Title
The influence of information sources on HIV-related knowledge of Indian adolescents

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Publication Date
2015

Peer reviewed|Thesis/dissertation

UNIVERSITY OF CALIFORNIA

Los Angeles

The influence of information sources on HIV-related knowledge of Indian adolescents

A dissertation submitted in partial satisfaction of the requirements for the degree Doctor of Philosophy in Public Health

by

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2015

ABSTRACT OF THE DISSERTATION

The influence of information sources on

HIV-related knowledge of Indian adolescents

by

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Doctor of Philosophy in Public Health

University of California, Los Angeles, 2015

Professor Linda B. Bourque, Chair

Indian adolescents are particularly vulnerable to HIV due to their well-documented lack of information about the disease. While there is ample evidence pertaining to the role of structural factors in the transmission of HIV-related information, much less is understood about the transmission of accurate and inaccurate information among information sources that Indian adolescents have at their disposal.

This dissertation investigated the role of information sources in the transmission of HIV-related knowledge in a nationally representative sample of Indian adolescents who are aware of the disease. A combination of multivariable regression and multiple mediation models examined secondary data from the National Family Health Survey-3 (2005-2006) (N=35,603).

Results revealed a disproportional reliance on non-reciprocal information sources coupled with an underutilization of reciprocal sources that served as conduits for accurate information. Television was the most common source of information and the most effective in terms of increasing comprehensive knowledge. In contrast, health workers were the least utilized source but the most efficacious at increasing accurate information pertaining to condom availability, mother to child transmission, and the availability of health services. Multiple mediation models also determined that sources of information fully or partially mediated nearly three-quarters of the established relationships between demographic characteristics and HIV-related knowledge.

Globally, social networks are rapidly increasing in size, composition, and speed. These findings underscore the importance of understanding, mitigating, and leveraging the social network properties that both constrain and promote HIV prevention efforts in our increasingly interconnected world.

The dissertation of Karen Marissa Byrnes is approved.

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Leibowitz, AA, Byrnes K, Wynn A, & Farrell, K. (2014). HIV Tests And New Diagnoses Declined After California Budget Cuts, But Reallocating Funds Helped Reduce Impact. Health Affairs, 33(3): 418-426.

Leibowitz AA, Parker KB, Rotheram MJ. (2011). A U.S. policy perspective on oral pre-exposure prophylaxis for HIV. American Journal of Public Health. 101(6): 982-5.

CHAPTER ONE: INTRODUCTION

India is home to 1.2 billion people, 2.4 million of whom are currently estimated to be living with HIV. With an official adult HIV prevalence rate of .31%, the nation ranks 84th in the world in terms of disease proportional to the population but it has the third highest number of infected individuals (NACO, 2011; World Bank 2011). While unprotected commercial female sex work, unprotected sex between men, and intravenous drug use drive and maintain India's HIV epidemic, the disease has been steadily moving into rural communities and affecting the general population. Today, 2/3 of all HIV-positive Indians live in rural areas. Over half of all infections are in women and 80% of those women are in monogamous relationships (NACO, 2011; Perkins et al., 2009). The burden of disease is concentrated in people younger than 45 years of age and 36% of all infections are in young people below the age of 25 (NACO, 2011).

In India, unprotected sex accounts for 88% of incident HIV infections and sexual activity often begins in, or near termination, of adolescence. Marriage is nearly universal and the sexual debut of women usually occurs with marriage (or after menarche in the case of child marriage) (Santhya, 2011). In spite of the federal law that prohibits marriage under the age of 18, more than a quarter of adolescent girls in India are married (NFHS-3, 2007). On average, marriage occurs later for men (mean age of 22.6) but it is estimated that 48% of males engage in premarital sex (NFHS-3, 2007; Hawkes and Santhya, 2002). Of those, 20% engage in sex with female commercial sex workers (Jejeebhoy, 1998) In a study investigating homosexual behavior in rural

Indian men, 9.5% of sexually active unmarried men reported unprotected anal sex with a man in the previous year (WHO, 2010).

Indian adolescents (13-19 years old) are considered particularly vulnerable to HIV in large part due to their well-documented lack of information about the disease (Char, et al., 2011; Jejeebhoy, 1998). The most recent National Family Health Survey [2005-2006] (NFHS-3) conducted under the direction of the Ministry of Health and Family Welfare indicates that while awareness of HIV is relatively widespread among adolescent boys, "comprehensive knowledge" among either gender is not. In India, a person with "comprehensive knowledge" of HIV is defined by the Ministry of Health and Family Welfare as someone who provides five correct answers to a set of five prompted questions: Can people reduce their chances of getting HIV by using a condom every time they have sex? Can people reduce their chances of getting HIV by having just one uninfected sex partner who has no other sex partners? Can people get HIV from mosquito bites? Can people get HIV by sharing food with a person who has HIV? Is it possible for a healthy-looking person to have HIV? Sixty-four percent of adolescent girls and 87% of adolescent boys have heard of HIV yet, out of those, only 30% of girls and 41% of boys have comprehensive knowledge about the disease (NFHS-3, 2007).

Data from the NFHS-3 also illustrates significant gender-based imbalances in the ***types*** of HIV-related knowledge that adolescents have about HIV and how to protect themselves against infection. Just over half of girls who have heard of HIV know that using condoms reduces the risk of HIV compared to 83% of boys, yet more girls than boys are aware that HIV can be transmitted from a mother to her child (76%

vs. 72%, respectively). Girls and boys are equally uninformed about the existence of antiretroviral therapy for HIV-infected individuals (87% unaware) but more boys than girls know where to obtain an HIV test (52% vs. 43%) and 68% of boys report the ability to obtain a condom compared to only 13% of girls (NFHS-3, 2007).

While there is ample evidence that cultural inhibitions about the discussion of sexuality, low rates of school enrollment coupled with limited sexual education curricula, low literacy rates, and inequitable access to media outlets play an important role in the transmission of information about HIV (Char et al, 2011; Sarkar, 2008; Santhya & Jejeebhoy, 2007; USAID, 2003; Jejeebhoy, 1998), much less is known about how accurate and inaccurate information is transmitted among the information sources that Indian adolescents have at their disposal. Peer networks and mass media outlets are often reported to be the most relied upon sources of information about sexual and reproductive health in Indian adolescents (Char et al., 2011; Nair et al., 2011; NFHS-3, 2007; ICRW, 2006; Goyal & Khanna, 2005; Jejeebhoy, 1998) yet little work has been done to understand how these – and other less-utilized sources of information – contribute to the transmission of specific types of HIV-related knowledge.

Since accurate and comprehensive information about HIV is fundamental to behavior change and service utilization (UNICEF, 2011), understanding more about the transmission of accurate and inaccurate information in adolescent populations is critical.

This dissertation examined the associations between eight sources of HIV-related information [five non-reciprocal sources: television, radio, print, posters, and

cinema and three reciprocal sources: peers, teachers, and health workers] and four types of HIV-related knowledge [comprehensive, condom availability, mother to child transmission, and health services availability] in Indian adolescents that are aware of the disease.

The theoretical context for this study was based, first, on the network perspective that individuals are embedded in social networks that both constrain and diffuse HIV prevention messaging (Valente, 2010; Kohler et al, 2007). It was guided by the Social Integration Framework proposed by Berkman et al (2000) that conceptualizes how social networks serve as the conduit through which structured social interaction takes place. Finally, it relied on the principles set forth in the Theory of Gender and Power which asserts, in part, that social norms affect and perpetuate gender-based inequities in access to information. (Connell,1987).

This study employed four specific aims and 11 research questions to investigate the primary research question: *What are the associations between the sources of HIV-related information and types of HIV-related knowledge in Indian adolescents who are aware of the disease?*

Specific Aim One: To describe the individual characteristics of adolescents who are aware of HIV.

Research question 1: Which individual characteristics are associated with being aware of HIV?

Specific Aim Two: To describe where HIV-aware adolescents obtain their HIV-related information.

Research question 2: From which reciprocal and non-reciprocal sources do adolescents obtain their HIV-related information?

Research question 3: Do individual characteristics explain where adolescents obtain their HIV-related information?

Research question 4: Do individual characteristics explain whether adolescents obtain all of their HIV-related from reciprocal as compared to non-reciprocal sources?

Specific Aim Three: To describe what types of accurate and inaccurate HIV-related knowledge HIV-aware adolescents possess.

Research question 5: What types of accurate HIV-related knowledge do adolescents possess?

Research question 6: What types of inaccurate HIV-related knowledge do adolescents possess?

Research question 7: Do individual characteristics explain whether adolescents possess accurate as compared to inaccurate types of HIV-related knowledge?

Research question 8: Do the individual characteristics that are associated with being unaware of HIV differ from the individual characteristics that are associated with inaccurate HIV-related knowledge?

Specific Aim Four: To determine whether there are association between the sources of HIV-related information and HIV-related knowledge among HIV-aware adolescents.

Research question 9: Do associations between sources of HIV-related information and HIV-related knowledge exist among adolescents?

Research question 10: Do individual characteristics serve as rival independent variables and have associations with both sources of HIV-related information and HIV-related knowledge?

Research question 11: Do sources of HIV-related information mediate the relationships between individual characteristics and HIV-related knowledge?

To achieve these aims, secondary analysis was conducted on a sample of 35,603 adolescents (15-19 years old) in India from the National Family Health Survey-3 (2005-2006). The National Family Health Survey (NFHS-3) is a nationally representative sample administered to households (n=109,041) and 15-49 year old men and women (n=198,754) in all 29 states of India in 2005-2006. The NFHS-3 is the third wave in a series of national Demographic and Health Surveys that are supported by the Government of India's Ministry of Health and Family Welfare. The NFHS-3 employed a multistage sample design to gather comprehensive information on household population and housing characteristics, including HIV/AIDS-related knowledge, attitudes, and behavior.

Using Stata version 12 and Mplus version 7.2, a combination of bivariate analysis, multivariable regression analysis, and multiple mediation analysis techniques were employed to address each of the four Specific Aims and the 11 corresponding research questions.

CHAPTER TWO: BACKGROUND

HIV IN INDIA: AN EPIDEMIOLOGIC OVERVIEW

The Acquired Immune Deficiency Syndrome (AIDS) and its source, the Human Immunodeficiency Virus (HIV) were first identified in India in 1986 (John et al, 1987).[1] While the earliest confirmed cases of the disease were concentrated in specific sub-populations residing in large urban centers, the epidemic has been moving into rural communities and affecting the general population (Yadav et al., 2011; Chandrasekaran et al., 2006; O'Neil et al., 2004). By the year 2000, HIV had been detected in nearly all areas of India (Verma et al., 2004). Currently 2.4 million people are estimated to be living with the disease (NACO, 2011; UNGASS, 2010a).

India is home to 1.2 billion people (World Bank, 2011). With an official adult HIV prevalence rate of .31%, the nation ranks 84th in the world in terms of disease proportional to the population but it has the third highest number of infected individuals (NACO, 2011; World Bank, 2011). Only South Africa and Nigeria have more people living with the disease (UNGASS, 2010a).

At the national level, both HIV prevalence and HIV incidence estimates have been in steady decline for the last decade (NACO, 2011). Since 2000 the estimated adult prevalence has decreased by 24% (from .41% to .31%) while the number of new infections has decreased by more than half − from an estimated 270,000 in 2000 to 120,000 in 2009 (NACO, 2011; UNGASS, 2010a). The estimated number of annual

[1]In accordance with the Centers for Disease Control, the diagnosis of AIDS in an HIV-infected individual occurs when the CD4 T cell count falls below 200/ µL of blood or the individual becomes co-infected with pulmonary tuberculosis, recurrent pneumonia, or invasive cervical cancer. In developing nations, where diagnostic capabilities are limited, AIDS diagnoses are based on the presence of co-morbidities such as toxoplasmosis of the brain or Kaposi's sarcoma. As the distinction between HIV and AIDS is often uncertain and difficult to diagnose in resource constrained settings, this proposal will use 'HIV' to refer to HIV or AIDS regardless of disease progression.

deaths attributed to HIV/AIDS peaked in 2006 at 200,000 and has since decreased to 172,000 in 2009 (NACO, 2011).

While there is an overall decline in HIV infection at the national level, nation-wide prevalence and incidence estimates mask important geographic and demographic variations in India's HIV epidemic.

GEOGRAPHIC VARIATION

There are four types of HIV epidemics as categorized by the Joint United Nations Programme on HIV/AIDS: 1) hyper-endemic epidemics are defined as those with greater than 15% prevalence in the entire population (this is normally measured by screening pregnant women for HIV at antenatal clinics in urban areas); 2) generalized epidemics are defined as those with consistently greater than 1% prevalence in the entire population (operationalized as the prevalence in pregnant women); 3) concentrated epidemics are defined as those with less than 1% prevalence in the entire population but greater than 5% prevalence in at least one sub-population; and 4) low-level epidemics are those in which HIV has been detected but prevalence has never exceeded 1% in the general population or 5% in any sub-population (Brookmeyer, 2010; WHO, 2006).

Within its 35 states (including union territories) and 640 districts, India is home to three different types of epidemics, each with different drivers and routes of transmission (World Bank, 2011; Chandraskeran et al., 2006). At the national level, the country has a concentrated epidemic, but at the state level, generalized, concentrated, and low-level epidemics all exist. Breaking the epidemiologic data down to the district

level indicates that "hotspots" of disease concentration occur throughout the country (NACO, 2011).

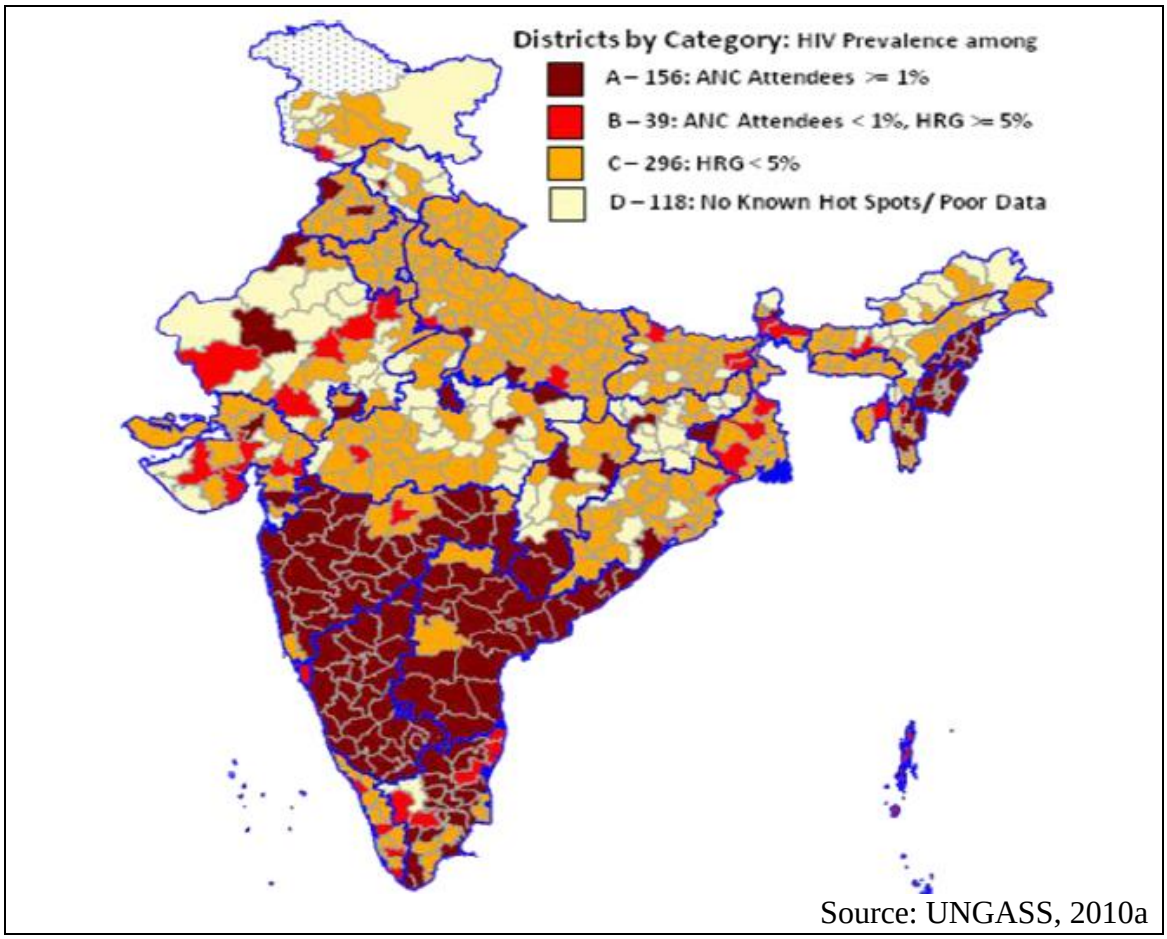
State Level. Sixty percent of the nation's HIV burden rests in six "high prevalence" states as defined by the National AIDS Control Organization: Andhra Pradesh, Karnataka, Maharashtra, Tamil Nadu, Manipur, and Nagaland.

One of the six high prevalence states, Manipur, is considered to have a generalized epidemic with HIV prevalence among antenatal clinic attendees of 1.4% (NACO, 2011). The remaining five have concentrated epidemics in which at least two subpopulations have an HIV prevalence greater than 5%. Out of the remaining 29 states, nine have a concentrated epidemic and 20 have low level epidemics (NACO, 2011; NIHFW, 2006).

District Level. Nearly one-fifth of districts (118/640) reported greater than 1% HIV prevalence among antenatal clinic attendees. Sixteen of these districts report a seropositivity of greater than 3%. Out of these 16 district level "hotspots," 14 are located within the six high prevalence states but two are located in states with low level epidemics (Rajasthan and Orissa) (NIHFW, 2006).

India's HIV epidemic can be classified as heterogeneous in spread. While the HIV prevalence in the general population is decreasing at the national level and within all of the high-prevalence states, there has been an increase in HIV prevalence in eight states with low-level epidemics in the last four years: Chandigarh, Orissa, Kerala, Jharkhand, Uttarakhand, Jammu & Kashmir, Arunachal Pradesh and Meghalaya (NACO 2011; UNGASS, 2010a). [Figure 1]

Figure 1. Map of districts by categories of HIV prevalence among antenatal clinic attendees in 2007



Source: UNGASS, 2010a

DEMOGRAPHIC VARIATION

The National AIDS Control Organization has identified three primary drivers of the national HIV epidemic: unprotected commercial female sex work, unprotected sex between men, and intravenous drug use. As a result, the federal government conducts annual sentinel surveillance for three sub-populations at highest risk of infection: female sex workers (FSW), men who have sex with men (MSM), and injection drug users (IDU). Sentinel HIV surveillance indicates that HIV prevalence is 10-20 times greater in high-risk groups as compared to the general population (WHO, 2010).

Heterosexual sex accounts for 87.4% of all reported HIV cases in India (NACO, 2011).While the risk behaviors of the three sub-groups drive and maintain India's HIV epidemic, the disease spreads to the general population via heterosexual contact between high-risk populations and "bridge populations" who engage in heterosexual sex with members of both high-risk populations and the general population (NACO, 2011; Chandrasekaran et al., 2006).

Female sex workers and their clients. Since the first cases of HIV in India were identified in FSW in 1986, FSW have been at the center of national surveillance, prevention, and treatment efforts (John et al, 1987). The estimated 1.3 to 2 million FSW in India comprise .5% of the adult female population yet account for 7% of the HIV infection in adult women (NACO, 2011; Steinbrook, 2007).

HIV prevalence in FSW varies dramatically between and within the 35 Indian states. At the state-level the percentage of those infected ranges from less than 1% to 17.9% (NIHFW, 2006). Population-based samples conducted in various urban centers have documented prevalence rates in FSWs as high as 50% (NACO, 2006a; FHI, 2000a; Verma et al., 2004). The national mean prevalence of HIV in FSW is an estimated 4.9% (NACO, 2011).

Female sex work in its many forms has been determined to be the most significant source of HIV incidence throughout India due to the large number of male clients who become infected from unprotected sex then transmit the disease to their regular sexual partner (mainly wives) (NACO, 2011; O'Neil et al., 2004).

Migratory workers, especially long-distance truck drivers and seasonal agricultural and construction workers, have long been targeted as primary bridge

populations as their occupations take them away from their families for long periods of time and facilitate travel over long distances (Hawkes & Santhya, 2002). Long distance truck drivers and single male migrants have an estimated HIV prevalence of 1.7% and 2.4%, respectively (NACO, 2011). It is important to note that FSW migrate as well, often traveling within and between rural and urban areas (Steinbrook, 2007; O'Neil et al., 2004).

The most recent nationally representative behavioral surveillance survey on the clients of female sex workers indicates that nearly two-thirds (63%) were currently married (NACO, 2006a). Population specific behavioral surveys carried out in two of the high-prevalence states (Tamil Nadu and Karnataka) indicate that up to 18% of rural men and 10% of men residing in urban slums engage the services of FSW (APAC, 2004).

Men who have sex with men. The number of men who engage in male to male sexual activity is difficult to estimate due, in part, to normative cultural beliefs and the complex nature of the sexual relationships (Chandrasekeran et al., 2006; Hawkes and Santhya, 2002). Officially, there are an estimated 2.4 MSM and 235,000 male sex workers in India but unofficial estimates believe the actual number to be much higher (NACO, 2006b; WHO, 2010).

As with FSW, the prevalence of HIV in MSM varies widely. Nationwide, the average HIV prevalence in MSM is 7.3% and this number varies from .40% to 17.6% across states (NIHFW, 2006).

Behavioral studies conducted in the general population have indicated that male to male sexual relationships are somewhat common in both urban and rural settings and

estimate that 7% to 13% of men engage in same sex behaviors (WHO, 2010). Unprotected anal sex between men accounts for 1.3% of reported HIV cases in India (NACO, 2011).

Men who have sex with both men and women serve as the bridge populations between the high risk group and the general population. The most recent nationally representative behavioral surveillance survey on MSM indicates that 34% of MSM had ever been married to a female partner and 35% had sexual intercourse with at least one female partner in the last six months (NACO, 2006b).

Injection drug users. Twenty-five percent of India's IDUs reside in the relatively small and sparsely populated northeastern states that border Burma, and the sharing of contaminated injection equipment remains the principal driver of the HIV epidemic in that region of the country (UNGASS, 2010a; Sarkar et al., 1994).The estimated 200,000 IDUs in India have a mean HIV prevalence of 9.2%, the largest of all three high risk groups (NACO, 2011). As with MSM and FSW, state level variations are significant and range from .6% in Bihar to 24% in Maharashtra. Injection drug use accounts for 1.6% of reported HIV cases in India (NACO, 2011).

Although the sharing of contaminated needles remains the greatest risk factor for IDUs, they also serve as a bridge population via sexual transmission (Charadsakaran et al., 2006; Sarkar et al., 1994). The most recent nationally representative behavioral surveillance survey on IDUs indicates that 44% of IDUs were currently residing with a spouse or sexual partner (NACO, 2006b).

HIV in the general population. Unprotected sex is the major route of HIV transmission in India. Heterosexual sex accounts for 87.4% of all HIV infection and

homosexual sex between men for another 1.3%. The transmission of HIV from mother to child accounts for 5.4% of new infections while injection drug use causes 1.6% of new HIV infections. Contaminated blood products account for 1% of HIV infections and the source of the remaining 3.3% of total infections is unknown (NACO, 2011). It is imperative to note that an estimated 80-90% of HIV-infected individuals in India are unaware of their status (Steinbrook, 2007).

Seventy percent of people living with HIV in India are married and 66% live in rural areas. Fifty-two percent of all infections are in women and 80% of all sero-positive women report being in monogamous relationships with their spouse (Perkins et al., 2009). While household wealth is not correlated with HIV infection, education is. Among both men and women, higher educational attainment is associated with a reduced risk of HIV-infection (Perkins et al, 2009). HIV is concentrated in people younger than 45 years of age and 36% of all infections are in young people below the age of 25 (Perkins et al., 2009).

HIV Prevention in Adolescent Populations

The World Health Organization defines adolescence as the period of transition between childhood and adulthood that takes place between the ages of 10 to 19.

Adolescence is a critical time in human development during which people experiment, take risks, and are greatly influenced by peers, families, and social values. During these years people develop knowledge, skills, and experiences that can greatly influence prospects and health status as an adult. It is a time of rapid physical and psychosocial development during which sexuality is explored (UNICEF, 2011; Rani and Lule, 2004). Without the opportunity to make sound decisions about their sexual

health, adolescents are rendered especially vulnerable to sexually transmitted infections, including HIV.

Adolescents are exposed to HIV in different ways that are dependent on the type of epidemic prevalent where they live. In low level and concentrated epidemics adolescents are most commonly exposed to HIV via commercial sex work, homosexuality, and injection drug use while exposure in generalized epidemics mainly occurs through heterosexual sexual contact (WHO, 2006). Engagement in all four types of risk behaviors often begins in, or near the termination of, adolescence. Therefore, it is imperative to provide adolescents with the tools they need to help avoid infection during the second decade of life.

NATURE OF HIV PREVENTION EFFORTS

Adolescents living in areas of both general and concentrated epidemics are most commonly reached through schools (via standardized curriculum or specific interventions designed to compensate for gaps in standardized curriculum); outreach programs for high-risk populations (e.g. FSW, MSM, or IDU); health care settings; or mass media outlets (e.g. radio, television, and the internet) (WHO, 2006). Through these different channels, adolescents are provided with three types of interventions: behavioral, biomedical, and structural (Coates, 2008).

Behavioral interventions seek to inform and modify risk behaviors**.** Since sexual transmission is responsible for the vast majority of incident HIV infections in adolescents, behavioral interventions that seek to modify individual risk behaviors by encouraging abstinence, the delay of sexual debut, and safer sex practices have always

been at the core of HIV intervention strategies (Bertozzi et al., 2008; Hearst and Chen, 2004).

Within sexual relationships, options for reducing one's susceptibility to sexually transmitted infections, including HIV, are limited. Outside the bounds of a monogamous relationship with an uninfected partner, the use of condoms is the only viable behavior that can reduce risk of infection and contribute to a disease-free health outcome (WHO, 2006).

Biomedical interventions leverage medical technologies to block infection or decrease infectiousness**.** Advances in antiretroviral therapies (ART) have effectively reduced HIV infection to a chronic and manageable disease for those who are diagnosed early, have consistent access to ART, and maintain a strict drug regimen. Consequently, the expansion in availability and utilization of voluntary HIV counseling and testing services (VCT) has become an international HIV prevention strategy (UNICEF, 2011, Granich, et al, 2009).

The benefits of early detection and introduction to ART are not limited to HIV-infected individuals: as it dramatically reduces viral load, the use of ART has been essential in the prevention of mother-to-child transmission and can minimize risk of transmission to uninfected sexual partners (Guay et al, 1999; Cohen, et al, 2011; Das et al., 2010).

Structural interventions seek to change the contextual factors that contribute to risk and vulnerability**.** There is increasing recognition that decisions to abstain from sex, engage in safe sex, or engage in HIV testing are heavily influenced by partners, peers, family, community, and context (Bertozzi et al., 2008) and decades of research

have contributed to a comprehensive recognition of the structural factors that influence adolescents' vulnerability to HIV. Structural factors which influence decisions about engaging in, or abstaining from, sexual risk behaviors and VCT uptake include, but are not limited to, inequity, discrimination, poverty, migration, exploitation, abuse, belonging to a particular sub-culture, and the quality of health services (Yadav et al., 2011; WHO, 2006; Rani and Lule, 2004; Hawkes and Santhya, 2002).

While addressing these structural factors is paramount in the mitigation of HIV transmission, it is a monumental task. Efforts to influence structural-level conditions are resource-intense endeavors that require inputs which often exceed the capabilities of HIV prevention providers (Coates, et al., 2008). Accordingly, prevention efforts that center on modification of risk behaviors and the promotion of biomedical strategies are critical.

ROLE OF ACCURATE AND COMPREHENSIVE INFORMATION

The associations between HIV-related knowledge and prevention are strong and the promotion of information is the cornerstone of all HIV-prevention efforts. Decades of research on adolescent sexual health (including HIV prevention) indicate that age-appropriate education that increases knowledge contributes to more responsible and risk-reducing sexual behaviors (Mavedzenge et al, 2011; Kirby et al, 2007; Ross (in WHO2006)). Accurate and comprehensive information about the modes of HIV transmission and how to protect one's self and one's partner from acquiring the virus, are considered essential, but not sufficient, components to decreasing adolescent susceptibility to HIV (Romero et al, 2010; UNICEF, 2011).

The United Nations (UN) UN definition of comprehensive and correct knowledge of HIV was released in 2000. It was created by a panel of experts from various UN agencies, the World Bank, the International Monetary Fund, and the Organization for Economic Cooperation and Development. The definition was designed to be an element for international monitoring and reporting systems that allow for comparison of Millennium Development Goal (MDG) progression over time and across geographic areas (Attaran, 2005, Bond 2006).

"The proportion of population aged 15-24 years with comprehensive and correct knowledge of HIV/AIDS" is one of four indicators used to measure MGD 6, Target 6.A: *Have halted by 2015 and begun to reverse the spread of HIV/AIDS* [the other three indicators are "HIV prevalence among population aged 15-24 years," "condom use at last high-risk sex," and "ratio of school attendance of orphans to school attendance of non-orphans aged 10-14 years."] (United Nations, 2000). "Comprehensive and correct knowledge" of HIV is defined by the United Nations as the ability to all of the following:

- Identify that using condoms and limiting sex to one faithful, uninfected partner are two major ways of preventing the sexual transmission of HIV; and
- Reject the two most common local misconceptions about HIV transmission (determined by national health authorities); and
- State that a healthy-looking person can be infected with HIV (United Nations, 2000).

The management of data and analysis towards measurement of this indicator is the joint responsibility of Joint United Nations Programme on HIV/AIDS (UNAIDS), United Nations Children's Fund (UNICEF), and the World Health Organization

(WHO) (UN, 2013). These individual agencies, in turn, obtain the data from the Measure DHS Demographic and Health Surveys (DHS) (UNAIDS, 2013a). Since 2004, DHS have measured comprehensive and correct knowledge about HIV in nationally-representative household surveys in sixty five countries (DHS, 2014a). DHS currently operationalizes the indicator from responses to a set of five prompted questions. Respondents that answer all five prompted questions correctly are considered to have comprehensive correct knowledge of the disease (DHS, 2014b):

1. Can the risk of HIV transmission be reduced by having sex with only one faithful, uninfected partner?
2. Can the risk of HIV transmission be reduced by using condoms?
3. Can a healthy-looking person have HIV?
4. Can a person get HIV from mosquito bites?
5. Can a person get HIV by sharing a meal with someone who is infected?

The processes surrounding development of the MDGs has been criticized for a lack of transparency (Attaran, 2005). Very little information exists about how these particular five components were selected but 2013 report by UNAIDS stated the following about the strengths and weakness of the indicator (UNAIDS, 2013b, pg. 25)

> "The belief that a healthy looking person cannot be infected with HIV is a common misconception that can result in unprotected sexual intercourse with infected partners. Rejecting major misconceptions about modes of HIV transmission is as important as correct knowledge of true modes of transmission. For example, belief that HIV is transmitted through mosquito bites can weaken motivation to adopt safer sexual behavior, while belief that HIV can be transmitted through sharing food reinforces the stigma faced by people living with HIV. This indicator is particularly useful in countries where knowledge about HIV and AIDS is poor because it permits easy measurement of incremental improvements over time. However, it is also important in other countries as it can be used to ensure that pre-existing high levels of knowledge are maintained."

Like all indicators developed during the formation of the MDGs, it was designed to be a "superficial vital sign" to monitor global progress and it is much too broad and basic in its definition to provide all of HIV-related knowledge that adolescents need to protect themselves against infection within specific cultural contexts (Higgins, 2013 UNGASS, 2010b).

A 2012 synthesis of global adolescent health indicators revealed that comprehensive and correct knowledge of HIV is alarmingly low, even in areas with endemic HIV epidemics. Within the 41 countries with relevant data, only 31% of adolescent boys and 28% of adolescent girls have comprehensive and correct knowledge of HIV. No country reported more than 65% of adolescent boys or girls with comprehensive knowledge of the disease (Patton, et al., 2012). Using data from the same dataset that will be used in this dissertation, the UNAIDS Global Report of 2013 reports that in India, only 19.9% of girls and 36.1% of boys aged 15-24 have comprehensive correct knowledge about HIV (UNAIDS, 2013b).

STRUCTURAL CONSTRUCTS ASSOCIATED WITH ACCURATE AND COMPREHENSIVE KNOWLEDGE OF INDIAN ADOLESCENTS

Indian adolescents are considered particularly vulnerable to HIV in large part due to their well-documented lack of accurate and comprehensive information about the disease (Char et al., 2011, 2009; Jejeebhoy, 1998). Cultural inhibitions about the discussion of sexuality; low rates of school enrollment coupled with limited sexual education curricula; inequitable access to media outlets (radio, print, television, and internet); early marriage; and lack of access to youth friendly health services have all

been identified as contributing factors (Ackerson et al. 2012; UNICEF, 2011; Char et al, 2011; Sarkar, 2008; Santhya and Jejeebhoy, 2007).

Below is a description about how each of these factors limit access to HIV-related information.

Cultural inhibitions about the discussion of sexuality. Reproductive health professionals have long noted the social norms that inhibit sexual health communications in Indian society. Parents rarely communicate with their children about sexual and reproductive issues and adolescents throughout the country have little knowledge about reproductive anatomy, sex, or contraception (Char et al, 2011; Nair et al 2011; ICRW, 2006; Goyal & Khanna, 2005; Jejeebhoy, 1998). Indeed, research indicates that the vast majority of adolescents obtain all of their information about HIV from peers and television (Yadav et al., 2011; Char et al., 2011; Banerjee & Mattle; 2005). The aversion to open discussion of sex and sexual behaviors has been identified as an obstacle to the promotion of sexual health and HIV prevention efforts throughout the country (Guliamo-Ramos, et al., 2012; Lambert&Wood, 2005).

Inequities in educational attainment coupled with limited HIV education curricula. In India, there are geographic, socioeconomic, and gender-based inequalities in education participation and attainment. These inequalities have been attributed to structural conditions fostered by state-level policies. India is a federal state and the provision of public goods and services is the responsibility of the individual 35 states. States with more government accountability, greater gains in poverty reduction, more inclusion of women in economic growth, and those that facilitate greater access to

financial capital have less inequality in educational attainment (Asadullah and Yalonetzky, 2010).

While gross primary school enrollment (defined as the total enrollment in primary education, regardless of age, expressed as a percentage of the official primary education age) is near 100% (Asadullah and Yalonetzky, 2010), school enrollment does not guarantee access to information about HIV. While the federal government has pledged to increase the amount of information in standardized HIV curricula (NACO, 2011; Santha & Jejeebhoy, 2007), there are significant barriers to providing any information on sexual health in the school setting. First, while a National Framework and State Action Plans for Adolescent HIV Education was introduced in 2005 there is no national mandate that state-run schools need to include information on sexual health or HIV. It is only information on family planning that must be covered in primary and secondary schools and even this curriculum has been criticized for providing minimal information and using terminology unfamiliar to adolescents (Nair et al, 2011; Santhya & Jejeebhoy, 2007).

Second, research indicates that teachers are often unable and unwilling to discuss issues pertaining to sexuality (Nair et al, 2011; Goyal & Khanna, 2005; USAID, 2003) and many parents do not want their children exposed to the material (Nair, et al., 2011).

Inequitable access to media outlets. Although the use of mass media sources has increased with overall economic development and nearly 78% of Indian households have access to paid television services, economic and gender-based inequities to media outlets exist (Ackerson et al, 2012). Television has been determined to be the most

effective source of information in terms of increasing comprehensive HIV knowledge in the general population yet 34.4% of women and 17.8% of men (aged 15-49) report never watching television (Ackerson et al., 2012).

In recognition of both the dearth of information that adolescents have about HIV and their reliance on peer networks for information, mass media campaigns have been employed by governmental and non-governmental programs throughout the country (Ackerson, et al., 2012; NACO, 2011; Yadav, et al., 2011; Sood & Nambiar, 2006). These interventions have been thought to increase awareness and comprehensive knowledge and it has been demonstrated that mass media use has a positive association with education and wealth in adult men and women (aged 15-49) (Ackerson et al., 2012).

Early marriage. In spite of a federal law that prohibits marriage under the age of 18, 47% of women aged 20-24 report being married before the age of 18 and 18% of women aged 20-24 report being married before the age of 15 (UNICEF, 2013). Married female adolescents experience a lack of control over their life choices and it has been documented that early marriage is associated with risky sexual activity, unwanted sexual activity, physical and sexual violence, low educational attainment, delay in reproductive health care, and adverse sexual and reproductive health outcomes, including HIV (Santhya, 2011; Raj et al., 2010).

Within marriages, communications about sexual morbidities and reproduction are severely limited. In a sub-nationally representative survey investigating reproductive health outcomes of young married females (n=8314), nearly half (47%) of the respondents who had married before the age of 18 reported no spousal

communications concerning contraceptive use or the number of children to have (Santhya et al., 2010).

Adolescent married girls face tremendous pressure to produce a child and as a result, contraception in married unions is rare (ICRW, 2006). In the same sub-nationally representative survey, only 3.4% of respondents who had married before they turned 18 reported using contraceptives to delay their first pregnancy, compared to 11.2% of respondents who were married after they turned 18.

Lack of access to youth-friendly health services. The quality and quantity of sexual health service provision is a structural factor that influences adolescent susceptibility to HIV by limiting access to health related information and VCT services.

Youth friendly health services that provide reproductive health information and counseling; encourage condom use by providing and demonstrating their use; and providing testing, care, and treatment of HIV and other sexually transmitted infections facilitate better health outcomes (UNICEF, 2011).

In India, seeking treatment for sexual and reproductive health morbidities is rare and delayed, and the treatments themselves are often inappropriate (Koenig et al., 2008). In the general population, poor reproductive health outcomes have been attributed to poor health service utilization (Sharma et al., 2002). Outside of the maternal health setting, very little is known about any of the reproductive and sexual health seeking behaviors of adolescents, including HIV testing. Too old for child-based services and generally lacking the resources needed to reach the few services that are available, adolescents are often inhibited from seeking care for their sexual health needs (ICRW, 2006).

Although there is ample evidence that the aforementioned structural factors restrict the transmission of information about HIV in Indian adolescent populations, much less is known about the transmission of accurate and inaccurate information through the sources of information that Indian adolescents have at their disposal. As the dissemination of accurate and comprehensive information about HIV prevention is central to all HIV prevention efforts, understanding more about the mechanisms that influence the transmission of both accurate and inaccurate information in the adolescent population can assist HIV prevention programs in becoming more efficacious.

Research shows that reliable sources of information about issues related to sex and sexual health (including HIV prevention) are limited (Char et al., 2011; Guilamo-Ramos, et al, 2012; ICRW, 2006). While peers and mass media outlets are often reported to be the most relied upon sources of information about sexual health in Indian adolescent populations (Char et al., 2011; Guilamo-Ramos, et al, 2012; NFHS-3, 2007; ICRW, 2006; Goyal & Khanna, 2005; Jejeebhoy, 1998), little work has been done to understand how these - and other, less-utilized sources of information - contribute to the transmission of specific *types* of HIV-related information among those aware of the disease.

My literature review uncovered only four studies that have investigated similar phenomena in the Indian context: two inductive, qualitative studies with limited generalizability but nuanced information pertaining to HIV-related communications and two deductive, quantitative studies that provide more generalizable yet less detailed findings.

In 2005, Sivaram et. al investigated the role of social networks in the diffusion of general sexual health promotion among 18-40 year olds. This qualitative study (n=93) took place in an urban slum of Chennai and sought to understand the composition of communication networks, the types of information exchanged within those networks, and the influence of communication on two particular behaviors – unprotected sex and treatment for sexually transmitted infections.

The study revealed distinctions in information sources and content based on gender and marital status. While the small sample size and restricted geographic location limits the generalizability of the findings, the study revealed nuances in social network properties and the specifics of sexual health related communications within those networks. It concluded that the communication networks of unmarried women were limited to same-sex peers and immediate family members while the networks of unmarried men were unrestricted with regard to age or residential location. While unmarried men reported the majority of their sexual health communications occurred with other men, they did report limited communications with older, married, females. The extent and content of sexual health communications varied widely between genders. Unmarried men had extensive and open discussions about sex while unmarried women did not. Unmarried women were categorized as not perceiving a need to discuss sex due to the lack of relevance to their lives (Sivaram et al, 2005).

In 2011, Yadev et al. assessed the HIV-related knowledge of rural Indian youth in a community based cross-sectional survey of 1,237 15-24 year olds in the State of Gujarat. This study provided evidence that age, education, wealth, and media exposure were important predictors of HIV awareness in rural Gujarati youth and proposed that

literacy and occupation were also significant predictors. They also proposed that increasing literacy rates and access to media sources were important components to increasing HIV awareness in the general population. The most cited sources of HIV-related information were friends (77%), followed by television (69%), special visits by health workers or social workers (18%), newspapers (13%), and radio (10%).

The study also captured distinctions in the different *types* of HIV-related knowledge that rural youth had in their possession: the modes of transmission, preventative measures, and the availability of health services.

Knowledge about the modes of transmission was relatively high among those aware of the disease: ninety-two percent knew that it could be transmitted through sexual intercourse and 84% knew it could be transmitted from mother to child. Knowledge about certain prevention measures was relatively high but had more variance: while 86% of youth reported that HIV could be prevented by having a sexual relationship with a single partner, only 70% knew that transmission could be prevented by the use of a condom. Knowledge about the availability of health services was very low: only a quarter of youth were aware of the existence of an HIV testing facility in their area while less than 20% knew about the availability of treatment.

In 2012, a study by Ackerson et al. used nationally representative data (the same dataset employed in this dissertation) to investigate the effect of access to and use of mass media on the relationship between social determinants and HIV-related awareness, stigma, knowledge, and attitudes among Indian men and women aged 15-49 (Ackerson, et al, 2012).

Ackerson, et al. investigated two types of HIV-related knowledge: prevention knowledge and transmission knowledge. Like the work of Yadev et al (2011), this study did not investigate "comprehensive knowledge" as defined by NACO. Rather, the five components that make up "comprehensive knowledge" were broken into two types of knowledge: prevention knowledge and transmission knowledge. Respondents were classified as knowledgeable about HIV *prevention* if they knew that the risk of HIV could be reduced by abstaining from sexual intercourse, by having only one uninfected partner, and by using a condom every time they had sex. They were classified as knowledgeable about *transmission* if they knew that HIV was not transmitted by mosquito bites or the sharing of food with an infected individual and that it was possible for a healthy looking person to have HIV. Unlike the study conducted by Yadev et al, this study did not investigate knowledge pertaining to maternal to child transmission or the availability of health services.

The study operationalized media access and use by self-reported data on the frequency of reading newspapers, listening to the radio, watching television, and attending the cinema.

The analysis used gender-stratified models because of gender-related differentials in media use and HIV-related message interpretation. Although the results were stratified by gender, they were not disaggregated by age.

Findings indicated that established associations between education, wealth, and HIV-related prevention and transmission knowledge were weakened when the reported use of media sources (television, radio, newspapers, and cinema) were added into the model. This suggested that media use could partially mediate, but not eliminate, the

impact of socioeconomic status on HIV prevention and transmission related knowledge. When media sources were broken into categorical components, daily television use had the strongest association with correct HIV prevention and transmission related knowledge among both men and women 15-49 years old (Ackerson, et al, 2012).

Finally, a 2012 qualitative investigation led by Guilamo-Ramos examined communications about sex, sexual health, and HIV among 20 adolescents (14-18 years old) and their same-gender parent living within a rural community in the State of Maharashtra.

In-depth interviews were conducted with participants to investigate issues relating to sexual health communications and critically assess the belief that parents were unable and unwilling to discuss sexual health-related, including HIV-related, issues with their same-sex children.

Although the study was too small to be generalizable to the larger population, analysis of the interviews supported previous research by Char et al (2011), the ICRW (2006) and Jejeebhoy (1998) that parent-adolescent communications about HIV were limited. It illustrated that both parents and adolescents shared similar barriers to communications about HIV. These barriers included embarrassment in discussing sexual topics; concern that the material was not appropriate to discuss before marriage; and lack of information about the disease.

While the study did not investigate the specific types of HIV-related knowledge adolescents had in their possession, it supported quantitative evidence in the NFHS-3 that adolescent girls were less informed than boys. Their study also purported that

adolescents relied on television, health workers, and school teachers for the majority of their HIV-related information (Guilamo-Ramos, et al., 2012).

To the best of my knowledge, there has been no study investigating the associations between the sources of HIV-related information and the types of HIV-related knowledge in Indian adolescents at the national level. This dissertation was an attempt to address this gap in the literature and increase collective understanding about the influence of information sources on the transmission of accurate and comprehensive HIV-related information in Indian adolescents.

THEORETICAL FRAMEWORK

The theoretical framework guiding this investigation was based, first, on the network perspective that individuals are imbedded in social networks that both constrain and promote HIV prevention messaging. Applied in a host of public settings, network properties are especially important to the promotion of sexual health where structural and environmental factors exert a strong influence on information and behaviors (Valente, 2010; Kohler et al, 2007). Second, it was guided by the work of Lisa Berkman and her team who conceptualized how social networks serve as the conduit through which structured social interaction takes place (Berkman et al, 2000). Third, it relied on the Theory of Gender and Power that asserts, in part, that social norms affect and perpetuate gender-based inequities in access to information (Connell, 1987).

THE NETWORK PERSPECTIVE

Network properties have important implications for the spread of ideas, attitudes, behaviors, and disease and public health researchers and sociologists use the network perspective to investigate the relationships between social interactions and health (Valente, 2010; Smith and Christakis, 2008).

The network perspective assumes that people are interdependent, asserts that social ties facilitate both information and influence, and examines the features of relationships in order to better understand human actions (Valente, 2010; Wasserman and Faust, 1994). It is rooted in seminal works on social structures and network analysis (Wellman and Berkowitz, 1988), established theories of communication such as Rogers' Diffusions of Innovations Theory which describes how new practices and ideas are spread within and between communities (1995), and Coleman's Social Capital Theory which argues that relationships are assets that can used for personal gains (1988) (Valente, 2010; Smith and Christakis, 2008).

Applicable to all facets of health to various degrees, network properties are especially important to sexual and reproductive health where structural and environmental factors have a strong influence on behavior. Social networks have been documented to both constrain and spread sexual health related knowledge and behaviors in a multitude of settings across the globe (Smith and Christakis, 2008; Montgomery and Casterline 1993, Rosero-Bixby and Casterline 1994, Entwisle et al 1996, Valente et al, 1997, Rindfuss et al 2004).

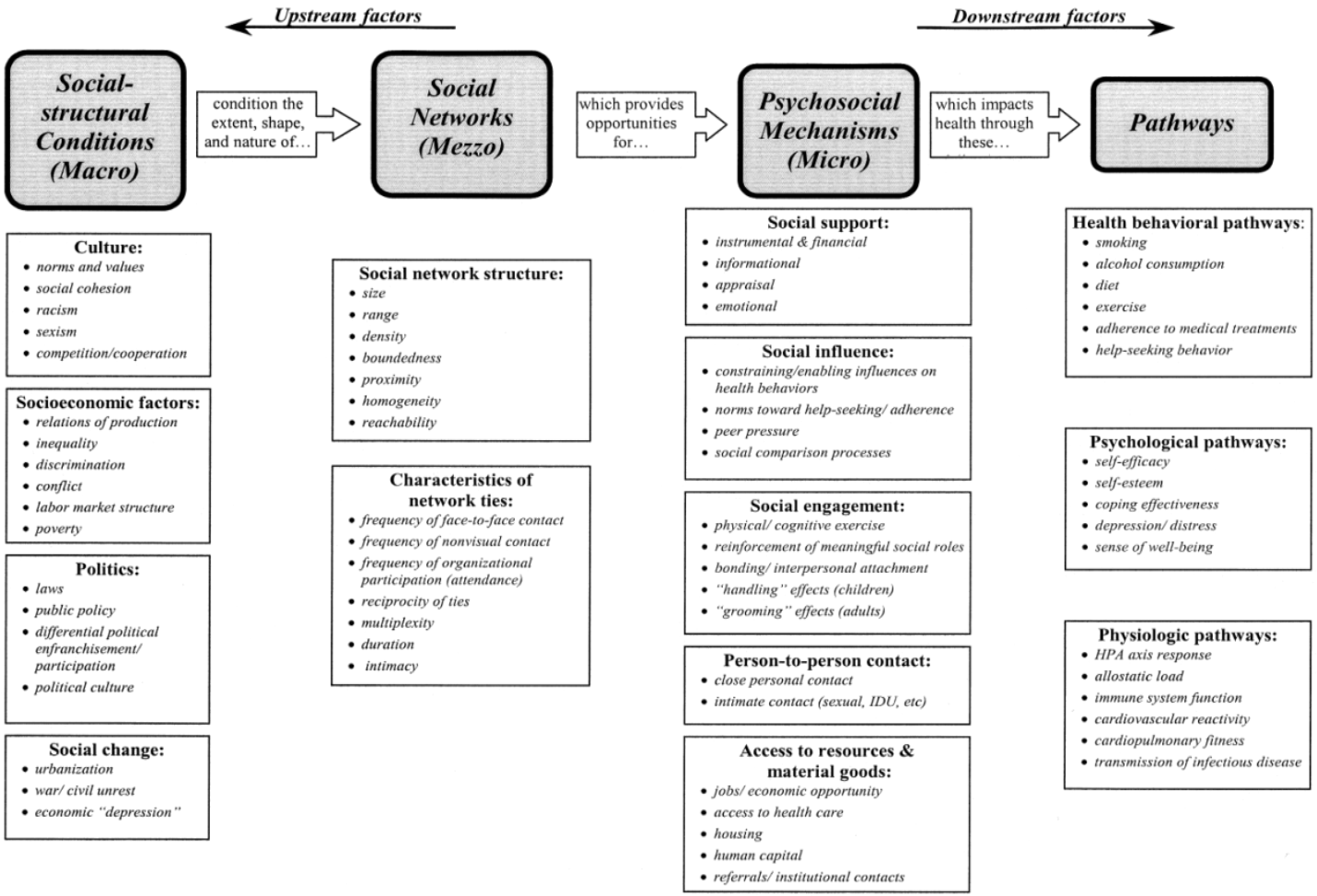
Within the field of HIV prevention, networks have been analyzed to better understand the onset of behaviors, investigated to track the spread of disease, and

leveraged to influence the uptake of desired health outcomes and behaviors (Watkins, 2004; Morris & Kretzschmar, 1995; Rothenberg 1998; Valente, 2010). Kohler, Behrman, and Watkins (2007) have proposed a mechanism of joint evaluation which posits that the diffusion of HIV-related information in a population first involves the members of a social network collectively evaluating prevention messaging. Through the lens of existing norms and attitudes, the network then interprets the information within the local context and moderates available messaging to appear more realistic.

Social Integration Framework

A unifying, multilevel, framework that conceptualizes how social networks serve as the conduit through which social conditions affect health outcomes has been proposed by Berkman, et al. (2000). The model, which is refer to as the Social Integration Framework for purposes of this research, was developed to illustrate a causal, cascading process through which social networks are shaped by structural-level factors and, in turn, influence the psychosocial mechanisms that impact health outcomes. It proposes that social-structural conditions (culture, socioeconomic factors, politics, and social change) influence the development and nature of social networks. These networks then function at the behavioral level through psychosocial mechanisms (social support, social influence, social engagement, person to person contact, and access to resources) that impact health through three distinct pathways (health behaviors, psychological, and physiologic). [Figure 2 – Social Integration Framework]

Figure 2. Social Integration Framework



Source: Berkman, et al., 2000

The Social Integration Framework was developed, in part, to provide a set of definitions for terms used when investigating the impact of social relationships on health. Table 1 describes the critical domains of social networks (network characteristics) and select psychosocial mechanisms as defined by Berkman et al.

Table 1. The critical domains of social networks (network characteristics) and select psychosocial mechanisms as defined by Berkman et al. (2000)

Network characteristics	***Definition***
Range or size	Number of network members
Density	The extent to which the members are connected to each other
Boundedness	The degree to which they are defined on the basis of traditional group structures such as kin, work, and neighborhood
Homogeneity	The extent to which individuals are similar to each other in a network
Frequency of contact	Number of face-to-face contacts and/or contacts by phone or mail
Multiplexity	The number of types of transactions or support flowing through a set of ties
Duration	The length of time an individual knows another
Reciprocity	The extent to which exchanges or transactions are even or reciprocal
Psychosocial mechanisms (social support)	***Definition***
Instrumental & financial	Help, aid, or assistance with tangible needs
Informational	Provision of advice or information in the service of particular needs
Appraisal	Help in decision making, giving appropriate feedback
Emotional	The amount of love and caring, sympathy, and understanding and/or esteem or value available from others

The Social Integration Framework had particular relevance for this dissertation as social-structural conditions (operationalized as gender, caste/tribe, religion, marital status, wealth, education, literacy, state of residence, and place of residence (urban/rural)) have all been determined to be associated with HIV-related knowledge in Indian adolescent populations (NACO, 2011). This research sought to understand

how network properties contribute to the established relationships between social-structural conditions and HIV-related knowledge. More specifically, it explored how the social networks (operationalized as self-reported sources of HIV-related information) shape the informational support (operationalized as types of HIV-related knowledge) that adolescents need – in part – to protect themselves against infection.

Theory of Gender and Power

Finally, the Theory of Gender and Power (TGP) was integrated into this research because of the assertion that social norms affect and perpetuate gender-based inequities in access to information (Connell, 1987). Based on the philosophical underpinnings of sexual inequality, gender, and power imbalance, the TGP asserts that the gender-based inequalities embedded in social structures result in males' disproportionate power and control in decision making (Connell, 1987). In an adaption of the TGP to better understand women's susceptibility to HIV, behavioral scientists Wingood and DiClemente have elaborated on the theory. They postulate that the gender-based inequalities developed at the societal level and promulgated by institutions also serve to increase exposure and risk factors for women (Wingood and DiClemente, 2000).

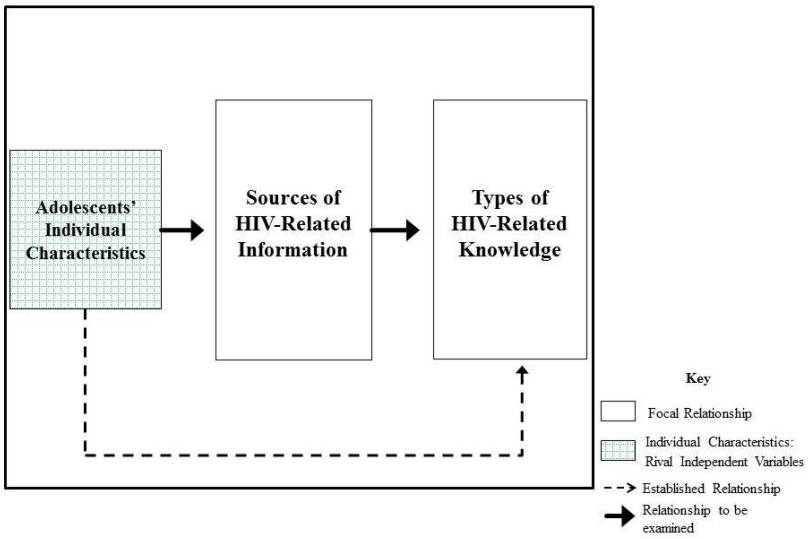
The TGP was integrated into this dissertation because gender-based inequity is a severe and persistent condition in Indian society. Research on HIV prevention for Indian adolescents highlights gender-based distinctions in information access, perceived need, uptake, and retention (Albarracin, et al., 2004; Sivaram et al., 2005; Chharba et al, 2010). Research also indicates a reliance on same-sex network members for sexual communications (Sivaram et al., 2005; Guilamo-Ramos, et al.,

2012). This research employed the Theory of Gender and Power to explore how elements of the focal relationship differed between adolescent girls and boys.

CONCEPTUAL MODEL

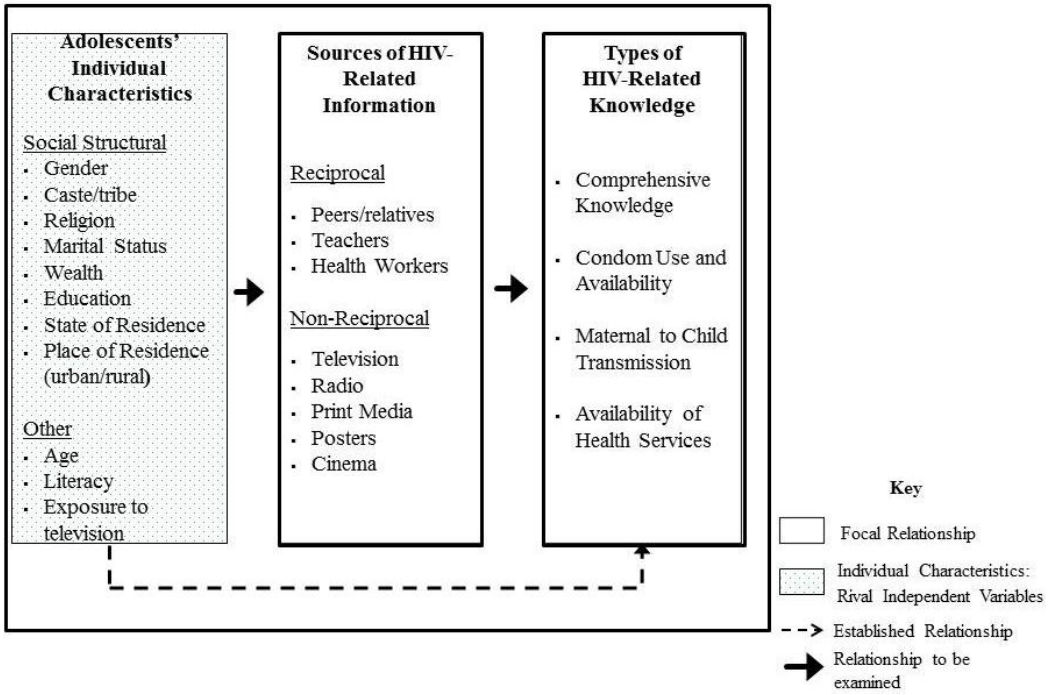
Integrating elements from network perspective that relationships matter and individuals are imbedded in networks that shape the exchange of ideas; the mechanisms presented in the Social Integration Framework; and the principles set forth in the Theory of Gender and Power, a conceptual model was developed to investigate the relationship between the sources of HIV-related information and HIV-related knowledge in HIV-aware Indian adolescents (Figure 3).

Figure 3: Conceptual model for the influence of information sources on the HIV-related knowledge of Indian adolescents.



This conceptual model illustrates the hypothesized relationships of adolescents' individual characteristics, sources of HIV-related information, and types of HIV-related knowledge. The focal relationship tested was the association between sources of HIV-related information and four types of HIV-related knowledge. Figure 4 provides a detailed illustration of the variables examined in the conceptual model.

Figure 4: Specific Variables in the Conceptual Model



FOCAL DEPENDENT VARIABLE: TYPES OF HIV-RELATED KNOWLEDGE

The outcome of interest (or focal dependent variable) was types of HIV-related knowledge in HIV-aware adolescents. Based on the Ministry of Health's definition of comprehensive knowledge, epidemiologic determinants of India's HIV epidemic in the general population, and categorizations used by Yadev et al (2011), the term "Types of HIV Related Knowledge" reflected four types of knowledge: 1) comprehensive knowledge as defined by the Ministry of Health; 2) condom use and availability; 3) maternal to child transmission; and 4) availability of health services.

Comprehensive knowledge. Defined by the UN and reinforced by India's Ministry of Health, comprehensive knowledge of HIV is defined as the ability to correctly identify the two major ways of preventing the sexual transmission of the disease (using condoms and limiting sex to one faithful, uninfected partner); reject the

two most common local misconceptions about transmission (knowledge that HIV cannot be transmitted via mosquito bites or the sharing of food); and knowing that a healthy-looking person can be HIV-infected (UNICEF, 2011; NACO, 2011). People must provide five correct answers to a set of five close-ended questions in order to have comprehensive knowledge of the disease.

Used as an indicator to monitor national progress against Millennium Development Goal 6, Target 6.A, the official definition of comprehensive knowledge is merely the starting point to understand the HIV-related information that adolescents possess (UNAIDS, 2010). This definition is important to include because the definition has been (arguably) unintentionally normalized and resources continued to be dedicated to the promulgation and evaluation of the measure (Fukuda-Parr, et al. 2013). Although it is being investigated, it does not contain adequate information to make Indian adolescents less vulnerable to HIV infection.

Condom availability. Sexual transmission is responsible for nearly 90% of incident HIV infection in India (NACO, 2011). Within sexual relationships, options for reducing one's susceptibility to sexually transmitted infections, including HIV, are limited. Outside the bounds of a monogamous relationship with an uninfected partner, the use of condoms is the only viable behavior that can reduce risk of infection and contribute to a disease-free health outcome (WHO, 2006). As prevention of the disease remains at the forefront of the national efforts to combat spread, it becomes important for adolescents to know not only that condoms can be used to prevent transmission, but where to get them and have the ability to do so.

Maternal to child transmission. The transmission of HIV from mother to child accounts for the second largest source of incident HIV infection in India (NACO, 2011). Nationwide, just under half of women aged 20-24 report being married before the age of 18 and 18% report being married before the age of 15 (UNICEF, 2013). As 80% of HIV infected women are in monogamous marital relationships (NACO, 2011; Perkins et al., 2009), knowledge about the ability for the virus to be transmitted from a mother to her child and the availability of medication to prevention mother-to-child transmission are important components of HIV-related knowledge in this population.

Availability of health services. The fourth type of knowledge under investigation is abstracted from Yadev et al (2011). In India, only three percent of women and four percent of men have ever been tested for HIV and an estimated 80-90% of HIV-infected individuals in India are unaware of their status (NFHS-3, 2007; Steinbrook, 2007). Advances in antiretroviral therapies (ART) have effectively rendered HIV infection a chronic and manageable disease for those who are diagnosed early, have consistent access to ART, and able to maintain a strict drug regimen. The benefits of early detection and introduction to ART are not limited to HIV-infected individuals: ART dramatically reduces the viral load and minimizes risk of transmission to uninfected sexual partners (Cohen, et al, 2011; Das et al., 2010). Therefore, knowledge about where to obtain an HIV test and the availability of ART have become an essential aspect of HIV-related knowledge.

FOCAL INDEPENDENT VARIABLE: SOURCES OF HIV-RELATED INFORMATION

The focal independent variable was the sources of HIV-related information. This dissertation investigated the role of eight information sources clustered into two groups based on their *potential* for reciprocity (defined by Berkman et al as "the extent to which exchanges or transactions are even or reciprocal"). Group one included three sources with the potential for the reciprocal exchange of information: peers/relatives, teachers, and health workers. Group two included five sources that have no potential for the reciprocal exchange of information: television, radio, print media, posters, and cinema.

RIVAL INDEPENDENT VARIABLES: INDIVIDUAL CHARACTERISTICS

The focal relationship was influenced by individual characteristics that were classified as rival independent variables. Within the Elaboration Model proposed by Lazarsfeld and expanded upon by Rosenburg (1968) and Aneshensel (2013), rival independent variables are considered to be associated with both the independent and dependent variable and used to denote competitive theories about the determinants of elements of the focal relationship (Aneshensel, 2013).

This dissertation investigated 11 rival independent variables that have been determined to be associated with HIV-related knowledge in the Indian context. Based on the Social Integration Framework, which posits that social networks are conditioned by social-structural conditions of culture, socioeconomics, politics, and social change, it was theorized that rather than affecting HIV-related knowledge directly, these rival independent variables *also* served as determinants of the sources of

HIV-related information which, in turn, affected HIV-related knowledge. The 11 rival independent variables were clustered into two groups: social structural and other. The social structural variables under investigation were: 1) gender, 2) caste/tribe, 3) religion, 4) marital status, 5) wealth, 6) education, 7) state of residence, and 8) place of residence (urban/rural). The other individual characteristics under investigation were: 1) age, 2) literacy, and 3) exposure to television.

HYPOTHESIZED MECHANISMS OF KEY CONSTRUCTS

This dissertation investigated associations between eight self-identified sources of HIV-related information (peers/relatives, teachers, health workers, television, radio, print media, posters, and cinema) and the four types of HIV-related knowledge (comprehensive, condom availability, mother-to-child transmission, and availability of health services).

FOCAL RELATIONSHIP

Based on the limited literature, Kohler et al's mechanism of joint evaluation which posits that social context shapes the interpretation of HIV prevention messaging within a social network (2007) and the Theory of Gender and Power, six hypotheses about the associations between the key constructs were developed. Table 2 illustrates the six hypothesized associations between sources of HIV-related information and HIV-related knowledge by gender.

Table 2. Hypothesized associations between sources of HIV-related information and HIV-related knowledge in HIV-aware adolescents by gender

Information Source	Type of HIV-related knowledge
Teachers	▪ (H1a) The use of teachers as a source of HIV-related information is positively associated with comprehensive knowledge (and by definition of the construct, each of the five components) for both genders. While there is no national mandate that public education needs to include information on HIV, under the guidance of NACO, the federal government has pledged to increase the amount of information in standardized curricula (NACO, 2011; Santhya & Jejeebhoy, 2007). ▪ (H1b) The use of teachers as a source of HIV-related information is not associated with accurate information about condom availability, maternal to child transmission, or the availability of health services for either gender. Research indicates that teachers are often unable and unwilling to discuss issues pertaining to sexuality (Nair et al, 2011; Goyal & Khanna, 2005; USAID, 2003)
Health Workers	▪ (H2) The use of health workers as a source of HIV-related information is positively associated with all four types of knowledge in both genders. Indian health workers are trained to dispatch appropriate health information (NACO, 2011).
Peers/ Relatives	▪ (H3a)The use of peers/relatives as a source of HIV-related information is positively associated with information about condom availability in boys and maternal to child transmission in girls. This is based on the tendency for adolescents to obtain sexual health related information from same-sex peers (Sivaram et al., 2005; Guilamo-Ramos, et al., 2012) and the mechanism of joint evaluation in which a network interprets the information within the local context and moderates available messaging to appear more realistic (Kohler et al., 2007). ▪ (H3b) The use of peers/relatives as a source of HIV-related information is not associated with comprehensive knowledge or the availability of health services in either gender. This is also based on the tendency for adolescents to obtain sexual health related information from same-sex peers (Sivaram et al., 2005; Guilamo-Ramos, et al., 2012) and the limited amount of correct information that exists within the peer network. Less than 20% of girls and 36% of boys aged 15-24 have comprehensive knowledge about HIV (UNICEF, 2013). Sub-nationally representative surveys indicate a similar lack of information about health services: only a quarter of rural adolescents in the State of Gujarat knew the location of an HIV testing facility and less than one-fifth were aware of the availability of treatment (Yadev et al, 2011).

Table 2, continued	
Television Radio Print Media Posters Cinema	▪ (H4) Non-reciprocal sources (television, radio, print media, posters, and cinema) are positively associated with all four types of knowledge in both genders. This is based on the findings of Ackerson, et al (2012) which indicated that mass media use can have positive affect on increasing the amount of HIV-related prevention and transmission knowledge in the adult (aged 15-49) population.

INDIVIDUAL CHARACTERISTICS

This conceptual model asserts that 11 individual characteristics served as rival independent variables (gender, caste/tribe, religion, marital status, wealth, education, state of residence, place of residence, age, literacy, and exposure to television). The literature review illustrated that each of these variables had known associations with HIV-related knowledge. Based on the Social Integration Framework, it was hypothesized that they also exerted important influences on the sources from which adolescents obtain their information about HIV and the specific types of knowledge they possess. The following hypotheses, presented in Table 3, were based on the extensive research that has been done on the associations between individual characteristics and HIV-related knowledge and the *dearth* of empirical research about the associations between individual characteristics and sources of HIV-related information.

Table 3. Hypothesized mechanisms of rival independent variables as predictors of both sources of HIV-related information and HIV-related knowledge.

Individual characteristic	As a predictor of HIV-awareness	As a predictor of source of HIV-related information	As a predictor of HIV-related knowledge
Gender	H5a. Being male has positive association with HIV awareness.	H5b. Males are more likely to obtain information from non-reciprocal sources and peers than girls. Girls are more likely to obtain information from health workers than boys.	H5c. Being male has positive association with all four types of knowledge.
Caste/Tribe	H6a. Belonging to the Residual General Class[1] has positive association with HIV awareness.	H6b. Adolescents belonging to the Residual General Class are more likely to obtain information from teachers and non-reciprocal[2] sources than those in one of the three legislatively defined marginalized groups.	H6c. Belonging to the Residual General Class has positive association with all four types of knowledge.
Religion	H7a. Being Muslim has negative association with HIV awareness.	H7b. Muslims are less likely to obtain information from teachers and non-reciprocal sources than members of other religions.	H7c. Being Muslim has negative association with all four types of knowledge.
Marital Status	H8a. Being ever married has a negative association with HIV awareness.	H8b. Ever married adolescents are less likely to obtain information from teachers and non-reciprocal sources as compared to never married adolescents.	H8c. Being ever married has a negative association with all four types of knowledge.
Education	H9a. Education is positively associated with HIV awareness.	H9b. Adolescents with at least a secondary education are more likely to obtain information from teachers and non-reciprocal sources as compared to those with lower education.	H9c. Education is positively associated with all four types of knowledge.

[1] Residual General Class - The Constitution of India officially recognizes the most marginalized groups in society: members of the "Scheduled Caste", "Scheduled Tribes" and "Other Backwards Class." People not belonging to one of these three groups are considered part of the "Residual General Class" | [2] Non-reciprocal sources of information have no potential for the reciprocal exchange of information.

Table 3, continued

Individual characteristic	As a predictor of HIV-awareness	As a predictor of source of HIV-related information	As a predictor of HIV-related knowledge
Wealth	H10a. Wealth is positively associated with HIV awareness.	H10b. Wealthier adolescents are more likely to obtain information from teachers, health workers, and non-reciprocal sources as opposed to less wealthy adolescents.	H10c. Wealth is positively associated with all four types of knowledge.
State of residence	H11a. Residence in one of the six "high prevalence" states has positive association with HIV awareness.	H11b. Adolescents residing in one of the the six "high prevalence" states are more likely to obtain information from teachers and health workers as compared to those residing in "low prevalence" states.	H11c. Residence in one of the six "high prevalence" states have positive association with all four types of knowledge.
Place of residence	H12a. Rural residence has a negative association with HIV awareness.	H12b. Rural adolescents are less likely to obtain information from non-reciprocal sources as compared to urban adolescents.	H12c. Rural residence has a negative association with all four types of knowledge.
Age	H13a. Age has a positive association with HIV awareness.	H13b. Older adolescents are more likely to obtain information from teachers as compared to younger adolescents	H13c. Age has a positive association with all four types of knowledge.
Literacy	H14a. Being literate has positive association with HIV awareness.	H14b. Literate adolescents are more likely to obtain information from teachers and non-reciprocal sources as compared to illiterate adolescents.	H14c. Being literate has positive association with all four types of knowledge.
Exposure to television	H15a. Exposure to television has positive association with HIV awareness.	H15b. Adolescents with exposure to television are more likely to source information from non-reciprocal sources as compared to adolescents without exposure to television.	H15c. Exposure to television has positive association with all four types of knowledge.

CHAPTER THREE: METHODS

THE NATIONAL FAMILY HEALTH SURVEY-3 (2005-2006)

The National Family Health Survey (NFHS-3) is a nationally representative cross-sectional study administered to households (n= 109,041) and 15-49 year old men and women (n=198,754) in all 29 states of India in 2005-2006.

The NFHS-3 was the third wave in a series of national Demographic and Health Surveys (DHS) that were supported by the Government of India's Ministry of Health and Family Welfare and the United States Agency for International Development, among others. Commissioned by the Ministry of Health and Family Welfare in the early 1990's, the surveys have emerged as an important data source that provides key indicators of national health and nutrition. The NFHS-3 is comprised of 10 sections that gather comprehensive information on household population and housing characteristics; fertility and fertility preferences; family planning; infant and child mortality; maternal health; child health; malnutrition and anemia; HIV/AIDS related knowledge, attitudes, and behavior; HIV prevalence; morbidity and health care; women's empowerment; and domestic violence.

Between November 2005 and August 2006, data were collected using a multistage sampling procedure that stratified each of the 29 states into rural and urban populations and eight cities into slum and non-slum areas. Within each state, urban and rural samples were drawn separately.

The selection of the rural sample was based on the official 2001 census list of villages and occurred in two stages. First, villages were selected as the primary sampling units with the probability of selection proportional to population size. Second, a random selection of households occurred within each primary sampling unit.

This was achieved by a "household listing operation" which mapped each primary sampling unit, assigned every residence a unique identifier, and used systematic sampling to select households. A total of 73,642 rural households were included in the survey.

Selection of the urban samples for which no slum and non-slum distinction was based on the 2001 list of wards and occurred in three stages. First, wards were selected as the primary sampling units with the probability of selection proportional to population size. Second, one census enumeration block was randomly selected from each ward. Third, households were systematically selected within each census enumeration block. As in rural areas, this was achieved by listing households within each census enumeration block. Each household was assigned a unique identifier, and systematic sampling was used to select households. A total of 35,579 urban households were included in the survey.

In eight cities (Chennai, Delhi, Hyderabad, Indore, Kolkuta, Mumbai, Meerut, and Nagpur) separate indicators for slum and non-slum areas were provided by the Registrar General of India. Sample selection for these eight urban cities occurred in two stages. First, slum and non-slum primary sampling units were selected independently from respective lists of slum and non-slum census enumeration blocks. Second, households were systematically selected within each primary sampling unit using the same procedure to that used for rural and urban samples.

The NFHS-3 employed three different questionnaires (Household, Women, and Men) that were translated into 18 different languages. Data were collected in same sex, face-to-face interviews within the sample households. The Household

Questionnaire was used to list all usual residents plus any overnight visitors who had stayed the previous night. The Women's Questionnaire was administered to all 15-49 year old women who were the usual residents or overnight visitors in the household. The Men's Questionnaire was administered to all 15-49 year old men who were the usual residents or overnight visitors in the household. The survey achieved a response rate of 98% for households, 95% for women, and 87% for men (NFHS-3, 3007).

The survey was designed to be self-weighting at the domain levels which are the urban and rural areas of each state slum and non-slum areas of eight cities. First, household sampling weights were calculated to account for differential non-response rates of household interviews in each domain. The household design weight for a particular household is the inverse of its section probability multiplied by the inverse of the household response rate for its particular domain. Second, individual sampling weights were calculated to account for differential non-response rates of individuals in each household. The individual design weight for a particular individual is the household weight multiplied by the inverse of the individual response rate of the individual response rate group (men or women). Third, household and individual weights were normalized at the state level to create individual state weights for single state analysis. Last, they were normalized at the national level to create a national (all-India) weight to be used for national-level or multi-state analysis (NFHS-3, 3007; Rutstein & Rojas, 2006).

ANALYTIC SAMPLE

The analytic sample for this dissertation was created from the NFHS-3 to perform all-India, individual-level empirical analyses on Indian adolescents. It contains two sub-sets. Sub-set one is restricted to adolescent boys and girls 15-19 years old with complete data on individual characteristics (unweighted N = 35,603). Sub-set two is restricted to adolescent boys and girls 15-19 years old who are aware of HIV and have complete information with regards to the focal relationship (unweighted N = 27,752).

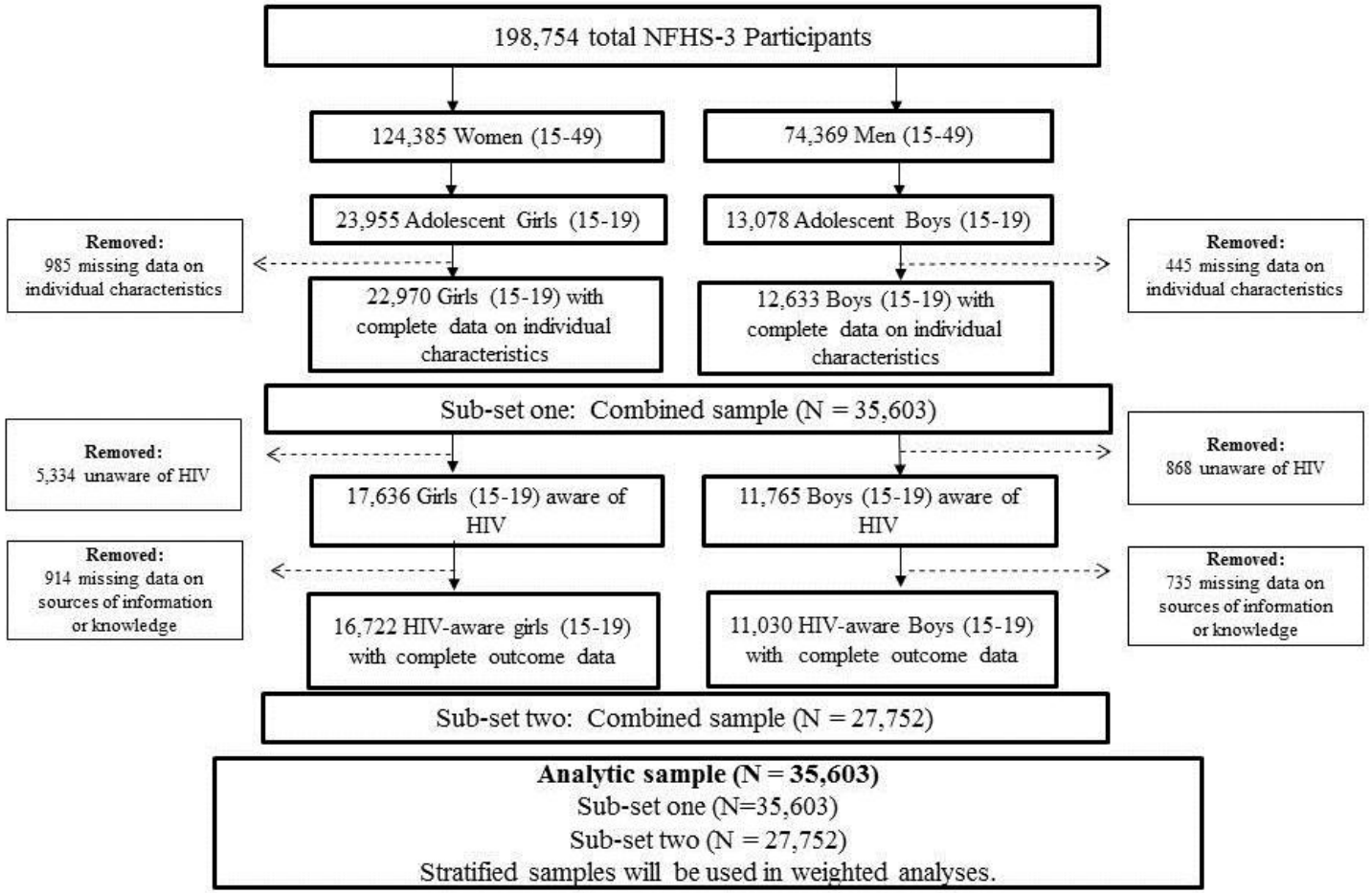
Data for the analytic sample came from two separate data sets for men (unweighted n= 74,369) and women (unweighted n = 124,385) that were provided by DHS in separate files. Both data sets were checked for accuracy in skip patterns and consistency in wording of questions and response categories. I designated the women's dataset as the master dataset and renamed variables in the men's dataset to ensure consistency in variables.

The sample of women (15-49 years old) was comprised of 124,385 respondents including 23,955 adolescents (15-19 years old). First, the data were reduced by 985 cases to the 22,970 adolescents with complete data on individual characteristics. This became sub-set one (Figure 5). This sub-set represents 95.9% of all adolescent girls responding to the questionnaire. Second, the data were reduced 23% to the 17,636 adolescents who were aware of HIV. Lastly, the data were reduced by 914 cases to the 16,722 HIV-aware girls with complete outcome data for independent variable (sources of HIV-related information) and the dependent variable (types of HIV-related knowledge). This became sub-set two (Figure 5). This sub-set represents 69.8% of all adolescent girls responding to the questionnaire.

The sample of men (15-49 years old) was comprised of 74,369 respondents including 13,078 adolescents (15-19 years old). First, the data were reduced by 445 cases to the 12,633 adolescents with complete data on individual characteristics. This became sub-set one (Figure 5). This sub-set represents 96.6% of all adolescent boys responding to the questionnaire. Second, the data were reduced 6.9% to the 11,765 adolescents who were aware of HIV. Lastly, the data were reduced by 735 cases to the 11,030 HIV-aware boys with complete outcome data for independent variable (sources of HIV-related information) and the dependent variable (types of HIV-related knowledge). This became sub-set two (Figure 5). This sub-set represents 84.3% of all adolescent boys responding to the questionnaire.

In the final step, I merged the two data files and verified that the merger was correct using crosstabs on key variables. The two data files contained individual sampling weights that were calculated by adjusting the households for individual non-response and I employed survey design capable software (Stata 12) that adjusted for the primary sampling units and the merged strata (women and men) (Stata, 2013). This adjustment may have altered the standard errors but it did not alter the coefficients. For sub-set one the final, combined, sample of boys and girls is comprised of 35,603 15-19 year old adolescents who have complete information with regard to individual characteristics. For sub-set two the final, combined, sample of boys and girls is comprised of 27,752 15-19 year old adolescents who are aware of HIV and have complete information with regard to individual characteristics and the focal relationship. A comparison of included and excluded survey respondents is provided in the results section (Tables 10 and 11).

Figure 5. Creation of the analytic sample (unweighted N = 35,603)



This analysis plan contains two sub-sections. Section One presents distribution of key constructs and the operationalization of HIV awareness, the focal dependent and focal independent variables, and individual characteristics. It also includes a comparison of included and excluded survey respondents.

Section Two presents each specific aim, the corresponding research questions, an illustration that depicts particular components of the conceptual model under investigation (when applicable), and the statistical procedures employed to address each aim.

DISTRIBUTION AND OPERATIONALIZATION OF KEY CONSTRUCTS

HIV Awareness

The first outcome of interest under investigation in this dissertation was HIV awareness. This analysis utilized one close ended question extracted from Section 8 of the NFHS-3 (HIV/AIDS and other sexually transmitted diseases) to operationalize this outcome. The question was asked "Have you ever heard of an illness called AIDS?" Enumerators were instructed to read the close-ended question prompt and record the respondent's answer by circling one of the two provided coding categories (yes or no).

Within subset-one of the analytic sample, 82.6% of adolescents were aware of the disease (unweighted N=35,603).

Focal Dependent Variable: Types of HIV-Related Knowledge

Original distribution

The primary outcome of interest under investigation in this analysis was types of HIV-related knowledge among HIV-aware adolescents. This variable encompassed four types of HIV-related knowledge: 1) The prescribed definition of "comprehensive knowledge" as defined

by the Ministry of Health; 2) knowledge pertaining to condom availability; 3) knowledge pertaining to the mother-to-child transmission; and 4) knowledge pertaining to the availability of health services.

This dissertation utilized 11 close-ended questions contained in the NFHS-3 to operationalize the dependent variable. These questions were extracted from two different sections of the NFHS-3 entitled 'HIV/AIDS and other sexually transmitted diseases' and 'Sexual life.' (note: the section entitled 'Sexual life' is referred to as 'Marriage and sexual life' in the Men's Questionnaire). The questions were selected because they pertain to the specific types of HIV-related knowledge under investigation in this study. All 11 questions were obtained using the same format: enumerators were instructed to read the close-ended question prompt and record the respondent's answer by circling one of the provided coding categories. Table 4 reports the distribution of the 11 questions with their response categories. This table includes questions exactly as presented in the official questionnaire but grouped into categorizes imposed by this research.

Within sub-set two of the analytic sample, over three-quarters of adolescents knew that having one uninfected sex partner with no other partners reduces the risk of infection (77.8%), that HIV is not transmitted via the sharing of food (78.2%), and that HIV can be transmitted from a mother to her child (77.1%). Less than half (47.5%) of adolescents in the sample were aware of a place to get tested for HIV and only 15.2% had heard about antiretroviral therapy.

Table 4. Original distribution of the focal dependent variable, types of HIV-related knowledge among HIV-aware adolescents (unweighted N=27,752)

Original Questions in the NFHS-3 categorized by types of knowledge	N= 27,752	%
COMPREHENSIVE KNOWLEDGE		
In your opinion, can people reduce their chances of getting HIV by using a condom every time they have sex?		
Yes	19,048	68.6
No	2,643	09.5
Don't know	6,061	21.9
In your opinion, can people reduce their chances of getting HIV by having just one uninfected sex partner who has no other sex partners?		
Yes	21,579	77.8
No	1,968	07.1
Don't know	4,205	15.1
In your opinion, can people get HIV from mosquito bites?		
Yes	5,364	19.3
No	19,143	69.0
Don't know	3,245	11.7
In your opinion, can people get HIV by sharing food with a person who has HIV?		
Yes	3,788	13.6
No	21,700	78.2
Don't know	2,264	08.2
Is it possible for a healthy-looking person to have HIV?		
Yes	19,388	69.9
No	5,203	18.7
Don't know	3,161	11.4
CONDOM AVAILABILITY KNOWLEDGE		
Do you know of a place where a person can get condoms?		
Yes	17,646	63.6
No	10,106	36.4
(If yes to above) If you wanted to, could you yourself get a condom?*		
Yes	9,468	53.6
No	6,847	38.8
Don't know	1,331	07.6
MOTHER-TO-CHILD TRANSMISSION KNOWLEDGE		
Can HIV be transmitted from a mother to her baby		
Yes	21,400	77.1
No	2,716	09.8
Don't know	3,636	13.1

Table 4, continued

(If yes to above) Are there any special medications that a doctor or nurse can give to a women infected with HIV to reduce the risk of transmitting HIV to the baby?*		
Yes	8,292	38.8
No	6,429	30.0
Don't know	6,679	31.2
AVAILABILITY OF HEALTH SERVICES KNOWLEDGE		
Do you know of a place where people can go get tested for HIV?		
Yes	13,195	47.5
No	14,557	52.4
Have you ever heard about special antiretroviral drugs that people infected with HIV can get from a doctor or nurse to help them live longer?		
Yes	4,227	15.2
No	23,525	84.8

* Corresponding percentages calculated as percentages of those who said "yes" to prior question

Operationalization and transformed distribution

The focal dependent variable was comprised of 11 nominal variables that addressed four types of HIV-related knowledge: 1) The prescribed definition of "comprehensive knowledge" as defined by the Ministry of Health; 2) knowledge pertaining to condom availability; 3) knowledge pertaining to the mother-to-child transmission; and 4) knowledge pertaining to the availability of health services. All 11 questions were framed in the same way: respondents were asked if they were knowledgeable about a specific topic, i.e. can HIV be transmitted from a mother to her baby? Original response categories were coded as follows:

0 = No
1 = Yes
8 = Don't know
9 = Missing

First, the data were transformed and all 11 variables were recoded to reflect accurate and inaccurate responses in a two step process. In step one, correct answers were classified as

accurate and the appropriate response category was recoded as accurate. For example, "yes" answers to the question "can HIV be transmitted from a mother to her baby?" were recoded as accurate while "no" answers to the question "In your opinion, can people get HIV from mosquito bites?" were recoded as accurate.

In step two, both incorrect and "don't know" answers were classified as inaccurate. For example, "no" and "don't know" answers to the question "can HIV be transmitted from a mother to her baby?" were recoded as inaccurate while "yes" and "don't know" answers to the question "In your opinion, can people get HIV from mosquito bites?" were recoded as inaccurate. Transformed response categories are coded as follows:

0 = Inaccurate
1 = Accurate

Following data transformation, 11 variables that pertained to the four types of HIV-related knowledge were operationalized. Four new variables (one binary variable and three three-level ordinal variables) were created to categorize possession of each of the four types of knowledge under investigation. Table 5 illustrates the transformed distribution of the dependent variable, types of accurate HIV-related knowledge among HIV-aware adolescents (unweighted N=27,752).

Comprehensive knowledge (binary variable). In accordance with the definition provided by the Ministry of Health and Family Welfare, a person with "comprehensive knowledge" of HIV is defined by as someone who provides five correct answers to a set of five prompted questions:

1) Can people reduce their chances of getting HIV by using a condom every time they have sex?
2) Can people reduce their chances of getting HIV by having just one uninfected sex partner who has no other sex partners?
3) Can people get HIV from mosquito bites?

4) Can people get HIV by sharing food with a person who has HIV?
5) Is it possible for a healthy-looking person to have HIV?

Respondents who provided five accurate answers to the prescribed set of five questions were categorized as "accurate" (coded as 1). Respondents who reported an inaccurate answer to one or more of the five questions were categorized as "inaccurate" (coded as 0). Thirty-six percent of the sample possessed comprehensive knowledge of the disease.

Condom availability (ordinal variable). A person with knowledge about condom availability was defined as someone who provides two correct answers to the following:

1) Do you know of a place where a person can get condoms?
2) If you wanted to, could you yourself get a condom?

Respondents who provided two accurate answers were categorized as "accurate" (coded as 2). Respondents who provided an accurate answer to the first question but an inaccurate answer to the second question were categorized as "somewhat accurate" (coded as 1). Respondents who reported an inaccurate answer to the first question (and, therefore, were not asked the second question) were categorized as "inaccurate" (coded as 0). Thirty-four percent of the sample possessed accurate knowledge pertaining to condom use and availability.

Mother-to-child transmission (ordinal variable). A person with mother-to-child transmission knowledge was defined as someone who provides two correct answers to the following:

1) Can HIV be transmitted from a mother to her baby?
2) (if yes to the previous) Are there any special medications that a doctor or nurse can give to a women infected with HIV to reduce the risk of transmitting HIV to the baby?

Respondents who provided two accurate answers were categorized as "accurate" (coded as 2). Respondents who provided an accurate answer to the first question but an inaccurate answer to the second question were categorized as "somewhat accurate" (coded as 1). Respondents who reported an inaccurate answer to the first question (and, therefore, were not asked the second

question) were categorized as “inaccurate” (coded as 0). Thirty percent of the sample possessed accurate knowledge pertaining to mother to child transmission.

Availability of health services (ordinal variable). A person with health services knowledge was defined as someone who provides two correct answers to the following:

1) Do you know of a place where people can go get tested for HIV?
2) Have you ever heard about special antiretroviral drugs that people infected with HIV can get from a doctor or nurse to help them live longer?

Respondents who provided two accurate answers were categorized as “accurate” (coded as 2). Respondents who provided an accurate answer to the first question but an inaccurate answer to the second question were categorized as “somewhat accurate” (coded as 1). Respondents who provided to inaccurate answers to both questions were categorized as “inaccurate” (coded as 0). Ten percent of the sample possessed accurate knowledge pertaining to the availability of health services.

Table 5. Transformed distribution of the dependent variable, types of accurate HIV-related knowledge among HIV-aware adolescents (unweighted N=27,752)

Types of Accurate Knowledge	N= 27,752	%
Binary Variable		
Comprehensive	**9,875**	**35.6**
Use of condoms prevents sexual transmission	19,048	68.6
Limiting sex to one faithful, uninfected partner prevents sexual transmission	21,579	77.8
Cannot be transmitted via mosquito bites	19,143	69.0
Cannot be transmitted by sharing food	21,700	78.2
Healthy-looking people can be infected	19,388	69.9
Ordinal Variables		
Condom availability	**9,468**	**34.1**
Aware of a place to obtain condoms	17,646	63.6
Aware of a place to obtain but unable to get a condom	8,178	29.5
Aware of a place to obtain and able to get a condom	9,468	34.1
Mother-to-child transmission	**8,292**	**29.9**
Can be transmitted from a mother to her baby	21,400	77.1
Aware of transmission but unaware of drug therapy	13,108	47.2
Aware of transmission and aware of drug therapy	8,292	29.9
Availability of health services	**2,837**	**10.2**
Aware of testing location	13,195	47.5
Aware of testing location but unaware of drug therapy	8,968	32.3
Aware of drug therapy	4,227	15.2

Note: Bold text indicates accurate knowledge by type. Not bold test indicates accurate knowledge by question

Independent Variable: Sources of HIV-Related Information

Original distribution

The focal independent variable under investigation was the sources of HIV-related information. This encompassed (on an *apriori* basis) two distinct groups and a total of eight distinct sources. Group one included three reciprocal information sources – peers/relatives; schools/teachers; and health workers. Group two included five non-reciprocal information sources – television, radio, newspapers/magazines, posters/billboards, and cinema. The eight

sources of information were clustered into two groups based on their *potential* for reciprocity as defined by Berkman et al.

Section 8 of the NFHS-3 (HIV/AIDS and other sexually transmitted diseases) contained one open-ended question, with a single follow-up question, that asked respondents where they got information about HIV. The question asked "From which sources of information have you learned about HIV?" Enumerators were instructed to record all sources mentioned and give one prompt of "Any other sources?"

Sixteen different sources of information were volunteered by respondents. Table 6 reports the original distribution of the 16 possible (not mutually exclusive) response categories for the independent variable, sources of HIV-related information, by gender. This table includes questions exactly as presented in the official questionnaire but grouped into categorizes imposed by this research.

It is important to highlight that open-ended questions are subject to particular concerns. There are challenges associated with garnering sufficiently rich responses from respondents who are uneducated and unaccustomed to expressing opinions (Schuman, 1966) and it has been argued that respondents are unlikely to probe their memories in enough detail to provide accurate responses to open-ended questions (Lodge et al, 1989). These limitations are further discussed in Chapter 5 (Discussion).

Table 6. Original distribution of the 16 possible response categories of the focal independent variable, sources of HIV-related information (unweighted N=27,752)

		N=27,752	%
Non-Reciprocal Sources			
Television	Yes	22,717	81.9
	No	5,035	18.1
Radio	Yes	11,840	42.7
	No	15,912	57.3
Newspapers/magazines	Yes	10,871	39.2
	No	16,881	60.8
Posters/billboards	Yes	5,510	19.9
	No	22,242	80.1
Cinema	Yes	234	0.8
	No	25,418	91.6
Reciprocal Sources			
Peers/relatives	Yes	9,444	34.0
	No	18,308	66.0
Schools/teachers	Yes	7,653	27.6
	No	20,099	72.4
Health workers	Yes	1,528	5.5
	No	26,224	94.5
Mean # of sources		*2.7*	
Additional sources not under investigation			
Adult education	Yes	709.0	2.6
	No	27043.0	97.4
Community meetings	Yes	612.0	2.2
	No	27140.0	97.8
Exhibitions	Yes	498.0	1.8
	No	27254.0	98.2
Workplace	Yes	476.0	1.7
	No	27276.0	98.3
Spouse	Yes	239.0	0.9
	No	27513.0	99.1
Religious leaders	Yes	184.0	0.7
	No	27568.0	99.3
Other	Yes	173.0	0.6
	No	27579.0	99.4
Political leaders	Yes	46.0	0.2
	No	27706.0	99.8

Operationalization and transformed distribution

The independent variable stemmed from one nominal variable with 16 possible (not mutually exclusive) response categories. Within the data set, each of the 16 possible response categories were presented as 16 different binary nominal variables with identical formats. The original response categories were coded as follows:

0 = No
1 = Yes
9 = Missing

In order to test the summative effects of non-reciprocal sources and the additive effects of the three reciprocal sources of information, the focal independent variable was operationalized in three ways: 1) one non-negative, continuous count variable (range: 0-5) that identified the total number of non-reciprocal sources for each respondent; 2) eight binary nominal variables that dichotomized each of the eight non-reciprocal and reciprocal information sources (0=no and 1=yes); and 3) two binary nominal variables that identified whether or not a respondent obtains all of their information from reciprocal and non-reciprocal sources (0=no and 1=yes).

Table 7 illustrates the transformed distribution of the independent variable, utilized sources of HIV-related information among HIV-aware adolescents (unweighted N=27,752). Television was the most common source of HIV-related information and utilized by 81.9% of adolescents in the sample. This is followed by radio (42.7%) and newspapers/magazines (39.2%). One third of the sample (34%) reported obtaining information from peers/relatives while just under one-third (27.6%) of the sample obtained their information from schools/teachers. Health workers were the least relied upon source of HIV-related information and used by only 5.5% of the analytic sample.

Table 7. Transformed distribution of the independent variable, utilized sources of HIV-related information among HIV-aware adolescents (unweighted N=27,752)

	N=27,752	%
Count of Non-Reciprocal Sources		
0	2,244	8.1
1	9,153	33.0
2	8,222	29.6
3	5,318	19.2
4	2,354	8.5
5	461	1.7
Mean # of non-reciprocal sources	1.9	
Non-Reciprocal Sources		
Television	22,717	81.9
Radio	11,840	42.7
Print	10,871	39.2
Posters	5,510	19.9
Cinema	2,334	8.4
All information from non-reciprocal sources	12,760	46.0
Reciprocal Sources		
None	12,760	46.0
Peers/relatives	9,444	34.0
Schools/Teachers	7,653	27.6
Health workers	1,528	5.5
All information from non-reciprocal sources	2,244	8.1

Individual Characteristics

Operationalization

All of the individual characteristics included in the conceptual model (education, wealth, marital status, literacy, occupation, age, caste/tribe, religion, state, gender, exposure to television, and place of residence) were extracted from variables available in the NFHS-3 data file. Table 8 summarizes the characteristics, the operational definitions provided by the NFHS-3, transformations that I have made to the data, and the response categories as used in the analysis.

Table 8. Individual characteristics: Operational definitions defined in the NFHS-3, transformations, and response categories.

Variable	Operational definition and transformations	Response categories used in analysis
Gender	No transformation made to data. Binary nominal variable created from participation in either men or women's questionnaire.	(0)Female (1)Male
Age	No transformation made to data. Interval variable created from self-report of month and year of birth.	15-19
Education	No transformation made to data. Ordinal variable based on the self-reported highest grade completed. Four response categories in accordance with important distinctions in the Indian education system.	(1) None (0 years) (2) Primary (1-5 y) (3) Secondary (6-10 y) (4) Higher (> 10 y)
Wealth	No transformation made to data. Ordinal variable defined by established methodology particular to the Indian context in which each individual is assigned a score created by weighted responses to 33 self-reported questions about household assets and observed characteristics imputed by the enumerator. At the national level, the household population is divided into five equal groups (quintiles) and five response categories were created	(1) Poorest (2) Poorer (3) Middle (4) Richer (5) Richest
Place of residence	No transformation made to data. Binary nominal variable indicating the de facto (based on location of the interview) place of residence as determined by official classification in the 2001 Census and imputed by enumerator.	(1) Urban (2) Rural
State of residence	Binary nominal variable based on transformation. Began as nominal variable imputed by enumerator with 29 response categories possible (one for each Indian state). Sixty percent of the nation's HIV burden rests in six states: Andhra Pradesh, Karnataka, Maharashtra, Tamil Nadu, Manipur, and Nagaland. The National AIDS Control Organization (NACO) defines these as "high prevalence states." I collapsed these into a binary variable that makes a distinction between the six "high prevalence" states as defined by NACO and the other 23 states (which I have labeled "low prevalence").	(0) Low prevalence (1) High prevalence

Table 8, continued

Marital status	Nominal variable based on transformation. Began as nominal variable based on self-report of current marital status. Three response categories were created: never married, currently married, and formerly married. As less than 1% of respondents were formerly married, I collapsed the last two categories into one category called "Ever Married."	(0) Never married (inc. married w/o consummation) (1) Ever married
Literacy	Ordinal variable based on transformation. Began as ordinal variable based on enumerator's assessment of ability. Each respondent was asked to read a sentence from a literacy card designed for this survey. Five response categories were created: cannot read, able to read part of a sentence, able to read whole sentence, no card with required language and blind/visually impaired. I collapsed the responses into two categories: Not literate (cannot read, able to read part of a sentence, able to no card with required language and blind/visually impaired) and Literate (able to read whole sentence)	(0) Not literate (1) Literate
Exposure to Television	Ordinal variable based on transformation Began as ordinal variable recorded by enumerator based on the self-reported frequency of watching television. Four response categories were created: not at all, at least once a week, less than once a week, almost daily. I collapsed the responses into three categories: Not at all, Less than daily, Almost daily	(0) Not at all (1) Less than daily (2) Almost daily
Caste/Tribe	Nominal variable based on transformation. Began as a nominal variable based on self-report of belonging to one of three legislatively defined groups. Four response categories were created: scheduled caste, scheduled tribe, other backward class, or none of them. I collapsed the responses into three categories: Scheduled Caste and Scheduled Tribe; Other Backward Class, and Residual General Caste.	(0) Schedule caste or tribe (1) Other backward class (2) Residual general caste
Religion	Nominal variable based on transformation. Began as nominal categorical variable based on self-report of religion. Eleven response categories were created. As 85% of the population identifies as Hindu or Muslim, I collapsed the additional nine categories into one category called "Other."	(0) Hindu (1) Muslim (2) Other

Transformed Distribution

Table 9 illustrates the transformed distribution of individual characteristics for each analytic subset (unweighted N=35,603 and unweighted N=27,752). In the general adolescent population (subset one) the majority of respondents are girls (64.5%). Twelve percent of the population had no formal education while 71% had a secondary education. Eleven percent were in the poorest wealth quintile and 28% were in the richest. Just under half (46.3%) resided in urban locales and one third (33.2%) lived in one of the six states with high HIV prevalence. Fourteen percent of the population was ever married, 20% could not read, and nearly 30% had no exposure to television. The vast majority of respondents (72.2%) were Hindu.

Subset two had a slightly different composition. Sixty percent of the respondents were girls. Just under 5% had no formal education and 81.1% had a secondary education. Only 5.8% were in the poorest wealth quintile while 33.9% were in the richest wealth quintile. A slight majority (52.6%) resided in urban locales and 37.9 lived in one of the six high prevalence states. Ten percent of this population could not read and only 8% had no exposure to television.

Table 9. Transformed distribution of individual characteristics for each analytic subsets (unweighted N=35,603 and unweighted N=27,752)

		Analytic Subset One [HIV aware and unaware]	Analytic Subset Two [HIV aware]
		Total n=35,603	Total n=27,752
Characteristics		%	%
Gender	Girls	64.5	60.3
	Boys	35.5	39.7
Age	15	18.7	17.8
	16	21.2	21.2
	17	19.4	19.7
	18	22.5	22.3
	19	18.2	18.9
Education	None	12.3	4.7
	Primary	13.1	9.6
	Secondary	71.0	81.1
	Higher	3.6	4.5
Wealth	Poorest	11.0	5.8
	Poorer	15.1	11.6
	Middle	20.8	20.7
	Richer	25.0	27.9
	Richest	28.1	33.9
Place of residence	Urban	46.3	52.6
	Rural	53.7	47.4
State of residence	Low Prevalence	66.8	62.1
	High Prevalence	33.2	37.9
Married	Never Married	86.1	90.6
	Ever Married	13.9	9.4
Literacy	Not literate	20.3	10.1
	Literate	79.7	89.9
Exposure to Television	Not at all	27.5	8.1
	Less than daily	14.5	24.6
	Almost every day	58.0	67.3
Caste/ Tribe	Scheduled caste and tribe	32.6	30.3
	Other backward class	38.8	34.2
	Residual general class	32.6	35.5
Religion	Hindu	72.2	71.9
	Muslim	13.8	13.2
	Other	14.0	14.9

** Statistically significant difference between boy and girl respondents (within the subset) at the p<.001 level (Pearsons Chi Square)*

ANALYSIS OF SPECIFIC AIMS

This dissertation attempted to better understand the associations between sources of HIV-related information and HIV-related knowledge among Indian adolescents who are aware of the disease. In order to answer this question and structure the analysis, four specific aims and 11 research questions were created. Using Stata version 12 and Mplus version 7.2, a combination of bivariate analysis, multivariable regression analysis, and multiple mediation analysis techniques were employed to address each of the four Specific Aims and the 11 corresponding research questions.

Specific Aim One: To describe the individual characteristics of adolescents who are aware of HIV.

Research question 1: Which individual characteristics are associated with being aware of HIV?

First, preliminary analysis was completed in order to understand the generalizability of the two analytic samples. Univariate distributions were examined and statistical hypothesis tests compared the individual characteristics of those included and excluded from the analytic samples. Specifically, Pearson's chi-square tests investigated the null hypothesis that adolescents included in each analytic sample did not differ on individual characteristics from the adolescents excluded from the respective sample (Woolridge, 2006).

Second, bivariate analysis compared the distribution of individual characteristics from the two analytic sub-samples disaggregated by gender.

Third, multivariate logistic regression was employed to examine which individual characteristics were associated with HIV awareness in the sample population. Logistic

regression estimates unknown parameters of regression models with multiple explanatory variables and allows for a binary response variable (Wooldridge, 2006).

The model is depicted as:

$$\text{Logit}\,(P(Y_i)) = \beta_o + \beta_k X_{ki} + \varepsilon$$

Where:
$P(Y_i)$ = the probability of the outcome
i = individual respondent
β_o = intercept term
β_k = the effect of the individual characteristic (k)
X_{ki} = individual characteristic (k) for individual respondent (i)
ε = error term

A parametric statistical test (the joint Wald test) was performed on the five multi-level categorical variables (education, wealth, exposure to television, caste, and religion) to test for overall main effects (or joint significance of the subset of coefficients) (Wooldridge, 2006). Differences in the odd ratios, confidence intervals, and probabilities for all covariates were examined for significance.

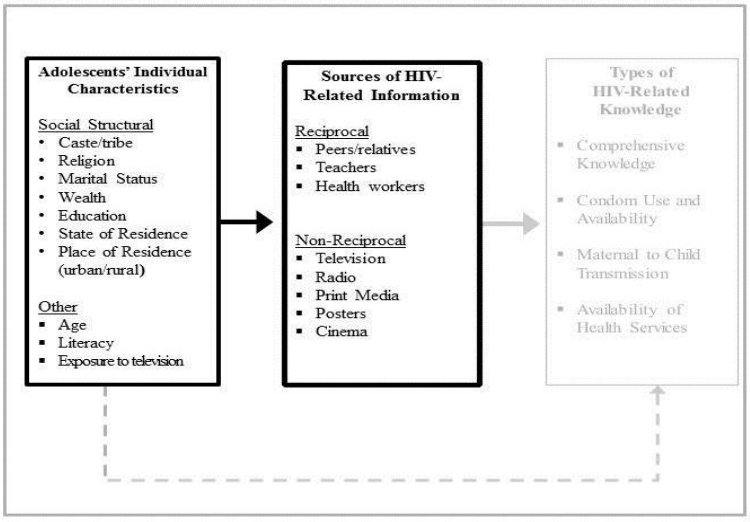
Specific Aim Two: To describe where HIV-aware adolescents obtain their HIV-related information.

Research question 2: From which reciprocal and non-reciprocal sources do adolescents obtain their HIV-related information?

Research question 3: Do individual characteristics explain where adolescents obtain their HIV-related information?

Research question 4: Do individual characteristics explain whether adolescents obtain all of their HIV-related information from reciprocal as compared to non-reciprocal sources?

Figure 6. Illustration of components of the model to be tested in Specific Aim Two



First, univariate distributions of the eight information sources were examined and Pearson's chi-square tests were applied to test the null hypothesis that there were no statistical associations between the eight sources of information under investigation in this study.

Second, exploratory factor analysis (EFA) was used as a data reduction tool to explore underlying structures in the set of focal independent variables under investigation. Factor analysis is a tool to explore statistical patterns of relationships among variables (Afifi et al. 2004). Typically employed to discern more about the nature of underlying constructs that survey questions are supposed to approximate (Afifi et al. 2004), EFA explored the presence of statistical associations in support of the theoretical construct of reciprocity under investigation in this study.

Third, bivariate analysis was employed to examine the distribution of sources of HIV-related information and individual characteristics from the combined sample and disaggregated

by gender. This step allowed for a description of the reciprocal and non-reciprocal sources from which HIV-aware adolescents obtain their HIV-related information.

To understand if individual characteristics differed among adolescents who obtain all of their HIV-related information from reciprocal sources as compared to non-reciprocal sources a combination of Poisson and logistic regression techniques were employed.

First, a Poisson regression model examined linear associations between individual characteristics and the number of non-reciprocal information sources using the new count variable. Poisson regression estimates conditional probabilities for any values of explanatory variables and allows for a non-negative count dependent variable (Wooldridge, 2006).

Second, mlutivariate logistic regression was used to examine associations between individual characteristics and each of the eight individual sources using the eight new binary nominal variables. Third, multivariate logistic regression was also employed to examine associations between individual characteristics and the two binary nominal variables that identify whether or not a respondent obtains all of their information from reciprocal and non-reciprocal sources.

Each regression employed the following model:

$$\text{Logit}\,(P(Y_i)) = \beta_o + \beta_k X_{ki} + \varepsilon$$

Where:
$P(Y_i)$ = the probability of the outcome
i = individual respondent
β_o = intercept term
β_k = the effect of the individual characteristic (k)
X_{ki} = individual characteristic (k) for individual respondent (i)
ε = error term

In each regression model the joint Wald test was performed on the five multi-level categorical variables (education, wealth, exposure to television, caste, and religion) to test for overall main effects. Differences in the incidence rate rations (IRR) for the Poisson model, odd ratios for the binary logistic models, confidence intervals, and probabilities for all covariates were examined for significance.

Specific Aim Three: To describe what types of accurate and inaccurate HIV-related knowledge HIV-aware adolescents possess.

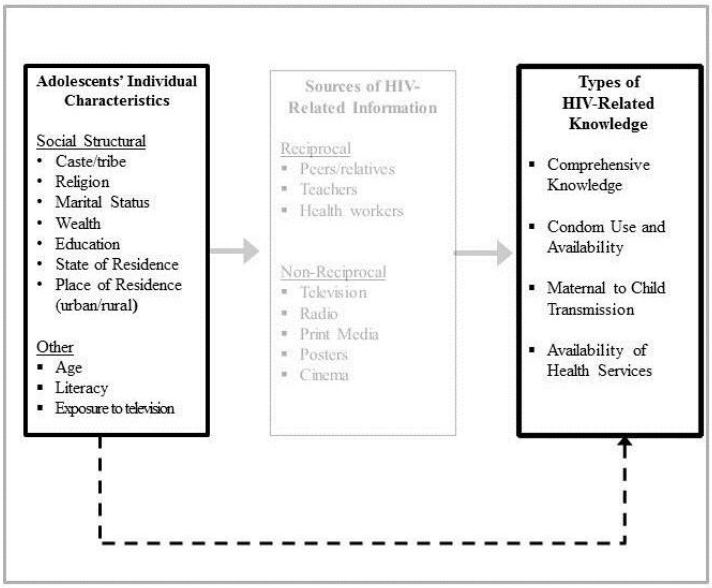
Research question 5: What types of accurate HIV-related knowledge do adolescents possess?

Research question 6: What types of inaccurate HIV-related knowledge do adolescents possess?

Research question 7: Do individual characteristics explain whether adolescents possess accurate as compared to inaccurate types of HIV-related knowledge?

Research question 8: Do the individual characteristics that are associated with being unaware of HIV differ from the individual characteristics that are associated with inaccurate HIV-related knowledge?

Figure 7: Illustration of components of the model to be tested in Specific Aim Three



First, Pearson's chi-square test was applied to test the null hypothesis that there were no statistical associations between the 11 knowledge questions that made up the four types of knowledge under investigation in this study.

Second, in order to describe the types of accurate and inaccurate HIV-related knowledge that HIV-aware adolescents possess, bivariate analysis examined the distribution of HIV-related knowledge by gender.

Then, a combination of multivariate logistic regression techniques were used to determine if individual characteristics explain whether adolescents possess accurate as compared to inaccurate types of HIV-related knowledge. Binary logistic regression was applied to the model investigating comprehensive knowledge (a variable with a binary outcome) while ordinal logistic regression was applied to the three models investigating the three other types of knowledge (variables with three-level ordinal outcomes). Ordinal logistic regression estimates unknown parameters of regression models with multiple explanatory variables and allows for ordinal dependent variables (Wooldridge, 2006).

Binary logistic regression was also used to understand if the individual characteristics that are associated with being unaware of HIV differ from the individual characteristics that are associated with inaccurate HIV-related knowledge.

The binary logistic model was the same as employed in Specific Aims 1 and 2 while the ordinal logistic regression was written as:

$$\text{logit}\,(P\,(\,Y_i \leq j)) = \beta_{oj} + \beta_k X_{ki} + \varepsilon$$

Where:

$(P\,(\,Y_i \leq j))$ = the probability that the outcome falls in category j or less for respondent i
i = individual respondent
β_o = intercept term for category j
β_k = the effect of individual characteristic (k)
X_{ki} = individual characteristic (k) for individual respondent i
ε = error term

As with analysis for the previous aims, in each regression model the joint Wald test was performed on the five multi-level categorical variables (education, wealth, exposure to television, caste, and religion) to test for overall main effects. Differences in the odd ratios, confidence intervals, and probabilities for all covariates were examined for significance.

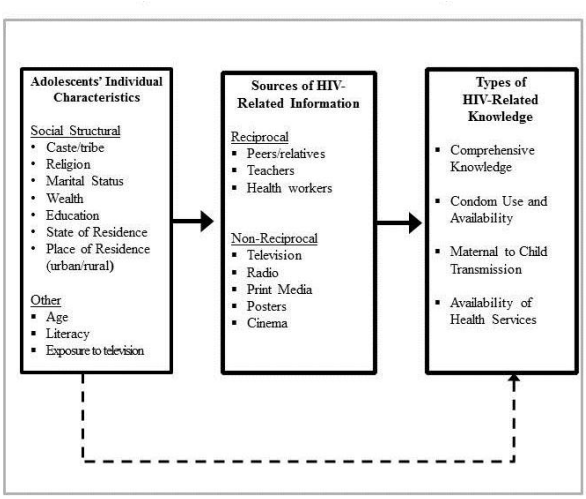
Specific Aim Four: To determine whether there are association between the sources of HIV-related information and HIV-related knowledge among HIV-aware adolescents.

Research question 9: Do associations between sources of HIV-related information and HIV-related knowledge exist among adolescents?

Research question 10: Do individual characteristics serve as rival independent variables and have associations with both sources of HIV-related information and HIV-related knowledge?

Research question 11: Do sources of HIV-related information mediate the relationships between individual characteristics and HIV-related knowledge?

Figure 8: Illustration of components of the model to be tested in Specific Aim Four



To examine associations between sources of HIV-related information and HIV-related knowledge I employed multivariate logistic regression to estimate the following model:

$Y_i^* = \beta_o + \beta_j X_j + \varepsilon$ where:

Y* = 1 if the respondent had accurate knowledge
i = individual respondent
β_o = intercept term
X_j = 1 if the respondent indicated use of j reciprocal sources (radio, television, cinema, print, posters, peers/relatives, schools/teachers, or health workers (added into the model individually)
β_j = the effect of reciprocal source j on the outcome
ε is the error term

Joint Wald test was performed on the five categorical variables (education, wealth, exposure to television, caste, and religion) to test for overall main effects. Differences in the odd ratios, confidence intervals, and probabilities for all covariates were examined for significance.

To analyze the hypothesized role of sources of HIV-related information mediating the relationships between individual characteristics and HIV-related knowledge, 40 multiple mediation models with binary categorical outcomes were developed and analyzed.

These models were based on the assumptions and framework proposed by MacKinnon (2008) (which built on the assumptions and framework proposed by Baron & Kinney (1986)).

Within these 40 models, the meditation effects of the sets of eight sources of HIV-related information were determined for each individual characteristic on each of the four types of HIV-related knowledge.

To examine the role of sources of information mediation the relationship between each individual characteristic and each type of knowledge, I employed the following equation for the eight mediator model:

$Y_i^* = \beta o + cx + \varepsilon_1$ [original model without mediators]

$Y_i^* = \beta o_i + c' x_k + b_j M_j + \varepsilon_i$

$M_{ji} = \beta o_{Mj} + a_{jk} x_k + \varepsilon_{ji}$

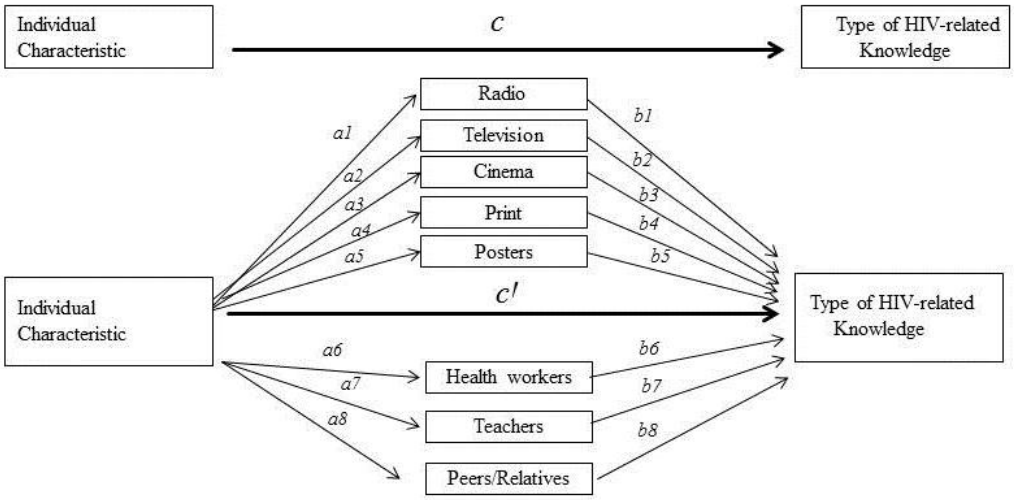
where:

Y* = dependent variable
X = independent variable
βo = intercept
Mj = mediators (j=8)
J = which mediator
K= which covariate
c = parameter relating the independent and dependent variables

c' = parameter relating the independent and dependent variables adjusting for the eight mediators
b_j = parameter relating the specific mediator to the dependent variable adjusting for the independent variable and the other seven mediators
a = parameter relating the independent variable to the specific mediator
ε is the error term

Figure 9 depicts the adoption of MacKinnon multiple mediation model for this research. A full mediation effect was represented as a statistically significant total effect (c) combined with a significant indirect effect (note: this is not purely $\hat{a}_1\hat{b}_1+ \hat{a}_2\hat{b}_2+ \hat{a}_3\hat{b}_3+ \hat{a}_4\hat{b}_4+ \hat{a}_5\hat{b}_5+ \hat{a}_6\hat{b}_6+ \hat{a}_7\hat{b}_7+ \hat{a}_8\hat{b}_8$ as depicted in MacKinnon (2008) – it a more complicated formula derived in Mplus) and a non-significant direct effect (c'). Partial mediation effect was represented by a statistically significant total effect (c) combined with a significant indirect effect (note: this is not purely $\hat{a}_1\hat{b}_1+ \hat{a}_2\hat{b}_2+ \hat{a}_3\hat{b}_3+ \hat{a}_4\hat{b}_4+ \hat{a}_5\hat{b}_5+ \hat{a}_6\hat{b}_6+ \hat{a}_7\hat{b}_7+ \hat{a}_8\hat{b}_8$ as depicted in MacKinnon (2008) – it a more complicated formula derived in Mplus) and a significant direct effect (c'). Suppression (or inconsistent mediation) was identified for variables <u>not</u> mediated by the eight sources of information when a significant direct effect (c') was suppressed by a significant indirect effect that resulted in non-significant total effect (c).

Figure 9. Multiple Mediation Model adopted from MacKinnon (2008)



CHAPTER FOUR: RESULTS

PRELIMINARY ANALYSIS

Preliminary data analysis was completed in order to understand the generalizability of the analytic samples; to test the null hypothesis that there were no statistical associations between the eight sources of information under investigation in this study; to understand if there were statistical associations in support of the theoretical construct of reciprocity under investigation in this study; and to test the null hypothesis that there were no statistical associations between the 11 knowledge questions under investigation in this study. This preliminary analysis does not correspond to specific research questions.

GENERALIZABILITY OF THE ANALYTIC SAMPLES

Preliminary data analysis was completed in order to understand the generalizability of the analytic samples. Table 10 compares the 11 individual characteristics of Indian adolescents who were included in (n = 35,603) and excluded from (n=1,430) sub-set one of the analytical sample. Sub-set one included adolescents who were aware and unaware of HIV. Pearson's chi-square tests compared the characteristics of those included and excluded from the sample.

Those included in the sample differed from those excluded on seven of 11 characteristics at the $p < .001$ level. Therefore, the null hypothesis that adolescents included in the sample do not differ from those excluded from the sample was rejected. This means that final results of Specific Aim One were slightly biased but they remained generalizable to the entire Indian adolescent population. There is no established threshold for an acceptable percentage of missing data. Some researchers have argued that a missing rate of 5% or less is inconsequential (Schafer, 1999) while others have put the acceptable percentage as high as 10% (Bennett, 2001). The

proportion of missing respondents in comparison to the overall sample size (3.9%) was not large enough to affect generalizability to this population.

Sixty-nine percent of those excluded from the sample were female compared to 65% of those included in the sample. Younger adolescents (age 15) were slightly more likely to be included (18.7% vs. 17.1%). Education had no association with inclusion: of those included in the sample 12.3 % had no education compared to 12.7% of those excluded from the sample. The same relationship did not hold true for wealth: of those included in the sample, 11% were from the poorest wealth category compared to 7.8% of those excluded from the sample. Conversely, of those included in the sample, 28.1% were from the richest wealth group, while 23% of those excluded were from the richest wealth group. Sixty-two percent of those excluded from the analytic sample resided in rural areas as compared with 53.7% of those included in the sample. State of residence had a strong impact on inclusion: of those included in the sample, 33.2% resided in one of the six states with high HIV prevalence compared to 13.7% of those excluded from the sample. Marital status had no impact on inclusion: of those excluded from the sample, 13.9% were ever married compared to 14.5% of those included in the sample. There was no association between study inclusion and literacy: of those included in the sample, 79.7% were literate compared to 78.3% of those excluded from the sample. Fifty-eight percent of those included in the combined sample were exposed to television almost every day compared to 52.2% of those excluded. Those included in the sample were less likely to be from a scheduled caste or tribe (32.6% included vs. 46.9% excluded) while members of the Other Backward Class were more likely to be included (38.8% included vs. 25.0% excluded). Finally, there were substantive associations between religion and inclusion with Hindus more likely to be included

(72.2% included vs. 17.3% excluded) as compared to Muslims (13.8% included vs. 63.5% excluded).

Table 10. Characteristics of the included and excluded respondents aware and unaware of HIV from sub-set one of the analytic sample (unweighted N=35,603)

Characteristics		Included (n=35,603) %	Excluded (n=1,430) %
Gender*	Girls	64.5	68.9
	Boys	35.5	31.1
Age	15	18.7	17.1
	16	21.2	21.1
	17	19.4	18.9
	18	22.5	23.8
	19	18.2	19.2
Education	None	12.3	12.7
	Primary	13.1	14.9
	Secondary	71.0	69.7
	Higher	3.6	2.8
Wealth*	Poorest	11.0	7.8
	Poorer	15.1	14.4
	Middle	20.8	25.9
	Richer	25.0	28.0
	Richest	28.1	23.0
Place of residence*	Urban	46.3	38.5
	Rural	53.7	61.5
State of residence*	Low Prevalence	66.8	86.3
	High Prevalence	33.2	13.7
Married	Never Married	86.1	85.5
	Ever Married	13.9	14.5
Literacy	Not literate	20.3	21.7
	Literate	79.7	78.3
Exposure to Television*	Not at all	27.5	31.7
	Less than daily	14.5	16.1
	Almost every day	58.0	52.2
Caste/ Tribe*	Scheduled caste and tribe	32.6	46.9
	Other backward class	38.8	25.0
	Residual general class	32.6	28.1
Religion*	Hindu	72.2	17.3
	Muslim	13.8	63.5
	Other	14.0	19.2

** Statistically significant difference between included and excluded respondents at the p<.001 level (Pearsons Chi Square) between girls and boys samples*

Table 11 compared the 11 individual characteristics of HIV-aware Indian adolescents included in (n=27,752) and excluded from (n=1,649) sub-set two of the analytical sample. Pearson's chi-square tests investigated the null hypothesis that HIV-aware adolescents included in the sample do not differ on individual characteristics from HIV-aware adolescents excluded from the sample. All characteristics were statistically different at the $p < .001$ level between included and excluded respondents except for one (martial status). Therefore, the null hypotheses that HIV-aware adolescents included in the sample do not differ from HIV-aware adolescents excluded from the sample can be rejected. Once again, this means that final results of Specific Aims Two, Three, and Four may be biased but generalizable to the entire Indian adolescent population who are aware of HIV. As with sub-set one, the proportion of missing respondents in comparison to the overall sample size (5.6%) was not a large enough to affect generalizability to this population.

Sixty percent of those excluded from the combined sample were male compared to 39.7% of those included in the sample. Younger adolescents (age 15) were more likely to be included (17.8% vs. 15.3%), while older adolescents (age 19) were more likely to be excluded (18.9% vs. 22.6%). Of those included, 81.1% had a secondary education compared to 77.6% of those excluded. Only 5.8% of those included were from the poorest wealth category compared to 6.4% of those excluded. Place and state of residence had little impact on inclusion. Of those excluded, 13.9% were illiterate compared to 10.1% of those included. Two-thirds (67.3%) of those included were exposed to television almost every day compared to just over half (59.3%) of those excluded. Finally, there are substantive associations between religion, caste/tribe, and inclusion. Of those excluded, 41.1% were from a scheduled caste or tribe compared to 30.3% of those included. Forty-two percent of those excluded from the sample were Muslim compared to 13.2% of those included.

Table 11. Characteristics of the included and excluded respondents aware of HIV from sub-set two of the analytic sample (unweighted N=27,752)

Characteristics		Included (n=27,752) %	Excluded (n=1,649) %
Gender*	Girls	60.3	55.4
	Boys	39.7	44.6
Age*	15	17.8	15.3
	16	21.2	18.8
	17	19.7	18.8
	18	22.3	24.4
	19	18.9	22.6
Education*	None	4.7	7.5
	Primary	9.6	11.2
	Secondary	81.1	77.6
	Higher	4.5	3.4
Wealth*	Poorest	5.8	6.4
	Poorer	11.6	11.6
	Middle	20.7	22.9
	Richer	27.9	29.8
	Richest	33.9	29.2
Place of residence*	Urban	52.6	45.7
	Rural	47.4	54.3
State of residence*	Low Prevalence	62.1	75.4
	High Prevalence	37.9	24.6
Married	Never Married	90.6	89.3
	Ever Married	9.4	10.7
Literacy*	Not literate	10.1	13.9
	Literate	89.9	86.1
Exposure to Television*	Not at all	8.1	12.5
	Less than daily	24.6	28.2
	Almost every day	67.3	59.3
Caste/ Tribe*	Scheduled caste and tribe	30.3	41.4
	Other backward class	34.2	31.8
	Residual general class	35.5	26.8
Religion*	Hindu	71.9	34.8
	Muslim	13.2	41.9
	Other	14.9	23.3

** Statistically significant difference between included and excluded respondents at the p<.001 level (Pearsons Chi Square) between girls and boys samples*

SOURCES OF HIV-RELATED INFORMATION

Pearson's chi-square test was applied to test the null hypothesis that there was no statistical association between the eight sources of information under investigation in this study (Table 12)

All but three of the Pearson's chi-square values of the 28 crosstabs were significant at the $p < .0001$ level indicating that for the majority of questions, the null hypothesis could be rejected (the three that could not be rejected at the $p<.0001$ level were schools/teachers and peers/relatives; health workers and radio; and newspapers and peers/relatives).

Table 12 also provides the percentage of people who cited each source as compared to every other source. Eighty-three percent of adolescents who obtained HIV-related information from radio also obtained information from television while 80.7% who did not obtain information from the radio obtained information from television. Less than one-third (30.2%) of adolescents who obtained information from television also obtained information from peers/relatives while over half (50.6%) who did not obtain information from television obtained information from peers/relatives.

Table 12. Bivariate distribution and overall association among types of HIV-related knowledge (unweighted n=27,752)

		Percentage of respondents who also cite:						
		Radio	TV	Cinema	Print.	Posters	Health workers	School/ Teachers	Peers/ Relatives
Distribution by type of information source	Radio								
	Y		82.9*	11.7*	47.9*	24.5*	**5.8**	25.3*	31.5*
	N		80.7	5.7	32.1	16.0	**5.3**	29.1	35.8
	Television								
	Y			9.5*	43*	21.3*	5.2*	26.9*	30.2*
	N			2.7	20.9	12.5	6.9	29.9	50.6
	Cinema								
	Y				63.3*	36.1*	7.3*	36.7*	41.9*
	N				36.7	18.2	5.4	26.7	33.2
	Print								
	Y					34.2*	6.7*	34.6*	**33.8**
	N					10.4	4.8	23.0	**34.0**
	Posters								
	Y						8.3*	34.1*	36.5*
	N						4.8	25.9	33.3
	Health workers								
	Y							39.2*	40.8*
	N							26.8	33.5
	Schools/ Teachers								
	Y								**39.1**
	N								**33.5**

Statistically significant difference (p < .001) Pearson's Chi-Square*

Exploratory factor analysis (EFA) was used as a data reduction tool to explore underlying structures in the set of independent variables under investigation. Tables 13 displays results of the EFA performed on the combined sample (see Appendix, Figure A1 for corresponding scree plot). The EFA resulted in three factors with Eigenvalues of .69, .23, and .07, respectively. It is commonly argued that only those factors with an eigenvalue larger than 1 should be retained (Guttman, 1954; Kaiser, 1960). Literature also cautions that this should serve as a lower-bound and reliance on this rule of thumb often leads to the retention of extraneous factors (Lance, et al 2006).

Examination of the unrotated EFA (Table 14) finds that the five non-reciprocal sources (radio, TV, cinema, newspapers/magazines, and posters) all load onto one of three factors. The three reciprocal sources (health workers, schools/teachers, and peers/relatives) jointly load onto a different, unique, factor. Television cross-loaded onto two factors (not surprising as 80% of respondents cited television as an information source). Schools/teachers cross-loaded onto two factors (also unsurprising as education is positively correlated with access to media in the Indian context).

Promax rotation (Table 15) indicated that several of the information sources were correlated. Promax rotation is an oblique rotation technique that supports correlated common factors (Afifi et al. 2004). The promax rotation resulted in identification of three factors, all with Eigenvalues well below 1 (.67, .24, and .13). The rotation resulted in seven of the eight variables loading onto a single factor with two variables (TV and radio) cross-loading onto additional factors.

Table 13. Eigenvalues and proportion of variance explained using exploratory factor analysis of eight sources of HIV-information (unweighted n=27,752)

Factor	Eigenvalue	Variance
1	0.69455	1.4377
2	0.23473	0.4859
3	0.06732	0.1393
4	-0.0099	-0.0205
5	-0.03759	-0.0778
6	-0.06028	-0.1248
7	-0.16113	-0.3335
8	-0.24459	-0.5063

Table 14. Unrotated factor loading matrix using exploratory factor analysis of eight sources of HIV-information (unweighted n=27,752)

	Factor		
Information Source	**1**	**2**	**3**
Radio	0.2582		-0.16
Television	0.2567	-0.2783	
Cinema	0.2967		
Newspapers/magazines	0.5106		
Posters	0.4257		
Health workers		0.1578	
Teachers	0.1545	0.1701	0.1592
Peers/relatives		0.3028	

Table 15. Promax-rotated factor loading matrix using exploratory factor analysis of eight sources of HIV-information (unweighted n=27,752)

	Factor		
Information Source	**1**	**2**	**3**
Radio	0.2461		-0.1851
Television	0.2037	-0.3188	
Cinema	0.3016		
Newspapers/magazines	0.5052		
Posters	0.4335		
Health workers	0.1103		
Teachers	0.1814		0.2134
Peers/relatives		0.3159	

In conclusion, the results of the EFA did not support latent statistical association and this analysis employed the theoretical groupings of reciprocal and non-reciprocal sources justified on an *apriori* basis.

TYPES OF HIV-RELATED KNOWLEDGE

This dissertation employed four dependent variables measuring four types of HIV-related knowledge. Tests of pairwise correlation coefficients (Pearson product-moment correlation coefficient) revealed a range of negligible to moderate (0.09 – 0.34) correlations among the four variables (Table 16a). The correlation between condom availability and mother to child transmission had the lowest association (r = 0.09) while the correlation between availability of health services and mother to child transmission had the highest association (r = 0.34). Although these variables were moderately correlated they were treated as separate constructs in this analysis. It was assumed that a portion of error terms were correlated and some of what was uncovered was due to common factors affecting the general construct of knowledge in addition to the specific mechanisms associated with each type.

Table 16a. Pairwise correlation coefficients among four dependent variables (types of HIV-related knowledge) (unweighted n = 27,752)

	Comprehensive	**Condom availability**	**Mother to child transmission**	**Availability of health services**
Comprehensive	r = 1.00*	r = 0.252*	r = 0.220*	r = 0.208*
Condom availability		r = 1.00*	r = 0.085*	r = 0.219*
Mother to child transmission			r = 1.00*	r = 0.339*
Availability of health services				r = 1.00*

Note: * $p \leq 0.001$

Pearson's chi-square tests were applied to test the null hypothesis that there was no statistical association between the 11 knowledge questions that made up the four types of knowledge under investigation in this study (Table 16b)

All but three of the Pearson's chi-square values of the 55 crosstabs were significant at the $p < .0001$ level indicating that for the majority of questions, the null hypothesis could be rejected (the three that could not be rejected at the $p<.0001$ level were the ability to get condoms and knowing that HIV cannot be transmitted via mosquito bites; the ability to get condoms and awareness of mother-to-child transmission; and ability to get condoms and awareness of drugs to prevent mother-to-child transmission).

Table 16 also describes the percentage of respondents who had accurate information on any two questions. Ninety percent of adolescents who had correct knowledge that condom use reduces the risk of disease also had correct knowledge that fidelity with an uninfected partner reduces risk while 50.4% of those who had incorrect knowledge about condom use had correct knowledge that fidelity with an uninfected partner reduces risk. Three-quarters of respondents who had correct knowledge that condom use reduces the risk of disease knows of a place to obtain condoms compared to 37.5% of those who had incorrect knowledge about condom use. Just over half (52.1%) of adolescents who had correct knowledge that fidelity with an uninfected partner reduces risk were aware of a place to obtain an HIV test compared to 29.1% of those with incorrect information about fidelity as a risk reduction strategy.

Table 16b: Bivariate distribution and overall association between the 11 knowledge questions that made up the four types of knowledge under investigation (unweighted n=27,752)

Percentage of respondents with accurate (A) and inaccurate (I) information	Percentage of respondents who also have accurate information of:									
	1partner /risk	Mosquito bites	Sharing food	Healthy /Infected	Condom / place	Condom / can get	MTCT	MTCT & Drug	Test	ART
Condom /Risk										
A	90.3*	74.3*	85.1*	77.4*	74.9*	57.4*	82.7*	41.7*	54.7*	18.3*
I	50.4	55.8	62.1	53.1	37.5	36.4	64.8	30.6	30.1	9.0
1 partner/risk										
A		72.7*	82.8*	75.8*	69.6*	55.9*	81.4*	40.5*	52.1*	17.1*
I		53.8	60.6	48.7	40.2	39.0	61.8	30.9	29.1	9.2
Mosquito bites										
A			89.1*	74.4*	66.6*	**54.1**	81.3*	40.9*	52.6*	16.7*
I			53.2	59.7	55.4	**51.8**	67.8	33.1	34.8	12.4
Sharing food										
A				74.9*	67.2*	54.5*	81.1*	40.9*	52.2*	17.2*
I				51.6	48.7	48.4	63.0	29.4	28.6	9.0
Healthy/infect										
A					68.6*	55.3*	84.5*	39.9*	53.2*	17.6*
I					50.3	47.8	59.8	35.1	32.6	10.3
Condom/place										
A						53.5*	79.9*	40.3*	58.8*	17.1*
I						n/a	72.2	39.9	26.8	12.3
Condom / get										
A							**80.4**	**40.6**	63.7*	18.7*
I							**79.4**	**39.8**	53.2	15.4
MTCT										
A								38.8*	51.9*	18.1*
I								n/a	30.4	6.0
MTCT & Drugs										
A									61.8*	33.4*
I									45.7	8.5
Test										
A										21.8*
I										9.6

Note: * p<.001 level (Pearson's Chi Square)

MTCT = mother to child transmission, Drug = drug therapy to prevent MTCT, Test = testing location, ART = antiretroviral drugs

BIVARIATE ANALYSIS

Specific Aims One, Two, and Three sought to describe the individual characteristics of adolescents who are aware of HIV, describe where HIV-aware adolescents obtain their HIV-related information, and describe what types of accurate and inaccurate knowledge HIV-aware adolescents possess.

A series of bivariate analyses were employed to understand the distributions of individual characteristics by gender, the reciprocal and non-reciprocal sources where adolescents obtain their HIV-related information (research question 2), HIV awareness, and the types of accurate and inaccurate HIV-related knowledge that adolescents possess (research questions 5 and 6).

DISTRIBUTION OF INDIVIDUAL CHARACTERISTICS BY GENDER

First, bivariate analysis examined the distribution of individual characteristics by gender in each of the analytic subsets under investigation in this study. Table 17 describes the individual characteristics of respondents from the combined, girls, and boys samples for each of the subsets. Subset one looked at adolescents both aware and unaware of HIV (the general population of adolescents) while subset two was restricted to adolescents who were aware of HIV. Pearson's chi-square statistics were used to determine statistically significant differences among girls and boys at the $\alpha \leq 0.001$ level of significance.

In the general population (subset one), 15.7% of girls received no formal education, compared to 6% of boys. More girls than boys reported primary school as the highest level obtained (14.0% vs. 11.6%) while more boys than girls obtained a secondary education (78.9% vs. 66.7%). Only 3.6% of the combined sample received higher education and there was no significant difference in higher education attainment between genders. Among those aware of HIV (subset two), gender based differentials were less pronounced. HIV-aware girls were

significantly more likely to receive no formal education but this was limited to only 5.4% of the girls sample (compared to 3.5% of aware boys). Girls and boys had equal probability to receive only a primary education (9.7% vs 9.6%) and attainment of secondary education had a significant but small differential between boys and girls (82.9% vs 80.0%). Among HIV aware adolescents, 4.9% of the girls sample received higher education compared to only 4.0% of boys.

In the general population, only two categories of wealth had significant differences among boys and girls. Twelve percent of girls were categorized as belonging to the poorest wealth quintile compared to 9.3% of boys. Among those aware of HIV, only 5.3% of girls were in the poorest wealth quintile compared to 6.8% of boys. While a slightly smaller percentage of girls in the general population belonged to the richest wealth quintile compared to boys (27.4% vs. 29.4%), a greater proportion of HIV-aware girls belonged to the richest group compared to HIV-aware boys (35.3% vs. 31.9%).

There were significant differences between the proportions of girls and boys living in urban locales (43.7% vs 51.0%) in the general population but significance was lost in the subset of HIV-aware adolescents. Both subsets had comparable percentages of girls living in low prevalence states: 72.4% in the general population and 67.5% in the HIV-aware population.

In the general population, 20.5% of adolescent girls were ever married compared to only 1.9% of boys. Among those aware of HIV, 14.6% of girls were ever marred compared to an even smaller percentage (1.6) of boys. Nearly a quarter (24.3%) of girls in the general population were not literate compared to 13% of boys. Among those aware of HIV, the proportion of not literate girls reduced to 10.9% (compared to 12.9% of HIV-aware boys). Nearly one-third (30.8%) of girls in the general population had no exposure to television compared to one-fifth (21.5%) of boys. Among HIV-aware adolescents, only 9.7% of girls and

5.7% of boys had no exposure to television while 69% of girls and 64.6% of boys reported watching television almost every day.

Table 17. Characteristics of respondents from the combined, girls, and boys samples for each analytic subsets (unweighted N=35,603 and unweighted N=27,752)

		Analytic Subset One [HIV aware and unaware]			Analytic Subset Two [HIV aware]		
		Total n= 35,603	Girls n= 22,970	Boys n= 12,663	Total n= 27,752	Girls n= 16,772	Boys n= 11,030
Characteristics		%	%	%	%	%	%
Gender	Girls	64.5	100.0	0.0	60.3	100.0	0.0
	Boys	35.5	0.0	100.0	39.7	0.0	100.0
Age	15	18.7	19.1*	17.9	17.8	18.1	17.4
	16	21.2	20.1*	21.7	21.2	20.9	21.8
	17	19.4	19.3	19.8	19.7	19.5	20.0
	18	22.5	22.3	22.7	22.3	22.2	22.6
	19	18.2	18.3	18.0	18.9	19.3	18.3
Education	None	12.3	15.7*	6.0	4.7	5.4*	3.5
	Primary	13.1	14.0*	11.6	9.6	9.7	9.6
	Secondary	71.0	66.7*	78.9	81.1	80.0*	82.9
	Higher	3.6	3.6	3.6	4.5	4.9*	4.0
Wealth	Poorest	11.0	12.0*	9.3	5.8	5.3*	6.8
	Poorer	15.1	15.4	14.4	11.6	10.6*	13.1
	Middle	20.8	20.7	21.1	20.7	20.2	21.2
	Richer	25.0	24.6	25.8	27.9	28.6*	26.9
	Richest	28.1	27.4*	29.4	33.9	35.3*	31.9
Place of residence	Urban	46.3	43.7*	51.0	52.6	52.1	53.4
	Rural	53.7	56.3*	49.0	47.4	47.9	46.6
State of residence	Low Prevalence	66.8	72.4*	56.6	62.1	67.5*	53.9
	High Prevalence	33.2	27.6*	43.4	37.9	32.5*	46.1
Married	Never Married	86.1	79.5*	98.1	90.6	85.4*	98.4
	Ever Married	13.9	20.5*	1.9	9.4	14.6*	1.6
Literacy	Not literate	20.3	24.3*	13.0	10.1	10.9*	12.9
	Literate	79.7	75.7*	87.0	89.9	89.1*	87.1
Exposure to Television	Not at all	27.5	30.8*	21.5	8.1	9.7*	5.7
	Less than daily	14.5	12.8*	17.5	24.6	21.3*	29.7
	Almost every day	58.0	56.4*	61.0	67.3	69.0*	64.6
Caste/ Tribe	Scheduled caste and tribe	32.6	33.2*	31.3	30.3	30.6	29.8
	Other backward	38.8	33.8*	36.6	34.2	32.3*	37.0
	Residual general	32.6	33.0	32.1	35.5	37.1*	33.1
Religion	Hindu	72.2	72.2	72.2	71.9	71.5	72.4
	Muslim	13.8	13.8	13.9	13.2	12.8	13.8
	Other	14.0	14.0	13.9	14.9	15.7*	13.8

** Statistically significant difference between boy and girl respondents (within the subset) at the p<.001 level (Pearsons Chi Square*

DISTRIBUTION OF THE SOURCES OF HIV-RELATED INFORMATION BY GENDER

Second, bivariate analysis was also employed to examine the distribution of the sources of HIV-related information by gender in HIV-aware adolescents (Table 18). Pearson's chi-square statistics were used to determine statistically significant differences among girls and boys at the $\alpha \leq 0.001$ level of significance (please note that weighted data was used in this, and all subsequent, analysis).

Television was the most common source of HIV-related information and utilized by 80.9 % of HIV-aware adolescents. This was followed by radio (45.7%) and newspapers/magazines (37.9%). Nearly identical percentages of girls and boys cited television as a source of information, but a greater percentage of boys obtained their information from radio and newspapers as compared to girls (54.6% vs. 39.6% and 50.2% vs. 29.5%, respectively). Approximately one third of all adolescents (34.2%) reported obtaining information from peers/relatives but more boys than girls used peers/relatives as a source (43.3% vs. 27.9%, respectively). Just over one quarter (25.8%) of the combined population obtained their information from schools/teachers and there was no statistically significant gender-based differential between boys and girls. Health workers were the least relied upon source of HIV-related information and used by only 5.5% of the combined, 4.3% of girls, and 7.4% of the boys samples.

More than half of girls (51.9%) of girls and 40% of boys did not obtain information from any of the three reciprocal sources of information. Distribution of the count of non-reciprocal sources indicated that a greater percentage of girls cited fewer non-reciprocal sources: 40.8% of girls reported only one non-reciprocal source of information compared to 22.7% of boys. Only

19.7% of girls reported three or more non-reciprocal sources of information compared to 41.7% of boys.

Table 18. Distribution of the independent variable, utilized sources of HIV-related information among HIV-aware adolescents by gender (weighted N=25,904)

	Combined		Girls		Boys	
	N=25,904	%	N=15,372	%	N=10,532	%
Count of Non-Reciprocal Sources						
0*	1,999	7.7	1,352	8.8	647	6.1
1*	8,668	33.5	6,275	40.8	2,393	22.7
2	7,867	30.4	4,728	30.7	3,138	29.8
3*	4,834	18.7	2,163	14.1	2,671	25.4
4*	2,118	8.2	722	4.7	1,396	13.6
5*	418	1.6	132	0.9	287	2.7
*Mean # of non-reciprocal sources**	1.9		1.7		2.2	
Non-Reciprocal Sources						
Television	20,962	80.9	12,501	81.3	8,461	80.3
Radio*	11,841	45.7	6,090	39.6	5,751	54.6
Print*	9,825	37.9	4,538	29.5	5,287	50.2
Posters*	4,795	18.5	1,797	11.7	2,998	28.5
Cinema*	2,041	7.9	840	5.5	1,201	11.4
Reciprocal Sources						
None*	12,195	47.1	7,983	51.9	4,212	40.0
Peers/relatives*	8,855	34.2	4,290	27.9	4,565	43.3
Schools/Teachers	6,690	25.8	3,842	25.0	2,849	27.1
Health workers*	1,437	5.5	653	4.3	783	7.4

** Statistically significant difference between boy and girl respondents at the p<.001 level (Pearsons Chi Square)*

DISTRIBUTION OF HIV AWARENESS AND TYPES OF HIV-RELATED KNOWLEDGE BY GENDER

Last, bivariate analysis examined both HIV awareness and distribution of the four types of HIV-related knowledge by gender (Table 19). As with the previous analyses, Pearson's chi-square statistics were used to determine statistically significant differences among girls and boys at the $\alpha \leq 0.001$ level of significance.

Seventy-two percent of all adolescents, 86.5% of boys, and 64.3% of girls were aware of HIV. Among those aware of the disease, there were significant (at the $\alpha \leq 0.001$ level) gender-based imbalances in the types of knowledge that adolescents possessed. Thirty-four percent of the combined sample, 29.5% of the girls sample, and 40.5% of the boys sample possessed comprehensive knowledge of the disease. Only one of the five components to comprehensive knowledge (knowledge that HIV cannot be transmitted via mosquito bites) did not have a statistically significant different between girls and boys. A smaller percentage of girls (as compared to boys) knew that the use of condoms prevents sexual transmission (57.1% vs. 82.9%), that limiting sex to one faithful partner prevents sexual transmission (72.4% vs. 84.9%), that HIV cannot be transmitted via the sharing of food (74.2 vs. 78.6%), and that health looking people can be infected with the disease (64.7% vs. 69.5%).

Only 12.5% of girls who had heard of HIV had accurate knowledge pertaining to condom use and availability compared to 68.1% of boys yet more girls than boys possessed accurate knowledge pertaining to mother to child transmission (32.1% vs. 23.2%).

Only nine percent of the combined population, 8.3% of the girls sample, and 9.7% of the boys sample possess accurate knowledge pertaining to the availability of health services. Girls and boys were equally uninformed about the existence of antiretroviral therapy for HIV-infected individuals (13.0% and 13.3%, respectively) but more boys than girls were aware of a place to obtain an HIV test (52.2% vs. 42.7%, respectively).

Table 19. Distribution of HIV awareness and types of accurate HIV-related knowledge among HIV-aware adolescents by gender (unweighted N=36,086 and 25,904)

	Combined		Girls		Boys	
	N= 36,086	%	N= 23,904	%	N= 12,182	%
Aware of HIV	**25,907**	**71.8**	**15,370**	**64.3**	**10,537**	**86.5**

Types of Accurate Knowledge among HIV-aware adolescents	N= 25,904	%	N= 15,372	%	N= 10,532	%
Comprehensive*	**8,801**	**34.0**	**4,531**	**29.5**	**4,279**	**40.5**
Use of condoms prevents sexual transmission*	17,515	67.6	8,787	57.1	8,728	82.9
Limiting sex to one faithful, uninfected partner prevents sexual transmission *	20,069	77.5	11,129	72.4	8,940	84.9
Cannot be transmitted via mosquito bites	17,798	68.7	10,499	68.3	7,299	69.3
Cannot be transmitted by sharing food*	19,684	76.0	11,406	74.2	8,278	78.6
Healthy-looking people can be infected*	17,265	66.7	9,950	64.7	7,315	69.5
Condom availability*	**9,091**	**35.1**	**1,918**	**12.5**	**7,173**	**68.1**
Aware of a place to obtain condoms*	16,631	64.2	7,543	49.1	9,088	86.3
Aware of a place to obtain but unable to get a condom*	7,540	29.1	5,625	36.6	1,915	18.2
Aware of a place to obtain and able to get a condom*	9,091	35.1	1,918	12.5	7,173	68.1
Mother-to-child transmission*	**7,368**	**28.4**	**4,929**	**32.1**	**2,439**	**23.2**
Can be transmitted from a mother to her baby*	19,349	74.7	11,744	76.4	7,601	72.2
Aware of transmission but unaware of drug therapy*	11,980	46.2	6,818	44.4	5,162	49.0
Aware of transmission and aware of drug therapy*	7,368	28.4	4,929	32.1	2,439	23.2
Availability of health services*	**2,295**	**8.9**	**1,277**	**8.3**	**1,019**	**9.7**
Aware of testing location *	12,272	47.4	6,562	42.7	5,710	52.2
Aware of testing location but unaware of drug therapy*	9,977	38.5	5,286	34.4	4,691	44.5
Aware of drug therapy	3,396	13.1	1,995	13.0	1,401	13.3

** Statistically significant difference between boy and girl respondents at the p<.001 level (Pearsons Chi Square)*

Note: Indented text indicates a question that was posed only after a respondent provided an accurate answer to the first question in the series

SUMMARY OF BIVARIATE ANALYSES

Bivariate analyses were used to understand how elements of the focal relationship differed between adolescent girls and boys. Specifically, Pearson's Chi Square tests were employed to understand how the distributions of individual characteristics and HIV awareness, sources of HIV-related information, and the types of HIV-related knowledge differed by gender.

In the unweighted sample of Indian adolescents, compared to boys, girls were less likely to be formally educated, obtain a secondary education, be literate, or have exposure to television. Nearly all of the married adolescents were girls. In the unweighted sample of those aware of HIV, the same gender-based differences also existed but to much lesser extents.

There were significant similarities and differences in the sources from which HIV-aware girls and boys obtained their HIV-related information. Television was the most common source of HIV-related information and used equally by girls and boys. Girls and boys also cited teachers as a source of HIV-related information with equal frequency. Girls were less likely than boys to obtain information from the other six sources under investigation (radio, print, posters, cinema, peers, and health workers).

Last, there were important gender-based differentials in HIV awareness and the types of accurate knowledge that HIV-aware adolescents possessed. Less than one-tenth of Indian boys had never heard of HIV compared to nearly a quarter of girls. Among those who had heard of the disease, girls were less likely to have accurate comprehensive, condom availability, or health services knowledge compared to boys but they were more likely to possess accurate knowledge pertaining to mother to child transmission.

MULTIVARIATE ANALYSIS

Specific Aims One, Two, and Three sought to describe the individual characteristics of adolescents who are aware of HIV, describe where HIV-aware adolescents obtain their HIV-related information, and describe what types of accurate and inaccurate knowledge HIV-aware adolescents possess.

A combination of logistic, Poisson, and ordinal regression analyses were used to determine which individual characteristics were associated with being aware of HIV (research question 1), explain where adolescents obtained their HIV-related information (research question 3), explain whether adolescents obtain all of their HIV-related information from reciprocal as compared to non-reciprocal sources (research question 4),and determine whether adolescents possess accurate as compared to inaccurate types of HIV-related knowledge (research question 7). In addition, logistic regression determined if the individual characteristics associated with being unaware of HIV differed from the individual characteristics that are associated with inaccurate HIV-related knowledge (research question 8).

HIV AWARENESS BY INDIVIDUAL CHARACTERISTICS **(***SPECIFIC AIM ONE)*

Multivariate logistic regression was conducted to determine the associations between individual characteristics and being aware of HIV. A parametric statistical test (the joint Wald test) was performed on the five multi-level categorical variables (education, wealth, exposure to television, caste, and religion) to test for overall main effects (or joint significance of the subset of coefficients). Table 20 presents the adjusted odds ratios (OR) and the 95% confidence intervals (CI) for HIV-awareness associated with individual characteristics. All individual characteristics, except for caste and religion, were associated with HIV awareness at the $\alpha \leq 0.001$ level of significance.

Adolescents who watched television on a daily basis had a 196% increased odds of being aware of HIV compared to those who never watched television (OR 2.96, 95% CI 2.64-3.31). Boys had a 177% increased odds of being aware of HIV compared to girls (OR 2.77, 95% CI 2.47-3.11). Compared to those residing in a low prevalence state, adolescents residing in a high prevalence state had a 134% increased odds of being aware of the disease (OR 2.34, 95% CI 2.01-2.73). Age, education, wealth, and literacy were significant predictors of HIV awareness (Note: the highest level of education ("higher") has an extremely large OR (6483.88) and wide CI (895.97-46921.95) due to the fact that only 4.5% of the sample population had a higher education and all of those were aware of the disease, questioning the validity of this result).

For adolescents residing in rural areas, the odds of being aware of HIV were 20% lower than for those in urban areas (OR 0.80, 95% CI 0.69-0.93). For married adolescents (93% of which are female), the odds of being aware of HIV were 24% lower than their unmarried counterparts (OR 0.76, 95% CI 0.67-0.86).

Table 20. Multivariate logistic regression of HIV awareness on individual characteristics (N=36,086)

Individual characteristics	OR	95% CI
Gender (/male)	2.77***	2.47, 3.11
Age (years)	1.18***	1.14, 1.22
Education (/none)	+++	
Primary	1.87***	1.59, 2.21
Secondary	5.37***	4.19, 6.89
Higher	6483.88***	895.97, 46921.95
Wealth (/poorest)	+++	
Poorer	1.25	1.09, 1.43
Middle	1.69***	1.46, 1.95
Richer	2.13***	1.79, 2.53
Richest	4.29***	3.41, 5.40
Rural Residence	0.80**	0.69, 0.93
High Prevalence State	2.35***	2.01, 2.73
Ever Married	0.76***	0.67, 0.86
Literacy	1.69***	1.39, 2.06
TV Frequency (/none)	+++	
At least 1/week	1.96***	1.73, 2.21
Almost daily	2.96***	2.64, 3.31
Caste (/Scheduled)		
Other Backward Class	0.97	0.86, 1.09
Residual General Class	1.09	0.95, 1.26
Religion (/Hindu)		
Muslim	1.03	0.86, 1.23
Other	1.09	0.90, 1.32

Note: *p≤0.05, ** p≤0.01,*** p≤0.001
+p≤0.05 ++ p≤0.01,+++ p≤0.001p [Wald test of overall main effects]

HIV-RELATED INFORMATION SOURCES BY INDIVIDUAL CHARACTERISTICS **(***SPECIFIC AIM TWO)*

Non-Reciprocal Sources

A Poisson regression model examined linear associations between individual characteristics and the number of non-reciprocal information sources (0-5) (television, radio, print, cinema, and posters). A parametric statistical test (the joint Wald test) was performed on the five categorical variables (education, wealth, exposure to television, caste, and religion) to test for overall main effects. Table 21 presents the incident rate ratios (IRR) and the 95% confidence intervals for the number of non-reciprocal information sources and individual characteristics. All individual characteristics, except for place of residence, state of residence,

and caste were associated with number of non-reciprocal information sources at the $\alpha \leq 0.001$ level of significance.

Holding all other variables constant, the incident rate of non-reciprocal sources for adolescents who received higher education was 1.54 times the incident rate for those with no education (IRR 1.54, CI 1.41-1.69) and the incident rate for those in the highest wealth quintile was 1.24 times the incident rate for those in the lowest wealth quintile (IRR 1.24, CI 1.18-1.30). Boys had an incident rate of 1.32 as compared to the incident rate for girls (IRR 1.32, CI 130-1.35). The incident rate for adolescents who watched television at least once per week was 1.22 times the incident rate of those who did not watch television (IRR 1.22, 95% CI 1.18-1.27). Literacy and age were also significantly predictive of an increased number of non-reciprocal information sources (IRR 1.19, 95% CI 1.11-1.27 and IRR 1.03, 95% CI 1.03-1.04, respectively).

The incident rate of non-reciprocal sources for Muslim adolescents was 0.93 of the incident rate of Hindus (IRR 0.93, 95% CI 0.90-0.97) while the incident rate for ever married adolescents was 0.92 of the incident rate of never married adolescents (IRR 0.92, 95% CI 0.88-0.95).

Table 21. Poisson regression of the count of non-reciprocal sources of HIV-related information on individual characteristics (N=25,904)

Individual characteristics	IRR	95% CI
Gender (/male)	1.32***	1.30, 1.35
Age (years)	1.03***	1.03, 1.04
Education (/none)	+++	
Primary	1.07	1.00, 1.14
Secondary	1.32***	1.21, 1.44
Higher	1.54***	1.41, 1.69
Wealth (/poorest)	+++	
Poorer	1.04	0.99, 1.09
Middle	1.10***	1.05, 1.15
Richer	1.15***	1.09, 1.20
Richest	1.24***	1.18, 1.30
Rural Residence	1.01	0.98, 1.04
High Prevalence State	1.00	0.97, 1.02
Ever Married	0.92***	0.88, 0.95
Literacy	1.19***	1.11, 1.27
TV Frequency (/none)	+++	
At least 1/week	1.22***	1.18, 1.27
Almost daily	1.21***	1.18, 1.25
Caste (/Scheduled)	+	
Other Backward Class	1.04**	1.01, 1.07
Residual General Class	1.02	1.00, 1.05
Religion (/Hindu)	+++	
Muslim	0.93***	0.90, 0.97
Other	0.95*	0.91, 1.00

Note: *p≤0.05, ** p≤0.01,*** p≤0.001
+p≤0.05 ++ p≤0.01,+++ p≤0.001 [Wald test of main effects]

Individual Sources

Multivariate logistic regression examined associations between individual characteristics and the reporting of the five individual non-reciprocal information sources (television, radio, cinema, print, and posters). The joint Wald test was performed on the five multi-level categorical variables to test for overall main effects. Tables 22a and 22b present the odds ratios and the 95% confidence intervals for each individual non-reciprocal source and the individual characteristics.

Television

Five individual characteristics were associated with television as an information source at the $\alpha \leq 0.001$ level of significance: age, wealth, place of residence, frequency of television, and religion (Table 22a). Gender, education, state of residence, marital status, literacy, and caste were not associated at $\alpha \leq 0.001$ level of significance.

Holding all other variables constant, almost daily television watching and the richest wealth quintile significantly predicted reporting television as a source of HIV-related information (OR 8.98, 95% CI 7.91-10.20 and OR 2.57, 95% CI 2.04-3.24, respectively). Each year increase in age (range: 15-19) was associated with a 10% increased odds of reporting television as a source (OR 1.10, 95% CI 1.06-1.14).

Rural adolescents had a 29% decreased odds of reporting television as an information sources compared to urban adolescents (OR 0.71, 95% CI 0.61-0.81). For Muslim adolescents, the odds of reporting television as an information source were 28% lower than their Hindu counterparts (OR 0.72, 95% CI 0.61-0.85).

Radio

Eight individual characteristics were associated with radio as an information source at the $\alpha \leq 0.001$ level of significance: gender, age, education, place of residence, state of residence, frequency of television, caste, and religion (Table 22a). Wealth, marital status, and literacy were not associated at $\alpha \leq 0.001$ level.

Holding all other variables constant, compared to those with no education, those with higher education had a 76% increased odds of reporting radio as a source of HIV-related

information (OR 1.76, 95% CI 1.24-2.50). Boys had a 71% increased odds of reporting radio as compared to girls (OR 1.71, 95% CI 1.57-1.86). Those residing in rural areas had a 48% increased odds of reporting radio as compared to those in urban areas (OR 1.48, 95% CI 1.32-1.66). Members of the Other Backwards Class had a 20% increased odds of reporting radio as a source as compared to members of Scheduled Castes and Tribes (OR 1.20, 95% CI 1.08-1.33). Each year increase in age was associated with an 8% increased odds of reporting radio as a source (OR 1.08, 95% CI 1.05-1.11).

Those who watched television almost daily had a 37% decreased odds of reporting radio as compared to those who never watched television (OR 0.67, 95% CI 0.60-0.74). Residence in a high prevalence state had a 32% decreased odds of reporting radio compared to those in low prevalence states (OR 0.68, 95% CI 0.62, 0.75). For adolescents belonging to 'other' religions, the odds of reporting radio as a source of information were 31% lower than for Hindus (OR 0.69, 95% CI 0.58-0.81).

Cinema

Six individual characteristics were associated with cinema as an information source at the $\alpha \leq 0.001$ level of significance: gender, age, education, place of residence, state of residence, and marital status (Table 22a). Wealth, literacy, frequency of television, caste, and religion were <u>not</u> associated at $\alpha \leq 0.001$ level.

Holding all other variables constant, adolescents living in high prevalence states had a 261% increased odds of reporting cinema as a source of information as compared to those living in low prevalence states (OR 3.61, 95% CI 3.08-4.23). Compared to those with no education, adolescents with a secondary education had a 195% increased odds of reporting cinema (OR

2.95, 95% CI 1.59-5.47). Boys had a 137% increased odds of reporting cinema as compared to girls (OR 2.37, 95% CI 2.02-2.78). Each year increase in age was associated with a 10% increased odds of reporting cinema as a source (OR 1.10, CI 1.05-1.15).

For ever married adolescents, the odds of reporting cinema as an information source were 41% lower than their never married counterparts (OR 0.59, 95% CI 0.44-0.79). Those residing in a rural area had a 28% decreased odds of reporting cinema as a source of HIV-related information as compared to those in urban areas (OR 0.72, 95% CI 0.60-0.88).

Print

Seven individual characteristics were associated with print as an information source at the $\alpha \leq 0.001$ level of significance: gender, age, education, wealth, marital status, literacy, and religion (Table 22b). State of residence, place of residence, frequency of television, and caste were not associated at $\alpha \leq 0.001$ level.

Holding all other variables constant, education and literacy significantly predicted reporting print as a source of HIV-related information (OR 5.29, 95% CI 2.54-11.01 (primary education) and OR 3.19, 95% CI 2.21-4.61 (literacy)). Boys had a 161% increased odds of reporting print as compared to girls (OR 2.61, 95% CI 2.39-2.184). Adolescents in the middle wealth quintile had a 64% increased odds in reporting the source as compared to those in the poorest (OR 1.64, 95% CI 1.35, 1.99). Each year increase in age was associated with a 9% increased odds of reporting print as a source (OR 1.19, CI 1.06-1.12).

Married adolescents reported a 31% decreased odds of reporting print as a source as compared to their never married counterparts (OR 0.69, 95% CI 0.59-0.79). Being Muslim was

associated with a 21% decreased odds of reporting print as a source of HIV-related information as compared to being Hindu (OR 0.79, 95% CI 0.69-0.91).

Posters

Five individual characteristics were associated with posters as an information source at the $\alpha \leq 0.001$ level of significance: gender, age, education, wealth, and literacy (Table 22b). State of residence, place of residence, marital status, frequency of television, caste and religion were not associated at $\alpha \leq 0.001$ level.

Each of the five individual characteristics displayed a positive significant association. As with print, education and literacy significantly predicted reporting posters as a source of HIV-related information (OR 3.59, 95% CI 1.93-6.68 (higher education) and OR 2.61, 95% CI 1.74-3.91 (literacy)), given the other variables were held constant. Boys had a 199% increased odds of reporting posters as compared to girls (OR 2.99, 95% CI 2.67-3.35). Adolescents in the richest wealth quintile had a 69% increased odds in reporting the source as compared to those in the poorest (OR 1.69, 95% CI 1.32-2.16). Each year increase in age was associated with an 8% increased odds of reporting posters as a source of HIV-related information (OR 1.08, 95% CI 1.05-1.12).

Table 22a. Multivariate logistic regression of three individual non-reciprocal sources of HIV-related information (television, radio, and cinema) on individual characteristics (N=25,904)

	Television		Radio		Cinema	
Individual characteristics	OR	95%CI	OR	95%CI	OR	95%CI
Gender (/male)	1.01	0.91, 1.13	1.71***	1.57, 1.86	2.37***	2.02, 2.78
Age (years)	1.10***	1.06, 1.14	1.08***	1.05, 1.11	1.10***	1.05, 1.15
Education (/none)	+		+++		+++	
Primary	0.96	0.74, 1.23	1.06	0.84, 1.34	1.72	1.03, 2.87
Secondary	1.15	0.79, 1.66	1.32	0.97, 1.81	2.95***	1.59, 5.47
Higher	1.97***	1.19, 3.28	1.76**	1.24, 2.50	4.32***	2.25, 8.27
Wealth (/poorest)	+++				+	
Poorer	1.18	0.99, 1.40	0.91	0.77, 1.06	1.10	0.77, 1.59
Middle	1.45***	1.21, 1.73	0.85*	0.73, 1.00	1.35	0.95, 1.92
Richer	2.06***	1.69, 2.53	0.79**	0.67, 0.94	1.23	0.86, 1.76
Richest	2.57***	2.04, 3.24	0.79*	0.65, 0.95	1.67	1.14. 2.45
Rural Residence	0.71***	0.61, 0.81	1.48***	1.32, 1.66	0.72***	0.60, 0.88
High Prevalence State	0.96	0.84, 1.08	0.68***	0.62, 0.75	3.61***	3.08, 4.23
Ever Married	1.00	0.85, 1.17	0.86*	0.75, 0.97	0.59***	0.44, 0.79
Literacy	1.20	0.90, 1.60	1.24	0.99, 1.56	0.89	0.55, 1.45
TV Frequency (/none)	+++		+++		++	
At least 1/week	4.33***	3.77, 4.97	0.96	0.85, 1.09	1.41**	1.08, 1.83
Almost daily	8.98***	7.91, 10.18	0.67***	0.60, 0.74	1.52***	1.21, 1.91
Caste (/Scheduled)			+++			
Other Backward Class	0.96	0.83, 1.10	1.20***	1.08, 1.33	1.16	0.95, 1.41
Residual General Class	1.07	0.92, 1.25	1.06	0.95, 1.18	1.06	0.87, 1.29
Religion (/Hindu)	+++		+++			
Muslim	0.72***	0.61, 0.85	1.00	0.87, 1.15	0.90	0.70, 1.14
Other	0.80*	0.66, 0.97	0.69***	0.58, 0.81	0.94	0.69, 1.28

Note: *p≤0.05, ** p≤0.01,*** p≤0.001
+p≤0.05 ++ p≤0.01,+++ p≤0.001 [Wald test of main effects]

Table 22b. Multivariate logistic regression of two individual non-reciprocal sources of HIV-related information (print and posters) on individual characteristics (N=25,904)

	Print		Posters	
Individual characteristics	OR	95%CI	OR	95%CI
Gender (/male)	2.61***	2.39, 2.84	2.99***	2.67, 3.35
Age (years)	1.09***	1.06, 1.12	1.08***	1.05, 1.12
Education (/none)	+++		+++	
Primary	5.29***	2.54, 11.02	1.16	0.68, 1.96
Secondary	13.89***	6.51, 29.66	2.47**	1.37, 4.47
Higher	29.65***	13.66, 64.38	3.59***	1.93, 6.68
Wealth (/poorest)	+++		+++	
Poorer	1.27*	1.05, 1.55	1.04	0.82, 1.32
Middle	1.64***	1.35, 1.99	1.18	0.94, 1.49
Richer	2.09***	1.71, 2.54	1.28*	1.02, 1.62
Richest	3.12***	2.54, 3.84	1.69***	1.32, 2.16
Rural Residence	0.99	0.90, 1.10	0.87*	0.76, 0.99
High Prevalence State	0.98	0.89, 1.07	0.91	0.80, 1.03
Ever Married	0.69***	0.59, 0.79	0.74**	0.60, 0.90
Literacy	3.19***	2.21, 4.61	2.61***	1.74, 3.91
TV Frequency (/none)				
At least 1/week	1.15	1.00, 1.32	1.08	0.92, 1.27
Almost daily	1.13*	1.01, 1.27	1.10	0.96, 1.27
Caste (/Scheduled)	++			
Other Backward Class	1.16**	1.05, 1.29	1.00	0.88, 1.14
Residual General Class	1.17**	1.05, 1.30	0.96	0.84, 1.09
Religion (/Hindu)	+++		+	
Muslim	0.79***	0.69, 0.91	0.75**	0.63, 0.90
Other	1.16*	1.00, 1.34	0.89	0.73, 1.10

Note: *p≤0.05, ** p≤0.01,*** p≤0.001
+p≤0.05 ++ p≤0.01,+++ p≤0.001 [Wald test of main effects]

Reciprocal Sources of HIV-Related information

Binary logistic regression also examined associations between individual characteristics and the reporting of the three individual reciprocal information sources (health workers, teachers, and peers). Joint Wald tests were performed on categorical variables to test for overall main effects. Table 23 presents the odds ratios and the 95% confidence intervals for each individual reciprocal source and the individual characteristics.

Health workers

Two individual characteristics were associated with the reporting of health workers as an information source at the $\alpha \leq 0.001$ level of significance: gender and marital status (Table 23). Age, education, wealth, place of residence, state of residence, literacy, frequency of television, caste and religion were not associated at $\alpha \leq 0.001$ level.

Both of the individual characteristics had a positive association. Boys had a 93% increased odds of reporting health workers as compared to girls (OR 1.93, 95% CI 1.64-2.28). Ever-married adolescents had a 59% increased odds in reporting health workers as a source as compared to the never-married (OR 1.59, 95% CI 1.25-2.03).

Teachers

Seven individual characteristics were associated with the reporting of teachers as an information source at the $\alpha \leq 0.001$ level of significance: age, education, wealth, place of residence, state of residence, marital status, and religion (Table 23). Gender, literacy, frequency of television, and caste were not associated at $\alpha \leq 0.001$ level.

As expected, education had a strong correlation with reporting teachers as a source of HIV-related information: holding all other variables constant, adolescents with a secondary education had a 3635% increased odds of reporting teachers as a source compared to those with no education (OR 37.25, 95% CI 9.33-148.78). Those in the richest wealth quartile had a 161% increased odds of reporting teachers compared to the poorest (OR 2.61, 95% CI 2.08-3.29). Residence in a high prevalence state and rural areas also had increased odds of reporting teachers compared to residence in a low prevalence state and urban areas (OR 2.59, 95% CI 2.34-2.86 and OR 1.20, 95% CI 1.08-1.34, respectively).

Ever married adolescents had a 70% decreased odds of reporting teachers as a source of HIV-related information as compared to their never married counterparts (OR 0.30, 95% CI 0.25-0.37). Being Muslin was associated with a 23% decreased odds of reporting teachers as compared to Hindus (OR 0.77, 95% CI 0.66-0.90). Each year increase in age was associated with a 20% decreased odds of reporting the same (OR 0.81, 95% CI 0.79-0.84).

Peers

Five individual characteristics were associated with the reporting of peers as an information source at the $\alpha \leq 0.001$ level of significance: gender, age, state of residence, marital status, and frequency of television (Table 23). Education, wealth, place of residence, literacy, caste, and religion were <u>not</u> associated at $\alpha \leq 0.001$ level.

Holding all other variables constant, boys had a 121% increased odds of reporting peers as compared to girls (OR 2.12, 95% CI 1.93-2.31). Ever-married adolescents had a 24% increased odds in reporting the source as compared to the never-married (OR 1.24, 95% CI 1.09-1.41). Living in a high prevalence state was associated with a 19% increased odds of reporting peers (OR 1.18, 95% CI 1.08-1.30). Each year increase in age was associated with a 5% increased odds of reporting peers as a source of HIV-related information (OR 1.05, 95% CI 1.02-1.08).

Finally, frequency of television had a negative association with reporting peers as an information source. Adolescents who watched television almost daily report a 19% decreased odds of peers compared to those who never watched television (OR 0.81, 95% CI 0.73-0.90).

Table 23. Multivariate logistic regression of the individual reciprocal sources of HIV-related information (peers/relatives, teachers, health workers) on individual characteristics (N=25,904)

	Peers/relatives		Teachers		Health workers	
Individual characteristics	OR	95%CI	OR	95%CI	OR	95%CI
Gender (/male)	2.12***	1.93, 2.31	1.04	0.95, 1.14	2.12***	1.64, 2.28
Age (years)	1.05***	1.02, 1.08	0.81***	0.79, 0.84	1.05**	1.02, 1.14
Education (/none)			+++			
Primary	0.96	0.79, 1.17	4.02	1.06, 15.21	0.96	0.63, 1.58
Secondary	0.87	0.66, 1.14	37.25***	9.33, 148.78	0.87	0.80, 2.86
Higher	0.95	0.69, 1.32	45.84***	11.45, 183.44	0.95	0.83, 3.43
Wealth (/poorest)	++		+++			
Poorer	1.03	0.88, 1.20	1.23	0.98, 1.54	1.03	0.53, 0.95
Middle	0.98	0.84, 1.14	1.30*	1.05, 1.61	0.98**	0.47, 0.86
Richer	0.84	0.72, 0.98	1.57***	1.27, 1.95	0.84	0.52, 0.97
Richest	0.81	0.68, 0.97	2.61***	2.08, 3.29	0.81	0.51, 0.97
Rural Residence	1.04	0.94, 1.14	1.20***	1.08, 1.35	1.04	1.10, 1.59
High Prevalence State	1.18***	1.08, 1.30	2.59***	2.34, 2.86	1.18	0.87, 1.22
Ever Married	1.24***	1.09, 1.41	0.30***	0.25, 0.37	1.24***	1.25, 2.03
Literacy	0.78*	0.63, 0.98	3.46**	1.51, 7.93	0.78	0.58, 1.81
TV Frequency (/none)	+++		+			
At least 1/week	0.74***	0.65, 0.83	0.82**	0.70, 0.95	0.74	0.86, 1.41
Almost daily	0.81***	0.73, 0.90	0.88*	0.78, 0.99	0.81	0.82, 1.26
Caste (/Scheduled)			++			
Other Backward Class	0.94	0.85, 1.03	1.08	0.95, 1.21	0.94*	0.68, 1.00
Residual General Class	1.03	0.93, 1.15	0.90	0.79, 1.02	1.03	0.72, 1.10
Religion (/Hindu)			+++			
Muslim	1.03	0.91, 1.16	0.77***	0.66, 0.90	1.03	0.62, 1.05
Other	0.99	0.86, 1.13	1.32***	1.12, 1.56	0.99	0.75, 1.31

Note: *p≤0.05, ** p≤0.01,*** p≤0.001
+p≤0.05 ++ p≤0.01,+++ p≤0.001 [Wald test of main effects]

Exclusive sourcing of HIV-related information

Multivariate logistic regression examined associations between individual characteristics and exclusively (or solely) obtaining HIV-related information from either non-reciprocal or reciprocal sources. Joint Wald tests were performed on multi-level categorical variables to test for overall main effects. Table 24 presents the odds ratios and the 95% confidence intervals for exclusive reporting of each type of source and the individual characteristics.

Non-reciprocal sources

Four individual characteristics were associated with obtaining HIV-related information exclusively from non-reciprocal sources at the $\alpha \leq 0.001$ level of significance: gender, age, state of residence, and frequency of television (Table 24). Education, wealth, place of residence, marital status, literacy, caste, and religion were <u>not</u> associated at $\alpha \leq 0.001$ level.

Holding all other variables constant, watching television at least once/week was associated with a 41% increased odds in getting all information from non-reciprocal sources, compared to no television watching (OR 1.41, 95% CI 1.26-1.59). Each year increase in age was associated with a 6% increased odds in getting all information from non-reciprocal sources (OR 1.06, 95% CI 1.03-1.09).

Living in a high prevalence state was associated with a 46% decreased odds of only getting information from non-reciprocal sources (OR 0.54, 95% CI 0.49-0.59) while boys had a 39% decreased odds of only obtaining information from non-reciprocal sources as compared to girls (OR 0.61, 95% CI 0.56-0.66).

Reciprocal sources

Five individual characteristics were associated with obtaining HIV-related information exclusively from reciprocal sources at the $\alpha \leq 0.001$ level of significance: gender, age, wealth, state of residence, and frequency of television (Table 24). Education, place of residence, marital status, literacy, caste, and religion were not associated at $\alpha \leq 0.001$ level.

State of residence was the only characteristic that had a positive association with exclusively reciprocal sources: holding all other variables constant, adolescents in high prevalence states had a 103% increased odds in reporting only reciprocal sources as compared to adolescents in low prevalence states.

Compared to adolescents who don't watch television, watching television at least once/week was associated with a 61% decreased odds in obtaining information only from reciprocal sources (OR 0.39; 95% CI 0.32-0.47). Those in the richest wealth quintile had a 55% decreased odds of exclusively reciprocal sources as compared to those in the poorest (OR 0.45; 95% CI 0.33-0.61). Boys had a 28% decreased odds of only obtaining from reciprocal sources as compared to girls (OR 0.72, 95% CI 0.61-0.83). Finally, each year increase in age was associated with an 11% decreased odds of obtaining information only from reciprocal sources (OR .89, 95% CI 0.85-0.94).

Table 24. Multivariate logistic regression of obtaining HIV-related information only from non-reciprocal sources and only from reciprocal sources on individual characteristics (N=25,904)

	Solely Non-Reciprocal		Solely Reciprocal	
Individual characteristics	OR	95%CI	OR	95%CI
Gender (/male)	0.61***	0.56, 0.66	0.72***	0.61, 0.83
Age (years)	1.06***	1.03, 1.09	0.89***	0.85, 0.94
Education (/none)	+++		+	
Primary	1.08	0.89, 1.33	0.95	0.73, 1.25
Secondary	0.70**	0.54, 0.92	0.80	0.54, 1.18
Higher	0.63**	0.47, 0.86	0.28***	0.13, 0.60
Wealth (/poorest)	+++		+++	
Poorer	0.95	0.82, 1.11	0.91	0.73, 1.14
Middle	1.00	0.86, 1.16	0.64***	0.52, 0.80
Richer	1.01	0.87, 1.18	0.56***	0.43, 0.72
Richest	0.79**	0.67, 0.94	0.45***	0.33, 0.61
Rural Residence	0.88	0.80, 0.97	1.13	0.94, 1.35
High Prevalence State	0.54***	0.49, 0.59	2.03***	1.75, 2.36
Ever Married	1.13*	1.00, 1.28	1.34**	1.10, 1.62
Literacy	1.14	0.91, 1.43	0.66*	0.47, 0.91
TV Frequency (/none)	+++		+++	
At least 1/week	1.41***	1.26, 1.59	0.39***	0.32, 0.47
Almost daily	1.38***	1.25, 1.53	0.27***	0.23, 0.31
Caste (/Scheduled)				
Other Backwards Class	1.03	0.94, 1.14	0.96	0.81, 1.14
Residual General Class	1.06	0.95, 1.18	0.89	0.73, 1.10
Religion (/Hindu)	+		++	
Muslim	1.11	0.98, 1.24	1.25*	1.02, 1.54
Other	0.86*	0.74, 0.99	1.45**	1.13, 1.85

Note: *p≤0.05, ** p≤0.01,*** p≤0.001
+p≤0.05 ++ p≤0.01,+++ p≤0.001 [Wald test of main effects]

TYPES OF HIV-RELATED KNOWLEDGE BY INDIVIDUAL CHARACTERISTICS **(***SPECIFIC AIM THREE)*

Comprehensive Knowledge

Multivariate logistic regression examined associations between the eleven individual characteristics and comprehensive knowledge of HIV. Joint Wald tests were performed on categorical variables to test for overall main effects. Table 25 presents the odds ratios and the 95% confidence intervals for comprehensive knowledge and the individual characteristics

Eight individual characteristics were associated with comprehensive knowledge at the $\alpha \leq 0.001$ level of significance: gender, age, education, wealth, state of residence, frequency of television, caste, and religion. Place of residence, marital status, and literacy were not associated at $\alpha \leq 0.001$ level.

Holding all other variables constant, education and wealth had the highest correlation with comprehensive knowledge: adolescents with higher education had 205% increased odds and those in the top wealth quintile had 113% increased odds of comprehensive knowledge (OR 3.05, 95% CIs 2.04-4.57 and OR 2.13, 95% CI 1.75-2.58, respectively). Boys had a 71% increased odds of comprehensive knowledge as compared to girls (OR 1.71, 95% CI 1.57-1.86). Compared to no television watching, almost daily frequency had a 44% increased odds of comprehensive knowledge (OR 1.44, 95% CI 1.28-1.62). Compared to members of the Scheduled Caste and Tribes, members of the General Residual Class had a 24% increased odds of comprehensive knowledge (OR 1.24, 95% CI 1.11-1.38). Finally, each year increase in age was associated with a 7% increased odds of reporting comprehensive knowledge (OR 1.07, 95% CI 1.04-1.10).

Adolescents in high prevalence states had a 19% decreased odds of comprehensive knowledge compared to those in low prevalence states (OR 0.81, 95% CI 0.73-0.89). Compared to Hindus, Muslims had a 25% decreased odds of having comprehensive knowledge of the disease (OR 0.75, 95% CI 0.65-0.87).

Table 25. Multivariate logistic regression of Comprehensive Knowledge on individual characteristics (N=25,904)

Individual characteristics	OR	95% CI
Gender (/male)	1.71***	1.57, 1.86
Age (years)	1.07***	1.04, 1.10
Education (/none)	+++	
Primary	0.90	0.66, 1.23
Secondary	1.88***	1.31, 2.71
Higher	3.05***	2.04, 4.57
Wealth (/poorest)	+++	
Poorer	1.20*	1.00, 1.43
Middle	1.43***	1.19, 1.71
Richer	1.74***	1.45, 2.08
Richest	2.13***	1.75, 2.58
Rural Residence	0.89*	0.80, 0.99
High Prevalence State	0.81***	0.73, 0.89
Ever Married	0.91	0.79, 1.05
Literacy	1.32	0.99, 1.76
TV Frequency (/none)	+++	
At least 1/week	1.14*	1.00, 1.30
Almost daily	1.44***	1.28, 1.62
Caste (/Scheduled)	+++	
Other backwards class	1.10	0.99, 1.23
Residual General Class	1.24***	1.11, 1.38
Religion (/Hindu)	+++	
Muslim	0.75***	0.65, 0.87
Other	1.03	0.90, 1.19

Note: *p≤0.05, ** p≤0.01,*** p≤0.001
+p≤0.05 ++ p≤0.01,+++ p≤0.001 [Wald test of main effects]

Ordinal logistic regression examined associations between individual characteristics and the three other types of knowledge under investigation: condom availability, mother to child transmission, and availability of health services. Each of these three types of knowledge had a three-level scale of information accuracy with the lowest level representing inaccurate knowledge and the highest level representing accurate knowledge. Joint Wald tests were performed on categorical variables to test for overall main effects. Table 26 presents the odds ratios and the 95% confidence intervals for each type of knowledge and the individual characteristics.

Condom Availability Knowledge

Condom availability knowledge was measured on a three-tiered ordinal scale: accurate, somewhat accurate, and inaccurate. Respondents with accurate knowledge (knowing where to get condoms and being able to get condoms) are classified as having condom availability knowledge. Six individual characteristics were associated with condom availability knowledge at the $\alpha \leq 0.001$ level of significance: gender, age, education, state of residence, marital status, and frequency of television (Table 26). Wealth, place of residence, literacy, caste, and religion were not associated at $\alpha \leq 0.001$ level.

Holding all other variables constant, gender had the strongest positive correlation with condom availability knowledge. Boys had 12 times increased odds of being higher on the scale of condom knowledge as compared to girls (OR 13.21, 95% CI 11.94-14.62).

Adolescents with higher education had a 200% increased odds of being higher on the condom knowledge scale compared to those with no education (OR 3.00, 95% CI 2.17-4.15). Compared to those never married, ever married adolescents had a 63% increased odds of being higher on the scale (OR 1.63, 95% CI 1.46-1.81). Almost daily television watching had a 31% increased odds of being higher on the scale as compared to no television watching (OR 1.31, 95% CI 1.18-1.45). Each year increase in age was associated with a 20% increased odds of being higher on the scale (OR 1.20, 95% CI 1.17-1.23).

Residence in a high prevalence state was the only variable with a significant negative correlation with condom knowledge: residence in one of the six states was associated with a 56% decreased odds of being higher on the scale compared to residence in a low prevalence state (OR 0.44, 95% CI 0.40-0.48).

Mother to Child Transmission Knowledge

Mother to child transmission knowledge was measured on a three-tiered ordinal scale: accurate, somewhat accurate, and inaccurate. Respondents with accurate knowledge (that HIV can be transmitted from a mother to her baby and that medications are available to prevent transmission) are classified as having mother to child transmission knowledge. Seven individual characteristics were associated with mother to child transmission knowledge at the $\alpha \leq 0.001$ level of significance: gender, education, wealth, place of residence, state of residence, frequency of television, and religion (Table 26). Age, marital status, literacy, and caste were not associated at $\alpha \leq 0.001$ level.

Holding all other variables constant, compared to those with no education, adolescents with higher education had 136% increased odds of being higher on the mother to child transmission scale (lowest being inaccurate and highest being accurate) (OR 2.36, 95% CI 1.80-3.10). Compared to those in the poorest wealth quintile, adolescents in the richest quintile had a 54% increased odds of being higher on the scale (OR 1.54, 95% CI 1.31-1.82). Adolescents in high prevalence states had a 39% increase odds of being higher on the scale compared to those in low prevalence states (OR 1.39, 95% CI 1.28-1.51) while those in rural areas had a 17% increased odds of the same (OR 1.17, 95% CI 1.07-1.28) Those who watched almost daily television had a 32% increased odds of being higher on the mother to child transmission scale compared to those who watched no television (OR 1.32, 95% CI 1.20-1.44).

Compared to girls, boys had a 28% decreased odds of being higher on the scale of the mother to child transmission knowledge (OR 0.72, 95% CI 0.67-0.78). Muslim adolescents, as

compared to Hindus, had a 23% decreased odds of being higher on the same scale (OR 0.77, 0.68-0.86).

Availability of Health Services Knowledge

Availability of health services knowledge was measured on a three-tiered ordinal scale: accurate, somewhat accurate, and inaccurate. Respondents with accurate knowledge (of a place to get tested for the disease and the availability of antiretroviral drugs) are classified as having health services availability knowledge. Six individual characteristics were associated with knowledge of health services availability at the $\alpha \leq 0.001$ level of significance: gender, age, education, wealth, state of residence, and frequency of television (Table 26). Place of residence, marital status, literacy, caste, and religion) were <u>not</u> associated at $\alpha \leq 0.001$ level.

Each of the six individual characteristics displayed a positive significant association. Holding all other variables constant, education had the largest association: compared to those with no education, those with higher education had a 173% increased odds of being higher on the health services knowledge scale (lowest being inaccurate and highest being accurate) (OR 2.73, 95% CI 1.92-3.89). Adolescents in the richest wealth quintile had a 77% increased odds of being higher on the knowledge scale as compared to those in the poorest (OR 1.77, 95% CI 1.50 - 2.09). Residents in a high prevalence state had a 54% increased odds of being higher on the scale as compared to residence in a low prevalence state (OR 1.54, 95% CI 1.41-1.68). Boys had a 47% increased odds of being higher on the scale as compared to girls (OR 1.47, 95% CI 1.36-1.59). Compared to watching no television, adolescents who watched television on an almost daily basis had a 21% increased odds of being higher on the scale (OR 1.21, 95% CI 1.10-1.33).

Finally, each year increase in age was associated with a 7% increased odds of being higher on the health services knowledge scale (OR 1.07, 95% CI 1.05-1.10).

Table 26. Multivariate ordinal logistic regression of three types of accurate HIV-related knowledge (condom availability, mother to child transmission, and availability of health services) on individual characteristics (N=25,904)

	Condom Availability		Mother to Child Transmission		Availability of Health Services	
Individual characteristics	OR	95%CI	OR	95%CI	OR	95%CI
Gender (/male)	13.21***	11.94, 14.62	0.72***	0.67, 0.78	1.47***	1.36, 1.59
Age (years)	1.20*** +++	1.17, 1.23	1.04** +++	1.02, 1.07	1.07*** +++	1.05, 1.10
Education (/none)						
Primary	1.29*	1.03, 1.61	1.05	0.86, 1.27	0.96	0.75, 1.21
Secondary	1.76***	1.31, 2.37	1.69***	1.33, 2.15	1.61**	1.16, 2.22
Higher	3.00*** ++	2.17, 4.15	2.36*** +++	1.80, 3.10	2.73*** +++	1.92, 3.89
Wealth (/poorest)						
Poorer	0.93	0.79, 1.10	1.06	0.92, 1.23	1.08	0.92, 1.26
Middle	0.95	0.81, 1.12	1.25**	1.09, 1.44	1.30***	1.12, 1.52
Richer	1.03	0.87, 1.22	1.40***	1.21, 1.63	1.43***	1.22, 1.67
Richest	1.22*	1.01, 1.47	1.54***	1.31, 1.82	1.77***	1.50, 2.09
Rural Residence	0.88*	0.79, 0.98	1.17***	1.07, 1.28	1.02	0.92, 1.12
High Prevalence State	0.44***	0.40, 0.48	1.39***	1.28, 1.51	1.54***	1.41, 1.68
Ever Married	1.63***	1.46, 1.81	0.99	0.89, 1.11	1.01	0.89, 1.13
Literacy	1.03 +++	0.82, 1.29	1.21 +++	0.99, 1.48	1.27 +++	0.97, 1.66
TV Frequency (/none)						
At least 1/week	1.19**	1.05, 1.34	1.17**	1.05, 1.31	1.18**	1.05, 1.32
Almost daily	1.31*** +	1.18, 1.45	1.32*** +	1.20, 1.44	1.21***	1.10, 1.33
Caste (/Scheduled)						
Other Backwards Class	1.13*	1.02, 1.24	1.13**	1.03, 1.23	1.06	0.97, 1.16
Residual General Class	1.05	0.95, 1.16	1.05 +++	0.95, 1.15	0.97 +	0.88, 1.07
Religion (/Hindu)						
Muslim	0.88*	0.78, 0.99	0.77***	0.68, 0.86	0.85*	0.75, 0.97
Other	0.99	0.86, 1.14	0.99	0.87, 1.13	1.02	0.88, 1.18

Note: *p≤0.05, ** p≤0.01,*** p≤0.001
+p≤0.05 ++ p≤0.01,+++ p≤0.001p [Wald test of main effects]

Inaccurate and fully accurate HIV-related Knowledge

Multivariate logistic regression examined associations between individual characteristics and inaccurate and fully accurate HIV-related knowledge. Adolescents with fully accurate HIV-related knowledge had accurate knowledge of all four types under investigation: comprehensive,

condom availability, mother to child transmission, and availability of health services. Adolescents with not fully accurate (inaccurate) HIV-related knowledge did not have accurate knowledge of one or more of the four types. Joint Wald tests were performed on multi-level categorical variables to test for overall main effects. Table 27 presents the odds ratios and the 95% confidence intervals for inaccurate and fully accurate information by individual characteristics.

Inaccurate HIV-related knowledge

Five individual characteristics were associated with inaccurate knowledge at the $\alpha \leq 0.001$ level of significance: gender, age, education, wealth, and frequency of television. Place of residence, state of residence, marital status, literacy, caste, and religion were not associated at $\alpha \leq 0.001$ level.

Each of the five individual characteristics displayed a significant negative association. Holding all other variables constant, adolescents with higher education had an 80% decreased odds of inaccurate HIV-related knowledge compared to those with no education (OR 0.20, 95% CI 0.10-0.39). Boys had a 61% decreased odds of inaccurate knowledge as compared to girls (OR 0.39, 95% CI 0.33-0.45). Compared to those in the poorest wealth quintile, the richest adolescents had a 51% decreased odds of inaccurate knowledge (OR 0.49, 95% CI 0.36-0.66). Almost daily television watching was associated with a 27% decreased odds of inaccurate knowledge compared to no television watching (OR 0.73, 95% CI 0.62-0.87). Each year increase in age was associated with a 13% decreased odds of inaccurate HIV-related knowledge (OR 0.87, 95% CI 0.82-0.91).

Fully accurate HIV-related knowledge

Three individual characteristics were associated with fully accurate knowledge at the $\alpha \leq 0.001$ level of significance: gender, age, and state of residence. Education, wealth, place of residence, marital status, literacy, frequency of television, caste, and religion were not associated at $\alpha \leq 0.001$ level.

Holding all other variables constant, boys had a 212% increased odds of fully accurate knowledge as compared to girls (OR 3.12, 95% CI 2.35-4.14). Adolescents who resided in one of the high prevalence states had a 102% increased odds of having fully accurate HIV-related knowledge as compared to those who resided in low prevalence states (OR 2.02, 95% CI 1.55-2.63). Each year increase in age was associated with a 16% increased odds of fully accurate HIV-related information (OR 1.16, 95% CI 1.06-1.27).

Table 27. Multivariate logistic regressions of inaccurate and fully accurate HIV related knowledge on individual characteristics (N=25,904)

	Inaccurate		Fully Accurate	
Individual characteristics	OR	95%CI	OR	95%CI
Gender (/male)	0.39***	0.33, 0.45	3.12***	2.35, 4.14
Age (years)	0.87***	0.82, 0.91	1.16***	1.06, 1.27
Education (/none)	+++		+++	
Primary	1.16	0.90, 1.50	1.12	0.12, 10.44
Secondary	0.64*	0.44, 0.92	8.20	0.52, 129.72
Higher	0.20***	0.10, 0.39	16.39	0.98, 274.48
Wealth (/poorest)	+++		++	
Poorer	0.82	0.65, 1.04	1.52	0.69, 3.38
Middle	0.73**	0.58, 0.93	1.77	0.86, 3.66
Richer	0.64***	0.50, 0.81	1.95	0.90, 4.23
Richest	0.49***	0.36, 0.66	2.94**	1.38, 6.25
Rural Residence	1.06	0.90, 1.25	1.25	0.94, 1.67
High Prevalence State	1.26**	1.09, 1.47	2.02***	1.55, 2.63
Ever Married	0.77*	0.62, 0.94	0.85	0.47, 1.55
Literacy	0.68*	0.50, 0.93	0.62	0.08, 4.78
TV Frequency (/none)	+++			
At least 1/week	0.77**	0.63, 0.94	0.98	0.57, 1.68
Almost daily	0.73***	0.62, 0.87	1.48	0.92, 2.38
Caste (/Scheduled)	+			
Other Backward Class	0.81**	0.69, 0.95	1.24	0.90, 1.71
Residual General Class	0.84	0.71, 1.00	1.25	0.89, 1.77
Religion (/Hindu)	++			
Muslim	1.40***	1.14, 1.71	0.63	0.39, 1.01
Other	1.22	0.95, 1.55	1.07	0.66, 1.71

Note: *p≤0.05, ** p≤0.01,*** p≤0.001
+p≤0.05 ++ p≤0.01,+++ p≤0.001p [Wald test of main effects]

SUMMARY OF MULTIVARIATE ANALYSIS PERTAINING TO SPECIFIC AIMS ONE, TWO, AND THREE

Multivariate analyses were used to explore the relationships between individual characteristics and HIV awareness, sources of HIV-related information, and the types of HIV-related knowledge. More specifically, a combination of multivariate logistic and Poisson regression techniques was employed to explore the predictive power of individual characteristics

on HIV awareness, eight types of HIV-related information sources and four distinct types of HIV-related knowledge.

Analyses testing the predictive power of individual characteristics on HIV awareness indicate that all characteristics except for caste and religion were predictive of being aware of the disease (Table 20). Specifically, exposure to television, being male, living in a high prevalence state, age, education, wealth, and literacy were positively correlated with being aware of HIV. Living in rural area and being ever married were negatively correlated with being aware of HIV.

Thus, the hypotheses that HIV awareness is associated with each of the individual characteristics (H5a-H15a) is partially supported.

The predictive power of individual characteristics on the reporting of all HIV-related information exclusively from either non-reciprocal or reciprocal sources was tested (Table 25). Results indicate that state of residence, exposure to television, gender, and age were significant predictors of both exclusivities. Education and wealth were predictive of exclusively obtaining information from reciprocal sources but not predictive of obtaining exclusively from non-reciprocal sources.

Specifically, age and exposure to television were positively correlated with obtaining HIV-related information exclusively from non-reciprocal sources. Living in a high prevalence state and being male were negatively associated with the same. Living in a high prevalence state was positively correlated with obtaining HIV-related information exclusively from reciprocal sources. Exposure to television, wealth, being male, and age were all negatively correlated with the same.

Analyses testing the predictive power of individual characteristics on both sources of HIV-related information and HIV-related knowledge indicate that the predictive power of individual characteristics among all eight information sources and three of the four types of knowledge varied. Table 28 summarizes how individual characteristics predict sources of HIV-related information and HIV-related knowledge at the $\alpha \leq 0.001$ level of significance (i.e. summary of the findings presented in tables 22-23, 25, 26).

Gender predicted obtaining HIV-related information from all sources except television and teachers. Specifically, being male was positively correlated with obtaining information from radio, cinema, print, posters, peers/relatives, and health workers. Gender also predicted all four types of knowledge. Specifically, being male was positively correlated with comprehensive knowledge, condom availability knowledge, and health services knowledge but negatively correlated with knowledge about mother to child transmission.

Age was positively correlated with obtaining information from all types of non-reciprocal sources, peers, and teachers, and three types of knowledge. This supports the hypothesis (H13b) that older adolescents are more likely to obtain information from teachers as compared to younger adolescents. Age was positively correlated with comprehensive knowledge, condom availability knowledge, and health services availability knowledge. This partially supports the hypothesis (H13c) that age is positively associated with all four types of knowledge.

Education was positively correlated with obtaining information from radio, cinema, print, posters, and teachers. This supports the hypothesis (H9b) that adolescents with at least a secondary education are more likely to obtain information from teachers and non-reciprocal

sources as compared to those with lower education. It was also positively correlated with all four types of knowledge. Thus, the hypothesis (H9c) was supported.

Wealth was positively correlated with obtaining information from print, posters, and teachers. This partially refutes the hypothesis (H10b) that wealthier adolescents are more likely to obtain information from teachers, health workers, and non-reciprocal sources as opposed to less wealthy adolescents. Wealth was also predictive of three types of knowledge. Specifically, wealth was positively correlated with knowledge about condom availability, mother to child transmission, and health services. This partially supports the hypothesis (H10c) that wealth is positively associated with all four types of knowledge.

Place of residence was predictive of obtaining information from television, radio, cinema, and teachers. Specifically, rural residence was positively correlated with obtaining information from radio and teachers while negatively correlated with obtaining information from television and cinema. This partially supports the hypothesis (H12b) that rural adolescents are less likely to obtain information from non-reciprocal sources as compared to urban adolescents. Living in a rural residence was positively correlated with mother to child transmission knowledge. This refutes the hypothesis (H12c) that rural residence has a negative association with all four types of knowledge.

State of residence was predictive of obtaining information from radio, cinema, peers/relatives and teachers. Specifically, residence in a high prevalence state was positively correlated with obtaining information from cinema, peers, and teachers while negatively correlated with obtaining information from radio. This partially supports the hypothesis (H11b) that adolescents residing in the six high prevalence states are more likely to obtain information

from teachers and health workers as compared to adolescents residing in low prevalence states. State of residence was also predictive of each type of knowledge. Specifically, living in a high prevalence state was positively correlated with knowledge about mother to child transmission and health services but negatively correlated with comprehensive and condom availability knowledge. This partially supports the hypothesis (H11c) that residence in the high prevalence states had positive association with all four types of knowledge.

Marital status was negatively correlated with obtaining information from cinema, print or teachers, but positively correlated with obtaining information from peers/relatives and health workers. Thus, the hypothesis (H8b) that ever married adolescents are less likely to obtain information from teachers and non-reciprocal sources as compared to never married adolescents is supported. Being ever married was positively correlated with condom availability knowledge. This refutes the hypothesis (H8c) that being ever married has negative association with all four types of knowledge.

Literacy was positively correlated with obtaining information from two non-reciprocal sources: print and posters. This mainly refutes the hypothesis (H14b) that literate adolescents are more likely to obtain information from teachers and non-reciprocal sources as compared to illiterate adolescents. Surprisingly, literacy was not predictive of any types of knowledge. This refutes the hypothesis (H14c) that being literate has positive association with all four types of knowledge.

Exposure to television was negatively correlated with obtaining information from two sources, radio and peers/relatives, refuting the hypothesis (H15b) that adolescents with exposure to television are more likely to obtain information from non-reciprocal sources as compared to

adolescents without exposure to television. Exposure to television was positively correlated with all four types of knowledge and the hypothesis (H15c) was supported.

Caste was predictive of only one source of HIV-related information: radio. Specifically, membership in the Other Backwards Class was positively correlated with radio as a source as compared to members of Scheduled Castes and Tribes. This refutes the hypothesis (H6b) that adolescents belonging to the Residual General Class are more likely to obtain information from teachers and non-reciprocal sources than adolescents in one of the three legislatively defined, marginalized, groups. Membership in the Residual General Class was positively associated with comprehensive knowledge. This mainly refutes the hypothesis (H6c) that belonging to the Residual General Class has positive association with all four types of knowledge.

Religion was predictive of obtaining information from television, radio, print, and teachers. Specifically, compared to being Hindu, being Muslim was negatively correlated with obtaining information from television, print, and teachers and being one of the "other" religions was negatively correlated with radio. This partially supports the hypothesis (H7b) that Muslims are less likely to obtain information from teachers and non-reciprocal sources than members of other religions. Being Muslim was negatively associated with comprehensive and mother to child transmission knowledge. This mainly refutes the hypothesis (H7c) that that being Muslim has negative association with all four types of knowledge.

Table 28. Summary of predictive power of individual characteristics on sources of HIV-related information and HIV-related knowledge at the $\alpha \leq 0.001$ level of significance

	Information Sources								Types of Knowledge			
	Non-reciprocal					Reciprocal						
	TV	Radio	Cinema	Print	Posters	HW	Teachers	Peers	Comp.	Condom	MTCT	HS
Individual characteristics												
Gender (/male)		+	+	+	+	+		+	+	+	-	+
Age (years)	+	+	+	+	+		-	+	+	+		+
Education (/none)												
Primary				+								
Secondary			+	+			+		+	+	+	
Higher	+	+	+	+	+		+		+	+	+	+
Wealth (/poorest)												
Poorer												
Middle	+			+					+			+
Richer	+			+			+		+		+	+
Richest	+			+	+		+		+		+	+
Rural Residence	-	+	-				+				+	
High Prevalence State		-	+				+	+	-	-	+	+
Ever Married			-	-		+	-	+		+		
Literacy				+	+							
TV Frequency (/none)												
At least 1/week	+							-				
Almost daily	+	-	+					-	+	+	+	+
Caste (/Scheduled)												
Other Backward Cl.		+										
Residual General Cl.									+			
Religion (/Hindu)												
Muslim	-			-			-		-		-	
Other		-					+					

Note: + indicates positive association at the $\alpha \leq 0.001$ level and – indicates negative association at the $\alpha \leq 0.001$ level
TV=television; HW=health workers; Comp.=Comprehensive; MTCT=Mother to child transmission; HS=Health services

Finally, the predictive power of individual characteristics on fully accurate and inaccurate (or not fully accurate) knowledge was explored in order to determine if the characteristics associated with being unaware of HIV differed from those with inaccurate knowledge (Table 27). Five individual characteristics were predictive of inaccuracy: gender, age, education, wealth, exposure to television. Specifically, being female, younger, without higher education, less wealthy, and having no exposure to television were correlated with inaccurate HIV-related information. Each of these characteristics were also associated with being unaware of the disease.

There were four individual characteristics predictive of fully accurate HIV-related information. Being male, being older, and living in a high prevalence state were positively correlated with having fully accurate information about the disease.

TYPES OF HIV-RELATED KNOWLEDGE BY SOURCES OF HIV-RELATED INFORMATION (SPECIFIC AIM FOUR)

Part one of Specific Aim Four investigated the relationship between sources of HIV-related information and HIV-related knowledge in HIV-aware adolescents. Multivariate logistic regression models explored the associations between eight sources of HIV-related information and four types of HIV-related knowledge (research question 9) and examined the role of 11 individual characteristics as rival independent variables with associations to both sources of HIV-related information and HIV-related knowledge (research question 10).

Comprehensive Knowledge

The multivariate logistic regression model (of Specific Aim Three) predicting the effects of individual characteristics on comprehensive knowledge of HIV (see Table 25) was expanded to determine the associations between the eight sources of HIV-related information and

comprehensive knowledge of HIV when controlling on individual characteristics. Joint Wald tests determined that the eight sources of HIV-related information were significant as a group ($F=118.37$, $p \leq 0.000$).

Table 29 presents the odds ratios and the 95% confidence intervals for comprehensive knowledge associated with sources of information and the individual characteristics. Figure 10 presents a graphical depiction of Table 29 that illustrates how each individual source affects comprehensive knowledge controlling for all other sources as well as individual characteristics.

The addition of information sources into the multivariate logistic regression model reduced the number of individual characteristics that were predictive of comprehensive knowledge at the $\alpha \leq 0.001$ level of significance from eight to six. Being male, older, more educated, wealthier, and a member of the residual general class retained positive associations with accurate comprehensive knowledge while residence in a high prevalence state retained a negative association with accurate comprehensive knowledge. Frequency of television and religion did not remain significant predictors of comprehensive knowledge.

Holding individual characteristics constant, five information sources were predictive of comprehensive knowledge at the $\alpha \leq 0.001$ level of significance: radio, television, print, posters, and teachers. Cinema, health workers, and peers were <u>not</u> associated at $\alpha \leq 0.001$ level.

Each of the five information sources had a positive association with comprehensive knowledge and television had the greatest odds. Adolescents who cited television as a source of HIV-related information had an 81% increased odds of having comprehensive knowledge as compared to those who did not cite television as a source (OR 1.81, 95% CI 1.59-2.06). This

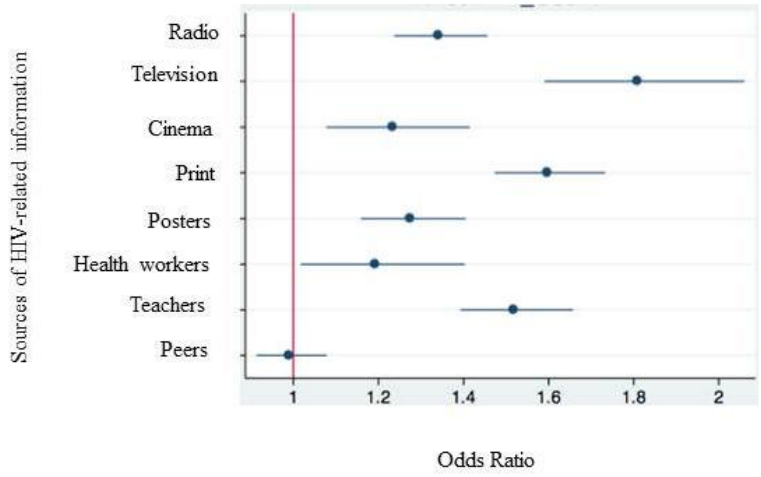
was followed by print (OR 1.60, 95% CI 1.47-1.73), teachers (OR 1.52, 95% CI 1.39-1.66), radio (OR 1.34, 95% CI 1.24-1.46), and posters (OR 1.28, 95% CI 1.16-1.41).

Table 29. Multivariate logistic regression of Comprehensive Knowledge on information sources and individual characteristics (N=25,904)

Information sources	OR	95% CI
Radio	1.34***	1.24, 1.46
Television	1.81***	1.59, 2.06
Cinema	1.23**	1.08, 1.41
Print	1.60***	1.47, 1.73
Posters	1.28***	1.16, 1.41
Health workers	1.19*	1.02, 1.40
Teachers	1.52***	1.39, 1.66
Peers	0.99	0.91, 1.08
Individual characteristics	OR	95% CI
Gender (/male)	1.43***	1.30, 1.56
Age (years)	1.06***	1.03, 1.09
Education (/none)	+++	
Primary	0.90	0.66, 1.22
Secondary	1.50*	1.04, 2.16
Higher	2.12***	1.41, 3.17
Wealth (/poorest)	+++	
Poorer	1.15	0.96, 1.37
Middle	1.31**	1.09, 1.58
Richer	1.51***	1.26, 1.82
Richest	1.68***	1.37, 2.05
Rural Residence	0.87*	0.79, 0.97
High Prevalence State	0.74***	0.67, 0.82
Ever Married	1.01	0.87, 1.16
Literacy	1.17	0.88, 1.57
TV Frequency (/none)	+++	
At least 1/week	0.96	0.84, 1.10
Almost daily	1.21**	1.07, 1.36
Caste (/Scheduled)	+++	
Other Backward Class	1.07	0.97, 1.19
Residual General Class	1.23***	1.10, 1.37
Religion (/Hindu)	++	
Muslim	0.80**	0.70, 0.93
Other	1.04	0.90, 1.20

Note: *p≤0.05, ** p≤0.01,*** p≤0.001
+p≤0.05 ++ p≤0.01,+++ p≤0.001 [Wald test of main effects]

Figure 10. Effects of eight individual information sources on comprehensive knowledge of HIV (holding individual characteristics constant) (N=25,904)



Condom Availability Knowledge

Condom availability knowledge was measured on a three-tiered ordinal scale: accurate, somewhat accurate, and inaccurate. Respondents with accurate knowledge (knowing where to get condoms and being able to get condoms) were classified as having condom availability knowledge. Those with somewhat accurate knowledge knew where to obtain condoms but were unable to get them. Respondents with inaccurate knowledge did not know where to obtain them (and, by definition, did not have the ability to get them).

The multivariate ordinal logistic regression models (of Specific Aim Three) predicting the effects of individual characteristics on condom availability knowledge (see Table 26) was expanded to include the associations between the eight sources of HIV-related information and condom availability knowledge. Joint Wald tests determined that the eight sources of HIV-related information were significant as a group ($F = 87.9$, $P \leq 0.000$).

Table 30 reports the odds ratios and the 95% confidence intervals for condom availability knowledge associated with sources of information and the individual characteristics. Figure 11 presents the graphical depictions of Table 30 that illustrates how each individual source affects

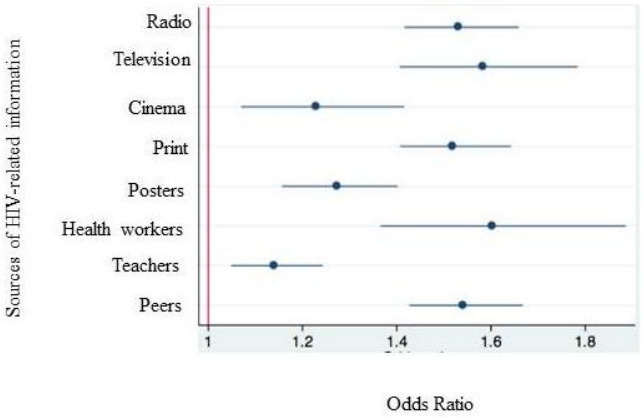
condom availability knowledge (controlling for all other sources as well as individual characteristics).

The addition of information sources into the ordinal logistic regression model reduced the number of individual characteristics that were predictive of condom availability knowledge at the $\alpha \leq 0.001$ level of significance from six to four (Table 30). Gender, age, higher education, state of residence, and marital status remained significant predictors of accurate information while exposure to television did not.

Holding individual characteristics constant, five information sources were predictive of condom availability knowledge at the $\alpha \leq 0.001$ level of significance: radio, television, print, posters, and peers. Cinema, health workers, and teachers were not associated at $\alpha \leq 0.001$ level.

All five of the information sources had a positive association with being higher on the condom availability knowledge scale and health workers had the strongest association. Adolescents who cited health workers as a source of HIV-related information had a 60% increased odds of being higher on condom availability knowledge scale as compared to those who did not cite health workers as a source (OR 1.60, 95% CI 1.37-1.89). This was followed by television (OR 1.58, 95% CI 1.41-1.78), peers (OR 1.54, 95% CI 1.43-1.67), radio (OR 1.53, 95% CI 1.42-1.66), print (OR 1.52, 95% CI 1.41-1.64), and posters (OR 1.27, 95% CI 1.16-1.40).

Figure 11. Effects of eight individual information sources on accurate condom availability knowledge (holding individual characteristics constant) (N=25,904)



Mother to Child Transmission Knowledge

Mother to child transmission knowledge was measured on a three-tiered ordinal scale: accurate, somewhat accurate, and inaccurate. Respondents with accurate knowledge (that HIV can be transmitted from a mother to her baby and that medications are available to prevent transmission) are classified as having mother to child transmission knowledge. Those with somewhat accurate knowledge knew about mother to child transmission but did not know about medications. Respondents with inaccurate knowledge did not know about transmission or medication.

The multivariate ordinal logistic regression models (of Specific Aim Three) predicting the effects of individual characteristics on mother to child transmission knowledge (see Table 26) was expanded to include the associations between the eight sources of HIV-related information and mother to child transmission knowledge. Joint Wald tests determined that the eight sources of HIV-related information were significant as a group ($F = 58.5$, $p \leq 0.000$).

Table 30 reports the odds ratios and the 95% confidence intervals for condom availability knowledge associated with sources of information and the individual characteristics. Figure 12

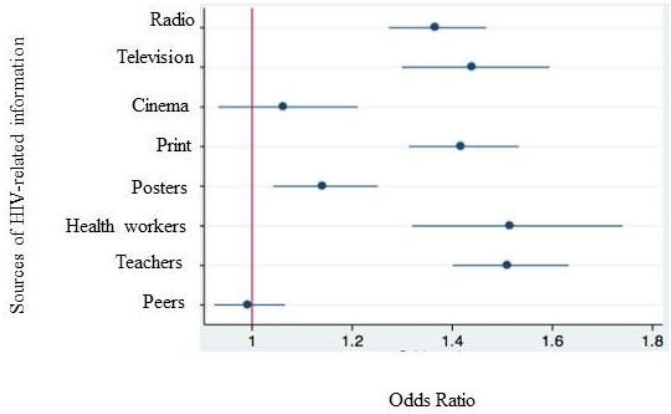
presents the graphical depictions of Table 30 that illustrates how each individual source affects mother to child transmission knowledge (controlling for all other sources as well as individual characteristics).

The addition of information sources into the model reduced the number of individual characteristics that were predictive of mother to child transmission knowledge at the $\alpha \leq 0.001$ level of significance from seven to six (Table 30). Gender, education, wealth, state of residence, frequency of television, and religion remained significant while place of residence did not.

Holding individual characteristics constant, five information sources were predictive of mother to child transmission knowledge at the $\alpha \leq 0.001$ level of significance: radio, television, print, health workers, and teachers. Cinema, posters, and peers were not associated at $\alpha \leq 0.001$ level.

All five of the information sources had a positive association with being higher on the mother to child transmission knowledge scale and health workers had the strongest association. Adolescents who cited health workers as a source of HIV-related information had a 52% increased odds of being higher on the mother to child transmission knowledge scale as compared to those who did not cite health workers as a source (OR 1.52, 95% CI 1.32-1.74). This was followed by teachers (OR 1.51, 95% CI 1.40- 1.63), television (OR 1.44, 95% CI 1.30-1.59), print (OR 1.42, 95% CI 1.31-1.53) and radio (OR 1.37, 95% CI 1.27-1.47).

Figure 12. Effects of eight individual information sources on accurate mother to child transmission knowledge (holding individual characteristics constant) (N=25,904)



Availability of Health Services Knowledge

Availability of health services knowledge was measured on a three-tiered ordinal scale: accurate, somewhat accurate, and inaccurate. Respondents with accurate knowledge (of a place to get tested for the disease and the availability of antiretroviral drugs) are classified as having health services availability knowledge. Respondents with somewhat accurate knowledge knew of a place to get tested but did not know about the availability of drugs. Those with inaccurate knowledge did not know about either.

The multivariate ordinal logistic regression models (of Specific Aim Three) predicting the effects of individual characteristics on availability of health services knowledge (see Table 26) was expanded to include the associations between the eight sources of HIV-related information and availability of health services knowledge. Joint Wald tests determined that the eight sources of HIV-related information were significant as a group (87.19, $p \leq 0.000$).

Table 30 reports the odds ratios and the 95% confidence intervals for condom availability knowledge associated with sources of information and the individual characteristics. Figure 13 presents the graphical depictions of Table 30 that illustrates how each individual source affects

availability of health services knowledge (controlling for all other sources as well as individual characteristics).

The addition of information sources into the model reduced the number of individual characteristics that were predictive of health services knowledge at the $\alpha \leq 0.001$ level of significance from six to five (Table 30). Gender, age, education, wealth, state of residence, remained significant while frequency of television did not.

Holding individual characteristics constant, all eight information sources were predictive of health services knowledge at the $\alpha \leq 0.001$ level of significance. All eight of the information sources had positive associations with being higher on the availability of health services knowledge scale and (as with condom availability and mother to child transmission knowledge) health workers had the strongest association. Holding all other variable constant, adolescents who cited health workers as a source of HIV-related information had a 73% increased odds of being higher on the availability of health services knowledge scale as compared to those who did not cite health workers as a source (OR 1.73, 95% CI 1.51-1.98). This was followed by teachers (OR 1.59, 95% CI 1.46-1.72), print (OR 1.54, 95% CI 1.43-1.67), radio (OR 1.42, 95% CI 1.32-1.52), television (OR 1.41, 95% CI 1.27-1.57), cinema (OR 1.40, 95% CI 1.22-1.60), posters (OR 1.36, 95% CI 1.24-1.49), and peers (OR 1.14, 95% CI 1.06-1.22).

Figure 13. Effects of eight individual information sources on accurate health services availability knowledge (holding individual characteristics constant) (N=25,904)

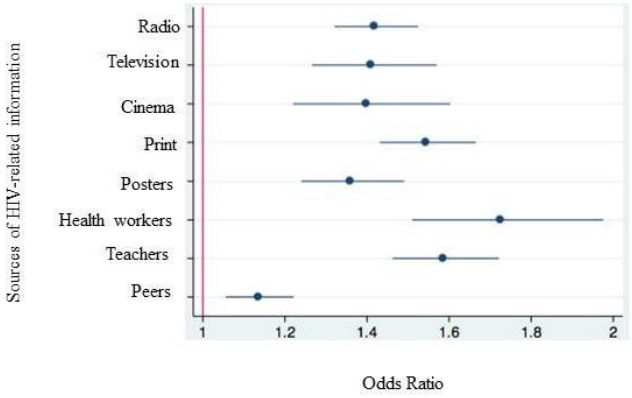


Table 30. Multivariate ordinal logistic regression of three types of accurate HIV-related knowledge (condom availability, mother to child transmission, and availability of health services) on information sources and individual characteristics (N=25,904)

	Condom Availability		Mother to Child Transmission		Availability of Health Services	
Information sources	OR	95%CI	OR	95%CI	OR	95%CI
Radio	1.53***	1.42, 1.66	1.37***	1.27, 1.47	1.42***	1.32, 1.52
Television	1.58***	1.41, 1.78	1.44***	1.30, 1.59	1.41***	1.27, 1.57
Cinema	1.23**	1.07, 1.42	1.06	0.93, 1.21	1.40***	1.22, 1.60
Print	1.52***	1.41, 1.64	1.42***	1.31, 1.53	1.54***	1.43, 1.67
Posters	1.27***	1.16, 1.40	1.14**	1.04, 1.25	1.36***	1.24, 1.49
Health workers	1.60***	1.37, 1.89	1.52***	1.32, 1.74	1.73***	1.51, 1.98
Teachers	1.14**	1.05, 1.24	1.51***	1.40, 1.63	1.59***	1.46, 1.72
Peers	1.54***	1.43, 1.67	0.99	0.92, 1.07	1.14***	1.06, 1.22
Individual characteristics						
Gender (/male)	10.97***	9.88, 12.18	0.61***	0.57, 0.66	1.15***	1.06, 1.25
Age (years)	1.18***	1.15, 1.22	1.04**	1.01, 1.07	1.06***	1.04, 1.09
Education (/none)	++		+++		+++	
Primary	1.28*	1.02, 1.60	1.05	0.87, 1.28	0.96	0.76, 1.21
Secondary	1.48*	1.09, 2.02	1.42**	1.11, 1.80	1.29	0.94, 1.78
Higher	2.20***	1.58, 3.06	1.77***	1.35, 2.33	1.88***	1.33, 2.67
Wealth (/poorest)			+++		+++	
Poorer	0.91	0.77, 1.07	1.05	0.90, 1.21	1.05	0.89, 1.23
Middle	0.90	0.77, 1.07	1.20*	1.04, 1.38	1.24**	1.06, 1.44
Richer	0.96	0.81, 1.14	1.29***	1.11, 1.50	1.29**	1.10, 1.52
Richest	1.07	0.88, 1.29	1.30***	1.11, 1.54	1.44***	1.21, 1.71
Rural Residence	0.85**	0.77, 0.95	1.15**	1.05, 1.25	0.99	0.90, 1.09
High Prevalence State	0.41***	0.37, 0.46	1.35***	1.24, 1.47	1.46***	1.34, 1.59
Ever Married	1.71***	1.53, 1.92	1.06	0.95, 1.19	1.10	0.98, 1.24
Literacy	0.98	0.77, 1.24	1.12	0.92, 1.37	1.16	0.88, 1.51
TV Frequency (/none)	+		+++			
At least 1/week	1.07	0.94, 1.22	1.06	0.94, 1.19	1.07	0.95, 1.20
Almost daily	1.17**	1.05, 1.31	1.19***	1.08, 1.31	1.11	1.00, 1.22
Caste (/Scheduled)						
Other Backwards Class	1.11*	1.00, 1.22	1.11*	1.02, 1.21	1.03	0.94, 1.13
Residual General Class	1.03	0.93, 1.14	1.04	0.95, 1.15	0.96	0.87, 1.06
Religion (/Hindu)			+++			
Muslim	0.92	0.82, 1.04	0.81***	0.72, 0.91	0.92	0.81, 1.04
Other	1.01	0.88, 1.16	1.00	0.88, 1.14	1.04	0.90, 1.20

Note: *p≤0.05, ** p≤0.01,*** p≤0.001
+p≤0.05 ++ p≤0.01,+++ p≤0.001 [Wald test of main effects]

SUMMARY OF MULTIVARIATE ANALYSIS PERTAINING TO SPECIFIC AIM FOUR

Part one of Specific Aim Four sought to determine whether there were associations between the sources of HIV-related information and HIV-related knowledge among HIV-aware adolescents. Multivariate logistic regression was employed to determine if there were associations between sources of HIV-related information and HIV-related knowledge exist among adolescents and to understand if individual characteristics served as rival independent variables and have associations with both sources of HIV-related information and HIV-related knowledge.

Multivariate logistic regression models (Tables 29 and 30) illustrated that all eight sources of HIV-related information were associated with at least two types of HIV-related knowledge (all significance is reported at the $\alpha \leq 0.001$ level). Three sources: radio, television, and print were associated with all four types of knowledge. Posters were associated with three types of accurate knowledge: comprehensive, condom, and health services. Teachers were also associated with three types of accurate knowledge: comprehensive, mother to child transmission, and health services. Health workers were associated with accurate knowledge about condom availability, mother to child transmission and health services while peers were associated with accurate knowledge about condom and health services. Finally, cinema was only related to one type: health services.

Comparisons of odds ratios (Tables 29 -30 and Figures 10-13) illustrated that television, print, and teachers had the largest associations with accurate comprehensive knowledge (OR 1.81, 1.60, 1.52, respectively). Health workers, television, and peers have the largest associations with accurate condom knowledge (OR 1.60, 1.58, 1.54, respectively). Health

workers, teachers, and television had the largest associations with accurate mother to child transmission knowledge (OR 1.52, 1.51, 1.44, respectively). Health workers, teachers, and print had the largest associations with accurate health services knowledge (OR 1.73,1.59, 1.54, respectively).

Analysis of the multivariate regression model (Tables 29 and 30) combined with findings from Specific Aim 2 and 3 (Tables 22ab, 23, 25, 26) indicate partial support for the assertion all 11 individual characteristics in the conceptual model served as rival independent variables with associations to both sources of HIV-related information and HIV-related knowledge. While gender, age, education, wealth, place of residence, state of residence, marital status, exposure to television, caste, and religion had statistical associations with at least one type of source and one type of knowledge, literacy did not. Therefore, 10 individual characteristics (gender, age, education, wealth, place of residence, state of residence, marital status, and exposure to television, caste, and religion) were classified as rival independent variables. Literacy was not (and it was excluded from further analysis).

In part two of Specific Aim Four a set four multiple mediation models with binary categorical outcomes were created and analyzed to determine if the eight sources of HIV-related information - as a set - mediated the relationships between each of the 10 individual characteristics and four types of accurate HIV-related knowledge (research question 11).

MacKinnon (2008) and MacKinnon, Lockwood, et al. (2002) specify two important conditions for multiple mediation. First, each independent variable had to be associated with at least one of the eight mediators. All of the variables in these models meet that condition (see Tables 22a, 22b, 23). Second, the mediators had to affect the dependent variables when the independent variables were controlled. All of the variables – except for cinema, peers and health workers – met that condition for all four types of knowledge at the $\alpha \leq 0.001$ level of significance (See tables 29 and 20). I retained cinema, peers and health workers in the models because cinema and health workers were associated with three types of knowledge at the $\alpha \leq 0.01$ level of significance, peers are associated with two types of knowledge at the $\alpha \leq 0.001$ level of significance, and it was important to control for their effects.

The variable literacy was not included in the final mediation models. Baron and Kenny (1986) assert that the first condition for mediation is the presence of statistical association between the independent and dependent variables. Although MacKinnon (2008) disagrees with this condition (on the basis of potential suppression effects), I choose to exclude literacy as there was scant indication of suppression: it was only associated with two of the eight sources of information and none of the four types of knowledge (see Tables 21-22, 24-25). Further, past

research provided only limited support for its inclusion in nationally representative data analysis (Yadev et al., 2011).

There are two issues that are important to highlight before proceeding with interpretation of the results. First, due to the capacity of the Mplus software, note that all four types of HIV-related knowledge were dichotomized for this analysis. Condom availability, mother to child transmission, and health services availability knowledge were recoded to reflect accurate and inaccurate information. Whereas accurate information did not change, somewhat accurate and inaccurate was collapsed into one category considered to reflect inaccurate information.

Second, a full mediation effect was represented as a statistically significant total effect combined with a significant indirect effect and a non-significant direct effect. Partial mediation effect was represented by a statistically significant total effect combined with a significant indirect effect and a significant direct effect. Suppression (or inconsistent mediation) was identified for variables not mediated by the eight sources of information when a significant direct effect was suppressed by significant indirect effect which resulted in a non-significant total effect.

Tables 31-34 present summaries of the extent to which the eight sources of HIV-related information mediate the effect of the 10 individual characteristics on each of the four types of knowledge (holding all of the other individual characteristics constant). [See Appendix A2 for the multiple mediation effect of each individual characteristic on the four types of knowledge through all eight information sources, holding all other individual characteristics constant].

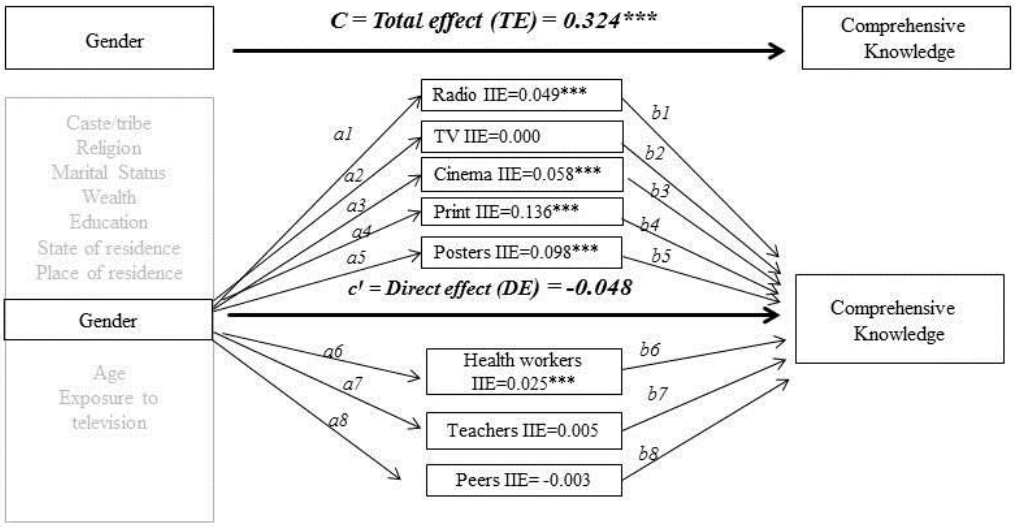
MULTIPLE MEDIATION OF THE EFFECT OF INDIVIDUAL CHARACTERISTICS ON COMPREHENSIVE KNOWLEDGE THROUGH HIV-RELATED INFORMATION SOURCES

Thirty-four percent of HIV-aware adolescents had comprehensive knowledge of the disease (see Table 19). The multivariate logistic regression model that examined the associations between individual characteristics and comprehensive knowledge (see Table 25) determined that eight individual characteristics were predictive of comprehensive knowledge at the $\alpha \leq 0.001$ level of significance: gender, age, education, wealth, state of residence, frequency of television, caste and religion.

Multiple mediation analyses illustrated that the set of eight HIV-related information sources fully or partially mediated the relationship between seven of these individual characteristics and comprehensive knowledge of HIV at the $\alpha \leq 0.001$ level of significance (Table 31). It was only the relationship between caste and comprehensive knowledge that failed to be mediated by sources of HIV-related information.

When the eight information sources were added to the equation, the effect of gender on comprehensive knowledge was fully mediated by the combination of statistically significant ($\alpha \leq 0.001$) individual indirect effects (IIE) of print (IIE=0.136), posters (IIE=0.098), radio (IIE=0.049), cinema (IIE=0.058), and health workers (IIE=0.025) and non-statistically significant ($\alpha \leq 0.001$) individual effects of teachers (IIE=0.005) and print (IIE = -0.003) [Total Effect (TE) = 0.324 ($\alpha \leq 0.001$), Indirect Effect (IE) = 0.372 ($\alpha \leq 0.001$), Direct Effect (DE) = -0.048 ($\alpha > 0.001$)]. Figure 14 illustrates the relationship between gender and comprehensive knowledge within the multiple mediation model.

Figure 14. The relationship between Gender and Comprehensive Knowledge in the multiple mediation model



Indirect effect (IE) = Mplus derivation of (a_1b_1+ a_2b_2+ a_3b_3+ a_4b_4+ a_5b_5+ a_6b_6+ a_7b_7+ a_8b_8) = 0.372***

Individual indirect effect (IIE) of radio (Mplus derivation of a_1b_1) = 0.049
IIE of cinema (Mplus derivation of a_3b_3) = 0.058
IIE of print (Mplus derivation of a_4b_4) = 0.136
IIE of posters (Mplus derivation of a_5b_5) = 0.098
IIE of health workers (Mplus derivation of a_6b_6) = 0.025

Note: *** p<0.001

The effect of age on comprehensive knowledge was fully mediated by the combination of statistically significant ($\alpha \leq 0.001$) individual indirect effects of television (IIE = 0.012), print (IIE=0.012), radio (IIE=0.007), posters (IIE=0.007), cinema (IIE=0.006), and teachers (IIE= -0.018) and the non-significant ($\alpha > 0.001$) individual effect of health workers (IIE=0.003) [TE= 0.039 ($\alpha \leq 0.001$), IE = 0.028 ($\alpha \leq 0.001$), DE = 0.011 ($\alpha > 0.001$)]. Note that positive non-significant ($\alpha > 0.001$) individual indirect effects with an IIE ≤ 0.001 are not reported in this analysis due to the very small influence they have on the indirect effect as a whole.

The relationship between each of the top three wealth quintiles (compared to the bottom quintile) and comprehensive knowledge were fully mediated and similar patterns of individual

indirect effects were exhibited in all three categories. The relationship between the richest wealth category (compared to the poorest wealth category) and comprehensive knowledge was fully mediated by the significant ($\alpha \leq 0.001$) individual indirect effects of print (IIE=0.166), television (IIE=0.113), teachers (IIE=0.088), and posters (IIE=0.049) and the non-significant ($\alpha > 0.001$) individual effects of radio (IIE= -0.019), cinema (IIE=0.031), and health workers (IIE=-0.015)[TE= 0.449 ($\alpha \leq 0.001$), IE = 0.414 ($\alpha \leq 0.001$), DE = 0.035 ($\alpha > 0.001$)].

The relationship between the second highest wealth category (compared to the poorest wealth category) and comprehensive knowledge was also fully mediated by the significant ($\alpha \leq 0.001$) individual indirect effects of print (IIE=0.106), television (IIE=0.091), and teachers (IIE=0.041) and the non-significant ($\alpha > 0.001$) individual indirect effects of posters (IIE=0.023), radio (IIE=-0.020), cinema (IIE=0.012), and health workers (IIE=-0.015) [TE= 0.321 ($\alpha \leq 0.001$), IE = 0.240 ($\alpha \leq 0.001$), DE = 0.081 ($\alpha > 0.001$)].

The association between the middle wealth category (compared to the poorest wealth category) and comprehensive knowledge was fully mediated by the significant ($\alpha \leq 0.001$) individual indirect effects of print (IIE=0.070) and television (IIE=0.050) combined with the non-significant ($\alpha > 0.001$) individual indirect effects of teachers (IIE=0.023), posters (IIE=0.023), cinema (IIE=0.016), radio (IIE=-0.020) and health workers (IIE=-0.015) [TE= 0.204 ($\alpha \leq 0.001$), IE = 0.142 ($\alpha \leq 0.001$), DE = 0.062 ($\alpha > 0.001$)].

The eight sources of information also fully mediated the association between almost daily television exposure and comprehensive knowledge. This relationship was fully mediated by the significant ($\alpha \leq 0.001$) individual indirect effects of television (IIE = 0.273) and radio (IIE = -0.038) combined with the non-significant ($\alpha > 0.001$) individual indirect effects of cinema

(IIE=0.027), print (IIE=0.017), posters (IIE=0.009), and teachers (IIE = -0.011) [TE= 0.217 ($\alpha \leq$ 0.001), IE = 0.279 ($\alpha \leq 0.001$), DE = -0.062 ($\alpha > 0.001$)].

Lastly, the negative association between being Muslim and comprehensive knowledge of HIV was fully mediated by the significant ($\alpha \leq 0.001$) negative individual indirect effects of television (IIE = -0.039) and print (IIE = -0.033) in combination with the non- significant ($\alpha >$ 0.001) negative individual indirect effects of posters (IIE=-0.025), teachers IIE=-0.023), health workers (IIE=-0.008), and cinema (IIE=-0.008) [TE= -0.167 ($\alpha \leq 0.001$), IE = -0.134 ($\alpha \leq$ 0.001), DE = -0.033 ($\alpha > 0.001$)].

Partial mediation (defined as statistically significant ($\alpha \leq 0.001$) total, indirect, and direct effects) was present in three multiple mediation models. In the first case, the positive relationship between having secondary education (compared to no education) and comprehensive knowledge was partially mediated by a significant ($\alpha \leq 0.001$) positive indirect effect. Specifically, the partial mediation was associated with the individual indirect effects of print (IIE = 0.444), teachers (IIE = 0.321), posters (IIE = 0.131), cinema (IIE = 0.060), and radio (IIE = 0.045) in combination with the non- significant ($\alpha > 0.001$) indirect effects from television (IIE=0.040), and health workers (IIE=0.017) [TE= 0.487 ($\alpha \leq 0.001$), IE = 1.059 ($\alpha \leq 0.001$), DE = -0.572 ($\alpha \leq 0.001$)]. In the second case, the positive relationship between having higher education (compared to no education) and comprehensive knowledge was partially mediated by a significant ($\alpha \leq 0.001$) positive indirect effect. Specifically, it was associated with the individual indirect effects from print (IIE = 0.567), teachers (IIE = 0.335), posters (IIE = 0.170), television (IIE = 0.102),cinema (IIE=0.090) and radio (IIE = 0.077) in combination with the non-significant ($\alpha > 0.001$) indirect effects from health workers (IIE=0.021) [TE= 0.778 ($\alpha \leq 0.001$), IE = 1.65 ($\alpha \leq 0.001$), DE = -0.587 ($\alpha \leq 0.001$)].

These models exposed two related findings. First, the set of HIV-related information sources partially mediated, or explained, the positive associations between two upper levels of education (secondary and higher) and comprehensive knowledge. Second, they revealed the existence of *negative* direct associations between secondary education and comprehensive knowledge (DE = -0.572) as well as higher education and comprehensive knowledge (DE= -0.587) after taking indirect effects into account.

In the third case, the negative association between residence in a high prevalence state and comprehensive knowledge was partially mediated by a significant ($\alpha \leq 0.001$) positive indirect effect [TE= -0.134 ($\alpha \leq 0.001$), IE = 0.114 ($\alpha \leq 0.001$), DE = -0.249 ($\alpha \leq 0.001$)]. Specifically, the indirect effect was created by the individual indirect effects of cinema (IIE = 0.087), teachers (IIE = 0.086), and radio (IIE = -0.036) combined with the non-significant ($\alpha > 0.001$) individual indirect effects of health workers (IIE = 0.002), television (IIE = -0.011), print (IIE = -0.004), posters (IIE = -0.009), and peers (IIE = -0.001). This finding indicates that despite the partial, positive, mediation of information sources on the associations between residence in a high prevalence state and comprehensive knowledge, negative total and direct associations between residence in a high prevalence state and comprehensive knowledge existed.

Suppression (identified by a significant direct effect that is suppressed by a significant indirect effect which results in a non-significant total effect) was present in three variables in this model: marital status, primary education, and less than daily television frequency.

In the case of marital status, there was a significant direct effect for being ever married on comprehensive knowledge (DE = 0.016). However, being ever married was also associated with a significant negative indirect effect (IE=-0.209) (influenced, primarily, by negative individual

indirect effects of radio, cinema, print, and teachers). This resulted in a non-significant total effect (TE = -0.049) between being ever married and comprehensive knowledge. Therefore, the significant negative indirect effect was suppressing the positive direct effect of being ever married on comprehensive knowledge. I assert that the relatively powerful negative indirect effect was driven by ever married adolescents lack of access to radio, cinema, print, and teachers that was uncovered in Specific Aim Two (see Tables 22-23) as all of these sources were determined to be associated with comprehensive knowledge when controlling for individual characteristics, including marital status (see Table 29).

In the case of primary education, the reverse was true. The significant ($\alpha \leq 0.001$) direct effect for having a primary education (compared to no education) had a negative association with comprehensive knowledge (DE= -0.446). However, having a primary education was associated a significant positive indirect effect (IE = 0.425) (influenced, primarily, by the indirect effect of print). This resulted in a non-significant total effect (TE= -0.21) between having a primary education and comprehensive knowledge. In this case, the significant positive indirect effect of information sources was suppressing the negative direct effect of primary education on comprehensive knowledge. This is consistent with the findings pertaining to the partial mediation of secondary and higher education levels as discussed above.

The same logic held true for less than daily television frequency. The significant direct effect of less than daily television frequency had a negative association with comprehensive knowledge (DE= -0.149). However, less than daily television was associated with a positive indirect effect (IE = 0.224). This resulted in a non-significant total effect (TE= -0.75) between less than daily television frequency and comprehensive knowledge. The significant positive

indirect effect of information sources was suppressing the negative direct effect of less than daily television frequency on comprehensive knowledge.

Table 31. Summary of the multiple mediation model illustrating the extent to which the set of eight sources of HIV-related information mediated the effects of 10 individual characteristics on comprehensive knowledge of HIV (N=25,904)

	Total	Indirect	Direct	Radio	TV	Cinema	Print	Posters	HW	Teachers	Peers	M
Individual characteristics												
Gender (/male)	0.324***	0.372***	-0.048	0.049***	0.000	0.058***	0.136***	0.098***	0.025***	0.005	-0.003	F***
Age (years)	0.039***	0.028***	0.011	0.007***	0.012***	0.006***	0.012***	0.007***	0.003*	-0.018***	0.000	F***
Education (/none)												
Primary	-0.021	0.425***	-0.446***	0.014	0.005	0.028	0.238***	0.037*	0.001	0.102**	0.000	
Secondary	0.487***	1.059***	-0.572***	0.045***	0.040**	0.06***	0.444***	0.131***	0.017*	0.321***	0.001	P***
Higher	0.778***	1.365***	-0.587***	0.077***	0.102***	0.09***	0.567***	0.170***	0.021	0.335***	0.001	P***
Wealth (/poorest)												
Poorer	0.101***	0.058***	0.042	-0.009	0.024*	0.004	0.034*	0.003	-0.015	0.018	0.000	
Middle	0.204***	0.142***	0.062	-0.015*	0.050***	0.016	0.070***	0.017	-0.019*	0.023*	0.000	F***
Richer	0.321***	0.240***	0.081	-0.020*	0.091***	0.012	0.106***	0.023*	-0.015	0.041***	0.001	F***
Richest	0.449***	0.414***	0.035	-0.019*	0.113***	0.031*	0.166***	0.049***	-0.015	0.088***	0.001	F***
Rural Residence	-0.068	-0.010	-0.058	0.037***	-0.038***	-0.022**	-0.001	-0.014*	0.011*	0.017**	0.000	
High Prev. State	-0.134***	0.114***	-0.249***	-0.036***	-0.011	0.087***	-0.004	-0.009	0.002	0.086***	-0.001	P***
Ever Married	-0.049	-0.209***	0.160***	-0.015 ***	-0.001	-0.035***	-0.052***	-0.026**	0.017**	-0.097***	-0.001	
TV Freq. (/none)												
At least 1/week	0.075	0.224***	-0.149***	-0.003	0.189***	0.023*	0.020*	0.007	0.004	-0.018**	0.001	
Almost daily	0.217***	0.279***	-0.062	-0.038***	0.273***	0.027**	0.017*	0.009	0.001	-0.011	0.001	F***
Caste (/Scheduled)												
OBC	0.063	0.045	0.018	0.017***	-0.005	0.011	0.022**	0.001	-0.008	0.007	0.000	
Residual General	0.130***	0.022	0.108**	0.005	0.008	0.005	0.023**	-0.004	-0.005	-0.010	0.000	
Religion (/Hindu)												
Muslim	-0.167***	-0.134***	-0.033	0.001	-0.039***	-0.008	-0.033***	-0.025**	-0.008	-0.023**	0.000	F***
Other	0.020	-0.026	0.046	-0.034***	-0.026*	-0.005	0.021*	-0.008	0.000	0.027***	0.000	

Note: *p≤0.05, ** p≤0.01,*** p≤0.001 M=Mediation P=Partial F=Full

MULTIPLE MEDIATION OF THE EFFECT OF INDIVIDUAL CHARACTERISTICS ON CONDOM AVAILABILITY KNOWLEDGE THROUGH HIV-RELATED INFORMATION SOURCES

Thirty-five percent of HIV-aware adolescents had accurate condom availability knowledge (see Table 19). The multivariate ordinal logistic regression model that examined associations between individual characteristics and condom availability knowledge (presented in Table 26) determined that six individual characteristics were associated with condom availability knowledge at the $\alpha \leq 0.001$ level of significance: gender, age, education, state of residence, marital status, and frequency of television.

Multiple mediation analyses illustrated that HIV-related information sources fully or partially mediated the relationships between five of the six individual characteristics and accurate condom availability knowledge (Table 32)[2]. Only one statistical association with condom availability knowledge - state of residence - was not mediated fully, or in part, by sources of information.

There was one case of full mediation (defined as statistically significant ($\alpha \leq 0.001$) total and indirect effects combined with a non-significant ($\alpha > 0.001$) direct effect) present in the mediation models. When information sources were added to the model as mediators, the relationship between almost daily television watching and condom knowledge was fully mediated. Mediation was the result of the combination of statistically significant ($\alpha \leq 0.001$) positive individual indirect effects (IIE) of television (IIE=1.57) and negative individual indirect effect from radio (IIE= - 0.046) peers (IIE= -0.016). The non-statistically significant ($\alpha > 0.001$) individual effects of cinema (IIE=0.018), print (IIE=0.014), posters (IIE=0.008), and teachers

[2] Due to the capacity of the Mplus software, condom availability knowledge was dichotomized for the multiple mediation analysis. Whereas accurate information did not change, somewhat accurate and inaccurate was collapsed into one category considered to reflect inaccurate information.

(IIE= -0.004) also contributed to the total indirect effect [TE = 0.183 ($\alpha \leq 0.001$), IE = 0.133 ($\alpha \leq 0.001$), DE = 0.050 ($\alpha > 0.001$)].

Partial mediation (defined as statistically significant ($\alpha \leq 0.001$) total, indirect, and direct effects) was present in four multiple mediation models. First, the positive effect of being male on condom availability knowledge was partially mediated by a positive indirect effect [TE= 1.73 ($\alpha \leq 0.001$), IE = 0.408 ($\alpha \leq 0.001$), DE = 1.322 ($\alpha \leq 0.001$)]. Specifically, the partial mediation was associated with the statistically significant ($\alpha \leq 0.001$) positive individual indirect effects of print (IIE=0.116), posters (IIE=0.093), radio (IIE=0.062), peers (IIE=0.057), health workers (0.043), and cinema (IIE=0.037). This finding indicated that sources of information partially mediated, or explained, the positive relationship between being male and condom availability knowledge that existed even after controlling for the indirect effect.

Second, the positive direct effect of age on condom availability knowledge was partially mediated by statistically significant ($\alpha \leq 0.001$) positive individual indirect effects of radio (IIE=0.009), television (IIE=0.007), print (IIE=0.010), posters (IIE= 0.006), and peers (IIE=0.004) and the non-statistically significant ($\alpha > 0.001$) indirect effects of cinema (IIE=0.004) and teachers (IIE = -0.006) [TE= 0.121 ($\alpha \leq 0.001$), IE = 0.038 ($\alpha \leq 0.001$), DE = 0.082 ($\alpha \leq 0.001$)]. As with gender, this finding indicates that sources of information contributed to an existing positive direct relationship between age and condom availability knowledge.

Third, the negative direct effect of having secondary education (compared to no education) on accurate condom knowledge was partially mediated by the positive indirect effects of information sources [TE= 0.311($\alpha \leq 0.001$), IE = 0.716($\alpha \leq 0.001$), DE = -0.405($\alpha \leq 0.001$)]. Specifically, it was the combination of statistically significant (at the $\alpha \leq 0.001$ level) individual

indirect effects of print (IIE=0.365), posters (IIE=0.132), radio (IIE=0.055), and peers (IIE = -0.028) and non-statistically significant ($\alpha > 0.001$) indirect effects of teachers (IIE=0.101), cinema (IIE=0.037), health workers (IIE=0.030), and television (IIE=0.023). As with the relationship between having a secondary education and comprehensive knowledge (discussed in the prior section), this finding indicates that that the set of HIV-related information sources partially mediate the association between secondary education and condom availability knowledge. In addition to these partial mediation effects, a *negative* direct association between secondary education and condom availability knowledge (DE = -0.405) was shown to exist.

Lastly, the positive direct effect of being ever married on condom availability knowledge was partially mediated by negative indirect effects of information sources [TE= 0.278 ($\alpha \leq 0.001$), IE = -0.094 ($\alpha \leq 0.001$), DE = 0.372 ($\alpha \leq 0.001$)]. Specifically, the indirect effect was the result of significant ($\alpha \leq 0.001$) negative indirect effects of print (IIE=-0.044), teachers (IIE=-0.031), and radio (IIE=-0.018) combined with the non-significant ($\alpha > 0.001$) negative indirect effects of posters (IIE=-0.024) and cinema (IIE=-0.022) and the non-significant positive indirect effects of health workers (IIE=0.031) and peers (IIE=0.016). This finding indicates that although there is a significant total effect of being ever married and condom availability knowledge (TE= 0.278), there is an even greater direct effect of being ever married and condom availability knowledge (DE = 0.372) that is being partially mediated (or inhibited) by the negative indirect effect of information sources (IE = -0.094).

Suppression (identified by a significant ($\alpha \leq 0.001$) direct effect that is suppressed by a significant ($\alpha \leq 0.001$) indirect effect which results in a non-significant ($\alpha > 0.001$) total effect) was not present in any of these multiple mediation models.

Table 32. Summary of the multiple mediation models illustrating the extent to which the set of eight sources of HIV-related information mediated the effects of 10 individual characteristics on accurate condom availability knowledge (N=25,904)

	Total	Indirect	Direct	Radio	TV	Cinema	Print	Posters	HW	Teachers	Peers	M
Individual characteristics												
Gender (/male)	1.73***	0.408***	1.322***	0.062***	-0.001	0.037***	0.116***	0.093***	0.043***	0.001	0.057***	P***
Age (years)	0.121***	0.038***	0.082***	0.009***	0.007***	0.004 **	0.01***	0.006***	0.005*	-0.006*	0.004***	P***
Education (/none)												
Primary	0.105	0.293***	-0.188**	0.016	0.002	0.018	0.196***	0.036 *	0.002	0.033*	-0.009	
Secondary	0.311***	0.716***	-0.405***	0.055***	0.023 **	0.037 **	0.365***	0.132***	0.03*	0.101*	-0.028***	P***
Higher	0.620***	0.96***	-0.339**	0.092***	0.056***	0.056 **	0.469***	0.163***	0.039*	0.106*	-0.022*	P**
Wealth (/poorest)												
Poorer	-0.067	0.018	-0.086	-0.012	0.014	0.003	0.028 *	0.003	-0.024 *	0.005	0.002	
Middle	-0.053	0.068*	-0.122*	-0.019*	0.029***	0.011	0.058***	0.015	-0.030**	0.007	-0.002	
Richer	0.002	0.118***	-0.116	-0.027**	0.052***	0.009	0.088***	0.021*	-0.024	0.012*	-0.014*	
Richest	0.025	0.233***	-0.207**	-0.023*	0.063***	0.023*	0.138***	0.046***	-0.025*	0.026*	-0.016*	
Rural Residence	0.021	0.020	0.001	0.044***	-0.021***	-0.014*	-0.001	-0.013*	0.018**	0.005*	0.002	
High Prev. State	-0.424***	0.034	-0.458***	-0.043***	-0.007	0.055***	-0.004	-0.008	0.003	0.026*	0.013***	
Ever Married	0.278***	-0.094***	0.372***	-0.018***	-0.001	-0.022**	-0.044***	-0.024**	0.031**	-0.031***	0.016**	P***
TV Freq. (/none)												
At least 1/week	0.143**	0.121***	0.022	-0.004	0.11***	0.014*	0.017	0.007	0.007	-0.006	-0.023***	F**
Almost daily	0.183***	0.133***	0.050	-0.046***	0.157***	0.018**	0.014	0.008	0.001	-0.004	-0.016***	F***
Caste (/Scheduled)												
OBC	0.082*	0.028	0.054	0.021***	-0.003	0.007	0.018**	0.001	-0.013	0.002	-0.005	
Residual General	0.013	0.02	-0.007	0.006	0.005	0.003	0.019**	-0.004	-0.008	-0.003	0.002	
Religion (/Hindu)												
Muslim	-0.069	-0.096***	0.026	0.000	-0.022**	-0.005	-0.027***	-0.024**	-0.013	-0.007	0.001	
Other	0.041	-0.042	0.083	-0.041***	-0.015*	-0.004	0.018*	-0.007	0.000	0.008*	-0.001	

Note: *p≤0.05, ** p≤0.01,*** p≤0.001 M=Mediation P=Partial F=Full

MULTIPLE MEDIATION OF THE EFFECT OF INDIVIDUAL CHARACTERISTICS ON MOTHER TO CHILD TRANSMISSION KNOWLEDGE THROUGH HIV-RELATED INFORMATION SOURCES

Twenty-eight percent of HIV-aware adolescents had accurate mother to child transmission knowledge (see Table 19). The multivariate ordinal logistic regression model that examined associations between individual characteristics and mother to child transmission knowledge (see Table 26) determined that seven individual characteristics were associated with mother to child transmission knowledge at the $\alpha \leq 0.001$ level of significance: gender, education, wealth, place of residence, state of residence, frequency of television, and religion.

Multiple mediation analyses illustrated that the set of eight HIV-related information sources fully or partially mediated the relationship between five of the individual characteristics and accurate mother to child transmission knowledge at the $\alpha \leq 0.001$ level of significance (gender, education, wealth, state of residence, and frequency of television) (Table 33)[3]. HIV-related information sources did not mediate the relationship between place of residence or religion and mother to child transmission knowledge at the $\alpha \leq 0.001$ level of significance.

Full mediation (defined as statistically significant ($\alpha \leq 0.001$) total and indirect effects combined with a non-significant ($\alpha > 0.001$) direct effect) was present in two of the multiple mediation models. First, the relationship between the richest wealth quintile (compared to the poorest) and mother to child transmission knowledge was fully mediated by the positive indirect effects of information sources [TE = 0.207 ($\alpha \leq 0.001$), IE = 0.272 ($\alpha \leq 0.001$), DE = -0.064 ($\alpha > 0.001$)]. Mediation was the result of the combination of statistically significant positive individual indirect effects (IIE) of teachers (IIE=0.074), television (IIE=0.068), posters

[3] Due to the capacity of the Mplus software, mother to child transmission knowledge was dichotomized for the multiple mediation analysis. Whereas accurate information did not change, somewhat accurate and inaccurate was collapsed into one category considered to reflect inaccurate information.

(IIE=0.034), cinema (IIE=0.025), and print (IIE=0.11) and negative non-significant individual indirect effect from radio (IIE= - 0.016) and health workers (IIE= -0.024).

In the second case, the relationship between almost daily television frequency (compared to no television exposure) and mother to child transmission knowledge was fully mediated by information sources [TE = 0.187 ($\alpha \leq 0.001$), IE = 0.162 ($\alpha \leq 0.001$), DE = 0.025 ($\alpha > 0.001$)]. Specifically, the significant positive indirect effect of television (IIE=0.116) and negative indirect effect of radio (IIE = -0.032) combined with the non-significant indirect effects of cinema (IIE=0.019), print (IIE=0.011), teachers (IIE= -0.011), and posters (IIE=0.006).

Partial mediation (defined as statistically significant ($\alpha \leq 0.001$) total, indirect, and direct effects) occurred in four multiple mediation models.

The significant negative direct effect of being male on mother to child transmission knowledge was partially mediated by positive indirect effect of HIV-related information sources [TE = -0.254 ($\alpha \leq 0.001$), IE = 0.285($\alpha \leq 0.001$), DE = -0.539($\alpha \leq 0.001$)]. Specifically, the partial mediation was associated with the statistically significant positive individual indirect effects of print (IIE=0.092), posters (IIE=0.068), radio (IIE=0.043), and health workers (IIE=0.042) combined with the non-significant individual indirect effects of teachers (IIE=0.003) and peers (IIE= -0.003). This finding indicated that while information sources had a positive indirect effect (IE = 0.285) on the relationship between being male and having mother to child transmission knowledge, a significant negative direct association between being male and having mother to child transmission knowledge remained (DE = -0.539).

When the eight information sources were added to the equation, the relationship between having secondary education (compared to no education) and mother to child transmission knowledge was partially mediated by significant indirect effects from print (IIE = 0.292), teachers (IIE = 0.275), posters (IIE = 0.094), and radio (IIE = 0.038) in combination with the non- significant indirect effects from cinema (IIE = 0.041), television (IIE=0.024), and health workers (IIE=0.029) [TE= 0.460 ($\alpha \leq 0.001$), IE = 0.793 ($\alpha \leq 0.001$), DE = -0.333($\alpha \leq 0.001$)]. The relationship between having higher education (compared to no education) and mother to child transmission knowledge was also partially mediated by a significant positive indirect effect [TE= 0.627 ($\alpha \leq 0.001$), IE = 1.004 ($\alpha \leq 0.001$), DE = -0.377 ($\alpha \leq 0.001$)]. Specifically, it was partially mediated by the individual indirect effects from print (IIE = 0.376), teachers (IIE = 0.298), posters (IIE = 0.116), cinema (IIE=0.062), television (IIE = 0.059), and radio (IIE = 0.065) in combination with the non- significant ($\alpha > 0.001$) indirect effects from health workers (IIE=0.037).

These findings revealed (like comprehensive and condom availability knowledge) that while sources of information partially mediate the positive associations between two upper levels of education (secondary and higher) and mother to child transmission knowledge, negative direct associations between secondary education and mother to child transmission knowledge (DE = -0. 333) as well as higher education and mother to child transmission knowledge (DE= -0. 377) exist.

Lastly, the positive direct effect of residence in a high prevalence state on mother to child transmission knowledge was partially mediated by statistically significant ($\alpha \leq 0.001$) individual indirect effects of teachers (IIE=0.071), cinema (IIE=0.060), and radio (IIE=-0.031) and non-significant ($\alpha > 0.001$) indirect effects of health workers (IIE=0.002), posters (IIE=-0.006), and

print(IIE=-0.002) [TE = 0.254 ($\alpha \leq 0.001$), IE = 0.087($\alpha \leq 0.001$), DE = 0.158 ($\alpha \leq 0.001$)]. This result indicated that sources of information contributed to an existing positive direct relationship between residence in a high prevalence state and mother to child transmission knowledge that is not explained by this research.

Suppression (identified by a significant ($\alpha \leq 0.001$) direct effect that is suppressed by a significant ($\alpha \leq 0.001$) indirect effect which results in a non-significant ($\alpha > 0.001$) total effect) was present in one multiple mediation model. The relationship between being ever married and mother to child transmission knowledge was adversely affected by suppression [TE = 0.004 ($\alpha > 0.001$), IE= -0.146 ($\alpha \leq 0.001$), DE = 0.150 ($\alpha \leq 0.001$)]. Although the total effect (TE = 0.004) for the relationship is not significant, being ever married had a significant direct effect (DE = 0.150) on mother to child transmission knowledge. However, being married was also associated with a negative indirect effect of information sources (driven, primarily, by the significant negative indirect relationships with radio, cinema, print, posters, and teachers) (IE= -0.146). Therefore, the significant negative indirect effect of information sources is suppressing the positive direct effect of being ever married on mother to child transmission knowledge. Using the same rationale as the suppression effect evident in the relationship between marital status and comprehensive knowledge, I postulate that the relatively powerful negative indirect effect was driven by ever married adolescents lack of access to radio, print, and teachers that was uncovered in Specific Aim Two (see Tables 22-23) as all of these sources were determined to be associated with mother to child transmission knowledge when controlling for individual characteristics, including marital status (see Table 30).

Table 33. Summary of the multiple mediation model illustrating the extent to which the set of eight sources of HIV-related information mediated the effects of 10 individual characteristics on accurate mother to child transmission knowledge (N=25,904)

	Total	Indirect	Direct	Radio	TV	Cinema	Print	Posters	HW	Teachers	Peers	*M*
Individual characteristics												
Gender (/male)	-0.254***	0.285***	-0.539***	0.043***	-0.001	0.04***	0.092***	0.068***	0.042***	0.003	-0.003	P***
Age (years)	0.020*	0.019***	0.001	0.006***	0.007***	0.004 **	0.008***	0.005***	0.005 *	-0.016***	0.000	F*
Education (/none)												
Primary	0.185**	0.306***	-0.121	0.011	0.002	0.019	0.157***	0.026 *	0.002	0.089 **	0.000	F**
Secondary	0.460***	0.793***	-0.333***	0.038***	0.024 **	0.041 **	0.292***	0.094***	0.029 *	0.275***	0.001	P***
Higher	0.627***	1.004***	-0.377***	0.065***	0.059***	0.062***	0.376***	0.116***	0.037 *	0.289***	0.001	P***
Wealth (/poorest)												
Poorer	0.009	0.025	-0.016	-0.008	0.014 *	0.003	0.022 *	0.002	-0.023 *	0.015	0.000	
Middle	0.111*	0.075**	0.036	-0.014 *	0.03***	0.012	0.046***	0.011	-0.03 **	0.019 *	0.000	F*
Richer	0.177**	0.142***	0.035	-0.019 **	0.054***	0.010	0.07***	0.016 *	-0.023 *	0.034***	0.001	F**
Richest	0.207***	0.272***	-0.064	-0.016 *	0.068***	0.025 ***	0.11***	0.034***	-0.024 *	0.074***	0.001	F***
Rural Residence	0.120***	0.014	0.106**	0.031***	-0.022***	-0.016 **	-0.001	-0.010 *	0.018 **	0.014 **	0.000	
High Prev. State	0.245***	0.087***	0.158***	-0.031***	-0.007	0.060***	-0.002	-0.006	0.002	0.071***	-0.001	P***
Ever Married	0.004	-0.146***	0.150***	-0.012 *	-0.001	-0.024 **	-0.035***	-0.018 **	0.029 **	-0.083***	-0.001	
TV Freq. (/none)												
At least 1/week	0.086*	0.140***	-0.054	-0.003	0.116***	0.015 *	0.014	0.005	0.006	-0.015 ***	0.001	F*
Almost daily	0.187***	0.162***	0.025	-0.032***	0.166***	0.019 **	0.011	0.006	0.001	-0.011 *	0.001	F***
Caste (/Scheduled)												
OBC	0.061	0.027	0.034	0.014***	-0.003	0.008	0.015 **	0.001	-0.013 *	0.005	0.000	
Residual General	0.016	0.008	0.008	0.004	0.005	0.004	0.015 **	-0.003	-0.008	-0.008	0.000	
Religion (/Hindu)												
Muslim	-0.105**	-0.099***	-0.006	0.000	-0.024***	-0.005	-0.022 **	-0.017 **	-0.012	-0.019 **	0.000	F**
Other	-0.017	-0.018	0.001	-0.029***	-0.016 *	-0.004	0.014 *	-0.006	0.000	0.023***	0.000	

Note: *p≤0.05, ** p≤0.01,*** p≤0.001 M=Mediation P=Partial F=Full

Knowledge about the availability of testing and treatment services was alarmingly low among HIV-aware adolescents. Only 8.9% of adolescents had accurate availability of health services knowledge (see Table 19). The multivariate ordinal logistic regression model that examined association between individual characteristics and availability of health services knowledge (see Table 25) determined that six individual characteristics were associated with knowledge of health services availability at the $\alpha \leq 0.001$ level of significance: gender, age, education, wealth, state of residence, and frequency of television.

Multiple mediation analyses illustrated that HIV-related information sources fully or partially mediated the relationship between three of the individual characteristics and health services knowledge at the $\alpha \leq 0.001$ level of significance (education, wealth, and state of residence). Information sources did not mediate the relationships between gender, age, or frequency of television at the $\alpha \leq 0.001$ level of significance (Table 34)[4].

Full mediation (defined as statistically significant ($\alpha \leq 0.001$) total and indirect effects combined with a non-significant ($\alpha > 0.001$) direct effect) was present in one multiple mediation model. The relationship between the richest wealth quintile (compared to the poorest) and availability of health services knowledge was fully mediated by the indirect effects of information sources [TE=0.304 ($\alpha \leq 0.001$), IE = .393 ($\alpha \leq 0.001$), DE=-0.089 ($\alpha > 0.001$)]. Mediation was the result of a combination of statistically significant positive individual indirect

[4] As with condom availability and mother to child transmission knowledge, health services availability knowledge was dichotomized for the multiple mediation analysis. Whereas accurate information did not change, somewhat accurate and inaccurate was collapsed into one category considered to reflect inaccurate information.

effects of print (IIE=0.161), teachers (IIE=0.110), television (IIE=0.071), and posters (IIE=0.058) and non-significant indirect effects of cinema (IIE=0.052), health workers (IIE= -0.033), radio (IIE=-0.021), and peers (IIE=0.004).

Partial mediation (defined as statistically significant ($\alpha \leq 0.001$) total, indirect, and direct effects) was present in three multiple mediation models.

When the eight information sources were added to the multiple mediation models, the relationship between having secondary education (compared to no education) and accurate health services knowledge was partially mediated by a significant indirect effect [TE= 0.353 ($\alpha \leq 0.001$), IE = 0.1.216 ($\alpha \leq 0.001$), DE = -0.863 ($\alpha \leq 0.001$)]. Specifically, it was driven by the significant individual indirect effects of print (IIE = 0.449), teachers (IIE = 0.403), posters (IIE = 0.167), cinema (IIE=0.100) and radio (IIE = 0.043) in combination with the non- significant indirect effects from television (IIE=0.025), health workers (IIE=0.036), and peers (IEE=-0.007). The relationship between having higher education (compared to no education) and availability of health services knowledge was also partially mediated by the significant individual indirect effects from print (IIE = 0.568), teachers (IIE = 0.418), posters (IIE = 0.207), cinema (IIE=0.143), and radio (IIE = 0.073) in combination with the non- significant indirect effects from television (IIE = 0.058), health workers (IIE=0.041), and peers (IIE=-0.006) [TE= 0.618 ($\alpha \leq 0.001$), IE = 1.502 ($\alpha \leq 0.001$), DE = -0.884 ($\alpha \leq 0.001$)].

These findings parallel findings uncovered in each of the previous mediation analyses. Once again, sources of information partially mediated, or explained, the positive associations between two upper levels of education (secondary and higher) and health services availability knowledge. In addition to these partial mediation effects, these analyses revealed *negative* direct

associations between secondary education, higher education, and health services availability knowledge (DE = -0.405).

The third case of partial mediation occurred within the model that explored the relationship between state of residence and health services knowledge [TE = 0.409 ($\alpha \leq 0.001$), IE = 0.201 ($\alpha \leq 0.001$), DE = 0.208 ($\alpha \leq 0.001$)]. The positive direct effect of residence in a high prevalence state on health services knowledge was partially mediated by statistically significant individual indirect effects of cinema (IIE=0.143), teachers (IIE=0.108), and radio (IIE=-0.033) and non-significant indirect effects of health workers (IIE=0.004), peers (IIE=0.004), posters (IIE=-0.011), and print (IIE=-0.005). Similar to the findings relating to mother to child transmission knowledge, this result indicates that sources of information partially mediated the existing positive direct relationship between residence in a high prevalence state and health services knowledge.

Suppression (identified by a significant ($\alpha \leq 0.001$) direct effect that is suppressed by a significant ($\alpha \leq 0.001$) indirect effect which results in a non-significant ($\alpha > 0.001$) total effect) was present in two multiple mediation models: having a primary education and being ever married.

After controlling for the significant mediator (the set of sources of information, IE=0.407), the direct effect of having a primary education (compared to no education) had a significant negative association with health services availability knowledge (DE= -0.386). This resulted in a non-significant total effect (TE= -0.21) between having a primary education and health services availability. In this situation, the significant positive indirect effect of

information sources (led, primarily, by the individual indirect effect of print) was suppressing the negative direct effect of primary education on health services availability knowledge.

Last, the relationship between being ever married and health services availability knowledge was again affected by suppression [TE = - 0.036 ($\alpha > 0.001$), IE= -0.245 ($\alpha \leq 0.001$), DE = 0.209 ($\alpha \leq 0.001$)]. Although the total effect (TE = - 0.036) for the relationship was not significant, being ever married had a significant direct effect (DE = 0.209) on health services availability knowledge. However, being married was also associated with a significant negative indirect effect (influenced, mainly, by the negative individual indirect effects of cinema, print, posters, and teachers) (IE= -0.245). Therefore, as in the findings pertaining to both comprehensive and mother to child transmission knowledge, the significant negative indirect effect of information sources is suppressing the positive direct effect of being ever married on health services availability knowledge.

As with the suppression effects observed in the mediation analyses pertaining to comprehensive and mother to child transmission knowledge, I believe that the relatively powerful negative indirect effect was driven by ever married adolescents lack of access to teachers, print, posters, and radio uncovered in Specific Aim Two (see Tables 22-23) as all of these sources were determined to be associated with health services availability when controlling for individual characteristics, including marital status (see Table 29).

Table 34. Summary of the multiple mediation model illustrating the extent to which the set of eight sources of HIV-related information mediated the effects of 10 individual characteristics on accurate health services availability knowledge (N=25,904)

	Total	Indirect	Direct	Radio	TV	Cinema	Print	Posters	HW	Teachers	Peers	*M*
Individual characteristics												
Gender (/male)	0.102**	0.475***	-0.373***	0.047***	0.000	0.097***	0.138***	0.119***	0.052***	0.006	0.015	P**
Age (years)	0.037**	0.028***	0.010	0.007***	0.008***	0.010***	0.012***	0.008***	0.006*	-0.023***	0.001	F**
Education (/none)												
Primary	0.085	0.47***	-0.386***	0.013	0.003	0.045	0.239***	0.046*	0.001	0.127**	-0.003	
Secondary	0.353***	1.216***	-0.863***	0.043***	0.025**	0.010***	0.449***	0.167***	0.036*	0.403***	-0.007	P***
Higher	0.618***	1.502***	-0.884***	0.073***	0.058**	0.143***	0.568***	0.207***	0.041*	0.418***	-0.006	P***
Wealth (/poorest)												
Poorer	0.019	0.04	-0.022	-0.009	0.015	0.006	0.033*	0.003	-0.031*	0.022	0.001	
Middle	0.117	0.121***	-0.004	-0.014	0.032***	0.027	0.069***	0.019	-0.039**	0.028*	0.000	
Richer	0.208**	0.199***	0.008	-0.020**	0.057***	0.019	0.103***	0.026*	-0.032*	0.050***	-0.004	F*
Richest	0.304***	0.393***	-0.089	-0.021*	0.071***	0.052**	0.161***	0.058***	-0.033*	0.110***	-0.004	F***
Rural Residence	0.106**	0.001	0.105*	0.035***	-0.024***	-0.037***	-0.001	-0.017*	0.022**	0.021**	0.001	
High Prev. State	0.409***	0.201***	0.208***	-0.033***	-0.007	0.143***	-0.005	-0.011	0.004	0.108***	0.004	P***
Ever Married	-0.036	-0.245***	0.209***	-0.014*	-0.001	-0.06***	-0.051***	-0.033**	0.034**	-0.124***	0.004	
TV Freq. (/none)												
At least 1/week	0.061	0.16***	-0.100	-0.003	0.12***	0.038***	0.019	0.009	0.008	-0.024**	-0.006	
Almost daily	0.138**	0.192***	-0.054	-0.036***	0.174***	0.045**	0.017*	0.011	0.001	-0.015*	-0.004	F**
Caste (/Scheduled)												
OBC	0.041	0.044	-0.003	0.016**	-0.003	0.018	0.022**	0.001	-0.016*	0.008	-0.001	
Residual General Class	-0.010	0.013	-0.023	0.005	0.005	0.008	0.022**	-0.005	-0.010	-0.013	0.001	
Religion (/Hindu)												
Muslim	-0.105	-0.147***	0.042	0.001	-0.025**	-0.015	-0.032**	-0.031**	-0.017	-0.028**	0.000	
Other	0.005	-0.015	0.020	-0.033***	-0.017*	-0.009	0.021*	-0.010	0.000	0.034***	0.000	

Note: *p≤0.05, ** p≤0.01,*** p≤0.001 M=Mediation P=Partial F=Full

SUMMARY OF MULTIPLE MEDIATION ANALYSES PERTAINING TO SPECIFIC AIM FOUR

Four multiple mediation models were created to determine if the eight sources of HIV-related information mediated the relationship between each individual characteristic and the four types of HIV-related knowledge.

Findings from the multiple mediation models (Tables 31-34) revealed that sources of HIV-related information fully or partially mediated 74% (20/27) of the established relationships between individual characteristics and HIV-related knowledge.

Sources of HIV-related information fully mediated the associations between comprehensive knowledge and gender, age, wealth, exposure to television, and religion. Information sources partially mediated the associations between comprehensive knowledge and education and state of residence. As place of residence or marital status did not have associations with comprehensive knowledge, it was only the relationship between caste and comprehensive knowledge that failed to be mediated by sources of HIV-related information.

The multiple mediation analyses illustrated that HIV-related information sources fully or partially mediated the relationships between five of the six individual characteristics and accurate condom availability knowledge. Sources of HIV-related information partially mediated relationships with gender, age, education, and marital status and fully mediated relationship with exposure to television. It was only the relationship between state of residence and condom knowledge that was not mediated.

Sources of HIV-related information fully mediated five of seven associations between individual characteristics and accurate mother to child transmission knowledge. Relationships with wealth and exposure to television were fully mediated. Information sources partially

mediated the associations with gender, education, and state of residence. The relationships between religion and state of residence with mother to child transmission were not mediated.

Sources of information also mediated half of the established associations between individual characteristics and health services knowledge. Information sources fully mediated the relationship with wealth and partially mediated the relationships with education and state of residence. The associations between accurate health services knowledge and gender, age, and exposure to television were not mediated by sources of HIV-related information.

CHAPTER FIVE: DISCUSSION

This dissertation investigated the role of information sources in the transmission of accurate and comprehensive HIV-related information in Indian adolescents. While there was ample evidence that structural factors such as cultural inhibitions about the discussion of sexuality; low rates of school enrollment coupled with limited sexual education curricula; and inequitable access to media outlets played an important role in the transmission of information about HIV (Char et al, 2011; Sarkar, 2008; Santhya & Jejeebhoy, 2007; USAID, 2003; Jejeebhoy, 1998), much less was known about the transmission of specific types of HIV-related knowledge via information sources that Indian adolescents had at their disposal. Since accurate and comprehensive information about HIV is fundamental to behavior change and service utilization (UNICEF, 2011), understanding more about how accurate and inaccurate information is transmitted to adolescent populations can assist HIV prevention programs in becoming more effective in disseminating important information.

This discussion section provides an overview of the analytical finding combined with interpretations and policy implications of the results.

SUMMARY OF MAJOR FINDINGS

Specific Aim One: To describe the individual characteristics of adolescents who are aware of HIV.

Specific Aim One had one research question: which individual characteristics are associated with being aware of HIV?

Eleven individual characteristics were under investigation in this study (gender, age, education, wealth, caste, religion, place of residence, state of residence, marital status, literacy status, and exposure to television). Multivariate logistic regression exploring the predictive power of individual characteristics on HIV awareness found that nine of the 11 individual

characteristics were predictive of awareness in the general population of Indian adolescents (Note: all statistical significance in this discussion is reported at the $\alpha \leq 0.001$ level). All individual characteristics except for caste and religion were predictive of being aware of the disease. Specifically, being male, being older, having at least a primary education, being part of the top three wealth quintiles, living in a high prevalence state, literacy, and exposure to television were positively correlated with being aware of HIV. Living in rural area and being ever married had a negative correlation with HIV awareness in the Indian adolescent population.

These findings were not surprising. They provide support to Yadev et al's (2001) claim that literacy is a significant predictor of HIV awareness in Indian adolescents. They also provide support to the documented evidence that mass media campaigns are an effective way to increase HIV awareness in this population (Ackerson, et al., 2012; NACO, 2011; Yadav, et al., 2011). Adolescents who watched television on a daily basis had a 196% increased odds of being aware of HIV compared to those who never watched television (OR 2.96, 95% CI 2.64-3.31).

Of notable concern was the lack of awareness in the one sub-population the most likely to engage in unprotected sex (the major route of HIV transmission in India): ever married adolescents. For ever married adolescents (93% of which are female), the odds of being aware of HIV were 24% lower than their unmarried counterparts (OR 0.76, 95% CI 0.67-0.86). This could be, in part, due to the lack of television availability for these already marginalized youth. In the general population of adolescents, 60% of ever married adolescents reported never watching television compared to 31% of their never married counterparts.

Specific Aim Two: To describe where HIV-aware adolescents obtain their HIV-related information.

The analysis for Specific Aim Two was structured around three research questions: 1) From which reciprocal and non-reciprocal sources do adolescents obtain their HIV-related information?; 2) Do individual characteristics explain where adolescents obtain their HIV-related information?; and 3) Do individual characteristics explain whether adolescents obtain all of their HIV-related information from reciprocal as compared to non-reciprocal sources?

The eight sources of HIV-related information explored in this research were grouped, on an *apriori* basis, on their potential for reciprocity (Berkman et al., 2000). Five non-reciprocal sources (television, radio, cinema, print, and posters) and three reciprocal sources (peers/relatives, teachers, and health workers) were investigated.

Bivariate analysis examined the distribution of reciprocal and non-reciprocal sources from which adolescents obtained their HIV-related information disaggregated by gender. Television was the most common source of HIV-related information and utilized by just over 80% of HIV-aware adolescents. This was followed by radio (45.7%), print (37.9%), peers (34.2%), and teachers (25.8%). Health workers were the least relied upon source of HIV-related information and used by only 5.5% of adolescents, 4.3% of girls, and 7.4% of boys. HIV-aware adolescents were disproportionality reliant on non-reciprocal sources of information: just over half of girls and 40% of boys did not obtain information from any of the three reciprocal sources of information under investigation in this study.

The relationships between individual characteristics and sources of HIV-related information were explored with logistic regression models. All 11 characteristics were predictive of at least one source of HIV-related information.

The use of television, the most commonly cited source of HIV-related information, had positive association with age, wealth and frequency of television watching. With an odds ratio of 8.98, it could be assumed that adolescents who watched television on a daily basis were using it as source of HIV-related information. Yet, holding all else constant (including frequency of television watching), obtaining HIV-related information from television had a negative relationship with rural residence (OR 0.71) and being Muslim (OR 0.72).

Conversely, residence in rural areas had positive correlation with obtaining information from the second most popular information source - the radio (OR 1.48). Boys, older adolescents, and members of the Other Backwards Class also had positive associations with radio use (OR 1.71, 1.08, and 1.20, respectively) while adolescents who watched television (OR 0.67) on an almost daily basis and those living in one of the six states with high HIV-prevalence (OR 0.68) were significantly less likely to obtain their HIV-related information from the radio. The third most population information source – print – was more likely to be cited by boys, older, educated, wealthier, and literate adolescents. Being ever married and being Muslim displayed negative associations with using print as a source.

Obtaining information exclusively from non-reciprocal or reciprocal sources was predicted by five individual characteristics. Boys were more likely to get their information from a mix of non-reciprocal and reciprocal sources. Older adolescents and those who watched television at least once a week were more likely to rely solely on non-reciprocal sources while those in high prevalence states were more likely to rely solely on reciprocal sources.

Among the three reciprocal source of information, peers/relatives were cited by the largest percentage of HIV-aware adolescents. In accordance with trends evident in the bivariate

analysis, gender played an important role in the utilization of peers with boys being more likely to get information from their peers as compared to girls. Holding all else constant (including gender), adolescents in high prevalence states and those who were ever married were also more likely obtain their information from peers. Those who watched television on a daily basis were the least likely to talk to their peers/relatives about the disease.

Not surprisingly, education had the largest positive association with obtaining information from teachers. Rural residence as well as residence in a high prevalence state was associated with a greater likelihood of obtaining information from teachers. Older, Muslim, and ever married adolescents were less likely to obtain information from teachers as compared to their younger, non-Muslin, and never marred counterparts.

Although health workers were the least relied upon source for this population, it is important to highlight that boys and ever married adolescents were significantly more likely to utilize this source as compared to girls and never married adolescents.

In combination, these findings lend support to the evidence that mass media and peers are the most relied upon sources of information about sexual and reproductive health in Indian adolescents (Guilamo-Ramos, et al., 2012, Char et al., 2011; Nair et al., 2011; NFHS-3, 2007; ICRW, 2006; Goyal & Khanna, 2005; Jejeebhoy, 1998). They also lend support to the comparatively limited evidence that teachers are an important reference group for this population, especially for those residing in rural areas and states with high prevalence (Guilamo-Ramos, et al., 2012). These findings refute the assertion that adolescents rely on health workers for the majority of their HIV-related communications (Guilamo-Ramos, et al., 2012).

These findings also support the concept that there are important gender-based differentials in social network properties between boys and girls (ICRW, 2006; Sivaram et al, 2005). While there was no gender-based differential between boys and girls in television or teacher utilization, there were gender-based differential evident in all other sources of information in addition to the exclusive sourcing of information. Boys relied on a greater number of absolute sources as well as a wider variety of both non-reciprocal and reciprocal sources.

Specific Aim Three: To describe what types of accurate and inaccurate HIV-related knowledge HIV-aware adolescents possess.

Four research questions were created to address Specific Aim Three: 1) What types of accurate HIV-related knowledge do adolescents possess?; 2) What types of inaccurate HIV-related knowledge do adolescents possess?; 3) Do individual characteristics explain whether adolescents possess accurate as compared to inaccurate types of HIV-related knowledge?, and 4) Do the individual characteristics that are associated with being unaware of HIV differ from the individual characteristics that are associated with inaccurate HIV-related knowledge?

This study investigated four types of HIV-related knowledge: comprehensive, condom availability, mother to child transmission, and health services availability.

Defined by the United Nations and reinforced by India's Ministry of Health and Family Welfare, comprehensive knowledge of HIV was defined as the ability to correctly identify the two major ways of preventing the sexual transmission of the disease (using condoms and limiting sex to one faithful, uninfected partner); reject the two most common local misconceptions about transmission (knowledge that HIV cannot be transmitted via mosquito bites or the sharing of food); and know that a healthy-looking person can be HIV-infected (UNICEF, 2011; NACO,

2011). This indicator is used to measure progress towards the Millennium Development Goals and well integrated into the national (and international) dialogue on HIV prevention.

While just one third of HIV-aware adolescents had comprehensive knowledge of the disease, a breakdown of the indicator by its five components revealed that the situation was not as dire as the cumulative measure indicated, especially for boys. While only 41% of boys had comprehensive knowledge of HIV, more than 80% of boys correctly identified the two major ways of preventing the sexual transmission of the disease, nearly 70% rejected the two most common local misconceptions about transmission, and 70% knew that a healthy-looking person could be HIV-infected. Girls fared nearly as well when it came to local misconceptions and knowledge that a healthy-looking person could be infected but lagged behind in the questions pertaining to correct identification of the two major ways of preventing the sexual transmission of the disease. Thirty percent of girls had comprehensive knowledge, 57% knew that the use of condoms prevent sexual transmission and 72% knew that limiting sex to one faithful, uninfected partner prevents sexual transmission.

Eight of 11 individual characteristics were associated with comprehensive knowledge. Higher education and the richest wealth quintile had the highest positive correlations with comprehensive knowledge (OR 3.05 and 2.13, respectively) followed by being male (OR 1.71), almost daily television watching (OR 1.44), being a member of the General Residual Class (OR 1.24), and increased age (OR 1.07). Adolescents in high prevalence states had a 19% decreased odds of comprehensive knowledge compared to those in low prevalence states while Muslims had a 25% decreased odds of having comprehensive knowledge of the disease compared to their Hindu counterparts.

Condom availability knowledge was a knowledge type created specifically for this dissertation. As sexual transmission is responsible for nearly 90% of incident HIV infection in India (NACO, 2011) and outside the bounds of a monogamous relationship with an uninfected partner, the use of condoms is the only viable behavior that can reduce risk of infection and contribute to a disease-free health outcome (WHO, 2006), it is critical for adolescents to know not only that condoms can be used to prevent transmission, but where to get them and have the ability to do so.

More HIV-aware adolescents had accurate condom availability knowledge as compared to the other three types under investigation in this study. Condom availability knowledge also had the largest gender-based differential. Thirty-five percent of adolescents, 12.5% of girls and 68.1% of boys knew where to get condoms and had the ability to do so. It is interesting to note that nearly half of girls knew where to obtain condoms but more than a third did not have the ability to obtain them. More than 85% of boys knew where to obtain them while less than 20% did not have the ability to obtain them.

This gender-based differential was exasperated when employing a crosstab analysis to look at the percentages of adolescents with accurate condom availability knowledge by the percentages of adolescents who were aware that the use of condoms was one way to prevent the transmission of HIV. While 74% of boys who knew that the use of condoms could prevent the sexual transmission of HIV had accurate condom availability knowledge, only 17% of girls who knew that the use of condoms could prevent the sexual transmission of HIV knew where to obtain them and had the ability to do so.

Six of the 11 individual characteristics were associated with condom availability knowledge. Gender was the strongest predictor of condom knowledge with boys having a 12 times increased odds of being higher on the condom knowledge scale as compared to girls. As with comprehensive knowledge, higher education (OR 3.00), almost daily television (OR 1.31) watching, and increased age (OR 1.20) were important predictors of accurate knowledge while residence in a high prevalence state (OR 0.44) had a negative association with accurate knowledge. This was the only knowledge type where marital status was predictive of an outcome and ever married adolescents were more informed and enabled as compared to their never married counterparts (OR 1.63).

Mother to child transmission was the second knowledge type created specifically for this dissertation. As the transmission of HIV from mother to child accounts for the second largest source of incident HIV infection in India (NACO, 2011), 80% of HIV infected women are in monogamous marital relationships (NACO, 2011; Perkins et al., 2009), and marriage normally commences during or just after adolescence, knowledge about the ability for the virus to be transmitted from a mother to her child and the availability of medication to prevention mother-to-child transmission are important components of HIV-related knowledge in this population.

Less than one-third of adolescents had accurate mother to child transmission knowledge and it was the only knowledge type in which the gender-based differential favored girls. Thirty two percent of girls and 23% of boys had accurate mother to child transmission knowledge. Approximately three quarters of HIV-aware girls and boys knew that the virus could be transmitted from a mother to her baby (and, indeed, this was the question that the largest percentage of girls answered correctly) but there was a lack of awareness about drugs to prevent mother to child transmission in both genders. Forty-four percent of girls and forty-nine percent

of boys were aware of mother to child transmission but unaware of drug therapy to prevent said transmission.

Seven of the individual characteristics were predictive of mother to child transmission knowledge. Higher education (OR 2.36), belonging to the richest wealth quintile (OR 1.54), and daily television frequency (OR 1.32) had strong associations with accurate knowledge. This was the only type of knowledge in which place of residence had predictive power and rural adolescents had a 15% increased odds of accurate knowledge compared to urban adolescents.

As with comprehensive and condom availability knowledge, state of residence also had predictive power but the association was reversed: residence in a high prevalence state had a positive association with mother to child transmission knowledge (OR 1.39). Surprisingly, marital status was not predictive of this type of knowledge.

Health services availability was the fourth, and final, type of knowledge under investigation in this dissertation. In India, only three percent of women and four percent of men have ever been tested for HIV and an estimated 80-90% of HIV-infected individuals in India are unaware of their status (NFHS-3, 2007; Steinbrook, 2007). Advances in antiretroviral therapies (ART) have effectively rendered HIV infection a chronic and manageable disease for those who are diagnosed early, have consistent access to ART, and able to maintain a strict drug regimen (Cohen, et al, 2011; Das et al., 2010). Therefore, knowledge about where to obtain an HIV test and the availability of ART have become an essential aspect of HIV-related knowledge. This measure was abstracted from the work of Yadev et al (2011).

Knowledge about the availability of testing and treatment services was alarmingly low among HIV-aware adolescents. Only 9.7% of boys and 8.3% of girls had accurate availability of

health services knowledge. While more than half (52.2%) of boys knew of a location to get tested for the disease, only 13.3% were aware of ART. Only 42.7% of girls knew of a testing location and a similarly small percentage (13.0%) were aware of ART. The question pertaining to the availability of ART was the question with the largest percentage of incorrect answers for either gender: 87% of adolescents were unaware of the availability of ART.

Six of the individual characteristics were predictive of health services availability knowledge. As with all other types of knowledge, higher education and almost daily television frequency were predictive of knowledge accuracy (OR 2.73 and 1.21, respectively). Being male (OR 1.47), belonging to the highest wealth quintile (OR 1.77), and being older (OR 1.07), were also predictive of accuracy. As with mother to child transmission knowledge, residence in a high prevalence state had a positive association with health services availability knowledge with adolescents in a high prevalence state having a 54% increased odds of information accuracy as compared to those in a low prevalence state.

Finally a comparison across multivariate logistic regression models indicate the presence of subtle, but important, differences in the individual characteristics that were associated with unawareness and information inaccuracy. Six characteristics had associations with both unawareness and inaccuracy. Males had increased odds of being aware of HIV and decreased odds of have inaccurate information. This same pattern was true for older adolescents, higher education, membership in the top two wealth quintiles, and those who watched television on a daily basis. State of residence was associated with increased odds of being aware and increased odds of information inaccuracy. Specifically, adolescents in high prevalence states were more likely to be aware of the disease but also more likely to have inaccurate information about comprehensive knowledge and condom availability knowledge.

Taken together, the findings in Specific Aim Three supported the notion that Indian adolescents are particularly vulnerable to HIV in large part due to their well-documented lack of accurate and comprehensive information about the disease (Char et al., 2011, 2009; Jejeebhoy, 1998). They also lend support to the limited literature that takes a more nuanced look at the types of HIV-related information that Indian adolescents possess. While HIV-aware adolescents certainly have a lack of accurate information in the aggregate, these findings support assertions that knowledge about modes of transmission were relatively high and that knowledge about the availability of health services was very low (Yadev, 2011). They also illustrate the gender-based inequities in access to information and control in decision making that are central tenet to the Theory of Gender and Power (Connell, 1987).

Specific Aim Four: To determine whether there is an association between the sources of HIV-related information and HIV-related knowledge among HIV-aware adolescents.

A combination of multivariate logistic regression models and multiple mediation models were employed to answer the three research questions that guided Specific Aim Four: 1) Do associations between sources of HIV-related information and HIV-related knowledge exist among adolescents?; 2) Do individual characteristics serve as rival independent variables and have associations with both sources of HIV-related information and HIV-related knowledge?; and 3) Do sources of HIV-related information mediate the relationship between individual characteristics and HIV-related knowledge?

In support of the network perspective that individuals are imbedded in social networks that both constrain and promote HIV prevention messaging (Valente, 2010; Kohler et al, 2007),

sources of HIV-related information were determined to have statistical associations with HIV-related knowledge in HIV-aware adolescents.

Multivariate logistic regression models demonstrated that holding individual characteristics constant, all eight sources of HIV-related information (television, radio, cinema, print, posters, peers/relatives, teachers, and health workers) were associated with at least two types of HIV-related knowledge (comprehensive, condom availability, mother to child transmission, and health services availability).

Television, print, and teachers had the largest associations with accurate comprehensive knowledge (OR 1.81, 1.60, 1.52, respectively). Health workers, television, and peers/relatives had the largest associations with accurate condom knowledge (OR 1.60, 1.58, 1.54, respectively). Health workers, teachers, and television had the largest associations with accurate mother to child transmission knowledge (OR 1.52, 1.51, 1.44, respectively). Health workers, teachers, and print had the largest associations with accurate health services knowledge (OR 1.73,1.59, 1.54, respectively).

These findings build on the limited literature that explored the influence of information sources on HIV-knowledge in the Indian adolescent context. Television had been determined to be the most effective source of information in terms of increasing comprehensive HIV knowledge in the general population (Ackerson et al., 2012). This dissertation supports that claim and asserts that television is the most effective source of information in term of increasing comprehensive knowledge in HIV-aware adolescents.

This dissertation also provides important evidence that this claim does not hold true for other types of HIV-related information that are imperative for effective prevention interventions.

Television was not associated with increasing accurate health services availability knowledge in this population nor was it the most efficacious source of information for the promotion of information about condom availability or mother to child transmission. Health workers were determined to be the most effective source of information in terms of increasing condom availability, mother to child transmission, and health services availability knowledge in HIV-aware adolescents. Alarmingly, only 4% of girls and 7% of boys report health workers as a source of HIV-related information. HIV prevention efforts that seek to increase knowledge in adolescents could be strengthened by expanding the availability of, and accessibility to, health workers equipped with the proper information and the ability to reach this vulnerable population.

In support of the Social Integration Framework (Berkman et al, 2000) that guided this analysis, two important findings were uncovered.

First, this dissertation investigated the role of the 11 individual characteristics that were previously determined to be associated with HIV-related knowledge in the Indian context. Based on the Social Integration Framework, which posits that social networks are conditioned by social-structural conditions of culture, socioeconomics, politics, and social change, it was hypothesized that rather than affecting HIV-related knowledge directly, these individual characteristics could be classified as rival independent variables that also served as determinants of the sources of HIV-related information which, in turn, affected HIV-related knowledge. All but one of the individual characteristics – literacy - had associations with both sources of HIV-related information and types of HIV-related knowledge and were classified as rival independent variables.

Second, this research investigated the role of sources of HIV-related information as mediators of the established relationships between individual characteristics and HIV-related knowledge. A set of four multiple mediation models determined that sources of HIV-related information fully or partially mediated nearly three-quarters (20/27) of the established relationships between individual characteristics and HIV-related knowledge in HIV-aware Indian adolescents.

Eight individual characteristics were associated with comprehensive knowledge of HIV (gender, age, education, wealth, state of residence, frequency of television, caste and religion). As a group, sources of HIV-related information fully or partially mediated all of those relationships except for the relationship between caste and comprehensive knowledge.

Six individual characteristics were predictive of condom availability knowledge (gender, age, education, state of residence, marital status, and frequency of television). Only one of these six statistical associations with condom availability knowledge - state of residence - was not mediated fully, or in part, by sources of information.

Five of seven associations between individual characteristics and mother to child transmission knowledge (gender, education, wealth, state of residence, and frequency of television) were mediated by source of HIV-related information. The associations between mother to child transmission knowledge and place of residence and religion were not.

Finally, sources of HIV-related information fully or partially mediated the relationships between three individual characteristics (education, wealth, and state of residence) and health services availability knowledge. Information sources did not mediate the established

relationships between health services availability knowledge and gender, age, or frequency of television.

Taken together, these findings indicate that sources of information are critical pathways that help to explain the established linkages between social inequalities and poor health outcomes. This has important implications for HIV prevention efforts that work to overcome inequities imposed by social structural conditions. It is much easier to actualize change among sources of information as compared to immutable individual characteristics. Therefore, programs and strategies that acknowledge and understand the roles of demographics in HIV prevention can be strengthened by influencing and leveraging the social networks that contribute to their effects.

STRENGTHS AND LIMITATIONS

There are four limitations to this study. First, the NFHS-3 is a cross-sectional survey that, in some sections, relies on self-reported data. Cross-sectional studies do not provide a basis for establishing causality. Further, the variables are measured at the same point in time, the ability to determine temporal sequence is restricted. By nature of their design, cross-sectional studies are also prone to selection bias. Self-reported data requires recall of events or experiences that took place in the past. Recall bias can affect the accuracy and completeness of information provided by respondents (Bradburn, et al., 1987).

Second, the focal independent variable under investigation – sources of HIV-related information – is abstracted from an open-ended question. While there are advantages and disadvantages to both closed and open ended questions, open-ended questions are subject to particular concerns that pertain to both the respondent and the analysis. Political scientists Lodge, McGraw, and Stroh (1989) argue that respondents are unlikely to probe their memories in

enough detail to provide accurate responses to open-ended questions while Sociologist Howard Schuman (1966) warns about challenges associated with garnering sufficiently rich responses from respondents who are uneducated and unaccustomed to expressing opinions. Responses to open ended questions are often considered more difficult to analyze as compared to close-ended questions (Schuman and Presser, 1996). Coding decisions imposed by researchers can pose threats to validity and reliability of results (Krippendorff, 1980) and categorization of responses at a sub-standard level of inter-rater agreement can inhibit proper analysis (Sheatsley, 1983). As the NFHS-3 was conducted under the auspice of the Government of India's Ministry of Health and Family Welfare and the United States Agency for International Development, I contend that these concerns have been mitigated to the best extent possible.

Third, the null hypotheses that HIV-aware adolescents included in the sample do not differ from HIV-aware adolescents excluded from the sample could not be rejected. This means that final results of this study were slightly biased (included respondents are slightly younger, urban, from high prevalence states, literate, and have daily television frequency, be part of the residual general class, or be Hindu than excluded respondents).

Last, there was very limited information about the types of HIV-prevention messaging that was directed to Indian adolescents before or during the time period this data was collected. The literature review uncovered only one article that discussed a one year mass media campaign on HIV knowledge and behavior addressed to 15-60 year old men and women in five low prevalence states in Northern India in 2002 (Sood, et al., 2007). A broader understanding of the available messaging would have potentially allowed for a more contextualized and robust analysis of the findings.

The strengths and implications of this proposed study are four-fold. First, it is a new use of a nationally representative sample of Indian adolescents to better understand how HIV-prevention messaging is disseminated throughout a sub-population. While research shows that structural factors affect the transmission of HIV-related information, much less is known about the associations between the information sources that adolescents have at their disposal and the transmission of accurate – and inaccurate – information.

Second, it has important implications for existing HIV prevention programs that target adolescents. As the dissemination of accurate and comprehensive information is central to all HIV prevention efforts, understanding more about the mechanisms that influence the transmission of both accurate and inaccurate information in the adolescent population can assist prevention programs in becoming more efficacious.

Third, it is a novel application of the Social Integration Framework to better understand the relationship between social-structural conditions and psychosocial mechanisms in this population. Globally, social networks are rapidly increasing in size, composition, and speed. I contend that the most efficacious HIV prevention programs will understand, embrace, and exploit the social network properties that surround adolescents in an increasingly interconnected world.

Last, in recognition of the increasing interconnectivity, I intend for this research to contribute to the ongoing dialogue surrounding the conclusion of the Millennium Development Goals and the creation of appropriate indicators for the ambitious Post-2015 Development Agenda.

This dissertation concludes with a set of four public health policy recommendations: two of which are India specific and two that pertain to global adolescent HIV prevention efforts.

Policy recommendations for India-specific HIV prevention efforts

The results of this dissertation indicate that sources of information play a critical role in the transmission of accurate and inaccurate HIV-related information in HIV-aware Indian adolescents. Furthermore, different types of sources are important conduits for different types of information. These sources can – and should – be leveraged accordingly to best reach this vulnerable population. Non-reciprocal (mass media) sources are important and cost effective tools for disseminating general HIV-related information to adolescents, however reciprocal sources − health workers, teachers, and peers − are needed to effectively disseminate information that allows for knowledge actualization (specifically where to get condoms and get tested for HIV).

Recommendation one: Expand federal funding for HIV-prevention initiatives that center on utilization of community health workers for information dissemination and increase the capacity of community health workers to effectively disseminate HIV-related information among adolescent populations.

Results from this dissertation determined that adolescents who obtained information from health workers had the largest associations with accurate condom knowledge, mother to child transmission knowledge, and health services knowledge. Specifically, adolescents who reported health workers as a source of HIV-related information had a 60% increased odds of accurate condom knowledge, a 52% increased odds of accurate mother to child transmission knowledge,

and a 73% increased odds of accurate health services knowledge compared to those who did not obtain information from health workers.

In 2007, the National AIDS Control Organization (NACO) launched a nation-wide outreach program entitled the Link Worker Scheme (LWS) in recognition of the increasing prevalence of HIV in rural communities. Employing a cadre of specially trained and locally based adult community health workers, the LWS aims to capacitate rural populations by reducing stigma and increasing comprehensive knowledge and service utilization in high risk groups (female sex workers, men who have sex with men, and injection drug users) and vulnerable sub-populations (women and adolescents) (NACO, 2011).

The latest iteration of the national Link Worker Facilitation Skills Handbook (NACO, 2010) focuses on the principles and facilitation of adult learning only. Based on the importance of health workers in disseminating accurate HIV prevention messaging to adolescents, it is recommended that the next iteration of the Link Worker Facilitation Skills Handbook be expanded to include the principles and facilitation of adolescent learning. It is also recommended that expansion of the LWS to include adolescent (as opposed to adult only) community health workers be explored.

Recommendation two: Mandate HIV prevention messaging in primary and secondary schools and increase capacity of teachers to effectively disseminate HIV-related information among adolescent populations.

Results from this dissertation illustrated that teachers are an important source of HIV-related information for HIV-aware adolescents (especially for those residing in rural areas and states with high prevalence). Nationwide, adolescents who reported teachers as a source of HIV-

related information had a 52% increased odds of comprehensive knowledge, a 51% increased odds of accurate mother to child transmission knowledge, and a 59% increased odds of accurate health services knowledge compared to those who did not obtain information from teachers.

Currently, there is no national mandate that state-run schools need to include information on sexual health or HIV. While a National Framework and State Action Plans for Adolescent HIV Education was introduced in 2005, it is only information on family planning that must be covered in primary and secondary schools and even this curriculum has been criticized for providing minimal information and using terminology unfamiliar to adolescents (Nair et al, 2011; Santhya & Jejeebhoy, 2007). Further, research indicates that teachers are often unable and unwilling to discuss issues pertaining to sexuality (including HIV) (Nair et al, 2011; Goyal & Khanna, 2005; USAID, 2003).

Based on the importance of teachers as a source of accurate HIV-related information for adolescents, and, to a lesser degree discrepancies in teacher utilization by place and state of residence, it is recommended that the National Framework and State Action Plans for Adolescent HIV Education be mandated in all state-run primary and secondary schools. It is also recommended that the Framework be expanded to integrate a training component that provides teachers with their own baseline understanding of content, familiarity with local resources, and an increased level of comfort with transmission of information.

Policy recommendations for global HIV prevention efforts in adolescent populations

While this research was limited to the dissemination of HIV-related information in HIV-aware Indian adolescents, I believe that there are important implications that can – and should – be applied to generalized and global HIV prevention strategies in adolescent populations.

Recommendation three: Re-conceptualize *and leverage* the role of social networks in interventions meant to increase baseline HIV-related knowledge of adolescents.

This dissertation revealed that sources of HIV-related information fully or partially mediated nearly three-quarters of the established relationships between individual characteristics and HIV-related knowledge in HIV-aware Indian adolescents.

A 2012 synthesis of global adolescent health indicators revealed that comprehensive and correct knowledge of HIV is alarmingly low, even in areas with endemic HIV epidemics. Worldwide, only 31% of adolescent boys and 28% of adolescent girls have comprehensive and correct knowledge of HIV (Patton, et al., 2012). As social networks have been documented to both constrain and spread sexual health related knowledge and behaviors in a multitude of settings across the globe (Smith and Christakis, 2008; Montgomery and Casterline 1993, Rosero-Bixby and Casterline 1994, Entwisle et al 1996, Valente et al, 1997, Rindfuss et al 2004), it is recommended that future HIV prevention efforts aimed at adolescents give more consideration to leveraging the social networks in which people reside - especially in areas where knowledge remains low despite decades of prevention efforts.

Recommendation four: As part of the Post-2015 Development Agenda, re-define two specific aspects of the construct of 'Comprehensive Knowledge of HIV': the individual components and the method of calculation.

This research was premised on the assertion that the official definition of Comprehensive Knowledge does not contain adequate information to make adolescents less vulnerable to HIV infection. It is recommended that a new definition of comprehensive knowledge of the disease

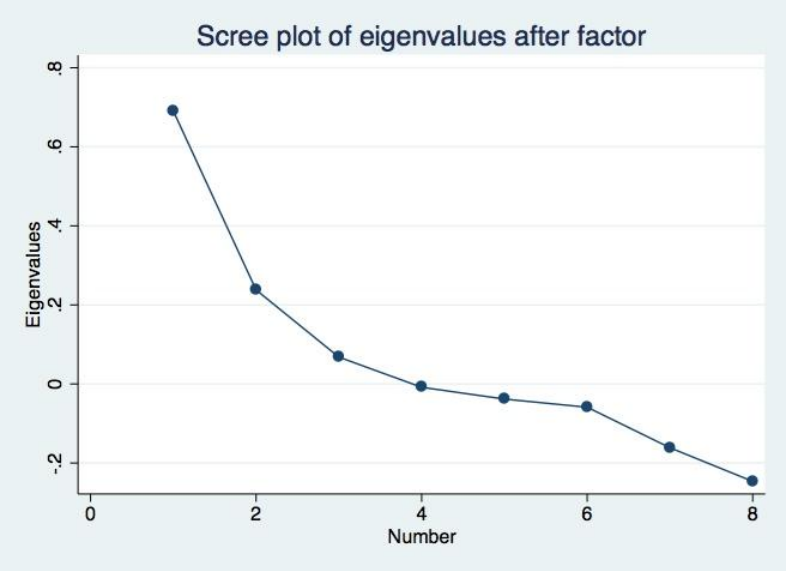
be expanded to include components pertaining to condom acquisition, mother to child transmission, and the availability of health services.

This recommendation comes with a caveat that pertains to condom acquisition. Although it is imperative for adolescents to know where to obtain condoms and have the ability to do so, the insertion of such a component introduces a normative aspect that may hinder widespread adoption in school settings. Any efforts to expand the official definition of comprehensive knowledge to include normative aspects must be coupled with incentives for mandatory insertion into national HIV prevention curriculums.

Finally, it is recommended that the means of calculation for Comprehensive Knowledge be reassessed. This dissertation revealed that in the Indian context, only one-third of HIV-aware adolescents had comprehensive knowledge of the disease yet adolescents were faring relatively well on the five individual components - more than two-thirds of adolescents had accurate knowledge about each individual component. By making the measure a function of getting all five questions correct we not only make the situation appear to be more dire than it actually is, we lose the ability to understand progress being made with regards to particular components, learn from those successes, and readjust intervention strategies accordingly.

APPENDIX

A1. Scree plot for exploratory factor analysis of eight sources of HIV-information (unweighted n=28,801)



A2. Multiple mediation of the effect of Gender on HIV-related Knowledge through eight HIV-related information sources (N=25,904)

	Point estimate	SE	Z
Comprehensive ++***			
Total effects	0.324***	0.026	12.267
Indirect effects	0.372***	0.028	13.120
Direct effects	-0.048	0.036	-1.341
Radio	0.049***	0.006	8.119
TV	0.000	0.007	0.068
Cinema	0.058***	0.011	5.307
Print	0.136***	0.010	13.261
Posters	0.098***	0.011	8.622
Health Workers	0.025***	0.008	3.348
Teachers	0.005	0.004	1.123
Peers	-0.003	0.007	-0.423
Condom Availability +***			
Total effects	1.730***	0.033	52.975
Indirect effects	0.408***	0.029	14.117
Direct effects	1.322***	0.043	31.022
Radio	0.062	0.007	8.573
Television	-0.001	0.004	-0.175
Cinema	0.037***	0.011	3.457
Print	0.116***	0.011	10.572
Posters	0.093***	0.013	7.370
Health workers	0.043***	0.009	4.677
Teachers	0.001	0.001	0.984
Peers	0.057***	0.008	6.829
Mother to Child Transmission +***			
Total effects	-0.254***	0.028	-9.015
Indirect effects	0.285***	0.027	10.722
Direct effects	-0.539***	0.037	-14.467
Radio	0.043***	0.006	7.217
Television	-0.001	0.004	-0.130
Cinema	0.040***	0.010	3.836
Print	0.092***	0.010	9.209
Posters	0.068***	0.011	5.996
Health workers	0.042***	0.009	4.664
Teachers	0.003	0.004	0.872
Peers	-0.003	0.007	-0.401
Health Services Availability+**			
Total effects	0.102**	0.036	2.844
Indirect effects	0.475***	0.036	13.125
Direct effects	-0.373***	0.048	-7.690
Radio	0.047	0.007	6.405
Television	0.000	0.004	0.091
Cinema	0.097***	0.015	6.271
Print	0.138***	0.013	10.339
Posters	0.119***	0.015	8.034
Health workers	0.052***	0.011	4.641
Teachers	0.006	0.005	1.158
Peers	0.015	0.009	1.610

Note: *p≤0.05, ** p≤0.01,*** p≤0.001 | ++ Full Mediation , +Partial Mediation

A2. Multiple mediation of the effect of Age on HIV-related Knowledge through eight HIV-related information sources (N=25,904)

	Point estimate	SE	Z
Comprehensive ++***			
Total effects	0.039***	0.009	4.512
Indirect effects	0.028***	0.006	4.789
Direct effects	0.011	0.009	1.211
Radio	0.007***	0.001	5.113
Television	0.012***	0.003	4.753
Cinema	0.006***	0.002	3.437
Print	0.012***	0.002	5.454
Posters	0.007***	0.002	4.014
Health workers	0.003*	0.001	2.051
Teachers	-0.018***	0.002	-7.926
Peers	0.000	0.000	-0.419
Condom Availability+***			
Total effects	0.121***	0.010	12.387
Indirect effects	0.038***	0.006	6.920
Direct effects	0.082***	0.011	7.753
Radio	0.009***	0.002	5.042
Television	0.007***	0.002	3.737
Cinema	0.004**	0.001	2.674
Print	0.010***	0.002	5.304
Posters	0.006***	0.002	3.747
Health workers	0.005*	0.002	2.239
Teachers	-0.006*	0.002	-2.387
Peers	0.004***	0.001	3.333
Mother to Child Transmission +*			
Total effects	0.020*	0.009	2.215
Indirect effects	0.019***	0.005	3.759
Direct effects	0.001	0.010	0.099
Radio	0.006***	0.001	4.855
Television	0.007***	0.002	3.994
Cinema	0.004**	0.002	2.862
Print	0.008***	0.002	5.068
Posters	0.005***	0.001	3.578
Health workers	0.005*	0.002	2.283
Teachers	-0.016***	0.002	-7.128
Peers	0.000	0.000	-0.396
Health Services Availability +**			
Total effects	0.037**	0.012	3.106
Indirect effects	0.028***	0.007	3.892
Direct effects	0.010	0.013	0.709
Radio	0.007***	0.001	4.645
Television	0.008***	0.002	3.745
Cinema	0.010***	0.003	3.636
Print	0.012***	0.002	5.209
Posters	0.008***	0.002	3.874
Health workers	0.006*	0.002	2.287
Teachers	-0.023***	0.003	-7.685
Peers	0.001	0.001	1.501

Note: *p≤0.05, ** p≤0.01,*** p≤0.001 | ++ Full Mediation , +Partial Mediation

A2. Multiple mediation of the effect of Primary Education on HIV-related Knowledge through eight HIV-related information sources (N=25,904)

	Point estimate	SE	Z
Comprehensive			
Total effects	-0.021	0.076	-0.278
Indirect effects	0.425***	0.059	7.242
Direct effects	-0.446***	0.093	-4.787
Radio	0.014	0.010	1.351
Television	0.005	0.015	0.352
Cinema	0.028	0.017	1.608
Print	0.238***	0.037	6.422
Posters	0.037*	0.018	2.061
Health workers	0.001	0.009	0.089
Teachers	0.102**	0.033	3.059
Peers	0.000	0.001	0.402
Condom Availability			
Total effects	0.105	0.075	1.395
Indirect effects	0.293***	0.047	6.175
Direct effects	-0.188	0.085	-2.217
Radio	0.016	0.013	1.238
Television	0.002	0.008	0.278
Cinema	0.018	0.012	1.477
Print	0.196***	0.032	6.025
Posters	0.036*	0.017	2.123
Health workers	0.002	0.015	0.104
Teachers	0.033*	0.017	1.966
Peers	-0.009	0.007	-1.242
Mother to Child Transmission +**			
Total effects	0.185**	0.073	2.522
Indirect effects	0.306***	0.048	6.374
Direct effects	-0.121	0.085	-1.431
Radio	0.011	0.009	1.218
Television	0.002	0.009	0.252
Cinema	0.019	0.013	1.531
Print	0.157***	0.028	5.597
Posters	0.026*	0.012	2.075
Health workers	0.002	0.014	0.124
Teachers	0.089**	0.029	3.048
Peers	0.000	0.001	0.386
Health Services Availability			
Total effects	0.085	0.116	0.734
Indirect effects	0.470***	0.070	6.768
Direct effects	-0.386**	0.133	-2.894
Radio	0.013	0.010	1.336
Television	0.003	0.009	0.317
Cinema	0.045	0.028	1.586
Print	0.239***	0.039	6.084
Posters	0.046*	0.022	2.077
Health workers	0.001	0.018	0.042
Teachers	0.127**	0.041	3.092
Peers	-0.003	0.002	-1.022

Note: *p≤0.05, ** p≤0.01,*** p≤0.001 | ++ Full Mediation , +Partial Mediation

A2. Multiple mediation of the effect of Secondary Education on HIV-related Knowledge through eight HIV-related information sources (N=25,904)

	Point estimate	SE	Z
Comprehensive +***			
Total effects	0.487***	0.065	7.496
Indirect effects	1.059***	0.072	14.777
Direct effects	-0.572***	0.094	-6.072
Radio	0.045***	0.011	4.268
Television	0.040**	0.014	2.922
Cinema	0.060***	0.018	3.262
Print	0.444***	0.042	10.553
Posters	0.131***	0.021	6.157
Health workers	0.017*	0.008	2.005
Teachers	0.321***	0.044	7.218
Peers	0.001	0.003	0.420
Condom Availability +***			
Total effects	0.311***	0.067	4.613
Indirect effects	0.716***	0.072	9.991
Direct effects	-0.405***	0.095	-4.266
Radio	0.055***	0.013	4.291
Television	0.023**	0.009	2.659
Cinema	0.037**	0.015	2.559
Print	0.365***	0.040	9.201
Posters	0.132***	0.023	5.848
Health workers	0.030*	0.013	2.251
Teachers	0.101*	0.042	2.369
Peers	-0.028***	0.008	-3.662
Mother to Child Transmission +***			
Total effects	0.460***	0.065	7.082
Indirect effects	0.793***	0.066	12.048
Direct effects	-0.333***	0.090	-3.708
Radio	0.038***	0.009	4.026
Television	0.024**	0.009	2.788
Cinema	0.041**	0.015	2.788
Print	0.292***	0.036	8.040
Posters	0.094***	0.018	5.154
Health workers	0.029*	0.013	2.295
Teachers	0.275***	0.043	6.438
Peers	0.001	0.004	0.400
Health Services Availability +***			
Total effects	0.353***	0.098	3.601
Indirect effects	1.216***	0.092	13.240
Direct effects	-0.863***	0.129	-6.667
Radio	0.043***	0.011	3.957
Television	0.025**	0.010	2.610
Cinema	0.100***	0.029	3.445
Print	0.449***	0.049	9.165
Posters	0.167***	0.027	6.078
Health workers	0.036*	0.016	2.304
Teachers	0.403***	0.055	7.312
Peers	-0.007	0.005	-1.529

Note: *p≤0.05, ** p≤0.01,*** p≤0.001 | ++ Full Mediation , +Partial Mediation

A2. Multiple mediation of the effect of Higher Education on HIV-related Knowledge through eight HIV-related information sources (N=25,904)

	Point estimate	SE	Z
Comprehensive + ***			
Total effects	0.778***	0.083	9.353
Indirect effects	1.365***	0.087	15.716
Direct effects	-0.587***	0.113	-5.205
Radio	0.077***	0.014	5.332
Television	0.102***	0.025	4.154
Cinema	0.090***	0.023	3.894
Print	0.567***	0.049	11.548
Posters	0.170***	0.026	6.587
Health workers	0.021	0.011	1.916
Teachers	0.335***	0.046	7.338
Peers	0.001	0.003	0.413
Condom Availability +*			
Total effects	0.620***	0.089	6.972
Indirect effects	0.960***	0.086	11.109
Direct effects	-0.339**	0.119	-2.864
Radio	0.092***	0.017	5.331
Television	0.056***	0.016	3.414
Cinema	0.056**	0.020	2.860
Print	0.469***	0.048	9.806
Posters	0.163***	0.027	6.023
Health workers	0.039*	0.018	2.220
Teachers	0.106*	0.045	2.373
Peers	-0.022*	0.010	-2.295
Mother to Child Transmission + ***			
Total effects	0.627***	0.082	7.638
Indirect effects	1.004***	0.079	12.687
Direct effects	-0.377***	0.110	-3.419
Radio	0.065***	0.013	5.124
Television	0.059***	0.016	3.604
Cinema	0.062***	0.019	3.221
Print	0.376***	0.044	8.550
Posters	0.116***	0.022	5.272
Health workers	0.037*	0.017	2.233
Teachers	0.289***	0.044	6.571
Peers	0.001	0.003	0.394
Health Services Availability + ***			
Total effects	0.618***	0.115	5.368
Indirect effects	1.502***	0.109	13.809
Direct effects	-0.884***	0.151	-5.840
Radio	0.073***	0.015	4.783
Television	0.058**	0.018	3.158
Cinema	0.143***	0.034	4.158
Print	0.568***	0.058	9.793
Posters	0.207***	0.033	6.345
Health workers	0.041*	0.020	2.000
Teachers	0.418***	0.057	7.380
Peers	-0.006	0.004	-1.343

Note: *p≤0.05, ** p≤0.01,*** p≤0.001 | ++ Full Mediation , +Partial Mediation

A2. Multiple mediation of the effect of Poorer Wealth status on HIV-related Knowledge through eight HIV-related information sources (N=25,904)

	Point estimate	SE	Z
Comprehensive			
Total effects	0.101	0.053	1.913
Indirect effects	0.058	0.033	1.771
Direct effects	0.042	0.056	0.759
Radio	-0.009	0.008	-1.226
Television	0.024*	0.012	2.018
Cinema	0.004	0.012	0.302
Print	0.034*	0.014	2.406
Posters	0.003	0.011	0.289
Health workers	-0.015*	0.007	-1.961
Teachers	0.018	0.010	1.824
Peers	0.000	0.000	-0.269
Condom Availability			
Total effects	-0.067	0.059	-1.146
Indirect effects	0.018	0.029	0.633
Direct effects	-0.086	0.058	-1.480
Radio	-0.012	0.009	-1.282
Television	0.014	0.007	1.924
Cinema	0.003	0.008	0.354
Print	0.028*	0.012	2.326
Posters	0.003	0.010	0.289
Health workers	-0.024	0.012	-2.080
Teachers	0.005	0.004	1.451
Peers	0.002	0.006	0.328
Mother to Child Transmission			
Total effects	0.009	0.057	0.149
Indirect effects	0.025	0.025	0.967
Direct effects	-0.016	0.060	-0.267
Radio	-0.008	0.007	-1.275
Television	0.014*	0.007	1.983
Cinema	0.003	0.009	0.345
Print	0.022*	0.010	2.307
Posters	0.002	0.007	0.294
Health workers	-0.023*	0.011	-2.158
Teachers	0.015	0.008	1.722
Peers	0.000	0.000	-0.261
Health Services Availability			
Total effects	0.019	0.087	0.213
Indirect effects	0.040	0.041	0.987
Direct effects	-0.022	0.089	-0.242
Radio	-0.009	0.007	-1.237
Television	0.015	0.008	1.900
Cinema	0.006	0.020	0.289
Print	0.033*	0.014	2.327
Posters	0.003	0.013	0.256
Health workers	-0.031*	0.014	-2.257
Teachers	0.022	0.012	1.798
Peers	0.001	0.002	0.349

Note: *p≤0.05, ** p≤0.01,*** p≤0.001 | ++ Full Mediation , +Partial Mediation

A2. Multiple mediation of the effect of Middle Wealth status on HIV-related Knowledge through eight HIV-related information sources (N=25,904)

	Point estimate	SE	Z
Comprehensive +***			
Total effects	0.204***	0.053	3.837
Indirect effects	0.142***	0.034	4.213
Direct effects	0.062	0.057	1.088
Radio	-0.015*	0.008	-1.979
Television	0.050***	0.012	4.058
Cinema	0.016	0.012	1.354
Print	0.070***	0.014	4.855
Posters	0.017	0.010	1.596
Health workers	-0.019*	0.008	-2.237
Teachers	0.023*	0.010	2.382
Peers	0.000	0.000	0.249
Condom Availability			
Total effects	-0.053	0.057	-0.931
Indirect effects	0.068*	0.030	2.291
Direct effects	-0.122*	0.058	-2.112
Radio	-0.019*	0.009	-2.069
Television	0.029***	0.009	3.407
Cinema	0.011	0.008	1.472
Print	0.058***	0.012	4.655
Posters	0.015	0.010	1.536
Health workers	-0.031*	0.012	-2.521
Teachers	0.007	0.004	1.687
Peers	-0.002	0.006	-0.333
Mother to Child Transmission +*			
Total effects	0.111*	0.053	2.090
Indirect effects	0.075**	0.027	2.819
Direct effects	0.036	0.058	0.627
Radio	-0.014*	0.007	-2.058
Television	0.030***	0.008	3.685
Cinema	0.012	0.008	1.479
Print	0.046***	0.010	4.467
Posters	0.011	0.007	1.508
Health workers	-0.030**	0.011	-2.610
Teachers	0.019*	0.008	2.249
Peers	0.000	0.000	0.238
Health Services Availability			
Total effects	0.117	0.080	1.458
Indirect effects	0.121**	0.042	2.879
Direct effects	-0.004	0.083	-0.051
Radio	-0.014	0.007	-1.929
Television	0.032***	0.009	3.426
Cinema	0.027	0.019	1.385
Print	0.069***	0.015	4.592
Posters	0.019	0.013	1.539
Health workers	-0.039**	0.015	-2.704
Teachers	0.028*	0.012	2.311
Peers	0.000	0.002	-0.286

Note: *p≤0.05, ** p≤0.01,*** p≤0.001 | ++ Full Mediation , +Partial Mediation

A2. Multiple mediation of the effect of Richer Wealth status on HIV-related Knowledge through eight HIV-related information sources (N=25,904)

	Point estimate	SE	Z
Comprehensive ++***			
Total effects	0.321***	0.054	5.897
Indirect effects	0.240***	0.036	6.720
Direct effects	0.081	0.059	1.369
Radio	-0.020*	0.008	-2.396
Television	0.091***	0.015	6.066
Cinema	0.012	0.012	1.040
Print	0.106***	0.015	6.988
Posters	0.023*	0.011	2.114
Health workers	-0.015	0.008	-1.855
Teachers	0.041***	0.010	3.944
Peers	0.001	0.002	0.417
Condom Availability			
Total effects	0.002	0.059	0.032
Indirect effects	0.118***	0.033	3.548
Direct effects	-0.116	0.062	-1.864
Radio	-0.027**	0.010	-2.668
Television	0.052***	0.012	4.456
Cinema	0.009	0.008	1.178
Print	0.088***	0.014	6.374
Posters	0.021*	0.010	2.092
Health workers	-0.024	0.012	-1.937
Teachers	0.012*	0.006	2.070
Peers	-0.014*	0.006	-2.293
Mother to Child Transmission ++**			
Total effects	0.177**	0.056	3.169
Indirect effects	0.142***	0.029	4.896
Direct effects	0.035	0.060	0.584
Radio	-0.019**	0.007	-2.561
Television	0.054***	0.011	4.838
Cinema	0.010	0.008	1.185
Print	0.070***	0.012	6.073
Posters	0.016*	0.008	2.045
Health workers	-0.023*	0.011	-2.054
Teachers	0.034***	0.009	3.657
Peers	0.001	0.002	0.394
Health Services Availability ++*			
Total effects	0.208*	0.083	2.497
Indirect effects	0.199***	0.044	4.527
Direct effects	0.008	0.087	0.096
Radio	-0.020*	0.008	-2.463
Television	0.057***	0.013	4.201
Cinema	0.019	0.019	1.011
Print	0.103***	0.016	6.236
Posters	0.026*	0.013	2.006
Health workers	-0.032*	0.014	-2.249
Teachers	0.050***	0.013	3.784
Peers	-0.004	0.003	-1.312

Note: *p≤0.05, ** p≤0.01,*** p≤0.001 | ++ Full Mediation , +Partial Mediation

A2. Multiple mediation of the effect of Richest Wealth status on HIV-related Knowledge through eight HIV-related information sources (N=25,904)

	Point estimate	SE	Z
Comprehensive ++***			
Total effects	0.449***	0.059	7.642
Indirect effects	0.414***	0.041	10.022
Direct effects	0.035	0.066	0.529
Radio	-0.019*	0.009	-2.093
Television	0.113***	0.017	6.684
Cinema	0.031*	0.013	2.346
Print	0.166***	0.018	9.420
Posters	0.049***	0.013	3.884
Health workers	-0.015	0.008	-1.773
Teachers	0.088***	0.013	6.540
Peers	0.001	0.002	0.418
Condom Availability			
Total effects	0.025	0.066	0.384
Indirect effects	0.233***	0.040	5.793
Direct effects	-0.207**	0.071	-2.901
Radio	-0.023*	0.011	-2.075
Television	0.063***	0.014	4.612
Cinema	0.023*	0.010	2.313
Print	0.138***	0.016	8.386
Posters	0.046***	0.012	3.895
Health workers	-0.025*	0.013	-1.962
Teachers	0.026*	0.011	2.333
Peers	-0.016*	0.007	-2.277
Mother to Child Transmission ++***			
Total effects	0.207***	0.060	3.462
Indirect effects	0.272***	0.035	7.721
Direct effects	-0.064	0.067	-0.964
Radio	-0.016*	0.008	-2.001
Television	0.068***	0.013	5.168
Cinema	0.025*	0.010	2.383
Print	0.110***	0.015	7.573
Posters	0.034***	0.009	3.703
Health workers	-0.024*	0.012	-1.970
Teachers	0.074***	0.013	5.819
Peers	0.001	0.002	0.395
Health Services Availability ++*			
Total effects	0.304***	0.087	3.490
Indirect effects	0.393***	0.052	7.616
Direct effects	-0.089	0.093	-0.961
Radio	-0.021*	0.009	-2.366
Television	0.071***	0.016	4.469
Cinema	0.052*	0.021	2.446
Print	0.161***	0.020	8.088
Posters	0.058***	0.015	3.860
Health workers	-0.033*	0.015	-2.137
Teachers	0.110***	0.018	6.216
Peers	-0.004	0.003	-1.314

Note: *p≤0.05, ** p≤0.01,*** p≤0.001 | ++ Full Mediation , +Partial Mediation

A2. Multiple mediation of the effect of Rural Residence on HIV-related Knowledge through eight HIV-related information sources (N=25,904)

	Point estimate	SE	Z
Comprehensive			
Total effects	-0.068*	0.033	-2.061
Indirect effects	-0.010	0.023	-0.457
Direct effects	-0.058	0.034	-1.707
Radio	0.037***	0.006	5.816
Television	-0.038***	0.009	-4.284
Cinema	-0.022**	0.007	-3.097
Print	-0.001	0.007	-0.125
Posters	-0.014*	0.006	-2.197
Health workers	0.011*	0.005	2.432
Teachers	0.017**	0.005	3.158
Peers	0.000	0.000	-0.356
Condom Availability			
Total effects	0.021	0.038	0.561
Indirect effects	0.020	0.020	0.994
Direct effects	0.001	0.040	0.026
Radio	0.044***	0.008	5.745
Television	-0.021***	0.006	-3.602
Cinema	-0.014*	0.005	-2.554
Print	-0.001	0.006	-0.194
Posters	-0.013*	0.006	-2.207
Health workers	0.018**	0.007	2.622
Teachers	0.005*	0.003	1.988
Peers	0.002	0.004	0.625
Mother to Child Transmission			
Total effects	0.120***	0.032	3.744
Indirect effects	0.014	0.018	0.783
Direct effects	0.106**	0.034	3.112
Radio	0.031***	0.006	5.433
Television	-0.022***	0.006	-3.722
Cinema	-0.016**	0.006	-2.728
Print	-0.001	0.005	-0.192
Posters	-0.010*	0.005	-2.101
Health workers	0.018**	0.007	2.640
Teachers	0.014**	0.005	3.105
Peers	0.000	0.000	-0.335
Health Services Availability			
Total effects	0.106*	0.042	2.526
Indirect effects	0.001	0.027	0.037
Direct effects	0.105*	0.044	2.413
Radio	0.035***	0.007	4.998
Television	-0.024***	0.007	-3.581
Cinema	-0.037***	0.011	-3.344
Print	-0.001	0.007	-0.070
Posters	-0.017*	0.008	-2.170
Health workers	0.022**	0.008	2.673
Teachers	0.021**	0.007	3.049
Peers	0.001	0.001	0.609

Note: *p≤0.05, ** p≤0.01,*** p≤0.001 | ++ Full Mediation , +Partial Mediation

A2. Multiple mediation of the effect of Residence in a High Prevalence State on HIV-related Knowledge through eight HIV-related information sources (N=25,904)

	Point estimate	SE	Z
Comprehensive +***			
Total effects	-0.134***	0.029	-4.572
Indirect effects	0.114***	0.026	4.480
Direct effects	-0.249***	0.035	-7.162
Radio	-0.036***	0.006	-6.016
Television	-0.011	0.008	-1.407
Cinema	0.087***	0.015	5.932
Print	-0.004	0.007	-0.648
Posters	-0.009	0.006	-1.500
Health workers	0.002	0.003	0.553
Teachers	0.086***	0.010	8.432
Peers	-0.001	0.002	-0.420
Condom Availability			
Total effects	-0.424***	0.035	-12.091
Indirect effects	0.034	0.025	1.364
Direct effects	-0.458***	0.041	-11.200
Radio	-0.043***	0.007	-6.023
Television	-0.007	0.004	-1.490
Cinema	0.055***	0.015	3.591
Print	-0.004	0.006	-0.704
Posters	-0.008	0.006	-1.541
Health workers	0.003	0.006	0.446
Teachers	0.026*	0.011	2.412
Peers	0.013***	0.004	3.278
Mother to Child Transmission +***			
Total effects	0.245***	0.029	8.466
Indirect effects	0.087***	0.022	3.946
Direct effects	0.158***	0.034	4.633
Radio	-0.031***	0.005	-5.790
Television	-0.007	0.005	-1.468
Cinema	0.060***	0.015	4.149
Print	-0.002	0.005	-0.456
Posters	-0.006	0.004	-1.576
Health workers	0.002	0.005	0.378
Teachers	0.071***	0.009	7.518
Peers	-0.001	0.002	-0.398
Health Services Availability +***			
Total effects	0.409***	0.038	10.734
Indirect effects	0.201***	0.031	6.586
Direct effects	0.208***	0.043	4.785
Radio	-0.033***	0.006	-5.360
Television	-0.007	0.005	-1.438
Cinema	0.143***	0.020	7.296
Print	-0.005	0.007	-0.728
Posters	-0.011	0.007	-1.561
Health workers	0.004	0.007	0.538
Teachers	0.108***	0.013	8.181
Peers	0.004	0.002	1.506

Note: *p≤0.05, ** p≤0.01,*** p≤0.001 | ++ Full Mediation , +Partial Mediation

A2. Multiple mediation of the effect of being Ever Married on HIV-related Knowledge through eight HIV-related information sources (N=25,904)

	Point estimate	SE	Z
Comprehensive			
Total effects	-0.049	0.042	-1.180
Indirect effects	-0.209***	0.029	-7.306
Direct effects	0.160***	0.048	3.360
Radio	-0.015*	0.006	-2.393
Television	-0.001	0.010	-0.114
Cinema	-0.035***	0.011	-3.294
Print	-0.052***	0.011	-4.893
Posters	-0.026**	0.009	-2.862
Health workers	0.017**	0.007	2.563
Teachers	-0.097***	0.013	-7.304
Peers	-0.001	0.002	-0.420
Condom Availability +***			
Total effects	0.278***	0.048	5.803
Indirect effects	-0.094***	0.026	-3.644
Direct effects	0.372***	0.053	7.054
Radio	-0.018*	0.008	-2.441
Television	-0.001	0.006	-0.236
Cinema	-0.022**	0.009	-2.572
Print	-0.044***	0.009	-4.774
Posters	-0.024**	0.009	-2.815
Health workers	0.031**	0.010	3.067
Teachers	-0.031*	0.013	-2.382
Peers	0.016*	0.005	2.967
Mother to Child Transmission			
Total effects	0.004	0.041	0.106
Indirect effects	-0.146***	0.024	-6.178
Direct effects	0.150***	0.045	3.356
Radio	-0.012*	0.005	-2.304
Television	-0.001	0.006	-0.197
Cinema	-0.024**	0.009	-2.823
Print	-0.035***	0.008	-4.535
Posters	-0.018**	0.007	-2.725
Health workers	0.029**	0.009	3.091
Teachers	-0.083**	0.013	-6.616
Peers	-0.001	0.002	-0.398
Health Services Availability			
Total effects	-0.036	0.058	-0.620
Indirect effects	-0.245***	0.036	-6.847
Direct effects	0.209***	0.063	3.322
Radio	-0.014**	0.006	-2.320
Television	-0.001	0.007	-0.156
Cinema	-0.060***	0.017	-3.476
Print	-0.051***	0.011	-4.694
Posters	-0.033**	0.011	-2.982
Health workers	0.034**	0.011	3.027
Teachers	-0.124***	0.017	-7.130
Peers	0.004	0.003	1.446

Note: *p≤0.05, ** p≤0.01,*** p≤0.001 | ++ Full Mediation , +Partial Mediation

A2. Multiple mediation of the effect of Less than Daily Television frequency on HIV-related Knowledge through eight HIV-related information sources (N=25,904)

	Point estimate	SE	Z
Comprehensive			
Total effects	0.075	0.040	1.901
Indirect effects	0.224***	0.030	7.546
Direct effects	-0.149***	0.046	-3.269
Radio	-0.003	0.006	-0.433
Television	0.189***	0.019	9.995
Cinema	0.023*	0.010	2.313
Print	0.020*	0.010	1.984
Posters	0.007	0.007	1.008
Health workers	0.004	0.005	0.730
Teachers	-0.018**	0.007	-2.606
Peers	0.001	0.003	0.421
Condom Availability ++*			
Total effects	0.143**	0.046	3.096
Indirect effects	0.121***	0.029	4.206
Direct effects	0.022	0.051	0.427
Radio	-0.004	0.007	-0.511
Television	0.110***	0.020	5.516
Cinema	0.014*	0.007	2.073
Print	0.017	0.009	1.918
Posters	0.007	0.007	1.050
Health workers	0.007	0.009	0.741
Teachers	-0.006	0.003	-1.851
Peers	-0.023***	0.006	-4.177
Mother to Child Transmission ++*			
Total effects	0.086*	0.044	1.965
Indirect effects	0.140***	0.026	5.391
Direct effects	-0.054	0.048	-1.122
Radio	-0.003	0.005	-0.504
Television	0.116***	0.018	6.274
Cinema	0.015*	0.007	2.081
Print	0.014	0.007	1.955
Posters	0.005	0.005	1.072
Health workers	0.006	0.008	0.708
Teachers	-0.015*	0.006	-2.476
Peers	0.001	0.003	0.398
Health Services Availability			
Total effects	0.061	0.058	1.040
Indirect effects	0.160***	0.038	4.246
Direct effects	-0.100	0.064	-1.546
Radio	-0.003	0.006	-0.558
Television	0.120***	0.024	5.045
Cinema	0.038*	0.015	2.470
Print	0.019	0.010	1.823
Posters	0.009	0.009	0.966
Health workers	0.008	0.010	0.778
Teachers	-0.024**	0.009	-2.676
Peers	-0.006	0.004	-1.553

Note: *p≤0.05, ** p≤0.01,*** p≤0.001 | ++ Full Mediation , +Partial Mediation

A2. Multiple mediation of the effect of Almost Daily Television frequency on HIV-related Knowledge through eight HIV-related information sources (N=25,904)

	Point estimate	SE	Z
Comprehensive ++ **			
Total effects	0.217***	0.035	6.224
Indirect effects	0.279***	0.033	8.445
Direct effects	-0.062	0.044	-1.414
Radio	-0.038***	0.006	-5.873
Television	0.273***	0.026	10.381
Cinema	0.027**	0.009	3.054
Print	0.017*	0.008	2.050
Posters	0.009	0.006	1.509
Health workers	0.001	0.004	0.162
Teachers	-0.011	0.006	-1.953
Peers	0.001	0.002	0.421
Condom Availability ++ **			
Total effects	0.183***	0.038	4.761
Indirect effects	0.133***	0.034	3.938
Direct effects	0.050	0.046	1.078
Radio	-0.046***	0.008	-6.086
Television	0.157***	0.028	5.602
Cinema	0.018**	0.007	2.605
Print	0.014	0.007	1.952
Posters	0.008	0.006	1.311
Health workers	0.001	0.007	0.206
Teachers	-0.004	0.002	-1.611
Peers	-0.016***	0.004	-3.648
Mother to Child Transmission ++ **			
Total effects	0.187***	0.035	5.372
Indirect effects	0.162***	0.030	5.406
Direct effects	0.025	0.044	0.565
Radio	-0.032***	0.006	-5.494
Television	0.166***	0.025	6.541
Cinema	0.019**	0.007	2.743
Print	0.011	0.006	1.922
Posters	0.006	0.004	1.313
Health workers	0.001	0.007	0.206
Teachers	-0.011*	0.005	-2.123
Peers	0.001	0.002	0.399
***Health Services Availability ++** **			
Total effects	0.138**	0.048	2.865
Indirect effects	0.192***	0.043	4.519
Direct effects	-0.054	0.059	-0.922
Radio	-0.036***	0.007	-5.295
Television	0.174***	0.034	5.153
Cinema	0.045***	0.013	3.372
Print	0.017*	0.008	2.016
Posters	0.011	0.007	1.415
Health workers	0.001	0.009	0.150
Teachers	-0.015*	0.007	-2.044
Peers	-0.004	0.003	-1.517

Note: *p≤0.05, ** p≤0.01,*** p≤0.001 | ++ Full Mediation , +Partial Mediation

A2. Multiple mediation of the effect of OBC Caste status on HIV-related Knowledge through eight HIV-related information sources (N=25,904)

	Point estimate	SE	Z
Comprehensive			
Total effects	0.063	0.032	1.929
Indirect effects	0.045*	0.020	2.206
Direct effects	0.018	0.034	0.527
Radio	0.017***	0.005	3.325
Television	-0.005	0.008	-0.584
Cinema	0.011	0.007	1.547
Print	0.022**	0.008	2.843
Posters	0.001	0.006	0.205
Health workers	-0.008	0.004	-1.836
Teachers	0.007	0.005	1.208
Peers	0.000	0.001	0.409
Condom Availability			
Total effects	0.082*	0.036	2.271
Indirect effects	0.028	0.018	1.585
Direct effects	0.054	0.037	1.453
Radio	0.021***	0.006	3.357
Television	-0.003	0.005	-0.569
Cinema	0.007	0.005	1.452
Print	0.018**	0.007	2.809
Posters	0.001	0.005	0.207
Health workers	-0.013	0.007	-1.926
Teachers	0.002	0.002	1.068
Peers	-0.005	0.004	-1.363
Mother to Child Transmission			
Total effects	0.061	0.032	1.924
Indirect effects	0.027	0.016	1.748
Direct effects	0.034	0.034	1.002
Radio	0.014***	0.004	3.242
Television	-0.003	0.005	-0.570
Cinema	0.008	0.005	1.491
Print	0.015**	0.005	2.750
Posters	0.001	0.004	0.205
Health workers	-0.013	0.007	-1.979
Teachers	0.005	0.005	1.184
Peers	0.000	0.001	0.380
Health Services Availability			
Total effects	0.041	0.044	0.948
Indirect effects	0.044	0.024	1.821
Direct effects	-0.003	0.045	-0.064
Radio	0.016**	0.005	3.152
Television	-0.003	0.005	-0.574
Cinema	0.018	0.011	1.564
Print	0.022**	0.008	2.846
Posters	0.001	0.007	0.172
Health workers	-0.016*	0.008	-2.005
Teachers	0.008	0.007	1.192
Peers	-0.001	0.001	-1.062

Note: *p≤0.05, ** p≤0.01,*** p≤0.001 | ++ Full Mediation , +Partial Mediation

A2. Multiple mediation of the effect of Residual General Class status on HIV-related Knowledge through eight HIV-related information sources (N=25,904)

	Point estimate	SE	Z
Comprehensive			
Total effects	0.130***	0.034	3.801
Indirect effects	0.022	0.021	1.060
Direct effects	0.108**	0.035	3.040
Radio	0.005	0.005	0.970
Television	0.008	0.009	0.840
Cinema	0.005	0.007	0.745
Print	0.023**	0.008	2.794
Posters	-0.004	0.006	-0.616
Health workers	-0.005	0.004	-1.089
Teachers	-0.010	0.006	-1.727
Peers	0.000	0.000	-0.329
Condom Availability			
Total effects	0.013	0.039	0.348
Indirect effects	0.020	0.018	1.095
Direct effects	-0.007	0.040	-0.163
Radio	0.006	0.006	0.934
Television	0.005	0.005	0.831
Cinema	0.003	0.004	0.756
Print	0.019**	0.007	2.732
Posters	-0.004	0.006	-0.625
Health workers	-0.008	0.007	-1.101
Teachers	-0.003	0.002	-1.415
Peers	0.002	0.004	0.522
Mother to Child Transmission			
Total effects	0.016	0.035	0.461
Indirect effects	0.008	0.016	0.514
Direct effects	0.008	0.037	0.207
Radio	0.004	0.004	0.902
Television	0.005	0.006	0.845
Cinema	0.004	0.005	0.763
Print	0.015**	0.006	2.641
Posters	-0.003	0.004	-0.623
Health workers	-0.008	0.007	-1.133
Teachers	-0.008	0.005	-1.705
Peers	0.000	0.000	-0.328
Health Services Availability			
Total effects	-0.010	0.047	-0.205
Indirect effects	0.013	0.025	0.534
Direct effects	-0.023	0.048	-0.473
Radio	0.005	0.005	0.927
Television	0.005	0.006	0.843
Cinema	0.008	0.011	0.726
Print	0.022**	0.008	2.741
Posters	-0.005	0.007	-0.665
Health workers	-0.010	0.008	-1.164
Teachers	-0.013	0.007	-1.763
Peers	0.001	0.001	0.503

Note: *p≤0.05, ** p≤0.01,*** p≤0.001 | ++ Full Mediation , +Partial Mediation

A2. Multiple mediation of the effect of Religion (Islam) on HIV-related Knowledge through eight HIV-related information sources (N=25,904)

	Point estimate	SE	Z
Comprehensive ++***			
Total effects	-0.167***	0.044	-3.822
Indirect effects	-0.134***	0.027	-4.927
Direct effects	-0.033	0.042	-0.778
Radio	0.001	0.007	0.092
Television	-0.039***	0.011	-3.548
Cinema	-0.008	0.008	-1.001
Print	-0.033***	0.010	-3.278
Posters	-0.025**	0.009	-2.866
Health workers	-0.008	0.006	-1.399
Teachers	-0.023**	0.007	-3.159
Peers	0.000	0.000	-0.235
Condom Availability			
Total effects	-0.069	0.049	-1.407
Indirect effects	-0.096***	0.025	-3.872
Direct effects	0.026	0.052	0.507
Radio	0.000	0.008	0.051
Television	-0.022**	0.007	-3.166
Cinema	-0.005	0.005	-0.916
Print	-0.027***	0.009	-3.205
Posters	-0.024**	0.008	-2.812
Health workers	-0.013	0.009	-1.423
Teachers	-0.007	0.004	-1.901
Peers	0.001	0.005	0.279
Mother to Child Transmission ++*			
Total effects	-0.105*	0.043	-2.448
Indirect effects	-0.099***	0.022	-4.562
Direct effects	-0.006	0.046	-0.133
Radio	0.000	0.006	0.029
Television	-0.024***	0.007	-3.386
Cinema	-0.005	0.006	-0.906
Print	-0.022**	0.007	-3.136
Posters	-0.017**	0.006	-2.746
Health workers	-0.012	0.008	-1.408
Teachers	-0.019**	0.006	-3.056
Peers	0.000	0.000	-0.225
Health Services Availability			
Total effects	-0.105	0.061	-1.738
Indirect effects	-0.147***	0.034	-4.366
Direct effects	0.042	0.064	0.654
Radio	0.001	0.006	0.120
Television	-0.025**	0.008	-3.101
Cinema	-0.015	0.014	-1.109
Print	-0.032**	0.010	-3.135
Posters	-0.031**	0.011	-2.875
Health workers	-0.017	0.011	-1.581
Teachers	-0.028**	0.009	-3.130
Peers	0.000	0.001	0.258

Note: *p≤0.05, ** p≤0.01,*** p≤0.001 | ++ Full Mediation , +Partial Mediation

A2. Multiple mediation of the effect of Religion (Other) on HIV-related Knowledge through eight HIV-related information sources (N=25,904)

	Point estimate	SE	Z
Comprehensive			
Total effects	0.020	0.044	0.461
Indirect effects	-0.026	0.032	-0.794
Direct effects	0.046	0.052	0.884
Radio	-0.034***	0.008	-4.215
Television	-0.026*	0.011	-2.293
Cinema	-0.005	0.011	-0.508
Print	0.021*	0.010	2.077
Posters	-0.008	0.009	-0.917
Health workers	0.000	0.006	-0.053
Teachers	0.027***	0.008	3.419
Peers	0.000	0.000	0.119
Condom Availability			
Total effects	0.041	0.051	0.803
Indirect effects	-0.042	0.028	-1.525
Direct effects	0.083	0.051	1.626
Radio	-0.041***	0.010	-4.203
Television	-0.015*	0.007	-2.178
Cinema	-0.004	0.007	-0.536
Print	0.018*	0.009	2.010
Posters	-0.007	0.008	-0.868
Health workers	0.000	0.009	-0.029
Teachers	0.008*	0.004	2.054
Peers	-0.001	0.005	-0.133
Mother to Child Transmission			
Total effects	-0.017	0.046	-0.361
Indirect effects	-0.018	0.024	-0.746
Direct effects	0.001	0.048	0.029
Radio	-0.029***	0.007	-4.136
Television	-0.016*	0.007	-2.276
Cinema	-0.004	0.008	-0.523
Print	0.014*	0.007	1.993
Posters	-0.006	0.006	-0.898
Health workers	0.000	0.009	-0.035
Teachers	0.023***	0.007	3.395
Peers	0.000	0.000	0.119
Health Services Availability			
Total effects	0.005	0.073	0.064
Indirect effects	-0.015	0.038	-0.391
Direct effects	0.020	0.066	0.295
Radio	-0.033***	0.008	-4.015
Television	-0.017*	0.008	-2.147
Cinema	-0.009	0.017	-0.517
Print	0.021*	0.010	2.032
Posters	-0.010	0.011	-0.947
Health workers	0.000	0.011	-0.040
Teachers	0.034***	0.010	3.367
Peers	0.000	0.001	-0.124

Note: *p≤0.05, ** p≤0.01,*** p≤0.001 | ++ Full Mediation , +Partial Mediation

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