4-10-2017

The Relationship Between The Prevalence of HIV/AIDS And Associated Socioeconomic And Behavioral Factors

Viktoria Kolpacoff
Andrews University, viktoria@andrews.edu

J. N. Andrews Honors Program
Andrews University

HONS 497
Honors Thesis

The relationship between the prevalence of HIV/AIDS and associated socioeconomic and behavioral factors

Viktoria L. Kolpacoff

10 April 2017

Advisor: Shandelle M. Henson

Primary Advisor Signature: Shandelle M. Henson

Department: Mathematics

Abstract:

Human immunodeficiency virus (HIV) and acquired immune deficiency syndrome (AIDS) are a global epidemic affecting almost 40 million people. Studies show that the spread of HIV is associated with numerous and complex factors such as poverty, religious beliefs, hygiene practices, and gender inequalities. I analyzed the relationship between the prevalence of HIV and four socioeconomic and behavioral factors: per capita Gross Domestic Product, the Globalization Index, the Social Institutions and Gender Index, and literacy rates. I used logistic regression to regress the log-odds of becoming infected with HIV against the four associated factors and calculated an odds ratio for each factor, and determined the effect of continent and GDP range on HIV prevalence through one-way and two-way ANOVAs. The results exhibit strong inverse relationships between HIV prevalence and each factor, and show that there is significant variability between continents.

Introduction

Human immunodeficiency virus (HIV) and acquired immune deficiency syndrome (AIDS) affect millions of individuals worldwide. In 2014, The World Health Organization estimated that 36.9 million people, including 2.6 million children, were living with HIV or AIDS and 2 million individuals were newly infected with HIV. During the year 2014, 1.2 million died from AIDS-related illnesses, and by the beginning of 2015, 41% of infected persons were accessing antiretroviral therapy (World Health Organization 2014).

Scientists classify HIV as a retrovirus due to its transmission process. HIV virions bind to CD4+ T-helper cells and inject their RNA into the host cell. The RNA is inserted into the cell nucleus, and the cell produces and assembles new virus cells. HIV infection may develop into AIDS if left untreated (Michael et al. 1997). Many individuals do not have symptoms until HIV begins to progress towards AIDS. Symptoms include aches, fevers, and a sore throat, and the progression to AIDS can be characterized by rapid weight loss and extreme fatigue. Antiretroviral therapy inhibits HIV replication by targeting various stages of the replication cycle (Simon et al. 2006).

In numerous demographic studies, researchers have identified a plethora of factors that impact the spread of HIV across the world. The list includes socio-economic factors such as corruption, internal conflict, and poverty levels (Drimie and Casale 2009), as well as cultural and behavioral factors such as the status of women (Richardson et al. 2014), religious beliefs (Tan et al. 2015), hygiene practices (Nkenfou et al. 2013), and polygamy (Nyindo 2005).

Many researchers consider poverty levels a particularly important factor in the spread of HIV/AIDS, specifically in sub-Saharan Africa. For example, Cohen (2000) emphasized the cyclic nature of the HIV/AIDS epidemic, pointing out that poverty levels affect the spread of

HIV, and, in turn, that families of HIV-infected individuals fall further into impoverishment. Cohen also discusses the multi-faceted factors that interact with poverty.

Much of the literature on the HIV/AIDS epidemic also emphasizes the complicated relationship between poverty levels, literacy and education, and gender inequality. One such study points out the need for education, particularly for young women and girls, in order to reduce the increased level of vulnerability due to cultural practices and social influences (Jukes et al. 2008). Other similar papers have reviewed literature concerning "health literacy", primarily focusing on literacy as it relates to health and preventative practices and steps to reduce the impact of low literacy rates (DeWalt et al. 2004).

In this study I investigated the relationships between HIV infection and measures of poverty, gender inequality, globalization, and literacy. To investigate the effect of poverty, I analyzed the prevalence of HIV as a function of per capita Gross Domestic Product (GDP). GDP is a numerical measure of the poverty level of each country. It measures the overall income of a country and is equal to the value of all goods and services produced during a year by its citizens. Unlike the Gross National Product (GNP), the GDP does not include any income from foreign investments. To investigate the effects of gender inequality, globalization, and literacy, I analyzed the prevalence of HIV as a function of the Globalization Index, the Social Institutions and Gender Index, and literacy rates. This quantitative work is important for a better understanding of how HIV prevalence responds to socioeconomic and behavioral practices. A number of studies have focused on separate factors on a quantitative level, as well as reviews of literature regarding a combination of factors. My study considers the intersection of factors within a quantitative context.

Methodology

Data for this study were obtained for the year 2009 from the Global Health Observatory data repository, the United States Census Bureau, The World Bank, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics, and the Organisation for Economic Co-Operation and Development (OECD). I collected data for the following categories: 1) estimated numbers of individuals living with HIV/AIDS, 2) total population size, 3) per capita GDP, 4) Globalization Index, 5) Social Institutions and Gender Index, and 6) literacy rate. I then identified all the countries for which I had the number of individuals living with HIV/AIDS, total population size, and per capita GDP. I was not able to find all of the other three factors for every country in this list. (Table 1).

For each country, I assumed a binary outcome for each resident: the resident either was infected with HIV (outcome = 1) or was not (outcome = 0). I used the standard technique of logistic regression (Hosmer and Lemeshow 2000) in MATLAB (Statistics and Machine Learning Toolbox, MATLAB 8.5.0) to analyze the relationship between HIV infection and the factors.

For each factor, using only the data for countries for which I could find that factor, I regressed the log-odds HIV infection against the factor using the logistic regression model

$$\log\frac{P}{1-P} = \beta_0 + \beta_1 \mathrm{FACTOR} \qquad (1)$$

where P is the probability of infection, β_0 and β_1 are parameters estimated from the data, and FACTOR is the per capita Gross Domestic Product (GDP), the Globalization Index (GLI), the Social Institutions and Gender Index (SIGI), or the literacy rate (LIT)

I calculated the odds ratio (OR) to determine how the odds of infection changes with an increase in FACTOR If P_1 and P_2 are the probabilities of infection before and after an increase

of c units in FACTOR, respectively, then by the properties of logarithms the change in log-odds is

$$\Delta \text{log odds} = \left[\log \frac{P_2}{1-P_2}\right] - \left[\log \frac{P_1}{1-P_1}\right] = \log \frac{\frac{P_2}{1-P_2}}{\frac{P_1}{1-P_1}}. \qquad (2)$$

By equation (1), the change in log-odds can also be written

$$\Delta \text{log odds} = [\beta_0 + \beta_1(\text{FACTOR} + c)] - [\beta_0 + \beta_1 \text{FACTOR})] = \beta_1 c. \qquad (3)$$

Equating the right hand sides of equations (2) and (3) and exponentiating both sides leads to the standard formula for the odds ratio OR (Hosmer and Lemeshow 2000):

$$OR = \frac{\frac{P_2}{1-P_2}}{\frac{P_1}{1-P_1}} = e^{\beta_1 c}. \qquad (4)$$

Odds ratios were calculated using increases of c = \$10,000 (US) for national per capita GDP, c = 50 for the Globalization Index, c = 0.05 for the Social Institutions and Gender Index, and c = 5% for the literacy rate.

I summarized the data with descriptive statistics and organized the data by continent and per capita GDP range. I used 6 continent classes (Africa, Asia, Europe, N. America, Oceania, and S. America) and 5 GDP classes (190 – 14086, 14086 – 27982, 27982 – 41878, 41878 – 55774, and 55774 – 69670). I analyzed the effect of continent with a one-way ANOVA and also

ran a two-way ANOVA to determine whether or not there was an interaction between continent and national per capita GDP.

Results

I collected and summarized data for 113 countries (Tables 1 and 2). Figures 1A – E represent the distribution of HIV prevalence, national per capita GDP, Globalization Index, Social Institutions and Gender Index, and literacy rate. The continent of Africa had the highest average national percent population living with HIV/AIDS at 2.48%, while Oceania had the lowest at 0.304%. It is important to note that Oceania had only three data points (countries) from which the mean was calculated. Europe had the highest average national per capita GDP ($21,198), as well as the highest national mean score on the Globalization Index (65.92). Oceania had the lowest average national Social Institutions and Gender Index value (0.100), and Asia had the highest mean national literacy rate (95.51%).

Most of the factors had weak or no correlation with each other or with the percent of individuals infected (Table 3). Literacy rate and percent infected were strongly negatively correlated ($r = -0.730$). Globalization and gender index were moderately negatively correlated ($r = -0.541$), as were literacy rate and gender index ($r = -0.324$). Globalization and GDP were strongly positively correlated with each other ($r = 0.712$).

Separate logistic regressions for each of the four factors resulted in inverse relationships between each factor and the odds of living with HIV or AIDS (Table 4). For each $10,000 increase in national per capita GDP, the odds of HIV infection decreased by 23.88% (OR = 0.7612, $p < 0.0001$). For each 50-unit increase in Globalization Index, the odds of HIV decreased by 2.96% (OR = 0.9704, $p < 0.0001$). For each 0.05-unit increase in Social Institutions and

Gender Index, the odds of HIV decreased by 18.59% (OR = 0.8141, $p < 0.0001$). For each 5% increase in literacy rate, the odds of HIV decreased by 26.99% (OR = 0.7301, $p < 0.0001$).

There was a significant difference in HIV infection rate between continents ($p < 0.0001$; Table 5). There was no interaction effect between continent and per capita GDP (Table 6).

Discussion

The results of my study highlight the complicated nature of HIV/AIDS prevalence, as it concerns multiple socioeconomic and behavioral factors. Per capita GDP had a strong inverse relationship with HIV prevalence, and the results provided a new look at the global spread of HIV, perhaps pointing toward a deeper analysis of prevalence and prevention within a cultural context.

Three caveats are in order. (1) Although each separate regression analysis of the four factors exhibited a significant inverse relationship with HIV prevalence, the data were overdispersed; and in each case significance was lost when the analysis was corrected for overdispersion. Overdispersion of data indicates that the data were not binomially distributed. (2) The logistic regression analysis for the Social Institutions and Gender Index exhibited an inverse relationship with HIV prevalence; however, the correlation between the percent population living with HIV/AIDS and the Social Institutions and Gender Index is weakly positive. This is due to a cluster of data points near the origin (Figure 2 C). (3) I was unable to analyze a multiple regression model of the form

$$\log\frac{P}{1-P} = \beta_0 + \beta_1 GDP + \beta_2 GLI + \beta_3 SIGI + \beta_4 LIT \qquad (5)$$

because not every country had data for all of the factors. Social Institutions and Gender Index and literacy rate data were particularly difficult to find (Table 1).

Many studies, both quantitative and qualitative, have examined poverty on a regional scale and detailed its complicated relationship with gender inequality, migration, and commercial sex (Obel et al. 2014). For example, Shisana et al. (2010) showed that poverty levels and the prevalence of HIV/AIDS were disproportionately high among young women in South Africa, and that women who were heads of the household were significantly more vulnerable to infection in comparison to other women. Udoh et al. (2009) demonstrated how migration behaviors, precipitated by an abundance of unemployment, contributed to the spread of HIV. Migrating women and young girls who were not able to find employment often resorted to exchanging sexual favors for the means to survive, thus promoting the spread of HIV.

Whereas many studies have focused on the ways in which poverty contributes to the prevalence of HIV, Whiteside (2002) and Cohen (2000) have noted that HIV/AIDS and poverty reinforce each other in a cyclic fashion. HIV infection and the progression towards AIDS reduces an individual's ability to contribute to the family income, and this lack of a source of income places a strain on the other members of the family, pushing that family deeper into poverty. Consequently, a region or country may become crippled economically by the spread of HIV, and reduced government funds may lead to less spending on poverty alleviation and health care for its citizens (Drimie and Casale 2009).

Much research on HIV/AIDS has focused on poverty alleviation through direct monetary assistance or distribution of healthcare and treatment. A recent study by Tsai et al. (2013), however, emphasizes the need for a deeper understanding of the social stigma surrounding HIV, which also contributes to the cyclic nature of poverty and HIV infection, and the need for addressing poverty alleviation within the cultural context. Rather than offering assistance in poverty-stricken areas through direct cash transfers and medical care and treatment, Tsai et al.

(2013) propose a method of poverty alleviation that concentrates on enabling individuals and families to become and remain economically stable, facilitating positive action in handling HIV infection.

Some studies have analyzed HIV prevalence within educational and gender inequality contexts. The literature available pertaining these factors, as well as globalization, are scarce, which could be due to a lack in funded research in these areas or could potentially point to the great impact poverty levels have on disease prevalence, with these other factors taking a smaller role in the overall scheme. A study mentioned earlier by Jukes et al. (2008), focusing on vulnerability in young girls and women in regards to HIV transmission, concentrated on the various ways that education may impact HIV transmission, concluding that education attainment lowers the risk of becoming infected over time, and that education regarding sexual practices and preventative measures may have some effect, although the outcome is less promising. The study acknowledged that education does not necessarily cause behavioral change.

Gender inequity and globalization constitute other factors that may have an impact on disease prevalence, although literature associated specifically with HIV is less frequent. A study by Jewkes et al. (2003) emphasized the need for communication between sexual partners regarding HIV infection and condom use, particularly in the integration of gender inequality issues into HIV prevention educational programs. The current study showed that HIV prevalence differs significantly between continents; some of this variability may be due in some part to gender inequality and lack of access to information. Moreover, the variability may be pointing to the high level of need to study HIV prevalence within cultural context and social norms, which may be aided by social studies. Additionally, the study conducted by Tsai et al. (2013) further

persuades the idea to consider social practices and stigma to plan and implement effective measures for both treatment and preventative methods.

This study points toward the need for more research on the complex and variable HIV prevalence has with poverty, literacy, gender inequality, and globalization. Much of the literature focuses on poverty, but within these studies, the research points to a variable relationship between these factors. In future work, I hope to focus more specifically on the intersection of the four factors I analyzed as they relate to HIV prevalence within cultural practices. Particularly, I would like to synthesize both quantitative and qualitative studies and combine those with future work on trends in HIV prevalence on a global scale, especially as it regards variability in prevalence between continents.

Acknowledgements

Thanks to Shandelle M. Henson and Joel Raveloharimisy for their comments.

Literature Cited

Cohen, Desmond. 2000. "Poverty and HIV/AIDS in Sub-Saharan Africa." New York: Social Development & Poverty Elimination Division, Bureau for Development Policy, United Nations Development Programme.

DeWalt, Darren A., Nancy D. Berkman, Stacey Sheridan, Kathleen N. Lohr, and Michael P. Pignone. 2004. "Literacy and health outcomes." Journal of General Internal Medicine 19 (12): 1228-1239.

Drimie, Scott, and Marisa Casale. 2009. "Multiple stressors in Southern Africa: the link between HIV/AIDS, food insecurity, poverty and children's vulnerability now and in the future." AIDS Care 21: 28-33. doi: 10.1080/09540120902942931.

Global Health Observatory data repository. 2009. "Number of people (all ages) living with HIV: Estimates by country." World Health Organization. Accessed October 13, 2015. http://apps.who.int/gho/data/node.main.620.

Hayward, James L., Lynelle M. Weldon, Shandelle M. Henson, Libby C. Megna, Brianna G. Payne, and Andre E. Moncrieff. 2014. "Egg cannibalism in a gull colony increases with sea surface temperature." The Condor 116 (1): 62-73. doi: 10.1650/condor-13-016-r1.1.

Hosmer, David W., and Stanley Lemeshow. 2000. Applied logistic regression. New York: Wiley.

Jewkes, Rachel K., Jonathan B. Levin, and Loveday A. Penn-Kekana. 2003. "Gender inequalities, intimate partner violence and HIV preventive practices: findings of a South African cross-sectional study." Social Science & Medicine 56 (1): 125-134.

Joint United Nations Programme on HIV/AIDS. 2014. "MDG 6: 15 Years, 15 Lessons of Hope from the AIDS Response Fact Sheet." UNAIDS.

Jukes, Matthew, Stephanie Simmons, and Donald Bundy. 2008. "Education and vulnerability: the role of schools in protecting young women and girls from HIV in southern Africa." Aids 22: S41-S56.

Michael, Nelson L., George Chang, Leslie G. Loum, John R. Mascola, Dale Dondero, Deborah L. Birx, and Haynes W. Sheppard. 1997. "The role of viral phenotype and CCR-5 gene defects in HIV-1 transmission and disease progression." Nature Medicine 3 (3): 338-340.

Nkenfou, Celine Nguefeu, Christelle Tafou Nana, and Vincent Khan Payne. 2013. "Intestinal parasitic infections in HIV infected and non-infected patients in a low HIV prevalence region, West-Cameroon." PloS one 8 (2): e57914.

Nyindo, M. 2005. "Complementary factors contributing to the rapid spread of HIV-I in sub-Saharan Africa: a review." East African Medical Journal 82 (1): 40-6.

Obel, Josephine, Markus Larsson, and Morten Sodemann. 2014. "Sexual and reproductive health and HIV in border districts affected by migration and poverty in Tanzania." European Journal of Contraception & Reproductive Health Care 19 (6): 420-431. doi: 10.3109/13625187.2014.944639.

Organisation for Economic Co-Operation and Development. 2009. "Social Institutions and Gender Index (SIGI)." OECD.Stats. Accessed February 20, 2017. http://stats.oecd.org/Index.aspx?DatasetCode=GID2#

Richardson, Eugene T., Sean E. Collins, Tiffany Kung, James H. Jones, Khai Hoan Tram, Victoria L. Boggiano, Linda-Gail Bekker, and Andrew R. Zolopa. 2014. "Gender inequality and HIV transmission: a global analysis." Journal of the International AIDS Society 17 (1).

Shisana, Olive, Kathleen Rice, Nompumelelo Zungu, and Khangelani Zuma. 2010. "Gender and Poverty in South Africa in the Era of HIV/AIDS: A Quantitative Study." Journal of Women's Health (15409996) 19 (1): 39-46. doi: 10.1089/jwh.2008.1200.

Simon, Viviana, David D. Ho, and Quarraisha Abdool Karim. 2006. "HIV/AIDS epidemiology, pathogenesis, prevention, and treatment." The Lancet 368 (9534): 489-504. doi: http://dx.doi.org/10.1016/S0140-6736(06)69157-5.

Swiss Federal Institute of Technology Zurich. 2009. "KOF Index of Globalization." Swiss Federal Institute of Technology Zurich. Accessed October 25, 2016. http://globalization.kof.ethz.ch/.

Tan, Judy Y., Valerie A. Earnshaw, Felicia Pratto, Lisa Rosenthal, and Seth Kalichman. 2015. "Social-structural indices and between-nation differences in HIV prevalence." International Journal of STD & AIDS 26 (1): 48-54.

The World Bank. 2009. "GDP per capita (current US$)." The World Bank. Accessed October 13, 2015. http://data.worldbank.org/indicator/NY.GDP.PCAP.CD/countries/1W?page=1&display=default.

Tsai, Alexander C., David R. Bangsberg, and Sheri D. Weiser. 2013. "Harnessing Poverty Alleviation to Reduce the Stigma of HIV in Sub-Saharan Africa." PLOS Medicine 10 (11): 1-6. doi: 10.1371/journal.pmed.1001557.

Udoh, Isidore A., Joanne E. Mantell, Theo Sandfort, and Myron A. Eighmy. 2009. "Potential pathways to HIV/AIDS transmission in the Niger Delta of Nigeria: poverty, migration and commercial sex." AIDS Care 21 (5):567-574. doi: 10.1080/09540120802301840.

United States Census Bureau. 2009. "Midyear population and density." United States Census Bureau. Accessed October 16, 2015. https://www.census.gov/population/international/data/idb/region.php?N=%20Results%20&T=6&A=separate&RT=0&Y=2009&R=1&C=.

Whiteside, Alan. 2002. "Poverty and HIV/AIDS in Africa." Third World Quarterly 23 (2): 313-332. doi: 10.1080/01436590220126667.

World Development Indicators. 2009. "Adult literacy rate, population 15+ years, both sexes (%)." The World Bank. Accessed October 25, 2016. http://databank.worldbank.org/data/reports.aspx?source=2&series=SE.ADT.LITR.ZS&country=

FIGURE CAPTIONS

Figure 1. Frequency distribution of the percent of the population living with HIV/AIDS (A), national per capita GDP (B), Globalization Index (C), Social Institutions and Gender Index (D), and literacy rate (E), divided into 25 classes. Distributions based on values from Table 1.

Figure 2. Scatterplot of national per capita GDP graphed against percent population living with HIV/AIDS (A), Globalization Index graphed against percent population living with HIV/AIDS (B), Social Institutions and Gender Index graphed against percent population living with HIV/AIDS (C), and literacy rate graphed against percent population living with HIV/AIDS (D). Each point represents a country. Graphs based on values from Table 1.

Table 1. Raw Data

Continent	Country	HIV	POP	GDP	PER	GLI	SIGI	LIT
Africa	**Algeria**	20000	35268128	3875.82	0.000567	54.88	0.1902	
Africa	**Angola**	200000	16565528	3678.95	0.012073	44.42		
Africa	**Bangladesh**	7000	153700334	683.61	0.000046	40.73	0.2446	
Africa	**Benin**	67000	8791832	712.53	0.007621	44.28	0.1890	
Africa	**Botswana**	310000	1990876	5115.11	0.155710	52.22	0.0810	
Africa	**Burkina Faso**	120000	15746232	551.84	0.007621	44.88	0.1616	
Africa	**Burundi**	97000	8831095	190.39	0.010984	34.93	0.1069	
Africa	**Cabo Verde**	1400	501182	3517.39	0.002793	46.10		
Africa	**Cameroon**	600000	20262861	1164.72	0.029611	45.81	0.0220	73.90
Africa	**Central African Republic**	140000	4741916	454.37	0.029524	35.94	0.1844	
Africa	**Chad**	220000	10329208	803.91	0.021299	40.99	0.3226	
Africa	**Congo, Dem. Rep.**	440000	68015710	286.05	0.006469	36.60	0.2045	
Africa	**Congo, Rep.**	77000	4063165	2428.26	0.018951	51.49		
Africa	**Cote d'Ivoire**	440000	20617068	1233.30	0.021342	47.87	0.1371	
Africa	**Djibouti**	9000	724622	1462.02	0.012420	50.17		
Africa	**Egypt**	5100	78866635	2349.29	0.000065	59.35	0.2177	84.21
Africa	**Eritrea**	20000	5647168	404.20	0.003542	28.34	0.1364	
Africa	**Ethiopia**	920000	83548430	380.26	0.011012	37.21	0.2333	
Africa	**Gabon**	44000	1514993	8061.57	0.029043	55.54	0.2189	
Africa	**Gambia**	12000	1713278	549.54	0.007004	51.94	0.1783	
Africa	**Ghana**	240000	23051965	1095.50	0.010411	54.94	0.1127	
Africa	**Guinea**	110000	10057975	430.20	0.010937	45.73	0.2280	
Africa	**Guinea-Bissau**	38000	1533964	517.15	0.024772	43.47		
Africa	**Kenya**	1500000	39707699	942.74	0.037776	49.39	0.1370	99.73
Africa	**Lesotho**	330000	1916134	859.86	0.172222	41.99		
Africa	**Liberia**	37000	3583392	302.28	0.010325	33.16	0.2265	75.80
Africa	**Madagascar**	65000	20282443	417.18	0.003205	43.87	0.2602	
Africa	**Malawi**	1100000	14673498	351.08	0.074965	40.70	0.1432	64.48
Africa	**Mali**	100000	14144020	610.05	0.007070	46.52	0.3395	
Africa	**Mauritius**	11000	1284264	7082.30	0.008565	63.39	0.0098	
Africa	**Morocco**	24000	31285174	2822.07	0.000767	60.99	0.0534	
Africa	**Mozambique**	1400000	21921697	453.26	0.063864	48.98	0.1995	56.08
Africa	**Namibia**	230000	2108665	4123.50	0.109074	55.70	0.0750	
Africa	**Niger**	51000	14748785	344.38	0.003458	38.20	0.1756	
Africa	**Nigeria**	3200000	156342001	1091.97	0.020468	58.01	0.2199	
Africa	**Rwanda**	190000	10746311	529.60	0.017680	39.54	0.1686	
Africa	**Sao Tome and Principe**	3200	172103	1175.11	0.018594	33.84		

Africa	**Senegal**	41000	12008068	1018.39	0.003414	54.48	0.1104	
Africa	**Sierra Leone**	54000	5132138	434.53	0.010522	38.56	0.3424	
Africa	**South Africa**	6100000	50680856	5912.14	0.120361	64.42	0.0868	
Africa	**Sudan**	40000	32426590	1183.19	0.001234	36.79	0.6778	
Africa	**Swaziland**	180000	1337186	2679.67	0.134611	51.72	0.1565	
Africa	**Tanzania**	140000	43094715	674.23	0.003249	39.42	0.1124	
Africa	**Togo**	130000	6405008	508.54	0.020297	47.94	0.2025	
Africa	**Tunisia**	2000	10420551	4162.59	0.000192	59.52	0.0191	
Africa	**Uganda**	1300000	30520924	529.92	0.042594	47.62	0.1872	
Africa	**Zambia**	1000000	12678115	1134.77	0.078876	53.78	0.2194	
Africa	**Zimbabwe**	1300000	11392629	594.50	0.114109	50.89	0.1870	
Asia	**Afghanistan**	3400	28483631	458.96	0.000119	31.35	0.5823	
Asia	**Bhutan**	750	691141	1786.81	0.001085	28.85	0.1625	
Asia	**Cambodia**	82000	14206230	735.41	0.005772	46.82	0.0220	
Asia	**India**	2100000	1156897766	1124.52	0.001815	51.88	0.3181	
Asia	**Indonesia**	450000	240714694	2262.72	0.001869	56.26	0.1278	
Asia	**Iran, Islamic Rep.**	59000	75967610	4942.84	0.000777	40.69	0.3044	92.58
Asia	**Kyrgyzstan**	5600	5358180	871.22	0.001045	56.12	0.0292	
Asia	**Lao PDR**	5100	6256865	947.96	0.000815	26.35	0.0358	99.24
Asia	**Malaysia**	77000	27817866	7312.00	0.002768	77.43		
Asia	**Maldives**	100	396334	6630.68	0.000252	41.24		
Asia	**Mongolia**	500	2741412	1717.07	0.000182	54.98	0.0391	
Asia	**Nepal**	48000	28563377	483.40	0.001680	37.44	0.1672	
Asia	**Pakistan**	32000	181457277	1009.80	0.000176	52.18	0.2832	
Asia	**Sri Lanka**	1700	20879197	2057.03	0.000081	50.15	0.0591	97.68
Asia	**Tajikistan**	12000	7349145	671.54	0.001633	40.23	0.0326	
Asia	**Thailand**	480000	66441491	3962.71	0.007224	64.15	0.0107	
Asia	**Uzbekistan**	41000	27606007	1181.85	0.001485	36.73		98.27
Asia	**Viet Nam**	240000	88576758	1232.37	0.002710	46.99	0.0301	95.51
Asia	**Yemen**	5500	22544016	1239.84	0.000244	46.66	0.3270	
Europe	**Albania**	750	2982540	4114.13	0.000251	58.43	0.1072	
Europe	**Armenia**	2800	3074268	2915.58	0.000911	54.27	0.0301	
Europe	**Azerbaijan**	6900	9206777	4950.29	0.000749	56.92	0.0339	
Europe	**Belarus**	19000	9696333	5176.04	0.001960	52.68	0.0134	
Europe	**Cyprus**	500	1084748	31673.46	0.000461	86.59		
Europe	**Czech Republic**	2400	10518271	19698.49	0.000228	85.76		
Europe	**Denmark**	5000	5500510	57895.50	0.000909	88.11		
Europe	**Estonia**	7900	1307409	14718.34	0.006042	79.34		
Europe	**Georgia**	4400	4855888	2440.96	0.000906	60.57	0.0307	
Europe	**Germany**	68000	81837700	41671.30	0.000831	81.53		

Europe	**Italy**	120000	60461585	36995.11	0.001985	81.02		
Europe	**Macedonia, FYR**	350	2066718	4566.34	0.000169	59.72	0.0179	
Europe	**Moldova, Rep.**	13000	3770698	1525.53	0.003448	60.94	0.0098	
Europe	**Romania**	17000	22011818	8069.02	0.000772	74.94		94.72
Europe	**Spain**	140000	46295240	32333.47	0.003024	84.36		
Europe	**Switzerland**	18000	7693227	69672.01	0.002340	86.64		
Europe	**Ukraine**	250000	45950761	2545.48	0.005441	68.48	0.0097	
Europe	**United Kingdom**	100000	61996848	37076.65	0.001613	85.54		
N. America	**Bahamas, The**	7600	307552	22043.01	0.024711	51.47		99.76
N. America	**Barbados**	1600	284589	16526.25	0.005622	56.55		
N. America	**Belize**	3000	307899	4258.84	0.009743	48.25		
N. America	**Costa Rica**	71000	4455046	6546.57	0.015937	63.09	0.0071	
N. America	**Cuba**	10000	11109721	5494.93	0.000900	48.65	0.0160	
N. America	**Dominican Republic**	51000	9690787	4902.78	0.005263	55.07	0.0398	
N. America	**El Salvador**	20000	6030596	3431.28	0.003316	63.71	0.0083	
N. America	**Guatemala**	49000	13276517	2617.12	0.003691	60.86	0.0319	
N. America	**Haiti**	140000	9777973	668.29	0.014318	36.55		84.99
N. America	**Honduras**	28000	7833696	1975.79	0.003574	61.44	0.0332	
N. America	**Jamaica**	31000	2825928	4521.92	0.010970	61.34	0.0484	
N. America	**Mexico**	160000	112426381	7661.21	0.001423	59.96		
N. America	**Nicaragua**	5300	5541165	1478.97	0.000956	55.11	0.0225	
N. America	**Panama**	13000	3360474	7283.56	0.003869	68.24		94.60
N. America	**Trinidad and Tobago**	14000	1229953	14508.77	0.011383	58.34	0.0229	
Oceania	**Australia**	25000	21262641	42702.20	0.001176	81.60		
Oceania	**Fiji**	750	868498	3369.84	0.000864	53.90	0.0545	
Oceania	**Papua New Guinea**	31000	5940775	1210.85	0.005218	46.67	0.2094	
S. America	**Bolivia**	18000	9775246	1776.86	0.001841	53.79	0.0098	
S. America	**Chile**	33000	16601954	10217.31	0.001988	73.31	0.0195	
S. America	**Colombia**	130000	43677372	5148.41	0.002976	56.32	0.0127	
S. America	**Ecuador**	34000	14573101	4255.56	0.002333	54.16	0.0091	
S. America	**Guyana**	6600	750463	2698.06	0.008795	53.19		
S. America	**Paraguay**	10000	6290878	2600.22	0.001590	57.53	0.0025	
S. America	**Peru**	65000	28647373	4178.81	0.002269	64.53	0.0121	93.75
S. America	**Suriname**	3300	538125	7561.45	0.006132	47.78		
S. America	**Uruguay**	14000	3293765	9415.15	0.004250	65.71	0.0099	
S. America	**Venezuela, RB**	95000	26814843	11534.84	0.003543	50.90	0.0104	

Table 2. Summary of Data[a]. Mean, standard deviation (SD), variance, range, skewness, and kurtosis for estimated numbers of individuals living with HIV/AIDS (HIV), total national population (POP), percent population living with HIV/AIDS (PER), national per capita gross domestic product (GDP), globalization index (GLI), social institutions and gender index (SIGI), and literacy rate (LIT) for each continent.

Continent	Statistic	HIV	POP	PER	GDP	GLI	SIGI	LIT
Africa	**Mean**	297881.25	22189022.38	0.02487	2138.30	49.136	0.128	84.99
	SD	903507.71	43828701.84	0.04362	2093.74	9.608	0.083	
	Variance	816326175918	1920955105358260	0.00190	4383727.00	92.311	0.007	
	Range	6099500.00	240542591.00	0.17205	9931.27	44.972	0.320	0.00[b]
	Skewness	5.93	3.87	2.31268	1.91	-0.101	0.291	
	Kurtosis	38.00	16.10	4.23573	4.39	-0.156	-0.786	
Asia	**Mean**	385960.53	93742339.68	0.00884	4006.96	51.339	0.138	95.51
	SD	849246.79	261752107.12	0.01779	4061.43	11.595	0.154	
	Variance	721220116827	68514165581327600	0.00032	16495215.97	134.448	0.024	
	Range	3199900.00	1156501432.00	0.07883	14318.38	46.079	0.573	0.00[b]
	Skewness	2.73	4.13	3.75503	1.25	0.320	1.605	
	Kurtosis	7.13	17.56	15.12760	1.20	0.171	3.137	
Europe	**Mean**	42533.33	28211044.39	0.00357	21198.57	65.922	0.121	93.94
	SD	48822.42	31007968.38	0.00584	21419.83	20.645	0.143	7.270
	Variance	2383628235	961494103125514	0.00003	458809195.35	426.224	0.021	52.85
	Range	139500.00	81530148.00	0.02465	69237.47	61.750	0.333	15.55
	Skewness	1.03	0.74	3.18506	0.85	-0.463	0.827	-1.010
	Kurtosis	-0.47	-1.26	11.00857	-0.13	-1.259	-1.477	-0.454
N. America	**Mean**	274096.67	23868548.33	0.01319	4456.46	53.132	0.143	79.37
	SD	460365.09	30269057.29	0.02040	4319.56	8.949	0.208	18.25
	Variance	211936013738	916215829293191	0.00042	18658635.40	80.084	0.043	333.11
	Range	1499650.00	112141792.00	0.07480	16175.17	28.923	0.671	35.25
	Skewness	1.93	2.14	2.35278	1.69	-0.251	1.832	1.228
	Kurtosis	3.03	4.88	5.85058	3.47	-1.061	3.227	
Oceania	**Mean**	14100.00	9505694.67	0.00305	14910.24	62.883	0.100	
	SD	10016.49	10360140.93	0.00343	24073.03	16.283	0.110	
	Variance	100330000	107332520034852	0.00001	579510808.57	265.146	0.012	
	Range	19700.00	19549363.00	0.00605	42152.66	29.656	0.156	0.00[b]
	Skewness	0.90	1.47	1.72409	1.73	1.658		
	Kurtosis							

S. America	**Mean**	160460.00	13532914.20	0.01009	3721.66	54.140	0.101	87.27
	SD	435981.17	11612933.78	0.01919	2967.75	13.574	0.105	15.73
	Variance	190079580444	134860230922761	0.00037	8807559.83	184.252	0.011	247.46
	Range	1398300.00	28109248.00	0.06378	7766.75	41.779	0.218	42.184
	Skewness	3.15	0.10	2.98417	0.46	-0.065	0.491	-1.697
	Kurtosis	9.94	-2.14	9.15381	-1.42	-0.900	-2.963	2.203

a. Empty cells due to divide by zero error.

b. Ranges for these continents are zero due to lack of data.

Table 3. Correlation Table.

	%INFECTED	GDP	GLI	SIGI	LIT
%INFECTED	1				
GDP	-0.130777312	1			
GLI	-0.110886117	0.712607883	1		
SIGI	0.041652526	-0.419941355	-0.540943481	1	
LIT	-0.730255566	0.161409833	0.161409833	-0.324008798	1

Table 4. Odds Ratios. Odds ratios for the odds of HIV given an increase in national per capita gross domestic product GDP), globalization index (GLI), social institutions and gender index (SIGI), and literacy rate (LIT).

Variable Name	Change in Factor	OR	Decrease in Odds of HIV	Variable Range	Sig.
GDP	$10000	0.7612	23.88%	$190 – $69,673	< 0.001
GLI	50	0.9704	2.96%	26 - 89	< 0.001
SIGI	0.05	0.8141	18.59%	0.02 – 0.70	< 0.001
LIT	5%	0.7301	26.99%	56 – 100%	< 0.001

Table 5. Variability between Continents. Variability between continents compared to variability within continents, for the percent of individuals living with HIV or AIDS.

Percent	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	0.022	5	0.004	5.195	<0.0001
Within Groups	0.091	107	0.001		
Total	0.113	112			

Table 6. Between-Subjects Effects. Effects of continent, per capita gross domestic product range (GDPrange), and Continent*GDPrange interaction.

Dependent Variable: Percent	Type III Sum of Squares	df	Mean Square	F	Sig.
Source					
Intercept	**Hypothesis**	0.008	1	0.008	8.254	0.035
	Error	0.005	5.045	0.001[a]		
Continent	**Hypothesis**	0.034	5	0.007	7.465	<0.0001
	Error	0.025	27.164	0.001[b]		
GDPrange	**Hypothesis**	0.004	4	0.001	1.118	0.371
	Error	0.023	24.355	0.001[c]		
Continent* GDPrange	**Hypothesis**	0.015	16	0.001	1.161	0.316
	Error	0.071	87	0.001[d]		

a. 0.864 MS(GDPrange) - 0.012 MS(Continent*GDPrange) + 0.148 MS(Error)

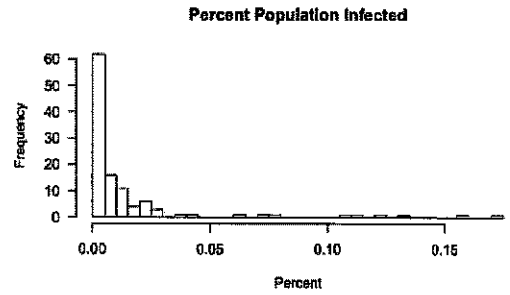
b. 0.732 MS(Continent*GDPrange) + 0.268 MS(Error)

c. 0.782 MS(Continent*GDPrange) + 0.218 MS(Error)

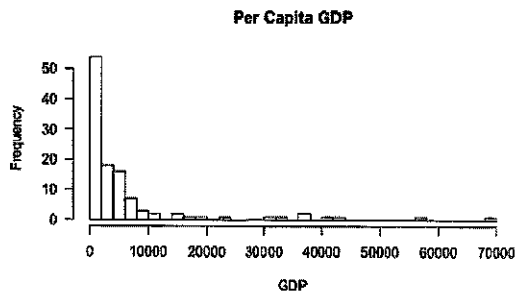
d. MS(Error)

Figure 1.

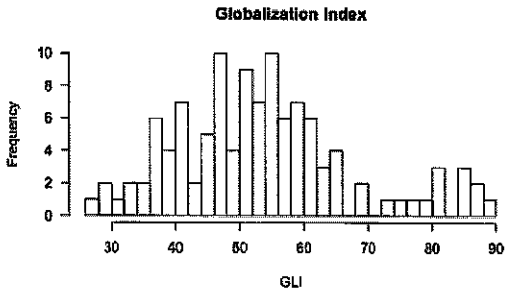
A.



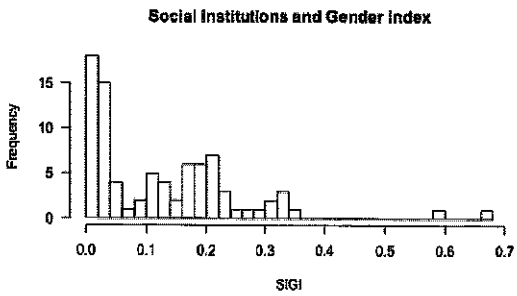
B.



C.



D.



E.

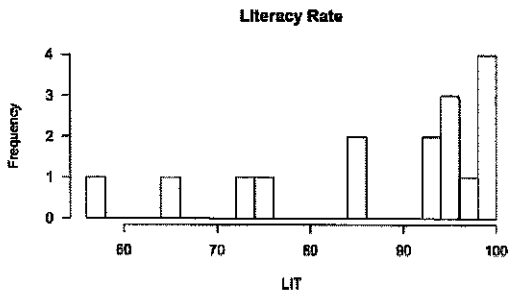
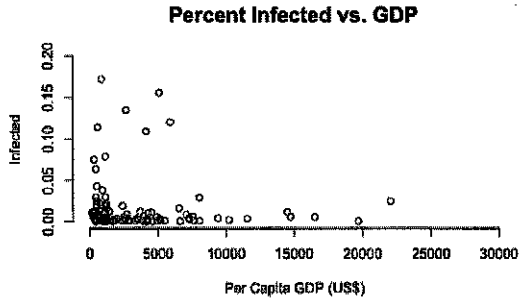
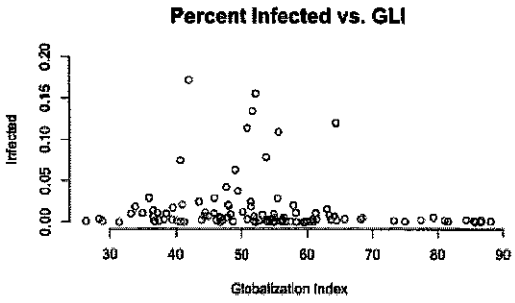


Figure 2.

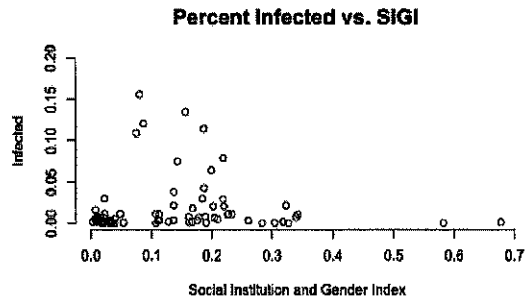
A.



B.



C.



D.