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Associations between sexual risk behaviours, and certain beliefs and perceptions about antiretroviral therapy in Botswana

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Dissertation

Associations between sexual risk behaviours, and certain beliefs and perceptions about antiretroviral therapy in Botswana

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Abstract

This study explored the association between sexually risky behaviour among individuals and their beliefs and perceptions regarding antiretroviral therapy or ART. Specifically, the paper examined the treatment optimism aspect of ART- that HIV is a less serious threat due to the availability of ART. In order to test this notion, the paper compared the behavior of those people who were HIV positive with those who were HIV negative. A second population subset also included in the comparative analyses were those aware of their HIV status and those unaware. To underline the prevalence of treatment optimism, the study also considered the link between ART, sexual risk behaviours and circumcision status following the 2009 implementation of the voluntary medical male circumcision (VMMC) programme in Botswana. The study leveraged secondary quantitative data from the Botswana AIDS Impact Survey, 2013 (BAIS IV) and included data from participants who completed an individual questionnaire; were aged 15-64 years old and had sexual experience. Findings from the BAIS IV showed statistically significant evidence to support treatment optimism especially among individuals who were unaware of their status. On the contrary, the co-relation between circumcision and treatment optimism were less conclusive. Interestingly, there were statistically significant relations "between treatment optimism among individuals who were circumcised," as well as uncircumcised men. Those who were HIV-positive counter the treatment optimism argument as findings indicate that they were practicing sexual risk reduction. Findings from this paper can inform public health interventions by tailoring approaches that target specific sub-populations in the community.

Dedication

This dissertation is dedicated to Rita White, who was one of the bravest and most courageous people that I have known, leading by example and strength of spirit in her own exceptional way - Joshua 1:9.

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I am so grateful for the support of my soul mate Barbara during this long journey. Your encouragement, patience, and understanding made this happen. To my son Jacob, I appreciate your love and support. Thank you so much.

Statement of originality

The work contained in this thesis has not been previously submitted for a degree or diploma at any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due references are made.

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Chapter 1 – Introduction

1.1. Background

Smarter scale-up is paramount in closing the gap between people who have protected themselves against, or not yet been exposed to, the potentially deadly Human Immunodeficiency Virus (HIV), and those who cannot or will not do so. Closing that gap will require a concerted global health governance effort, providing a balanced, targeted, and cost-efficient prevention strategy (UNAIDS 2015).

HIV is predominantly a sexually transmitted, potentially life-threatening condition that negatively affects a person's immune system and interferes with the body's ability to fight the organisms that cause disease. The virus can be spread by direct contact with infected blood, or from a mother to a child during pregnancy, childbirth or breast-feeding, but in most countries sexual transmission is the leading cause of HIV transmission. HIV infection can take years before reaching the point that an individual falls ill and develops into Acquired Immunodeficiency Syndrome (AIDS). At this stage, in the absence of treatment, a person's condition worsens and can eventually lead to death. There is still no cure for HIV or AIDS, but there are medications that can slow the progression of the disease. Antiretroviral treatment[1] (ART) has been rolled-out globally and is responsible for reducing AIDS deaths worldwide (UNAIDS 2018).

However, concerns have been raised that the availability of ART may perpetuate or cause relapses in risky sexual behaviours[2] among HIV infected people and those who are at risk of HIV infection. It has been argued, for example, that the improvement in physical health and quality of life in response to ART may lead to a reduction in protective and preventive

[1] ART - The combination of antiretroviral (ARV) drugs to maximally suppress the HIV virus and stop the progression of HIV disease

[2] Risky sexual behavior - Having more than one sexual partner; changing sexual partners frequently; having oral, vaginal or anal sexual contact without a condom.

behaviours among people living with HIV or PLWHIV (Kalichman, Cain, and Simbayi 2010; Levy et al. 2017; Ragnarsson et al. 2011a). For example, in the management of sexually transmitted infections (STI) decreased condom use has been evidenced as a result of the rising confidence that the use of ART for prevention attenuates transmission risk or the belief that HIV is no longer a serious health concern (Kalichman et al. 2017; Marrazzo et al. 2018; Traeger et al. 2019).

This dissertation hypothesises that the perception of reduced HIV severity and decreased HIV transmissibility of HIV and AIDS will not be correlated with higher-risk sexual behaviours. The thesis presents Botswana as a middle-income, hyper-epidemic country case study in the context of the above issues.

1.1.1 Context

ART or antiretrovirals (ARVs), is a combination of medications used to slow the rate at which HIV multiplies in the body, and has been proven to decrease HIV viral loads to undetectable levels (Abera et al. 2010; Montaner et al. 2014; Nii-Trebi et al. 2013).

Although ART may not be effective for all infected persons due to drug-resistant strains of HIV and/or unmanageable adverse effects of ART, treatment has had proven beneficial clinical effects reflected in, for example, prevention of transmission of HIV infection in individual patients taking ART, AIDS-related deaths, and HIV related opportunistic infections in countries where ART has been made widely available (Montaner et al. 2014; Shapiro et al. 2010).

ART has been shown to provide, AIDS-free survival, with improved quality of life for HIV-infected patients (Kaida et al. 2009; Nogueira-martins 2010; Obel et al. 2011). More recently, the landmark HPTN 052 trial, which involved starting ART early in HIV-positive

partners of HIV-discordant couples[3] showed a 96% reduction in the transmission risk of HIV to their HIV negative partner (M. Cohen et al. 2012). That is, providing ART to HIV-positive individuals, regardless of their CD4[4] cell count was highly effective in reducing the risk of transmission.

Hence, in 2015 the World Health Organisation (WHO) recommended that people diagnosed with HIV immediately be placed on ART and then came to be known as Treatment as Prevention (TasP). This ensures optimum care and a reduction in the chance of transmitting the disease to an uninfected partner (WHO 2015). A number of follow-up studies since the HPTN 052 trial, have also reported significant reductions in HIV transmission, with new infections averted as a result (Baeten et al. 2012; Rodger et al. 2019; Thigpen et al. 2012). In 2014, the PARTNER study, a four-year study conducted across 14 European countries observed mixed status couples where the viral load of the HIV-positive partner was undetectable. The study found zero transmissions after multiple sexual encounters without a condom (Rodger et al. 2016).

There are positive indications that new HIV infections are trending downward on a global scale. For the first time in the history of HIV there seems to be an air of optimism about the possibilities of reaching the UNAIDS 90-90-90 target: 90% of people with HIV diagnosed, 90% of diagnosed people on therapy, and 90% of treated people virally suppressed. In 2014, UNAIDS reported the "lowest levels of new infections this century at 2.1 million" (UNAIDS 2014).

Unfortunately, HIV and AIDS continue to devastate populations. Since 2000, 38.1 million people worldwide have become infected and 25.3 million people have died of AIDS-related illnesses. In 2017 alone, out of an estimated 36.9 million people living with HIV (PLWHIV), there were 1.8 million new HIV infections. In the same year, there were 25.8 million

[3] HIV Discordant couple - A pair of long-term sexual partners in which one has a sexually transmitted infection and the other does not.

[4] CD4 cells are a type of white blood cell that fights infection.

PLWHIV located in sub-Saharan Africa, accounting for 70% of the global total (UNAIDS 2017).

More recently, declines in new HIV infections among adults have slowed, threatening further progress towards the end of the AIDS epidemic. Since 2010, the annual number of new infections among adults (15+) has remained static at an estimated 1.9 million (UNAIDS 2018). Data from 146 countries show that some have achieved declines in new HIV infections among adults, while many others have not made measurable progress, and still others have experienced worrying increases in new HIV infections (UNAIDS 2018).

At the same time, availability of ART has increased dramatically in recent years, particularly in resource-poor countries. Remarkable progress has been made globally with 75% of all people reporting knowing their HIV status at the end of 2017. Among those who knew their HIV status, 79% were accessing ART, and 81% of people who accessed treatment had suppressed viral loads (UNAIDS 2018).

Eastern and Southern Africa remain the regions most affected by the HIV epidemic, together accounting for 45% of the world's HIV infections and 53% of PLWHIV globally. More than three quarters of the 19.6 million PLWHIV in Eastern and Southern Africa at the end of 2017 were aware of their HIV status. Of those who knew their status, 12.9 million were accessing ART, which is equivalent to 66% of all PLWHIV in the region (UNAIDS 2018).

Thus, progress has been made towards slowing the epidemic. Regrettably, as pointed out earlier, concerted global efforts have had less impact on reducing incidence of new infections than on HIV-related mortality. Ending the AIDS epidemic by 2030, which is a target within the Sustainable Development Goals (SDGs) will require a dramatic change in how HIV prevention is pursued (Carter 2016; Collaborators 2016). Historically, global health governance has been the domain of the WHO. However, weak internal coordination, a

cumbersome bureaucracy and ineffective leadership have raised concerns about the organisation (Moon et al. 2015).

Although the global health community widely accepted the WHO's recommendation for the TasP model, it remains uncertain whether enough has been done to ensure that along with TasP, a comprehensive prevention package that can effectively curb or eliminate new infections is deployed during the course of the epidemic. Although it is with certainty that if one could identify and treat all HIV-infected people immediately after infection, the HIV and AIDS epidemic would eventually disappear (M. S. Cohen 2019). Yet maximising the benefits of ART has proven to be daunting and currently unrealistic. It is not always easy for people to get tested, especially when they fear stigma and discrimination. Therefore, not all HIV-infected individuals are identified and of those PLWHIV, access to therapy may not be possible or they may not agree to be treated (Ambrosioni, Calmy, and Hirschel 2011).

In addition, TasP is only efficacious if the CD4 count is undetectable, which is not always the case, in particular during the first three to six month period after the initiation of ART (M. S. Cohen 2019). Also, of critical importance is having a high adherence to treatment in order to maintain an undetectable viral load over time. Unfortunately, not everyone's viral load becomes and remains undetectable on treatment. This most commonly happens when someone has low adherence to medications, but it can also occur due to drug resistance or drug toxicity. When treatment fails, a person won't know that their viral load is detectable. This limitation also compromises the treatment as prevention strategy (Ambrosioni, Calmy, and Hirschel 2011).

Therefore, to meet the needs of a population, an ideal prevention package should be efficacious and available. Eliminating HIV will be best pursued by combining several prevention strategies including: sexual abstinence, or condom use, reducing the number of multiple and concurrent partners (MCP), voluntary medical male circumcision (VMMC), HIV

testing, and TasP for those infected with HIV and pre-exposure prophylaxis (PrEP) for those not infected with HIV, but at high risk of exposure (Blumenthal et al. 2014). Accomplishing the above will require a concerted global effort, providing a balanced, targeted and cost-efficient prevention strategy.

1.1.2 ART and High-Risk Sexual Behaviour

As the evidence for the success of biomedical HIV prevention interventions increase, a growing concern has emerged about how users of these interventions, particularly PrEP and TasP, may change their HIV sexual risk behaviors. Namely, that widespread use of biomedical interventions can decrease uptake of preventative behaviors, such as condom use, and in turn reverse the benefit of treatment and even lead to an increase in HIV transmission (Chen 2013; Bajunirwe et al. 2013; Demissie et al. 2015; Kalichman et al. 2010; Levy et al. 2017; Luchters et al. 2008; Marrazzo et al. 2018; Ragnarsson et al. 2011). Given the vast quantity of resources that are being invested in the purchase and distribution of ART, there will be little room for any counteracting effect brought on by increased risk behaviors. Therefore, it is crucial for the field of global health governance to eliminate any potential impact of treatment-related beliefs or misconceptions about HIV transmission in order to optimize the effect of TasP at the population level (Chen 2014).

HIV treatment optimism has traditionally been comprised of two distinct components. Firstly, a belief that HIV is a less serious health threat due to the availability of ART, otherwise known as 'reduced-severity optimism'. Secondly, a belief in reduced susceptibility to HIV due to the suppressive effect of ART on the viral load of infected sexual partners known as 'reduced-susceptibility optimism' (Levy et al. 2017). These perceptions resonate with the prevailing theory about how individuals manage their personal risks. Risk "homeostasis" is defined as "a system in which individuals accept a certain level of subjectively estimated [or "perceived"] risk to their health in exchange for benefits they expect to receive from an activity" (Blumenthal and Haubrich 2015). In taking a calculated risk during a risky event, individuals maintain an approximate "risk set point". However, the

introduction of an intervention or technology such as PreP, TasP or VMMC, which reduces the perceived risk of the behavior may cause a person to increase risky behavior, which is called “risk compensation”. While taking ART or after being circumcised or both, individuals perceive that they are protected from transmitting or acquiring HIV (Blumenthal and Haubrich 2015).

Risk compensation has also been observed beyond the field of HIV. For instance, researchers have found that workers who wear back-support belts try to lift heavier loads; children who wear protective sports equipment engage in rougher play; equipping a vehicle with an airbag increases the relative personal injury claims; and drivers of vehicles with automatic braking systems tend to drive faster, follow closer and brake later (Froeb et al. 2016; Vrolix 2012).

It is important to note that much of the literature concerning treatment optimism comes largely from studies conducted among HIV-positive people, and those at a particularly higher risk of infection such as men who have sex with men (MSM), sex workers, injection drug users and people in unstable unions or relationships. Data on perception, attitudes, sexual behaviours and HIV risk among the general HIV-negative population and those unaware of their status is minimal. Therefore, it is difficult to ascertain from this population the perception between the availability of ART and HIV risk.

Globally, we continue to advocate for the provision of ART to treat every infected individual. However, as we do this it must be recognised that the global TasP drive may be negatively influencing people with regards to their concern about engaging in risky sexual behaviours due to this availability, and may possibly be responsible for recent indications showing that the incidence of new infections has flatlined and that impact level reductions are not taking place as expected since the rollout of TasP (Kalichman et al. 2017). Where treatment optimism does indeed occur, it may have the potential to mitigate the benefits of ART-based HIV prevention strategies.

In order to examine this, I will analyze the prevention behaviours of people in a country that has a solid track record of implementing protective HIV responses that include the widespread and free distribution of ART.

1.2. Is ART replacing traditional prevention strategies in Botswana?

HIV prevention refers to practices that prevent the transmission of HIV. Historically, prevention techniques have focused on the ABC's of HIV prevention; "Abstinence, Be faithful, use a Condom". Overtime, prevention strategies developed into approaches where prevention was grounded in evidence-based decision-making through a measurement framework called Know Your Epidemic (KYE), that was implemented at a country level and focused on the last 1000 new infections (Wilson and Halperin 2008). KYE enabled national and sub-national prevention responses that targeted interventions according to identified pathways of high transmission occurrence, resulting in interventions that were different across countries, regions and the world.

This tailored response ensured that prevention programming was effective both in terms of costs and efficacy. Each country-specific approach utilised evidence based, and human rights-based methodology. This new approach combines behavioural, biomedical, and structural interventions to address both the immediate risks and underlying causes of vulnerability to HIV infection, and the pathways that link them. This people-centred, combination approach includes: comprehensive sexuality education; prevention programmes for key populations; national condom programmes; and VMMC (UNAIDS 2016).

1.2.1. Botswana

Botswana attained independence from British protectorate in 1966. It is an upper middle-income country with a stable democracy since independence. Geographically, it is a landlocked country in Southern Africa, bordered by Namibia, Zambia, South Africa and Zimbabwe. The most recent census in 2011 registered a population of just over 2 million, an increase of 1.9% from the 2001 census. The population density increased from 3 people per square kilometre in 2001 to 3.5 people in 2011. 34% of the population were under the age of 15 years and 6% over the age of 65 years (Statistics Botswana 2016).

Botswana is a resource based economy and dominated by mining, in particular diamonds. Tourism is becoming increasingly important to the country's economy and accounts for 10% of the GDP. Botswana is known for its political stability and low rates of violence and as a result has been rated high on governance according to the World Bank's Worldwide Governance Indicators. It is also known as the least corrupt country in Africa by Transparency International (World Bank 2014). Amongst other things one of the major threats to the country's economy that has contributed to its slow diversification has been HIV and AIDS (Barnett and Whiteside 2006).

HIV and AIDS has been managed as part of Botswana's National Health Programme through the National AIDS Coordinating Agency and is positioned within the Ministry of Health. It covers health system interventions including prevention, diagnosis, treatment and care.

This consists of public, private for-profit, private non-profit and traditional medicine. The public sector dominates the health system and operates the vast majority of the health facilities including hospitals, clinics and health posts. The services are decentralized and operated by the Government of Botswana through the Ministry of Health. In addition, there are over 800 mobile services to populations in remote areas. There are a number of

NGOs providing mostly HIV and AIDS-related services such as counselling and testing (Seitio-Kgokgwe et al. 2014).

What Botswana has done is largely integrated and combined clinical and "population health" - establishing norms and services, and research for populations at risk. The term "population health" distinguishes (and synergizes) between clinical medicine and population health (Kindig and Stoddart 2003). Population health is of growing interest to academics and funding agencies and Botswana exemplifies this new approach.

In terms of HIV and AIDS Botswana is one of the countries in the world that has been deeply affected. The first AIDS case was reported in Botswana in 1985. In 1994 there were 4,400 estimated deaths and the first visible sign that the disease had reached epidemic proportions. AIDS related deaths continued to grow reaching 23,000 in 2003 in a population of only 1.8 million. At that time, it was expected that by 2050 the population would be reduced to 1.7 million. By 2003 the epidemic reached its peak prevalence rate of 37.3% of the adult population aged 15-49 years (WHO, 2005). In 2005, prevalence stood at 25.4%, suggesting an increase in AIDS deaths indicated by the reduction of PLWHIV by about 8% in only two years (Stoneburner et al. 2006). In 2016, Botswana had the third highest HIV prevalence rate in the world (21.9%), after Lesotho and Swaziland (UNAIDS 2017).

Considering Botswana's small population, the social and economic impact of the epidemic has been significant. In particular, there were substantial reversals of positive trends such as the reduction of adult and child mortality, as well as the increase of life expectancy (Barnett and Whiteside 2006). Life expectancy at birth for females improved from an average of 57 years in 1970 to 67 years in 1992 and for males from 53 years to 62 years. However, between 1995 and 2002 total life expectancy fell by 36% or roughly 20 years less than it had been in 1970 (OECD, 2003). Life expectancy rates in South Africa and Swaziland also indicate that AIDS had an adverse impact on these countries. However, the rate of

decrease in life expectancy was markedly more pronounced in Botswana as compared to its neighbours (OECD 2003).

Over the last decades, the epidemic increased the number of orphaned children[5], and more family members became sick and infirmed. These events led to the increased burden of care on families. According to UNAIDS (2017) approximately 61,000 children aged between 0 and 17 years had been orphaned by AIDS in Botswana by 2017. The United Nations Development Programme (UNDP) estimated that more than 20% of children in the country will be orphaned by 2020 (United Nations 2015). The country also felt an economic impact for much of the late 1990s and 2000s as the epidemic negatively affected the size of the labour force and the availability of skills, reduced productivity, and decreased economic development spending by 10% due to the rise in healthcare spending (Econsult 2007).

Owing to the socio-economic impact of the epidemic, the government of Botswana declared HIV and AIDS as a national emergency and an issue of high national priority in 2001. As a direct result of this, various structures, policies and programmes were developed and implemented as part of a multi-sectoral response aimed at, preventing new HIV infections and scaling-up treatment, care and support (NACA 2010). One avenue of the response has been the provision of free ART to all eligible citizens through the National ARV Therapy Programme or “Masa”. Masa is a Setswana word meaning "new dawn" and heralds the rising of a dawn over Botswana's struggle against HIV and AIDS. In 2002, Botswana was the first African country to provide ART to its citizens on a national scale and thus quickly became one of the most successful ART programmes in sub-Saharan Africa. As a result, new HIV infections declined from almost 30,000 in 2000 to 15,000 in 2005. AIDS related deaths dropped from 23,000 in 2003 to 4,100 in 2017 (UNAIDS 2017).

However, the most recent nationally representative estimates available show only marginal gains and indicate that approximately 350,000 or 21.9% of the adult population are

[5] An AIDS orphan is a child who became an orphan because one or both parents died from AIDS.

infected with HIV in 2016 (UNAIDS 2017). In the 2004 and 2008 Botswana AIDS Impact Surveys (BAIS), HIV prevalence[6] rates were 17.1% and 17.6% respectively (NACA 2005; NACA 2008). Ideally, at this stage in the epidemic it is preferable to see prevalence rates start to flatten out, not increase or decrease. A decrease in the prevalence rate might suggest that PLWHIV are not accessing ART and are dying. Conversely, if the prevalence rate increases then new infections are occurring. In terms of new infections, estimates indicate that 15,000 new infections occurred in 2005, 13,000 in 2010 and 14,000 in 2017 underscoring a troubling trend in new infections over the last decade despite Masa (UNAIDS, 2017).

One of Botswana's greatest challenges in responding to HIV is funding. Due to Botswana's upper-middle income country status, many international donors have been withdrawing funding and instead redirecting their donor support to low-income countries. Financial security and sustainability are critical for providing universal access to antiretroviral treatment, allowing Botswana to continue with their highly successful treatment programme. According to the 2013/2014 National Health Accounts (NHA) data, the government of Botswana (GoB) was the primary funder of HIV and AIDS programs in Botswana. The GoB contributed 57% of funding for HIV and AIDS programs, while external donors contributed 43%. More than half of the GoB's HIV and AIDS funding was spent on care and treatment, 16% on orphans and vulnerable children (OVC) activities and 14% on prevention (PEPFAR 2018).

The U.S. President's Emergency Plan for AIDS Relief (PEPFAR) followed by the Global Fund (GF) are the largest external donors. PEPFAR was covering the costs of all ARVs for new initiations for the "Treat All" roll out programme. However, this funding ended in 2018. The next planned GF allocation began in 2019, but funding has been considerably less than its previous grant. The GoB will need to increase its HIV budget in the upcoming years (PEPFAR

[6] Prevalence is the number of people living with HIV infection in a given population at a given time, such as at the end of a given year.

2018). While the GoB provides the majority of funding for its HIV programme, PEPFAR has challenged how GoB budgets and spends its resources, stating that the GoB activities are not sustainable (PEPFAR 2018).

Botswana's response to the epidemic has been remarkable. It has one of the most comprehensive and effective HIV programmes in Africa. Not long ago, Botswana was facing a national crisis as AIDS was decimating the country's population. However, in response to the HIV epidemic, Botswana has become an exemplar within sub-Saharan Africa.

1.2.2. Rationale of this study

This study proposed to build on exploratory research conducted in the community of Chukumuchu, Botswana (Gill, 2007). The findings indicated high levels of awareness of ART in the community and perceptions that these drugs (ARVs) "reduce the strength of the virus in the body". While no significant relationships between awareness of ART and variables such as economic status, gender, age, education and HIV status were observed, the study suggested that for 15-49 year olds, the ART roll-out and information education communication (IEC) campaign had contributed to changes in awareness of ART (Gill 2007).

The exploratory research in Chukumuchu reported that changed sexual behaviour in the community after the introduction of ART generally indicated that respondents had adopted safer sexual practices. Therefore, the impression gained from the exploratory study was that the availability of ART had not elevated risky sexual behaviour among people. At the time this was contrary to findings from a meta-analytic review of ART and sexual risk behaviour studies conducted in various European countries and the United States (Crepaz, Hart, and Marks 2014). This meta-analytic review indicated that regardless of their HIV serostatus, the likelihood of unprotected sex was higher in people who indicated that receiving ART protects against transmitting HIV (this was prior to the Cohen study proving this to be the case), or that the availability of ART reduces their concerns about having unsafe sex.

The Chukumuchu findings were also contrary to results from multiple studies that explored ART and sexual risk behaviour conducted in various high-, middle- and low-income countries (Bajunirwe et al. 2013; Demissie et al. 2015; Ezekiel et al. 2008; Luchters et al. 2008; Kalichman et al. 2010) . It is therefore necessary to also verify these findings and determine the situation at a national level in an African high-incidence country.

1.2.3. Academic Contribution

There has been minimal research on the potential impact of large-scale ART distribution on the sexual behaviour of an HIV-negative population and on those unaware of their status. As mentioned, it is worth noting that much of the literature on effects of ART on populations come from studies conducted among HIV-positive people, and those at a particularly higher risk of infection (Mackellar et al. 2011; Maggiolo and Leone 2010; Yalew et al. 2012). This research on a more representative population will be important to the academic and public health communities by providing a nationally representative analysis regarding sexual behaviour linked to HIV sero-prevalence in relation to expanded coverage of ART amongst the HIV-negative population, those unaware of their status and those circumcised compared to those not circumcised.

1.2.4. Societal Contribution

The findings of this dissertation will be important for providing insights into the changing nature of the epidemic in Botswana within the context of ART. In addition, by establishing the extent to which ARVs have impacted on sexual risk taking behaviour, this study will indicate ways in which government and private sector programmes could be explicitly adapted to optimise prevention programming in the larger framework of prevention. The analysis of ART availability in Botswana and the effects on possible increases in sexual risk-taking behaviour could have critical implications for government policies in health and development sectors.

In order to contain the epidemic in Botswana, the scaling up of ART needs to be complemented by successful preventative measures to reduce the incidence of HIV infection (NACA 2014; Baggaley et al. 2016). Successful HIV prevention campaigns include knowledge, stigma reduction, access to services, delay of first intercourse, a reduction in number of partners, increases in condom use, circumcision, and a downturn in sharing of contaminated injection equipment.

Education and effective behavioural change programmes have been credited for reduced rates of HIV infection in Uganda, Senegal, Brazil, Cote d'Ivoire, Kenya, Malawi, Tanzania, Zimbabwe, Botswana, Burkina Faso, Namibia, Swaziland, Burundi, Haiti, and Rwanda (Coates et al. 2008). During the 1990's, prevention programs in Uganda focused on abstinence, faithfulness, as well as the distribution of condoms, which were accompanied by a fall in HIV prevalence from 15% in 1991 to 5% in 2001 (UNAIDS 2004). The success of these programs should not be forgotten but should evolve to include TasP (De Coninck 2014).

1.3. Analytical Framework

Although there exists some complexity in the discourse around the causal relationship between ART availability and reduced HIV and AIDS concern, the dominant thesis in this regard relates to perceptions of threat and disease susceptibility or treatment optimism - the notion that changes in the perceived threat of HIV, may lead to reduced caution in sexual practices, reduced concerns about HIV; an escalation in unsafe sex and incidences of sexually transmitted infections in the ART era (Diabate 2013; Mayanja et al. 2012).

However, it is necessary to recognise the intertwined relationship existing between individuals and their environment. This study will consider both the individual level, which includes; the individual characteristics that influence behaviour such as a person's knowledge, attitudes, skills, and beliefs and; the community level, which recognises

established norms and values as well as societal factors that help to maintain economic and/or social inequalities between groups in society.

In accordance with treatment optimism, the analytic frame posits that perceptions and beliefs about ART are underlying determinants of behaviour, and that the effects of belief on behaviour are partly mediated by attitudes at both the individual and community levels. The most effective approach to prevention and control uses a combination of interventions at both levels . A major strength of this approach is that it will be possible to offer strategies of behavioural change in relation to the environment. Multilevel analyses among individual and community and related intervention strategies will also be possible.

1.4. Literature review of treatment optimism in relation to ART and circumcision

1.4.1. ART

Attitudes towards HIV infection and ART in Botswana as well as sexual behaviour in the context of ART availability are supported by the literature. Anecdotal accounts suggest that the availability of ART may increase opportunities for continued or relapse of risky sexual behaviours among HIV infected people and those at risk of infection. In particular, reduction in the perceived threat of HIV may lead to reduced caution in sexual practices.

Indeed, studies of ART users in several high-income countries have reported reduced concerns about HIV as well as an increase in unsafe sex and in incidence of sexually transmitted infections. These concerns of decreased awareness of HIV risks and increases in HIV risk behaviour were documented among MSM (Bavinton et al. 2016; Kalichman and Eaton 2017; Levy et al. 2017), and heterosexuals (Burman et al. 2009; Chen 2014; Mechoulan 2007).

In low- and middle-income settings, studies exploring heterosexual behaviour amongst ART users suggest that having access to ART may lead to a rise in risky behaviour (Bajunirwe,

Bangsberg, and Sethi 2013; Demissie et al. 2015b; Kalichman, Cain, and Simbayi 2010; Ragnarsson et al. 2011b; Vu et al. 2018; Yaya et al. 2014).

Other researchers have found no evidence of escalated unsafe sex across all income level countries in PLWHIV (Doyle et al. 2014; Marshall et al. 2011; Thanawuth and Rojpibulstit 2016; Tsung-chieh et al. 2013; Venkatesh et al. 2011; Wamoyi et al. 2011). Chen et al (2013) conducted a literature review on 14 studies that examined the impact of treatment-related optimistic beliefs on the risk of HIV transmission and sexual risk behaviors. Chen concluded that findings from quantitative studies were largely in support of an association between optimistic beliefs and risk of HIV transmission. However, findings from qualitative studies "pointed to the need for more rigorous and comprehensive examination of the relationship between optimistic beliefs and HIV transmission risk and identified gaps in current research" (Chen 2014).

The scarcity of available research documenting the potential association between ART access and sexual disinhibition in the HIV-negative population and those unaware of their status, is an area of concern as there are very few studies available (Avina Sarna et al. 2012). As a result, little is known about the attitudes, sexual behaviours and HIV risk perception of the HIV-negative population and those unaware of their status in the context of ART availability. Of particular concern, people who are unaware of their HIV status with acute and early infection have been found to be the most infectious (M. Cohen et al. 2014). HIV-negative individuals and those who are unaware, make up a substantially larger proportion of the population, than the HIV-positive population. If risky behaviour among this population increases due to the feeling that ART lowers the 'death sentence' that was once associated with HIV, then this change in behaviour may affect the impact that ART has on the epidemic.

In addition, although ART has been a success for those who have access to lifelong treatment, AIDS-related illnesses and HIV-associated complications have emerged,

resulting in a chronic disease that will span several decades of life. “Treatment does not fully restore immune health and as a consequence several inflammation-associated and/or immunodeficiency complications such as cardiovascular disease and cancer are increasing in importance. Cumulative toxicities from exposure to ART for decades cause clinically-relevant metabolic disturbances and end-organ damage. There are growing concerns that the multi-morbidity associated with HIV disease may impact healthy aging and could overwhelm some health care systems, particularly those in resource-limited regions that have yet to fully develop a chronic care model” (Deeks et al. 2014).

1.4.2. VMMC

Treatment optimism is a major concern relating to male circumcision. The issue of sexual disinhibition may be especially relevant for young and sexually active populations in high HIV-prevalence areas. Shi et al (2017) suggests that sexual risk compensation could undercut the effectiveness of VMMC as an anti-HIV measure particularly since circumcision is only partially protective, and could also expand the transmission risk of other sexually transmitted infections (STI) (Shi, Li, and Dushoff 2017).

A study in Uganda found that circumcised men were more inclined to have additional non-marital sex and more sexual partners. They were also less likely to use condoms with a non-marital partner compared to uncircumcised men (Kibira et al. 2016). Qualitative studies found results ranging from no sexual risk behaviour in men with VMMC (L’Engle et al. 2014) to a limited number of participants reporting an upturn in risk behavior in men with VMMC (Grund and Hennink 2012). Although researchers have expressed concern that VMMC programming may lead to risk compensation, Shi et al’s (2017) study of 10 nations (Kenya, Lesotho, Malawi, Mozambique, Namibia, Rwanda, Tanzania, Uganda, Zambia and Zimbabwe) part of the WHO VMMC scale-up programme found no evidence of increased risky behavior by circumcised men compared to those uncircumcised. Results from post- and pre-intervention surveys were analyzed. More importantly, the author’s estimates indicated that the relative amount of risky behaviour decreased (Shi, Li, and Dushoff 2017).

The importance of investigating the relationship between ART and sexual behaviour in these sub-populations cannot be underestimated. ART access is going to be scaled up globally over the foreseeable future and a rise in high-risk sex due to treatment optimism could radically impact the epidemiology of the epidemic. If research conducted on this topic indicates that it may lead to an increase in high-risk sexual behaviour, then health education and a message of 'prevention', which has worked effectively in a number of settings needs to be adapted and utilized in conjunction with access to ART (De Coninck 2014; Yeatman et al. 2013).

1.5. Research aim and objectives

The research objective is to have a better understanding of how ART is impacting sexual behavior in the context of ART in Botswana. This objective will be achieved in chapters 2, 3 and 4 by conducting a review of existing research on the impact of ART on sexual risk behaviour, and examining sexual risk-taking differences in adults who are: (1) unaware of their status; (2) who are circumcised; (3) who are HIV-negative respectively; and (4) comparing those sub-populations to those who are aware of their status, those who are uncircumcised and those HIV-positive, respectively. The measures of risk employed are consistent condom use, condom use at last sex and the number of multiple partners.

1.5.1. Research questions

Construction of the variables is founded on questions from the BAIS IV survey and the accompanying household survey. ART impact perception was measured using the following five questions: 1), "What do you believe ARVs do?" 2), "Has the introduction of ARVs influenced your sexual behaviour?" 3), "Do you think that people on ARV's should always use condoms?" 4), "Do you think a person on ARVs should discontinue/stop taking them once they feel better?" and 5), "Has your personal concern about getting HIV changed since the introduction of ARV's?". These questions are intended to measure the

constructs of susceptibility and severity and used as key independent variables in the regression analysis, and collectively described as HIV treatment optimism.

The next three questions used are 'behavioural'-based and used as dependent variables to measure high-risk sex, commencing with two condom use questions: "In the past 12 months have you always used a condom with this partner?" followed by "The last time you had sexual intercourse with this partner did you or this partner use a condom?". Multiple partnerships are measured quantitatively as the total number of sexual partners (at least more than one) in the last twelve months. The question used was: "In the last 12 months how many people overall have you had sex with?".

1.6. Research methodology

The Botswana AIDS Impact Surveys were sexual behavioural surveys implemented jointly by Statistics Botswana and NACA at a national population level. BAIS surveys were conducted to fulfill the international reporting obligations signed by the government of Botswana in June 2001 for the UNGASS Declaration on HIV and AIDS. Botswana joined other countries in conducting its first national population based household sexual behavioural survey, BAIS I, 2001. The second BAIS survey was conducted in 2004 followed by BAIS III (2008) and BAIS IV (2013). BAIS V is currently in the planning stage and is expected to begin fieldwork in late 2019 with data availability anticipated in late 2020. BAIS has become a regular survey in the Statistics Botswana's programme of household surveys. The regularity of the surveys serves to assist in the monitoring of HIV trends in Botswana (CSO, 2013).

The BAIS surveys took place in collaboration with multi-sectoral stakeholders in Botswana's National HIV and AIDS response. The consultative planning process for BAIS revolves around a very inclusive process with several meetings and workshops held under the stewardship of NACA. As such the author had the opportunity to advocate for the treatment perceptions and belief questions contained in BAIS IV and utilised in this study to assess treatment optimism.

This research utilised secondary quantitative data from the BAIS IV. The BAIS IV survey, conducted in 2013 provides demographic, developmental and health statistics, including data on sexual behaviour, relevant to this study. The BAIS IV individual questionnaire represents the primary recording instrument for this study and was adapted by the candidate to capture data on ART and sexual risk behaviour, required to meet the objectives of this study.

The sampling frame for BAIS IV was based on the Population and Housing Census. This was comprised of a list of all enumeration areas (EAs) together with the number of households in each EA. A stratified two-stage probability sample design was used for the selection of the sample. The first stage was the selection of EAs as primary sampling units selected with probability proportional-to-size (PPS) sampling, where measures of size were the number of households in the EA as defined by the Census. At the second stage of sampling, the households were systematically selected from an updated list of occupied households prepared at the beginning of the survey's fieldwork (i.e. listing of households for the selected EAs).

As part of BAIS IV, national HIV prevalence rates among the population aged 18 months through 64 years were captured. All usual household members aged 18 months through 64 years living in the sampled households were requested to provide a finger-stick blood sample on filter paper for subsequent HIV testing in a central laboratory. The results can be linked with the individual questionnaire enabling in-depth analysis of sero-prevalence and high risk sexual behaviour including numbers, types, and durations of sex partnerships in order to assess concurrency, attitudes, beliefs, and normative influence in the era of high ART coverage. Very few previous studies have had access to a measure of actual HIV status in addition to self-reported status, and this allows this dissertation to provide a valuable contribution to the literature. According to Demographic and Health Surveys (DHS) only four published surveys: Uganda AIS 2011, Malawi DHS 2010, Mozambique AIS/MIS 2015,

and Namibia DHS 2013 had self-reported HIV status. Mozambique was the only country other than Botswana that had both the blood test and self-reported status.

Additionally, linking of the HIV test results to the individual questionnaires enabled analysis of HIV status compared to behaviour. This information is only available through a barcode system thereby making it impossible to link the respondents' identities to their sero-status.

Ethical clearance for this BAIS IV was received from the Health Research Development Committee in Botswana.

1.7. Research limitations

A limitation of this study is that it was a cross-sectional study and therefore could not measure changes in condom use behaviour overtime. In other words, no clear causality could be established rather changes are inferential only. Also, responses to questions were based on self-reported face-to-face interviews and therefore may have been subject to social desirability bias. Sensitive questions about personal sexual behaviors were likely underreported such as the question about testing and what the results of the test was.

1.8. Dissertation outline

This study weaves findings from three separate papers investigating treatment optimism as a relevant and current issue to consider in today's HIV and AIDS epidemic both academically and practically. Each chapter highlights new contributions to the literature and provides important findings towards HIV programming in Botswana and the region.

Chapter 2 reveals research gaps and finds that only two other studies in Africa have assessed risky sex in those who were unaware of their status and no other studies as it relates to treatment optimism. This study may be the first study to investigate this pattern in Africa. Chapter 2 also reveals that high risk sex was evident amongst those who had never

tested and were unaware of their status and is possibly contributing towards the increasing new infections highlighting the need to refocus testing in Botswana. From a programmatic and policy point of view, one of the causes for new infections flatlining since 2010 may be a result of risky sex behaviour amongst individuals who never tested.

Chapter 3 is one of the first studies to consider treatment optimism and circumcision and adds to the literature by examining whether or not there were associations between sexual risk behaviours, circumcision status and ART following the 2009 implementation of the VMMC programme in Botswana. Findings indicate conflicting results regarding sexual risk behaviours among circumcised men and treatment optimism. Those who were circumcised and had changed their sexual practices since the introduction of ART, showed elevated condom use yet other beliefs denoting the impact of ART on safe sex indicated the opposite and a reduction in condom use and more likely to have multiple partners. Clear findings indicate lower condom use for: those married or living together; those of lower socioeconomic status; and those that are not Batswana. In terms of policies and programmes in Botswana, information, communication and education should target both circumcised and uncircumcised men, and their sexual partners, specifically targeting: the 15-24 year olds; those with lower education levels; those married or living together; and those of lower socioeconomic status.

Findings in chapter 4 considers the treatment optimism argument that HIV is a less serious threat due to ART and suggests that those who were HIV-positive were more inclined to practice sexual risk reduction and as a result counters the treatment optimism argument. Chapter 4 reveals that studies on older people have mainly focused on the experiences of older people as HIV-affected rather than HIV-infected. Research and literature on older populations is limited and very few surveys even collect data. As a result, older adults have been largely neglected by prevention programming. However, the sexual behavior and health of this growing population has important implications for HIV.

Each of the chapters individually and as a whole uncover findings that meet the research objective of having a better understanding of how ART is impacting sexual behavior in the context of ART in Botswana.

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Chapter 2: Awareness of HIV status, treatment optimism and ART in Botswana

Abstract

This chapter examined whether or not there were associations between sexual risk behaviours, and certain perceptions about ART, otherwise known as treatment optimism. This paper will counter the treatment optimism argument that HIV is a less serious threat due to ART, by investigating the relationship between ART and sexual behaviour among individuals who were aware of their HIV status and those who were not, while considering personal and community level influences. The study utilised secondary quantitative data from the Botswana AIDS Impact Survey, 2013 (BAIS IV). The national study included 6,239 participants, between the ages 15 and 64, who had sexual experience. Respondents provided a blood sample and participated in a self-reported question regarding HIV testing and results. Findings suggested that on the basis of the predominant theory of treatment optimism, there was statistically significant evidence to support treatment optimism among those who were unaware of their status. Individuals who had never tested reported risky sexual behaviour in the context of certain beliefs and perceptions about ART. This risky behavior included lower condom use and greater frequency of multiple partners. However, those who had tested and were aware of their status were more inclined to protect themselves. Therefore, continued emphasis on testing and counselling should remain a priority for prevention programming in Botswana.

Key words: ART, Botswana, HIV status, risky sexual behaviours

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2.1. Introduction

Studies of individuals undergoing ART[7] in selected high-income countries showed reduced concerns about HIV infection, or treatment optimism. This may lead to increases in unprotected sex and incidence in sexually transmitted infections. Reduced awareness of HIV risks and an increase in HIV risk behaviour have been documented among men who have sex with men or MSM (Bavinton et al., 2016; Kalichman et al., 2017; Levy et al. 2017), and heterosexuals (Burman et al. 2009; Chen 2014; Mechoulan 2007). In low- and middle-income settings, studies exploring heterosexual behaviour amongst those on ART suggest that having access to treatment may lead to an escalation in risky behaviour (Bajunirwe, Bangsberg, and Sethi 2013; Demissie et al. 2015; Kalichman, Cain, and Simbayi 2010; Ragnarsson et al. 2011; Vu et al. 2018; Yaya et al. 2014).

On the contrary, among people living with HIV (PLWHIV), in high and low income countries researchers have found no evidence of elevated incidences of unsafe sex (Doyle et al. 2014; Marshall et al. 2011; Thanawuth and Rojpibulstit 2016; Tsung-chieh et al. 2013; Venkatesh et al. 2011; Wamoyi et al. 2011). In a systematic review to determine whether or not ART is undermining HIV prevention efforts by changing individual risk-taking behavior Doyle et al (2014) concluded that despite concerns, research suggested that unprotected sex is reduced among HIV-infected individuals on treatment.

The present study investigated the treatment optimism argument that HIV is a less serious threat due to ART. In examining the relationship between ART and sexual behaviour among individuals who were aware and unaware of their HIV status, while considering personal and community level influences, I identified a gap in available research supporting this argument. By exploring health promotion campaigns in Botswana, a country with a solid track record of implementing successful public health campaigns with ART distribution, this study aimed to enrich this field of research.

[7] ART - The combination of antiretroviral (ARV) drugs to maximally suppress the HIV virus and stop the progression of HIV disease.

2.2. Analytical Framework

The notion that changes in the perceived threat of HIV, due for example, to beliefs that ART has made HIV less lethal, or that HIV infection is now more of a chronic than a life-threatening illness, may lead to reduced caution in sexual practices, to reduced concerns about HIV, and/or increases in unsafe sex and incidences of sexually transmitted infections in the ART era (Diabate 2013; Mayanja et al. 2012). However, it is necessary to recognise the intertwined relationship existing between an individual and the individual's environment. Recognising that individual behaviour is influenced by multiple factors at different levels (Gombachika et al. 2012), this framework addresses the individual and communities levels.

The first level is the individual level, which examines the individual characteristics that influence behaviour, such as an individual's knowledge, attitudes, skills, and beliefs**.** The second level is the community level, which recognises established norms and values as well as societal factors that lead to economic and/or social inequalities between groups in society.

This analytic frame posits that beliefs are underlying determinants of behaviour, and that the effects of belief on behaviour are partly mediated by influences in accordance with the two levels. Presumably, the most effective approach to prevention and control would use a combination of interventions at both levels of the frame. A major strength of this approach is that it can offer strategies of behavioural change in relation to both levels.

2.3. Methods

2.3.1. Data sources

The dissertation utilised secondary quantitative data from the Botswana AIDS Impact Survey, 2013 (BAIS IV). BAIS IV provided demographic, social and health statistics, that

included data on sexual behaviour. The Survey's individual questionnaire represented the primary recording instrument for this study. It was adapted by the author, while working in Botswana, to capture data on ART and sexual risk behaviour, making the present study possible.

The sampling frame for BAIS IV was based on the Population and Housing Census. The sample size was 15,061 successfully interviewed respondents. This present study focuses on those 6,239 participants who completed the individual questionnaire in 2013, were aged 15-64, had sexual experience, and provided a blood sample and responded to the self-reported question regarding HIV testing and results: 6,239. Prevalence of HIV was determined in two ways: a) by dried blood spot samples collected at the sampled households for subsequent HIV testing; and b) questions related to testing from the individual questionnaire. Complementary to the BAIS study was the household study, which collected additional data from the respondents concerning, citizenship, housing, assets, water access and is used to roughly assess socio-economic status.

Variables identified in the following section posited that beliefs are underlying determinants of behaviour, and that the effects of belief on behaviour are partly mediated by attitudes in accordance with the personal and community levels (see Table 1). Analyses was undertaken using Stata 15.1. Variables are considered significant using $p<0.05$.

2.3.2. Measures

The principal variables are shown in Table 1. Construction of the variables was based on questions from BAIS IV and from the accompanying household survey. Table 1 details the level of the analytical framework to which the variables relate, the variable descriptions , and the units of measure.

The first three variables defined are 'behavioural'-based and are used as dependent variables to measure high-risk sex, commencing with two condom use variables followed

by multiple partnerships. Multiple partnerships are measured quantitatively as the total number of sexual partners (at least more than one) in the last twelve months.

Next, are five independent variables concerning the individual's beliefs related to ARV. For instance, 'ARVs cure AIDS' is based on asking the respondent; "What do you believe ARVs do?" The response options are: "Cure AIDS; Cure HIV; Suppress HIV; and Don't Know". The other four variables are constructed in a similar fashion. These are intended to measure the constructs of susceptibility and severity and are used as key independent variables in the regression analysis, and collectively described as HIV treatment optimism.

Table 1: Principal variables using BIAS IV, 2013

Level	Dependent Variables	Unit of measure
Personal	*In the past 12 months have you always used a condom with this partner?	0=No 1=Yes
Personal	*The last time you had sexual intercourse with this partner did you or this partner use a condom?	0=No 1=Yes
Personal	*In the last 12 months with how many people overall have you had sex with?	0=1 Partner 1=2 or more partners
Level	**Independent Variables**	**Unit of measure**
Personal	What do you believe ARVs do?	0=Suppress HIV and AIDS 1=Cure HIV and AIDS
Personal	Has the introduction of ARVs influenced your sexual behaviour?	0=No 1=Yes
Personal	Do you think that people on ARV's should always use condoms?	0=No 1=Yes
Personal	Do you think a person on ARVs should discontinue/stop taking them once they feel better?	0=Yes 1=No
Personal	Has your personal concern about getting HIV changed since the introduction of ARV's?	0=Less Concerned 1=More Concerned
Level	**Control Variables**	**Unit of measure**
Personal	Education	1=None 2=Primary 3=Secondary 4=Tertiary
Personal	Urban/Rural	0=City 1=Rural

Personal	Citizenship	0=Botswana 1=Africans 2=Elsewhere
Personal	Age	1=15-24 yrs. 2=25-34 yrs. 3=35-44 yrs. 4=45-54 yrs. 5=55-64 yrs.
Personal	Marriage	1=Living together or married 2=Never married 3=widowed, divorced, separated
Community	Cooking	1=Electrical 2=Gas and propane 3=Wood, coal and dung
Community	Employment - In the past 7 days did you work for payment, profit or home use for at least 1 h?	0=No 1=Yes
Community	Does any member of this household own a motor vehicle in working condition?	0=No 1=Yes
Community	What is the main toilet facility used by this household? Flush?	0=Other 1=Flush
Community	Which of the following social and medical services are available in this locality/area? ARV programme?	0=No 1=Yes

*These questions relate to the respondent's "main" partner only. There are also questions about other partners. However, they are not analyzed here.

2.4. Ethical statement

The Research Ethics Board at Wilfrid Laurier University, Canada granted ethical clearance for the study while permission to use the secondary data was obtained from Statistics Botswana.

2.5. Results

2.5.1. Description of the sample

Table 2 presents distribution of respondents by various socio-demographic characteristics. Respondents were also categorised into two groups: individuals who were unaware of their HIV status and individuals who were aware of their HIV status. 57% fell between the ages of 25 and 44. Over 70% had obtained secondary or tertiary education. The majority of those surveyed were Christian. Half of the population were married or cohabitating and almost two thirds of the respondents resided in an urban setting. Notably, a higher percentage of 15-24 year olds and 55-64 year olds (23% in both cases) were unaware of their status compared to much lower percentages in the other age groups. This could be an indication they assume they were relatively low risk. Out of those with no education, 23% were unaware of their HIV status, which is much higher than for those with primary, secondary and tertiary education (11%, 12% and 8% respectively).

Table 2: Characteristics of the study population

Variables	Unaware of HIV Status	Aware of HIV Status	*p value	n=
Age				
15-24 yrs	23%	77%	0.0000	1163
25-34 yrs	6%	94%	0.0000	2021
35-44 yrs	7%	93%	0.0000	1388
45-54 yrs	11%	89%	0.0000	861
55-64 yrs	23%	77%	0.0000	491
				5924
Education				
None	23%	77%	0.0000	562
Primary	11%	89%	0.0000	1085
Secondary	12%	88%	0.0000	2892
Tertiary	8%	92%	0.0000	1385
				5924
Religion				
Christian	11%	89%	0.0000	5114
Other	28%	72%	0.0000	32
Badimo	21%	79%	0.0000	224
No Religion	14%	86%	0.0000	554
				5924
Marriage Status				

Married	9%	91%	0.0000	2964
Never married	15%	85%	0.0000	2722
Separated	11%	89%	0.0000	238
				5924
Urban/Rural				
Urban	11%	89%	0.0000	3805
Rural	14%	86%	0.0000	2119
Overall mean	14%	86%		5924

*p values are one-sample t-tests

Although not all of those surveyed were aware of their HIV status, the study requested that participants provided a blood sample, upon consent. Results were collected to determine status and linked to the anonymized individual data. In table 3, among those who were unaware of their status, for each age category, individuals had lower HIV prevalence rates compared to those who were aware of their status. For instance, in the age category between 15-24 years, those who that were unaware of their status had a prevalence rate of 6% while those who were aware of their status had a prevalence rate of 13%. Individuals who were aware of their status consistently reported higher rates of HIV prevalence. This could be a result of having symptoms of HIV and getting tested. Individuals claiming to be unaware may have lower rates of prevalence because they feel they were unlikely to have been exposed to HIV and were never tested. Respondents between the ages of 25 and 44 demonstrated the highest prevalence rate of infection.

Table 3: HIV prevalence in the study population

Variables	Unaware of HIV Status	Aware of HIV Status	Mean	*p value
***HIV Prevalence**				
15-24 Years	6%	13%	11%	0.0000
25-34 Years	22%	26%	26%	0.0000
35-44 Years	39%	41%	41%	0.0000
45-54 Years	17%	37%	35%	0.0000
55-64 Years	7%	26%	22%	0.0000
Mean	14%	29%	27%	
	n=606	n=3996	n=4602	

***** HIV prevalence rates are based on the HIV blood test results for only those that gave consent on the day of the survey (n=4602).

2.5.2. Awareness and knowledge of ART

In terms of treatment options available for HIV infected people, findings in table 4 indicate that 98% of those aware of their status understood that ART was the dominant treatment option. This was only slightly lower for those unaware of their HIV status. In terms of functional knowledge of ART and what ARVs could or could not do, 97% of those aware and 92% of those unaware believed that ARVs suppress AIDS.

Table 4: Awareness and knowledge of the study population

What treatment options are available for HIV infected people?	Unaware of HIV Status	Aware of HIV Status	*p value	Mean
ART	92%	98%	0.000	97%
	n=701	n=5229		n=5930
What do you believe ARVs do?				
Suppress	92%	97%	0.000	96%
	n=646	n=5103		n=5749

2.5.3. Personal beliefs about ART

Data for young people aged 15-24, indicate that condom use at last sex with a main partner was 80% for those aware of their HIV status, and 89% for those unaware. In table 5, among individuals between 15 and 64 years old, and who were aware of their status, 70% used a condom at last sex, while the proportion of those unaware was lower, at 66%. Condom use is quite low for main partner, which may indicate that the availability of ART is having a negative impact on condom use. It may also be a reflection of the established and familiar relationship between main partners. As BAIS IV was conducted prior to the Botswana "treat all" strategy rolled out in 2016, this is probably not a reflection of the general population's

understanding that ART reduces transmission. Rates of condom usage were higher with second and third partners.

Table 5: Consistent condom use (a, 15-64 years and b, 15-24 years)

a) Did you use a condom the last time you had sex with this partner? (15-64)	Unaware of HIV Status	Aware of HIV Status	*p value	Mean
Partner 1				
Yes	66%	70%		70%
No	34%	30%		30%
	n=521	n=4434	0.000	n=4919
Partner 2				
Yes	88%	86%		86%
No	12%	14%		14%
	n=98	n=627	0.000	n=724
Partner 3				
Yes	83%	89%		87%
No	17%	11%		13%
	n=42	n=215	0.000	n=257

b) Did you always use a condom with this partner? (15-24)	Unaware of HIV Status	Aware of HIV Status	*p value	Mean
Partner 1				
Yes	59%	60%		60%
No	41%	40%		40%
	n=521	n=4434	0.000	n=4919

*p values are two-sample t-tests

Results in Table 6 indicate that 94% of individuals who were aware of their HIV status believed that ARV treatment should continue despite feeling better. 88% stated that a condom should still be used while on ARV treatment. Percentages for each category drops only slightly among the population who are unaware of their HIV status.

Table 6: Beliefs about ART

Do you think a person on antiretroviral (ARV) should	Unaware of HIV Status	Aware of HIV Status	*p value	Mean

discontinue / stop taking them once they feel better?				
No	92%	94%		94%
Yes	8%	6%		6%
	n=646	n=5103	0.0000	n=5618
Do you think that people on ARV's should always use condoms?				
No	13%	12%		12%
Yes	87%	88%		88%
	n=651	n=5103	0.0000	n=5618

*p values are two-sample t-tests

The advice of the government of Botswana in relation to condom use and ART, at the time of BAIS IV, was to always use a condom as this was in the timeframe prior to the 'treat all' campaign. These findings may indicate that the availability of ART had a positive impact on condom use. This may in part be due to the counselling received by those who were tested at a health clinic. Results indicate that, in 2013, 94% of the population believed that you should not stop taking ARVs if you are feeling better, and 88% specified that they believe you should use a condom if you are on ARVs.

Table 7 indicates that only 10% of those who knew their HIV status agreed that men could have more than one partner at a time. For respondents who were unaware of their status, the percentage who agreed with this statement, increased only to 12%. In this same group, only 7% stated that a woman could have more than one partner at a time.

Table 7: Acceptability of multiple partners

Do you think it is acceptable for a man to have more than one sexual partner?	Unaware of HIV Status	Aware of HIV Status	*p value	Mean
No	88%	90%		90%
Yes	12%	10%		10%
Do you think it is acceptable for a woman to have more than one sexual partner?	n=683	n=5204	0.0000	n=5887
No	93%	93%		93%

Yes	7%	7%		7%
	n=683	n=5204	0.0000	n=5887

*p values are two-sample t-tests

Findings in table 8 indicate that for women and men who were aware of their status, and who were between ages 15 and 64; and had had sex during the last 12 months, 14% had two or more partners. Among those who were unaware, 19% had two or more partners.

Table 8: Prevalence of multiple partners

In the last 12 months, how many people have you had sex with?	Unaware of HIV Status	Aware of HIV Status	*p value	Mean
1	81%	86%		85%
2 or more	19%	14%		15%
	n=521	n=4434	0.0000	n=4955

*p values are two-sample t-tests

Findings from table 9 indicate that 92% of those who were aware of their status (and 84% of those who were unaware) agreed that it was acceptable for a woman to obtain male condoms. Also, 95% of those who knew their status agreed that it is a woman's right to decide if she will have safe sex. However, only 89% of those unaware of their status agreed that a woman has the right to decide.

Table 9: Acceptability of obtaining condoms

Do you think it should be acceptable for a woman to obtain male condoms	Unaware of HIV Status	Aware of HIV Status	*p value	Mean
No/unsure	16%	7%		9%
Yes	84%	92%	0.0000	91%
Do you think it should be acceptable for a man to obtain female condoms?				
No/unsure	26%	15%		17%
Yes	74%	85%	0.0000	83%
Do you agree that a woman has a right to decide if she will				

have safe sex? (e.g. use a condom)				
No/unsure	11%	5%		6%
Yes	89%	95%	0.0000	94%
	n=701	n=5229		n=5930

*p values are two-sample t-tests

2.5.4. Regression analysis

To analyse this further, results in tables 10, 11 and 12 present logistic regression analysis of the impact of ART perception on inconsistent condom use, condom use at last sex and the number of partners in the last 12 months. Those unaware of their HIV status will be compared to those who were aware of their status. Throughout, the text only highlights coefficients which were significant at the 95% CI level.

Table 10: Logistic regression - ART perception on consistent condom use

Logistic regression coefficients showing the impact of ART perception on consistent condom use (In the past 12 months have you always used a condom with this partner?), by HIV status.

Variable	Unaware of HIV Status n=331	Aware of HIV Status n=3187
Belief that ARVs cure AIDS. (1=Cure HIV and AIDS)	.0555 (0.615)	-.0192 (0.737)
Has the introduction of ARVs influenced your sexual behaviour? (1=yes)	-.0153 (0.701)	.0428*** (0.006)
Do you think that people on ARV's should always use condoms? (1=yes)	-.1219 (0.108)	-.0156 (0.539)
Do you think a person on ARVs should discontinue/stop taking them once they feel better? (1=no)	.1260 (0.177)	.0371 (0.312)
Female	-.0239 (0.669)	-.0667*** (0.000)

25-34 year olds (15-24 year olds is the base category and used for comparison)	-.2463*** (0.000)	-.0460* (0.072)
35-44 year olds	-.4135*** (0.000)	-.0382 (0.190)
45-54 year olds	-.3417*** (0.000)	-.0065 (0.860)
55-64 year olds	-.5743*** (0.000)	-.1446*** (0.003)
Gas and propane for cooking (Electricity for cooking is the base category and used for comparison)	-.0391 (0.546)	.0334 (0.123)
Wood, coal, dung for cooking	.0813 (0.337)	-.0765** (0.011)
Employment (1=Yes)	-.0804 (0.146)	.0150 (0.445)
What is the main toilet facility used by this household? (1=Flush)	.0590 (0.379	-.0366 (0.134)
Does any member of this household own a motor vehicle in working condition? (1=Yes)	.0728 (0.276	-.0537*** (0.005)
Never married (Married/living together is the omitted category used	.1338** (0.018)	.1780*** (0.000)
Separated	.3185 (0.106)	.2343*** (0.000)
Islam, Bahai, Hinduism (Christian is the base category and used for comparison)	.2789 (0.521)	.1103 (0.542)
Badimo	-.0535 (0.624)	-.0038 (0.937)
No religion	.1231** (0.082)	.0504* (0.088)
Education Primary (No education is the base category and used for comparison)	.0472 (0.600)	.0947** (0.018)
Education Secondary	.0334 (0.749)	.1382*** (0.001)
Education Tertiary	.1171 (0.159)	.0762* (0.081)
Access to ART services (1=Yes)	.0315 (0.520)	.0180 (0.313)

Rural (Urban is the base category and used for comparison)	-.0705 (0.264)	-.0278 (0.229)
Country of origin - Africa (Country of origin Botswana is the base category and used for comparison)	-.1826*** (0.012	-.2204*** (0.000)
Country of origin - elsewhere in world	-.3556* (0.081)	-.1570 (0.270)
Adj R-squared	0.2903	0.0732

* The table reports regression coefficients and (standard errors). (* indicates significance at the < 0.1 level, ** significance at the < 0.05 level; and *** significance at the < 0.01 level).

Table 11: Logistic regression - ART perception on condom use at last sex

Logistic regression coefficients showing the impact of ART perception on condom use at last sex (The last time you had sexual intercourse with this partner did you or this partner use a condom?), by HIV status.

Variable	Unaware of HIV Status n=476	Aware of HIV Status n=4,168
Belief that ARVs cure AIDS. (1=Cure HIV and AIDS)	-.0068 (0.949)	-.0297 (0.574)
Has the introduction of ARVs influenced your sexual behaviour? (1=yes)	.0281 (0.469)	.0482*** (0.001)
Do you think that people on ARV's should always use condoms? (1=yes)	-.0104 (0.887)	-.0054 (0.817)
Do you think a person on ARVs should discontinue/stop taking them once they feel better? (1=no)	-.2253** (0.013)	.0854** (0.012)
Female	-.0807 (0.137)	-.0745*** (0.000)
25-34 year olds (15-24 year olds is the base category and used for comparison)	-.1165* (0.087)	-.0172 (0.466)
35-44 year olds	-.2457*** (0.003)	-.0530** (0.050)
45-54 year olds	-.2718*** (0.004)	-.0656** (0.055)
55-64 year olds	-.4832*** (0.000)	-.2247*** (0.000)
Gas and propane for cooking (Electricity for cooking is the base category and used for comparison)	-.0318 (0.613)	.0378** (0.060)
Wood, coal, dung for cooking	.0577	-.0360

	(0.482)	(0.198)
Employment (1=Yes)	-.0700	-.0081
	(0.191)	(0.655)
What is the main toilet facility used by this household? (1=Flush)	-.0235	-.0296
	(0.717)	(0.189)
Does any member of this household own a motor vehicle in working condition? (1=Yes)	.0479	-.0575***
	(0.359)	(0.001)
Never married (Married/living together is the omitted category used	.1854***	.1320***
	(0.001)	(0.000)
Separated	.3012	.2117***
	(0.115)	(0.000)
Islam, Bahai, Hinduism (Christian is the base category and used for comparison)	.1253	-.0388
	(0.766)	(0.817)
Badimo	-.1139	.0318
	(0.283)	(0.485)
No religion	.1445***	.0218
	(0.036)	(0.425)
Education Primary (No education is the base category and used for comparison)	.1233	0978***
	(0.162)	(0.008)
Education Secondary	.1197	.1423***
	(0.171)	(0.000)
Education Tertiary	.1534	.1158***
	(0.131)	(0.004)
Access to ART services (1=Yes)	.0278	.0175
	(0.558)	(0.290)
Rural (Urban is the base category and used for comparison)	-.1632**	-.0299
	(0.055)	(0.163)
Country of origin - Africa (Country of origin Botswana is the base category and used for comparison)	-.1977***	-.2500***
	(0.004)	(0.000)
Country of origin - elsewhere in world	-.4523***	.0078
	(0.018)	(0.963)
Adj R-squared	0.2837	0.0788

* The table reports regression coefficients and standard errors. (* indicates significance at the < 0.1 level, ** significance at the < 0.05 level; and *** significance at the < 0.01 level).

Table 12: Logistic regression - ART perception on multiple concurrent partnerships

Logistic regression coefficients showing the impact of ART perception on multiple concurrent partnerships (In the last 12 months with how many people overall have you had sex?), by HIV status.

Variable	Unaware of HIV Status	Aware of HIV Status

	n=476	n=4,168
Belief that ARVs cure AIDS. (1=Cure HIV and AIDS)	.0259 (0.792)	-.0064 (0.873)
Has the introduction of ARVs influenced your sexual behaviour? (1=yes)	.0508 (0.154)	.0169 (0.127)
Do you think that people on ARV's should always use condoms? (1=yes)	.1258** (0.062)	-.0236 (0.190)
Do you think a person on ARVs should discontinue/stop taking them once they feel better? (1=no)	-.0351 (0.672)	-.0043 (0.866)
Female	-.1335*** (0.008)	-.1379*** (0.000)
25-34 year olds (15-24 year olds is the base category and used for comparison)	.0290 (0.641)	-.0572*** (0.002)
35-44 year olds	-.1341* (0.073)	-.1189*** (0.000)
45-54 year olds	-.1786** (0.037)	-.1475*** (0.000)
55-64 year olds	-.1655* (0.088)	-.1398*** (0.000)
Gas and propane for cooking (Electricity for cooking is the base category and used for comparison)	-.0373 (0.518)	-.0057 (0.707)
Wood, coal, dung for cooking	-.0525 (0.485)	-.0227 (0.289)
Employment (1=Yes)	.0334 (0.496)	.0278** (0.046)
What is the main toilet facility used by this household? (1=Flush)	.0205 (0.730)	.0037 (0.828)
Does any member of this household own a motor vehicle in working condition? (1=Yes)	.0322 (0.501)	-.0013 (0.923)
Never married (Married/living together is the omitted category used	.0470 (0.347)	.0943*** (0.000)
Separated	.2438 (0.164)	.0685** (0.071)
Islam, Bahai, Hinduism (Christian is the base category and used for comparison)	-.0374 (0.923)	.2230* (0.082)
Badimo	-.0822 (0.397)	.0506 (0.147)
No religion	-.0041 (0.947)	.0019 (0.924)
Education Primary (No education is the base category and used for comparison)	.0057 (0.943)	.0121 (0.669)
Education Secondary	.0758 (0.344)	.0297 (0.294)

Education Tertiary	.0441 (0.634)	.0332 (0.282)
Access to ART services (1=Yes)	.0490 (0.261)	.0005 (0.965)
Rural (Urban is the base category and used for comparison)	-.0484 (0.388)	-.0054 (0.739)
Country of origin - Africa (Country of origin Botswana is the base category and used for comparison)	-.0130 (0.842)	-.0273 (0.422)
Country of origin - elsewhere in world	-.0130 (0.820)	-.1985 (0.123)
Adj R-squared	0.0798	0.0844

* The table reports regression coefficients and standard errors. (* indicates significance at the < 0.1 level, ** significance at the < 0.05 level; and *** significance at the < 0.01 level).

2.5.4.1. The impact of ART beliefs on condom use and multiple partners

Regression findings from this study indicate that for those who were aware of their HIV status and answered yes to the question - "Do you think a person on ARVs should discontinue/stop taking them once they feel better?", was associated with increased probability of using a condom at last sex by roughly 8%. Conversely, those unaware of their status who had the same response were 22% less likely to use a condom at last sex.

Findings also indicate that for those who were aware of their HIV status and responded yes (compared to no) to whether ARVs influenced their sexual behaviour by practicing safer sex, there was an increased probability of consistent condom use by 4%, and increased probability of condom use at last sex by 5%.

Table 11 finds a significant effect on one belief variable and the likelihood of having multiple partnerships. Regression results indicate that for participants who were unaware of their HIV status and who think that people on ARV's should always use condoms, 13% were more likely to report multiple partnerships. Among respondents who were aware of their HIV status, 2% were less likely to have multiple partners.

2.5.4.2. Socio-demographic information

For those that were aware of their HIV status, primary, secondary and tertiary education were associated with a greater likelihood of using a condom consistently (10%, 14% and 8%) and at last sex (10%, 14% and 12%), compared to someone with no education. For those unaware of their status, living in a rural area is associated with a lower likelihood of using a condom at last sex by 16% compared to those in an urban area. Both those who are unaware and aware of their status and living in Botswana, but from elsewhere in Africa were less likely to use a condom consistently compared to a Batswana or people from Botswana, by 18% and 22% respectively. For non-citizens who are not African, and unaware of their HIV status, they were 35% less likely. The same trend was found with condom use at last sex.

In terms of age, and compared to the 15-24 year old category, those unaware of their status were less likely to use a condom consistently in the age groups, 25-34, 35-44, 45-54 and 55-64, commencing with 24% and climbing to 57%. Condom use at last sex had similar results. Those aware of their HIV status followed a similar pattern, but this difference was significant only in the age categories 25-34 (4%) and 55-64 (14%). As age increases, the likelihood of multiple partners decreases.

Among respondents who never married and were unaware of their HIV status, 13% were more likely than those married to use condoms consistently. For the same group of individuals, 18% were more likely to use condoms at last intercourse compared to participants who were married. On the other hand, among those surveyed who never married and were aware of their HIV status, 18% were more likely than those married to use condoms. Moreover, this same group was 13% more likely to use condoms at last intercourse than married individuals. There is a similar effect for those who were separated and aware of their status. In terms of multiple partnerships, those aware of their HIV status indicated a higher number of multiple partners, compared with those who were married.

Among those aware of their HIV status, females were 7% less likely than men aware of their status to use a condom consistently, and 6% less likely to use one during last sex. For females who were both aware and unaware, multiple partners decreased. Participants without religious affiliation were more inclined to use condoms for both aware and unaware categories. Followers of Islam, Bahai and Hinduism and who were aware of their HIV status, were more inclined to report having had multiple partners compared to Christians.

In summary and in terms of treatment optimism, there were differences between the behaviors of those who were aware of their status and those who were unaware. Those who were aware of their HIV status were more likely to state that the availability of ARVs had affected their sexual behaviour and as a result decreased their risky sexual behaviour. By comparison, those who were unaware of their HIV status reported more risky sexual behaviours. These patterns suggest that those who were aware of their status, also had greater knowledge and agreement with prevailing scientific guidance regarding HIV prevention. This guidance may have been received at the health clinic where the test was conducted.

For those aware of their HIV status, men were more likely than women to have used condoms and both those aware and those unaware were less likely to have had multiple partners; condom use decreased with age along with multiple partners, and more so for those unaware of their status. Those who were either never married or separated were more likely to use condoms than those who were married in both awareness categories; those aware of their HIV status and with more education were more likely to use condoms, compared to those with no education. Condom use was lower for those who were not citizens of Botswana for both those aware as well as those not aware of their HIV status. Results also indicate that those with no religion were more inclined to use condoms for both categories.

2.6. Discussion

Botswana established a national ART programme in 2002, the first African country to do so. It has become one of the most successful in sub-Saharan Africa (Stover 2014). The key characteristics are that it is universal and free, making ART available to all eligible citizens. In 2016, in line with the WHO treatment guidelines, Botswana launched the 'treat all' strategy, which aimed to start anyone who tested positive for HIV on treatment immediately (PEPFAR 2018).

ART has transformed the management of HIV infection to the point where ART is used as a primary HIV prevention method (Cohen et al. 2012; Kalichman et al., 2017). The first step in the 90-90-90 UNAIDS targets is to diagnose 90% all HIV-positive persons. Once accomplished the remaining goals can be tackled: provide ART for 90% of those diagnosed, and achieve viral suppression for 90% of those treated by 2020. However, 20% or 4 million of all PLWHIV in Eastern and Southern Africa were unaware that they had the virus (UNAIDS 2018). This ambitious goal set by UNAIDS will require a dramatic change in how HIV prevention is pursued and especially as it depends in part upon diagnostics (Carter 2016; Collaborators 2016). Transmission rate-modeling estimates that almost half of all transmissions in the USA were from less than a quarter of people living with HIV who were unaware of their infection (Hall et al. 2012).

In Botswana new infections dramatically decreased from the mid 1990s at 37,000 per year to about 13,000 in 2010. However, new HIV infections have remained constant since 2010 notwithstanding the wide distribution of ART (UNAIDS 2017). This phenomenon has also been observed in South Africa where reductions in HIV infections have not occurred in spite of ART availability (Oldenburg et al. 2016). In addition, HIV infections remain stable or were rising among with MSM in countries that have wide-scale access to ART (Kalichman et al. 2017).

Kalichman et al (2017) argues that "the potential for ART to change the course of HIV epidemics has not yet demonstrated significant reductions in HIV incidence at the community-level in major cities where ART is widely accessible" (Kalichman et al. 2017). Possible factors that may account for this include large populations of those unaware of their status, poor retention in care, and incomplete ART adherence or slow ART uptake (Iwuji et al. 2016; S. C. Kalichman et al. 2017).

Although Botswana's ART programme has done well, there were concerns around the number of adults who tested positive but did not continue onto treatment. The 'loss to follow-up rate' steadily worsened for first line treatment. The failure rate was less than 6% in 2012 and grew to over 10% in 2013. ART coverage was also compromised by low rates of HIV testing (NACA 2014). The PEPFAR (2018) country report indicated that in Q1 2018, over 100,000 people were tested, more than 5,000 participants were identified as HIV positive and slightly over 3,000 individuals initiated ART, making the overall ART initiation rate just over 60%. The same report points out that there is still a significant proportion of Batswana who, despite knowing they are HIV infected, do not want to initiate treatment. Also, retaining those on ART and keeping them virologially suppressed is challenging and relates to literacy and understanding the need to stay on treatment. This also relates to viral load testing labs currently operating at 60% due to lab reagent stock-outs and out-of-service machines, often prohibiting timely viral load testing. The national supply chain issues are also negatively impacting the distribution of required commodities and causing periodic stock-outs of essential commodities (PEPFAR, 2018).

Kalichman (2017) also argues that "a pattern is emerging where increased awareness of the preventive effects of ART coincide with sexual behaviors that boost exposure to sexually transmitted pathogens that in turn increase risks for HIV transmission" (Kalichman et al., 2017; Kaufman et al. 2008). Knowledge about HIV and AIDS, including treatment, is one of the important precursors for behavioural responses to the epidemic, but it is widely

recognised that basic knowledge is not always sufficient to change behaviour (Shisana et al. 2012).

The comprehensive rollout of ART in Botswana has been widely acknowledged and understood, which may lead people to believe AIDS is no longer a death sentence, but a chronic disease (Kalichman et al., 2017; Paulson, 2011). Also, as people become increasingly aware of the effects of ART on HIV transmission, individuals may reduce their motivation to use condoms to prevent the spread of HIV (Bavinton et al. 2016). As condom use lowers, individuals will be exposed to other sexually transmitted infections (STIs) which could also escalate risks of HIV transmission (Alaei et al. 2016; Kalichman et al., 2017). Shifts in HIV treatment-related beliefs over the course of the HIV epidemic were associated with reductions in condom use and increased risks for other STI (Kalichman et al. 2017).

As the uptake of biomedical interventions increase, sexual behaviors will continue to evolve along with enhanced quality of life and increased sexual health and possibly contribute towards the increasing rates of STIs such as, those reported among PLWHIV, specifically syphilis and especially among MSM (Centers for Disease Control 2017). Marrazzo et al (2018) also argues that as ART uptake gains traction, a "new wave" of increasing STI incidence is gathering strength and MSM are not the only concern (Marrazzo et al. 2018). Although condoms remain highly effective in preventing STI transmission, their decreased use in this era of antiretroviral optimism has been associated with STI increasing globally (Mayer et al. 2018). Emerging evidence suggests that risk of STI increases among gay and bisexual men following initiation of ART (Traeger et al. 2019) begging the question - is high STI incidence likely to undermine the success of TasP or PrEP in the long term or in certain populations?

2.6.1. Individual level

Scientific evidence shows that when used correctly and consistently, condoms are highly effective in HIV prevention. To this end, it can be expected that lower perceived

vulnerability and reduced anxiety about the risk of HIV infection, which could prevail in the context of free and wide availability of ART, could reduce the motivation to use condoms consistently. Findings from this study found that there were statistically significant differences between the behaviors of those who were aware of their status and those who were not, as this relates to beliefs and perceptions about ART. The study indicates that those who were aware of their status were likely to use condoms and therefore exhibited less risky sexual behaviour, supporting similar conclusions from earlier work in Botswana (Gill, 2007; Letamo, Keetile, and Navaneetham 2017). By comparison, those unaware of their status were more likely to have exhibited risky sexual behaviour.

These patterns suggest that those aware of their status, also had greater compliance with scientific guidance regarding HIV. Those unaware of their status include a group who were less informed of such guidance, possibly in part as a result of not receiving prevention communication through testing facilities. They were taking greater risks by not using condoms, an observation supported by a study indicating that people at higher levels of risk may want to remain unaware of their status (Grov, Rendina, and Parsons 2016). Correspondingly, a study of Cameroonian young adults found that being unaware of HIV status was associated with inconsistent condom use (Morris et al. 2014).

There is an evolving relationship between level of education and the risk of HIV infection. Earlier in the epidemic, HIV prevalence tended to be higher among people with higher levels of education. However, HIV prevalence subsequently declined among people with higher education and it increased among people with lower levels of education, presumably as a result of prevention behaviours (De Walque et al. 2005; Hargreaves et al. 2008). This study shows that those who were aware of their status and had higher levels of education were reducing their risky sexual practices. Similar correlations within general populations have been reported in studies on the impact of universal primary education policies in Botswana, Malawi and Uganda (Neve et al. 2015).

Those living in a rural setting who were unaware of their status were less likely than those in an urban area to use condoms at last sex. Citizenship findings indicate that for those who were both aware and unaware of their HIV status and from elsewhere on the African continent or from off the continent were less inclined to use condoms consistently. Currently, in Botswana non-citizens are ineligible for publicly-funded ARVs. Recent data found that 71% of citizens living with HIV are on ART, while only 27% of non-citizens in Botswana are receiving treatment. This disparity undermines the full implementation of the Treat All strategy (PEPFAR 2018).

The BAIS III results indicated that as age increases, inconsistent condom use also increased (Keetile and Letamo 2015). This study found that for both those aware and those unaware of their HIV status, inconsistent condom use, and reduced condom use at last sex, increased with age as well. However, for those who were unaware of their status, reduced condom use was substantially higher than those who were aware of their status. Yet, multiple partners decreased possibly offsetting this finding.

In general, a primary driver of HIV incidence is sexual transmission between married or living together sero-discordant couples. Consistent and correct condom use is effective at preventing sexually transmitted infections and were considered an integral component of a comprehensive approach to HIV prevention according to the government of Botswana's new National HIV and Strategic Framework 2018–2023. More recently, the demonstrated effectiveness of ART to prevent HIV transmission, has raised the question of necessity in terms of condom use among individuals in sero-discordant relationships (Koff et al. 2017; Curran et al. 2012). Findings from this study were not differentiated between sero-concordant or sero-discordant couples. However, in the current study both population subsets (aware and unaware) identified more consistent condom use in those that were never married or separated compared to those that were married.

Testing and counselling is a critical component of prevention programming, and in this study, findings indicate there were some significant gaps for those unaware of their status including: those in age categories 15-24 and 55-64; those with no education; those of "other" religions and Badimo; and those never married. This coincides with findings from a regional study of 16 African countries identifying gaps in HIV testing coverage, particularly among adolescents and the least educated. They also found additional gaps in those less economically well off and men (Staveteig et al. 2017).

2.6.2. Community level

Gender relations have an exceptionally prominent role in the HIV and AIDS epidemic in sub-Saharan Africa, where HIV rates in women substantively exceed those in men (UNAIDS 2018). In this study gender was understood as the state of being male or female and typically used with reference to social and cultural roles rather than biological ones. The relative status of women in society in general and in their intimate relationships can strongly impact the chances of being infected and is a common theme in the literature (Sovran 2013). Gender inequality was attributed as being one of the primary factors in the epidemiology of HIV in Africa. For example, if women find themselves in a subordinate position to male sexual partners, particularly with the threat of violence, they may be unable to refuse unsafe sexual practices. According to the Botswana Gender-Based Violence Indicators Study (2012), 67% of women in Botswana had experienced some form of gender violence in their lifetime including partner and non-partner violence. When a healthy relationship is not a culturally viable option for women, their vulnerability to HIV infection is compounded (Sovran 2013).

One potentially unsafe sexual practice is MCP; sexual relationships with more than one person either at the same time or serially (Gourvenec et al. 2007). In Botswana, it was common cultural practice for men to have multiple partners. In these types of sexual

networks, an infected individual with a high viral load[8] who continues to have unprotected sex with their partners, could spread the disease unless they used condoms (Kim 2014). Hence, MCP in Botswana, has been a key driver of HIV transmission as they increase the number of infected individuals, the growth rate of the epidemic during its initial phase, and the persistence of the epidemic within the population (Epstein and Morris 2011; Halperin and Epstein 2004). Findings from this study indicate that 10% of those who were aware of their HIV status agreed that men could have more than one partner at a time, but this was slightly higher for those unaware. Only 7% stated that a woman could have more than one partner at a time. This appears to be a positive indication that MCP, once seen to be an acceptable practice and one that puts women at risk, is in decline. However, when considering the number of partners in the last 12 months, those that were aware of their status indicated that 14% had 2 or more partners, while those unaware indicated 19% have had 2 or more partners.

In terms of condom use, in this study, regressions highlighted concerns for females. For instance, compared to males, females that were aware of their HIV status were less likely to have used condoms consistently or to have used a condom at last sex. This statistically significant inconsistent condom use with women compared to men illustrates a gender imbalance in Botswana and a women's subordinate position to male sexual partners, particularly to insist on condom usage. Other studies of sexual behaviours of men and women show similar findings in Botswana and Kenya in 2008 (Cohen 2008).

Religion and a strong adherence to religious principles have been thought to protect against HIV and AIDS transmission by promoting abstinence, monogamy or other protective measures, e.g. Islam favours male circumcision, which reduces HIV transmission (Gray et al. 2007). On the other hand, religion may be detrimental by banning certain protective measures, such as condom use in the Catholic church. Since religion has been a

[8] Viral load is the term used to describe the amount of HIV in your blood.

motivator of behaviour and behavioural change throughout history, it may play an important role in determining patterns of HIV and AIDS in Botswana.

Findings from this study indicate that for both groups - those who were aware of their HIV status and those not, and reported not being part of a faith group, participants were more likely to have used a condom at last intercourse. For those who were aware of their status and of no religion were more inclined to have had multiple partners. Also, for those who were aware of their status; and who were Muslim, Bahai and Hindu followers, individuals were more inclined to have had multiple partners. This is consistent with other similar studies in Botswana that suggest that religious identity serves as a reliable indicator of attitudes and practices that influence the risk of HIV transmission (Haron and Jensen 2008; Keetile 2014).

In summary, at the personal level and in terms of beliefs and attitudes, people's protective behaviours grew if they were aware of their status. However, being in the HIV unaware category was associated with decreases in condom use and an increase in multiple partners. Condom use increased with education, both for those who were aware and those who were unaware of their status. Those living in a rural setting that were unaware of their status, were less likely to use condoms compared to those in an urban area. Citizenship findings indicate that for those that were unaware of their HIV status and from outside of Botswana, were less inclined to use condoms. Also, findings indicate that the older one is the less likelihood that a condom will be used. However, inconsistent condom use was notably higher in adults when unaware of their status. Those in both the aware and unaware categories who were never married or were separated, increased consistent condom use compared to those married or living together. Lower prevalence rates for those unaware compared to those who were aware of their HIV status may be a result of people not testing because they had no symptoms and/or were uninformed.

At the community level, gender roles and woman's inequality continued to play an important role in the AIDS epidemic in Botswana and subsequently a woman's vulnerability to HIV infection. Acceptability of multiple partners was higher for those unaware of their status compared to those aware. In terms of a woman's right to decide if she will have safe sex, findings indicate that those who were unaware of their status were less likely to agree that they did have the right to decide. When considering gender relations and role definition in decision the making process, it is clear that females were less likely to have used condoms compared to males, both those who were aware of their status and those who did not, highlighting concerns for female respondents in general.

2.8. Conclusion

On the basis of the predominant theory of treatment optimism, it is the conclusion of this study is that there is statistically significant evidence to support treatment optimism with those who were unaware of their status. Indeed, those who had never tested were engaging in risky sexual behaviour in the context of certain beliefs and perceptions about ART. Condom use lowered, multiple partners increased and as a result individuals were more exposed to STI, increasing risks of HIV transmission and possibly contributing towards the annual and increasing number of new infections. However, those who had been tested and were aware of their status were more inclined to protect themselves, suggesting that those who were aware of their status, also had greater knowledge and agreement with prevailing scientific guidance regarding HIV.

Riskier sex appears to be associated with those unaware of their HIV status who: had low levels of education; were married or in stable unions; were foreign citizens; live in a rural setting; and were females. In particular, both younger and older people, with fairly low HIV prevalence who were unaware in part because they were relatively low risk. However, many of the risky groups were the ones in the middle of the age spectrum, who were likely sexually active and assumingly practicing high risk sex. Data from this study shows that they had a high HIV prevalence rate. This cadre of people wasn't large at about 10% of the

survey population, but a significant number of them had HIV and were at risk of infecting others.

Therefore, to stop new infections, it is of paramount importance that the government of Botswana continues to prioritize prevention alongside sustained treatment efforts. Continued emphasis on testing and prevention counselling should remain a priority for prevention programming in Botswana as the findings from this study indicate that with those that had not tested and were unaware of their status, continued to put themselves and others at risk. According to Hall et al (2012) about eight transmissions would be averted per 100 persons newly aware of their infection. Public awareness of HIV infection and a reduction in high-risk sex is the first critical step in 90-90-90 targets, which ultimately leads to receiving ART, an undetectable HIV viral load, and reduction in HIV transmissions (Hall, Holtgrave, and Maulsby 2012).

To the author's knowledge, only two other studies in Africa have assessed risky sex amongst those who were unaware of their status. Morris et al (2014) found inconsistent condom use with those unaware of their status in Cameroon. Mhlongo et al (2013) found that condom use was poor amongst Soweto men whether tested or not. Only two other studies exploring self-awareness were found, which were located in USA, but they were not for the purpose of assessing risky sex (Sanchez et al. 2015; Grov, Rendina, and Parsons 2016). Only one of these studies compared self-reported HIV status with blood test results, but the focus was on MSM. Given that there is limited research available on this topic, further enquiry is recommended.

2.9. Limitations

Many of the outcomes we present in this article were self-reported by the participants in face-to-face interviews and may thus have been subject to social desirability bias. Sensitive questions about personal sexual behaviors were likely underreported in this sample.

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Chapter 3: Male circumcision in Botswana: an invisible condom?

Abstract

This study examined whether or not there were associations between sexual risk behaviours, circumcision status and ART otherwise known as treatment optimism following the 2009 implementation of the VMMC programme in Botswana. A higher prevalence of sexual risk behaviours among circumcised men after being informed of the protective nature of circumcision on HIV transmission is hypothesised. The study utilises secondary quantitative data from the Botswana AIDS Impact Survey, 2013 (BAIS IV) and included those participants who completed the individual questionnaire, were aged 15-64 years old, had sexual experience and were males, which totaled 2,641 participants. The findings regarding treatment optimism were contradictory in this study. In terms of beliefs about ART, findings for condom use indicated that circumcised men, who reported that they changed their sexual practice since the introduction of ARVs, were more inclined to have used a condom consistently and at last sex. Uncircumcised men on the other hand, who believed that they should discontinue taking ARVs once they feel better, were similarly more inclined to have used a condom. However, when both those circumcised and those uncircumcised men who believed that you should always use a condom if you are on ARVs, were less likely to have used a condom. This effect was stronger for those circumcised than for those uncircumcised men. Therefore, the Ministry of Health, NACA and their partners should continue sensitising the population to use condoms even when a man is circumcised.

Key words: Botswana, circumcision, risky sexual behaviours, ART

3.1. Introduction

Circumcision pre-dates recorded history. Male circumcision is one of the oldest and most common surgical procedures known (Bailey et al. 2007; Cox, Krieger, and Morris 2015; Gray et al. 2010; Siegfried et al. 2005; Warner and Strashin 1981). Historically, male circumcision was practised among the ancient Egyptians. It is part of the Jewish and Islamic faiths having started with Abraham (Genesis 17: 11) who lived around 2000 BC. Male circumcision has been practiced in Africa for thousands of years as a ritual and rite of passage to manhood especially in West African countries (Sovran 2013). In Botswana, prior to being a British protectorate circumcision was practiced as far back as 1874 marked by an initiation ceremony into manhood called "Bogwera". During Bogwera young adolescent males underwent a month-long period of seclusion in the wild. During this time, they were taught survival tactics, tribal laws and customs, and underwent traditional circumcision. Bogwera was only practiced by the Bakgatla and the Balete tribes. In 1917 the British High Commissioner passed a proclamation banning initiation ceremonies as it was found to be cruel and unhygienic (Ministry of Health 2008).

In the 1990s and into the early 2000s an association between lower HIV prevalence rates and circumcision was observed (Caldwell and Caldwell 1994). Countries with high rates of male circumcision (MC) showed lower rates of HIV prevalence. This was seen in settings where similar sexual practices prevailed in West, East and Southern Africa. In west Africa where there were higher rates of circumcision there were lower HIV prevalence rates (Bongaarts et al. 1989; Moses et al. 1990). This was then statistically supported comparing lower prevalence rates and higher circumcised populations. Findings concluded that circumcision reduced vulnerability to HIV (Halperin and Bailey 2000; Moses 2009; Weiss et al, 2000).

To provide conclusive evidence three randomised controlled trials were undertaken to analyse the effect of male circumcision for the prevention of HIV infection through heterosexual contact in Uganda, Kenya and South Africa (Auvert et al. 2005; Bailey et al.

2007; Gray et al. 2007). Findings indicated that transmission of HIV to males was reduced by upwards of 68%. All three trials were terminated early because it was considered to be unethical to continue (Siegfried et al. 2005). During heterosexual intercourse the reduction in transmission is a result of the foreskin being pulled back and the inner surface of the foreskin being exposed to secretions, providing a large area where HIV transmission can take place (Szabo and Short 2000). Circumcision only protects men (not women) from acquiring HIV.

In Botswana, a mathematical model was used to calculate the public health impact of large-scale male circumcision for HIV prevention. The results showed a potential reduction in male HIV prevalence from 30% to around 10%; and a reduction among females from 40% to about 20% (Ministry of Health 2008). Until recently, circumcision was not routinely offered for male children and was very limited for adults. However, an earlier study on the acceptability of male circumcision in Botswana found that circumcision of a male child was highly acceptable (90%) and 81% for uncircumcised men, provided the procedure was offered at no cost to the patient, and in a hospital setting (Kebaabetswe et al. 2003).

VMMC represents a new phase in the context of HIV prevention in Botswana. It is noteworthy, however, that male circumcision does not completely prevent HIV transmission and risk remains a very real concern for circumcised men who believe they are protected with an “invisible condom”. This could easily negate the benefits of circumcision by increasing their exposure through unprotected sexual intercourse with greater numbers of partners, referred to as “risk compensation”. The objective of this paper is to determine whether there are associations between sexual risk behaviours and circumcision status after the 2009 implementation of the VMMC programme in Botswana. It is hypothesized that there will be a higher prevalence of sexual risk behaviours among circumcised men.

3.2. Analytical Framework

HIV treatment optimism has traditionally been comprised of two distinct components: a belief that HIV is a less serious health threat due to the availability of ART otherwise known as 'reduced-severity optimism' and a belief in reduced susceptibility to HIV due to the suppressive effect of ART on the viral load of infected sexual partners known as 'reduced-susceptibility optimism' (Levy et al. 2017). Variables on beliefs and perceptions about ART will be examined while investigating the treatment optimism theory. Risk compensation, the modification between the level of risk one takes, and the perceived risk will be used to address the sociodemographic variables.

However, it is necessary to recognise the intertwined relationship existing between an individual and the individual's environment. For the purpose of this study, I will use the individual level: includes the individual characteristics that influence behaviour such as a person's knowledge, attitudes, skills, and beliefs**.** The second level is the community level and it recognises established norms and values as well as societal factors that help to maintain economic and/or social inequalities between groups in society.

The framework posits that beliefs are underlying determinants of behaviour, and that the effects of belief on behaviour are partly mediated by influences in accordance with these levels. The most effective approach to prevention and control uses a combination of interventions at both levels of the model. A major strength of this approach is that it will be possible to offer strategies of behavioural change in relation to the two levels.

3.3. Methods

3.3.1. Data

The paper utilised secondary quantitative data from the Botswana AIDS Impact Survey, 2013 (BAIS IV). BAIS IV, provided demographic, social and health statistics, including data

on sexual behaviour. The survey's individual questionnaire represents the primary recording instrument for this study and was adapted by the author while working in Botswana to capture data on ART and sexual risk behaviour, making this analysis possible.

The sampling frame for BAIS IV was based on the Population and Housing Census. The sample size was 15,061 successfully interviewed respondents. The present study uses those participants who completed the individual questionnaire in 2013, aged 15-64 years old, had sexual experience and were males: 2,641 participants. Complementary to the BAIS study was the Household study, which collected additional data from the respondents concerning, citizenship, housing, assets, water access, etc., and is used to roughly determine socio-economic status.

Linking the analytical model to the measures will be arranged by two levels. Variables identified in the following section posit that beliefs are underlying determinants of behaviour, and that the effects of belief on behaviour are partly mediated by attitudes in accordance with the levels – personal and community. Analysis was undertaken using Stata 15.1. Variables were considered significant using $p<0.05$.

3.3.2. Measures

The principal variables for each of the explanatory factors are shown in Table 1. Construction of the variables is founded on questions from BAIS IV and the associated household survey. Table 1 details the level of the analytical framework to which the variable relates, the variable description , and the unit of measure.

The first three variables defined are 'behavioural' based and will be used as dependent variables to measure high-risk sex, commencing with two condom use variables followed by multiple partnerships. Multiple partnerships are measured quantitatively as the total number of sexual partners (at least more than one) in the last twelve months.

Next, are five independent variables concerning the individual's beliefs. For instance, 'ARVs cure AIDS' is based on asking the respondent; "What do you believe ARVs do?" The response options are: "Cure AIDS; Cure HIV; Suppress HIV; and Don't Know". The other four variables are constructed in a similar fashion. These are intended to measure the constructs of susceptibility and severity and used as key independent variables in the regression analysis, and collectively described as HIV treatment optimism.

Table 1: Principal variables using BAIS IV, 2013

Level	Dependent Variables	Unit of measure
Personal	*In the past 12 months have you always used a condom with this partner?	0=No 1=Yes
Personal	*The last time you had sexual intercourse with this partner did you or this partner use a condom?	0=No 1=Yes
Personal	*In the last 12 months with how many people overall have you had sex with?	0=1 Partner 1=2 or more partners
Level	**Independent Variables**	**Unit of measure**
Personal	What do you believe ARVs do?	0=Suppress HIV and AIDS 1=Cure HIV and AIDS
Personal	Has the introduction of ARVs influenced your sexual behaviour?	0=No 1=Yes
Personal	Do you think that people on ARV's should always use condoms?	0=No 1=Yes
Personal	Do you think a person on ARVs should discontinue/stop taking them once they feel better?	0=Yes 1=No
Personal	Has your personal concern about getting HIV changed since the introduction of ARV's?	0=Less Concerned 1=More Concerned
Level	**Control Variables**	**Unit of measure**
Personal	Education	1=None 2=Primary 3=Secondary 4=Tertiary
Personal	Urban/Rural	0=City 1=Rural
Personal	Citizenship	0=Botswana 1=Africans 2=Elsewhere

Personal	Age	1=15-24 yrs. 2=25-34 yrs. 3=35-44 yrs. 4=45-54 yrs. 5=55-64 yrs.
Personal	Marriage	1=Living together or married 2=Never married 3=widowed, divorced, separated
Community	Cooking	1=Electrical 2=Gas and propane 3=Wood, coal and dung
Community	Employment - In the past 7 days did you work for payment, profit or home use for at least 1 h?	0=No 1=Yes
Community	Does any member of this household own a motor vehicle in working condition?	0=No 1=Yes
Community	What is the main toilet facility used by this household? Flush?	0=Other 1=Flush
Community	Which of the following social and medical services are available in this locality/area? ARV programme?	0=No 1=Yes

*These questions relate to the respondent's "main" partner only. There are also questions about other partners. However, they are not analyzed here.

3.4 Ethical statement

The Research Ethics Board at Wilfrid Laurier University, Canada granted ethical clearance for the study while permission to use the secondary data was obtained from Statistics Botswana.

3.5. Results

3.5.1. Description of the sample

Table 2 presents the distribution of respondents by various socio-demographic characteristics and is categorised by those who are circumcised and those who are not. The analysis is restricted to males aged 15-64 years old, who have ever had sex.

In general, 30% of the sample population were circumcised. Among younger age groups, circumcision rates appear to be lower. For example, 24% of individuals between the ages of 15 and 24 years old were circumcised. Education and marital status also seem to be factors in rates of circumcision. Respondents with tertiary education who were separated, divorced and widowed demonstrated higher rates of circumcision. Among households that cooked with wood (possibly an indication of lower socioeconomic status), 21% of males were circumcised. Lower rates were also reported for participants who used a non-flush toilet, as well as those who did not own a vehicle. Furthermore, males from rural areas have lower rates of circumcision. These patterns in the data suggest a potential link between rates of circumcision and individual wealth and social structure factors.

Table 2: Characteristics of the study population

Variables	% Circumcised		
	%	*p value	n=
Age Groups			
15-24 yrs	24%	0.000	503
25-34 yrs	28%	0.000	879
35-44 yrs	31%	0.000	654
45-54 yrs	31%	0.000	364
55-64 yrs	37%	0.000	244
			2644
Education			
No education	23%	0.000	291
Education Primary	24%	0.000	480
Education Secondary	27%	0.000	1180
Education Tertiary	39%	0.000	693
			2644
Marriage			
Married	30%	0.000	1377
Never married	28%	0.000	1214
Separated	40%	0.000	53
			2644
Cooking			
Electric	35%	0.000	667

Gas	33%	0.000	957
Wood	21%	0.000	915
			2644
Toilets			
Other	24%	0.000	1424
Flush	35%	0.000	1117
			2644
Vehicle			
No	25%	0.000	1413
Yes	34%	0.000	1128
			2644
Urban/Rural			
Urban	32%	0.000	1696
Rural	23%	0.000	950
			2644
Citizenship			
Botswana	29%	0.000	2378
Africa (Not Botswana)	29%	0.000	153
Elsewhere (Not Africa)	40%	0.000	10
Overall mean	30%		2644

*p values are one-sample t-tests

3.5.2. Awareness and knowledge of ART

Knowledge and awareness of what treatment options were available are presented in Table 3. 97% of circumcised respondents agreed that ART was the best option compared to 95% of those uncircumcised. Only 2% of the circumcised population believed that ARVs cure AIDS compared to 4% of those uncircumcised.

Table 3: Awareness and knowledge of the study population, 15-64 years

What treatment options are available for HIV infected people?	Circumcised	Uncircumcised	*p value	Mean
ART	97%	95%	0.0264	96%
	n=761	n=1846		n=2607
What do you believe ARVs do?				
Suppress HIV?	98%	96%	0.0303	97%

	n=740	n=1759		n=2499

*p values are two-sample t-tests

3.5.3. Personal beliefs about ART

In terms of concern contracting HIV since the introduction of ARVs, results indicate that almost half of the respondants were less concerned and the other half more concerned as shown in table 4. Of those men that stated they were practicing safer sex since the introduction of ARVs, 75% stated that they were using condoms more, 28% were having fewer partners, 16% discontinued multiple concurrent partnerships (MCP), and 9% were abstaining from sex (respondents could give multiple responses).

Table 4: Concern in contracting HIV

Has your personal concern about getting HIV changed since the introduction of ARV's?	Circumcised	Uncircumcised	*p value	Mean
Less concerned	54%	52%		52%
More concerned	46%	48%		48%
	n=739	n=1759	0.000	n=2498
Has the introduction of ARVs influenced your sexual behavior?				
Yes	43%	40%		41%
No	57%	60%		59%
	n=739	n=1759	0.000	n=2498
Out of those who answered yes, those who are practicing <u>more</u> prevention indicate the following prevention methods:				
More condom use	78%	74%		75%
Fewer sexual partners	31%	26%		28%
Discontinue MCP	16%	16%		16%
Abstinence	9%	9%		9%

*p values are two-sample t-tests

Results seem to indicate that the majority of the population sample were aware that a circumcised male should continue to use condoms post VMMC. It would appear according to the findings in table 5, that a significant percentage (8%) of uncircumcised men believed that a circumcised male could stop wearing condoms. These results could have important implications for prevention programs.

Table 5: Condoms and circumcision (circumcised and uncircumcised)

Do you think a circumcised male should stop using condoms?	Circumcised	Uncircumcised	*p value	Mean
No	92%	87%		89%
Yes/Unsure	8%	13%		8%
	n=769	n=1877	0.000	n=2646

*p values are two-sample t-tests

In addition, table 6 is a snapshot of both females and males in the population sample (n=6,043) who thought a circumcised male could stop using condoms or were unsure. 87% of females and 89% of males shared that circumcised men should not stop using condoms. This misunderstanding of the benefits of VMMC could reduce the perceived need for safe sex behaviors, thus counteracting positive VMMC program effects. This is a more nuanced form of risk compensation, but does support the evidence from South Africa, where women who heard about the protective benefits of circumcision perceived reduced personal HIV risk and engaged in riskier sexual behavior (Maughan-Brown and Venkataramani 2013).

Table 6: Condoms and circumcision – (females and males)

Do you think a circumcised male should stop using condoms?	Female	Male	*p value	Mean
No	87%	89%		88%
Yes/Unsure	13%	11%		12%
	n=3387	n=2656	0.000	n=6043

*p values are two-sample t-tests

Although a number of studies were conducted to understand the determinants of VMMC uptake, only a few examined the characteristics of men who are willing to be circumcised or identify the motivational link between circumcision and risky sexual behaviour. Table 7 indicates that among men who were not circumcised, 48% had the intention to undergo circumcision in the next 12 months. Among this same group, 60% shared that their main motivation is related to HIV prevention and not because they desired riskier sex. However, another study did identify an association between wanting circumcision and risky sexual behaviour (Chikutsa, Ncube, and Mutsau 2014).

Table 7: Intention for circumcision

Do you intend to get circumcised in the next 12 months?	Uncircumcised
Yes	48%
No	44%
Don't know	8%
	n=1,879
Why would you get circumcised?	
HIV Prevention	60%
Peer Influence	5%
Cultural Right	1%
Hygienic Reason	29%
Fashion	1%
Religion	1%
Sexual Pleasure	2%
Other	2%
	n=1,070

Table 8 indicates that circumcised men had significantly (p value) lower HIV prevalence than their uncircumcised counterparts. This follows similar findings from a study in Uganda (Kibira et al. 2016).

Table 8: *HIV Sero-status

HIV sero-status	Circumcised	Uncircumcised
Negative	83%	76%
Positive	17%	24%
	n=535	n=1385

*Based on blood sample at time of survey

3.5.4. Regression analysis

To analyse this further, results in tables 9, 10 and 11 present logistic regression analysis of the impact of ART perception on inconsistent condom use, condom use at last sex and the number of partners in the last 12 months. Those men who are circumcised will be compared to those who are not. Throughout we only highlight in the text coefficients which are significant at the 95% CI level.

Table 9: Logistic regression - ART perception on consistent condom use

Logistic regression coefficients showing the impact of ART perception on consistent condom use (In the past 12 months have you always used a condom with this partner?), by circumcision status.

Variable	Circumcised n=476	Uncircumcised n=1,141
Belief that ARVs cure AIDS. (1=Cure HIV and AIDS)	.2281 (0.495)	-.0334 (0.698)
Has the introduction of ARVs influenced your sexual behaviour? (1=Yes)	.1056** (0.013)	-.0234 (0.362)
Do you think that people on ARV's should always use condoms? (1=Yes)	-.1270* (0.065)	-.0748* (0.080)
Do you think a person on ARVs should discontinue/stop taking them once they feel better? (1=No)	-.1214 (0.281)	.0553 (0.347)
25-34 year olds (omitted category is 15-24 year olds)	-.0551 (0.461)	-.1917*** (0.000)
35-44 year olds	-.1192 (0.151)	-.1949*** (0.000)
45-54 year olds	-.1338	-.1335**

	(0.187)	(0.031)
55-64 year olds	-.1385	-.2510***
	(0.244)	(0.001)
Gas and propane for cooking (omitted category is electricity for cooking)	.0370	.0104
	(0.468)	(0.772)
Wood, coal, dung for cooking	-.1379	-.0296
	(0.074)	(0.538)
Employment (1=Yes)	-.0396	-.0294
	(0.507)	(0.413)
What is the main toilet facility used by this household? (1=Flush)	-.0057*	.0145
	(0.057)	(0.710)
Does any member of this household own a motor vehicle in working condition? (1=Yes)	-.0119	.0001
	(0.805)	(0.996)
Never married (omitted category is married)	.2047***	.1371***
	(0.000)	(0.000)
Separated	.1023	.4368***
	(0.477)	(0.000)
Education Primary (omitted category is no education)	.1643	.0793
	(0.166)	(0.159)
Education Secondary	.1893	.1034*
	(0.114)	(0.069).
Education Tertiary	.1154	.0888
	(0.352)	(0.167)
Access to ART services (1=Yes)	.0336	.0109
	(0.457)	(0.707)
Rural	-.0499	-.0019
	(0.397)	(0.958)
Country of origin Africa (omitted category is compared to Botswana)	-.2865**	-.1567**
	(0.012)	(0.015)
Country of origin elsewhere in world (compared to Botswana)	-.0686	-.0500
	(0.850)	(0.887)
R-squared	0.1685	0.0792

* The table reports regression coefficients and standard errors. (* indicates significance at the < 0.1 level, ** significance at the < 0.05 level; and *** significance at the < 0.01 level).

Table 10: Logistic regression - ART perception on condom use at last sex

Logistic regression coefficients showing the impact of ART perception on condom use at last sex (The last time you had sexual intercourse with this partner did you or this partner use a condom?), by circumcision status.

Variable	Circumcised n=476	Uncircumcised n=1,141
Belief that ARVs cure AIDS. (1=Cure HIV and AIDS)	.1458	-.0629
	(0.641)	(0.419)
Has the introduction of ARVs influenced your sexual behaviour? (1=Yes)	.0659*	-.0009
	(0.096)	(0.966)
Do you think that people on ARV's should always use condoms? (1=Yes)	-.0782	-.0542
	(0.225)	(0.160)
Do you think a person on ARVs should discontinue/stop taking them once they feel better? (1=No)	-.1326	.1162**
	(0.208)	(0.029)
25-34 year olds (omitted category is 15-24 year olds)	-.0438	-.0752**
	(0.531)	(0.046)
35-44 year olds	-.0773	-.0877**
	(0.319)	(0.043)
45-54 year olds	-.1413	-.1068**
	(0.137)	(0.055)
55-64 year olds	-.2493**	-.2291***
	(0.025)	(0.000)
Gas and propane for cooking (omitted category is electricity for cooking)	.0186	.0385
	(0.696)	(0.236)
Wood, coal, dung for cooking	-.0551	-.0512
	(0.445)	(0.240)
Employment (1=Yes)	-.0546	-.0047
	(0.329)	(0.885)
What is the main toilet facility used by this household? (1=Flush)	-.0953*	-.0269
	(0.094)	(0.446)
Does any member of this household own a motor vehicle in working condition? (1=Yes)	-.0432	-.0013
	(0.339)	(0.962)
Never married (omitted category is married)	.1242***	.1648***
	(0.007)	(0.000)
Separated	.2351*	.3658***
	(0.081)	(0.000)
Education Primary (omitted category is no education)	.0076	0951**
	(0.945)	(0.062)
Education Secondary	-.0097	.1370***
	(0.931)	(0.008)
Education Tertiary	-.0587	.1401***
	(0.613)	(0.016)
Access to ART services (1=Yes)	.0710*	.0037
	(0.093)	(0.887)
Rural	-.0946*	.0139
	(0.087)	(0.684)
Country of origin Africa (omitted category is compared to Botswana)	-.2372***	-.2519***
	(0.026)	(0.000)

Country of origin elsewhere in world (compared to Botswana)	-.6905** (0.043)	-.4476 (0.162)
R-squared	0.1447	0.1056

* The table reports regression coefficients and standard errors. (* indicates significance at the < 0.1 level, ** significance at the < 0.05 level; and *** significance at the < 0.01 level).

3.5.4.1. The impact of ART beliefs on condom use

Findings from regression analysis on consistent condom use and condom use at last intercourse are similar and therefore will be investigated together. Tables 9 and 10 indicate that those men who were circumcised and changed their sexual practice since the introduction of ARVs, show higher consistent condom use by roughly 10% and 6% for condom use at last intercourse compared to those who had not changed their sexual practices. There was no significant effect for those uncircumcised.

Of those who agreed that people should always use a condom if they are on ARVs, both those circumcised and those uncircumcised reduced condom use, by 12% and 7% respectively. Those who were uncircumcised, and believed that they should discontinue taking ARVs once they feel better, were more inclined to use a condom at last sex by 11%.

3.5.4.2. Socio-demographic information

In terms of impact of age on HIV prevention practices, uncircumcised men reduced consistent condom use as they became older, by 19% for the 25-34 year old category up to 25% for the 55-64 year old category. There was no significant age effect for those who were circumcised. The likelihood of using a condom at last sex decreased with age as well for both groups, but this is significant only for the uncircumcised and the oldest group of circumcised.

Both those circumcised and those never married were more likely to have used a condom consistently than those married by 20% and 13% respectively. Both those circumcised and those uncircumcised that had never married were more likely to have used a condom at

last sex by 12% and 16% respectively. Also, those uncircumcised and separated were more likely to use condoms than a married person by 43%, while the effect is not significant for those circumcised. Those separated were more likely to have used a condom at last sex by 23% and 36% for the circumcised and uncircumcised correspondingly.

A person with secondary education who was uncircumcised was 10% more likely to have used a condom consistently. A higher level of education significantly increased condom use at last sex for those not circumcised whereas the effect is inconsistent and insignificant for those circumcised.

For those who were not from Botswana, both those who were circumcised and those that were not, were less likely to have used a condom consistently compared to a Motswana by 28% and 15% respectively. For both those circumcised and those not, a citizen from elsewhere on the continent was 23% and 25% less likely to have used a condom at last sex, and those off the continent were less likely to have used a condom by 69% and 44% respectively.

Those circumcised who had access to ART services were more likely to have used a condom at last sex by 7%. Those from a rural area and are circumcised were less likely to have used a condom at last sex by 9%.

In summary, and in terms of beliefs, findings for condom use indicate that those circumcised and who reported they changed their sexual practice since the introduction of ARVs were more inclined to have used a condom. Those uncircumcised who believe that they should discontinue taking ARVs once they feel better, were more inclined to have used a condom. However, both those circumcised and those uncircumcised who believed that you should always use a condom if you are on ARVs, were less likely to have used a condom and therefore supports treatment optimism. However, those circumcised were more inclined to engage less consistent condom use than those uncircumcised.

Sociodemographic data suggest that consistent condom use and condom use at last sex was lower for those: uncircumcised as age increased; married or living together; with lower levels of education; and that are not Botswana citizens. For those circumcised those: who were married or living together; from a rural setting; that owned a flush toilet; and that were not Botswana citizens indicated a reduction in condom use.

Table 11: Logistic regression - ART perception on multiple concurrent partnerships

Logistic regression coefficients showing the impact of ART perception on multiple concurrent partnerships (In the last 12 months with how many people overall have you had sex?) by circumcision status.

Variable	Circumcised n=476	Uncircumcised n=4,168
Belief that ARVs cure AIDS. (1=Cure HIV and AIDS)	-.1532 (0.598)	-.0250 (0.738)
Has the introduction of ARVs influenced your sexual behaviour? (1=Yes)	.0347 (0.343)	.0336 (0.131)
Do you think that people on ARV's should always use condoms? (1=Yes)	.1198** (0.045)	-.0175 (0.636)
Do you think a person on ARVs should discontinue/stop taking them once they feel better? (1=No)	-.0666 (0.496)	-.0148 (0.771)
25-34 year olds (omitted category is 15-24 year olds)	.0425 (0.512)	-.0545 (0.133)
35-44 year olds	-.1047 (0.146)	-.0715* (0.086)
45-54 year olds	-.1353 (0.125)	-.1303*** (0.015)
55-64 year olds	-.0521 (0.614)	-.1253** (0.047)
Gas and propane for cooking (omitted category is electricity for cooking)	.0017 (0.968)	.0000 (1.000)
Wood, coal, dung for cooking	-.0133 (0.842)	-.1005** (0.017)
Employment (1=Yes)	-.0629 (0.225)	.0421 (0.178)

What is the main toilet facility used by this household? (1=Flush)	-.0257 (0.626)	-.0230 (0.499)
Does any member of this household own a motor vehicle in working condition? (1=Yes)	.0467 (0.264)	-.0212 (0.430)
Never married (omitted category is married)	.0938*** (0.028)	.1468*** (0.000)
Separated	.3181*** (0.011)	.0177 (0.857)
Education Primary (omitted category is no education)	.0223 (0.828)	.0199 (0.685)
Education Secondary	.0578 (0.578)	.0871* (0.078)
Education Tertiary	.1131 (0.294)	.0325 (0.559)
Access to ART services (1=Yes)	-.0668* (0.089)	.0186 (0.463)
Rural	-.0354 (0.489)	.0459 (0.164)
Country of origin Africa (omitted category is compared to Botswana)	-.1392 (0.159)	.0066 (0.905)
Country of origin elsewhere in world (compared to Botswana)	-.3907 (0.217)	-.1357 (0.659)
R-squared	0.0691	0.0630

* The table reports regression coefficients and standard errors. (* indicates significance at the < 0.1 level, ** significance at the < 0.05 level; and *** significance at the < 0.01 level).

3.5.4.3. The impact of ART beliefs on multiple partnerships

Findings from Table 11 indicate that those who were circumcised and believed that people on ARVs should always use condoms were 12% more inclined to have multiple partnerships; the coefficient has the opposite sign (but is insignificant) for those not circumcised.

Regarding age, uncircumcised older men were less likely to have had multiple partnerships, from 7% less for the 35-44 year olds (compared to those 15-24), to 13% less for the 55-64 year olds. Reported effects were similar for circumcised men but not statistically significant. For marriage, both those who were circumcised and those who were not, and never married were more likely to have multiple partners by 9% and 14% respectively.

Separated and circumcised men were 31% more likely to have had multiple partners. Circumcised men with secondary education were 9% more likely to have had multiple partners (compared to those with no education).

In terms of improved access to ART services, among circumcised men, the findings implied that this group was 7% less likely to have had multiple partners if they had access to services, whereas for those who were uncircumcised the sign is opposite, but the effect is not significant.

To summarize, the results on risk are somewhat contradictory. On the one hand those who were circumcised and who indicated they changed their behavior, were more likely to use condoms consistently and at last sex. On the other hand, those circumcised who believed that people on ARVs should continue using condoms, were less likely to use a condom consistently and more likely to have multiple partners. Those uncircumcised were also less inclined to use a condom consistently when believing that people on ARVs should continue using condoms, and more inclined to use condoms at last sex if they believed that a person on ARVs could stop taking them once they felt better. In addition, for those circumcised, condom use was lower for those: married or living together; who seem to be from a lower socioeconomic status; and that are not Batswana. Multiple partners increased for those: never married; separated; and with a secondary education.

3.6. Discussion

Botswana is a country that has been deeply affected by the HIV and AIDS epidemic. Due to the financial burden of the epidemic on the economy, in 2001 the government declared HIV and AIDS a national emergency and an issue of high national priority. Structures and policies were developed, and programmes deployed as part of a multi-sectoral response aimed at curbing HIV-related deaths and preventing new HIV infections (NACA 2014).

One key component of the government's strategy was the provision of ART to all eligible citizens through the National ARV Therapy Programme. In addition, routine testing and counseling was introduced through all functional health facilities; and prevention of mother to child transmission (PMTCT) services were scaled up to all health facilities. As a result, mother to child transmission of HIV was reduced from an estimated 40% without PMTCT to about 5%. A rigorous behavioural change communication campaign identifying the benefits of condom use and the call for a reduction in multiple and concurrent partnerships (MCP) was also rolled out nationwide (Ministry of Health 2008).

These commendable and innovative efforts together with other prevention programmes have contributed to the reduction of HIV infection rates in the country. However, infection rates are still high, and more needs to be done. Thus, having reviewed all the available information and evidence on VMMC as an HIV intervention, the National AIDS Council recommended VMMC as an additional HIV prevention strategy in the Country in 2009.

The percentage of males aged 15-49 who had been circumcised ranged from 11% in 2018 to around 30% in 2016. However, this rate of development failed to reach government targets of 80% coverage among HIV negative men, despite efforts to boost demand for VMMC. PEPFAR (2018) reports that since inception of the national safe male circumcision (SMC) program, 206,030 procedures were performed representing 30% coverage in the male populations aged 10 to 49 years. This closely aligns with the findings from this study. It is however, uncertain as to why rates continue to be lower than the targeted number, but according to a study by Katisi and Daniel (2015) there is substantial cultural resistance to VMMC in Botswana. Issues that have generated resistance include public marketing campaigns, sexualized language and female health staff implementing the programme. Apparently chiefs and traditional leaders initially cooperated with VMMC but subsequently discouraged men from participating. Cultural resistance has had a significant impact on the SMC programme (Katisi and Daniel 2015).

Also, if risk compensation factors into the VMMC rollout, the benefits of the programme may be at risk. To this point, evidence for risk compensation following VMMC programmes have produced mixed findings. A study in Zimbabwe indicated that almost a quarter of young men believed they did not need to use condoms after undergoing VMMC (Hatzold et al. 2014). Using the 2008 BAIS III, Ayiga and Letamo (2011) found that male circumcision did not impede condom use in Botswana, but that condom use at last sex was impeded by misconceptions regarding ART (Ayiga and Letamo 2012). Letamo et al 2017 who also examined treatment optimism in BAIS IV for males and females 15 years and older, found that respondents who believed that ARVs cure HIV, and that people who believed that, when on ARVs, one should use a condom, were less likely to engage in unsafe sex. However, they found that respondents who believed that a person on ARVs should discontinue taking them once they feel better increased engagement in risky sexual behaviour (Letamo, Keetile, and Navaneetham 2017). Findings from this study concerning beliefs about ART indicated that those who were circumcised and had changed their sexual practices since the introduction of ART, had shown increased condom use. Nevertheless, other beliefs denoting the impact of ART on safe sex indicate the opposite and a reduction in condom use and more likely to have multiple partners.

A study that examined Zulu individuals in South Africa found evidence consistent with risk compensation among women who heard about the protective benefits of circumcision and as a result perceived reduced personal HIV risk and engaged in riskier sexual behavior (Maughan-Brown and Venkataramani 2013). Further attention should be paid to the role of new information regarding VMMC, and drivers of HIV risk more broadly, in moderating sexual behavior among women. In this study, more females than males thought that a circumcised male could stop wearing condoms. Misunderstanding of the benefits of VMMC could reduce the perceived need for safe sex behaviors, thus counteracting positive VMMC program effects. This is a more nuanced form of risk compensation, but does support the evidence from South Africa, where women who heard about the protective

benefits of circumcision perceived reduced personal HIV risk and engaged in riskier sexual behavior.

3.6.1. Individual level

Contrary to this, evidence from studies in Kenya, Uganda, South Africa and a Southern Africa regional study, concluded that risk compensation was not associated with VMMC (Govender et al. 2018; Kalichman et al. 2007; Kong et al. 2012; Mattson et al. 2008; Shi, Li, and Dushoff 2017; Westercamp et al. 2014; Ortblad et al., 2019). Othieno (2015) also found that duration of ART was a significant predictor of consistent condom use. Patients who had received ART for more than 3 years were more likely to use condoms consistently compared with those on ART for shorter duration. This is possibly due to the effect of prevention programs and counseling among ART-experienced patients compared with those who were new to ART (Othieno et al. 2015).

Earlier in the epidemic, the more educated members of society were the most vulnerable to HIV infection. However, with intensification of information and understanding, their behavior changed in terms of reducing the number of partners and increasing condom use amongst other actions, to decrease risk of infection compared to someone less educated. Statistically significant findings in this study indicate that a person with secondary education that was uncircumcised is more likely to use a condom consistently and at last sex compared to those with less education. Other studies indicate similar findings for those of higher education (Ayiga and Letamo 2012; Balekang and Dintwa 2016). In this study there was a much higher rate of circumcision with those that have tertiary education.

Those separated, divorced or widowed had a much higher rate of circumcision. Findings indicate that those never married, both circumcised and not, were more likely to use a condom than those married. Those uncircumcised and separated were more likely to use condoms than a married person. Both those circumcised and those not that had never

married were more likely to use a condom at last sex. These findings are consistent with a study from Botswana using the BAIS III data and a study in Zambia where being married/living with a partner and being formerly married were highly associated with risky sexual behaviour (Ayiga and Letamo 2012; Mapoma and Bwalya 2017). In terms of multiple partners, those never married, both those who were circumcised and those who were not, were more likely to have had multiple partners. For those separated and circumcised, they were 31% more likely to have had multiple partners, which support similar findings from Balekang and Dintwa in Botswana (2016).

A lower percentage of those from rural areas were circumcised. Those from a rural area and were circumcised were less likely to have used a condom at last sex, similar to findings from South Africa (Beksinska. et al. 2012).

In summary, at the individual level, this study indicates conflicting results regarding sexual risk behaviours among circumcised men with certain beliefs about ART or treatment optimism. Those who were circumcised and had changed their sexual practices since the introduction of ART, showed a rise in condom use. Nevertheless, other beliefs denoting the impact of ART on safe sex indicate the opposite and a reduction in condom use and more likely to have multiple partners.

Clear signs of risk compensation are witnessed for those circumcised with lower condom use for those: married or living together; who seem to be from a lower socioeconomic status; and that are not Batswana. An upsurge in multiple partners was found with those: having a higher education and; never married or separated. However, even so, circumcised men still had significantly lower HIV prevalence than their uncircumcised counterparts. This follows similar findings from a study in Uganda (Kibira et al. 2016).

3.6.2. Community level

The association between lower socioeconomic status and HIV and AIDS is difficult to determine. At the community level, it's not possible to correlate levels of socioeconomic status following conventional approaches of providing income and expenditures, due to the limited BAIS data collected. However, Steinert et al (2017) argue that poverty may also be realised through various household level material assets denoting wellbeing such as what cooking fuel is used, type of toilet facilities and vehicle ownership. Also, human capital like employment and access to health services may correlate to levels of poverty (Steinert et al. 2017). In this study there were lower rates of circumcision found with lower socioeconomic status (as indicated by those that used a non-flush toilet, those who cooked with wood rather than those who used electricity or gas, and those that did not own a vehicle).

Also, at the community level regression analysis found that those circumcised and had access to ART services were more inclined to practice condom use and less likely to have had multiple partners. This difference may be a result of the prevention messaging received at the VMMC programme. This was also found to be the case when counseling is placed within or related to VMMC programs which promoted protective behavior change among participants in Kenya (Riess et al. 2010).

3.8. Conclusion

Findings indicate that treatment optimism is contradictory in this study. In terms of beliefs about ART, findings for condom use indicate that those circumcised and reported that they changed their sexual practice since the introduction of ARVs were more inclined to use a condom consistently and at last sex. Those uncircumcised who believe that they should discontinue taking ARVs once they feel better, were also more inclined to use a condom. However, both circumcised and uncircumcised men, who believed that you should always use a condom if you are on ARVs, were less likely to have used a condom.

Sociodemographic data suggest that consistent condom use and condom use at last sex was lower for those: uncircumcised as age increased; married or living together; with lower levels of education; and that are not Botswana citizens. For those circumcised those: who were married or living together; from a rural setting; that owned a flush toilet; and that were not Botswana citizens indicated a reduction in condom use.

Therefore, considering the level of sexual risk behaviours among men observed in this study, the Ministry of Health, NACA and their partners should continue sensitising the population to use condoms even when a man is circumcised. These messages should target both circumcised and uncircumcised men, and their sexual partners, specifically targeting: the 15-24 year olds; those with lower education levels; those married or living together, and those of lower socioeconomic status.

Circumcision should continue to be considered an integral part of the Botswana HIV prevention strategy, including HIV counseling and testing, condom promotion, behavioural change communication, ART, etc. The benefit should be expanded to its fullest potential for both males and females where evidence has demonstrated that the use of a combination of proven HIV prevention options including VMMC, deliver population-level impact.

3.9. Limitations

This study was limited as a result of the data being secondary in nature and therefore restricted in terms of in-depth analysis. Also, information was self-reported and consequently subject to reporting errors. Bias may have factored into responses where there is social desirability and the need to comply with social norms and behaviour.

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Chapter 4: Reflecting on the relationship between antiretroviral therapy beliefs and sexual behavior for people living with HIV and AIDS in Botswana

Abstract

This study examined associations between sexual risk behaviours, ART beliefs and perceptions according to an individual's HIV status. This is often known as 'treatment optimism'. In particular, the paper explored the aspect of treatment optimism theory that argues that HIV is a less serious threat due to ART. The primary method of doing this was investigating the relationship between ART and sexual behaviour in those people that are HIV-positive and HIV-negative, at the personal and community levels. The study utilised secondary quantitative data from the Botswana AIDS Impact Survey, 2013 (BAIS IV) and included participants who completed an individual questionnaire, were aged 15-64 years old and had sexual experience. Sample size of this group totaled 6,239 participants. Findings suggested that HIV-positive individuals were more inclined to adopt sexual risk reduction behaviour and countered the treatment optimism argument. Increases in condom use were found correlating with the belief that ARVs cure AIDS, and that a person on ARVs should always use a condom. For those HIV-negative, if they agreed that a person on ARVs should always use a condom, they themselves were less inclined to use a condom supporting treatment optimism in that case. This implies that the increased access to ART and possible misconceptions have not compromised safer sex and seems to support the substantive government information, education and communication campaigning, which sensitizes people to the risks associated with unsafe sexual practices and the need to test. Also continued emphasis on prevention should be geared towards those: HIV-negative with lower education levels; HIV-negative and HIV-positive that are married or in long-term relationships; HIV-positive that appear to be less economically successful; and females that were both HIV-negative and HIV-positive.

Key words: ART, Botswana, PLWHIV, risky sexual behaviours

4.1. Introduction

Prevention of HIV infection has been an important public health challenge since the first AIDS case was reported 30 years ago. Remarkable progress has been made with 75% of all people knowing their HIV status at the end of 2017. Among those who knew their HIV status, 79% were on ART, and 81% of people accessing treatment had suppressed viral loads (UNAIDS 2018).

Eastern and Southern Africa remains the region most affected by the HIV epidemic, accounting for 45% of the world's HIV infections and 53% of PLWHIV globally. More than three quarters of the 19.6 million (81%) PLWHIV in Eastern and Southern Africa at the end of 2017 were aware of their HIV status. Of those who knew their status, 12.9 million were accessing antiretroviral therapy, which is equivalent to 66% of all PLWHIV in the region. Among those accessing treatment, 52% were virally suppressed, which translates into half of all PLWHIV in the region at the end of 2017. Therefore, a third of all PLWHIV are still not receiving treatment (UNAIDS 2018).

Although the majority of HIV-infected people adopt safer sexual practices after learning their HIV status, some people continue to engage in high-risk behaviors such as unprotected sex with HIV-negative partners and represent an important source of transmission (Hernando et al. 2009; Ping Du et al. 2012). As HIV-infected people live longer in the ART era, HIV prevention efforts are increasingly targeting persons living with HIV and AIDS with prevention with positive programs (PwP) often called positive health, dignity and prevention (PHDP)[9] which provide comprehensive HIV services (Musinguzi et al. 2014; Kennedy et al. 2010).

[9] The PHDP approach places the person living with HIV at the centre of managing his or her own health and wellbeing. It is a model which links HIV treatment, prevention, support and care issues within a human rights framework. It emphasizes the importance of addressing prevention and treatment simultaneously and holistically.

However, the availability and incorrect knowledge of ART may present opportunities for a relapse of risky sexual behaviour[10] known as, 'treatment optimism.' This study will investigate the treatment optimism argument that HIV is a less serious threat due to ART, by investigating the relationship between ART and sexual behaviour in those people that are HIV-positive and those HIV-negative.

4.2. Analytical Framework

The notion that changes in the perceived threat of HIV, due for example, to beliefs that ART has made HIV less lethal, or that HIV infection is now more of a chronic than a life-threatening illness may lead to reduced caution in sexual practices, reduced concerns about HIV; increases in unsafe sex and incidence of sexually transmitted infections in the ART era (Diabate 2013; Mayanja et al. 2012). However, it is necessary to recognise the intertwined relationship existing between an individual and their environment. Recognising that individual behaviour is influenced by factors at different levels (Gombachika et al. 2012), addressing the complexities and interdependences between socioeconomic, cultural, environmental, and biological determinants of behaviour.

For the purpose of this study, two levels as discussed in Chapter 1. The first level, individual: includes the individual characteristics that influence behaviour such as a person's knowledge, attitudes, skills, and beliefs**.** The second level is the community level and it recognises established norms and values as well as societal factors that help to maintain economic and/or social inequalities between groups in society.

The framework posits that beliefs are underlying determinants of behaviour, and that the effects of belief on behaviour are partly mediated by influences in accordance with both levels. The most effective approach to prevention and control uses a combination of

[10] Risky sexual behavior - Having more than one sexual partner; changing sexual partners frequently; concurrent partnering; and having unprotected oral, vaginal or anal sexual contact.

interventions at both levels. A major strength of this approach is that it will be possible to offer strategies of behavioural change in relation to the levels.

4.3. Methods

4.3.1. Data

The dissertation utilised secondary quantitative data from the Botswana AIDS Impact Survey, 2013 (BAIS IV). BAIS IV provides demographic, social and health statistics, including data on sexual behaviour. The Survey's individual questionnaire represents the primary recording instrument for this study and was adapted by the author while working in Botswana to capture data on ART and sexual risk behaviour, making the present study possible.

The sampling frame for BAIS IV was based on the Population and Housing Census. The sample size was 15,061 successfully interviewed respondents. The present study uses those participants who completed the individual questionnaire in 2013, were aged 15-64 and had sexual experience, totalling 6,239 participants. Prevalence of HIV was determined in two ways: by dried blood spot samples collected at the sampled households for subsequent HIV testing; and self-reported questions related to testing from the individual questionnaire. Complementary to the BAIS study was the Household study, which collected additional data from the respondents concerning, citizenship, housing, assets, water access, etc., and is used to roughly assess socio-economic status.

Linking the analytical model to the measures will be arranged by two levels. Variables identified in the following section will posit that beliefs are underlying determinants of behaviour, and that the effects of belief on behaviour are partly mediated by attitudes in accordance with levels – personal and community (see Table 1). Analyses was undertaken using Stata 15.1. Variables were considered significant using $p<0.05$.

4.3.2. Measures

The principal variables for each of the explanatory factors are shown in Table 1. Construction of the variables is founded on questions from BAIS IV and from the associated household survey. Table 1 details the level of the analytical framework to which the variables relate, the variable descriptions, and the units of measure.

The first three variables defined are 'behavioural' based and are used as dependent variables to measure high-risk sex, commencing with two condom use variables followed by multiple partnerships. Multiple partnerships are measured quantitatively as the total number of sexual partners (at least more than one) in the last twelve months.

Next, are five independent variables concerning the individual's beliefs related to ARVs. For instance, 'ARVs cure AIDS' is based on asking the respondent; "What do you believe ARVs do?" The response options are: "Cure AIDS; Cure HIV; Suppress HIV; and Don't Know". The other four variables are constructed in a similar fashion. These are intended to measure the constructs of susceptibility and severity and are used as key independent variables in the regression analysis, and collectively described as HIV treatment optimism.

Table 1: Principal variables using BIAS IV, 2013

Level	Dependent Variables	Unit of measure
Personal	*In the past 12 months have you always used a condom with this partner?	0=No 1=Yes
Personal	*The last time you had sexual intercourse with this partner did you or this partner use a condom?	0=No 1=Yes
Personal	*In the last 12 months with how many people overall have you had sex with?	0=1 Partner 1=2 or more partners
Level	**Independent Variables**	**Unit of measure**
Personal	What do you believe ARVs do?	0=Suppress HIV and AIDS 1=Cure HIV and AIDS
Personal	Has the introduction of ARVs influenced your sexual behaviour?	0=No 1=Yes

Personal	Do you think that people on ARV's should always use condoms?	0=No 1=Yes
Personal	Do you think a person on ARVs should discontinue/stop taking them once they feel better?	0=Yes 1=No
Personal	Has your personal concern about getting HIV changed since the introduction of ARV's?	0=Less Concerned 1=More Concerned
Level	Control Variables	Unit of measure
Personal	Education	1=None 2=Primary 3=Secondary 4=Tertiary
Personal	Urban/Rural	0=City 1=Rural
Personal	Citizenship	0=Botswana 1=Africans 2=Elsewhere
Personal	Age	1=15-24 yrs. 2=25-34 yrs. 3=35-44 yrs. 4=45-54 yrs. 5=55-64 yrs.
Personal	Marriage	1=Living together or married 2=Never married 3=widowed, divorced, separated
Community	Cooking	1=Electrical 2=Gas and propane 3=Wood, coal and dung
Community	Employment - In the past 7 days did you work for payment, profit or home use for at least 1 h?	0=No 1=Yes
Community	Does any member of this household own a motor vehicle in working condition?	0=No 1=Yes
Community	What is the main toilet facility used by this household? Flush?	0=Other 1=Flush
Community	Which of the following social and medical services are available in this locality/area? ARV programme?	0=No 1=Yes

*These questions relate to the respondent's "main" partner only. There are also questions about other partners. However, they are not analyzed here.

4.4. Ethical statement

The Research Ethics Board at Wilfrid Laurier University, Canada granted ethical clearance for the study while permission to use the secondary data was obtained from Statistics Botswana.

4.5. Results

4.5.1. Description of the sample

Table 2 presents the distribution of respondents by various socio-demographic characteristics and is categorised by self-reported HIV status. The analysis is restricted to those aged 15 to 64, who had sex in the last year, and have tested and reported the result of the test.

The results of the two tiered question; "were you told/given your result for your last HIV test and if so, what was the result?" - indicate that the prevalence rate increases as age goes up to the 35 to 44 year olds who have the highest rate, then declines in the age groups 45 to 54 and 55 to 64 year olds . This may be a case of under reporting which will be covered in Table 3. Those with lower educational levels (no education and primary); those of the Christian religion and no religion; those separated; and those that lived in rural areas had higher self-reported prevalence rates.

Table 2: Characteristics of the study population, 15-64 years.

Variables	**HIV-positive (self-reported)**	***p value**	**n=**
Age			
15-24 yrs	8%	0.0000	874
25-34 yrs	19%	0.0000	1874

35-44 yrs	35%	0.0000	1246
45-54 yrs	29%	0.0000	739
55-64 yrs	26%	0.0000	356
			5089
Education			
No education	32%	0.0000	401
Education Primary	35%	0.0000	928
Education Secondary	23%	0.0000	2505
Education Tertiary	11%	0.0000	1255
			5089
****Religion**			
Christian	23%	0.0000	4441
Badimo	18%	0.0000	168
No Religion	25%	0.0000	459
			5089
Marriage Status			
Married	23%	0.0000	2628
Never married	22%	0.0000	2258
Separated	40%	0.0000	203
			5089
Urban/Rural			
Urban	21%	0.0000	3335
Rural	26%	0.0000	1754
Overall mean	24%		5089

*p values are one-sample t-tests

**The category "Other" was dropped due to the limited number of respondents.

In 2013 the HIV prevalence rate in Botswana was 18.5% among the population aged 18 months and above (NACA 2015). Table 3 compares the age groupings by blood test results conducted the day of the interview compared to the self-reported results. This unique dual feature of BAIS IV was conducted based on a respondent's consent to the blood test for the population aged 18 months through 64 years. The self-reported HIV status was based on the following questions: "Have you ever been tested for HIV, the virus that causes AIDS?"; a) Were you told/given your result for your last HIV test? and; b) What was the result? (answer if you do not mind).

The sero-status comparison reveals that there may have been under reporting of HIV-positivity, as the results of the blood test had a higher prevalence of HIV than self-reporting. The overall mean for prevalence ranged from 21% to 29% and could be an indication of respondents not wanting to divulge a socially unacceptable test to the interviewer and a possible indication of stigma. Letshwenyo-Maruatona et al (2019) indicate that in Botswana stigma remains a barrier in effective HIV prevention management (Letshwenyo-Maruatona et al. 2019). This could also be a case of the respondent having become infected since their last test.

Table 3: HIV prevalence of the study population

Variables	**Sero-status (self-reported)**	**Sero-status (blood test)** [11]	***p value**
HIV Prevalence			
15-24 Years	8%	13%	0.0465
25-34 Years	18%	27%	0.0000
35-44 Years	33%	41%	0.0030
45-54 Years	28%	37%	0.0331
55-64 Years	23%	27%	0.2773
Mean	21%	29%	
	n=3757	n=3757	

*p values are two-sample t-tests

In the next section the results will be unpacked within the analytical framework. The first level relates to the individual and the second level is based on community influences.

4.5.2. Awareness and knowledge of ART

In terms of what treatment options are available for HIV infected people, Table 4 indicates that 98% of the total population believed that ART was the dominant treatment option. The distribution within the HIV-positive and HIV-negative categories was only slightly

[11] HIV prevalence rates were based on the HIV blood test results from the survey.

different indicating that those who were HIV-positive were more aware of ART, which could be an indication of information received at the testing site.

In terms of functional knowledge of ART and what ARVs could or could not do, only 3% of the population believed that ARVs cure AIDS, which is a significant decrease from 25% of the population in BAIS III (Statistics Botswana 2009). Clearly, awareness of ART has not only expanded, but with a better understanding of what it can or cannot do.

Table 4: Awareness and knowledge of the study population, 15-64 years

What treatment options are available for HIV infected people?	**HIV-negative**	**HIV-positive**	***p value**	**Mean**
ART	97%	99%	0.0000	98%
	n=3916	n=1173		n=5089
What do you believe ARVs do?				
Suppress	97%	97%	0.0000	97%
	n=3815	n=1158		n=4973

*p values are two-sample t-tests

4.5.3. Personal beliefs about ART

Table 5 considers condom use at last sex by main partner and indicates that 67% of the HIV-negative population used a condom at last sex, while for those HIV-positive it was substantially higher at 82%. The same was also true for consistent condom use. The lower rates of condom use among HIV-negative individuals may indicate that the availability of ART is causing lower compliance among this group. It may also be a reflection of the established and familiar relationship between main partners where both partners are HIV-negative while for those HIV-positive partners are having to protect themselves and their partners.

Table 5: Condom use, 15-64 years

Did you use a condom the last time you had sex with this partner?	**HIV-negative**	**HIV-positive**	***p value**	**Mean**
Partner 1				
Yes	67%	82%		70%
No	33%	18%		30%
	n=3368	n=960	0.0000	n=4328
Partner 2				
Yes	87%	83%		86%
No	13%	17%		14%
	n=526	n=89	0.0000	n=615
Partner 3				
Yes	89%	86%		89%
No	11%	14%		11%
	n=187	n=22	0.0000	n=209
In the past 12 months have you always used a condom with this partner?				
Partner 1				
Yes Always	56%	72%		60%
No, Never/Sometimes	44%	28%		40%
	3368	960	0.0000	4328
Partner 2				
Yes Always	79%	78%		60%
No, Never/Sometimes	21%	22%		40%
	526	89	0.0000	615
Partner 3				
Yes Always	81%	91%		82%
No, Never/Sometimes	19%	9%		18%
	n=187	n=22	0.0000	n=209

*p values are two-sample t-tests

In Table 6, when asked the question; “has your personal concern about getting HIV changed since the introduction of ARV’s?” both groups of respondents indicate being more concerned. When further asked if the introduction of ARVs influenced their sexual behavior, 49% of the HIV-positives said yes while only 38% of the HIV-negatives said yes.

These "yes" groups are also practicing more prevention: 75% used condoms; 26% had less sexual partners and 15% discontinued practicing MCP.

Table 6: Concern in contracting HIV

Has your personal concern about getting HIV changed since the introduction of ARV's?	**HIV-negative**	**HIV-positive**	***p value**	**Mean**
Less concerned	30%	33%		31%
More concerned	70%	67%		69%
	n=3703	n=1128	0.0000	n=4831
Has the introduction of ARVs influenced your sexual behavior?				
Yes	38%	49%		41%
No	62%	51%		59%
	n=3703	n=1128	0.0000	n=4831
Out of the ones that answered yes, the ones that are practicing <u>more</u> prevention indicate the following prevention methods[12]:				
More condom use	75%	75%	0.0000	75%
Less sexual partners	26%	25%	0.0165	26%
Discontinue MCP	14%	16%	0.0000	15%
Abstinence	8%	10%	0.0000	9%
Out of the ones that answered yes, the ones that are practicing <u>less</u> prevention indicate the following prevention methods:				
Less condom use	5%	6%	0.0000	5%
More sexual partners	1%	0%	0.0000	1%
Continue to practice MCP	1%	1%	0.0000	1%

*p values are two-sample t-tests

[12] Respondents could choose more than one response.

Results from table 7 indicate that 94% of the population believes that you should not stop taking ARVs if you are feeling better and 88% specify that they believe that you should use a condom if you are on ARVs.

Table 7: ART and condoms

Q520 – Do you think a person on antiretroviral (ARV) should discontinue / stop taking them once they feel better?	**HIV-negative**	**HIV-positive**	***p value**	**Mean**
No	94%	94%		94%
Yes	6%	6%	0.0000	6%
Q518 - Do you think that people on ARV's should always use condoms?				
No	12%	12%		12%
Yes	88%	88%		88%
	n=3815	n=1158	0.0000	n=4973

*p values are two-sample t-tests

In Table 8, 10% of the population agreed that men could have more than one partner at a time and 7% stated that a woman could have more than one partner at a time.

Table 8: Acceptability of multiple partners

Q322a) Do you think it is acceptable for a man to have more than one sexual partner?	**HIV-negative**	**HIV-positive**	***p value**	**Mean**
No	90%	90%		90%
Yes	10%	10%		10%
	n=3899	n=1167	0.0000	n=5066
Q322b) Do you think it is acceptable for a woman to have more than one sexual partner?				
No	94%	93%		93%

Yes	6%	7%		7%
	n=3899	n=1167	0.0000	n=5066

*p values are two-sample t-tests

Table 9 details the population 15-64 that had sex during the last 12 months according to the number of partners. Findings indicate that 84% of the HIV-negatives have had sex with 1 partner only, while 16% have had 2 or more partners. The HIV-positive category indicates 91% having had one partner only and 9% having had 2 or more.

Table 9: Multiple partners (15-64 yrs.)

Q307b - In the last 12 months, how many people have you had sex with?	**HIV-negative**	**HIV-positive**	***p value**	**Mean**
1	84%	91%		86%
2 or more	16%	9%		14%
	n=3368	n=960	0.0000	n=4328

*p values are two-sample t-tests

In Botswana, gender inequalities also surface in the discussions surrounding acceptability of using condoms. Table 10 shows the proportion of respondents who reported that it is acceptable for a woman to obtain male condoms (93%). The proportion of people reporting that it was acceptable for a man to obtain female condoms was 85%.

Table 10: Acceptability of obtaining condoms

Q526a – Do you think it should be acceptable for a woman to obtain male condoms	**HIV-negative**	**HIV-positive**	***p value**	**Mean**
No/Unsure	8%	6%		8%
Yes	92%	94%		93%
	n=3916	n=1173	0.0000	n=5089
Q526b) Do you think it should be acceptable for a man to obtain female condoms?				

No/Unsure	15%	14%		15%
Yes	84%	86%		85%
	n=3916	n=1173	0.0000	n=5089
Q526 – c) Do you agree that a woman has a right to decide if she will have safe sex? (e.g. use a condom)				
No/Unsure	6%	4%		5%
Yes	95%	96%		95%
	n=3916	n=1173	0.0000	n=5089

*p values are two-sample t-tests

Table 10 also indicates that 95% of all respondents agree that it is a woman's right to decide if she will have safe sex.

4.5.4. Regressions

To analyse this further, results from Tables 11, 12 and 13 present logistic regression analysis of the impact of ART perception on inconsistent condom use, condom use at last sex and the number of partners in the last 12 months. Regression results are presented as the percentage in marginal effects referring to the range of probability. Those that are HIV-negative will be compared with those that are HIV-positive.

Table 11: Logistic regression – ART perception on consistent condom use

Logistic regression coefficients showing the impact of beliefs on consistent condom use (In the past 12 months have you always used a condom with this main partner?), by HIV status.

Variable	HIV-negative n=2775	HIV-positive n=743
Belief that ARVs cure AIDS. (1=Cure HIV and AIDS)	-.0475 (0.412)	.1808* (0.082)
Has the introduction of ARVs influenced your sexual behaviour? (1=yes)	.0294* (0.074)	.0252 (0.407)

Do you think that people on ARV's should always use condoms? (1=yes)	-.0560** (0.039)	.0854* (0.085)
Do you think a person on ARVs should discontinue/stop taking them once they feel better? (1=no)	.0490 (0.208)	.0846 (0.469)
Female	-.1121*** (0.0000)	-.0019* (0.959)
25-34 year olds (omitted category is 15-24 year olds)	-.1657*** (0.0000)	.1174* (0.092)
35-44 year olds	-.1039*** (0.007)	.1530** (0.031)
45-54 year olds	-.0916** (0.0000)	.2180*** (0.007)
55-64 year olds	-.2853*** (0.0000)	.2624*** (0.014)
Gas and propane for cooking (omitted category is electricity for cooking)	.0278 (0.217)	-.0224 (0.632)
Wood, coal, dung for cooking	-.0541* (0.091)	-.1281** (0.031)
Employment (1=Yes)	-.0093 (0.659)	.0099 (0.785)
What is the main toilet facility used by this household? (1=Flush) (omitted category is 15-24 year olds)	-.0331 (0.203)	.0494 (0.287)
Does any member of this household own a motor vehicle in working condition? (1=Yes)	-.0430 (0.036)	.0200 (0.591)
Never married	.1618*** (0.0000)	.2172*** (0.0000)
Separated	.2509*** (0.0000)	.1583** (0.054)
**Islam, Bahai, Hinduism (omitted category is Christian)	.1270 (0.449)	
Badimo	-.0036 (0.940)	.0328 (0.764)
No religion	.0412 (0.184)	.1151** (0.037)
Education Primary	.0803** (0.066)	.0328* (0.076)
Education Secondary	.1749*** (0.0000)	.0754 (0.254)
Education Tertiary	.1258*** (0.007)	.0675 (0.393)
Access to ART services (1=Yes)	.0111 (0.552)	.0044 (0.904)
Rural	-.0324 (0.191)	-0057 (0.893)

Country of origin Africa (omitted category is compared to Botswana)	-.2215*** (0.0000)	-.0637 (0.621)
Country of origin elsewhere in world (compared to Botswana)	-.0143 (0.936)	
Adj R-squared	0.1107	0.0608

* The table reports regression coefficients and (standard errors). (* indicates significance at the < 0.1 level, ** significance at the < 0.05 level; and *** significance at the < 0.01 level).
**There were too few individuals whose religion was Islam/Bahai/Hinduism who were HIV-positive, to be able to retrieve a coefficient

Table 12: Logistic regression - ART perception on condom use at last sex

Logistic regression coefficients showing the impact of ART perception on condom use at last sex (The last time you had sexual intercourse with this partner (i.e. your main partner) did you or this partner use a condom?), by HIV status.

Variable	HIV-negative n=2,775	HIV-positive n=743
Belief that ARVs cure AIDS. (1=Cure HIV and AIDS)	-.0511 (0.348)	.0680 (0.453)
Has the introduction of ARVs influenced your sexual behaviour? (1=yes)	.0420*** (0.007)	.0318 (0.230)
Do you think that people on ARV's should always use condoms? (1=yes)	-.0276 (0.278)	.0612 (0.156)
Do you think a person on ARVs should discontinue/stop taking them once they feel better? (1=no)	.1012*** (0.006)	.0936 (0.110)
Female	-.0856*** (0.0000)	.-0492* (0.131)
25-34 year olds (omitted category is 15-24 year olds)	-.0614*** (0.010)	.1086* (0.074)
35-44 year olds	-.1423*** (0.0000)	.0812 (0.188)
45-54 year olds	-.1361*** (0.0000)	.1007 (0.154)
55-64 year olds	-.3392*** (0.0000)	.1169 (0.210)
Gas and propane for cooking (omitted category is electricity for cooking)	.0401* (0.058)	-.0329 (0.419)
Wood, coal, dung for cooking	-.0137 (0.647)	-.1103** (0.033)
Employment (1=Yes)	-.0198 (0.952)	-.0239 (0.453)

What is the main toilet facility used by this household? (1=Flush) (omitted category is 15-24 year olds)	-.0225 (0.357)	-.0006 (0.986)
Does any member of this household own a motor vehicle in working condition? (1=Yes)	-.0526*** (0.006)	.0205 (0.528)
Never married	.1381*** (0.0000)	.1224*** (0.0000)
Separated	.1935*** (0.001)	.1963*** (0.006)
**Islam, Bahai, Hinduism (omitted category is Christian)	-.0176 (0.911)	
Badimo	.0132 (0.774)	.1282 (0.179)
No religion	.0476 (0.103)	-.0222 (0.644)
Education Primary	.1231*** (0.003)	.0565 (0.303)
Education Secondary	.1885*** (0.0000)	.0818 (0.148)
Education Tertiary	.1909*** (0.0000)	.0246 (0.721)
Access to ART services (1=Yes)	.0099 (0.571)	.0119 (0.714)
Rural	-.0351 (0.132)	-.0093 (0.803)
Country of origin Africa (omitted category is compared to Botswana)	-.2627*** (0.0000)	.0419 (0.709)
Country of origin elsewhere in world (compared to Botswana)	-.0518 (0.757)	
Adj R-squared	0.1258	0.0338

* The table reports regression coefficients and standard errors. (* indicates significance at the < 0.1 level, ** significance at the < 0.05 level; and *** significance at the < 0.01 level). **There were too few individuals whose religion was Islam/Bahai/Hinduism who were HIV-positive, to be able to retrieve a coefficient

Table 13: Logistic regression - ART perception on multiple concurrent partnerships

Logistic regression coefficients showing the impact of ART perception on multiple concurrent partnerships (In the last 12 months with how many people overall have you had sex?), by HIV status.

Variable	HIV-negative n=2775	HIV-positive n=743
Belief that ARVs cure AIDS.	-.0228	-.0513

(1=Cure HIV and AIDS)	(0.600)	(0.445)
Has the introduction of ARVs influenced your sexual behaviour? (1=yes)	.0141 (0.251)	.0430** (0.029)
Do you think that people on ARV's should always use condoms? (1=yes)	-.0126 (0.533)	-.0112 (0.727)
Do you think a person on ARVs should discontinue/stop taking them once they feel better? (1=no)	-.0109 (0.709)	0.0000 (1.000)
Female	-.1490*** (0.0000)	-.0713*** (0.003)
25-34 year olds (omitted category is 15-24 year olds)	-.0409** (0.030)	-.1527** (0.034)
35-44 year olds	-.1037*** (0.0000)	-.1527*** (0.001)
45-54 year olds	-.1440*** (0.0000)	-.1657*** (0.002)
55-64 year olds	-.1460*** (0.0000)	-.0978 (0.158)
Gas and propane for cooking (omitted category is electricity for cooking)	-.0237 (0.161)	0.0499 (0.100)
Wood, coal, dung for cooking	-.0419* (0.081)	.0343 (0.372)
Employment (1=Yes)	-.0242) (0.127)	.0451* (0.058)
What is the main toilet facility used by this household? (1=Flush) (omitted category is 15-24 year olds)	-.0005 (0.979)	.0208 (0.488)
Does any member of this household own a motor vehicle in working condition? (1=Yes)	-.0011 (0.939)	.0122 (0.613)
Never married	.0854*** (0.0000)	.0909*** (0.0000)
Separated	.0976** (0.042)	.0331 (0.534)
**Islam, Bahai, Hinduism (omitted category is Christian)	.1527 (0.225)	
Badimo	.0377 (0.304)	.0277 (0.696)
No religion	.0052 (0.822)	.0263 (0.462)
Education Primary	.0344 (0.293)	-.0456 (0.264)
Education Secondary	.0464 (0.154)	-.0002 (0.996)
Education Tertiary	.0445 (0.204)	-.0409 (0.424)

Access to ART services (1=Yes)	.0050 (0.717)	.0290 (0.230)
Rural	-.0035 (0.847)	.0117 (0.671)
Country of origin Africa (omitted category is compared to Botswana)	-.0383 (0.251)	-.0519 (0.535)
Country of origin elsewhere in world (compared to Botswana)	-.1730 (0.196)	
Adj R-squared	0.0862	0.0471

* The table reports regression coefficients and standard errors. (* indicates significance at the < 0.1 level, ** significance at the < 0.05 level; and *** significance at the < 0.01 level).
**There were too few individuals whose religion was Islam/Bahai/Hinduism who were HIV-positive, to be able to retrieve a coefficient

4.5.4.1. The impact of ART beliefs on condom use

The belief variable "ARVs cure AIDS" has a statistically significant effect on behavior for those HIV-positive indicating a rise in consistent condom use. The finding implies that believing that ARVs cure AIDS increases the probability of using a condom at last sex by 18%. In addition, for those HIV-positive, there was a higher rate (8%) of consistent condom use if they agreed that a person on ARVs should always use a condom. However, if they agreed that the introduction of ARVs had influenced their sexual behaviour, they show an increase (4%) in multiple partners.

For those HIV-negative, if they agreed that a person on ARVs should always use a condom, they were 6% less inclined to use a condom. However, there was a statistically significant higher rate of consistent condom use at 3% and condom use at last sex (4%) if they agreed that the introduction of ARVs had influenced their sexual behaviour. Also, for those HIV-negative, condom use at last sex was 10% higher if they thought a person on ARVs should discontinue/stop taking them if they feel better.

4.5.4.2. Sociodemographic information

In this study, sociodemographic variables used as control variables in the regressions highlighted some concerns for female respondents. For instance, compared to males, females who were HIV-negative are 11% less likely to have always used a condom consistently; 8% less likely to use condoms at last intercourse, and show a 14% lower rate in multiple partners. Those who were HIV-positive follow the same pattern.

In terms of age, condom usage decreases with age for those that were HIV-negative. By contrast, those who are HIV-positive show an increasing rate of condom use, with age. Both those HIV-negative and HIV-positive show a reduction in multiple partners as age increases.

Consistent condom use, condom use at last sex and multiple partners are higher for those never married or separated for both the HIV-negative and HIV-positive. Findings indicate that for those who are HIV-positive and are of the no religion category, compared to a person from the Christian category, are 11% more likely to use a condom consistently. Those HIV-negative with primary, secondary and tertiary education are more likely to use a condom consistently and at last sex.

Those HIV-negative from elsewhere on the African continent are less likely to use a condom than a Motswana. Those cooking on coal or wood and are HIV-positive are 12% less likely to use a condom consistently and 11% less likely to use a condom at last sex. Those HIV-negative are 5% less likely to use a condom at last sex if they own a vehicle and those HIV-positive are more inclined to have multiple partners if they are employed.

4.6. Discussion

4.6.1. Individual level

The statistically significant findings from this study on ART misconceptions and the intertwined impact on risky sexual behaviour implies that believing that ARVs cure AIDS increases the probability of using a condom for those HIV-positive, supporting similar conclusions from Botswana (Gill 2007; Letamo, Keetile, and Navaneetham 2017). Supporting this supposition, for those HIV-positive, there was a higher rate of consistent condom use if they agreed that a person on ARVs should always use a condom. However, if they agreed that the introduction of ARVs had influenced their sexual behaviour, they show a rise in multiple partners.

For individuals who were HIV-negative, who agreed that a person on ARVs should always use a condom, they were less inclined to use a condom. However, there was a statistically significant higher rate of consistent condom use and condom use at last sex if they agreed that the introduction of ARVs had influenced their sexual behaviour. Condom use at last sex was also higher if they thought a person on ARVs should discontinue/stop taking them if they feel better.

This chapter of the study did not support the hypothesis of treatment optimism that sexual risk behaviour would increase as a result of beliefs and perceptions on ART. Quite the opposite, as there was a statistically significantly higher rate of consistent condom use and condom use at last sex for those that were HIV-positive. However, for those HIV-negative, there was inconsistent condom use if they agreed that a person on ARVs should always use a condom, yet consistent condom use was higher if they thought a person on ARVs should discontinue/stop taking them if they feel better. In summary, these findings imply that the increased availability of ART is not compromising safer sex for those HIV-positive, but enhancing risk behaviour.

As a result of the expansive coverage of ART across Africa, increasing numbers of Africans in their middle and older ages are living and aging with HIV (Hontelez et al. 2014; Mojola et al. 2015). UNAIDS estimates that adults over 50 years old account for an increasing proportion of PLWHIV, and 75% of older adults who acquire HIV live in sub-Saharan Africa (Mahy et al. 2014). Modeling suggests that HIV prevalence among people older than 50 years of age will double in the next 30 years, and that the number of similarly aged HIV-infected patients will triple in the same period (Mills et al. 2012).

Findings in this study revealed that all age groups self-reported a lower prevalence of HIV (9%) than the actual blood test results. This may be a reflection of stigma as these results concur with findings observed by Rosenburg et al (2017) in South Africa where they found that those who tested HIV-positive may have reported a negative or unknown status (Rosenberg et al. 2017). This chapter did not include those unaware of their status (according to self-reporting). See chapter 2 for those aware and unaware of their status.

Programmes on older people and HIV such as the Stephen Lewis foundation have emphasised the important role of the older generation in caring for HIV-positive family members in low income contexts[13]. Studies have mainly focused on the experiences of older people as HIV-affected rather than HIV-infected (Richards et al. 2013). Research on older populations is limited and very few surveys even collect data. As a result older adults have been largely neglected by prevention programming as the focus has been on reproductive health, mother-to-child transmission, and younger populations where known HIV incidence is high (Negin et al. 2015). However, the sexual behavior and health of this growing population has important implications for HIV transmission.

[13] The Stephen Lewis Foundation (SLF) works with community-level organizations which are turning the tide of HIV & AIDS in Africa by providing care and support to women, orphaned children, grandmothers and people living with HIV & AIDS.

Findings from this study indicate that those who are HIV-positive show a significant incremental upsurge in consistent condom use as age increases reaching the 55-64 year olds at 26% more condom use than the 15-24 year olds. In contrast, those who are HIV-negative indicate an equally gradual reduction in condom use as they age. Similar findings occurred in South Africa where Houle et al (2018) found that HIV-positive women reported higher condom use at older ages compared to HIV-negative women. Older HIV-positive men (ages 40+) reported a higher prevalence of condom use than HIV-negative men (Houle et al. 2018). This could be an indication that HIV prevention programing may be having a positive impact in Botswana. At older ages, HIV-positive adults are more likely to report condom use compared to HIV-negative adults, suggesting efforts on their part to prevent onward transmission of HIV (Mojola et al. 2015; Rosenberg et al. 2017). Rosenberg et al (2017) also observed that older people in South Africa modify their behaviors in response to their HIV status to avoid transmission to their partners or vice versa (Rosenberg et al. 2017). These findings point to the important influence that HIV testing and counseling may have in behavioral change of older HIV-positive people.

However, in this study, the very low condom use among sexually active HIV-negative adults aged 55-64 years (28% lower rate of condom use than the 15-25 year olds) highlights the potential for HIV infections to occur in this high prevalence group which was similar to the findings in South Africa (Rosenberg et al. 2017). “One possible explanation for this finding is that the older HIV-positive individuals may have a greater sense of personal responsibility than younger HIV-positive individuals to not infect their partners” (Conserve et al. 2014). Also, statistically significant findings in this study indicate that those older age groups that are HIV-negative indicate a reduction in partners, which could help off-set the reduced condom use.

HIV prevention among youth is a top priority in sub-Saharan Africa. The most promising interventions have been scaled-up, evaluated, and show successful impact on HIV incidence and may explain the higher rate of condom use within the youth compared to

older adults (Houle et al. 2018; Mills, Bärnighausen, and Negin 2012; Napierala Mavedzenge, Doyle, and Ross 2011). However, Rosenberg et al (2017) argues that there is a growing body of evidence that older adults urgently require HIV interventions that are tailored to their particular prevention needs such as - considering behavioural change communication messages through different channels than those used for younger age groups like social media campaigns. Older adults may also face different physical and cognitive barriers to access health services than found in younger populations (Rosenberg et al 2017). Research is urgently required to intensify and improve HIV prevention in this important but neglected vulnerable group.

Results in this study also find that those with lower educational levels (no education and primary) have higher prevalence rates. Those HIV-negative with higher education levels are more likely to use a condom consistently and at last sex. Similar correlations have been reported in studies of the impact of universal primary education policies in Botswana, Malawi and Uganda (Neve et al. 2015).

Compared to those married or living together, consistent condom use, condom use at last sex, and multiple partners are higher for those never married or separated for both the HIV negative and HIV-positive. This infers that those married or living together are at risk in the spread of HIV if they engage in extramarital sex, which is consistent with literature. Setume (2016) concludes that Batswana in marriage know the basic facts about HIV and AIDS but, there are some who still cannot negotiate safe sex or refuse sex suggesting a lack of effective negotiation and refusal skills possibly due to patriarchal beliefs and practices (Setume 2016; Widman et al. 2014).

4.6.2. Community level

Household and community level circumstances may constrain an individual's choices regarding HIV outcomes. Outside an individual’s decision-making in terms of personal sexual behavior, various external domains work together to shape those actions (Mojola

et al. 2015). Social and structural factors such as gender and socio-economic inequalities can drive individual risk and vulnerability to HIV. Prevention interventions have been more successful in changing behaviour when they have better understood and address structural factors (Richards et al. 2013).

Findings indicate that a high proportion of HIV-positive individuals that appear to be less economically successful are less likely to use a condom consistently and at last sex, which means there is a high risk for HIV transmission. This same group are also more inclined to have multiple partners. Since this finding was associated with certain socio-structural variables, more efforts at the national level are necessary in working with this group (Conserve et al. 2014).

Cultural norms such as gender roles appear to continue to play an important part in the AIDS epidemic in Botswana. The community level considered established norms and values including gender and social that help to maintain economic or social inequalities between groups in society. When considering gender relations, it was clear from these data that females were less likely to use condoms compared to males among those HIV-positive and HIV-negative, highlighting concerns for female respondents specifically. This statistically significant inconsistent condom use for women compared to men appears to support the gender imbalance in Botswana and a women's subordinate position to male sexual partners, particularly to insist on condom usage. Other studies of sexual behaviours of men and women found similar findings in Botswana and Kenya (Cohen 2008).

4.7. Conclusion

This chapter suggests that HIV-positive individuals were more inclined to practice sexual risk reduction and runs counter to the treatment optimism argument. More pointedly, condom use increases among individuals who possessed the belief that ARVs cure AIDS and that a person on ARVs should always use a condom. For those HIV-negative, if they agreed that a person on ARVs should always use a condom, they were less inclined to use

a condom supporting treatment optimism in that case. However, there was a higher rate of consistent condom use if they agreed that the introduction of ARVs had influenced their sexual behaviour and if they thought a person on ARVs should discontinue/stop taking them if they feel better.

ART having become widely known and understood, those that are HIV-positive and to a lesser extent HIV-negative are more inclined to practice safer sex countering the treatment optimism theory. This implies that increased access to ART and misconceptions have not compromised safer sex and seems to support the substantive government information, education and communication campaigning, which sensitizes people to the risks associated with unsafe sexual practices and the need to test.

Age specific interventions should however be considered as young people require a heightened urgency in rolling out HIV prevention, testing and treatment interventions. For those in their middle and older ages, there is a need for more nuanced HIV prevention communication and interventions that engage the HIV-negative population specifically. In addition, research is urgently required to intensify HIV prevention in the important but neglected vulnerable group of older adults.

Continued emphasis on prevention should be geared towards those: HIV-negative with lower education levels; HIV-negative and HIV-positive that are married or in long-term relationships; HIV-positive that appear to be less economically successful; and both HIV-negative and HIV-positive females.

4.8. Limitations

Many of the outcomes we present in this article were self-reported by the participants in face-to-face interviews and may thus have been subject to social desirability bias. Sensitive questions about personal sexual behaviors were likely underreported in this sample.

4.9. References

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Chapter 5 – Summary

This study investigated treatment optimism as a relevant and current issue to consider in today's HIV and AIDS epidemic. It is one of the first studies, utilising empirical methodology, to consider ART beliefs and perceptions in relation to high risk sexual behaviour amongst segments of the population including: individuals who were aware and unaware of their HIV status; circumcised men and uncircumcised men; and participants who self-reported their status whether HIV-negative or HIV-positive.

Chapter 2 revealed statistically significant evidence to support treatment optimism among respondents who were unaware of their HIV infection. Indeed, those who had never been tested for HIV engaged in risky sexual behaviour in the context of certain beliefs and perceptions about ART. Risky behavior included lower condom use and greater frequency of multiple partners resulting in increased exposure to sexually transmitted infections. Cascading effects included increased risks of HIV transmission and potentially contributed towards rising rates of new infections with HIV and/or STIs in the general population. The author also found that individuals who had tested for HIV and were aware of their status were more inclined to protect themselves, suggesting that those who were aware of their status, also had greater knowledge and agreement with prevailing scientific guidance regarding HIV.

Other findings from this chapter indicated that riskier sex appeared to be associated with those unaware of their HIV status who: had low levels of education; were married or in stable unions; were foreign citizens; lived in a rural setting; and were females. Continued emphasis on testing and prevention counselling should remain a priority for prevention programming in Botswana. The findings from this study indicate that those who had not tested and were unaware of their status, continued to put themselves and others at risk.

Chapter 3 examined the effect of circumcision and sexual behaviour. Results indicated that the findings regarding treatment optimism are contradictory. In terms of beliefs about ART,

findings for condom use indicate that those circumcised and who reported that they changed their sexual practice since the introduction of ARVs, were more inclined to use a condom consistently and at last sex. Those uncircumcised who believed that they should discontinue taking ARVs once they feel better, were similarly more inclined to use a condom. Paradoxically, those who agreed that you should always use a condom if you are on ARVs were less likely to have used a condom regardless of their circumcision status. This effect was stronger for those circumcised than for those uncircumcised.

Sociodemographic data results showed that for circumcised and uncircumcised men, consistent condom use, and condom use at last sex was lower for both groups as they: became older; were married or living together; possessed lower levels of education; and were not Botswana citizens. Therefore, considering the level of sexual risk behaviours among men observed in this study, the Ministry of Health, NACA and their partners should continue sensitising the population to use condoms even when a man is circumcised.

Chapter 4 explored sexual risk behaviour among HIV-negative and HIV-positive individuals. Among those surveyed, individuals who were HIV-positive practiced sexual risk reduction countering the treatment optimism argument. This same group demonstrated an upturn in condom use both if they believed that ARVs cure AIDS, and if they believed that a person on ARVs should always use a condom. For those HIV-negative, if they agreed that a person on ARVs should always use a condom, they themselves were less inclined to use a condom, supporting treatment optimism in that case. However, there was a higher rate of consistent condom use if they agreed that the introduction of ARVs had influenced their sexual behaviour and if they thought a person on ARVs should discontinue/stop taking them if they feel better.

This implies that the increased access to ART and possible misconceptions about the effects of ART have not compromised safer sex and seems to support the substantive population level government information, education and communication campaigning,

which sensitizes people to the risks associated with unsafe sexual practices and the need to test. Continued emphasis on prevention should be geared towards those who are: HIV-negative with lower education levels; both HIV-negative and HIV-positive who are married or in long-term relationships; HIV-positive who appear to be less economically successful; and all females irrespective of HIV status .

In conclusion, the findings from chapter 2 indicate that there is statistically significant evidence to support treatment optimism among those who were unaware of their status and engaging in risky sexual behaviour, particularly among those whose beliefs were least informed by prevailing scientific consensus. Those who tested for HIV or were aware of their status, by contrast, were protecting themselves and their partners. Chapter 3 indicates that findings regarding treatment optimism are somewhat contradictory, but circumcised men were more likely to practice risky sexual behaviour than those uncircumcised. In chapter 4, findings largely counter the treatment optimism argument for those HIV-positive, however there were instances of treatment optimism among those who were HIV negative.

This research on a more representative population is important to the academic community by providing a nationally representative analysis regarding sexual behaviour linked to self-reported HIV status in relation to the expanded coverage of ART amongst the HIV-negative population, those unaware of their status and those circumcised compared to those not. Chapter 2 revealed gaps in research and found that only two other studies in Africa had assessed risky sex in those who were unaware of their status and no studies as it relates to treatment optimism. This study may be the first to investigate this pattern in Africa. Given that there is limited research available on this topic, further enquiry is recommended. Chapter 2 also revealed Botswana's accomplishment in terms of integrating and combining clinical and "population health" – establishing norms and services, and research for populations at risk. The term "population health" is of growing interest to

academics, which Botswana has developed and emphasized. A case study documenting the process would be beneficial to the regional and global health community.

Implications of rising STI rates related to treatment optimism was also discussed in Chapter 2 and requires an assessment of current HIV research, policies, and programmes. Questions about the linkages between STIs and biomedical HIV prevention must be considered as high STI incidence could undermine the success of TasP or PrEP. Also, what are the associations for further research addressing the HIV and STI epidemics in tandem?

The scarcity of available research documenting the potential association between ART access and sexual disinhibition in the HIV-negative population is an area of concern as there are very few studies available. Chapter 4 revealed that previous studies have mainly focused on the experiences of older people as HIV-affected rather than HIV-infected, for example grandparents caring for "AIDS orphans". Research and literature on older populations is limited and very few surveys even collect data. As a result, older adults have been largely neglected by the academic community. However, the sexual behavior and health of this growing population has important implications for HIV.

Comparing respondents by blood test results conducted the day of the interview compared to the self-reported results in the questionnaire is a unique dual feature of this study and revealed that there are very few studies that have access to these types of data. As a result, the sero-status comparison discovered that self-reporting underestimates the extent of actual HIV-positivity, a possible indication of respondents not wanting to divulge a socially unacceptable test result to the interviewer and a possible indication of perceived stigma.

There are limitations to this study, which were discussed in the first chapter. However, in summary, these findings contribute to the global health governance literature by providing evidence that treatment optimism is substantial for those who have not tested and were unaware of their status; is contradictory in the circumcision chapter; and is countered in the HIV-positive population. This informs the Government of Botswana and partners by

providing the needed information to target specific populations, which can contribute towards the reduction of new infections, making the 2013 BAIS IV dataset still relevant and important at informing policies and programmes today.

Based on the HPTN 052 trial WHO recommended that people diagnosed with HIV immediately be placed on ART. As a result, positive indications appeared that new HIV infections were trending downward on a global scale, and for the first time in the history of the epidemic, there seemed to be an air of optimism about the possibilities of reaching the UNAIDS 90-90-90 target. This moment in the HIV continuum should have served as a best practice for global health.

However, signs that the global commitment to build on the gains achieved against HIV are wavering. From 2013 to 2016, Global HIV funding declined by roughly 20%, i.e. fell from US$10 billion to US$8 billion at the same time as HIV and AIDS continued on its destructive path infecting more than 38.1 million people since 2000 and killing over 25 million. Also, declines in new HIV infections among adults have slowed, threatening further progress towards the end of the AIDS epidemic. Since 2010, the annual number of new infections among adults has remained static at an estimated 1.9 million per year (UNAIDS 2018), all this in spite of the extensive rollout of TasP and VMMC. Unless further investments are made to accelerate comprehensive prevention including TasP and VMMC, the epidemic is likely to regain its footing and possibly become more serious in the coming years, nullifying any gains made and making the SDG targets unattainable.

Now is the time for global health governance to draw on the innovations led by the Government of Botswana. Although Botswana has shown an exemplary country level response to the AIDS epidemic, individual governments alone are unable to mobilise and deploy sufficient knowledge, human capital and other resources globally. Findings from this study should compel and inspire the global health community to not relinquish the fight against HIV before it is over, but to ensure that treatment efforts are part of a broader prevention package and push towards the end of AIDS.