

**A SYSTEMATIC REVIEW OF THE EFFECTIVENESS OF HIV INTERVENTION PROGRAMS ON HIV
RATES, CONDOM USE, AND ABSTINENCE IN ADOLESCENTS IN LOW RESOURCE COUNTRIES
AND
THE PATHOPHYSIOLOGY, ROLE, PREVENTION, AND TREATMENT OF HIV
IN LOW RESOURCE COUNTRIES**

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Abstract: There are extremely high rates of HIV in adolescent girls in low resource countries due to the high incidence and prevalence of sexual violence. In order to decrease these rates of HIV, several educational programs have been conducted and researched in several low resource countries. The purpose of this project was to collect the data of these programs and describe their characteristics, factors included and measured before and after and determine their overall effect. This project aims to study the rates of HIV, the rate of sexual violence, condom use, and sexual practices before and after intervention by education programs. This information can then be used to determine the effectiveness of preventative public health strategies about HIV and sexual violence in adolescents. We found through a meta-analysis that there were no differences between condom use, abstinence, and HIV rates after education programs.

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Introduction

HIV is a disease that can seriously devastate patients when they are diagnosed with it. With its effect on CD4 T cells, it creates high risks for patients to get diseases that are easy to fend off for most people and become life threateningly ill from them. From an economic standpoint, HIV is an extremely expensive disease to treat and in order to control the virus, there needs to be continuous lifelong management. Finally, HIV is also a disease that affects the social aspect of patients' lives, as stigma against people with the disease is prevalent across the world. In some countries, such as Swaziland, where the HIV rates are amongst the highest in the world, there are superstitions that if men have sex with virgins, they can cure themselves of HIV (Shannon, 2012). Often times, when girls are found to be HIV positive, they are shunned from their families and society and can often only work in prostitution to survive (Hatcher, 2015; Shamos et al, 2009; Sprague et al, 2015). Exaggerated superstitions and stigma further propagate the disease and causes patients suffering both socially and economically in their societies (Maughan-Brown et al, 2014).

When looking at the epidemiology of HIV infections in low resource countries, adolescent girls and young women (ages 15-24) account for 60% of people newly affected with the disease every year (WHO, 2013). In comparison, the population most highly diagnosed with HIV every year are males between the ages of 20-29 in the United States (CDC, 2015). Extensive research in the past has shown that this disparity in the affected populations is because of high rates of sexual violence against adolescent girls in these low resource countries (WHO, 2013).

Superstitions like the one mentioned previously about men having sex with virgin females contribute to these rates of HIV among young women who not only have to live with a devastating disease, but also with the trauma of sexual violence for the rest of their lives.

Research has consistently shown that sexual violence has an increased chance of transmitting HIV from person to person because of the violent nature of the act, the lack of contraception in most cases, and the inability of the victim to negotiate.

Because of the extremely high rates of HIV affecting adolescent girls and young women in low resource countries, we feel that implementing programs that target adolescent population of

both boys and girls and educating them about safe sex, HIV, and condom use will decrease the chances of misinformation being spread, the propagation of sexual violence, and increase the chances of people taking measures to prevent contracting HIV (Fevissa, 2015). Several types of educational programs have been implemented across the world in developing countries to try and reduce HIV rates and sexual violence. Many randomized control trials have implemented programs in schools, communities and clinics where different types of programs ranging from behavioral interventions, to education about HIV knowledge and healthy relationships, to discussions about gender norms and safe sex practices. All of these different types of programs have aimed to decrease the incidence of HIV, increasing HIV testing, and decrease gender-based violence. In one primary journal article, their program, they measured the prevalence of HIV in women and men in both the control and intervention groups before and after they intervened with their education program. After implementing their program, when they measured the incidence of HIV in all of the groups, they found a significant decrease in HIV rates in the intervention group as compared to the control group, indicating that HIV education programs can help decrease HIV infection rates (Jewkes et al., 2006). Another randomized control study done in Swaziland showed that between the intervention group and the control group, the intervention group had significantly better HIV knowledge, self-efficacy for abstinence, condom use, getting HIV test results, and knowing one's HIV status. This program was implemented in a school setting and demonstrated how these programs can successfully increase HIV testing in youth (Burnett, 2011)

This paper will be a systematic review of research on HIV in low resource countries with a focus on research that have implemented educational programs aimed at adolescents to teach them about safe sex, condom use, and HIV. If we find that there is a positive correlation between a decrease in HIV transmission, and an increase in an understanding of how HIV is transmitted from these programs, then the systematic review will be a strong force in driving further research and implementation of such programs into adolescent education in low resource countries across the globe. If the systematic review finds that there is no correlation between the education programs that have been implemented and a decrease in HIV rates and an

increase in understanding of HIV transmission, then future research can focus on figuring out why these programs failed and focus on different approaches to the problem.

Methodological Approach

This systematic review focused on gathering research evidence on the correlation between HIV rates in low resource countries. Along with establishing what evidence research shows about how these variables are connected, I focused on gathering evidence of studies that have been implemented in low resource countries that focus on education on safe sex, HIV, and condom use. The primary goal of this paper is to evaluate what programs have been implemented in low resource countries and what the outcome of these programs were on the rates of education about HIV and decrease in HIV rates, increased condom use, and increased abstinence following the programs. Once I gathered all the data on the programs that have been implemented and their outcomes, I compiled the research and assessed the overall quality of education on HIV rates, sexual practices, and condom use.

I have primarily used PubMed, the Arizona Health Sciences Library, and Google Scholar as the databases to find pertinent literature and primary journal articles on HIV and sexual violence education programs. From there, I have also referred to the references section of several high quality primary research and other systematic reviews to find additional literature relevant to my research question. My inclusion criteria involves primary journal articles that have implemented randomized control trials for their educational programs on sexual violence and HIV. My exclusion criteria include studies that don't discuss HIV rates and non-English articles. I have included a table of keywords I have used as well as search strings and number of usable journal articles from these searches below. I also used the reference section of other systematic reviews and journal articles to find primary journal articles not found through PubMed.

Search strings and Useable Articles

HIV education programs	25 usable articles
Violence HIV developing countries	16
Intimate partner violence HIV	15
HIV stigma developing countries	12
Sex education developing countries	20
Sexual violence health	7

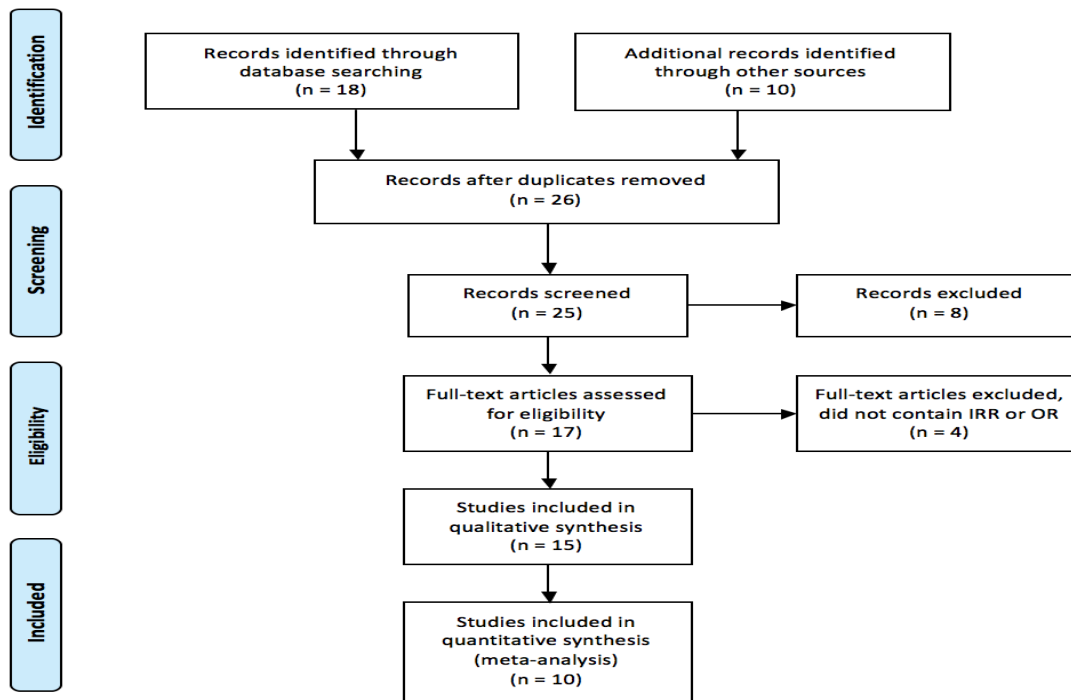


Table 3. Flow Diagram Describing the Literature Search Criteria and Strategy

In the initial review, I looked at titles and abstracts that met the search criteria to see if they qualified for further review. Once articles were determined to be eligible for review, the full article was retrieved and they were assessed to extract relevant data. Texts were excluded if they did not have original data, if they were not random control trials, and if they didn't include odds ratios, relative risk ratios, or confidence intervals for the relevant variables. Data extracted from the papers included the study characteristics such as the year it was published, locations, population, study type, type of intervention, and method of statistical analysis (Table 2).

Article	Population	Study Design	Intervention (rHFSC)	Control (IVF)	Primary Outcome	Secondary Outcomes
	Age	Prospective	Type of Intervention	Type of control	HIV Rates	HIV Knowledge
	Gender	Retrospective	Number of people in this intervention (n, %)	Number of people in this control (n, %)	Percent of people with HIV in intervention	
	Country	Pre/Post	Include Sex Education		Percent of people with HIV in control	
	Ethnicity	Case-control			Reported Odds Ratios	
					Relative Risk	
					Risk Ratios	
					Hazard Ratios	

Table 4. Table Representing Primary and Secondary Outcomes

Results

From the primary journal articles I have researched on educational programs implemented in randomized control trials, I have chosen several variables and outcomes that I focused on finding in order to create a standardized analysis. I looked at HIV incidence, condom use, abstinence and sexual practices as my primary outcomes. Some of my secondary outcomes included HIV testing rates and overall STD rates to assess how well the education programs objectively helped decrease the incidence of diseases.

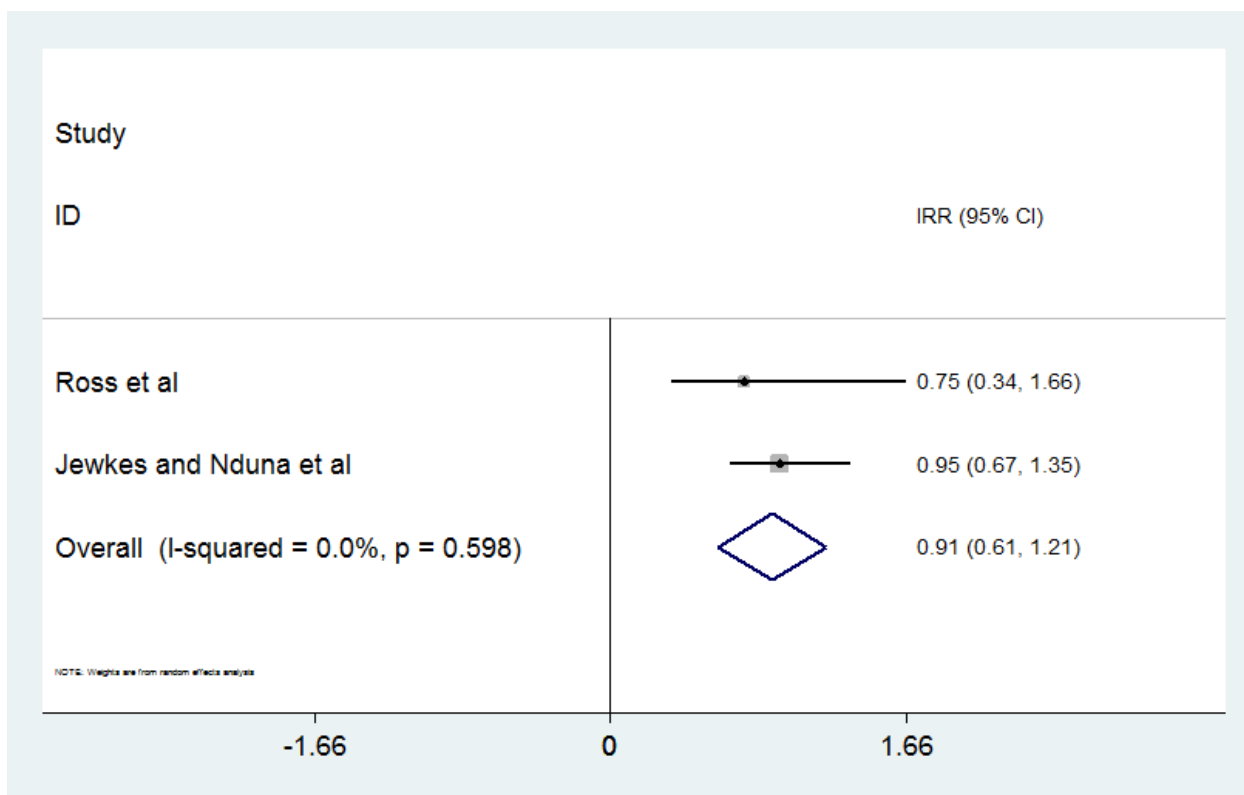


Figure 4. Incidence Rate Ratios of HIV incidence between intervention and control groups

Studies conducted in several settings with different programs show that HIV incidence in the intervention groups did not differ from rates of HIV in the control group.

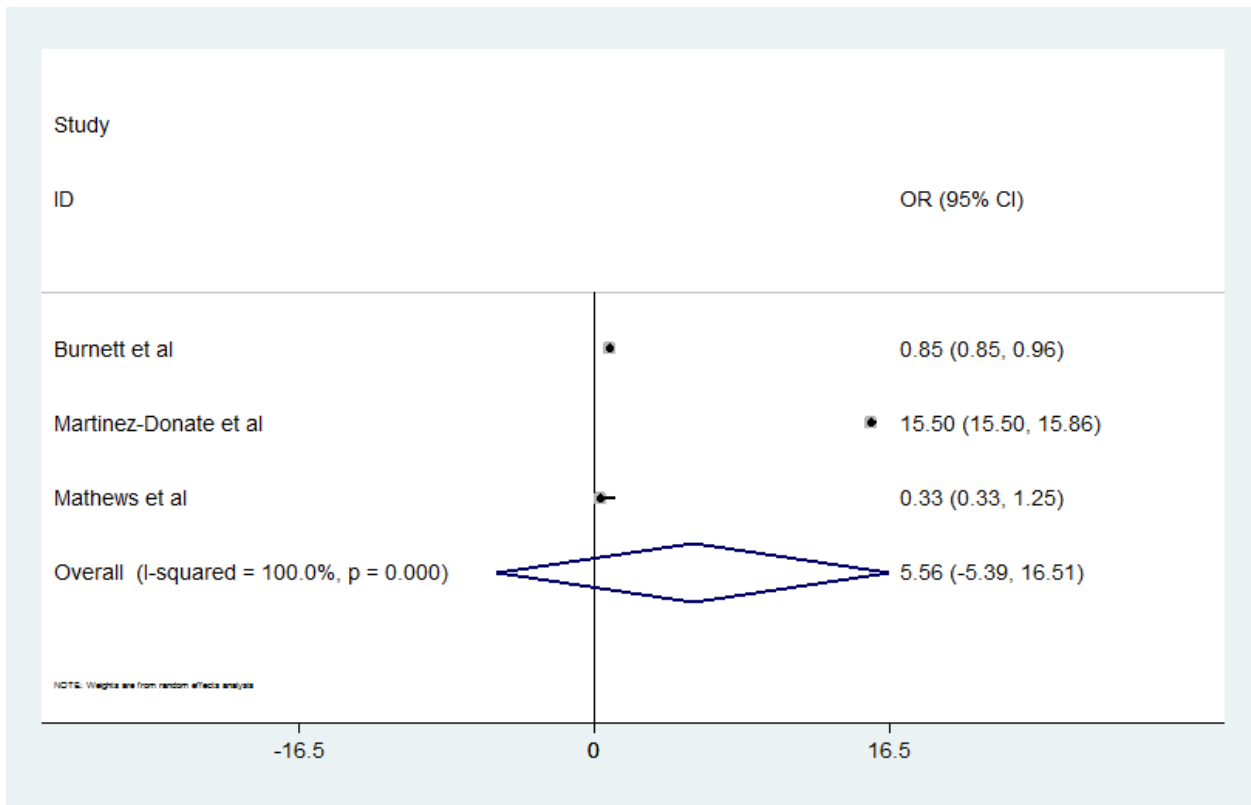


Figure 5. Odds ratios of condom use between intervention and control groups

Meta-analysis of condom use between the intervention group and the control group show that there is no statistically significant difference between the groups.

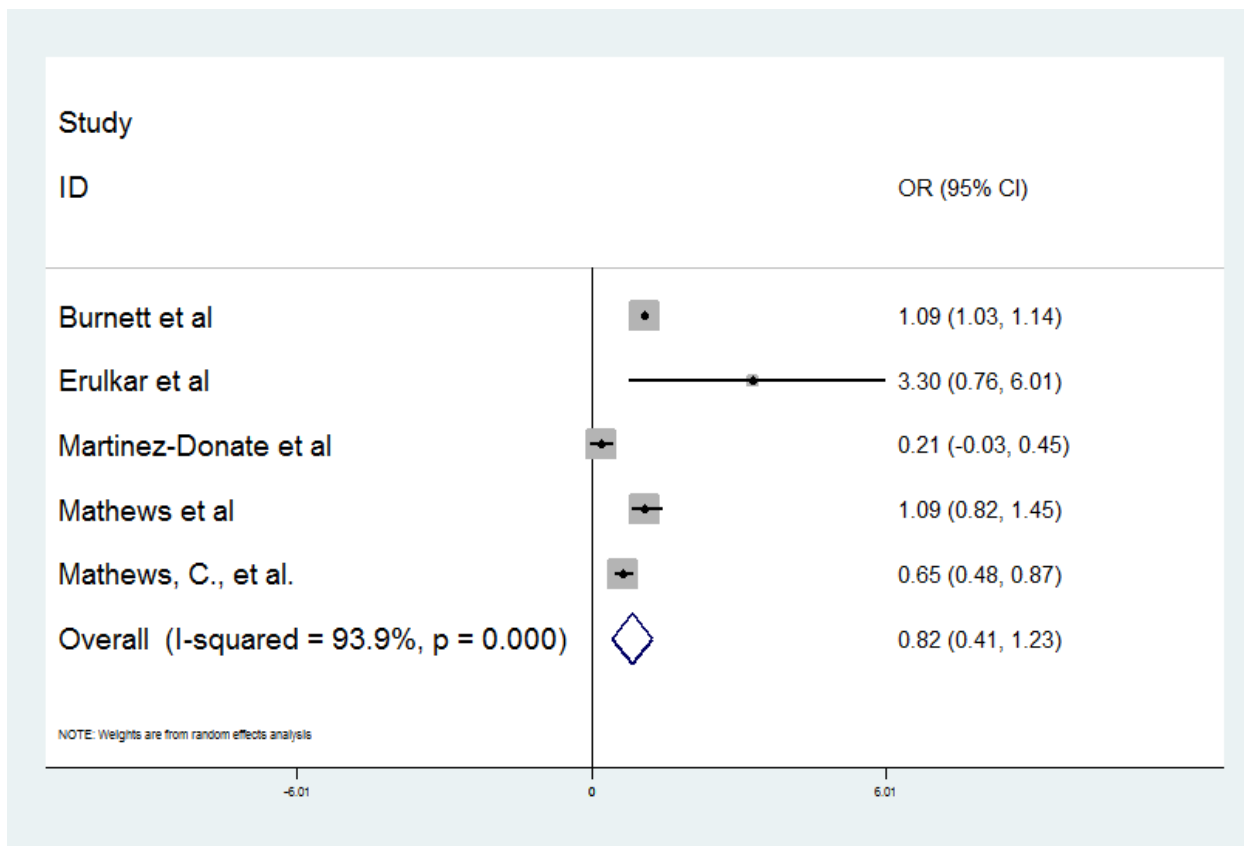


Figure 6. Odds ratios of abstinence and sexual practices between intervention and control groups

Analysis of five studies reported data that the intervention decreased abstinence compared to the control group, though the meta-analysis showed that this difference was not statistically significant.

Discussion

This systematic review aims to look at the evidence in research for educational programs about HIV, safe sex, and healthy relationships implemented in low resource countries geared towards the adolescent population. If the compilation of the results from these programs show an overall increase in education on HIV, and a decrease in HIV rates, this can demonstrate good evidence towards a preventative medicine strategy that can be implemented across schools and communities in countries with extremely high rates of HIV. Based off of this systematic review's analysis of the components of the programs that have been implemented, future researchers can also gain a better understanding of what strategies and factors are beneficial to include in their educational programs and what strategies did not work well in prior research.

1. HIV Incidence

The analysis showed that there was no statistically significant difference between the incidence rate ratios of HIV incidence between the intervention and control groups. Both articles included in the analysis showed no difference and the confidence interval for the meta-analysis was small. However, it was difficult to find articles that included incidence rate ratios and confidence intervals for HIV incidence, so the power of the meta-analysis is low. I hypothesized that the intervention would decrease HIV incidence, but this was not found in any of the randomized control trials that I read.

2. Condom Use

Meta-analysis of condom use between the intervention group and the control group show that there is no statistically significant difference between the groups. Burnett at al and Martinez-Donate et al showed statistically significant differences but Mathews et al did not. However, in the Martinez-Donate et al study, the intervention group increased their condom use by twice the amount after the intervention while the control group had not changed in condom use, so the odds ratio for that study was extremely high. Therefore, in the meta-analysis, the confidence interval was wide, making it statistically insignificant. The analysis did not support my hypothesis that condom use would increase in the intervention group compared to the control group.

3. Abstinence and sexual practices

The meta-analysis of the five studies showed that there was a decrease in abstinence in the intervention group compared to the control group, though this was not statistically significant. Three of the five studies in the analysis showed a statistically significant difference with small confidence intervals, showing that there's decreased abstinence in the intervention groups. The study by Erulkar et al showed no difference between the intervention group and control with a wide confidence interval, which contributed the most to the lack of significant difference in the meta-analysis. This finding was the opposite of what I expected in my hypothesis, showing that education about HIV, condom use and sexual practices actually increased initiation of sex and decreased abstinence.

Conclusion

The goal of this project was to compile data on the research that is out there on educational programs and analyze how these programs have been used to decrease HIV rates and increase HIV education and awareness of healthy relationships. The meta-analysis showed that of the primary outcomes that I looked at, none of them supported my hypotheses. The educational programs in the interventions did not decrease HIV incidences, increase condom use, and decrease abstinence or sexual practices. Possible reasons for this could include the fact that none of the articles I looked at used the same educational intervention, so there was no standardized program that was analyzed across several trials. Another reason could be that most of the articles had several participants that they had lost in follow up, which could have decreased the power of their studies. Ultimately however, meta-analysis of several randomized control trials of education programs in low resource countries on HIV showed that these programs did not have a significant effect in decreasing HIV incidence, increasing condom use, and decreasing sexual practices. Although the interventions showed promise of increasing education in adolescents, they are still lacking in creating a difference that lasts in making a difference in HIV transmission. Therefore, these programs need to be re-assessed and re-implemented in new trials to continue to improve educational tools that can create a lasting impact in decreasing HIV rates and safe sex practices.

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**THE PATHOPHYSIOLOGY, ROLE, PREVENTION, AND TREATMENT OF HIV
IN LOW RESOURCE COUNTRIES**

HIV in Low Resource Countries

HIV has become an epidemic over the last 30 years, especially in developing countries. It is so prevalent in these countries that they harbor 68% of all HIV infections, despite only having 13% of the world's total population¹. Because of the extremely high incidence and prevalence of the disease in low resource countries, there was a Joint United Nations Program on HIV/AIDS (UNAIDS) created, with the goal to decrease and eradicate AIDS by 2030. Their goal consisted of making a plan to initially have 90% of those with HIV knowledgeable of their status, 90% of those who know their status able to receive antiretroviral therapy (ART), and 90% of those on ART with viral suppression¹. The numbers goal included to reduce the incidence of HIV to less than 500,000 new infections by 2020, and less than 200,000 by 2030, and to decrease mother to child transmission to less than 50 infants infected in 100,000 live births¹.

This epidemic has been the most prevalent in sub-Saharan Africa, but in the early 2000s, the epidemic also began to spread widely to Latin America, the Caribbean, and several parts of Asia. The first case of documented AIDS in a low resource setting was in the 1980s in Zaire, now known as the Democratic Republic of Congo, where it began by affecting predominantly heterosexual communities. It then spread to Rwanda and Uganda, and was initially called "Slim disease," as it was associated with severe diarrhea and weight loss². The disease subsequently spread to South Africa in the mid to late 1980s. While the spread of HIV was mostly associated with heterosexual sex practices, the progression and spread of the disease in Latin America has been more closely associated with intravenous drug use (IVDU) and men who have sex with men (MSM). Meanwhile, in Asia, the first reported cases of HIV were in Thailand, India, and China in the late 1980s, and has been frequently associated with female sex workers and IVDU². However, in more recent times in several Asian countries, there has been a decrease in sex workers and IVDU transmission of HIV and increase in the MSM HIV epidemic. For example, in China, the proportion of MSM in annual reported HIV cases increased from 12% in 2007 to 33% in 2009³.

As mentioned previously, 68% of people infected with HIV reside in low income countries, and when including middle income countries as well, that jumps up to 91% of all people infected with the virus, or approximately 30 million people. The region with the highest rate of infection continues to remain sub-Saharan Africa, with greater than $\frac{3}{4}$ of all the HIV cases in low income countries. While the rate of HIV in the USA is about 1 in every 300 people, in parts of Africa, it is as high as 1 in every 25 people. Globally, the worst affected country is Swaziland, where 26% of adults are infected with HIV^{2, 4-8}.

In low resource countries, numerous behavioral factors contribute to the spread of HIV, namely the number of sex partners, condom use, age of sexual debut, intergenerational sex, and sex networks^{4,6,7}. Many of these countries also lack circumcision, which has been associated with increased risk of transmission when having sex with a person infected with HIV. Studies have shown that there is a 60% risk reduction of receiving HIV with circumcision⁹⁻¹⁰.

HIV Pathophysiology, Diagnosis, Transmission, and Mortality

HIV is a retrovirus that was first identified in 1981 in North America, with the geographical origin suspected to be in west-central Africa. HIV's mechanism of action involves mainly attacking the CD4 T-lymphocytes, preventing the activation of cell-mediated and humoral immune systems¹¹⁻¹³. HIV can remain dormant in a human for on average between 2-15 years, where once it is able to successfully replicated and attack enough CD4 cells in the body, is able to collapse the immune system and throw the patient into having acquired immune deficiency syndrome (AIDS), as seen in Figure 1.

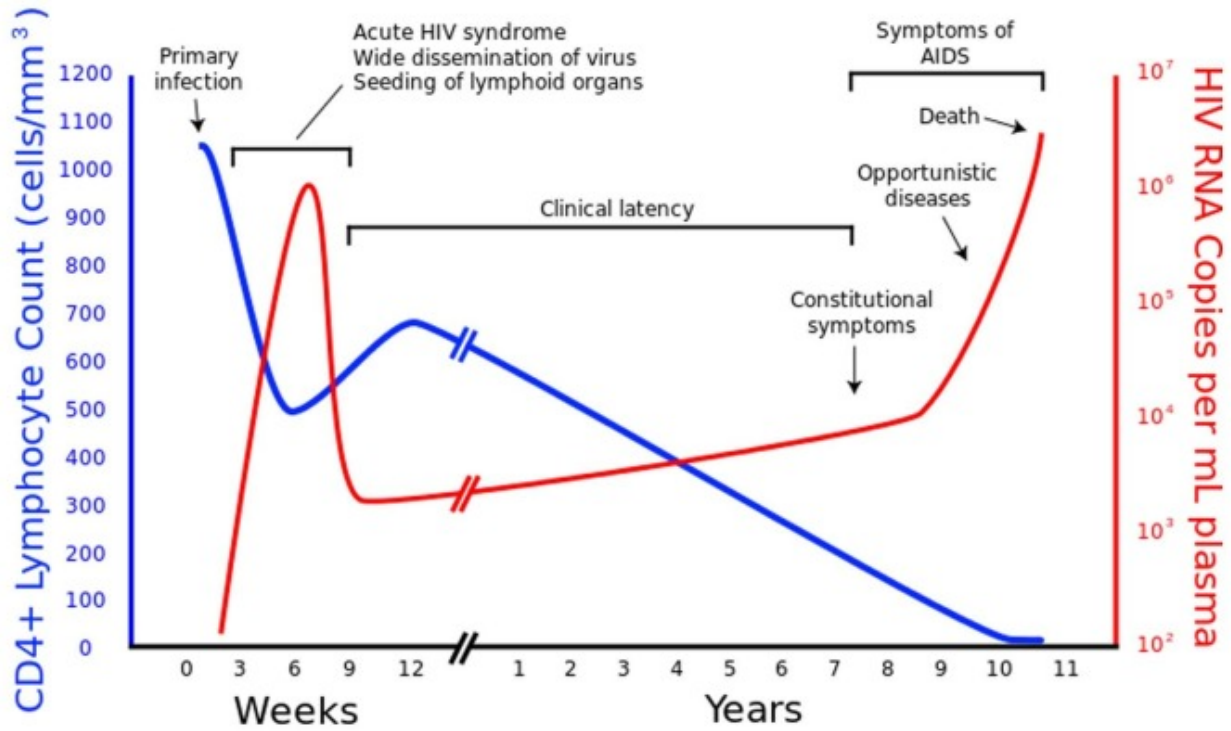


Figure 1. Mechanism of infection and progression to AIDS for HIV

There are two main subgroups of HIV, broken up into HIV-1 and HIV-2. HIV-1 is the most commonly spread subgroup, and specifically, of the four lineages that exist within HIV-1 (M,N,O,P)¹⁴, M is the most common and causes the most frequent pandemics. The N lineage is mostly seen in Cameroon¹⁵, the O lineage is rare, accounting for 1% of cases, and also only seen in Cameroon and Gabon, and P is the rarest, only seen in Cameroonian women in France, accounting for 0.06% of cases¹⁴⁻¹⁸. Often times, as different lineages mix in transmission from one person to another, genetic recombinations of the various forms develop subepidemics that can be resistant to some standard treatments, and are referred to as circulating recombinant forms (CRFs). There are currently 48 known circulating recombinant forms, termed CRF 01-48, which is visually demonstrated on Figure 2 below¹⁹.

HIV-2 is the other subgroup, and it is most common in West Africa, where the highest incidence is in Senegal. There have been eight subgroups identified, ranging from A-H, with specific regions more commonly having certain subgroups. HIV-A is more common in the sub-Saharan region, HIV-B more common in the Ivory Coast, and C-H are termed “dead-end transmissions,” which refers to the fact that they are very sporadic infections and the incidence is very difficult to estimate²⁰⁻²².

As HIV is a retrovirus and able to highly mutate to avoid a standard treatment, at least three medications, or antiretrovirals, are needed in order to suppress the virus. If three or more medications are used in combination, it is often termed highly effective antiretroviral therapy, or HAART, as these combinations are extremely good at decreasing the multiplication of HIV and increasing the patient’s CD4 count to lengthen the asymptomatic phase and slow the progression to AIDS.

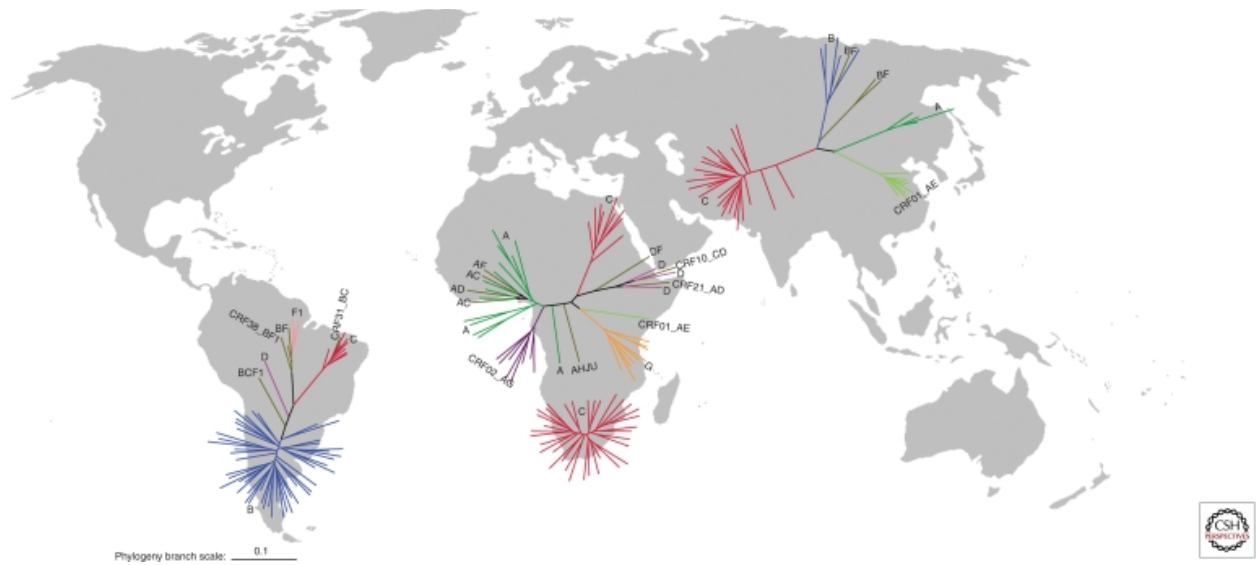


Figure 2. The diversity of HIV infections in Africa, Asia and Latin America with the number of sequences within each phylogeny proportional to percent subtype contributing to each epidemic.

HIV In Adolescents

HIV infection and transmission is especially concerning in the younger population, as in recent years, 60% of HIV transmission occurs in those aged 15-24 years old, and at least 5-6,000 young people are infected every day. Of those aged 15-24 with HIV in sub-Saharan Africa, 70% of them are female². Research shows that these high rates of transmission are due to lack of knowledge about HIV, lack of education and life skills, poor access to health services and commodities, early sexual debut, early marriage, sexual coercion, violence, trafficking, and lack of parental protection. In the hardest hit countries, adolescent girls account for more than 80% of all new HIV infections amongst adolescents, and globally, adolescent girls and young women aged 15-24 years old are twice as likely as males of the same age to be at risk of HIV^{2,23-24}. Of the 26 million people living with HIV in low resource countries, around 2.3 million of those are children under the age of 15 years old. In addition, 90% of all children living with HIV are in sub-Saharan Africa, which also account for 70% of AIDS related deaths in the world^{2, 23-24}.

Role of Intimate Partner Violence (IPV) and HIV Transmission

It is estimated that each year, 4.8 million intimate partner physical and sexual assaults occur against women, and one in four women will experience domestic violence in their lifetimes, often higher in developing countries²⁵. Often times, there are strategies being placed for women in these situations to find safety, but one of the major aspects of their safety that is often ignored is their need for strategies to reduce sexually transmitted infections (STIs), which includes HIV. According to the CDC, women in relationships with violence have four times more likelihood of contracting STIs, including HIV.

Risky Behavior Amongst Women Who Experience IPV

Multiple aspects play into the reason behind this, but one of the major ones is that victims of IPV report partaking in more risky behaviors, including IVDU, having multiple sex partners, and having to participate in anal intercourse without the use of a condom²⁶. Some studies have even found that there is an inverse correlations between IPV and condom use²⁷.

Coercion and Lack of Empowerment in Relationships

Another factor that plays into the increased risk of transmission of HIV in women experiencing IPV is the coercive nature of sexual acts from their partners. Partners often refuse to wear condoms, there is a correlation with increased IVDU amongst coercive partners, and abusive partners also often limit early diagnosis and treatment for these women²⁸. This study also found that IPV was associated with inconsistent condom use, multiple STIs, early sexual debut, multiple sex partners, especially amongst adolescents. Some cross-sectional studies have found that HIV, IPV, and substance use may constitute a syndemic. A study by Dunk et al found that the association between IPV and HIV infection has an odds ratio of 1.48, with a 95% confidence interval of 1.15-1.89, specifically done in South African women after adjustment for risky behavior²⁹.

IPV on ART Access and Adherence

In addition to physical and sexual coercion, economic and financial control against women who suffer IPV has also demonstrated a strong association with increased HIV infection. In a study in South Africa with an intervention of using microfinance in women compared to placebo, there was a reduction in IPV by 55%²⁹.

Even in resource rich settings, clinical samples estimate that 68-95% of HIV positive women experience IPV³⁰. In resource poor countries, HIV positive women are twice as likely as HIV-negative women to report lifetime violence from their partner³¹. Not only does IPV lead to increased rate of infection, but also to decline in HIV-related health overall, as there are also multiple studies showing an association between IPV and inappropriate viral suppression, lower CD4 counts, and higher incidences of opportunistic infections³²⁻³⁴. There is also an increase in intermittent diseases, such as pneumonia, bronchitis, sinusitis, and a greater risk of overall mortality. Women who face IPV have a significant negative impact on access to care and poorer health outcomes when they are HIV positive. IPV has also shown reductions in the odds of ART adherence as seen in studies by Cohen et al, which demonstrated that lifetime trauma increases nonadherence, even when they controlled for depression, substance abuse, and race²⁹⁻³².

HIV Education Programs for Adolescents

When the UNAIDS set the goal of educating 90% of the population infected with HIV about their status, many education programs were created and studied in hopes of finding the best curriculum to reduce the transmission of HIV and increase treatment. Several of these studies have found varying data on types of interventions, especially in the adolescent population in developing countries, a group that is known to be the most vulnerable. Many of these school or afterschool based curriculums that have been studied have focused on reducing risky behaviors amongst adolescents, specifically sexual initiation, frequency of sex, number of partners, and condom use³⁵.

A study done in 2011 by Burnett et al., evaluated the effectiveness of a 13 week life skills based HIV prevention education (LSBE) program at a school in Swaziland that focused on increasing HIV knowledge of the students participating and changing attitudes and their behavior related to: abstinence, condom use, knowledge of one's own HIV status, and knowing their partner's HIV status. Their outcomes showed that both teaching about condom use and abstinence had a significant effect on their attitudes and performing risky behaviors assessed via surveys, but knowing one's own HIV status or one's partner's HIV status did not change the attitudes or behaviors³⁵.

Another study that showed similar findings was by Martinez-Donate, where they assessed adolescents in Tijuana, Mexico on: sexual initiation, condom use, intention to use condoms in the future, and attitudes towards condoms. Using self-administered surveys, they found that while boys were more likely to engage in sex earlier than girls, girls were more likely to have unprotected sex. After the intervention, the girls were more likely to avoid unprotected sex in the future and held more favorable attitudes towards condoms³⁶.

Overall, many randomized control trials that implement a curriculum for adolescents have shown a decrease in risky behaviors. However, these studies have not yet looked longitudinally following these groups of adolescents to see if there was any decrease in HIV incidence or an increase in treatment adherence yet. Since UNAIDS set their goal, there has been a significant

decrease in HIV morbidity and mortality in developing countries. Data shows that in 2015, there were 1.1 million deaths related to AIDS worldwide, as compared to 2 million in 2005. In addition, there was a 45% decrease in in new infections between 2000 and 2015². These educational programs for adolescents could play a major role in helping decrease the HIV epidemic in developing countries and aid with the goals of UNAIDS, but more longitudinal data and follow up from these programs is necessary to find the best curriculums to combat the epidemic.

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