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Research Paper

On The Probability of Any Individual Being Infected By Hiv/Aids in a Year

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ABSTRACT:*In this work, sexual activities of a susceptible population are taken into consideration. It is believed that each sexually active individual has sexual intercourse with at least a partner for at least once in a year. The probabilities of getting infected with the disease by sex were obtained given the same sexual behaviour.*
KEYWORDS:*Sexual behaviour, Susceptible Population, Infection, Probability,Transmission*

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I. INTRODUCTION

A major driver of sexually transmitted diseases in many countries is the Human Immunodeficiency Virus (HIV)Acquired Immune Deficiency Syndrome (AIDS) epidemic. Sexual intercourse is one of the most vulnerable means of the spread of HIV/AIDS. This is because the likelihood is one that there will be at least one act of sexual intercourse every year and this is the more reason why the mode of transmission of HIV/AIDS is highly probable through sex. According to the statistical fact sheet published by WHO (World Health Organization), the likelihood of a male contracting the disease is 0.2 and that of a female as 0.8. (WHO; 2010)

An intriguing question that remains poorly investigated is whether or not the progression of HIV to AIDS is altered at all by the presence of other diseases. The dynamic of HIV transmission could be sharply altered if other diseases accelerate (or decelerate) the time during which the virus remains inactive. If, on the other hand, immunosuppressant associated with HIV were to increase susceptibility and lower resistance to or decrease the capacity to recover from other diseases, the impact of HIV on morbidity (and its ultimate effects on social and economic outcomes) would be considerably magnified but the dynamic of HIV spread should not be altered.

There are four groups of diseases that may affect HIV progression to AIDS. The first group is again constituted of Sexually transmitted diseases (STD). Circumstantial evidence suggests that individuals with STD experience shorter progression to AIDS (N'Galy et al., 1988). In one study of prostitutes diagnosed with STD the median incubation period was as short as 34 months (Anzala, et al., 1991). A second group of diseases are caused by HTLV- 1 (Human Tcellymphotropic virus type I), the first human retrovirus to be identified. These virus are present throughout Africa and their prevalence is highly correlated with the prevalence of HIV (Verdier et al., 1994). In vitro observations suggest that HTLV tends to activate HIV and vice versa and are confirmed by clinical studies that show sharp reductions in the incubation times of HIV among individuals co-infected with HTLV (Chen and Sankale, 1994).

It is known that people infected with HIV are several times more likely to develop clinical TB and that this occurs as HIV reactivates latent infections with Mycobacterium Tuberculosis (MT) (rather than the latter affecting the chances of infection with HIV). It has been known for years that the reactivation of MT occurs when the immune system is under severe stress (Lunn, 1991) and hence it should not be surprising to verify that infection with HIV and the immunosuppressant that follows lead to a resurgence of TB cases. Malaria is the fourth illness suspected to interact with HIV, but, despite the existence of early evidence supporting mutual activation, the conjecture has never been conclusively proven. Since malarial antigens trigger proliferation of T lymphocytes and reduce the CD4 lymphocyte count, there is reason to believe that infection with the malaria parasite has at least the potential to alter the course of HIV or, conversely, that HIV immunosuppressant may worsen the course of malaria, Morrow, 1989. Since malaria is so prevalent in some areas heavily affected by

HIV (Africa and to a lesser extent Central America), their interaction could have important consequences for the health status of HIV-positive individuals. As in the case of TB, the interaction with malaria not only magnifies HIV's impact on the health of populations but could also alter the dynamics of transmission by modifying the progression from infection to AIDS.

Gender is an important variable in determining the risk of HIV infection. The spread of HIV/AIDs through sex depends on the number of sexual partnerships, the number of acts of intercourse per partnership as well as the likelihood of transmission in a single act of sex. It also depends on the probability that a randomly selected partner is HIV positive.

II. MATERIALS AND METHODS

Let individuals have **m** sexual partnerships per annum, and that the average number of acts of intercourse per partnership is **n**. Furthermore, assume that the probability of transmission in a single act of sex is **β**, and the HIV positive is **P** (the endemic prevalence). Then the probability that any sexually active individual being HIV positive in a year based on the multiplication rule of probability can be obtained as follows:

$P_y = 1 - P_y^1$ (P_y^1 is the probability of not getting infected in a year)

$= 1 - [P_y^1$ is the probability of not getting infected in a year$]^{\mathbf{m}}$

$P_y = 1 - [$ (Probability that a randomly selected partner is HIV positive ***** (Probability of not getting infected by an HIV positive partner)$^{\mathbf{n}}$ + the probability that randomly selected partner is HIV negative$]^{\mathbf{m}}$

Therefore,

$$P_y = 1 - [P(1-\beta)^n + (1-P)]^m$$

P_y = probability of an individual becoming HIV positive in a year
m = number of sexual partnerships per annum
n = number of acts of intercourse per partnership
β = the probability of transmission in a single act of sex.
P = the probability that a randomly selected individual is HIV positive.

III. RESULTS AND DISCUSSION

According to the epidemiological fact sheet an HIV and AIDs, 2008, the probability of a female getting infected with the disease in a single act of sex with an infected male is 0.8 and that of the male is 0.2.
From the data of HIV/AIDS prevalence in Nigeria, the endemic prevalence P is

$$P = \frac{2{,}714{,}000}{40{,}900{,}000}$$

$= 0.06$

and with β = (0.8, 0.2), varies probabilities of infection can be obtained based on varying values of the **m** and **n**. For example, if an uninfected male had 4 sexual partnerships in a year and 10 acts of intercourse per partner, then

$$P_y = 1 - [0.06(1-0.2)^{10} + (1-0.06)]^4$$

$= 0.1976260023$

Similarly, if an uninfected female had 4 sexual partnerships in a year and 10 acts of intercourse per partnership, then

$$P_y = 1 - [0.06(1-0.8)^{10} + (1-0.94)]^4$$

$$= 0.2193$$

Suppose that **m** = 2 and **n** = 30
For Male

$$P_y = 1 - [0.06(1-0.2)^{30} + (1-0.06)]^2 = 0.1163$$

For Female $P_y = 0.1164$
Also with **m** = 2 and **n** = 40
For Male

$$P_y = 1 - [0.06(1-0.2)^2 + (1-0.06)]^{40} = 0.5825$$

For Female

$$P_y = 1 - [0.06(1-0.8)^2 + (1-0.06)]^{40} = 0.9068$$

With**m** = 2 and **n** = 30
For Male $P_y = 0.4806$
For Female $P_y = 0.8313$

IV. CONCLUSION

The results showed clearly that given the same sexual activities and under the same condition of sexual partnership, females are at a higher risk of getting infected than mates. This may be due to the fact that the female reproductive opening has a longer area compared to that of male and the virus can easily be passed to them.

REFERENCES

[1]. AnzalaAO, Simonsen JN, Kimani J, Ball TB, Nagelkerke NJ, Rutherford J, Ngugi EN, Bwayo JJ, Plummer FA.(1991) Acute sexually transmitted infections increase human inmmuno-deficiency virus type 1 plasma viremia, increase plasma type 2 cytokines, and decrease CD4 cell counts. J Infect Dis. 2000 Aug;182(2):459-66.
[2]. Busenberg S and Hadeler K. P. (1990). Demographics and Epidemics Matt Broscil 101, 41-62.
[3]. Chen and Sankale (1994) Slower Heterosexual Spread of HIV-2 than HIV-1, Lancet, 343(8903): 943-946
[4]. Inaba H., Kermack and Mc Kendrick (2001). The variable susceptibility model for infections diseases. Japan J. Industr. Appli Matts, 18 (2) :273-292.
[5]. Joint United Nations Programme on HIV/AIDS (UNAIDS). Global report: UNAIDS report on the global AIDS epidemic 2010. Geneva: WHO; 2010.
[6]. May R.M. and Andersan (1985): Endemic Infections in growing population. Matt biosci: 77:1411-156.
[7]. Morrow (1989) Randomized, Controlled Intervention Trial of Male Circumcision for Reduction of HIV Infection Risks: the ANRS 1265 trial PLoS Medicine, 2: e298
[8]. N'galy B. Ryder R.W and BilaK(1988) Human Immunodeficiency Virus Infection among Employers in African Hospital. N. Engl J. Med. 319:1123-1127
[9]. Sylvain Garden, Margaret Mackinnan, Sean vee and Andrew Recd (2003). Imperfect vaccination: some epidemiological and evolutionary consequences prof R. Soc London 270: 1129-1136.
[10]. Verdier (1994) Sexual Behaviour in Context: A Global Perspective. Lancet, 368: 1706-1728

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