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Full Length Research Paper

A relationship between HIV/AIDS and the productivity of hardest hit regions

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HIV/AIDS impacts demographics, since it has already killed more than 20 million people. HIV/AIDS is predicted to cause about 100 million additional deaths from a total of 500 million deaths in sub-Saharan Africa. This paper examines the impact of HIV/AIDS related deaths on the productivity of selected, affected regions. Data used in this study, was sourced from textbooks, journal articles and the internet. The T-test analytical technique was utilised to analyse collated data, whilst the finding show that there is a positive relationship between the HIV/AIDS pandemic and a decrease in global productivity owing to seriously affected regions.

Key words: Agriculture, Business, Epidemic, Diagnosis, HIV/AIDS, Infection Virus, Productivity

INTRODUCTION

More than 42 million people around the world are currently infected with the Human Immunodeficiency Virus (HIV), which causes the Acquired Immunodeficiency Syndrome (AIDS) (Ojukwu, 2004). Although new cases of HIV/AIDS infections have declined in most developed countries, the virus has spread rapidly through much of the developing world. In some areas of sub-Saharan Africa, one in four adults is infected with the virus (Saloner, 2002). Acquired Immunodeficiency Syndrome (AIDS) comprises a collection of symptoms and infections, which result from specific damage to the immune system as a result of HIV. Latter stages of the condition leave individuals susceptible to opportunistic infections and tumours (Arnett, 2001; UNAIDS, 2004).

Most European researchers believe that HIV originated from sub-Saharan Africa. Although, this allegation may appear to be libellous, sub-Saharan Africa has become one of the worst affected regions (UNAIDS, 2003). An estimated 38.6 million people currently live with the disease worldwide (Nunn et al., 2004). According to the joint United Nations Program on HIV/AIDS

(UNAIDS, 2006), HIV/AIDS has killed more than 25 million people since it was first recognized in 1981, which makes it one of the most destructive epidemics in recorded history. HIV/AIDS has claimed an estimated 2.8 million (2.4 - 3.3 million) lives, of which more than 570,000 were children in 2005 (WHO, 2006). Almost one third of the deaths accruing to HIV/AIDS occurred in Sub-Saharan Africa. This development has adversely impacted on economic growth and human capital development within this region.

Antiretroviral treatment reduces both mortality and morbidity regarding HIV infection, however, routine access to antiretroviral medication is not available in all countries (WHO, 2003). HIV/AIDS stigma is more severe than that associated with other life-threatening conditions and extends beyond affected individuals, care providers and even volunteers who are involved with caring for people who live with the disease (Salati, 2004).

Evidently, the physical size of a country, its population and its national income level per head, are important determinants of economic potential- a major factor, which differentiates one country from another. A country's potential for economic growth is influenced by its endowment of physical resources (land, minerals and raw materials), in addition to its endowment of human resources (the number of people in a country and

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their skill level) (Dhar, 1995). However, the latter seems to have been demoted by the scourge of the HIV/AIDS pandemic within regions that are most affected. That HIV/AIDS epidemic has been ravishing the world for the past three decades is a given fact and therefore, calls for urgent action both individually and collectively. This paper attempts to ascertain the possibility of a relationship between HIV/AIDS and productivity of worst affected regions pursuant to broadening knowledge regarding HIV/AIDS as it affects the global economy. The following hypothesis are proposed:

H_0 : There is no significant relationship between the productivity of a total population and the productivity of a reduced population owing to the HIV/AIDS epidemic.

H_A : There is a significant relationship between the productivity of total a population and the productivity of a reduced population owing to the HIV/AIDS epidemic.

DIAGNOSES OF HIV/AIDS

Since its inception, several definitions have been developed for epidemiological surveillance such as the Bangui definition and the 1994 expanded World Health Organization AIDS case definition. However, clinical staging of patients was not an intended use for these systems as they are neither sensitive nor specific. In developing countries, the World Health Organization's staging system for HIV infection and disease relied on clinical and laboratory data (UNAIDS, 2004). In 1990, the World Health Organization (WHO) grouped these infections and conditions by introducing a staging for patients infected with HIV-1, which was updated in September 2005 (WHO, 2006). Most of these conditions are opportunistic infections that are easily treatable in healthy people.

Stage i: HIV infection is asymptomatic and not categorized as AIDS.

Stage ii: includes minor mucocutaneous manifestations and recurrent upper respiratory tract infections.

Stage iii: includes unexplained chronic diarrhoea for longer than a month, severe bacterial infections and pulmonary tuberculosis.

Stage iv: includes toxoplasmosis of the brain, candidacies of the esophagus, trachea, bronchi or lungs and Kaposi's Sarcoma, which are all diseases that are indicative of AIDS.

Previously, the Centre for Disease Control and Prevention (CDCP) did not have an official name for the disease and had often referred to it by other diseases that were associated with it, for example, lymphadenopathy, a disease after which the discoverers of HIV originally named the virus. They also used Kaposi Sarcoma, an opportunistic infection and named a task force after this, which was set up in 1981. In the general

press, the term GRID, which abbreviated Gay-Related Immune Deficiency, was also coined (Goldstein, 1983). However, after determining that AIDS was not confined to the homosexual community, the term GRID became misleading, therefore, AIDS was adopted at a meeting in July 1982 (Altman, 1984). By September 1982, the CDCP began to use the name AIDS to include all HIV positive people with a CD4⁺T cell count below 200 per μ l of blood. However, 14% of all cases in developed countries use either this definition or the pre-1993 CDCP definition.

AIDS diagnosis still applies even if, after treatment, the CD4⁺T cell count rises to above 200 per μ l of blood and even if other AIDS-defining illnesses are cured (Black, 1986; Nomcebo, 2005). The following criteria should be satisfied before a diagnosis of AIDS can be made: First and foremost, there should be laboratory evidence of infection with the HIV, which is usually achieved by demonstrating the presence of antibodies, to the virus. In the absence of antibodies, a diagnosis may be made by viral isolation or viral antigen detection by means of serological tests (International AIDS Society, 2000). If possible, laboratory evidence of deficient cell mediated immunity should be demonstrated. The following tests should be conducted: total lymphocyte count, T cell subset, delayed hyper-sensitivity skin testing by using a number of antigens and lymphocyte proliferative studies, which uses various mitogens (Daka and Loha, 2008). In addition, there should be clinical evidence, which is either definitive or presumptive of opportunistic infections, certain cancers or direct central nervous system involvement owing to virus infection of the brain (AVERT, 2009).

PATHOPHYSIOLOGY

Retroviruses have a unique method of reproducing, which allows the virus to copy its genetic information into a form that can be integrated into the host cells' own genetic code. Each time the host cell divides, viral copies are produced along with more host cells. The HIV attacks and gradually depletes a specialized group of lymphocytes, T helper or T4 cells. T cells normally play a key role in setting the immune system's responses in motion (McMichael, 2000). They send out chemical signals that stimulate production of antibodies and trigger maturation of other types of cells within the immune systems (B cell, macrophages and nerve cells). HIV not only depletes T helper cells, but also prevents remaining cells from functioning properly. B-cells become defective in an ability to produce immunoglobulin in response to appropriate stimuli. Loss of immunity is selective and affects primarily parts of the immune system that are involved in defenses against parasites, viral and fungal organisms, hence people who have AIDS, develop certain unusual life infections (McMichael, 2000).

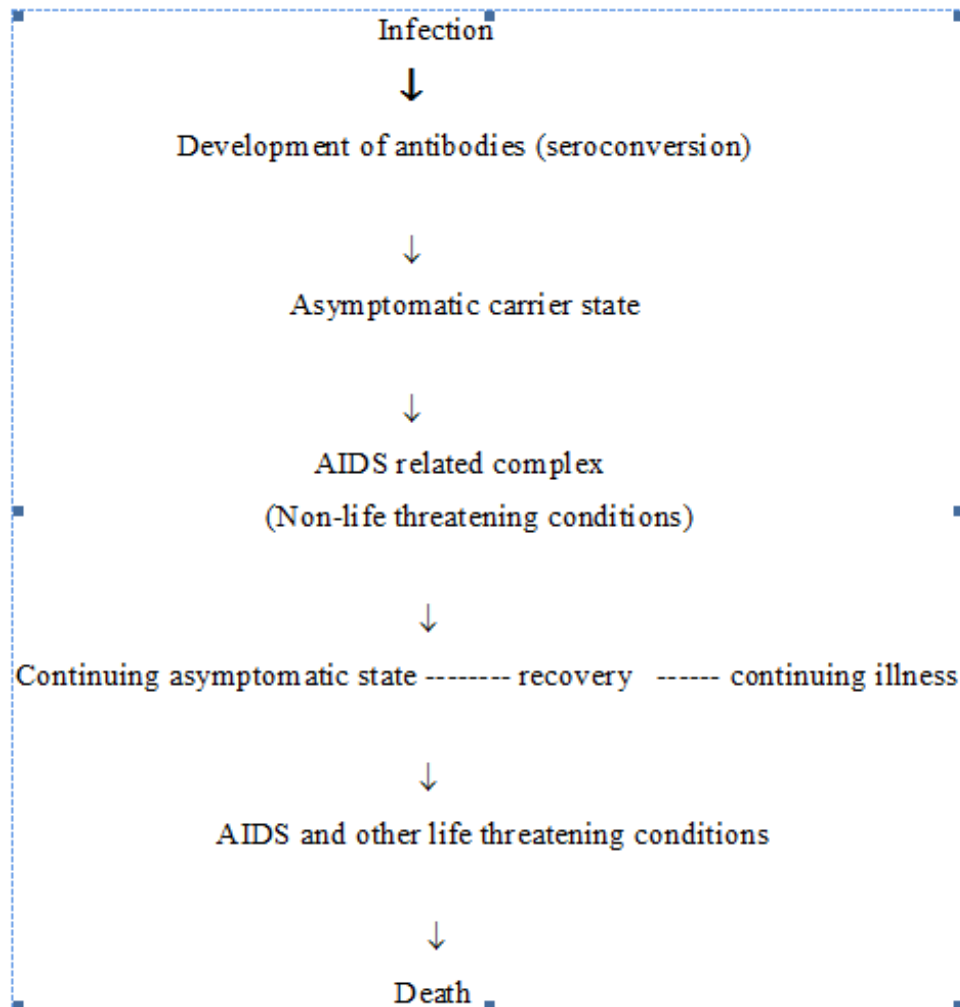


Figure 1. Stages of HIV/AIDS infection in Humans. Source: Ukpere (2007).

Several common diseases such as tuberculosis, malaria, influenza, measles malnutrition and stress temporarily suppress immune response, but once infection subside, the immune system returns to normal but in AIDS, it does not. Antibodies to HIV form in 1 - 4 months after infection but symptoms may not appear for up to 5 years and beyond in some cases and during these years, a person can transmit the virus to others without knowing (Figure 1).

PREVENTION

Perhaps, the most important fact about AIDS is that it is a preventable disease. Ideally, this can be achieved by development of a vaccine, although much effort and money have been directed towards production of a vaccine. However, presently, there is none yet, and, it is unlikely that one will be available within the next five years (National Institute of Allergy and Infectious Diseases (NIAID), 2009). In the absence of a vaccine,

health education and counselling to create a sense of awareness and to reduce the risk of transmission by employing safe sex practices and other high risk behaviours, should become imperative (CDCP, 2002). Other factors that may prevent the spread of AIDS includes ensuring a supply of safe blood and blood products, no sharing of needles and syringes and deferment of pregnancy among high risk subjects. Surveillance to monitor the size of the problem and how it changes is an important component of prevention (CDCP), 2002).

HIV TEST

In most developing countries, many people are not aware of their HIV status. Less than 1% of sexually active persons in urban Nigeria have been tested for HIV and this proportion is even lower within rural populations (Akande, 2001). Furthermore, a mere 0.5% of pregnant women who attend urban health facilities

are counselled, tested or receive their test results. In fact, this proportion is even lower in rural health facilities. Hence, donor blood and blood products that are used in medicine and medical research, are screened for HIV (Nunn et al., 2004). A typical HIV test, including the HIV Enzyme Immunoassay (EI) and the Western Blot Assay (WBA), detects HIV antibodies in serum, plasma, oral fluid, dried blood spot and urine of patients. However, the window period (the time between initial infection and the development of detectable antibodies against the infection), can vary. This is why it can take 3 - 6 months to seroconvert, test and detect other HIV antigens, HIV-RNA and HIV-DNA (Scripps Research Institute, n.d). In order to detect HIV infection these assays are not officially approved, but are nonetheless routinely used in some countries.

TRANSMISSION

Three main transmission routes of HIV include sexual contact, exposure to infected body fluids or tissues and from mother to child during the prenatal period. It is possible to find HIV in the saliva, tears and urine of individuals but there have not been recorded cases of infection from these secretions (WHO, 2006). Therefore, the risk of infection through saliva, tears and urine is negligible.

Sexual contact

A majority of HIV infections are acquired through unprotected sexual contact between partners, one of whom has HIV (UNAID, 2004; Ojukwu, 2004). Sexual intercourse is a primary mode of HIV infection worldwide. Sexual transmission occurs with contact between sexual secretions from one partner with the rectal, genital or oral mucous membranes of another. Unprotected receptive sexual acts have a greater risk of transmitting HIV from an infected partner to an uninfected partner through unprotected anal and vaginal intercourse/sex (Nomcebo, 2005). Oral sex is not without its risks as HIV may be transmissible through both assertive and receptive oral sex (HIV InSite, 2003). The WHO (2006) reported that the risk of HIV transmission from exposure to saliva is considerably smaller than the risk from exposure to semen. Contrary to popular belief, one would have to swallow gallons of saliva, for a person to run a significant risk of becoming infected. About 30% of women in ten countries representing 'diverse cultural, geographical and urban/rural settings', reported that their first sexual experiences were either forced or coerced, which makes sexual violence a key driver of the HIV/AIDS pandemic. Frequent sexual assaults result in physical trauma to the vaginal cavity, which facilitates transmission of HIV. During a sexual act, male/female

condoms can reduce the chances of infection with HIV and other STDs and of course the chances of becoming pregnant (Rutter and Quine, 2002; Nomcebo, 2005). The best evidence, to date, indicates that proper condom use reduces the risk of heterosexual HIV transmission by about 80% over the long-term. The benefit is higher if condoms are used correctly on every occasion. Promoting condom use, however, has often proven controversial and difficult. Several religious groups, particularly the Roman Catholic Church, have opposed the use of condoms on religious grounds and have sometimes perceived condom promotion as an affront to the promotion of marriage, monogamy and sexual morality (BBC News, 2009).

TREATMENT

WHO (2004) reported that there is currently no vaccine or cure for HIV/AIDS. The only known methods of prevention are based on avoiding exposure to the virus and an antiretroviral treatment, which, when taken directly after a highly significant exposure, called post-exposure prophylaxis (PEP), has a demanding four week schedule of dosage. Current treatments for HIV infection consist of highly active antiretroviral therapy (HAART). This has been highly beneficial to several HIV-infected individuals since its introduction in 1996 (UNAIDS, 2009).

In the first decade of the epidemic when no useful conventional treatment was available, a large number of people had AIDS experimented with alternative therapies (Nomcebo, 2005). The definition of "alternative therapies" in AIDS has changed since then. During that time, the phrase often referred to community-driven treatments, were untested by government or pharmaceutical company research and which most people hoped would directly suppress the virus or stimulate immunity against it. Despite widespread use of complementary and alternative medicines by people who live with HIV/AIDS, effectiveness of these therapies has not been established (UNAIDS, 2004).

Treatment of AIDS consists of treatment of the HIV infection and complications, which result from the immune deficiency. A number of chemotherapeutic agents such as Zidovudine or AZT, Ribavirin, Suramin, Foscarnet and HPA- 23 have been used as antiviral agents, with limited success. Thus far, only Zidovudine has been approved for use in several countries, since it has been shown to cross the blood brain barrier. However, it is expensive and toxic to bone marrow.

ECONOMIC IMPACT

HIV/AIDS retards economic growth by destroying human capital. According to a UN report, HIV/AIDS epidemics will have devastating consequences in decades

to come for virtually every sector of society ranging from households, farms and other economic activities (Nomcebo, 2005). The epidemic is predicted to hinder possibility of achieving UN millennium development goals within most affected regions, particularly sub Saharan Africa (Todaro, 1992).

IMPACT ON AGRICULTURE

Agriculture is one of the most important sectors in several developing countries, particularly when measured by the percentage of people dependent on it for their livelihood. Although, the sector may produce only 20% of a country's wealth (measured as a percentage of the gross national product), it might provide a living (survival) for as much as 80% of some developing countries' populations (Agarwal, 2002). Indirectly, it provides a living for other parts of the population, for example, processing workers on sugar estates. The effect of AIDS is debilitating at a family level. As an infected farmer becomes increasingly ill, he and family members who take care of him, spend less and less time working on family crops. The family, therefore, begins to lose income from "un-marketed" or incompletely tended crops and may even sell off farm implements or household properties as a means to survive (Dhar, 1999).

This cycle is compounded by high costs of health care. Whether the sick person turns to a traditional healer or to health services, he/she will surely spend money. A 1997 study by the Food and Agriculture Organization of the United Nations (FAO) showed that in the mid-west of Cote d'ivoires (Ivory Coast), care for male AIDS patients cost, on average, about US\$ 300 a year, which is a quarter to a half of the net annual income for most small scale farms (Kaplan, 2000). The time lost by family members should also be taken into account. For instance, repeated absence of another member of the farm to accompany the patient to a healer, also reduces the farm's production. Also, when the most debilitating phases of AIDS coincide with key farming periods such as clearing or sowing, time spent nursing a sick member, certainly has a negative impact on turnover (Answers.com, 2009).

HIV AND BUSINESS

Some companies in Africa have already felt the impact of HIV on their bottom line. A manager at one sugar processing estate in Kenya counted the cost of HIV infection in a number of ways: absenteeism (8000 days of labour cost owing to sickness between 1995 and 1997 alone); lower productivity (50% drop in the ratio of processed sugar recovered from raw cane between 1993 and 1997) and higher overtime costs for workers who are Obligated to work longer hours to compensate for the void

left by sick colleagues (Booth, 2005).

RESEARCH METHODOLOGY

The research methodology encompasses different techniques and procedures that are used to collect and analyze data for research. This is important, since it provides a better view of how the conclusion was made. The methodology covers the population of study, method of data collection and data analysis technique.

Population of study

The population of study comprises countries that have the highest prevalence of HIV/AIDS epidemic in sub-Saharan Africa. These countries are Botswana, Kenya, Uganda, South Africa and Zimbabwe and were used to reflect rising trends of the epidemic.

Method of data collection and analysis

Data for the research was obtained from secondary sources such as textbooks, journal articles and the internet. The data collected was analyzed by use of the T-test, which is used when comparing two population means. The formula for finding significant differences between two independent means is stated as follows:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{(N_1 S_1^2 + N_2 S_2^2)}{(N_1 + N_2 - 2)}}}$$

Where:

$\bar{X}_1$ = mean of the first group;

$\bar{X}_2$ = means of the second group;

N_1 = number of cases in the first group;

N_2 = number of cases in the second group;

S_1 = standard deviation of the first group;

S_2 = standard deviation of the second group.

In using this formula, the degree of freedom (df) is noted. At the end, if the value of the critical value is less than the calculated value, the null hypothesis is rejected and the alternative hypothesis is accepted.

Data presentation and analyses

The essence of this presentation and analysis is to ensure that the collected data is meaningful for decision-making. Therefore, this section is the critical aspect of the research, which provides the background upon which the results and conclusion of the study will rest (Table 1).

An assumption was proposed that the productivity of these countries is one dollar (\$1), in order to show manageable figures. The total population's productivity is then compared with the productivity of the reduced population as a result of the influence of the epidemic. Finally, this is used to represent its effects on the world economy.

Table 1. Countries that have the highest prevalence of HIV/AIDS.

Countries	Total population (in 000)	Population with HIV/AIDS (in 000)	Population without HIV/AIDS (in 000)
Botswana	1600	300	1300
Kenya	34000	2300	31700
Zimbabwe	12900	2000	10900
South Africa	44900	4700	40200
Uganda	27800	510	27290
Total	12100	9810	111390

Source: Field survey data, 2007.

Table 2. Deviation of population with HIV/AIDS productivity and population productivity without HIV/AIDS.

Country	Productivity of total population (in 000)	Deviation	Productivity of population without HIV/AIDS	Deviation
Botswana	1,600	22640	1,300	22,940
Kenya	34,000	9,760	31,700	7,460
Zimbabwe	12,900	11,340	10,900	13,340
South Africa	44,900	20,660	40,200	15,960
Uganda	27,800	3,560	27,290	3,050
	n	n	nx1	n = i
	$\Sigma p = 121,200$	$\Sigma d_{x1} = 67,960$	$\Sigma P_w = 111390$	$\Sigma d_{x2} = 62,750$
	101	$l = i$	$l = i$	$l = i$
	$\bar{X}_1 = 24,40$	$\bar{d}_{R1} = 13,592$	$\bar{X}_2 = 22,278$	$\bar{d}_{x2} = 12,550$

$$\bar{X}_1 = \sqrt{13,592}$$

Standard deviation,

$$= 116.58$$

$$\bar{X}_2 = \sqrt{12,500}$$

Standard deviation,

$$= 111.80$$

$$T\text{-test} = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{(N_1 s_1^2 + N_2 s_2^2)(N_1 + N_2)}{(N_1 + N_2 - 2)(N_1 \times N_2)}}$$

Where:

 $\bar{X}_1$ is mean of the total population's productivity = 24,240; $\bar{X}_2$ is mean of the reduced population's productivity = 22,278; N_1 is number of countries in the first group = 5; N_2 is the same = 5; S_1 = standard deviation of productivity of the total population = 116.58 S_2 = standard deviation of the productivity of the reduced = 111.80

$$\Rightarrow t = \frac{24,240 - 22,278}{\sqrt{\frac{(5(116.58)^2 + 5(111.80)^2)}{(5+5-2)} \cdot \frac{(5+5)}{(5(5))}}}$$

$$= 1962$$

$$\sqrt{\frac{(5(13,590.90) + 5(12,499.29))}{(8)} \cdot \frac{(10)}{(25)}}$$

$$= 1962$$

$$\sqrt{\frac{(67,954.5 + 62,496.2)(0.4)}{8}}$$

$$= 1962$$

$$\sqrt{(16,306.34)(0.4)}$$

$$= 1962$$

$$\sqrt{6522.535}$$

$$= \frac{1962}{80.76}$$

$$= 24.29$$

Using the degree of freedom: $N_1 + N_2 - 2 = 5 + 5 - 2 = 8$.

Therefore, at a level of significance of 0.05, it could be observed that t - critical value is 15.507.

Decision

Since the calculated value (24.29) > t- critical value (15.507), the null hypothesis is rejected and its alternative is accepted. This implies that there exists a significant relationship between the HIV/AIDS epidemic and productivity of the analysed region.

RESULTS AND CONCLUSION

From the above analyses, it should be noted that the influence of the HIV/AIDS epidemic on general productivity, cannot be underrated. This could be judged from its influence on the productivity of countries that are most affected by the disease. Some empirical researches have correlated the life expectancies of these countries with their respective GDPs. Therefore, this paper has validated that there is a positive relationship between HIV/AIDS pandemic and a decrease in global productivity owing to seriously affected regions.

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