CHAPTER 1

Abstract

HIV/AIDS continues to be a significant global health challenge, with millions of people affected worldwide. This research aims to develop statistical models and forecasting techniques to better understand the dynamics of HIV/AIDS and predict future trends.

The study will utilize available data on HIV/AIDS prevalence, incidence, and associated risk factors from various sources, including national health surveys, surveillance programs, and research studies.

The statistical modeling approach will involve analyzing the relationship between HIV/AIDS and relevant covariates using regression models, time series analysis, and other appropriate techniques. The forecasting models will be developed to predict future HIV/AIDS prevalence and incidence rates based on the observed trends and projected changes in risk factors. The findings of this research will contribute to improving our understanding of the HIV/AIDS epidemic and provide valuable insights for policymakers and public health officials to design targeted interventions and prevention strategies.

Keywords: HIV/AIDS, statistical modeling, forecasting, prevalence, incidence, regression models, time series analysis, risk factors, public health.

1.1. <u>INTRODUCTION</u>

Acquired Immune Deficiency Syndrome (AIDS), is a devastating disease caused by Human Immunodeficiency Virus (HIV) that is transmitted by either sexual or other contacts in which body fluids are exchanged. Following a few recognized cases among homosexual men in United States in year 1981, new cases of AIDS were subsequently reported in a majority of countries throughout the world. It has now reached a pandemic proportion, as no country in the world is free from it. This epidemic ranks as one of the most destructive microbial scourges in human history and has passed a formidable challenge to the biomedical research and public health communities of the world.

Biological aspects of HIV/AIDS and its transmission

AIDS is a condition in which the inbuilt immune mechanism of the human body would breakdown completely. The process is gradual but ultimately suppresses the immunity of the individuals. It is a medically accepted fact that HIV is one among the casual agents of AIDS.

Modes of Transmission

HIV can be transmitted via the exchange of a variety of body fluids from people living with HIV, such as blood, breast milk, semen and vaginal secretions. HIV can also be transmitted during pregnancy and delivery to the child. People cannot become infected through ordinary day-to-day contact such as kissing, hugging, shaking hands, or sharing personal objects, food or water.

Signs and symptoms

The disease spreads more easily in the first few months after a person is infected, but many are unaware of their status until the later stages. In the first few weeks after being infected people may not experience symptoms. Others may have an influenza-like illness including: Fever, headache, rash, sore throat. The infection progressively weakens the immune system. This can cause other signs and symptoms: swollen lymph nodes, weight loss, fever, diarrhoea, cough. Without treatment, people with HIV infection can also develop severe illnesses: tuberculosis (TB), cryptococcal meningitis, severe bacterial infections, cancers such as lymphomas and Kaposi's sarcoma.

Risk factors

Behaviours and conditions that put people at greater risk of contracting HIV include: having condomless anal or vaginal sex; having another sexually transmitted infection (STI) such as syphilis, herpes, chlamydia, gonorrhoea and bacterial vaginosis; engaging in harmful use of alcohol and drugs in the context of sexual behaviour; sharing contaminated needles, syringes and other injecting equipment and drug solutions when injecting drugs; receiving unsafe injections, blood transfusions and tissue transplantation, and medical procedures that involve unsterile cutting or piercing; and experiencing accidental needle stick injuries, including among health workers.

Treatment for HIV infection

There is no cure for HIV infection. It is treated with antiretroviral drugs, which stop the virus from replicating in the body. Current **antiretroviral therapy (ART)** does not cure HIV infection but allows a person's immune system to get stronger. This helps them to fight other infections. Currently, ART must be taken every day for the rest of a person's life

Global Scenario: According to the UNAIDS at the end of year 2022, 38.4 million people globally were living with HIV. 1.5 million people became newly infected with HIV in 2021.

Country with highest AIDS rate 2022: In absolute numbers, South Africa (7.5 million), followed by Mozambique (2.2 million), India (2.1 million) and Nigeria (1.8 million) had the highest HIV/AIDS number of cases by the end of 2022.

India: HIV/AIDS picture in South Asia remains dominated by the epidemic in India.

The Government of India estimates that about 2.40 million Indians are living with HIV (1.93 -3.04 million) with an adult prevalence of 0.31% (2009). Children (<15 years) account for 3.5% of all infections, while 83% are the in age group 15-49 years. Of all HIV infections, 39% (930,000) are among women.

North East India scenario: The northeastern part of India comprises of some high HIV prevalence states and some low HIV prevalence states. In India, Mizoram had the highest estimated adult HIV prevalence of 2.37%, followed by Nagaland (1.44%) and Manipur (1.15%). The other North Eastern State with an estimated adult HIV prevalence that was higher than the national average included Meghalaya 0.53%. Similarly, the number of PLHIV per million population was the highest in Mizoram (17,207), followed by Nagaland (10,421), Manipur (9,510). The estimated incidence per 1,000 uninfected populations continued to be the highest in the three northeastern States of Mizoram (0.94), Nagaland (0.68) and Manipur (0.33) in 2020 including Meghalaya (0.21). (Source NACO 2021)

1.2. LITERATURE REVIEW:

Solomon and Ganesh (2006) studied the factors contributing to the epidemic and discussed the suggestions made for its management. HIV infection in India was first detected in 1986 among female sex workers in Chennai, India being home to the second largest population of people living with HIV and AIDS. This article describes the state of the epidemic in India, the main contributing factors and suggestions for changes that should be made in the management of the epidemic.

Mondal M and Shitan M (2013) tried to determine the social and health factors which contribute to increase the size of HIV epidemic globally. In this study they found that the national HIV prevalence rate was significantly correlated with almost all the predictors they considered. They used backward multiple regression analysis technique to identify the proportion of Muslims, Physicians density and adolescent fertility rate which are the three most important factors related to National HIV prevalence.

Philips et al. (2014) studied the factors that increase the risk of HIV infection in rural school- going adolescents and young adults. Peer influence, especially for boys is a factor that increases the preponderance of risky sexual behavior in adolescents. They also found that there is a need to strengthen comprehensive sexual health education and youth-friendly HIV prevention strategies to promote abstinence or at least safe sex behaviors, especially among boys.

Joshua et al. (2015) analyzed the determinants of HIV infections in Nigeria which characterizes health determinants in terms of successive layers of social influence. The inner most layer includes personal

characteristics such as age and sex, the next layer includes personal factors such as lifestyles and habits etc, the third layer includes social interaction with local community, the fourth layer includes living and working conditions and the outermost layer takes into account the overall socio-economic, cultural and political factors.

Jennifer et al. (2020) aimed to study the expectations of people living with HIV and its implications this has for HIV cure research trials. The study showed the impact of HIV affects an individual's social, psychological and emotional life, extending far beyond physical health alone.

Priya (2014) studied the factors affecting women's susceptibility to HIV in India. It was found that the majority of HIV- positive women in India were infected by their husbands, their only sex partners, which makes them difficult identify as a high-risk population. This paper seeks to assess social factors associated with the transmission of HIV based on demographic determinants such as age, sexual behavior and gender discrimination such as domestic violence. The results of the study shows that Indian women vulnerability to HIV infection is not the product of their sexual risk behavior but the most prominent social factors are their socioeconomic status such as their level of education, their religion of residence etc.

Malik et al. (2023) analyzed the knowledge of HIV/AIDS and its determinants in India. The study revealed the proportion and predictors of knowledge and attitude of HIV/AIDS in the Indian population through a large, nationally representative demographic health survey and found that nearly, three in four young and middle-aged Indians have a persistent lack of comprehensive knowledge of HIV, which increases their risk of infection.

1.3. AIM & OBTECTIVE

1. To study the demographic profile of HIV/AIDS prevalence in India with special reference to North Eastern states.

2. To forecast the future HIV/AIDS prevalence in North East India.

3. To evaluate and apprise the relevance and significance of various factors affecting HIV/AIDS prevalence in North East India.

4. To assess the relationship between attitude and awareness regarding HIV/AIDS among students in Assam.

Chapter 2

Data and Methods

2.1. Data Source

1. Secondary Sources:

   i. Ministry of Health and Family Welfare (MoHFW) conducts one integrated survey namely National Family Health Survey (NFHS) which provides information on population, health and nutrition in India to strengthen India's demographic and health policies and programme. NFHS also provides evidence on the effectiveness of ongoing program, which are implemented by the Government of India. In 1992–93, the first round of the National Family Health Survey was conducted in three phases.

List of Surveys

- National Family Health Survey-1 (1992–93)
- National Family Health Survey-2 (1998–99)
- National Family Health Survey-3 (2005-2006)
- National Family Health Survey-4 (2015-2016)
- National Family Health Survey-5 (2019-2021) (*latest*)

   ii. National AIDS Control Organization (NACO) is a division of the Ministry of Health and Family Welfare that provides leadership to HIV/AIDS control programme in India.

In 1986, following the detection of the first AIDS case in the country, the National AIDS Committee was constituted in the Ministry of Health and Family Welfare. As the epidemic spread, need was felt for a nationwide programme and an organization to steer the programme. In 1992 India's first National AIDS Control Programme (1992-1999) was launched, and National AIDS Control Organization (NACO) was constituted to implement the programme. NACO also undertakes HIV estimations biennially (every 2 years) in collaboration with the Indian Council of Medical Research (ICMR) – National Institute of Medical Statistics (NIMS). The first round of HIV estimation in India was done in 1998, while the last round was done in 2017.

2. Primary Sources:
   College and University students in Assam.

2.2 Methodology
2.2.1 Some Definitions for the Study

HIV- It stands for *human immunodeficiency virus* that attacks cells that help the body fight infection, making a person more vulnerable to other infections and diseases.

AIDS- If left untreated, HIV can lead to the disease AIDS (*acquired immunodeficiency syndrome*). It is a chronic immune system disease.

HIV incidence- HIV incidence refers to the estimated number of new HIV infections during specified period (such as a year), which is different from the number of people diagnosed with HIV during a given year.

HIV prevalence- The number of persons living with HIV disease at a given time regardless of the time of infection, whether the person has

received a diagnosis (aware of infection), or the stage of HIV disease.

Infection rate- An infection rate (or incident rate) is the probability or risk of an infection in a population. It is used to measure the frequency of occurrence of new instances of infection within a population during a specific time period.

Contraceptives- Contraceptives refer to methods or devices used to prevent pregnancy by either blocking or reducing the chances of fertilization or implantation. They are used to control and plan pregnancies according to the individual's or couple's preferences.

2.2.2 Methods used for Analysis

1. **Forecasting:** It is a technique of predicting the future based on the results of previous data. It involves a detailed analysis of past and present trends or events to predict future events. It uses statistical tools and techniques. Therefore, it is also called Statistical analysis. To be as accurate as possible, the data must be current. Forecasting can be done in numerous ways. We employ the time series module. A time series is a set of observations obtained by measuring a single variable regularly over time. Time series forecasting is the use of a model to predict future events based on known past events. The Time Series Modeler procedure estimates exponential smoothing, univariate Autoregressive Integrated Moving Average (ARIMA), and multivariate ARIMA (or transfer function models) models for time series, and produces forecasts.

2. **Canonical Correlation**- Canonical Correlation Analysis (CCA) is a multivariate technique that is used to quantify the association between two sets of variables. In CCA parameters are estimated for two different sets of variables called predictor or dependent sets of variable and

criterion or independent sets of variables. Then these parameters are used to find the linear combination between the original grouped variables like simple linear regression. These linear combinations are called canonical variables or variates. The correlation between these canonical variates are called canonical correlation (CC). Parameters are estimated in such a way that the correlation between the first canonical variate should be maximum among all pairs of canonical variates. The algorithm of canonical correlation generates a canonical variable in such a way that they are correlated with each other but orthogonal to the other canonical variates. The number of canonical correlations is equal to the smaller number of variables in both sets.

3. **Principal Component Analysis:** Principal component analysis is a popular technique for analyzing large datasets containing a high number of dimensions/features per observation, increasing the interpretability of data while preserving the maximum amount of information, and enabling the visualization of multidimensional data.

Principal Component Analysis (PCA). Principal Component Analysis was used due to the presence of collinearity among predictor variables. The data were checked for their suitability for the PCA by calculating Kaiser-Mayer-Olkin (KMO) index. Kaiser's criterion (Eigen value > 1) was used to ascertain the number of principal components (PC) to be retained in the final analysis. Varimax rotation was carried out on principal components retained and the PC scores for individual North Eastern States of India were calculated. Consistently high HIV prevalence in a North Eastern States of India was considered as a binary outcome variable and the PC scores were used as covariates for further multi-level analysis.
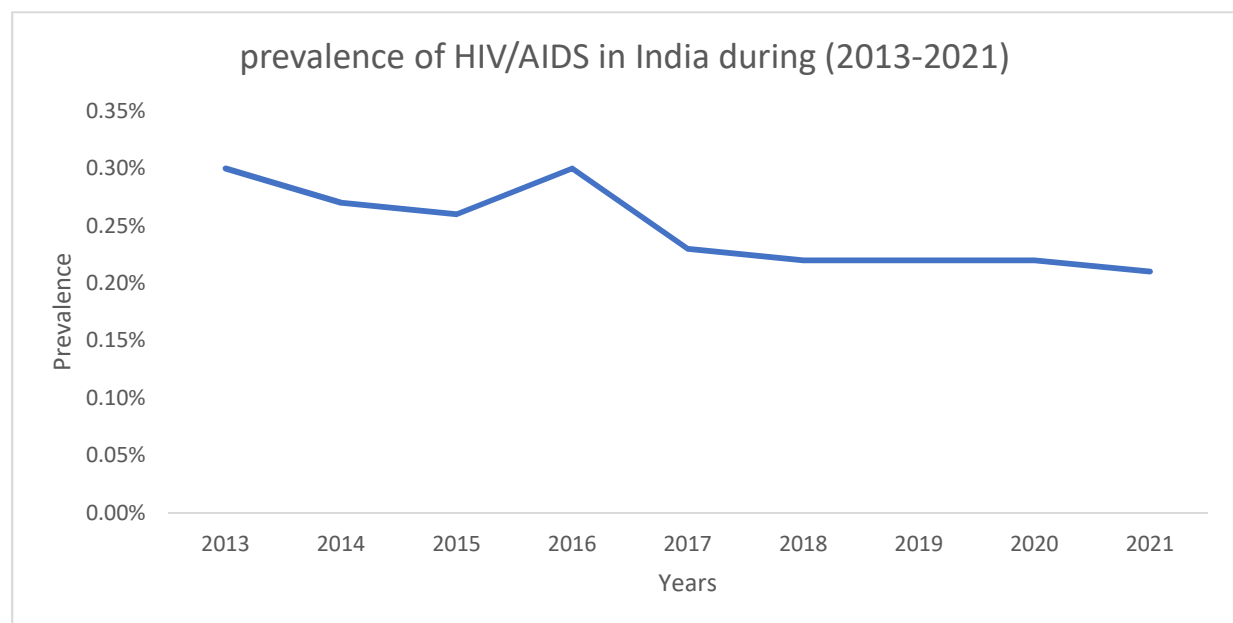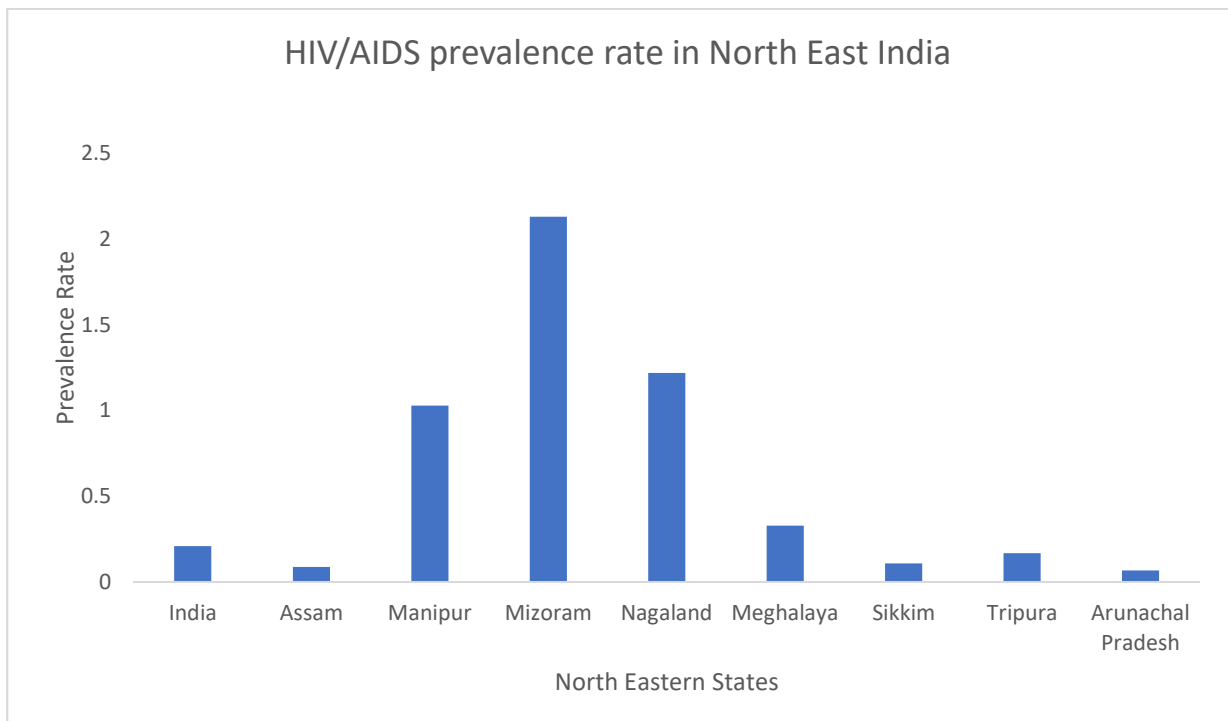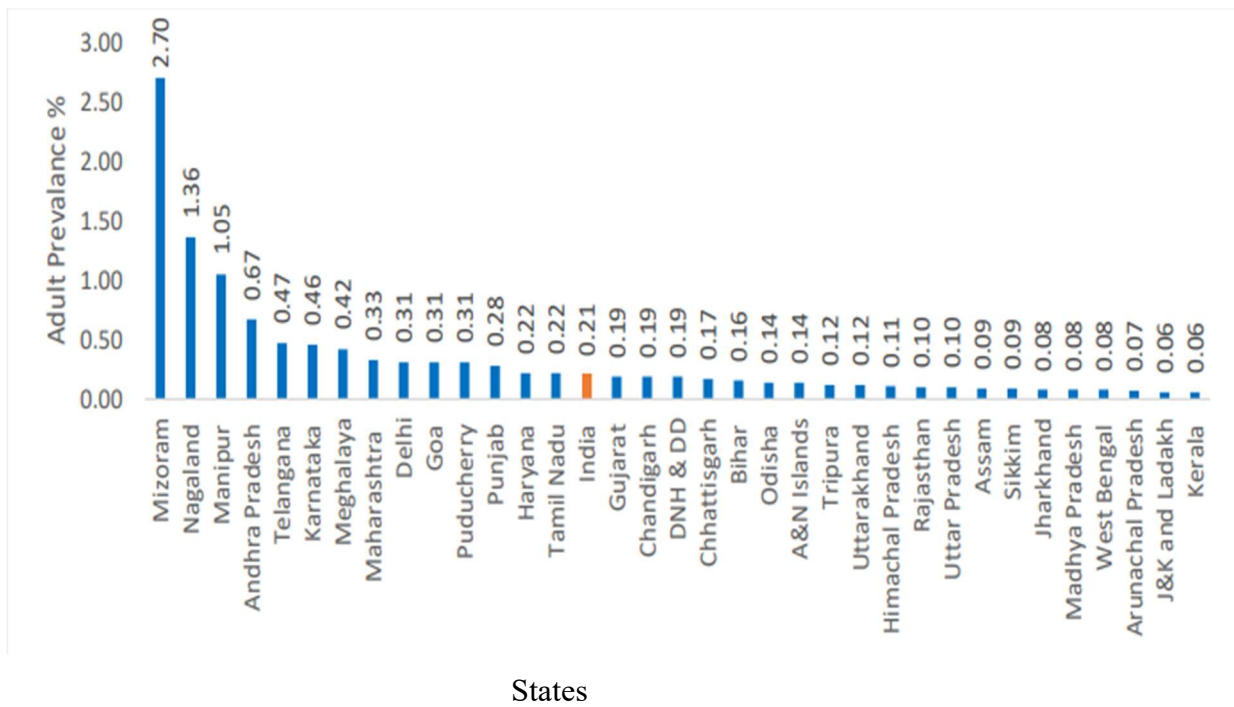
Chapter 3

Analysis

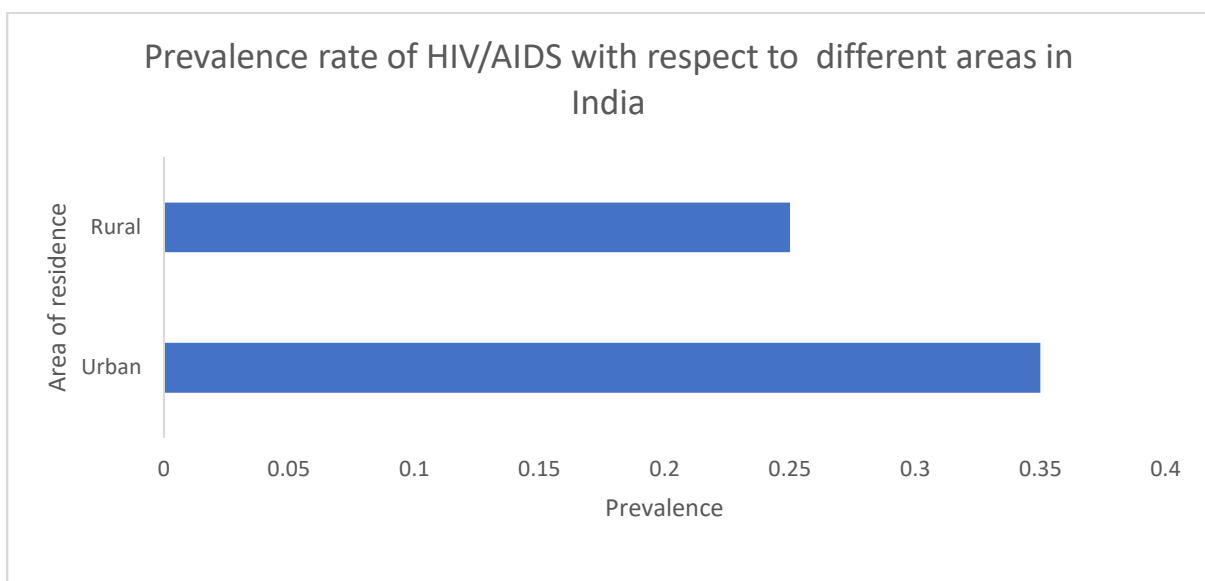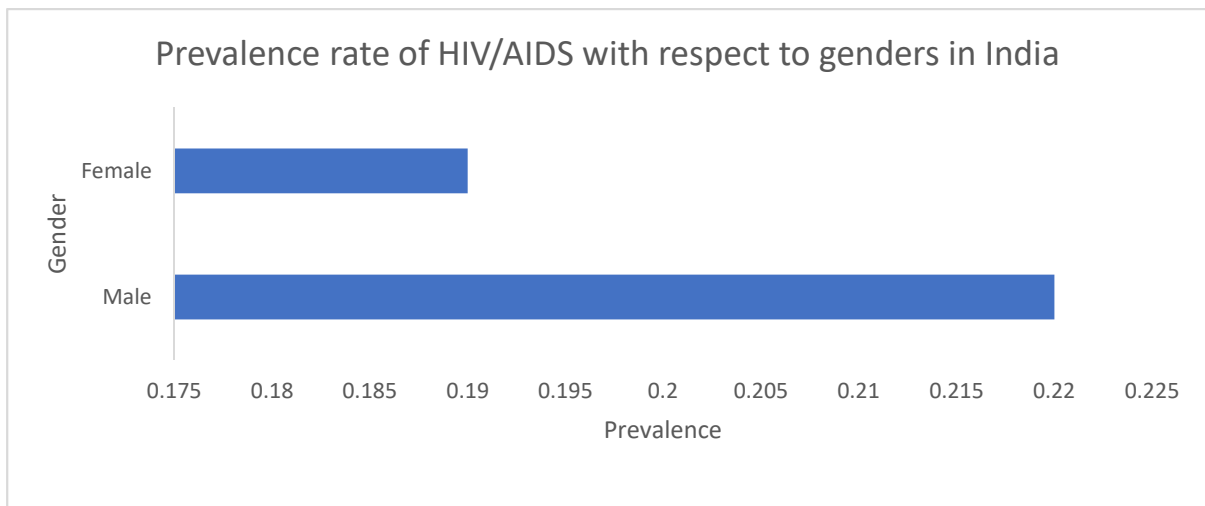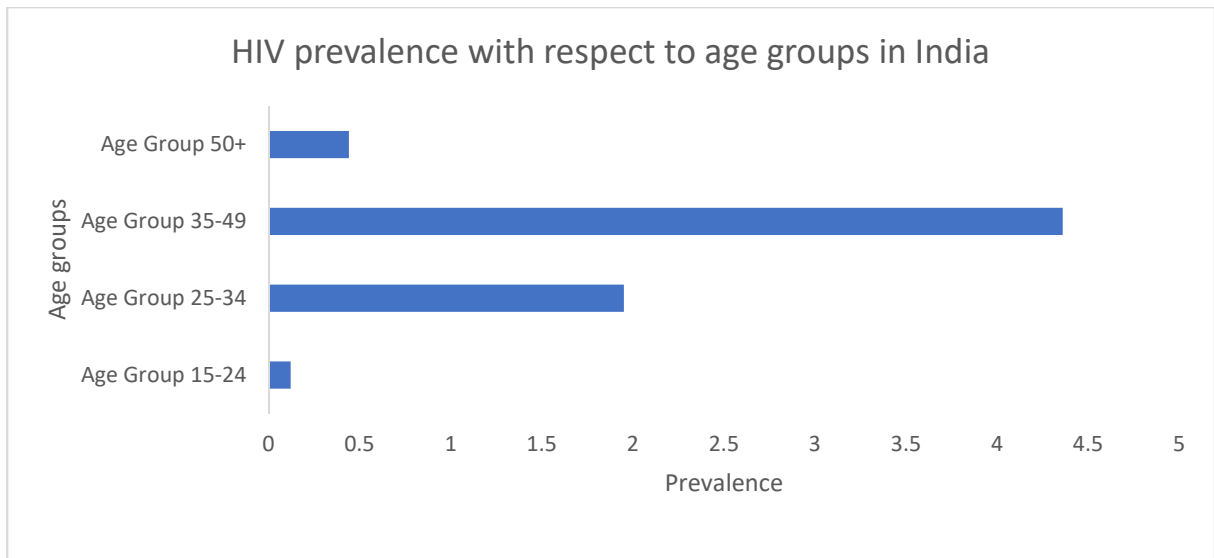### 3.1. Demographic profile of prevalence of HIV/AIDS in India.

In relation to the first objective, we investigate the demographics of HIV/AIDS prevalence. First, we research India's position in relation to the top seven countries with a high prevalence of HIV/AIDS.

The prevalence rate of HIV/AIDS during the previous 9 years is then examined. We then research the Indian states with the highest and lowest prevalence percentages. Then, we research the HIV/AIDS prevalence rates in the states of the northeast to determine which state has the highest and lowest rates. Then, we examine the categorical factors that determine the prevalence of HIV/AIDS, including age groups, sex, religion, region of residence, marital status, wealth index, women's educational attainment, and men's educational attainment.

Global scenario of HIV/AIDS prevalence with respect to India.

prevalence of HIV/AIDS in India during (2013-2021)

States

HIV prevalence with respect to age groups in India

Prevalence rate of HIV/AIDS with respect to genders in India

Prevalence rate of HIV/AIDS with respect to different areas in India

Prevalence rate of HIV/AIDS with respect to wealth index in India

Bar chart titled "Prevalence rate of HIV/AIDS with respect to wealth index in India" showing Prevalence Rate (y-axis, 0 to 0.5) versus wealth index (x-axis). Values: lowest ≈ 0.27, second ≈ 0.25, middle ≈ 0.28, fourth ≈ 0.43, highest ≈ 0.18.

Prevalence rate of HIV/AIDS with respect to marital status

Horizontal bar chart titled "Prevalence rate of HIV/AIDS with respect to marital status" showing Marital Status (y-axis) versus Prevalence (x-axis, 0 to 1.6). Values: Never Married ≈ 0.11, Currently married ≈ 0.30, Widowed ≈ 1.27, Divorced ≈ 1.35.

Prevalence rate of HIV/AIDS with respect to Religion in India

Pie chart values: 0.13 Muslim, 0.41 Christian, 0.22 Sikh, 0.44 Buddhist, 0 Jain, 0.21 Others

■ Muslim ■ Christian ■ Sikh ■ Buddhist ■ Jain ■ Others
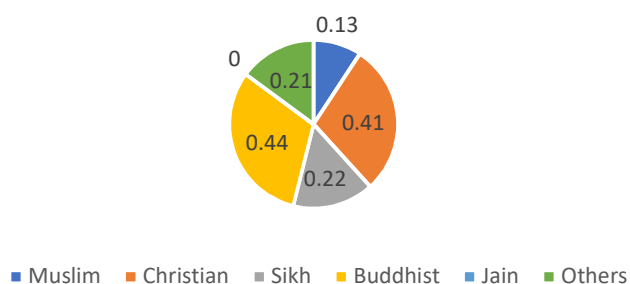
Prevalence rate of HIV/AIDS according to the level of Women education in India

Prevalence Rate (y-axis) vs Years of education (x-axis): no education, <5 years complete, 5-7 years complete, 8-9 years complete, 10-11 years complete, 12 or more years complete
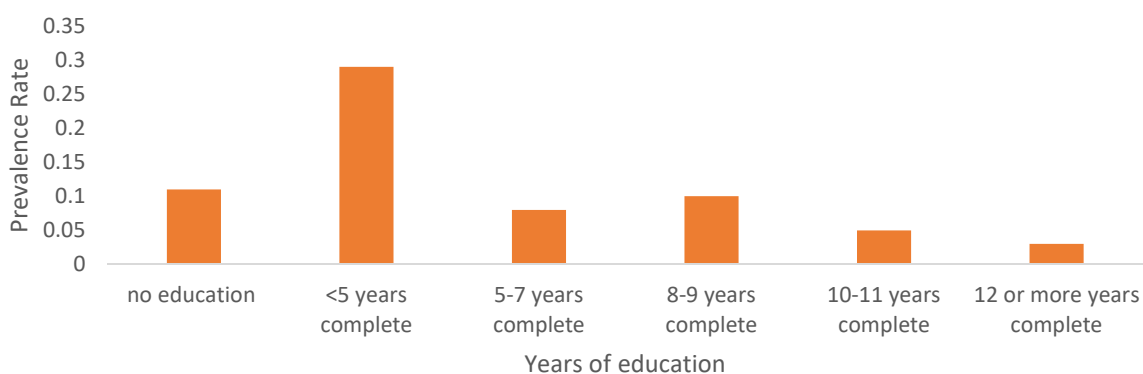
Prevalence rate of HIV/AIDS according to the level of men education in India

Prevalence Rate (y-axis) vs Years of education (x-axis): no education, <5 years complete, 5-7 years complete, 8-9 years complete, 10-11 years complete, 12 or more years complete
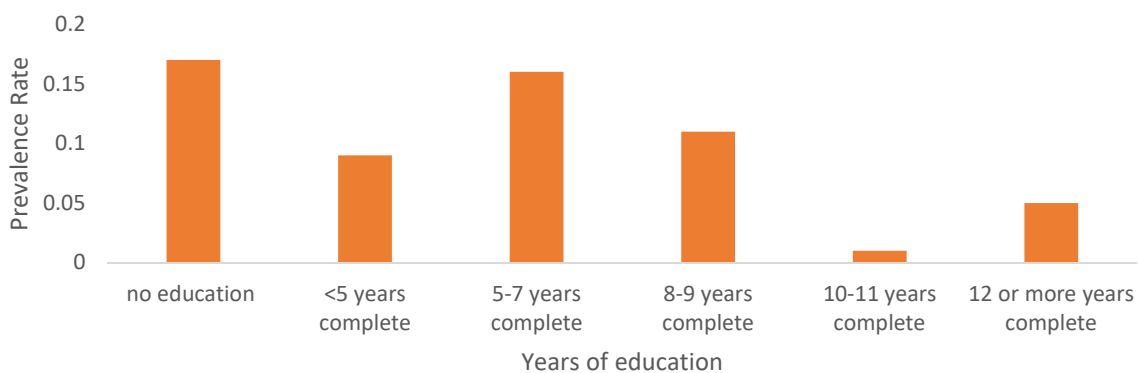
Source-NFHS-5

15

According to the aforementioned graph, India is ranked 3rd in the world overall for people living with HIV/AIDS. We have also seen that India's prevalence rate has been declining over time, continuing the downward trend. We can also infer that Mizoram has the greatest prevalence of HIV/AIDS, while Kerela, J&K, and Ladakh have the lowest prevalence. Mizoram has the highest rate of HIV/AIDS prevalence among north eastern states, whereas Arunachal Pradesh has the lowest. According to the categorical demographical parameters, we came to the conclusion that those aged 35 to 49 have the highest prevalence of HIV/AIDS. When comparing prevalence rates between men and women, women outnumber men. Urban residents experience a higher prevalence rate than rural residents. Compared to other wealth level indexes, those with a fourth level wealth index had a higher prevalence of HIV/AIDS. Divorced people have a higher prevalence of HIV/AIDS with respect to other marital status. Most people with HIV/AIDS prevalence are Buddhists. In contrast to men who lack education, women with fewer than five years of school have a significant prevalence of HIV/AIDS.

3.2. Forecasting and Prediction:

For our final objective, we employ the prevalence rate of India and other eight north eastern states over a 5- years period as a univariate time series to train our forecasting model. We will forecast the prevalence of HIV/AIDS for the next three NFHS years i.e., for 2323-24, 2027-28, 2031-32

Table1: forecasting of future HIV/AIDS prevalence rate for the next three NFHS years

Years	India	Assam	Manipur	Mizoram	Nagaland	Meghalaya	Sikkim	Tripura	Arunachal Pradesh
1992-93	0.47	0.01	2.84	0.12	0.68	0.01	0.11	0.17	0.07
1998-99	0.40	0.03	2.35	0.44	0.82	0.05	0.11	0.17	0.07
2005-06	0.34	0.05	1.90	1.01	0.95	0.14	0.11	0.17	0.07
2015-16	0.28	0.07	1.46	1.57	1.09	0.23	0.11	0.17	0.07
2019-21	0.21	0.09	1.03	2.13	1.22	0.33	0.11	0.17	0.07
Predicted HIV/AIDS prevalence rate of next three NFHS years									
2023-24	0.15	0.11	0.77	2.70	1.36	0.42	0.11	0.17	0.07
2027-28	0.08	0.13	0.52	3.26	1.50	0.51	0.11	0.17	0.07
2031-32	0.02	0.15	0.28	3.83	1.63	0.61	0.11	0.17	0.07

Graphs showing the forecasted HIV/AIDS prevalence rate for the next three NFHS years
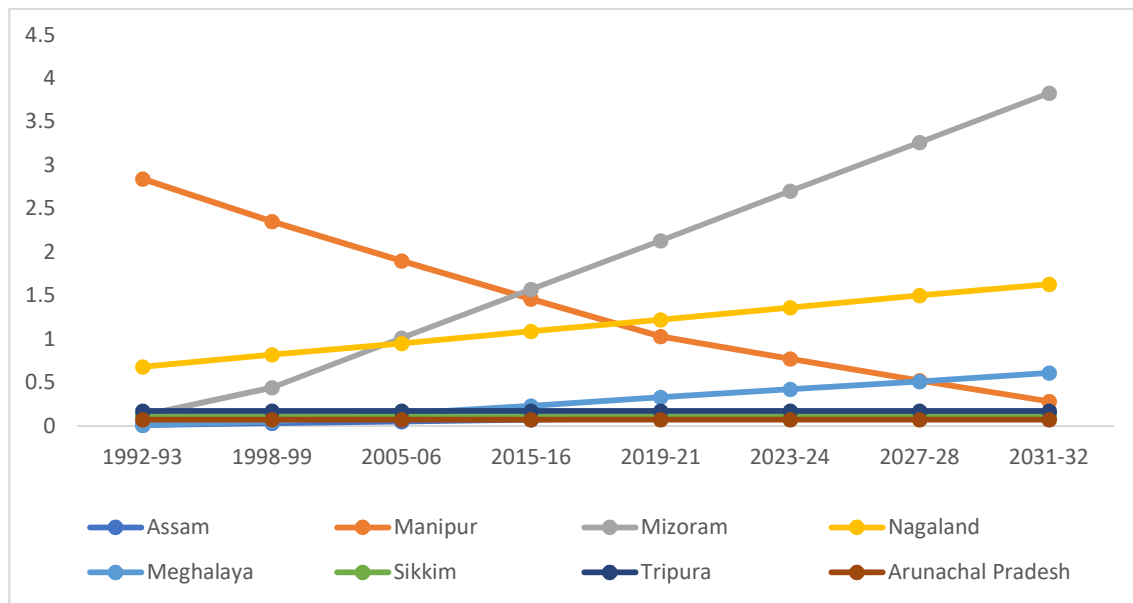
India, as a nation, the prevalence rate of HIV might decrease in upcoming years , which may be due to increasing literacy rate and awareness regarding contraceptives among women. But for states like assam, Manipur, Mizoram and Meghalaya the HIV positive cases might increase. But it is observed that states like Aruncahal Pradesh, Sikkim and Tripura are having the same pattern of HIV positive prevalence in the upcoming years.

3.3. Principal Component Analysis between factors affecting HIV/AIDS

The number of principal components that has a practical significance is determined by the eigenvalues. One of the simple but arbitrary rules-of-thumb is to consider the principal components, which have eigenvalues of one or greater as having practical significance. Predictor variables are:

- Population profile: -The data on population size, population density, proportion of urban and tribal population, proportion of population in reproductive age (15–49 years) group, sex ratio (number of females /1000 males) and mean age of marriage were obtained from the NFHS- (2019-21).

- Socio-economic factors: - Data on the proportion of households with low and high standard of living and the Census data on literacy rate were used.

- HIV/STI awareness levels and condom use: - Data regarding the proportion of females in India who had heard of HIV and STIs or reproductive tract infections (RTIs); who had knowledge about utility of condoms for prevention against HIV and who reported condom use for contraception.

Principal Component Analysis was used due to the presence of collinearity among predictor variables. The data were checked for their suitability for the PCA by calculating Kaiser-Mayer-Olkin (KMO) index. Kaiser's criterion (Eigen value > 1) was used to ascertain the number of principal components (PC) to be retained in the final analysis. Varimax rotation was carried out on principal components retained and the PC scores were calculated. Consistently high HIV prevalence was considered as a binary outcome variable and the PC scores were used as covariates for further multi-level analysis.
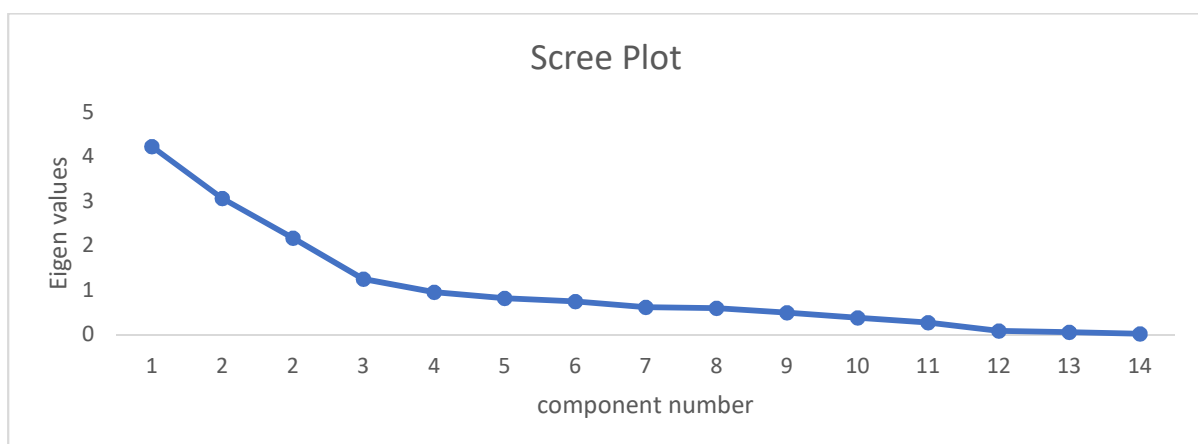
KMO index calculated was 0.821, indicating suitability of the data for PCA. Four PC were retained for the final analysis based on Kaiser's criteria. Cumulative variance explained by these four PC retained was 89%. The variables with significant loading (> 0.6) on these PC after varimax rotation.

Table 2: Principal component analysis with varimax rotation—significant loadings.

Predictor variables	Principal Component 1	Principal Component 2	Principal Component 3	Principal Component 4
A) population profile				
Population size			0.78	
Proportion of urban population			0.66	
Population density			0.64	
Sex ratio		-0.69		
Proportion of population between 15-49 years age	0.78			
Mean age of marriage males	0.86			
Mean age of marriage females	0.91			
B) socio economic factors				
Total literacy rate	0.77			
Proportion of population with low standard of living	-0.68			
Proportion of population with high standard of living	0.67			
C) HIV/STI awareness and condom use				
Proportion of female who have heard of HIV/AIDS	0.78			
Proportion of female who have heard of RTI/STIs				0.86
Proportion of female who knew that consistent condom use can reduce chance of getting HIV/AIDS		0.70		
Use of condom as method of contraceptive		0.74		

Principal Component 1:- Literate population in reproductive age group with better standard of living and late marriage.

Principal Component 2:- Condom use and knowledge.

Principal Component 3:- Large population size with high density and urbanisation.

Principal Component 4:- Awareness regarding RTI/STIs

Our analysis shows that the areas with a large population size, high population density, more urbanization, higher proportion of population in the reproductive age group, higher sex ratio, better standard of living and higher mean marriage age were more likely to have consistently high HIV prevalence levels in India. We found that higher knowledge levels about the role of condoms for HIV prevention as well as the use of condoms at the population level were associated with lower HIV levels.

3.4. Canonical Correlation:

A study was conducted using primary data to evaluate the knowledge among students from various colleges like Darrang College, Nagoan College, Arya Vidyapeeth College, DHSK Commerce College, Bongaigaon College, Nalbari College, Jagiroad College, B.N College, Cachar College, Tinsukia College and Universities like Assam University, Cotton University, Dibrugarh University, Gauhati University, Tezpur University via google forms accruing regarding a viral disease HIV/AIDS. Through a questionnaire consist of 20 questions. In a sample of 457 respondents, 68% females and 32% males were participated. The respondent's age mostly varies from 16-29 years, having few outside this range. Among them only 13% claim that they can recognize the person having HIV by their physical appearance. Whereas, almost 51% cannot recognize the person. The study showed that the students have partial understanding regarding HIV/AIDS transmission as although a reasonable proportion of students are able to identify main cause of HIV/AIDS transmission but have misconceptions too of correctly identifying the causes.

Table 3: Descriptive Statistics for Positive (Yes) Response for all variables, all values are in percentages.

Variables	Female	Male	Overall
AIDS is severe phase of HIV	63.9	39.8	56.3
HIV/AIDS is contagious	53.9	55.4	54.4
HIV/AIDS cause by sexual interaction	91.7	97.6	93.5
Cause by blood transfusion	92.2	91.6	92
Cause by mother to unborn	67.2	44.6	60.1
Cause by sharing sharp objects	89.4	84.3	87.8
Cause by sharing toilets	27.2	19.3	24.7

Cause by utensils	32.8	33.7	33.1
Cause by sharing clothes	31.1	19.3	27.4
Spread by sneezing/coughing	39.4	27.7	35.7
Cause by shaking hands	14.4	10.8	13.3
Spread by mosquito bites	21.7	27.7	23.6
Spread by sharing swimming pools	27.2	16.9	24
Cause by black magic	12.8	7.2	11
HIV/AIDS Curable disease	18.3	22.9	19.8
Spending some time with infected	56.1	57.8	56.7
Infected person bears bad character	15.6	22.9	17.9
Infected feel ashamed	12.2	15.7	13.3
Infected indulge in immoral practices	18.9	15.7	17.9
Infected deserve good job	51.7	48.2	50.6
Infected should be marginalized	22.2	26.5	23.6

Table 4 shows the structural loadings regarding HIV/AIDS awareness and behavior towards infected person. This table reflects that the most important variables for the prediction of behavior towards infected person in first canonical variates are

Table 4: Loadings and Canonical Variate for First and Second Canonical Function

Variables	Canonical variate 1	Canonical variate 2
Set 1		
HIV/AIDS cause by sexual interaction	-0.158	-0.552
Cause by blood transfusion	-0.510	-0.049
Cause by mother to unborn	-0.600	-0.046
Cause by sharing sharp objects	-0.294	-0.309
Cause by sharing toilets	0.277	0.490
Cause by utensils	0.162	0.220
Spread by sneezing/coughing	0.299	0.229
Cause by shaking hands	0.240	-0.180
Spread by mosquito bites	0.037	-0.008
Spread by sharing swimming pools	0.132	0.189
Cause by black magic	0.612	-0.196
Set 2		
Psychological issue due to societal behavior toward infected person	-0.540	-0.304
Infected person bears bad character	0.422	0.074
Infected feel ashamed	0.856	-0.126
Infected indulge in immoral practices	0.773	0.173
Infected deserve good job	0.009	-0.567
Infected should be marginalized	0.417	0.489

Transmission of AIDS through black magic (supernatural means) (with loading 0.612) , Transmission of AIDS by mother to unborn child (with loading -0.600) , Transmission of AIDS by blood transfusion (with loadings -0.510), Spread of AIDS by sneezing/coughing (with loading 0.299), Transmission of AIDS by sharing sharp objects (with loadings -0.294), Transmission of AIDS through toilet sharing (with loading 0.277) .

The above loadings show people perceive that main modes of AIDS transmission are mother to unborn child, blood transfusion and sharing of sharp objects. Whereas, students of various colleges and universities of Assam believe that AIDS can't be transmitted through supernatural means, sneezing/coughing and toilet sharing. Loadings of first canonical variate for behavior towards the infected shows that contribution of all variables are high for first canonical variable except infected deserve good job.

Psychological issues due to societal behavior is positively correlated with main modes of AIDS transmission. This shows that those who are aware of main channels of AIDS transmission believes that societal behavior leads the infected person towards suicidal thoughts and other psychological issues. It is also captivating that all behavioral variables except psychological issues due to societal behavior are positively correlated with misconceived modes of AIDS transmission. This reflects that as the chances of misconception regarding the AIDS transmission increases the behavior towards infected becomes insensitive. From the first canonical correlation function it can be concluded that correct awareness regarding the HIV/AIDS leads the sympathetic feelings for infected person. First canonical function represents the approximately 12% variance of the original variables for Set 1 of variables and 32.9% variance for Set 2 of variables.

The most important variables for the prediction of behavior towards infected person in second canonical variates, are transmission of AIDS by sexual interaction (with loading -0.552), transmission of AIDS by sharing toilets (with loading 0.490), and transmission of AIDS by sharing sharp objects (with loading -0.309). Loadings of behavioral variable demonstrate that infected deserves good job (with loading -0.567), infected should be marginalized (with loading 0.489), and psychological issues due to societal behavior (with loading -0.304) are the variables that contributes for second canonical correlation. It can be observed that infected deserves good job and psychological issues due to societal behavior are positively correlated with correct mode of HIV/AIDS transmission.

This depicts that adequate knowledge regarding HIV/AIDS transmission leads to sympathetic behavior and also leads to assume that societal behavior can compel infected to commit suicide

or cause any other psychological disorder. Some misconceptions can also be observed in second canonical correlation and hence this leads to insensitive behavior towards the infected person. Second canonical function also shows awareness regarding HIV/AIDS of participants leads to positive behavior towards the infected person. Second canonical variate for Set 1 represents the approximately 7% variance of the original variables, and for Set 2 it approximately explains 11.74% variance of original variables. From both canonical variates it can be concluded that adequate awareness regarding HIV/AIDS of participants leads to positive behavior towards the infected person.

Chapter 4

Conclusion:

- States like Mizoram, Nagaland, Meghalaya, Assam are indicating an upward trend in future prevalence rate line with a cycle and periodicity. Additionally, Manipur is showing a decreasing trend in future prevalence rate line. While, Tripura and Arunachal Pradesh is showing a constant prevalence rate over years.

- Our analysis shows that the states with a large population size, high population density, more urbanization, higher proportion of population in the reproductive age group, higher sex ratio, better standard of living and higher mean marriage age were more likely to have consistently high HIV prevalence levels in India.

- We also found that higher knowledge levels about the role of condoms for HIV prevention as well as the use of condoms at the population level were associated with lower HIV levels in the North Eastern States. Our findings are similar to other studies which demonstrated higher HIV levels in states with higher urban population, better socio-economic conditions and lower condom use. The positive association of the awareness.

- This research shows that students of various colleges and universities of Assam have adequate knowledge regarding the HIV/AIDS transmission as percentages for correct mode of transmission are sufficiently high but students also have some misconceptions regarding the mode of HIV/AIDS transmission. It has been observed that 39% students believe AIDS can be transmitted by sneezing and coughing. This is the highest percentage among all misconceived variables for HIV/AIDS transmission. It is proved from canonical correlation analysis that adequate knowledge regarding HIV/AIDS leads sympathetic attitude towards the infected.

4.1. Discussion:

- The findings of this study have practical implications for policymakers and healthcare professionals, enabling them to develop effective strategies for HIV AIDS prevention and control. The findings of this paper underscore the urgent need for comprehensive and tailored interventions that address the unique socio-cultural, economic, and geographical factors influencing the epidemic.

- By implementing evidence-based strategies focusing on prevention, awareness, healthcare infrastructure, collaboration, and research, it is possible to mitigate the impact of HIV/AIDS in the North East.

- This forecasting study should also be helpful to determine the social and financial burden of the disease on the profile of the country. So that the development of practically sound social and scientific strategies to decrease the load of the infection.

- It has been determined that the prevalence rate data sets can be used to predict future AIDS prevalence in addition to being utilized for training, validating, and testing the model.

- As students of various colleges and universities of Assam have false conception regarding the HIV/AIDS transmission, therefore it is recommended either to conduct workshops on the awareness of HIV/AIDS transmission or incorporate some modules related to HIV/AIDS awareness in educational programs.

- Regular studies should be undertaken to better understand the associations of various socio-demographic factors with HIV, as the drivers of HIV epidemic change with place and time.

- As there is large discrepancies between the estimated and reported number of HIV and AIDS cases, projection has to be done with a clear understanding of the HIV spread mechanism at the present and likely changes that may take place in the future.

In spite of the level of uncertainty that remains around epidemic, what is clear is that the HIV/AIDS epidemic is a major public health challenge that demands an effective policy response. We hope that this study towards continuing efforts to improve understanding of the epidemic as an important step in planning and evaluating this response.

Recommendations:

Based on the research findings, the following recommendations are proposed to address the HIV/AIDS epidemic in the North East region of India:

- Enhanced Prevention Efforts: Implementing comprehensive prevention programs targeting key populations, including Injecting Drug Users, Female Sex Workers and homosexuals. These programs should include outreach initiatives, behavior change interventions, access to harm reduction services, and provision of free condoms and clean needles.

- Increased Awareness and Education: Developing culturally sensitive and region-specific awareness campaigns to overcome the stigma associated with HIV/AIDS. Promoting accurate information about transmission, prevention, and treatment options through various channels, including schools, community centers, and mass media.

- Strengthened Healthcare Infrastructure: Investing in improving healthcare facilities, particularly in rural and remote areas. Enhance access to HIV testing, counseling, treatment, and support services, ensuring they are affordable, confidential, and non-discriminatory.

- Collaborative Efforts: Fostering partnerships between governmental organizations, NGOs, community-based organizations, and international agencies to coordinate efforts, share resources, and build capacity for effective prevention and control measures.

- Research and Surveillance: Encouraging and supporting ongoing research initiatives to gather updated data on HIV/AIDS prevalence, risk factors, and emerging trends in the North East region. Regular surveillance and monitoring will aid in developing targeted interventions and evaluating the impact of existing programs.

References

1. Adih WK and Alexander CS (1999): Determinants of condom use to prevent HIV infection among youth in Ghana, Journal of Adolescent Health,24(l):63-72

2. Alary M, Jayachandran AA, Lowndes CM, Bradley J, Demers E, Adhikary R, et al. Ecological analysis of the association between high-risk population parameters and HIV prevalence among pregnant women enrolled in sentinel surveillance in four Southern India states. Sexually transmitted infections. 2010; 86 Suppl 1:i10–6.

3. Des Raj (1968): Sampling Theory, Tata McGraw Hill Publishing Co., Bombay.

4. Ezeikiel, M. (1941): Methods of Correlation Analysis, John Wiley, London, 2nd edn.

5. Gupta C.B. (1978): An Introduction to Statistical Methods, Vikas Publishing House, Delhi, 8th edn.

6. Gupta, S.C. and Kapoor, Y.K. (1983): Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi, 8th edn.

7. Lehmann, E.L. (1976): Testing Statistical Hypotheses, Wiley Eastern, New Delhi.

8. Mood, A.M., Graybill, F.A. and Boes D.C. (1974): Introduction to the Theory of Statistics, McGraw Hill, Kogakusha, Tokyo, 3rd edn.

9. Rao, C.R. (1973): Linear Statistical Interference and its Applications, Wiley Eastern, New Delhi, 2nd edn..

10. Saxena, H.C. and Surendran, P.U. (1973): Statistical Inference, S. Chand, New Delhi, 2nd edn.

11. Snderson, T. and Sclove, S. (1978): An Introduction to the Statistical Analysis of Data, Houghton Mifflin, Boston

12. National AIDS Control Organization (NACO), factsheet, (2015)

13. National AIDS Control Organization (NACO), factsheet, (2019)

14. National AIDS Control Organization (NACO), factsheet (2021)

15. National Family Health Survey (NFHS), factsheet (1992-93)

16. National Family Health Survey (NFHS), factsheet (1998-99)

17. National Family Health Survey (NFHS), factsheet (2005-06)

18. National Family Health Survey (NFHS), factsheet (2015-16)

19. National Family Health Survey (NFHS), factsheet (2019-21)

20. UNAIDS, HIV and AIDS (2021) Related Stigmatization, Discrimination and Denial

India. UNAIDS, UNFPA and UNIFEM (2021) Women and HIV/AIDS: Confronting the Crisis.

21. UNAIDS (2021), Report on the Global AIDS Epidemic. Retrieved on 15-06- 2023

22. UNAIDS (2021), "Overview of the Global AIDS Epidemic. Retrieved on 15-06-2023

23. WHO (2015) Handbook on AIDS Home Care, New Delhi, India.

24. www.averts.org

25. www.nacoonline.com

26. www.svnervaids.com

27. www.unaids.org

28. www.indiastat.com