," USA TODAY, February 23, 2005, accessed December 8, 2013, http://usatoday30.usatoday.com/news/health/2005-02-23-aids-india_x.htm.

the government set up the National AIDS Control Organization to oversee many programs related to fighting the disease with substantial improvements in HIV prevention including blood safety. It is important to note that during this time period an infection was identified in every state in the country. It was also clear that the disease had become widespread enough to include members of the population that were less susceptible to the disease and deemed low risk such as housewives and richer members of society.[15]

In 1999, the National AIDS Control Program had already began its second phase (NACP-II) in order to decrease the reach of HIV/AIDS by promoting changes in behavior. This included programs such as the prevention of mother-to-child transmission and the implementation of free antiretroviral treatment. In 2001, the government of India adopted the National AIDS Prevention and Control Policy and former Prime Minister Atal Bihari Vajpayee referred to HIV/AIDS as one of the most serious health challenges facing the country.[16]

In 2006, the National AIDS Control Program had begun its third phase (NACP-III) in order to reach high-risk groups identified commonly as female sex workers, injecting drug users, and men having sex with men. This time period also included an effort to decentralize the HIV/AIDS effort to the most local level and engage more non-governmental organizations in providing more services to those living with HIV/AIDS. This program called "link workers scheme" had a high focus on ensuring that local communities are connected to HIV support since these areas are often missed in the effort to combat HIV due to poor infrastructure and lack of outreach work. This also insures that migrant workers got treated when they returned home, since it is hard to access this

[15] "HIV & AIDS in India", AVERT, accessed December 8, 2013, http://www.avert.org/hiv-aids-india.htm.
[16] Ibid.

kind of help when working in another place. There have also been other recent programs in response to this epidemic that include the Condom Social Marketing Program which includes initiatives like the "Condom Bindas Bol" to distribute millions of condoms.[17]

The National AIDS Control Program began its fourth phase from 2012-2017 with a focus on reducing new infections (and trying to keep prevalence in areas where it is already low), targeting high-risk groups and vulnerable populations with prevention campaigns, promoting and improving access to treatment and care, preventing mother to child transmission, reducing stigma and discrimination, and building the capacities of state and district level facilities. Recent efforts also include ensuring HIV testing to detect the disease early on and counseling in order to ensure that its spread does not continue. This has been helped by the efforts of Integrated Counselling and Testing Centers. (By the end of 2012 there were 12,897 centers whereas in 1997 there were 62). Anti-retroviral drugs are also an important part of the effort since 55% of those people eligible for these drugs are getting them (with an estimated number at 1.1 million people). An important factor in all of this includes preventing stigma and discrimination as many people with HIV/AIDS face violence attacks, are rejected by families, have been refused medical treatment, and denied last rites before they die. Many alternative efforts are now being made that include the Red Ribbon Express (a train that has made journeys across India in order to increase awareness about the disease) and television advertisements. Much of the fourth phase hopes to raise 90% of its funds domestically to ensure sustainability of current projects. These funds will now try to reach individuals such as truck drivers since this is a demographic that has not seen adequate access.[18]

[17] Ibid.
[18] Ibid.

Methods

In order to complete the objectives of this paper, data was obtained through several different sources. Data relating to the GINI coefficient was obtained from an online newspaper source that had collected the important information from a government report for the years 2004-2005 and 2009-2010. All prevalence rates were obtained from the National AIDS Control Organization website with a specific focus on rates in the annual reports. Most of the information was obtained by looking at several specific years in the past decade. Economic data was obtained using statistics from the government of India. This data included growth rates of the individual states as well as per capita income. It is important to remember that data includes real growth rates that adjust for inflation (instead of nominal rates). The data regarding income per capita for the year is measured in the standard form of rupees. Geographic and anthropological data was obtained in order to find not only numerical results but explanations for the increase or high rates of prevalence in particular regions of India or India as a whole.

All of this data was used to compare different years, HIV prevalence rates, and income measures with the individual states and territories in India. Economic data was compared with the prevalence data with the intention of creating a scatter plot in order to graph and determine correlation between economic growth in the individual states in India and income per capita with prevalence rates. This was also used to determine the r-squared values, r-values, along with the linear regression line, and outliers in the data set. Data about high-risk individuals was obtained from the most recent years possible (2011) according to the sentinel surveys that were obtained for each state from an HIV/AIDS technical report. This data focused on prevalence rates in several high-risk groups

including antenatal clinic patients (ANC), female sex workers (FSW), men having sex with men (MSM), and injecting drug users (IDU). This data helped in formulating graphs that compared each individual state or territory with the prevalence among high-risk groups. This was also used to determine which states had above 1.5 times the rate of a specific type of prevalence compared to the national average. There were also scatter plots created between prevalence among each of the four categories of antenatal clinics, female sex workers, men having sex with men, and injecting drug users, in order to determine correlation with regression lines, r-squared values, and r-values. It is also important to note that data was obtained from Gapminder and UNAIDS in order to track the general rates of prevalence as well for the population of individuals in all of India living with AIDS.

Data

Map of India (with divisions by state/territory including the location of capital cities)[19]

[19] "India: States and Union Territories," India Book, accessed December 13, 2013, http://www.indiabook.com/images/indian_map1.gif.

Figure 1: States/Territories in India vs. GINI Coefficient for Rural Areas

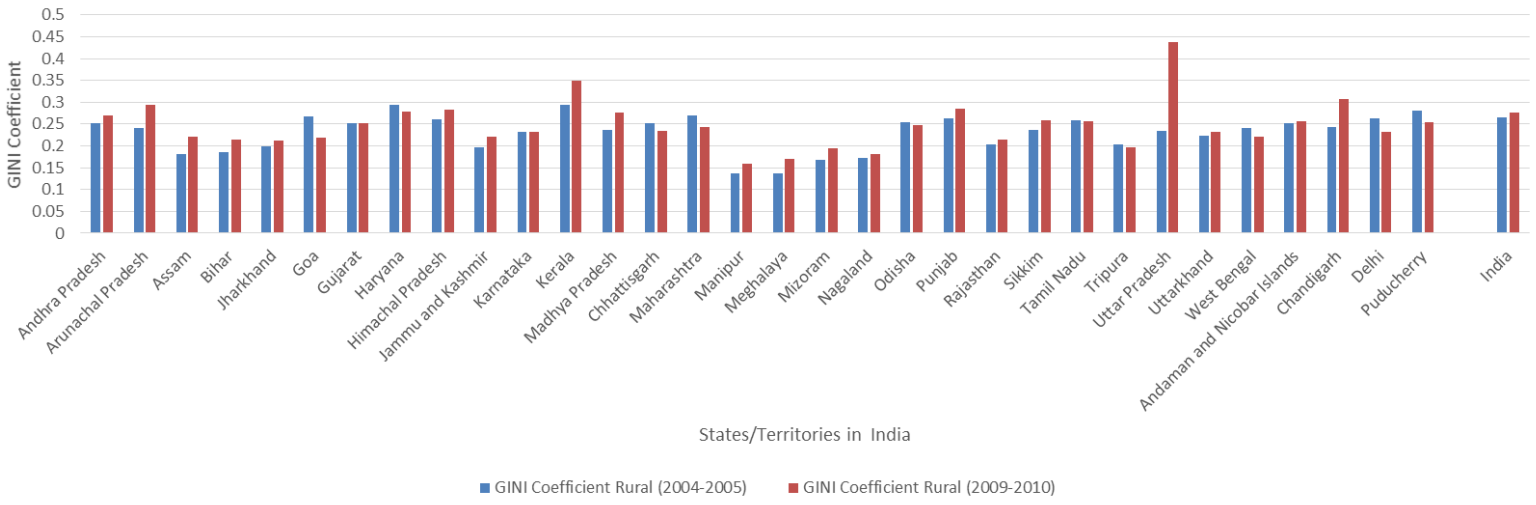
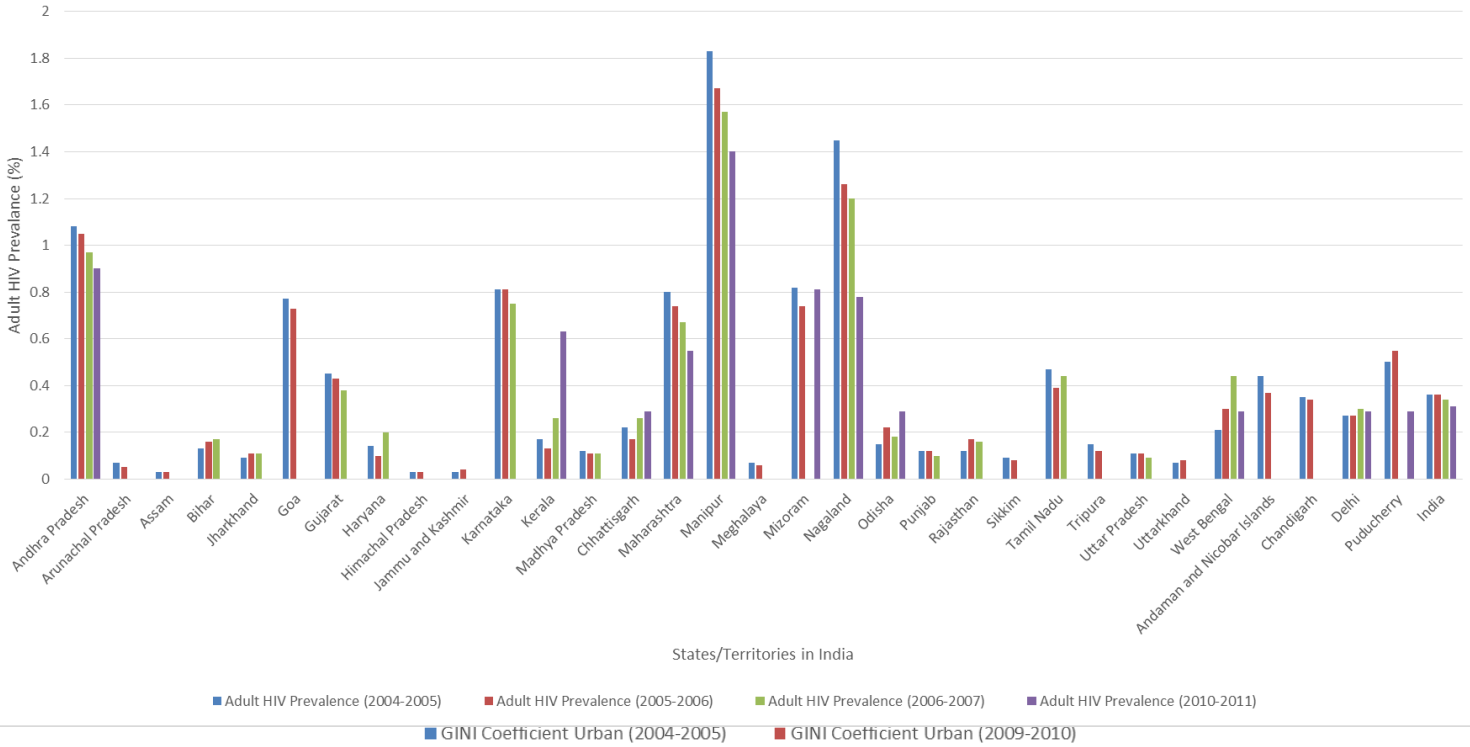


Figure 2: States/Territories in India vs. GINI Coefficient for Urban Areas

Figure 3: States/Territories in India vs. Adult HIV Prevalence



GINI Coefficient Urban (2004-2005) GINI Coefficient Urban (2009-2010)

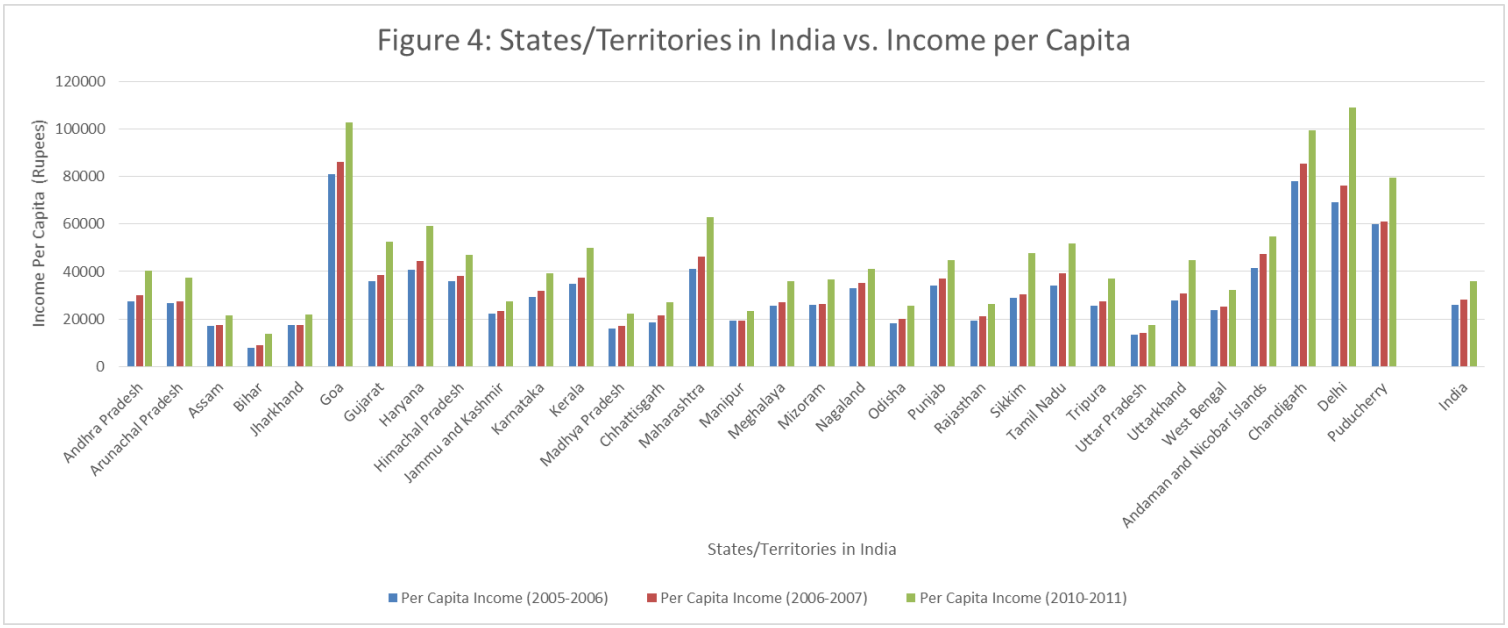


Figure 4: States/Territories in India vs. Income per Capita
Income Per Capita (Rupees)
120000
100000
80000
60000
40000
20000
0
Andhra Pradesh
Arunachal Pradesh
Assam
Bihar
Jharkhand
Goa
Gujarat
Haryana
Himachal Pradesh
Jammu and Kashmir
Karnataka
Kerala
Madhya Pradesh
Chhattisgarh
Maharashtra
Manipur
Meghalaya
Mizoram
Nagaland
Odisha
Punjab
Rajasthan
Sikkim
Tamil Nadu
Tripura
Uttar Pradesh
Uttarkhand
West Bengal
Andaman and Nicobar Islands
Chandigarh
Delhi
Puducherry
India
States/Territories in India
Per Capita Income (2005-2006)
Per Capita Income (2006-2007)
Per Capita Income (2010-2011)

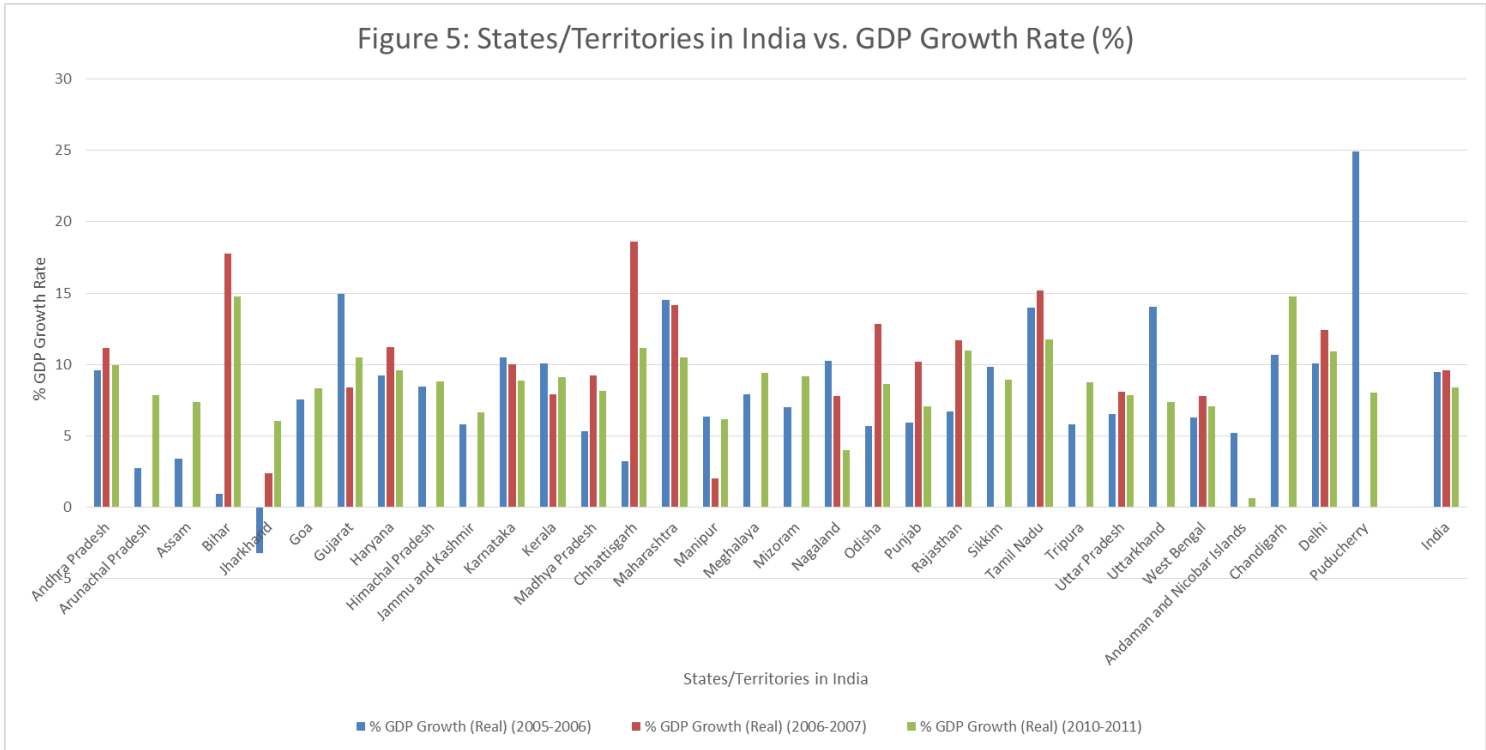


Figure 5: States/Territories in India vs. GDP Growth Rate (%)
% GDP Growth Rate
30
25
20
15
10
5
0
Andhra Pradesh
Arunachal Pradesh
Assam
Bihar
Jharkhand
Goa
Gujarat
Haryana
Himachal Pradesh
Jammu and Kashmir
Karnataka
Kerala
Madhya Pradesh
Chhattisgarh
Maharashtra
Manipur
Meghalaya
Mizoram
Nagaland
Odisha
Punjab
Rajasthan
Sikkim
Tamil Nadu
Tripura
Uttar Pradesh
Uttarkhand
West Bengal
Andaman and Nicobar Islands
Chandigarh
Delhi
Puducherry
India
States/Territories in India
% GDP Growth (Real) (2005-2006)
% GDP Growth (Real) (2006-2007)
% GDP Growth (Real) (2010-2011)

Figure 6: GDP Economic Growth in Indian States/Territories vs. Prevalence for 2005-2006

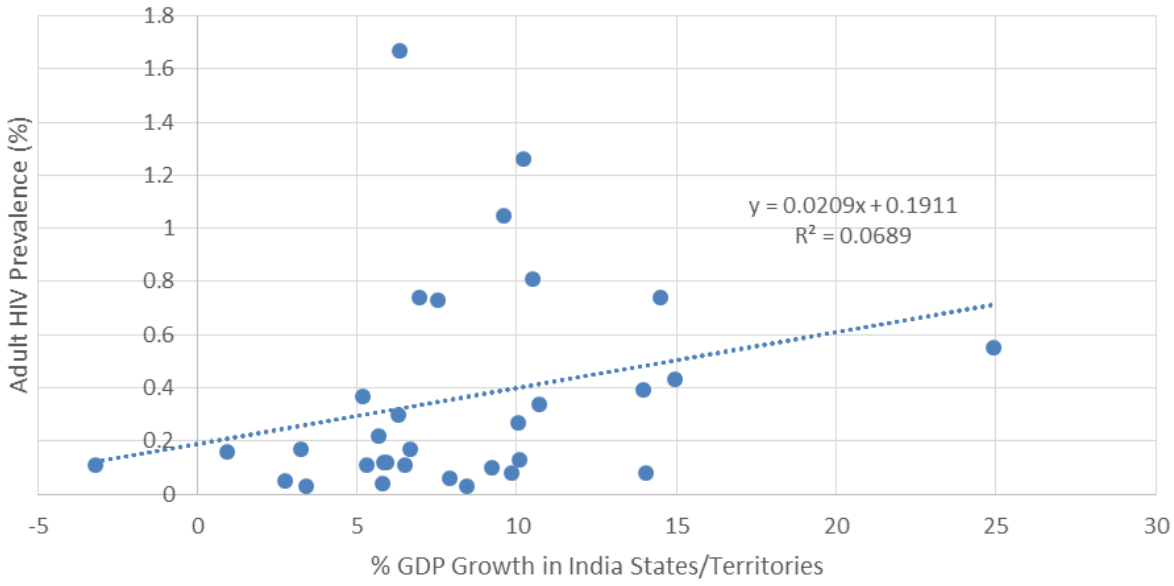
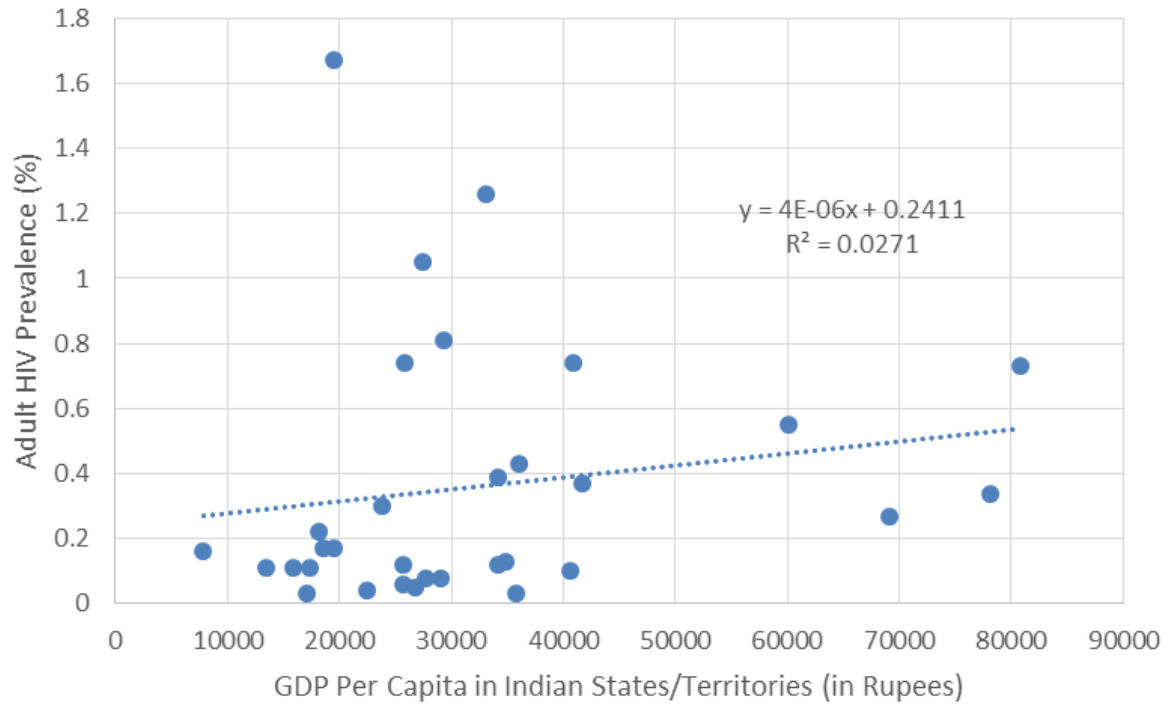


Figure 7: GDP Per Capita in Indian States/Territories vs. Prevalence for 2005-2006



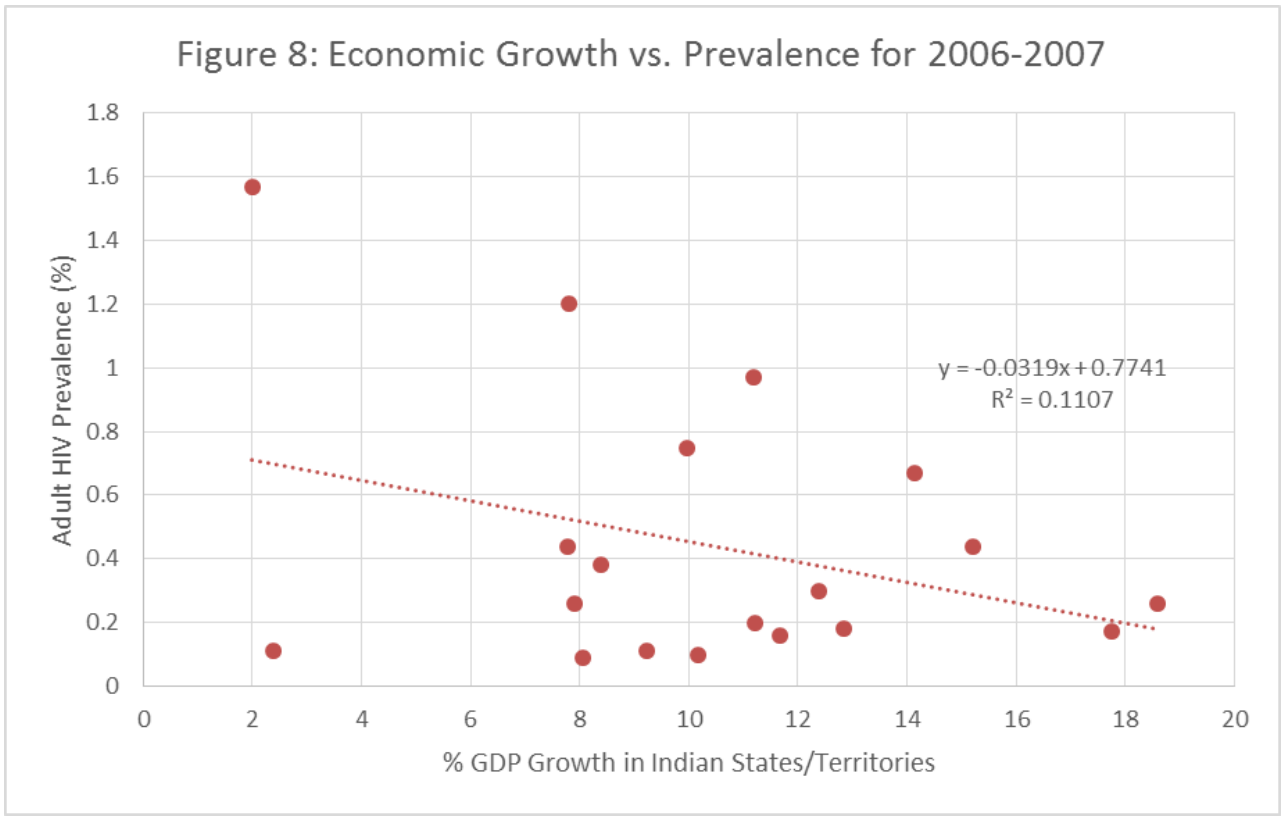


Figure 8: Economic Growth vs. Prevalence for 2006-2007
Adult HIV Prevalence (%)
% GDP Growth in Indian States/Territories
y = -0.0319x + 0.7741
R² = 0.1107
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
0
2
4
6
8
10
12
14
16
18
20

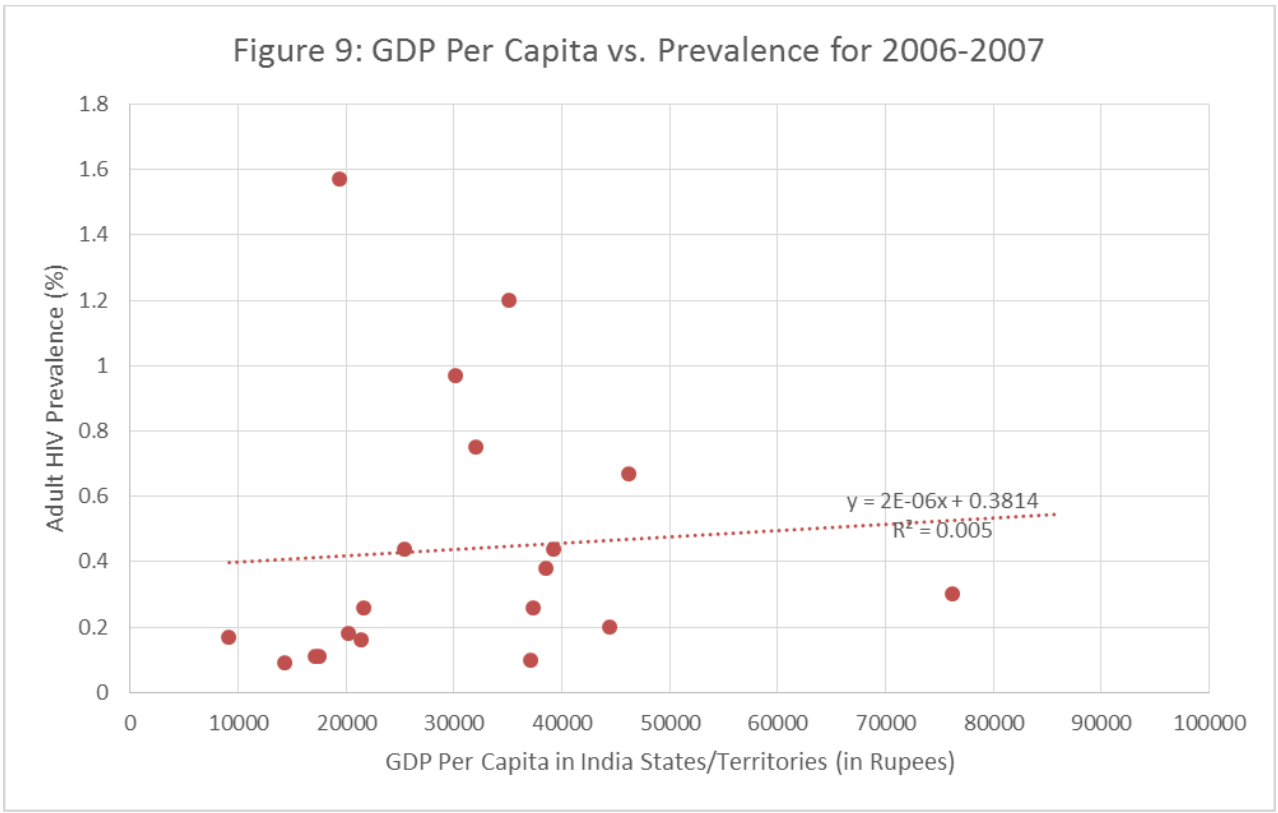


Figure 9: GDP Per Capita vs. Prevalence for 2006-2007
Adult HIV Prevalence (%)
GDP Per Capita in India States/Territories (in Rupees)
y = 2E-06x + 0.3814
R² = 0.005
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
0
10000
20000
30000
40000
50000
60000
70000
80000
90000
100000

Figure 11: GDP per capita vs. Prevalence for 2010-2011

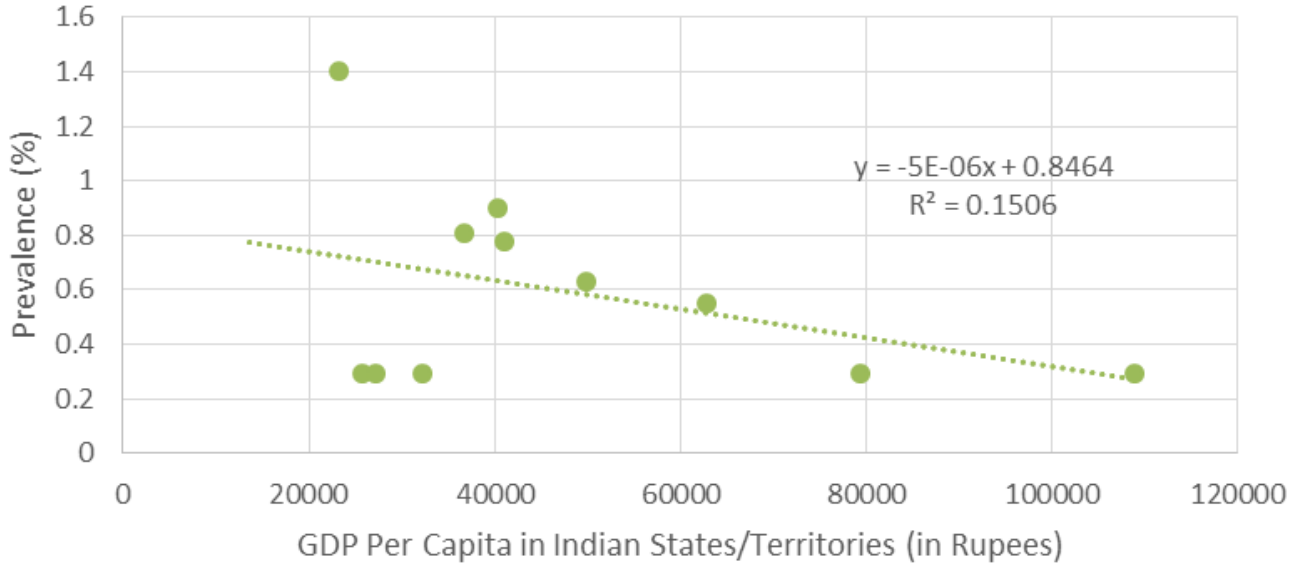


Figure 10: Economic Growth vs. Prevalence for 2010-2011

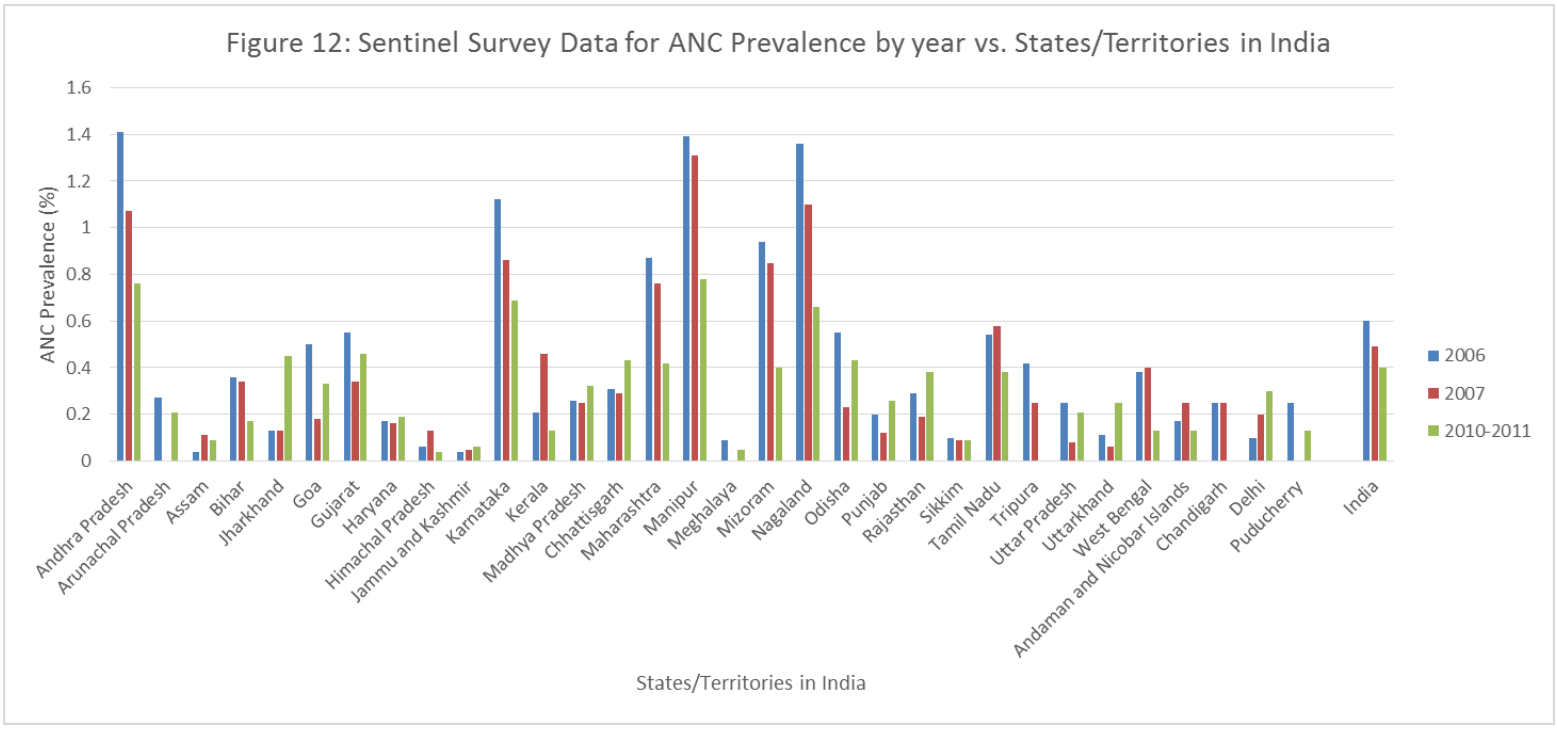


Figure 12: Sentinel Survey Data for ANC Prevalence by year vs. States/Territories in India
ANC Prevalence (%)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Andhra Pradesh
Arunachal Pradesh
Assam
Bihar
Jharkhand
Goa
Gujarat
Haryana
Himachal Pradesh
Jammu and Kashmir
Karnataka
Kerala
Madhya Pradesh
Chhattisgarh
Maharashtra
Manipur
Meghalaya
Mizoram
Nagaland
Odisha
Punjab
Rajasthan
Sikkim
Tamil Nadu
Tripura
Uttar Pradesh
Uttarkhand
West Bengal
Andaman and Nicobar Islands
Chandigarh
Delhi
Puducherry
India
2006
2007
2010-2011
States/Territories in India

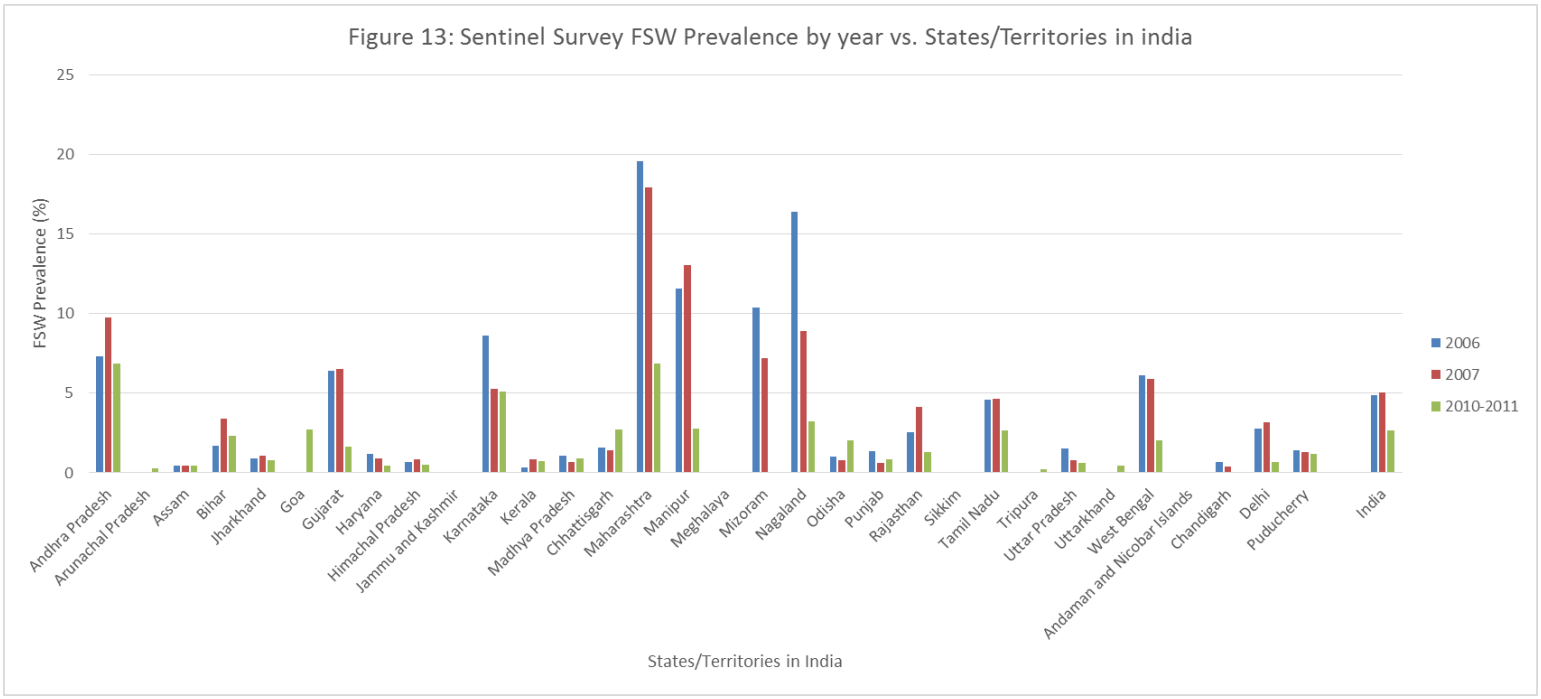


Figure 13: Sentinel Survey FSW Prevalence by year vs. States/Territories in india
FSW Prevalence (%)
25
20
15
10
5
0
Andhra Pradesh
Arunachal Pradesh
Assam
Bihar
Jharkhand
Goa
Gujarat
Haryana
Himachal Pradesh
Jammu and Kashmir
Karnataka
Kerala
Madhya Pradesh
Chhattisgarh
Maharashtra
Manipur
Meghalaya
Mizoram
Nagaland
Odisha
Punjab
Rajasthan
Sikkim
Tamil Nadu
Tripura
Uttar Pradesh
Uttarkhand
West Bengal
Andaman and Nicobar Islands
Chandigarh
Delhi
Puducherry
India
2006
2007
2010-2011
States/Territories in India

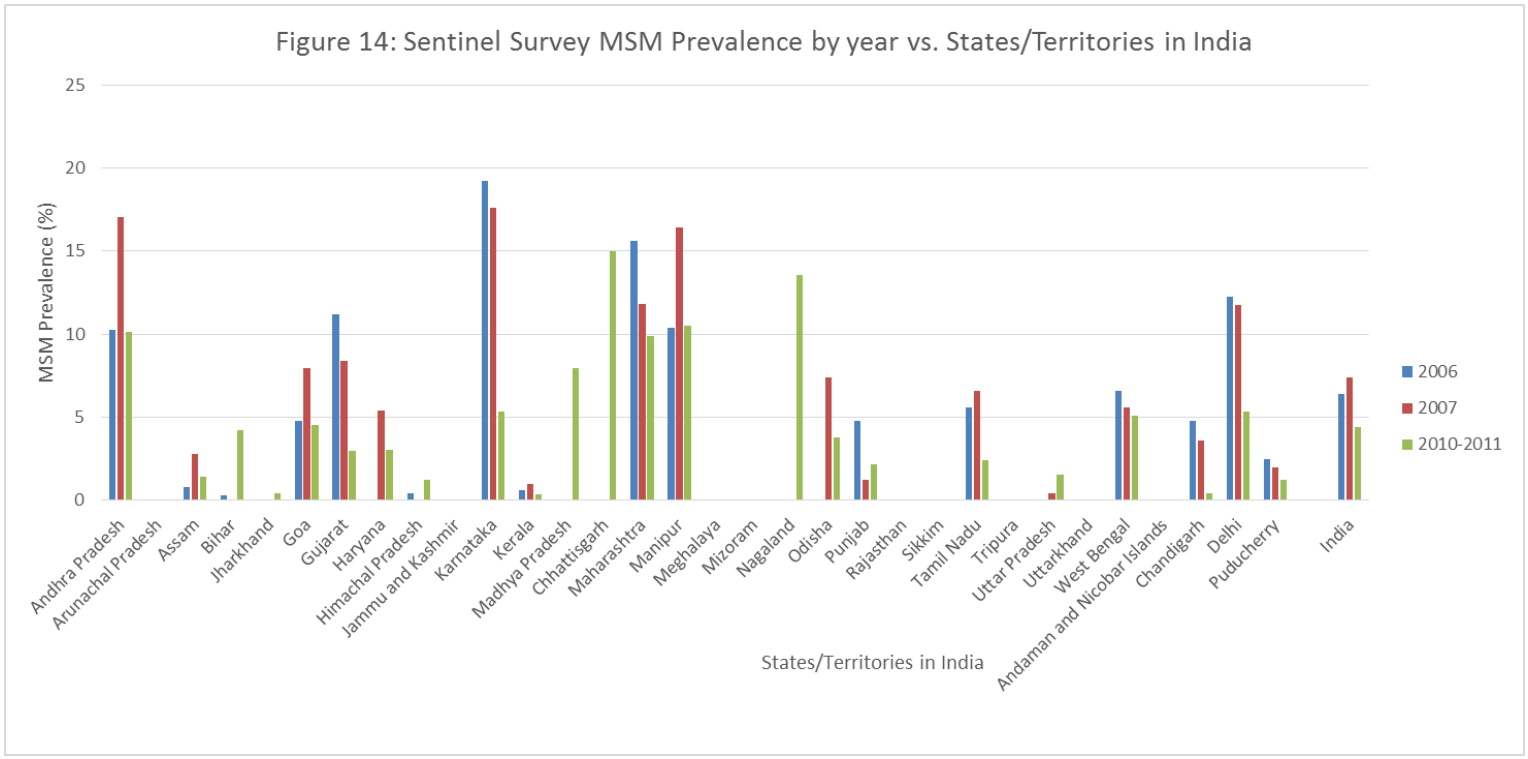


Figure 14: Sentinel Survey MSM Prevalence by year vs. States/Territories in India
MSM Prevalence (%)
25
20
15
10
5
0
Andhra Pradesh
Arunachal Pradesh
Assam
Bihar
Jharkhand
Goa
Gujarat
Haryana
Himachal Pradesh
Jammu and Kashmir
Karnataka
Kerala
Madhya Pradesh
Chhattisgarh
Maharashtra
Manipur
Meghalaya
Mizoram
Nagaland
Odisha
Punjab
Rajasthan
Sikkim
Tamil Nadu
Tripura
Uttar Pradesh
Uttarkhand
West Bengal
Andaman and Nicobar Islands
Chandigarh
Delhi
Puducherry
India
States/Territories in India
2006
2007
2010-2011

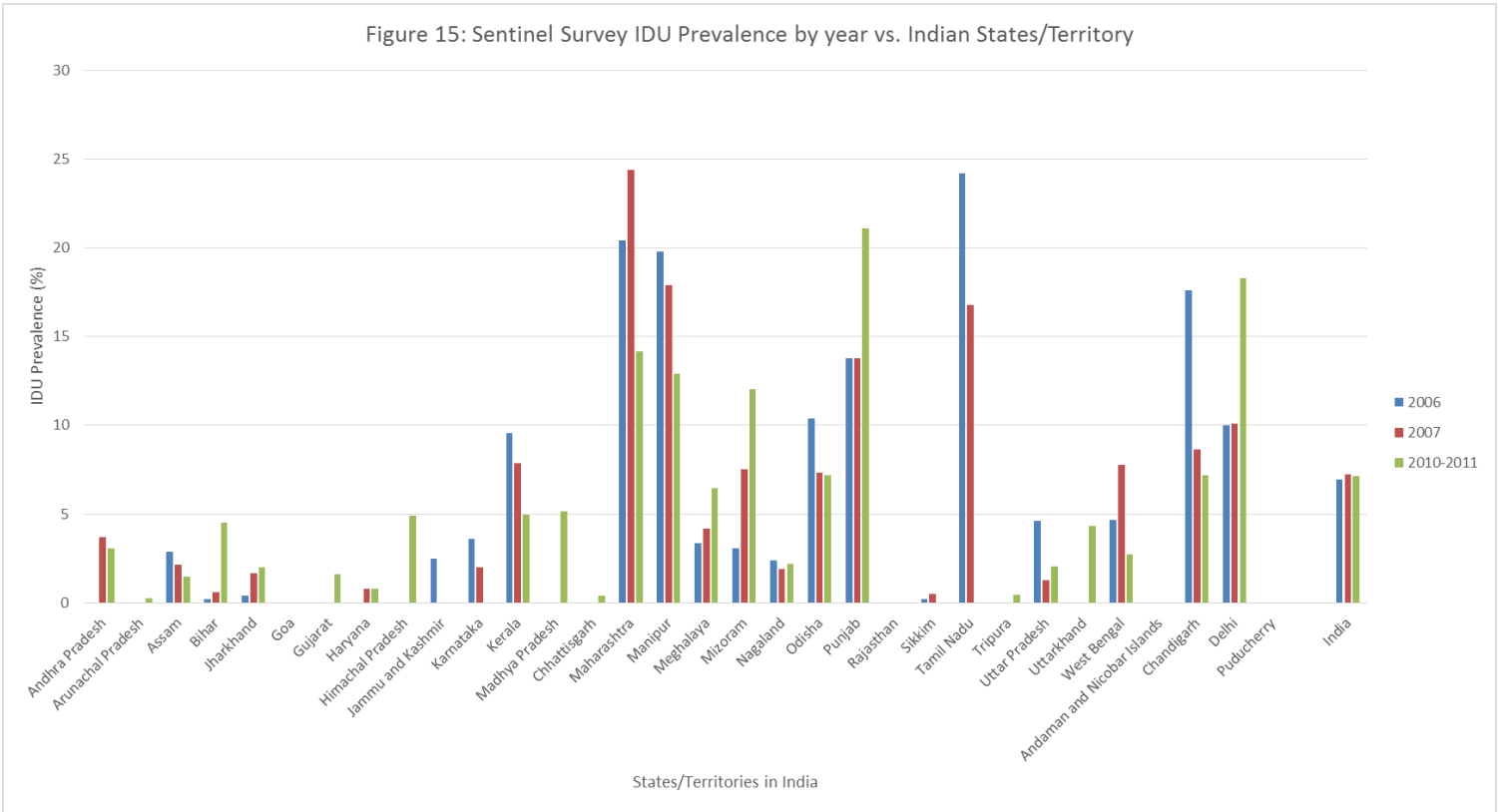


Figure 15: Sentinel Survey IDU Prevalence by year vs. Indian States/Territory
IDU Prevalence (%)
30
25
20
15
10
5
0
Andhra Pradesh
Arunachal Pradesh
Assam
Bihar
Jharkhand
Goa
Gujarat
Haryana
Himachal Pradesh
Jammu and Kashmir
Karnataka
Kerala
Madhya Pradesh
Chhattisgarh
Maharashtra
Manipur
Meghalaya
Mizoram
Nagaland
Odisha
Punjab
Rajasthan
Sikkim
Tamil Nadu
Tripura
Uttar Pradesh
Uttarkhand
West Bengal
Andaman and Nicobar Islands
Chandigarh
Delhi
Puducherry
India
States/Territories in India
2006
2007
2010-2011

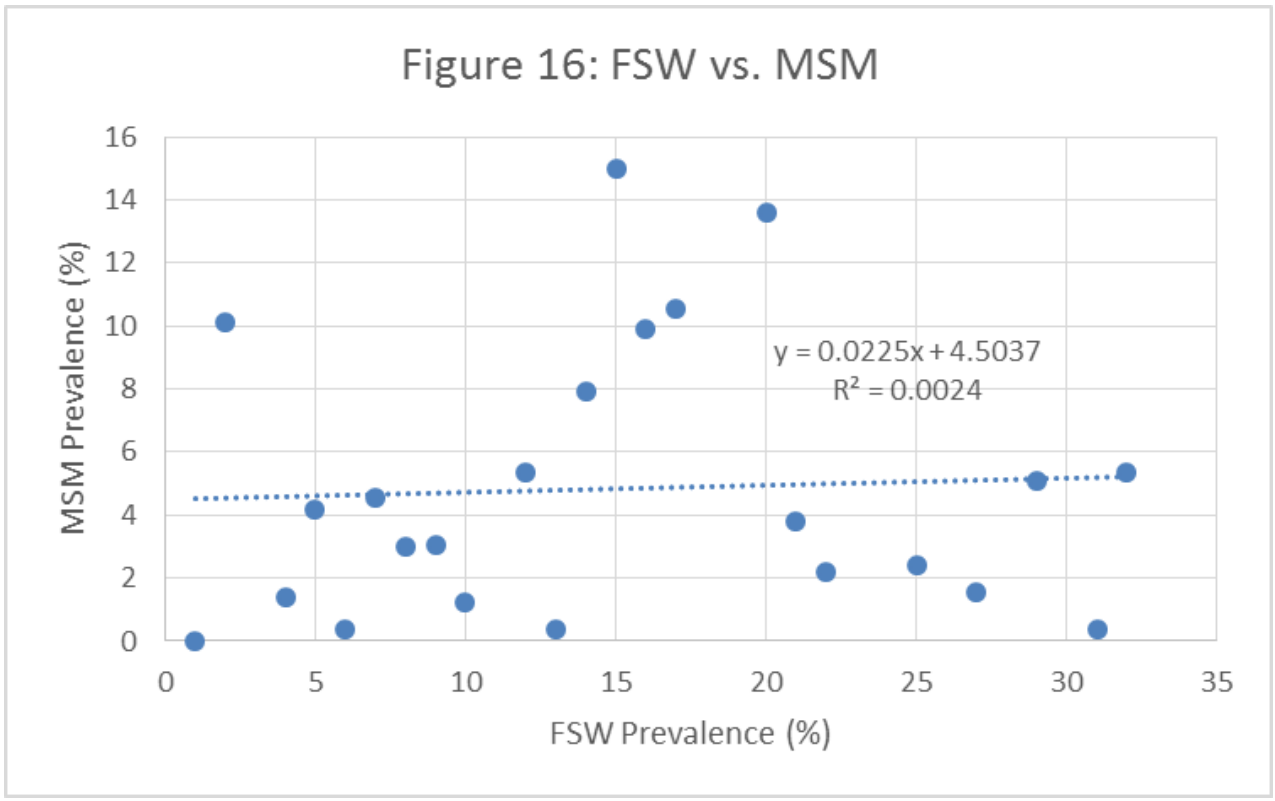


Figure 16: FSW vs. MSM
MSM Prevalence (%)
FSW Prevalence (%)
y = 0.0225x + 4.5037
R² = 0.0024
0
2
4
6
8
10
12
14
16
0
5
10
15
20
25
30
35

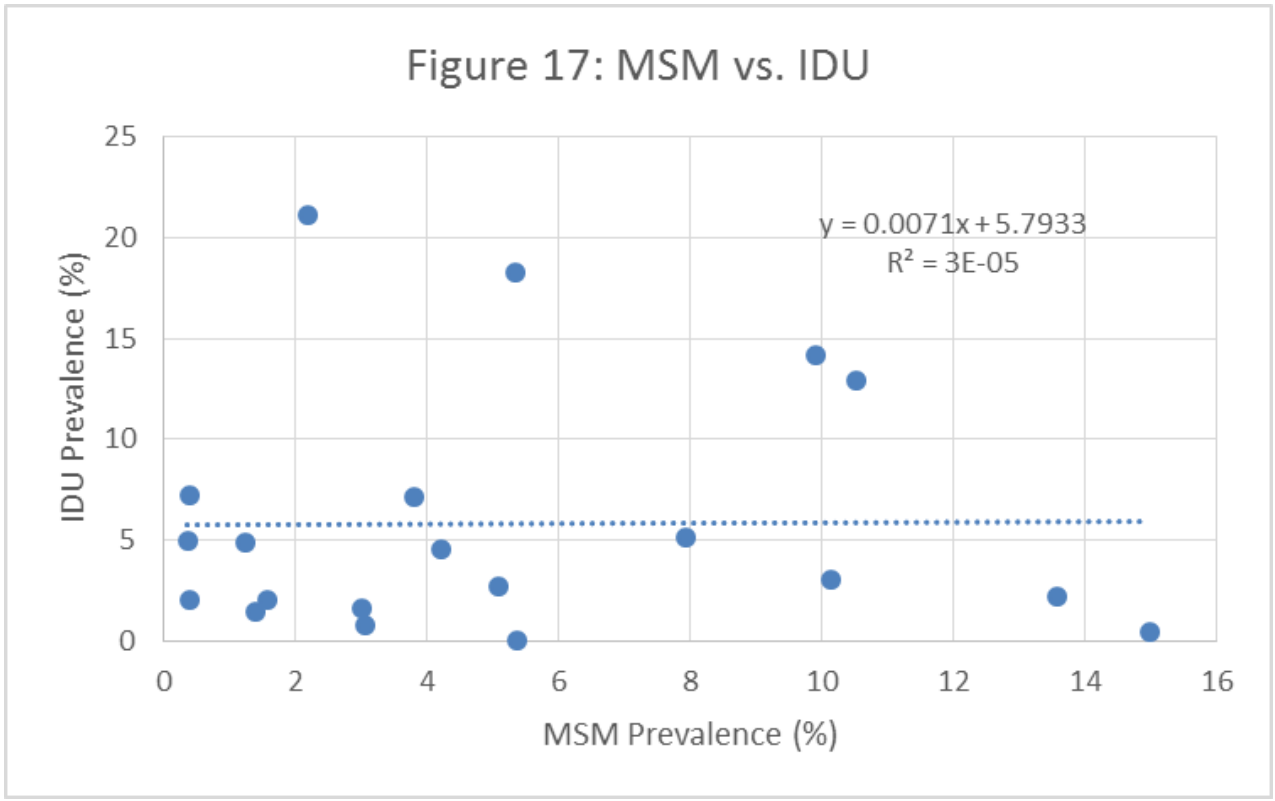


Figure 17: MSM vs. IDU
IDU Prevalence (%)
MSM Prevalence (%)
y = 0.0071x + 5.7933
R² = 3E-05
0
5
10
15
20
25
0
2
4
6
8
10
12
14
16

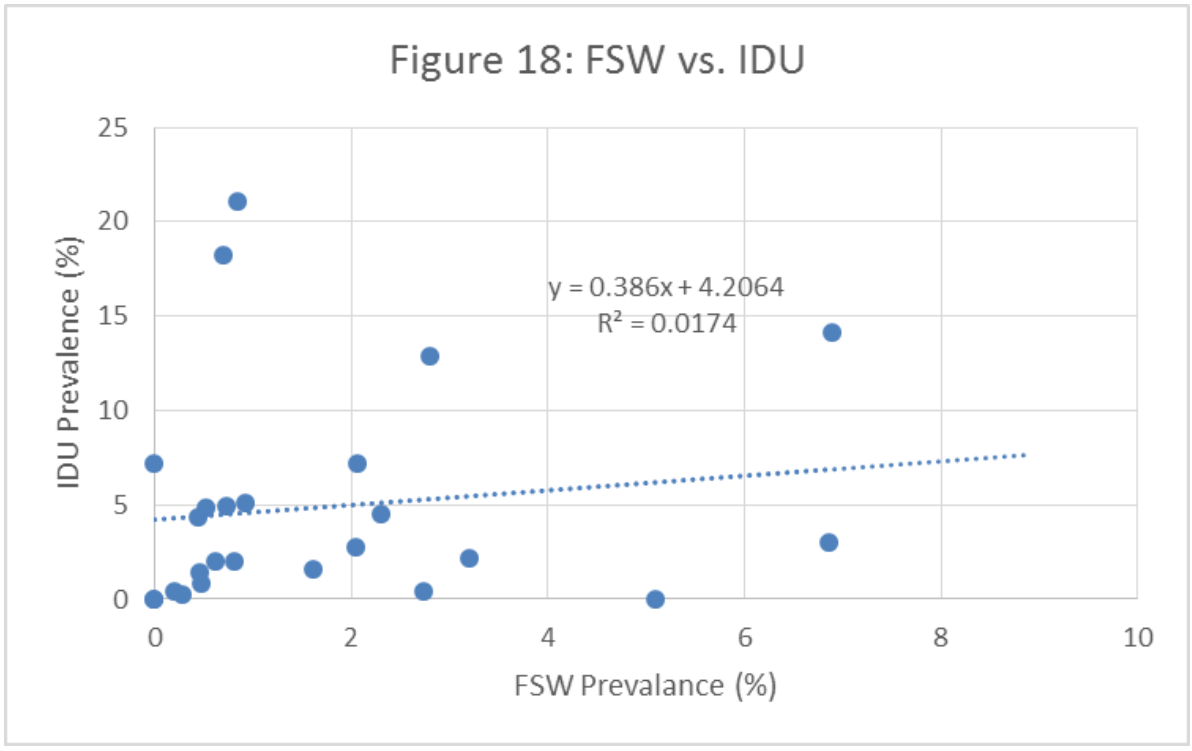


Figure 18: FSW vs. IDU
IDU Prevalence (%)
FSW Prevalance (%)
y = 0.386x + 4.2064
R² = 0.0174
0
5
10
15
20
25
0
2
4
6
8
10

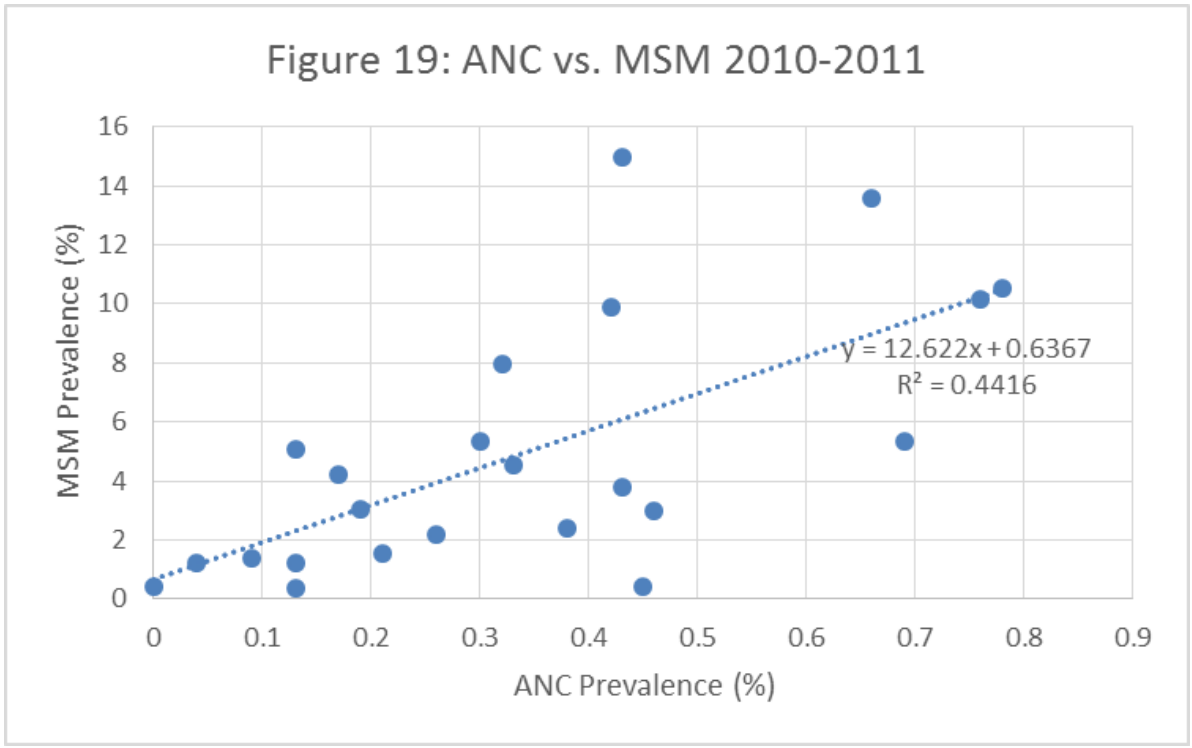


Figure 19: ANC vs. MSM 2010-2011
MSM Prevalence (%)
ANC Prevalence (%)
y = 12.622x + 0.6367
R² = 0.4416
0
2
4
6
8
10
12
14
16
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9

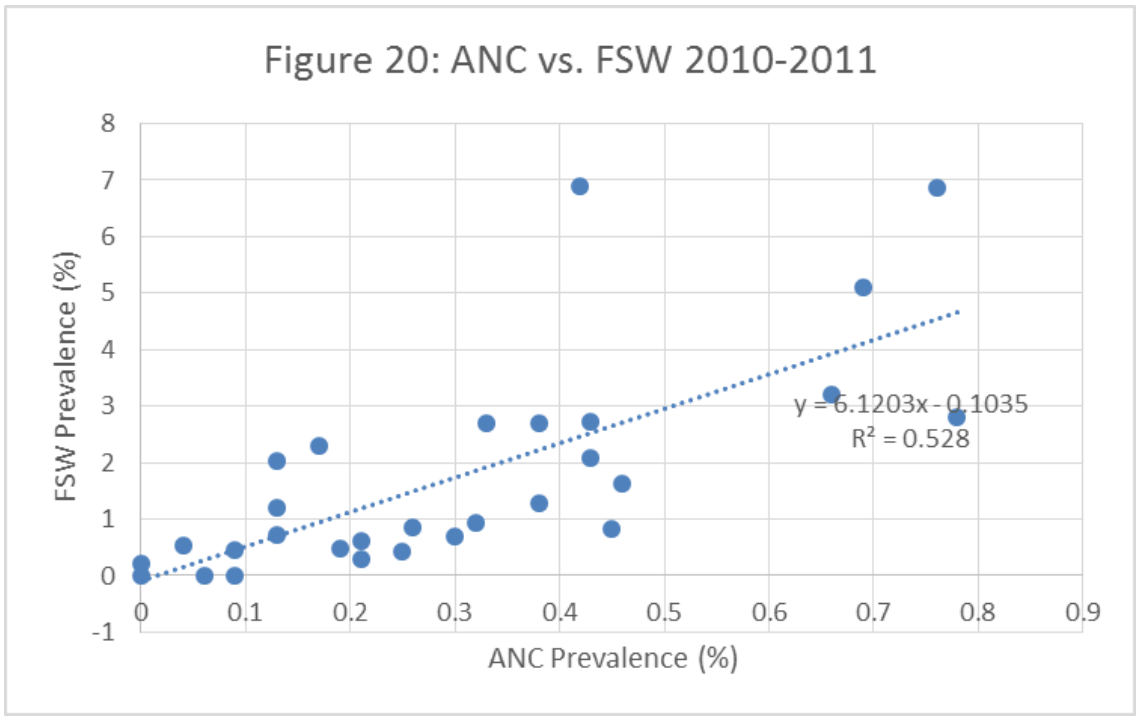


Figure 20: ANC vs. FSW 2010-2011
FSW Prevalence (%)
ANC Prevalence (%)
y = 6.1203x - 0.1035
R² = 0.528
8
7
6
5
4
3
2
1
0
-1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9

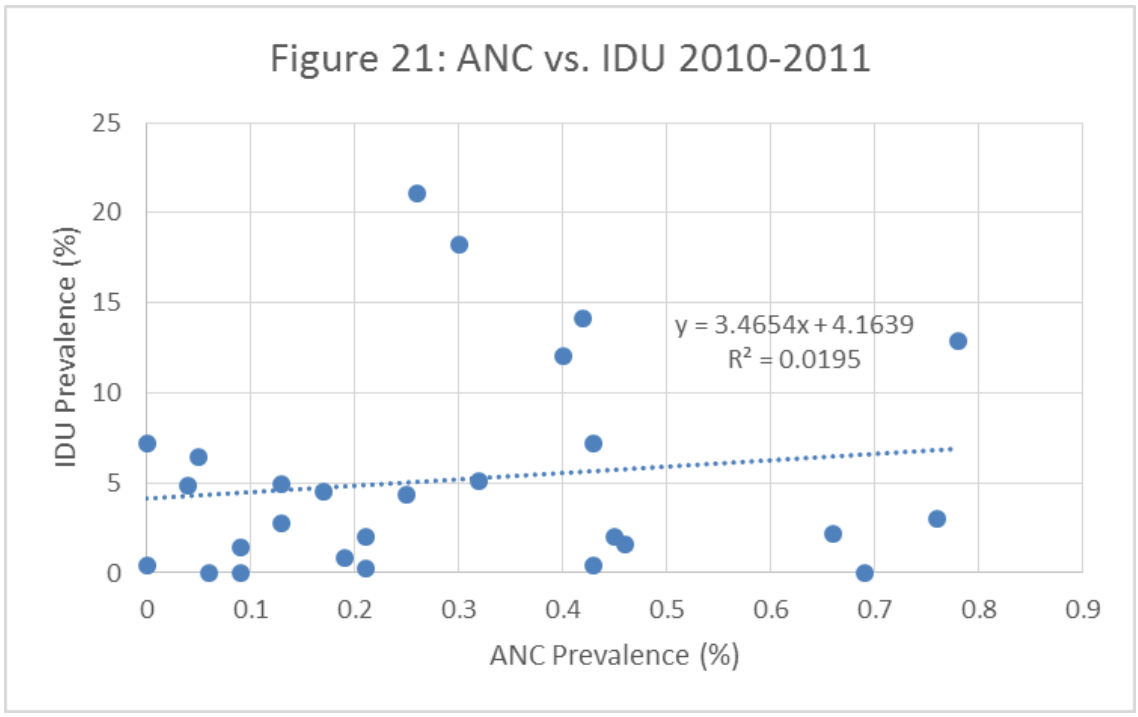


Figure 21: ANC vs. IDU 2010-2011
IDU Prevalence (%)
ANC Prevalence (%)
y = 3.4654x + 4.1639
R² = 0.0195
25
20
15
10
5
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9

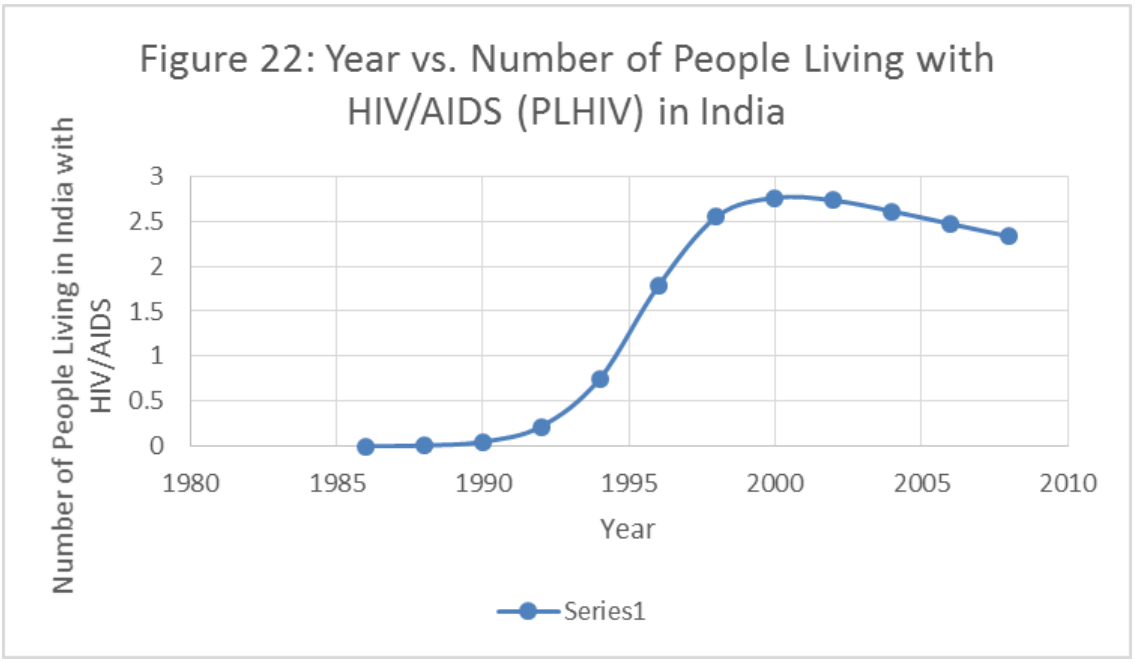


Figure 22: Year vs. Number of People Living with HIV/AIDS (PLHIV) in India
Number of People Living in India with HIV/AIDS
3
2.5
2
1.5
1
0.5
0
1980
1985
1990
1995
2000
2005
2010
Year
Series1

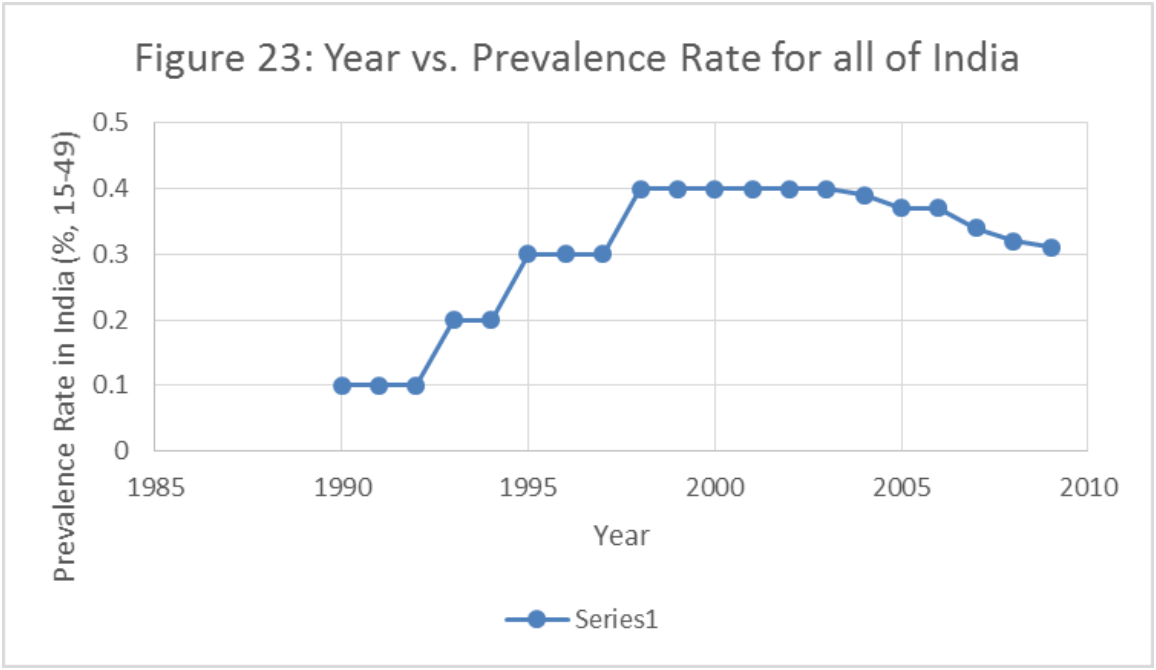


Figure 23: Year vs. Prevalence Rate for all of India
Prevalence Rate in India (%, 15-49)
0.5
0.4
0.3
0.2
0.1
0
1985
1990
1995
2000
2005
2010
Year
Series1

Results

Figure 1[20]:

The data shows that there is a general trend in the increase of the inequality in India. From data obtained about the GINI coefficient in rural areas from 32 states/territories in India, the GINI coefficient for all of rural India for 2004-2005 was 0.266 and the GINI coefficient for all of rural India from 2009-2010 was 0.276. This is a general increase of 0.01.

Figure 2[21]:

The GINI coefficient for urban areas also had a general increase for all of India, with an increase from 2004-2005 where the GINI coefficient was 0.348 and became 0.371 in 2009-2010. This was a difference of 0.023.

Figure 3[22] [23]:

This graph indicates the Adult HIV Prevalence in India based on a collection of 32 states/territories. The prevalence rate for all of India has declined significantly. In 2004-2005 the prevalence rate was 0.36, in 2005-2006 the prevalence rate was 0.36, in 2006-2007 the prevalence rate was 0.34, and in 2010-2011 the prevalence rate was 0.31. Most states showed steady value or a decline in the prevalence rate from the first and last years surveyed (and with data) with the exception of Bihar, Jharkhand, Haryana, Jammu and

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[20] "Gini Coefficient of Distribution of Consumption: 1973-74 to 2009-10," Unofficial estimates of Planning Commission; 61st Round 2004-2005 MRP & 2009-2010; 66th Round, last modified April 22, 2013, http://planningcommission.nic.in/data/datatable/2504/databook_74.pdf.

[21] Ibid.

[22] "Technical Report: India HIV Estimates 2006," National AIDS Control Organisation, last accessed December 13, 2013, http://naco.gov.in/upload/NACO%20PDF/Technical%20Report%20on%20HIV%20Estimation%202006.pdf.

[23] "Department of AIDS Control: Annual Report 2010-2011," National AIDS Control Organisation, last accessed December 13, 2013, http://www.aidsdatahub.org/sites/default/files/documents/NACO_Annual_Report_2010_11.pdf.

Kashmir, Kerala, Chhattisgarh, Mizoram, Odisha, Rajhasthan, Tamil Nadu, Uttarkhand, West Bengal, and Delhi.

Figure 4[24]:

The graph indicating per capita income shows a general increase in the per capita income in every state while adjusting for inflation. In general, there was increase in the per capita income from 26,015 rupees in 2005-2006, to 28,076 in 2006-2007, and an additional increase in the per capita income to 35,993 rupees. Every state's income per capita increased with the exception of Manipur which had a slight decrease in income in 2006-2007 from the previous year surveyed (2005-2006) but again an increase in the final year surveyed (2010-2011).

Figure 5[25]:

The graph indicating the growth rates of each state shows there was a general trend of increasing growth in India. The growth rate for 2005-2006 for all of India was 9.48%. The growth rate for 2006-2007 for all of India increased slightly to 9.57%, and the growth rate for all of India from 2010 to 2011 declined slightly to 8.39% with positive growth shown for the all years analyzed. From 2005-2006 to 2006-2007, all states showed an increase in growth rate with the exceptions of Gujarat, Kanataka, Kerala, Maharashtra, Manipur, and Nagaland. From 2006-2007 to 2011-2012, all states had a decreasing growth rate except Jharkhand, Gujarat, Kerala, and Manipur. From 2005-2006 to 2010-2011, the all states had a net increase in the growth rate with the exception of

[24] "Per Capita Net State Domestic Product at Constant(2004-2005) Prices. Directorate of Economics & Statistics of respective State Governments, and of all-India – Central Statistics Office, last modified March 1, 2012, http://mospi.nic.in/Mospi_New/upload/State_wise_SDP_2004-05_14mar12.pdf.

[25] "Gross State Domestic Product at Constant(2004-2005) Prices. Directorate of Economics & Statistics of respective State Governments, and of all-India – Central Statistics Office, last modified March 1, 2012, http://mospi.nic.in/Mospi_New/upload/State_wise_SDP_2004-05_14mar12.pdf.

Gujarat, Karnataka, Kerala, Maharashtra, Manipur, Nagaland, Sikkim, Tamil Nadu, Uttarkhand, Andaman and Nicobar Islands, and Puducherry.

Figure 6[26] [27]:

This particular graph analyzes the relationship between economic growth in individual states and territories in India and the HIV/AIDS prevalence in those states. This particular data focuses on the 2005-2006 time period. This has graphs shows a positive correlation. The linear regression line had a slope of 0.029, the r^2-value was 0.0689 with an r-value of 0.2625.

Figure 7[28] [29]:

This particular graph analyzes the relationship between income per capita and prevalence rates in Indian states/territories with a particular focus on the time period 2005-2006. There was positive correlation in this particular graph as well with a linear regression slope of 0.000004, an r^2-value of 0.0271, and an r-value of 0.1646.

Figure 8[30] [31]:

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[26] Ibid.
[27] "Technical Report: India HIV Estimates 2006," National AIDS Control Organisation, last accessed December 13, 2013, http://naco.gov.in/upload/NACO%20PDF/Technical%20Report%20on%20HIV%20Estimation%202006.pdf.
[28] "Per Capita Net State Domestic Product at Constant(2004-2005) Prices. Directorate of Economics & Statistics of respective State Governments, and of all-India – Central Statistics Office, last modified March 1, 2012, http://mospi.nic.in/Mospi_New/upload/State_wise_SDP_2004-05_14mar12.pdf.
[29] "Technical Report: India HIV Estimates 2006," National AIDS Control Organisation, last accessed December 13, 2013, http://naco.gov.in/upload/NACO%20PDF/Technical%20Report%20on%20HIV%20Estimation%202006.pdf.
[30] "Gross State Domestic Product at Constant(2004-2005) Prices. Directorate of Economics & Statistics of respective State Governments, and of all-India – Central Statistics Office, last modified March 1, 2012, http://mospi.nic.in/Mospi_New/upload/State_wise_SDP_2004-05_14mar12.pdf.
[31] "Technical Report: India HIV Estimates 2006," National AIDS Control Organisation, last accessed December 13, 2013, http://naco.gov.in/upload/NACO%20PDF/Technical%20Report%20on%20HIV%20Estimation%202006.pdf.

This particular graph analyzes the relationship between economic growth in individual states and territories in India and the HIV/AIDS prevalence in those states. This particular data focuses on the 2006-2007 time period. This has graphs shows a negative correlation. The linear regression like had a slope of -0.0319, the r^2-value was 0.1107 with an r-value of 0.333. There are a few items to note in this graph that include

Figure 9[32] [33]:

This particular graph analyzes the relationship between income per capita in individual states and territories in India and the HIV/AIDS prevalence in those states. This particular data focuses on the 2006-2007 time period. This has graphs shows a positive correlation. The linear regression line had a slope of 0.000002, the r^2-value was 0.005 with an r-value of 0.0707.

Figure 10[34] [35]:

This particular graph analyzes the relationship between economic growth in individual states and territories in India and the HIV/AIDS prevalence in those states. This particular data focuses on the 2010-2011 time period. This has graphs shows a negative correlation. The linear regression line had a slope of 0.000002, the r^2-value was 0.1647 with an r-value of 0.406.

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[32] "Per Capita Net State Domestic Product at Constant(2004-2005) Prices." Directorate of Economics & Statistics of respective State Governments, and of all-India – Central Statistics Office, last modified March 1, 2012, http://mospi.nic.in/Mospi_New/upload/State_wise_SDP_2004-05_14mar12.pdf.

[33] "Technical Report: India HIV Estimates 2006," National AIDS Control Organisation, last accessed December 13, 2013, http://naco.gov.in/upload/NACO%20PDF/Technical%20Report%20on%20HIV%20Estimation%202006.pdf.

[34] "Gross State Domestic Product at Constant(2004-2005) Prices." Directorate of Economics & Statistics of respective State Governments, and of all-India – Central Statistics Office, last modified March 1, 2012, http://mospi.nic.in/Mospi_New/upload/State_wise_SDP_2004-05_14mar12.pdf.

[35] "Department of AIDS Control: Annual Report 2010-2011," National AIDS Control Organisation, last accessed December 13, 2013, http://www.aidsdatahub.org/sites/default/files/documents/NACO_Annual_Report_2010_11.pdf.

Figure 11[36] [37]:

This particular graph analyzes the relationship between income per capita in individual states and territories in India and the HIV/AIDS prevalence in those states. This particular data focuses on the 2010-2011 time period. This has graphs shows a negative correlation. The linear regression like had a slope of -0.000005, the r^2-value was 0.1506 with an r-value of 0.3881.

Figure 12[38]:

The graph plots the data of sentinel surveys regarding HIV/AIDS prevalence of antenatal clinic patients (ANC) and compares it to individual states/territories in India. From 2006 to 2010-2011, the prevalence rate in ANC has declined from 0.6 to 0.4 for all of India. According to the data, for states in which data was available there was a general decline in the prevalence of antenatal clinic patients in Andhra Pradesh, Arunachal Pradesh, Bihar, Karnataka, Mahasrashtra, Manipur, Mizoram, Nagaland, Sikkim, and Chandigarh. There were a mix of increasing and decreases of prevalence rate of several states including Assam, Goa, Gujarat, Haryana, Himachal Pradesh, Kerala, Madhya Pradesh, Chhattisgarh, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, Uttarkhand, West Bengal, and the Andaman and Nicobar Islands. There were increases in the prevalence of antenatal clinic patients in Jharkhand, Jammu and Kashmir, and Delhi.

Figure 13[39]:

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[36] "Per Capita Net State Domestic Product at Constant(2004-2005) Prices." Directorate of Economics & Statistics of respective State Governments, and of all-India – Central Statistics Office, last modified March 1, 2012, http://mospi.nic.in/Mospi_New/upload/State_wise_SDP_2004-05_14mar12.pdf.
[37] "Gross State Domestic Product at Constant(2004-2005) Prices. Directorate of Economics & Statistics of respective State Governments, and of all-India – Central Statistics Office, last modified March 1, 2012, http://mospi.nic.in/Mospi_New/upload/State_wise_SDP_2004-05_14mar12.pdf.
[38] Ibid.
[39] Ibid.

The graph plots the data of sentinel surveys regarding HIV/AIDS prevalence of Female Sex Workers (FSW) and compares it to individual states/territories in India. The prevalence rate in India overall among female sex workers was 4.9 in 2006, 5.06 in 2007, and 2.67 for the 2010-2011 time period. There was a general decline in the prevalence of female sex workers in Haryana, Karnataka, Mahashtra, Mizoram, Nagaland, Uttar Pradesh, West Bengal, and Puducherry. There were a mix of increasing and decreases for the years noted in several states including Andhra Pradesh, Assam, Bihar, Jharkhand, Gurajat, Himachal Pradesh, Kerala, Madhya Pradesh, Chhattisgarh, Manipur, Odisha, Punjab, Rajasthan, Tamil Nadu, and Delhi. There were consistent increases in the prevalence of female sex workers in none of the states.

Figure 14[40]:

The graph plots the data of sentinel surveys regarding HIV/AIDS prevalence of males having sex with males and compares it to individual states/territories in India. The prevalence rate among men having sex with men in India in 2006 was 6.41, 7.41 in 2007, and 4.43 in 2010-2011. There was a general decline in the prevalence of males having sex with males in Gujarat, Haryana, Karnataka, Maharasthra, Odisha, West Bengal, Chandigarh, Delhi, and Puducherry. There were a mix of increasing and decreases for the years noted in Andhra Pradesh, Assam, Goa, Kerala, Manipur, Punjab, and Tamil Nadu. There were increases in the prevalence of men having sex with men in Uttar Pradesh.

Figure 15[41]:

The graph plots the data of sentinel surveys regarding HIV/AIDS prevalence by Injecting Drug Users (IDU). In all of India, there was a general increase and slight decline in the

[40] Ibid.
[41] Ibid.

prevalence rate among injecting drug users with a prevalence rate of 6.92 in 2006, a prevalence rate of 7.23 in 2007, and a prevalence rate of 7.14 in 2010-2011. There was a general decline in the prevalence of injecting drug users in Andhra Pradesh, Assam, Kerala, Manipur, Odisha, Punjab, Tamil Nadu, and Chandigarh. There were a mix of increasing and decreases in prevalence rates for the years noted in Maharashtra, Nagaland, Punjab, and Uttar Pradesh, and West Bengal. There were increases in the prevalence of injecting drug users in Bihar, Jharkhand, Meghalaya, Mizoram, and Delhi.

Figure 16[42]:

This graph plots the prevalence HIV/AIDS among female sex workers and men having sex with men for all states in India in order to find a correlation between the two factors for the time period of 2010-2011. This particular plot has a linear regression line with a slope of 0.0225, an r^2-value of 0.0024, an r-value of 0.0490.

Figure 17[43]:

This graph plots of the prevalence HIV/AIDS among men having sex with men and injecting drug users for all states in India in order to find a correlation between the two factors for the time period of 2010-2011. This particular plot has a linear regression line with a slope of 0.0071, an r^2-value of 0.00003, an r-value of 0.0055.

Figure 18[44]:

This graph plots of the prevalence HIV/AIDS among female sex workers and injecting drug users for all states in India in order to find a correlation between the two factors for

[42] Ibid.
[43] Ibid.
[44] Ibid.

the time period of 2010-2011. This particular plot has a linear regression line with a slope of 0.386, an r^2-value of 0.0174, an r-value of 0.1319.

Figure 19[45]:

This graph plots of the prevalence HIV/AIDS among antenatal clinic patients and injecting drug users for all states in India in order to find a correlation between the two factors for the time period of 2010-2011. This particular plot has a linear regression line with a slope of 12.622, an r^2-value of 0.4416, an r-value of 0.6645.

Figure 20[46]:

This graph plots the prevalence of HIV/AIDS among antenatal clinic patients and female sex workers for all India states in order to find a correlation between the two for the time period of 2010-2011. This particular plot has a linear regression line with a slope of 6.1203, an r-square value of 0.528, and an r-value of 0.7266.

Figure 21[47]:

This graph plots the prevalence HIV/AIDS among antenatal clinic patients and injecting drug users for all states in India in order to find a correlation between the two factors for the time period of 2010-2011. This particular plot has a linear regression line slope of 3.645, an r-squared value of 0.0195, an r-value of 0.1396.

Figure 22[48]:

The graph indicating Number of People Living with HIV/AIDS shows a general decreasing trend in the number of people living with the disease from the year 2000.

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[45] Ibid.
[46] Ibid.
[47] Ibid.
[48] "Technical Report: India HIV Estimates 2006," National AIDS Control Organisation, last accessed December 13, 2013, http://naco.gov.in/upload/NACO%20PDF/Technical%20Report%20on%20HIV%20Estimation%202006.pdf.

Figure 23[49]:

The prevalence rate appears to have decreased in the years following the year 2000 in parallel with the data seen in Figure 22 regarding the number of people living with HIV/AIDS.

Discussion

Since India opened its markets to the outside world in 1992, there have been significant changes to the entire country especially at the economic, cultural, and social levels.[50] This change has led to massive growth overall for the entire country of India and for individual states as well. This growth and relative success are also seen in great contrast to overall development of the country that is still important given that nearly 30% of people in India still live below of the poverty.[51] Among the key factors affecting people below the poverty line are infectious diseases. Among the diseases most affecting India is HIV/AIDS which has become a large problem all across the country.

In this paper, the relationships between economic growth, economic income per capita, economic inequality, HIV prevalence (between different categories), and differences of these factors among states were all seen in several specific years in the past decade. The results appear to show several important results regarding the case study of India and several of its states that may bring light to the relative situation of HIV/AIDS in India.

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[49] "Adults with HIV (%, age 15-49)." Gapminder, last accessed December 13, 2013, http://www.gapminder.org/data/

[50] Aman Sethi, "India's More Perfect Union", *International New York Times*, November 10, 2011, accessed December 11, 2013, http://latitude.blogs.nytimes.com/2011/11/10/indias-more-perfect-union/?_r=0.

[51] "The World Factbook: India," United States Central Intelligence Agency, accessed November 28, 2013, https://www.cia.gov/library/publications/the-world-factbook/geos/in.html.

The data shows that the GINI coefficient for India did change for both the rural and urban areas. The 2004-2005 and 2009-2010 data shows that GINI coefficient increased for rural areas. This was also the case for the GINI coefficient for urban areas. This data suggests an overall rise in inequality in India over the past several years. This is in contrast to the fact that income per capita increased for all states in India with the time periods of 2005-2006, 2006-2007, and 2010-2011 even when adjusted for inflation. It is also worth mentioning that overall growth rates remained positive (with the exception of Jharkhand in 2005-2006, which had a negative growth rate) for all of India during the time period of 2005-2006, 2006-2007, and 2010-2011. It is important to note that growth rates did decline from 2006-2007 to 2010-2011 most likely as a results of the economic recession that occurred in 2008 which had wide scale financial implications for the rest of the world.[52]

When data between income per capita and economic growth rates were compared to each state, there were a few differences between the time periods. The data from 2005-2006 shows there was a positive correlation between economic growth and prevalence rates when each state or territory for which data was available was included. There was also a positive correlation with the data that looked at income per capita and the prevalence rate based on data from individual states and territories. The comparison between economic growth and prevalence for the 2006-2007 year shows a negative correlation and the comparison of income per capita and prevalence for that same year indicates a positive correlation. In the last time period, there was a negative correlation

[52] Nelson D. Schwartz, "Financial Turmoil Evokes Comparison to 2008 Crisis," *New York Times,* August 11, 2011, accessed December 13, 2013, http://www.nytimes.com/2011/08/11/business/financial-turmoil-evokes-comparison-to-2008-crisis.html?pagewanted=all

between economic growth and prevalence for 2010-2011 and a negative correlation was also found for the comparison between income per capita and prevalence in that same year. This largely indicates that over the years as economic development in a country increased with positive growth rates and increases in income, the prevalence rate overall decreased.

There were several interesting pieces of data that resulted when high risk populations were observed by state. This was especially true for the 2010-2011 time period. The national data showed an overall decline in HIV prevalence of antenatal clinic patients. There was a decrease between 2006, 2007, and 2010-2011 for female sex workers. It should be noted that several points of data stand out in the antenatal data. While the national prevalence rate for antenatal patients was 0.4, several states including Andhra Pradesh, Karnataka, Manipur, and Nagaland had a prevalence above 0.6 for the latest year obtained in that specific report. For female sex workers, the national average of the prevalence for female sex workers was 2.67 and several states had a prevalence above 4 including Andhra Pradesh, Karnataka, and Maharashtra. The national average of prevalence for men having sex with men was 4.43. There were several states in which the prevalence for men having sex with men was greater than 6.645 including Andhra Pradesh, Chattisgarh, Maharashtra, Manipur, and Nagaland. For the same time period, data on injecting drug users was obtained. The average prevalence for all of India regarding all drug users was 7.14. Several states exceed a prevalence rate of 10.71 including Maharashtra, Manipur, Mizoram, Punjab, and Delhi. Based on the analysis of this data, rates that were 1.5 times of the national average or more were seen repeatedly in Andhra Pradesh (this state fit the criteria 3 times), Manipur (this state fit the criteria 3

times), Karnataka (this state fit the criteria 2 times), and Nagaland (which fit the criteria 2 times).

When the data for the 2010-2011 was observed. These 4 states had the prevalence rates that were substantially over the national average of HIV prevalence among adults as well indicating that the high risk population have contributed greatly to the large prevalence rates. The national prevalence rate 0.31 in 2011 (with a factor of 1.5 equaling 0.465). For states in which data could be observed for all time periods Andhra Pradesh had a prevalence of 0.9, Maharashtra had a prevalence of 0.55, Manipur had a prevalence of 1.4, Mizoram had a prevalence of 0.81, and Nagaland had a prevalence of 0.78.

There were also important trends to be seen regarding the correlation of economic growth and income in comparison to the prevalence rates. In the years surveyed including 2005-2006, 2006-2007, and 2010-2011, all the states with points that were above the regression line when graphed alone would have a negative regression line indicating a negative correlation. This means that states with higher incomes but with a substantial rate of prevalence did far better when their economic growth rate was higher and their per capita income was higher. This includes examples like Manipur that had a high rate of prevalence and one of the lowest incomes and growth rates in India. While this does not imply causation, it is important in establishing that states in India with better standards of development did far better in comparison to states without growth and economic development in the form of per capita income.

High-Prevalence Region Analysis

Andhra Pradesh is the first case study to look at regarding the spread of HIV/AIDS. Andhra Pradesh lies at the center of India and is often seen as the bridge

between North and South India. As a result, it is also home to a number of people known as bridge populations that tend to stay away from home and are likely to visit sex workers and have multiple sex partners. According to the data, this mobile population of includes large numbers of truckers that are travelling through the state and migrant laborers that visit the state as well.[53] It is also possible that this major mobile population encompasses men who are likely to have sex with men. These men also have multiple sex partners especially female sex workers with a strong likelihood of then spreading the disease to other high risk groups. This causes female sex workers to then contract the disease in which case they are more likely to spread it to their children.

Maharashtra is also a crucial state in which the HIV/AIDS epidemic is still playing a substantial role. Maharashtra's numbers may be largely explained by the migration of individuals to the city and the presence of India's largest city. Urbanization continues to be a large trend in India with Mumbai leading this trend as India's most populous city and economic capital. This is coupled with the well-established brothels. There are an estimated 100,000 prostitutes in Mumbai.[54] This has contributed to the high rates of HIV/AIDS among female sex workers. In addition, Maharashtra has the highest number of people registered as drug users in the country. This is largely explained by the "applecart syndrome" in which large quantities of drugs bound for the state of Goa from Uttar Pradesh get sold in Maharashtra.[55]

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[53] "Facts, Figures and Response to HIV/AIDS in Andhra Pradesh," last modified January 4, 2006, http://www.prb.org/pdf06/FactsFiguresResponse_HIVAIDS_AndraPradesh.pdf.
[54] "India: Sex work & HIV/AIDS," AIDS Data Hub, last accessed December 13, 2013, http://aidsdatahub.org/sites/default/files/documents/sex_work_and_hiv_aids_india.pdf.
[55] Kartikeya Tripathi, "Maharashtra has highest number of registered drug addicts," *The Times of India*, March 10, 2010, accessed December 13, 2013, http://articles.timesofindia.indiatimes.com/2010-03-10/mumbai/28137417_1_drug-users-drug-abuse-drug-trade.

Karnataka also has some of the highest rates of prevalence of HIV/AIDS in southern India and for all of India overall. There is an especially high prevalence of HIV/AIDS among female sex workers in this state. This can be largely explained by the use of sex workers in a region termed the "devdasi belt". Devdasi women are people who are dedicated to serving God (coming from the Sanskrit *dev*, meaning God, and *das*, meaning servant or slave). However, these women often become prostitutes contributing to the high numbers of sex workers in urban centers like Bangalore and the surrounding areas of Karnataka.[56] As a result HIV/AIDS likely spreads through these female sex workers and eventually ends up spreading to other high-risk populations in the state.

Manipur, Mizoram, and Nagaland are states in bordering the country of Burma which is largely seen as a hub of drug activities. This is particularly important as Burma is part of the Golden Triangle encompassing much of Southeast Asia and Southern China as a major hotspot for drug trafficking.[57] Drug usage is the largest explanation of the continued high prevalence in each of these states. The trafficked and subsequently used drugs contribute to an overall trend that propagates the spread of the HIV/AIDS virus. This virus then spreads to other high-risk populations including antenatal patients, men who have sex with other men, and female sex workers. The high prevalence may also be explained by low per capita incomes and low rates of economic growth.

Methods

The objective of the overall thesis underwent multiple changes. While the initial paper's objectives were to focus on several dimensions including the socio-economic

[56] "HIV & AIDS in India", AVERT, accessed December 8, 2013, http://www.avert.org/hiv-aids-india.htm.
[57] Stephen Moses et al., AIDS in South Asia: Understanding and Responding to a Heterogeneous Epidemic (Washingon, D.C.: The World Bank, 2006), 14.

context of India starting from the early 1980s to the present day, reliable data could not be obtained for several different factors in India. The eventual focus of the paper became looking at the pieces of the historical context of HIV/AIDS, economic data, prevalence rates for HIV/AIDS, and focusing particularly on the recent years in the range of 2005-2012. This is important to note since data was not available at other time periods especially at the state and local levels. Data was not officially available for every successive year despite the establishment of the presence of HIV/AIDS in the early 1980s. Connecting economic, anthropological, geographic, and epidemiological factors was the main objective of the paper in order to find explanations for why HIV/AIDS was occurring in certain parts of India at higher rates or above national averages. This is different than the objective of most of the reports that focus on disease since they deal with mostly collecting data. In addition, there were important factors to consider such as the correlation between growth rates of individual states, income per capita, and prevalence rates of the disease. There were also attempts to find outliers in the data in order to explain more in depth why some correlations were not exact. The design of the paper was to synthesize different disciplines in also verifying or disproving commonly held ideas about the reasons for high rates of HIV/AIDS in India. Last, the paper works to observe the key focuses of HIV/AIDS at the current time period and where.

Limitations and Data Issues

There were several limitations of this particular paper. This includes the fact that parallel data for the same year was hard to obtain as data was taken for some years regarding prevalence in each state but not for other years. In addition, there were a few cases in which economic data was not available. This is why all data obtained for this

paper does not exactly correspond since relevant data for the closest possible years were obtained. In addition, accurate data regarding prevalence rates for the 1980s, 1990s, and early 2000s was hard to come by regarding prevalence rates for HIV/AIDS. Therefore the time period to focus on became more recent for the purposes of this paper. One of the key limitations of this data was also the fact that sentinel survey prevalence rates were used for the data obtained on high-risk groups indicating that survey results may show different data for different years since these are surveyed and not exact figures.

Conclusion

While India continues to grow in the global stage as economic power, an increasing political influence in the international arena, and a country waiting to move millions of its citizens out of poverty, it is a country that still needs to pay close attention to the issues affecting economic development especially disease. This report shows that while there is a general increase in economic growth in individual states and an increase in GDP per capita in individual states, inequality has increased in the recent years sampled. There is also a higher negative correlation in later years with greater economic growth and greater per capita income with lower prevalence rates. The trends in relation to HIV/AIDS also show a declining prevalence rate overall with fewer members of society living with this particular disease in India. However, a careful look needs to be taken at a few states in particular in which the epidemic is remaining stable or increasing particularly among high risk users such as antenatal clinic patients, female sex workers, men having sex with men, and injecting drug users. There are several particular states that are critical if India would like to see larger declines in its prevalence rate which

include the states of Andhra Pradesh, Maharashtra, Manipur, Mizoram, Nagaland, and Karnataka.

An analysis of these data sets has important implications for the future of India. India is a major economic power in the world but is still a country struggling to assist in the basic needs of its citizens. In relation to HIV/AIDS, India has made great progress in the last 27 years the disease has been present in the country and especially substantial progress in the last 13 years. While it looks like economic growth has substantially improved the lives of many people and has even made an impact on mitigating the effects of diseases such as HIV/AIDS, India must be careful of the trend of rising inequality which has severely negative consequences for development. Large disparities between populations must be a central focus of the Indian government. In addition, the continued practice of government programs in assisting people in treating or preventing HIV/AIDS is essential. Although India continues to display positive signs in many development indicators, it must concentrate on the most high-risk population and socially excluded populations when trying to battle the HIV/AIDS epidemic. In addition, it is critical that an approach considering sociological, anthropological, and geographical factors be considered in conjunction with the traditional factors already being considered now.