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A Profile of Male Circumcision in South Africa: Socio-demographic predictors of the type of circumcision among circumcised men

By

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This research report is submitted to the Faculty of Humanities at the University of the Witwatersrand in partial fulfilment of the requirements for the Master of Arts in Demography and Population Studies Degree

Supervisor: Dr Nicole De Wet-Billings

Date: 19 August 2019

DECLARATION

I **Jabulani Farayi Sikula**, declare that this research report is my own work. It is being submitted for the degree of Master of Arts in Demography and Population Studies at the University of the Witwatersrand, Johannesburg. To the best of my knowledge, it has not been submitted before, in part or full for any degree or examination at this or any other University.

…… [Signature of candidate]

……day of ……, 20……

DEDICATION

I dedicate this work to my mother, Wadzanayi Machada and my late father, Major Lazarus Sikula.

ACKNOWLEDGEDMNTS

Much appreciation goes to my supervisor Dr Nicole De Wet for academic guidance and support. I am so thankful for your patience and not giving up on me even when it seemed impossible for me to accomplish this task. To my dear wife Portia, thanks for the encouragement, love and support. I will forever cherish your friendship and companionship. To my kids Muno and Maka, thanks for being my main inspiration for taking on postgraduate studies.

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ACRONYMS

AIDS	Acquired Immunodeficiency Syndrome
ART	Antiretroviral Therapy
EA	Enumeration Area
HBM	Health Belief Model
HIV	Human Immunodeficiency Virus
MC	Male Circumcision
NSP	South Africa National Strategic Plan for HIV, TB and STIs
RCT	Randomised Control Trials
STI	Sexually Transmitted Infection
TMC	Traditional Male Circumcision
VMMC	Voluntary Medical Male Circumcision
WHO	World Health Organisation

Abstract

Background: HIV prevalence and transmission rates remain high in South Africa. Voluntary Medical Male Circumcision (VMMC) is one of the interventions that have been included in the comprehensive package for HIV prevention strategies. Although resources, campaigns and interventions have been directed towards the upscale of this practice, VMMC prevalence still remains low in South Africa. Although studies have shown a reduction in transmission rates among those who are medically circumcised, traditional male circumcisions are more common in South African communities. This preference of traditional circumcision is besides the fact that some scholars have argued that Traditional Male Circumcision (TMC) has not been proven to offer any HIV protective benefits. This study investigates the socio-demographic predictors of type of circumcision and explores the reason or motivation for undergoing male circumcision in South Africa.

Methods: This study used data from the South African National HIV Prevalence, Incidence and Behaviour Survey conducted in 2012 to explore the predictors of type of circumcision in South Africa. Frequencies were calculated to determine the levels of male circumcision by type of circumcision and reason for circumcision. Bivariate analysis was conducted to investigate the relationship between type of circumcision and socio-demographic factors, reason for circumcising and perception variables. Bivariate analysis was also conducted to investigate the variations in reason for circumcision by socio-demographic characteristics. Data was analysed at the multivariate level using binary logistic regression analysis to determine the main predictors of the type of male circumcision in South Africa.

Results: The study found that 53.5% of the circumcised male population in South Africa is circumcised through TMC. The reasons for undertaking male circumcision included religious reasons, hygiene, prevention of HIV and STIs, traditional practice and other reasons. About 60.1% of circumcised males had circumcision done as part of traditional practice. The majority of males (87.9%) who reported circumcising for traditional reasons had TMC and the majority of respondents who reported circumcising for hygiene and prevention of HIV and STIs had VMMC (88.4% and 90.4% respectively). VMMC is most common in KwaZulu-Natal (70.8%) and Gauteng (59.9%). Males residing in urban formal settings are mostly circumcised through VMMC (52.3%). TMC is more common among the respondents with primary and secondary education (82.5% and 61% respectively). The multivariate analysis found race, age at circumcision, marital or relationship status, education status, province, having access to a radio, magazine and internet and reason for circumcision to be the main predictors of the type male circumcision. All categories of reason for circumcising were significantly associated with type of circumcision.

Contribution: This study contributed to our understanding of predictors of type of male circumcision in South Africa. This understanding is helpful in the design of context relevant VMMC upscale interventions that consider race, age at circumcision, marital or relationship status, education status, province, having access to a radio, magazine and internet access. The study is also useful in providing baseline characteristics for use in measuring the success of future interventions.

CHAPTER 1: INTRODUCTION

1.1 Background

Although there has been a decline in global HIV incidence and AIDS-related mortality, HIV prevalence and transmission rates remain comparatively high in South Africa (Joint United Nations Programme on HIV/AIDS (UNAIDS), 2015). HIV prevalence estimation models estimate South African HIV sero-prevalence to be around 15% for males aged 15-49 years and around 23% for females aged 15-49 years (Harling, Moyo, McGovern, Mabaso, Marra, Barnighausen & Rehle, 2017). The South African National AIDS Council (SANAC) reported that an estimated 270 000 people became newly infected with HIV in 2017 (South African National AIDS Council, 2017). This high rate of transmission has been shown to be mainly through heterosexual transmission and is linked to biological vulnerabilities, socio-behavioural and contextual factors (Zuma, Shisana, Rehle, Simbayi, Jooste, Zungu, Labadarios, Onoya, Evans, Moyo & Abdullah, 2016). Due to these links, HIV transmission reduction interventions have been targeted at promoting biological interventions, behaviour modification and use of medical interventions such as voluntary medical male circumcision (VMMC), scaling up HIV testing, Antiretroviral Therapy (ART) initiation and improving ART adherence, delaying onset of first intercourse, decreasing the number of sexual partners, increased use of protection, Treatment as Prevention (TasP), pre-exposure prophylaxis (PrEP) and use of microbicides (Coates, Richter, & Caceres, 2008; Baxter & Karim, 2016; Pettifor et al., 2013; Günthard et al., 2016 & Cohen et al., 2016).

A low level of VMMC in populations with generalised HIV epidemics has been identified as being one of the main factors increasing biological vulnerabilities to HIV transmission. VMMC is defined as the removal of the prepuce from the glans of a flaccid penis (a penis in a flaccid state is when it is soft and hanging and not erect) (Faleye, 2014; Lukong, 2011; Burgu, Aydogdu, Tangal, & Soygur, 2010). Interventions have been directed at increasing the level of VMMC with the objective of reducing HIV transmission (Sgaier et al., 2016). This reduction in HIV transmission is a result of the removal of the prepuce which contains a large number of Langerhans cells which are

immunological in nature and are rich in CD4 cells which make them a target for HIV entry and replication (Faleye, 2014). The increased incidence of genital ulcers in uncircumcised men and minute tears resulting from sexual intercourse have been cited as encouraging viral invasion (Weiss, Thomas, Munabi, & Hayes, 2006). The link between HIV transmission and Male Circumcision (MC) was first noticed in observational studies which found a spatial link between MC and HIV prevalence, with countries that traditionally practise MC having lower rates of HIV prevalence compared to those that do not (Alcena, 1986 ; Fink 1986 & Moses, Bradley, Nagelkerke, Ronald, Ndinya-Achola & Plummer, 1990; Moses et al., 1990).

This correlation was supported by three Randomised Controlled Trials (RCTs) conducted from 2002 to 2006 in South Africa, Kenya and Uganda which showed that VMMC reduced HIV transmission in circumcised men by 60%, 53% and 51%, respectively (Auvert, Taljaard, Lagarde, Sobngwi-Tambekou, Sitta, & Puren, 2005; Gray, Kigozi, Serwadda, Makumbi, Watya, Nalugoda, Wawer, 2007; Bailey, Moses, Parker, Agot, Maclean, Krieger, Ndinya-Achola, 2007). Following these findings, in 2007, the World Health Organisation (WHO) and the Joint United Nations Programme on HIV/AIDS (UNAIDS) recommended VMMC as an additional HIV prevention strategy (Ncayiyana, 2011). A total 14 priority countries with a generalised HIV epidemic, and low MC prevalence were identified in eastern and southern Africa for rapid scale-up of VMMC. A target was set to provide VMMC services to more than 20 million men in these priority countries by the end of 2016 (UNAIDS, 2007; Howard-Payne, 2016; Tchuenche et al., 2016; Reed et al., 2012). South Africa was identified as one of the priority countries. In terms of MC prevalence, a nationally representative survey in South Africa found a self-reported MC prevalence of 43%. However, there was variation in provincial prevalence rates, and some provinces like the Northern Cape reported a MC prevalence as low as 19% (Peltzer, Onoya, Mokonko, & Simbayi, 2014). There were also variations by type of circumcision across provinces with the North West province reporting the lowest levels of MMC (8.8%) and Eastern Cape province having the most traditionally circumcised men (54.3%) (Peltzer, Onoya, Makonko, & Simbayi, 2014).

HIV prevalence and HIV mortality rates in South Africa are high, they are estimated at 11% and 28%, respectively. Given these high rates of HIV prevalence and mortality and also the low levels of circumcision, in 2010, the South African government started implementing the WHO/UNAIDS recommendation of offering VMMC services as an HIV prevention intervention (Tchuenche et al., 2018). The initial target was to reach 80% of HIV-negative males aged 15–49 years old by 2016 (Tchuenche, Palmer, Haté, Thambinayagam, Loykissoonlal, Njeuhmeli,& Forsythe ,2016; SANAC, 2017; Wamai, Morris, Bailis, Sokal, Klausner, Appleton, Banerjee, 2011; STATSSA, 2015). The target was based on early mathematical models which showed that scaling-up VMMC to 80% of the target population had the potential to prevent one new HIV infection for every 5 to 15 circumcisions performed (Njeuhmeli et al., 2011).

Although there has been lot of drive towards offering VMMC, uptake has been below targeted levels. By the end of 2016, South Africa had performed over 2.8 million VMMCs, about 65% of the 4.3 million VMMCs set out by the 2011 targets (WHO, 2017). Although this is a significant advancement, one of the main challenges to VMMC scaling up or uptake has been the seeming continued preference of traditional circumcision. Representative national surveys in South Africa have found an overall traditional MC prevalence rate of 48% among the Black population (Peltzer, Onoya, Mokonko, et al., 2014). In the Eastern Cape Province, traditional circumcision rates are as high as 54% (Peltzer, Onoya, Mokonko, et al., 2014). Among the Xhosa in the Eastern Cape and the Ndebele in the Limpopo province, traditional circumcision remains the most preferred form of circumcision (Mark et al., 2012). Among these tribes, traditional circumcision is an entrenched cultural practice which is an integral part of the communities and is part of initiation into manhood (Moodley & Rennie, 2018).

1.2 Problem Statement

Even though a lot of effort has gone into implementing the VMMC programme, VMMC rates in South Africa still remain low (HSRC, 2018). Although the South African VMMC programme had reached about

65% of the 4.3 million VMMCs set out by the 2011 targets by end 2016, VMMC accounts for only 31.8%% of the circumcisions in the country (HSRC, 2018; Tchuenche et al., 2016; WHO, 2017). This falls below the 80% target that is required to have a herd immunity effect that is required to effectively reduces HIV transmission over time (Boily, Desai, Masse, & Gumel, 2008). In the case of male circumcision, herd immunity refers to the indirect protection of uncircumcised population, whereby an increase in the prevalence of MMC lowers HIV transmission rates in susceptible populations (Kim, Johnstone, & Loeb, 2011). HIV prevalence is high in South Africa, estimated at 13.1% (STATSSA, 2018). There were an estimated 270 000 new HIV infections in 2016 alone (SANAC, 2017). Given the high HIV prevalence and high rate of transmission, there is need to upscale all preventive interventions including VMMC for HIV prevention (SANAC, 2017). A lot of work still needs to be done to ensure that the nation reaches the target levels needed to realise the maximum benefits of VMMC.

Male circumcision prevalence studies have found geographical variations in prevalence by type of circumcision. In the Eastern Cape, results have shown that traditional circumcision continues to be the most preferred type of circumcision with 92.2% of the boys preferring TMC over VMMC (Douglas & Maluleke, 2018). This raises concerns since the effectiveness of traditional male circumcision as an HIV prevention method has not been scientifically proven (Maffioli, 2017). Traditional circumcision is not standardised, the amount of foreskin removed differs by practitioner and does not remove as much of the foreskin as a medical circumcision (Maffioli, 2017). Clinical examination of respondents who self-report male circumcision has found that TMC respondents are actually not circumcised (Odoyo-June et al., 2018). Some scholars believe that the remaining foreskin lessens traditionally circumcised males' protection against HIV (Deacon & Thomson, 2012). The remaining prepuce contains a large number of Langerhans cells which are immunological in nature and are rich in CD4 cells, making them a target for HIV entry and replication (Faleye, 2014).

This has been supported by studies which found that men with partial circumcisions had a 7% point greater risk of being HIV positive than fully circumcised men (Maughan-Brown, Venkataramani,

Nattrass, Seekings, & Whiteside, 2011). A study in Lesotho which investigated the medical effects of traditional circumcision compared to the benefits of VMMC on HIV status found that circumcision performed in initiation schools eliminated medical benefits of the surgical procedure (Maffioli, 2017).

Traditional circumcision has also been shown to be associated with other public health challenges. A significant proportion of the male population that undergoes traditional circumcision reportedly experience adverse effects or medical complications ranging from septicaemia, gangrene, severe dehydration, sexual dysfunction, complete or partial penile amputations, viral hepatitis B, HIV transmission and deaths (Behrens, 2014; Anike, Govender, Ndimade, & Tumbo, 2013; Shisana et al., 2014). A systematic review of studies on the prevalence and complications of traditional male circumcision reported an average 41.5% complication rate (Wilcken, Keil, & Dick, 2010). In the period 2006 to 2013, the Eastern Cape recorded 453 deaths of circumcision initiates and 214 penile amputations (Douglas, Maluleke, Labadarios, Hongoro, & Nyembezi, 2016).

Studies have shown variations in complication rates by person performing circumcision. Generally, VMMC has been shown to be safer with significantly lower complication rates when compared to circumcision by a traditional circumciser. Randomised Control Trials (RCT) reported complication rates of 1.7%, 3.8% and 5.5% for Kenya, South Africa and Uganda respectively (Bailey et al. 2007; Auvert et al. 2005; Gray et al. 2007). A study in Eastern Cape, South Africa found that complications were more prevalent when the practitioner was a traditional circumciser. (Anike et al., 2013). Similar outcomes have also been found in relation to place of circumcision (Peltzer & Kanta, 2009).

Apart from the extent of foreskin removal and complication rates, traditional male circumcision presents a greater risk of increased HIV transmission. It has been reported that among the Xhosa, an unsterilized unwashed blade may be used on a dozen or more initiates in a single session (Peltzer, Nqeketo, Petros, & Kanta, 2008; Behrens, 2014).

Although numerous studies have been conducted to explore VMMC uptake, there are numerous limitations with generalisability of the results. The Kwa-Zulu Natal study by George et al. (2017) looking

at uptake of VMMC did not use representative samples which undermines the applicability/generalisability of the findings to the South African population (George et al., 2017; George et al., 2014). The results cannot be generalised to older male populations, low HIV prevalence areas. They cannot generalised due to the qualitative nature of the study design and the sampling methods used. The study used a limited sample of 750 adolescents purposively selected from 42 rural secondary schools in Kwa-Zulu Natal. The study only looked at VMMC linked motivations and did not look at other motivations related to TMC (George et al., 2017).

Similar studies from the region share the same fate. The Lesotho cross-sectional study on motivations for circumcising suffers from the limitation that results are of limited generalizability due to sampling issues. Study participants were conveniently sampled among four non-randomly selected sites (Skolnik, Tsui, Ashengo, Kikaya, & Lukobo-Durrell, 2014).

Although there has been research exploring VMMC uptake related factors, these factors are susceptible to change overtime with improved access to information and changes to socio-economic, political environment. Tram and Bertrand (2014) note that as the VMMC scale-up intensifies in countries across Eastern and Southern Africa, the correlates of VMMC are likely to change.

We know from literature that age, socio-economic status, race, religion, education and place of residence are related to the type male circumcision (Gasasira et al., 2012 ; UNAIDS, 2007 ; Thaele, 2016). The main limitation with these studies is that they do not account for reason for circumcising as a mediating factor between socio-economic determinants and choice of circumcision method or circumcision status in the conceptual framework.

Most of the challenges that have been associated with scaling up VMMC have been linked to demand side factors such as fear of pain, adverse events and complications, threats to masculinity, age and sexual inactivity, cultural norms and traditions and lack of knowledge of the protective effects of MMC (International Initiative for Impact Evaluation, 2013). Most VMMC demand creation strategies have been centred around these factors (Sgaier et al., 2015). Although there has been a lot of research on

barriers and facilitators of VMMCs with the objective of understanding factors related to VMMC uptake, there has been a plateau in demand for VMMC services (George et al., 2017).

In South Africa, there have been protracted behaviour change and demand creation campaigns like the Brothers for Life Campaign and the Man Up Campaign aimed at promoting VMMC uptake and educating the population on the proven medical benefits conferred by the procedure (Blankenberg, 2017; Brothers For Life, Online). Since these campaigns are aimed at promoting and changing behaviour, one would expect a change in preference overtime in favour of VMMC due to the proven medical benefits conferred by the procedure. However, data from South Africa has demonstrated continued preference of traditional circumcision over VMMC possibly due to the former being an entrenched cultural or traditional practice (Douglas & Maluleke, 2018). Given the seeming continued preference of traditional circumcision over VMMC, this study seeks to explore the socio-demographic predictors of type of circumcision controlling for reason for circumcision.

1.3 Justification

It has been estimated that VMMC has the capacity to avert two million new HIV infections and 300 000 deaths (Williams et al., 2006). Studies have also shown that medically circumcised men are at a lower risk of sexually transmitted infections (STIs), like syphilis and Herpes simplex virus type 2 (HSV-2) (Weiss et al., 2006). To realise these benefits, the country needs to perform 2.5 million VMMCs as set out in the 2017-2022 South Africa National Strategic Plan for HIV, TB and STIs (NSP) (SANAC, 2017). Studies have reported a plateau in uptake of VMMC uptake and this has been linked to demand side factors (George et al., 2017; International Initiative for Impact Evaluation, 2013). The NSP has acceleration of preventive efforts to reduce new HIV and TB infections and new STIs as one of the objectives (South African National AIDS Council, 2017). The NSP sets out intensified prevention programmes that combine biomedical prevention methods, such as VMMC with the aim of reducing new HIV infections by more than 60%, from an estimated 270 000 in 2016 to below 100 000 by 2022 (South African National AIDS Council, 2017). VMMC for HIV transmission reduction falls within the

broader United Nation's Sustainable Development Goals (SDGs) agreed on in 2015, specifically, sub-goal 3.3 which targets to end AIDS by 2030.

Attainment of 2017-2022 NSP's objectives will require a relook at drivers for VMMC uptake to inform targeted high impact VMMC uptake interventions. Although a lot of research has been conducted to explore VMMC uptake related factors to inform the post 2015 VMMC targets, most of these studies have looked at acceptability of VMMC procedures, barriers and facilitators for seeking VMMC and determinants of demand for VMMC. (International Initiative for Impact Evaluation, 2013; Lagarde, Taljaard, Adrien, Rain-Taljaard, & Auvert, 2003; Bridges, Selck, Gray, McIntyre, & Martinson, 2011; Masese et al., 2017; Chiringa et al., 2016; Chamusingarevi et al., 2016; George et al., 2017; George et al., 2014; Cockburn, 2016 & Hatzold et al., 2014). These studies assume a direct link between socio-demographic factors and type of circumcision and do not take into account reason/ motivation for circumcising as an intermediating factor. The choice of opting for VMMC rather than TMC is intricably linked to the reason for undergoing male circumcision. However, there is paucity of studies exploring the way socio-demographic factors interact with the motivation or reason for undergoing male circumcision to influence type of circumcision method. To fill this gap, this study explores the interaction between socio-demographic factors and reason or motivation for circumcision and how these factors have a combined effect on the type of circumcision method. It is hoped that this study will produce a profile of male circumcision through profiling the socio-demographic predictors of type of circumcision. This has potential to help in the development of targeted interventions and strategies for improving VMMC uptake among populations groups profiled as preferring TMC. It is hoped this will feed into the bigger objective of achieving the World Health Organization (WHO) and the Joint United Nations Programme on HIV/AIDS (UNAIDS) Fast-Track goal of achieving 90% coverage of (VMMC) among boys and men aged 10-29 years in priority settings by 2021. It also has potential to contribute to the broader plan of reducing new HIV infections to less than 100 000 by 2022 (SANAC, 2017; Gasasira et al., 2012 ; Patel et al., 2018).

1.4 Main Research Questions

What are the socio-demographic predictors of type of circumcision among circumcised males in South Africa?

1.4.1 Sub-questions

i) What are the levels of male circumcision in South Africa by type of circumcision and reason of circumcision?

ii) What is the relationship between socio-demographic characteristics, reason for circumcision, perception factors and type of circumcision among circumcised males in South Africa?

iii) What are the variations in reason for circumcision by socio-demographic factors and perception factors among circumcised males?

iv) What are the socio-demographic predictors of type of circumcision controlling for other factors among circumcised males?

1.5 Main Research Objectives

To investigate the socio-demographic predictors of type of male circumcision in South Africa among circumcised males.

1.5.1 Sub-Objectives

i) To investigate the levels of male circumcision in South Africa by type of circumcision and reason for male circumcision.

ii) To investigate the relationship between socio-demographic characteristics, reason for circumcision, perception factors and type of circumcision among circumcised males in South Africa.

iii) To investigate the variations in reasons for male circumcision by socio-demographic factors and perception factors among circumcised males.

iv) To investigate the socio-demographic predictors of type of circumcision controlling for other factors among circumcised males.

CHAPTER 2: LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2. Introduction

Male circumcision (MC) is the oldest known human excision procedure, with historical records and archaeological evidence dating the practice back to ancient Egyptians in the 23rd century BCE (Kacker & Tobian, 2013; Burgu, Aydogdu, Tangal, & Soygur, 2010). In some societies, circumcision is practiced as a traditional and religious practice, and in such cases the practice is almost universal. In Southern Africa, the practice is less common and as such there are spatial variations in prevalence of MC. Although the practice is less common in countries like South Africa, there has been a drive towards achieving near-universal VMMC of all males (Lane, Bailey, Luo, & Parks, 2018). This has been necessitated by evidence from RCTs which showed that VMMC reduces sexual transmission of HIV from women to men by up to 60% (Bailey et al., 2007; Auvert et al., 2005; Gray et al., 2007). Although there has been a lot of programmatic effort towards implementing VMMC in South Africa, uptake remains lower than targeted levels (WHO, 2017). Some of the work that has been done to guide programmatic interventions aimed at increasing the uptake of VMMC has been though acceptability studies (Kateule et al., 2019; Chikutsa & Maharaj, 2015; George et al., 2017). These studies have the objective of understanding acceptance of the procedure, motivation for undergoing male circumcision and also to identify modifiable socio-demographic factors that can be targeted to increase the uptake of male circumcision services (Bridges, Selck, Gray, McIntyre, & Martinson, 2011;Masese et al., 2017; Chiringa et al., 2016; Chamusingarevi et al., 2016; George et al., 2017; George et al., 2014; Cockburn, 2016 & Hatzold et al., 2014).

Studies have also looked at the role of media in improving access to information. (Wilcken, Miiro-Nakayima, Hizaamu, Keil, & Balaba-Byansi, 2010). A study in Uganda found that media was reported to be the main source of information on male circumcision and its protective benefits against HIV. Awareness campaigns have been attributed to increasing overall response to VMMC uptake in Zambia (Howard-Payne, 2016).

2.1 Motivation for undergoing male circumcision

A scoping report commissioned by the International Initiative for Impact Evaluation 3 years after the VMMC programme had started looked at the general barriers and facilitators to VMMC. The report noted that innovations on the VMMC demand side have been limited and most of the work on the acceptability of VMMC has been focused on barriers to seeking VMMC (International Initiative for Impact Evaluation, 2013). Similar more recent studies have been carried out exploring VMMC facilitators in South Africa. These studies have found that men are opting for VMMC mainly for its HIV and STI transmission reduction benefits and for hygienic reasons. A recent study in rural Kwa-Zulu Natal which looked at factors associated with the uptake of VMMC amongst learners found that learners who perceived VMMC as having health benefits such as HIV and STIs transmission reduction and increased penile hygiene were more likely to undergo VMMC (George et al., 2017). In another KZN acceptability study, it was found that belief that VMMC reduced the risk of HIV infection, led to better hygiene and improvement in sexual desirability and performance facilitated the uptake of VMMC (George et al., 2014).

Other studies which explored the motivations and barriers to VMMC include a cross-sectional study in Lesotho which found that 73% of the men sought VMMC for protection against HIV and 62% for protection from other sexually transmitted infections. About 47% reported seeking VMMC for improved penile hygiene. Another population-based survey conducted in Zimbabwe found that 44% of the men underwent VMMC for HIV/STI prevention, 26% for hygiene, 6% for enhanced sexual performance and 6% cited cervical cancer prevention for partner (Hatzold et al., 2014).

On the other hand, other studies have found TMC to be the preferred to VMMC. A study in the Eastern Cape province of South Africa found that participants preferred TMC because of social recognition, status and social acceptance that comes with the ritual and procedure (Douglas, Maluleke, Manyaapelo, & Pinkney-Atkinson, 2018). Another study which explored the reasons for becoming traditionally circumcised among gay men found reasons such as the desire to conform to societal

norms and expectations (Ntozini & Ngqangweni, 2016). A study looking at economic determinants related to traditional circumcision of boys 12 to 18 years of age found that boys preferred traditional male circumcision for attainment of community respect and attainment of social manhood values (Douglas & Hongoro, 2018).

Although hygiene is among the reasons often cited for undergoing VMMC, this reason is not confined to VMMC. TMC studies have found participants who cite undergoing TMC for hygienic reasons. A study in the Eastern Cape of South Africa found that 33% of the respondents reported accepting traditional male circumcision for hygienic purposes (Douglas & Hongoro, 2018).

2.2 Socio-demographic determinants of male circumcision

As part of understanding the determinants of male circumcision, there has been several studies looking at social, economic and demographic factors related to the type of male circumcision. Most of the studies on determinants of prevalence and acceptability of male circumcision found that male circumcision is determined by factors such as socioeconomic status, education, religion, social desirability, perceived health and sexual benefits (UNAIDS, 2007). A study which investigated the correlates of male circumcision in Eastern and Southern Africa found age (being older), religion (being Muslim) and ethnicity to be consistently associated with male circumcision status (Tram & Bertrand, 2014). A population-based survey conducted in Zimbabwe found a relationship between age and religion and reason for circumcision. Older men cited “improved hygiene” and “improved sexual performance” as the main reasons for circumcising. Christians were more likely to be circumcised compared to non-Christians (Hatzold et al., 2014).

Similar associations were also found in a study which looked at socio-economic and sexual behavioural correlates of VMMC across eleven priority countries. The study found that being of Muslim faith, residing in rural areas, having higher or secondary education attainment, holding a professional occupation, being in the richest wealth quintile were more likely to be circumcised (Lau, Jayakumar, & Sgaier, 2015). Employment status has also been found to be a predictor of male circumcision

(Mangombe & Kalule-Sabiti, 2018). The main weakness of these studies is that they did not distinguish between medical male circumcision and traditional circumcision. A recent research report looking at determinants of choice of male circumcision method in South Africa found ethnicity, province, race and age to be related to choice of male circumcision method. Males with tertiary education were 3.41 times more likely to get medical circumcision than males with no education/primary education (Thaele, 2016). However, this study did not control reason or motivation for undergoing male circumcision.

Although socio-demographic factors explored in the preceding paragraph have been found to be positively associated with male circumcision, other studies have produced inconsistent findings. For instance, a study in Tanzania have found higher rates of male circumcision among men with higher levels of education, higher socioeconomic status and living in urban areas. In contrast, studies in Lesotho found circumcision to be most common among men with no education, in the lowest wealth quintile and living in rural areas (UNAIDS, 2007).

2.3 Socio-demographic determinants of reason for male circumcision

Ever since the link between MMC HIV transmission reduction has been empirically proven, the focus in the priority countries has been promoting VMMC for HIV/AIDS prevention (Mangombe & Kalule-Sabiti, 2018). The link between socio-demographic determinants and reason for male circumcision has not been widely explored. A review of a study which looked at associated with safe male circumcision found that men who are older and come from non-traditionally circumcising areas are less likely to circumcise for HIV/AIDS prevention (Kironde, 2016). A study looking at age differences in perceptions and motivations for VMMC in South Africa, Tanzania and Zimbabwe found that younger adolescents (10-14 yrs) were less likely to cite protection against human immunodeficiency virus (HIV) or other sexually transmitted infections and hygienic reasons as their motivation to undergo VMMC when compared with older adolescents (15-19 years) (Patel et al., 2018). Most studies have biased towards

exploring the determinants of male circumcision for HIV/AIDS prevention (Mangombe & Kalule-Sabiti, 2018; Kironde, 2016; Patel et al., 2018).

2.4 General critique of male circumcision studies

Although there has been a lot of research around male circumcision, the focus has been polarised between TMC and VMMC. Most of the studies in South Africa around motivation for male circumcision have looked at motivation for VMMC (International Initiative for Impact Evaluation, 2013; George et al., 2017; George et al., 2014 ; Hatzold et al., 2014 ; Patel et al., 2018 ; Peltzer & Mlambo, 2012 ; Peltzer, Onoya, Makonko, et al., 2014 ; Faleye, 2014a). The studies have explored health related motivations for undergoing VMMC at the expense of other motivations that are not linked to health or hygienic reasons. Studies by Mark et al. (2012), George et al. (2017), George et al. (2014) and Hatzold et al. (2014) have been useful in showing that men seek for VMMC for STI/HIV prevention reasons and also for personal hygiene but they neglect circumcision for religious or traditional reasons. Even though they explore motivations for VMMC they fail to explore possible link or relationship of the reason for circumcising with socio-demographic factors.

We know from TMC studies that TMC is preferred for traditional and cultural reasons (Douglas, Maluleke, Manyaapelo, & Pinkney-Atkinson, 2018; Ntozini & Ngqangweni, 2016; Douglas & Hongoro, 2018). In regions where TMC continues to be the most preferred form of circumcision, TMC is undertaken for the desire to conform to societal norms and expectations, social recognition, status and social acceptance that comes with the ritual and procedure (Douglas et al., 2018; Ntozini & Ngqangweni, 2016). Although this preference poses a challenge to the attainment of VMMC goals, research has been biased mainly towards understanding the barriers and motivators or reasons for undergoing VMMC and associated socio-demographic factors. The studies have identified barriers to VMMC such as fear of pain during and after surgery, fear of long healing periods and adverse events, financial and opportunity costs associated with getting circumcised, threats to masculinity, loss of penile sensitivity and size, concerns about sexual performance, religious concerns, and fear of

undergoing HIV testing (Masese, Chimango, & Mbirimtengerenji, 2017; Chiringa, Ramathuba, & Mashau, 2016; Chamusingarevi, Mhlanga, & Ndaimani, 2016 & George, Govender, Beckett, Montague, & Frohlich, 2017). Apart from barriers, the studies have also identified motivators or reasons for undergoing VMMC and these include reduction in the risk of contracting HIV, improved hygiene, peer pressure, preferences of intimate female partners, and improvement in sexual desirability performance (George et al., 2014; Cockburn, 2016 & Hatzold et al., 2014).

A study by Zungu et al. (2016) looked at the effect of circumcision on HIV risk perception. The study investigated HIV risk perception and risk behaviours among men who have undergone either VMMC or traditional male circumcision (TMC) compared to those that had not been circumcised. The study found that 27.2% of the makes reported being traditionally circumcised and 19.5% reported being medically circumcised. The study also found that males who reported VMMC were significantly more likely to have had more than two sexual partners. Although the study used national household survey data, it analysed data for the general male populace, including those who were not circumcised. The study used a different method (Multinomial regression) than the logistic regression method used in this study.

2.5. Hypothesis

H0 (Null): There is no relationship between socio-demographic determinants and type of male circumcision in South Africa.

H1 (Alternative): There is a relationship socio-demographic determinants and type of male circumcision South Africa.

2.6. Theoretical Framework

The study used the health belief model to explore the study objectives (Ramaprasad, Lang, & Sessa, 2014; Hall, 2012; Rawlett, 2011; Mackie, Moneti, Shakya, & Denny, 2015; Waldeck, 2003; Mackie et al., 2015). The Health Belief Model was used to guide the exploration of factors associated with

circumcising for health related reasons. The use of the Health Belief Model (HBM) is justified by the link between VMMC and positive sexual and reproductive benefits. The HBM model has been used to explain the change and maintenance of health-related behaviours and also as a framework to guide health behaviour interventions (Ramaprasad, Lang, & Sessa, 2014). The theory was selected because it offers constructs that can be modified to come up with a conceptual framework for analysing the study variables. It emphasises focus on modifiable factors, which can be targeted for the implementation of feasible interventions to reduce public health problems. The main constructs of model are perceived threat (susceptibility and seriousness); perceived barriers; perceived benefits; cues to action and modifying and enabling factors. For the purposes of this study, we will use only three constructs: perceived threat (susceptibility) and perceived benefits and cues to action. Perceived susceptibility is a person's own opinion of the chances of being affected by a health condition. Perceived severity is one's opinion about the seriousness of the health condition and its consequences. This study uses Hall (2012) as a template for applying the HBM to understand uptake of male circumcision as a sexual reproductive practices. In the context of the benefits of circumcision to reduce contraction of HIV, perceived threat of being uncircumcised, HIV infection and its sequelae (susceptibility to disease and AIDS) provides the incentive to be circumcised. Perceived benefits relate to the perceived effectiveness of male circumcision in reducing the risk of HIV and STI infection in males. Cues to action for this study are external stimuli that trigger a consciousness of the perceived HIV threat and facilitate consideration of using circumcision to reduce the threat. Access to information via different forms of media will be taken as cues for action in this study (Hall, 2012; Rawlett, 2011).

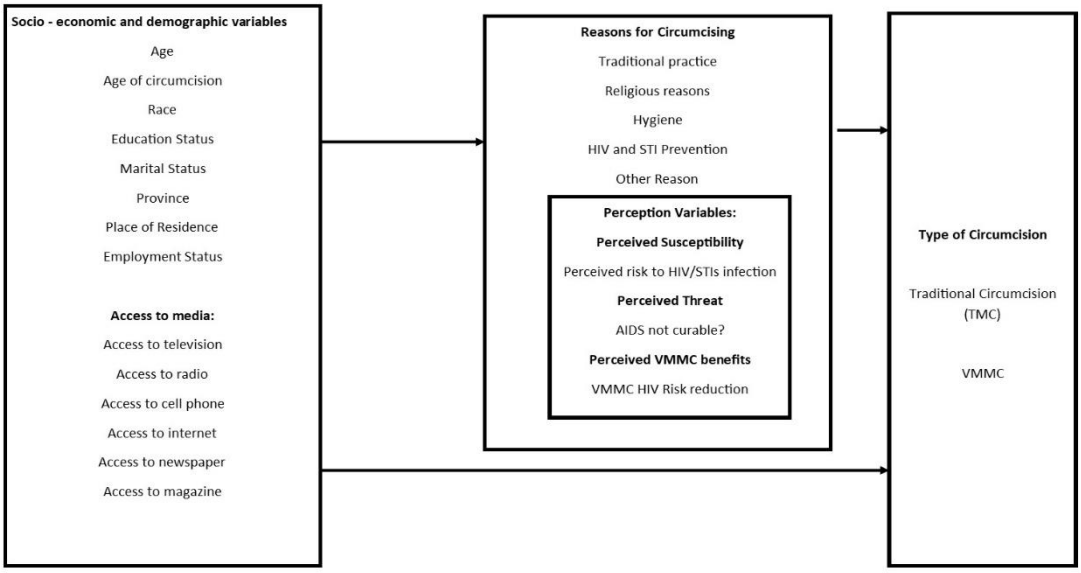
The theories for the study will be modelled into an adaptation of the proximate determinates model (Bongaarts, 1978). The proximate determinants models aims to diagrammatically show the linear flow or relationship between predictor variables and the dependent variable. The independent variables are categorised into intermediate variables and indirect determinants based on their influence on the independent variable. A variable is considered an intermediate variable if its change induces a direct

response to an independent variable. Indirect determinants have no direct impact on the dependent variable (Bongaarts, 1978).

2.7 Conceptual Framework

The conceptual framework used for this study is an adaptation of the Health Belief Model set out in a proximate determinants framework. The conceptual framework looks at the interplay of socio-demographic factors, reason for male circumcision and perception factors to influence the type of male circumcision. The conceptual framework used for the study considers that although socio-demographic factors can operate directly to influence type of circumcision, they mostly operate through other mediating factors to influence the type of circumcision. For the purposes of this study, socio-demographic factors are seen as operating through reason for male circumcision to influence the type of circumcision. Although socio-demographic factors are seen as operating through reason for male circumcision to influence the type of circumcision, other factors like perceived risk to HIV/STI infection, perceived benefits of VMMC in reducing HIV transmission and one's perception of whether or not HIV is curable may also play an intermediate role. These factors are also directly affected by socio-demographic factors and are in the causal pathway between socio-demographic factors and type of circumcision. Operating at the same level, as socio-demographic factors, are access to media variables. These include access to internet, television, radio, cellphone, magazines and newspapers. Access to these different forms of media also has a direct relationship with reason of circumcision.

Figure 1: Diagrammatic presentation of the conceptual framework for the study



This study assumes that if determinants of type of male circumcision are laid out in the proximate determinants model, reason for male circumcision and the perception variables mediates between socio-demographic determinants and access to media to influence the type of male circumcision (VMMC vs TMC). This study aims to explore the link between the socio-demographic determinants and type of male circumcision taking into account the mediating effect of reason for circumcising and perception variables.

CHAPTER 3. METHODOLOGY

3.1 Data Source

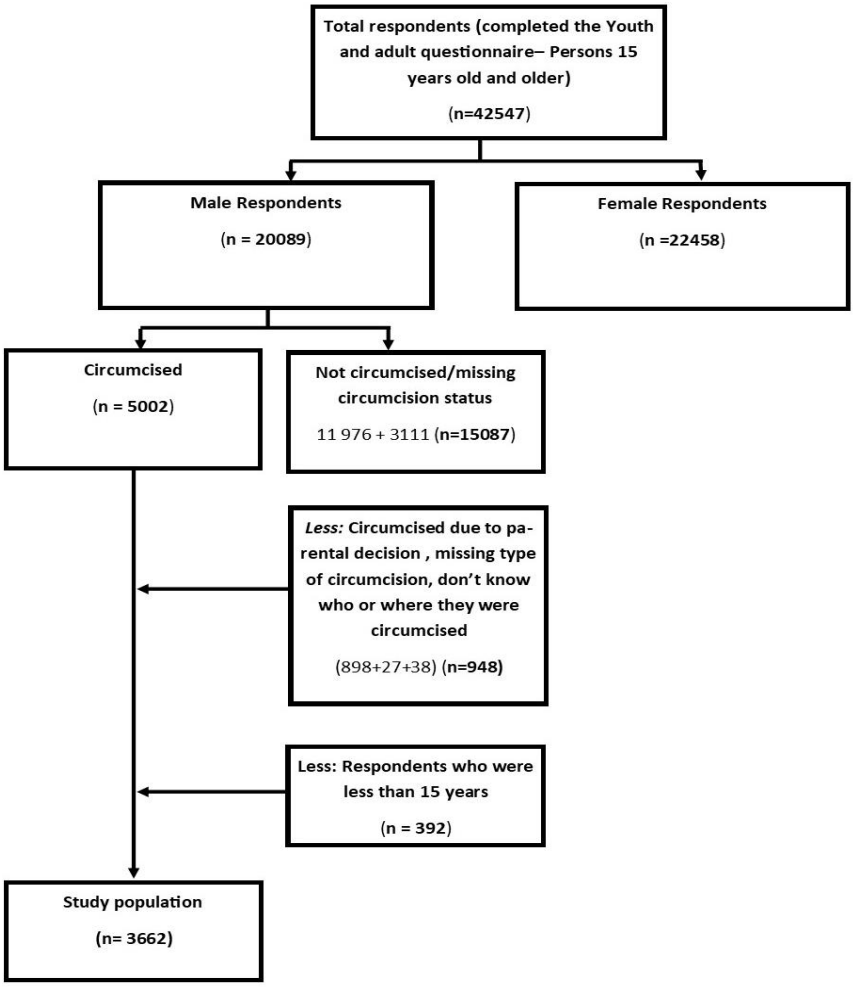
The study used data that was collected by the South African National HIV Prevalence, Incidence and Behaviour Survey, 2012, which was a national survey aimed at understanding the drivers of the HIV pandemic in South Africa through surveillance of HIV infection and behaviour (Shisana et al., 2014). The survey collected data on male circumcision with the aim of determining the proportion of circumcised men. The selection of the survey sample was based on a multi-stage stratified cluster sampling design. Data was collected from 15 households selected from each of the 1000 census enumeration areas (EAs) which were randomly selected from the 2001 population census EAs. The 1000 census enumeration areas were selected on the basis of probability proportional to size and were stratified by province, locality type and race. Locality types were defined as urban formal, urban informal, rural formal (including commercial farms), and rural informal (tribal authority) areas. Oversampling of Coloureds and Indians or Asians was done to meet the required minimum sample size (Shisana et al., 2014). Sample weights were applied at the individual, household or EA levels (Shisana et al., 2014). Everyone in the sampled household was invited to participate (Shisana et al., 2014). Persons of all ages living in South African households and hostels were eligible to participate. Data was collected using structured questionnaires administered by trained field workers.

3.2 Study Population

The study sample included all circumcised males who were interviewed during the survey. Participants who reported being circumcised due to parental decision were excluded from the study. Age restrictions were applied to the sample. All respondents who were less than 15 years were excluded from the analysis. This decision was based on the fact that the SA VMMC programme is from the age of 15 due to parental consent requirements. The other reason was that the majority of males under 15 years of age were missing data on the perception variables and most were circumcised due to a decision made by an adult. Due to the nature in which the outcome variable was constructed,

respondents who did not know who circumcised them and where they were circumcised were dropped from the analysis. After applying these restrictions, the unweighted sample size for the study is 3622 circumcised men. Sampling weights were applied on the data before analysis to correct for potential bias due to the study design, unequal sampling probabilities and to adjust for non-response. Calculation of the unweighted sample size was based on the flow diagram below.

Figure 2: Unweighted sample size calculation



3.3 Study Variables

3.3.1 Variable Definition and Measurement

The outcome variable and predictor variables for the study are outlined below:

3.3.2 Outcome Variable:

The dependent variable for the study is ***type of circumcision***. This was obtained from the youth and adult persons 15 years and older questionnaire. Circumcised males were asked the question: "Who performed the circumcision?" The responses for this question were "(1) Doctor; (2) Spiritual or religious leader; (3) Traditional Circumciser; (4) Other and (5) Don't Know". These responses were recoded to form a dichotomous variable with two options: Traditional Circumcision and MMC. Circumcision by a doctor is considered a proxy for MMC and is coded as such. Circumcision by a Spiritual or religious leader; Traditional Circumciser or Other are considered a proxy for Traditional circumcision and they were recoded as such. Those who reported not knowing the circumciser were dropped from the analysis. Traditional circumcision is coded as (0) and VMMC is coded as (1). For the purpose of this study, where we have missing information on the person who conducted the circumcision, circumcision at a health facility is considered a proxy of MMC and circumcision in the bush for traditional reasons is considered a proxy for traditional circumcision. Participants who did not know who circumcised them and where they were circumcised were dropped or excluded from the analysis. Respondents who were less than 15 years were also excluded from the analysis.

3.3.3 Socio-Demographic predictors

The study also looked at socio-demographic predictors of type of circumcision. These are explored below.

Race is a categorical variable that records the respondent's racial classification as observed by the data collector. For the purpose of this study, race will be recoded into four main racial categories of

South Africa (1) African (2) White (3) Coloured and (4) Indian/Asian. The questionnaire had the option of “Other”, this was recoded into the Indian/Asian category.

Age is a categorical variable that records the respondent’s self-reported age. For participants younger than 15 years, the age category 0-14 years was used. For age groups 15 years and older, age was categorised into 5 year intervals. The intervals are: (1)15-19 years; (2) 20-24 years; (3) 25-29 years; (4) 30-34 years; (5) 35-39 years; (6) 40+ years.

Age at circumcision is a categorical variable which records the self-reported age at which a respondent was circumcised. Data was collected as a continuous variable. For the purposes of the study, the age variable was recoded into 7 age categories. Respondents circumcised before the age 15 were coded into one category (0-14 years). The other age groups had 5 year intervals and these are 15-19, 20-24, 25-29, 30-34 and 35-39. Those who were circumcised after 39 years were coded as 40+.

Marital/Relationship Status is a categorical variable which records the self-reported current marital status of circumcised men. This was measured through the question: “What is your current relationship or marital status?” The responses to this question were recoded into 4 categories (0) Single (1) Married/In Sexual Union (2) Widowed/Divorced/separated (3) Other. Those who had multiple entries on relationship status were coded as missing.

Employment Status is a categorical variable that records the self-reported economic activity of respondents. This was measured through the question: “How would you describe your present employment situation?”. This was categorised into (0) Unemployed; and (1) Employed. All respondents who reported that they were not looking for work, or were sick/disabled and unable to work were recoded as unemployed. Student/pupil/learner were recoded as unemployed. Part time, self-employed, working in informal sector respondents were recoded as employed.

Education Status is a categorical variable describing the self-reported highest educational attainment of a respondent. Education level was categorised into (0) primary; (1) Secondary; and (3) Tertiary.

Grade 0-7 was recoded as primary, grades 8 -12 were recoded as secondary and some post school studies and further degrees was recoded as tertiary.

Province is a categorical variable and records the reported de facto province of resident of a respondent. It is categorised into (1) Western Cape (2) Eastern Cape (3) Northern Cape (4) Free State (5) Kwa-Zulu Natal (6) North West (7) Gauteng (8) Mpumalanga (9) Limpopo.

Place of Residence is a categorical variable that describes the residential area of a respondent. Given that there are differences in the conditions between formal and informal residential areas, the study will use 4 categories for the place of residence category. This will be helpful to make a distinction between: (1) Rural informal (2) Rural formal (3) Urban informal (4) Urban formal.

Access to media variables. The study also considered access to different types of media as variables related to the type of circumcision. The variables are looked at separately. The variables are categorical in nature and describes the respondent's access to information via different forms of public media. These were derived from questions 2.1 (a-f) which asks how often a respondent listen to the radio, reads a magazine, watches television and use the internet e.tc.

Access to television is a categorical variable that measures the respondent's frequency of watching a television. It is categorised as (1) Never (2) Once a week (3) 2-6 days a week (4) Every day of the week.

Access to radio is a categorical variable that measures the respondent's frequency of listening to a radio. It is categorised as (1) Never (2) Once a week (3) 2-6 days a week (4) Every day of the week.

Access to a cell phone is a categorical variable that measures the respondent's frequency of using a cell phone. It is categorised as (1) Never (2) Once a week (3) 2-6 days a week (4) Every day of the week.

Access to the internet is a categorical variable that measures the respondent's frequency of using the internet. It is categorised as (1) Never (2) Once a week (3) 2-6 days a week (4) Every day of the week.

Access to newspaper is a categorical variable that measures the respondent's frequency of reading a newspaper. It is categorised as (1) Never (2) Once a week (3) 2-6 days a week (4) Every day of the week

Access to magazine is a categorical variable that measures the respondent's frequency of reading a magazine. It is categorised as (1) Never (2) Once a week (3) 2-6 days a week (4) Every day of the week

3.3.4 Perception Variables

Perceived VMMC benefits is a categorical variable that measures a participant's perceived medical benefits of male circumcision in reducing the risk of HIV infection. It is measured from question 3.1 (h) which asks: "Can medical male circumcision reduce the risk of HIV infection in males?" The variable has 3 categories (0) No, (1) yes, and (2) Don't Know.

Perceived threat of HIV is a categorical variable that measures a participant's knowledge of whether or not AIDS can be cured. It is measured from question 3.1 (a) which asks: "Can AIDS be cured?" The variable has 3 categories (0) No, (1) yes, and (2) Don't Know.

Perceived Susceptibility is a categorical variable that measures a participant's perception of their risk to contracting HIV. It is measured from question 10.1 which asks participants to rate themselves on a scale of 1 to 4 their risk of becoming infected with HIV. The variable is categorised as (0) Definitely not (1) Probably won't (2) Probably will (3) definitely yes.

3.3.5 Reason for circumcising

The study considered reason for circumcising as a predictor variable for the type of circumcision. This was based on the question: "What was your main reason for being circumcised". Participants who reported that they were circumcised due to a parental decision were excluded from the analysis.

Table 1: Description and measurement of the Dependent and Independent Variables

Variable	Variable Description	Variable Measurement
Dependent variable		
Type of circumcision	Who performed the circumcision? *(Question 9.6)*	(0) Traditional Circumcision (1) VMMC
Independent Variables		
Reason for Circumcising	Main reason given by participant for undergoing male circumcision (*Question 9.7*)	(1) Traditional practice (2) Religious reasons (3) Hygiene (4) Prevent HIV and other STIs (5) Other
Socio-demographic variables		
Race	Participant's race as recorded by interviewer *(Question 1.3*)	(1) African (2) White (3) Coloured (4) Indian/Asian
Age	Participant's self-reported age (*Age categories*)	(1) 15-19 (2) 20-24 (3) 25-29 (4) 30-34 (5) 35-39 (6) 40+
Age at circumcision	*Participant's self-reported age at circumcision (Question 9.2)*	(1) 0-14 (2) 15-19 (3) 20-24 (4) 25-29 (5) 30-34 (6) 35-39 (7) 40+
Marital/Relationship Status	Participant's self-reported marital/ relationship status (*Questions 1.7*)	(0) Single (1) Married/In Sexual Union (2) Widowed/Divorced/separated (3) Other relationship

Variable	Variable Description	Variable Measurement
Employment Status	Participants self-reported employment status (*Question 1.13*)	(0) Unemployed (1) Employed
Education Status	Participants self-reported educational attainment *(Question 19 of Household Data)*	(0) Primary (1) Secondary (2) Tertiary
Province	Province in which interview was conducted (*Section A of the questionnaire*)	(1) Western Cape (2) Eastern Cape (3) Northern Cape (4) Free State (5) Kwa-Zulu Natal (6) North West (7) Gauteng (8) Mpumalanga (9) Limpopo
Place of Residence	Place of residence of participant	(1) Rural informal (2) Rural formal (3) Urban informal (4) Urban formal
Cues to action: Access to Media variables • **Access to television** • **Access to radio** • **Access to cell phone** • **Access to internet** • **Access to newspaper** • **Access to Magazine**	Access to information through either the radio, television, magazine, newspaper or the internet (*Questions 2.1 (a-f)*)	(1) Never (2) Once a week (3) 2-6 days a week (4) Every day of the week
Perception Variables		
Perceived benefits: VMMC has HIV Risk Reduction benefits	Participants perceived medical benefits of male circumcision in reducing the risk of HIV infection (*Question 3.1 (h)*)	(0) No (1) Yes (2) Don't Know
Perceived threat of HIV: AIDS not curable?	Participants knowledge of whether or not AIDS can be cured (*Question 3.1 (a))*	(0) No (1) Yes (2) Don't Know
Perceived Susceptibility: Perceived risk to HIV/STIs infection	Participants perception of their risk to contracting HIV (*Question 10.1*)	0) Definitely no 1) Probably wont 2) Probably will 3) Definitely yes

3.4 Data management and Statistical Analysis Plan

Data management and statistical analysis was done using Stata version 14.1. Stata has the capability to conduct survey data analysis which is crucial given that sampling design affects both the calculation of the point estimates and the standard errors of those estimates (Institute for Digital Research and Education, 2019). Owing to the sampling design, some individuals have a greater or lesser probability of selection than others. To correct this, data was weighted before analysis to correct for bias at the EA, household, and individual levels and also to adjust for non-response (Shisana et al., 2014). This process ensured that analysis was conducted on a final sample representative of the population in South Africa for sex, age, race, locality type, and province (Shisana et al., 2014). The sampling weight affects the calculation of the point estimate, and the stratification and/or clustering affects the calculation of the standard errors (Institute for Digital Research and Education, 2019). Ignoring the clustering will likely lead to standard errors that are underestimated, possibly leading to results that seem to be statistically significant, when in fact, they are not (Institute for Digital Research and Education, 2019). Data will be analysed at the univariate, bivariate and multivariate levels.

The survey data used for the analysis had some missing values or non-responses. These were included using the missing option when tabulations were being done in Stata and they were included in the tables of the descriptive statistics for the characteristics of the study population by study variables. However, complete case analysis was done in the case of regression models and bivariate associations.

3.4.1 Investigation of the levels of male circumcision in South Africa by type of circumcision and reason for circumcision.

The initial step in the analysis was analysis of data at the univariate level. Analysis of the levels of male circumcision by type of male circumcision in South Africa was achieved through doing tabulations of the type of circumcision variable in Stata. Since the objective was to get overall levels of male circumcision by type of circumcision, this analysis did not put restrictions on age and also did not

exclude males who were circumcised due to parental decision. The study made use of frequency tables and bar graphs to gain insight into the distribution of the outcome variable of the study. To investigate the levels of male circumcision by reason of circumcising, tabulation of the reason for circumcision variable was also conducted and the results were reported in the form of a frequency table and a bar graph.

3.4.2 Investigation of the relationship between socio-demographic factors, reason for male circumcision, perception variables and type of circumcision.

Bivariate analysis was conducted to explore the relationships/links outlined in the conceptual framework. Bivariate analysis was used to examine the relationship between the type of circumcision and background socio-demographic characteristics, reason for circumcision and perception variables. The study conceptualises a link in which socio-demographic variables can either directly influence the type of circumcision or can operate through reason for male circumcision and perception variables to influence the type of circumcision. Bivariate analysis of weighted data was done through use of Pearson's chi-square test. This was achieved through cross tabulation in Stata on type of circumcision and socio-demographic factors, reason for circumcision and perception variables. The chi-square was used to identify whether selected socio-demographic variables, reason for circumcising and perception variables have a significant association with type of circumcision. The confidence interval for the chi square test association was determined through use of the ci option which can be used with the *svy: tabulate* command. This was presented as part of the results table. A p-value of 0.05 or less was taken as indicative of a statistically significant relationship.

3.4.3 Investigation of variations in reason for male circumcision by socio-demographic and perception factors

This was also achieved through chi square analysis of reason for male circumcision and the socio-demographic factors and perception variables. This was achieved through cross tabulation in Stata of reason for male circumcision and socio-demographic factors and perception variables. The confidence

interval for the chi square test association was determined through use of the ci option which can be used with the *svy: tabulate* command. This was presented as part of the results table. A p-value of 0.05 or less was taken as indicative of a statistically significant relationship.

3.4.4 Investigation of the socio-demographic predictors of type of male circumcision controlling for other factors.

Variables found significant in the bivariate analysis were incorporated in the multivariate analysis. Since the outcome variable is dichotomous in nature, binary logistic regression analysis was used. The goal of logistic regression is to find the best fitting model to describe the relationship between the dependent variable and a set of predictor variables. Since the main objective of the study is to come up with a profile of predictors of type of circumcision, which is a binary outcome, binary logistic regression was used in the multivariate analysis.

The multivariate logistic regression formula is:

$$\text{Logit (Y)} = \ln\left(\frac{\pi}{1-n}\right) = \alpha + \beta_1 X_1 + \beta_2 X_2 \ldots\ldots$$

Therefore,

$$\pi = Probability\ (Y = outconme\ of\ interest \mid X_1 = x_1, X_2 = x_2)$$

$$= \frac{e^{\alpha+\beta_1 X_1+\beta_2 X_2}}{1+e^{\alpha+\beta_1 X_1+\beta_2 X_2}}$$

Where ∏ is the probability of the event;

Y is the outcome of interest (Type of circumcision);

α is the intercept;

β are regression coefficients;

Xs are a set of predictors (socio-demographic variables, reason for circumcising and perception variables (Peng & So, 2002).

The study took into account the main assumptions and limitations of the logistic regression model. The main assumptions of logistic regression include:

- The true conditional probabilities are a logistic function of the independent variables.
- No important variables are omitted.
- No extraneous variables are included.
- The independent variables are measured without error.
- The observations are independent.
- The independent variables are not linear combinations of each other (idre, 2019).

Multi-collinearity testing was conducted to evaluate correlations among the independent variables *(See Appendix A attached for multi-collinearity test STATA output*). The Pearson's correlation (*pwcorr*) command was used to evaluate correlations and the *sig start (0.5)* option was used to mark all correlations with a significant p value of 0.5. Also, multivariate diagnostics will be conducted to assess for if the model has all the relevant predictors and if the linear combination of them is sufficient (specification error). Test for model specification was done using *linktest* command in Stata. "Stata creates two new variables, the variable of prediction, *_hat*, and the variable of squared prediction, *_hatsq*. The model is then refit using these two variables as predictors. *_hat* should be significant since it is the predicted value. On the other hand, *_hatsq* should not, because if our model is specified correctly, the squared predictions should not have much explanatory power" (idre, 2019). To check how the model fits the data, Hosmer and Lemeshow's goodness of fit test was used. This test was applied on unweighted data since it cannot be used with pweights (idre, 2019).

CHAPTER 4: RESULTS

4.1 Introduction

This chapter describes the results of the study. Data analysis was performed at the univariate, bivariate and multivariate levels. At the univariate level, the study analysed the level of circumcision in South Africa by type of circumcision and reason for circumcision. Frequencies and percentages of the study population by background characteristics were also generated. At the bivariate level, Chi square tests were conducted to test the association between predictor variables and type of circumcision and also to examine variation in reason for circumcision by socio-demographic characteristics and perception variables. At the multivariate level, Odds Ratios, Confidence Intervals and statistical significance levels were generated from multivariate binary logistic regression analysis to profile the socio-demographic predictors of type of circumcision.

4.2 Distribution of characteristics of circumcised men in South Africa

The first step in data analysis was analysis of distribution of the study population by the predictor variables. About 60% of the respondents indicated that they circumcised for traditional practice reasons. Men who circumcised for hygienic reasons account for 12.1% of the circumcised population. About 9.4% of the respondents reported that they circumcised for religious reasons. Those who circumcise for other unspecified reasons accounted for 9.8% of the circumcised population. Only 8.6% of the respondents reported prevention of HIV and other STI as the main reason for undergoing male circumcision

In terms of weighted distribution by race, 91.9% of the respondents were African. Coloureds accounted for 3.9% of the study population. Indians/Asian/Other accounted for 2.2% of the study population and Whites constituted another 2%. In terms of the weighted distribution, the 15-19-year age group had the least proportion of males who were circumcised. Participants who were 40 years and older accounted for 36% of the study population. From 15 -29 years, the frequency increases with an increase in age of the respondents, reaching a peak of 14.9% for the 25-29 age groups and starts

decreasing from the 30-39-year age groups. Most of the males are circumcised when they are 15-19 years old (30%). The frequency decreases with an increase in age. A total of 4.8% of the males reported being circumcised after 29 years of age and only 1% of the males reported being circumcised at 40years or older. The majority of the circumcised males are married or in sexual union (42.7%). About 14.1% of respondents had missing data on age at circumcision. Single people accounted for 21.6% of the males who are circumcised. Those in other unspecified relationships, accounted for 30.2 % of the circumcised males. The majority of the respondents were unemployed. This group constituted 55.9% of the respondents.

The majority of the circumcised males received education up to secondary education 59.6%. Only 9.6% of the respondents had a tertiary education and 15.7% had received only primary level education. About 15.1% of the respondents were missing data on education status. About 24.6% of the circumcised men are from Gauteng followed by Eastern Cape which has 23.5%. Western Cape, Mpumalanga and Kwa-Zulu Natal contributes 9.5%, 9.2% and 8.4% of the respondents respectively. Limpopo contributed 13.3% of the respondents and the Northern Cape only contributed 0.9% of the respondents. The majority of the respondents resided in a formal urban area (44.4%) and in informal rural areas (40.4%). About 48.7 % of the circumcised men perceived VMMC as beneficial for HIV transmission reduction and about 29.4% perceived VMMC as having no HIV transmission reduction benefits. Almost a third of the respondents (29%) expressed that they did not know whether VMMC was beneficial for HIV reduction. In terms of perceived threat of HIV, 68.6% of the circumcised males reported that HIV cannot be cured and 9.7% did not know. About a third of the circumcised men (33.3%) expressed that they definitely more likely to infected by the HIV virus and 41.2% felt that they would probably get infected by HIV. The majority of the circumcised men (64.3%) watch television every day of the week. Cell phone access seems to be the most common way of accessing information. About 84.4% have access to the cell phone every day of the week. The majority of the respondents never had access to the internet (66.8%) and only 49.3% listen to the radio every day of the week. In terms of accessing public media via newspapers and magazines, 32% and 47% had never accessed

these media. Only 3% of the study population were confident that they will not get infected with the HIV virus and 41.3% were definite that they were going to be infected at some stage (41.2%).

Table 2: Frequency and Percentage Distribution of the study population by predictor variables, Source SAHBMS, 2012)

Characteristic of the study population	*Unweighted weighted data*		*Weighted data*	
Variable	**Frequency (circumcised men)**	**Percentage %**	**Frequency (circumcised men #)**	**Percentage %**
Socio-Demographic Variables				
Race				
African	2828	77.2	6218237	91.9
White	88	2.4	134537	2.0
Coloured	353	9.6	263195	3.9
Indian/Asian	393	10.7	151089	2.2
Total	**3662**	**100**	**6767057**	**100**
Age				
15-19	398	10.8	682806	10.1
20-24	548	15.0	950757	14.0
25-29	493	13.5	1010108	14.9
30-34	344	9.4	837562	12.4
35-39	337	9.2	852503	12.6
40+	1542	42.1	2433321	36.0
Total	**3662**	**100**	**676705**	**100**
Age at circumcision				
0-14	1070	29.2	1629810	24.1
15-19	1064	29.1	2064316	30.5
20-24	656	17.9	1418965	21.0
25-29	184	5.0	351855	5.2
30-34	88	2.4	173166	2.6
35-39	39	1.1	81907	1.2
40+	52	1.4	66874	1.0
Missing	509	13.9	980164	14.5
Total	**3622**	**100**	**6767057**	**100**
Marital/Relationship Status				
Single	765	20.9	1461317	21.6
Married/In Sexual Union	1699	46.4	2886394	42.7
Widowed/Divorced/separated	220	6.0	314546	4.6
Other relationship	939	25.6	2042402	30.2
Missing	39	1.1	62398	0.9
Total	**3662**	**100**	**6767057**	**100**
Employment Status				
Unemployed	1960	53.5	3782310	55.9
Employed	1702	46.5	2984748	44.1
Total	**3662**	**100**	**7172601**	**100**

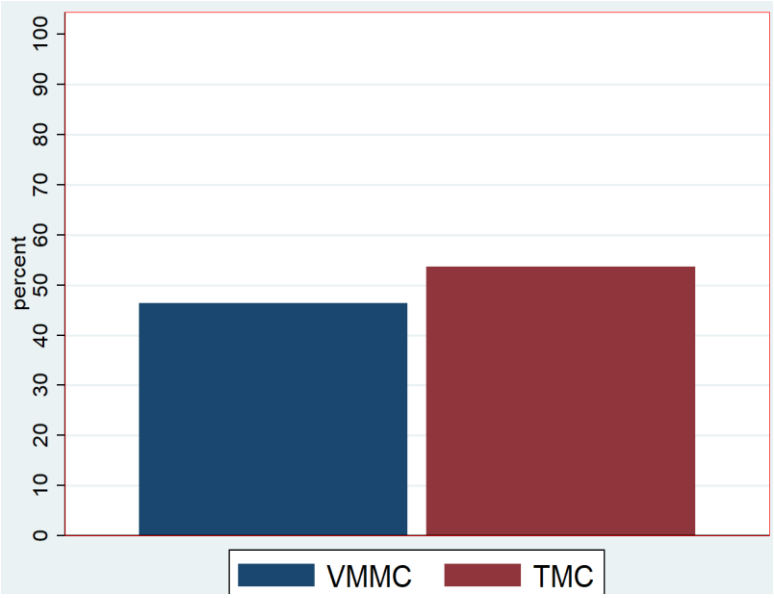
Characteristic of the study population	**Unweighted weighted data**		**Weighted data**	
Variable	**Frequency (circumcised men)**	**Percentage %**	**Frequency (circumcised men #)**	**Percentage %**
Education Level				
primary	626	17.1	1062639	15.7
secondary	2180	59.5	4035131	59.6
tertiary	303	8.3	646637	9.6
Missing	553	15.1	1022650	15.1
Total	**3662**	**100**	**6767057**	**100**
Province				
Western Cape	375	10.2	642290	9.5
Eastern Cape	860	23.5	1590003	23.5
Northern Cape	133	3.6	60032	0.9
Free State	263	7.2	329437	4.9
Kwa-Zulu Natal	424	11.6	566481	8.4
North West	227	6.2	391404	5.8
Gauteng	578	15.8	1666487	24.6
Mpumalanga	328	9.0	620261	9.2
Limpopo	474	12.9	900663	13.3
Total	**3662**	**100**	**6767057**	**100**
Place of Residence				
Rural informal	1010	27.6	2736307	40.4
Rural formal	272	7.4	325970	4.8
Urban informal	557	15.2	697258	10.3
Urban formal	1823	49.8	3007522	44.4
Total	**3662**	**100**	**6767057**	**100**
Perceived VMMC benefits				
No	1107	30.2	1989716	29.4
Yes	1718	46.9	3293958	48.7
Don't Know	802	21.9	1425699	21.1
Missing	35	1.0	57684	0.8
Total	**3662**	**100**	**6767057**	**100**
Perceived threat of HIV				
No	2501	68.3	4641636	68.6
Yes	708	19.3	1422031	21.0
Don't Know	419	11.5	656263	9.7
Missing	34	0.9	47128	0.7
Total	**3662**	**100**	**6767057**	**100**
Perceived Susceptibility				
Definitely no	111	3.0	207755	3.1
Probably wont	662	18.1	1473828	21.8
Probably will	1361	37.2	2785913	41.2
Definitely yes	1499	40.9	2255512	33.3
Missing	29	0.8	44049	0.6
Total	**3662**	**100**	**6767057**	**100**

Characteristic of the study population	**Unweighted weighted data**		**Weighted data**	
Variable	**Frequency (circumcised men)**	**Percentage %**	**Frequency (circumcised men #)**	**Percentage %**
Access to Tv				
Never	542	14.8	1060622	15.7
Once a week	234	6.4	459427	6.8
2-6 days a week	497	13.6	884258	13.1
Every day of the week	2381	65.0	4353533	64.3
Missing	8	0.2	9217	0.1
Total	3622	100	**6767057**	**100**
Access to Radio				
Never	628	17.1	1193351	17.6
Once a week	470	12.8	863982	12.8
2-6 days a week	649	17.7	1215359	18.0
Every day of the week	1820	49.7	3337691	49.3
Missing	95	2.6	156675	2.3
Total	**3662**	**100**	**6767057**	**100**
Access to Cell phone				
Never	447	12.2	720966	10.6
Once a week	70	1.9	94475	1.4
2-6 days a week	136	3.7	205756	3.0
Every day of the week	2990	81.6	5714967	84.5
Missing	19	0.5	30893	0.5
Total	**3662**	**100**	**6767057**	**100**
Access to Newspaper				
Never	1186	32.4	2164862	32.0
Once a week	964	26.3	1812335	26.8
2-6 days a week	713	19.5	1314208	19.4
Every day of the week	786	21.5	1458082	21.5
Missing	13	0.3	17571	0.3
Total	**3662**	**100**	**6767057**	**100**
Access to Magazine				
Never	1677	14.8	3179579	47.0
Once a week	1069	6.4	1844678	27.3
2-6 days a week	517	13.6	1019349	15.1
Every day of the week	381	65.0	705167	10.4
Missing	18	0.2	18284	0.3
Total	**3662**	**100**	**6767057**	**100**
Access to Internet				
Never	2462	67.2	4517436	66.8
Once a week	260	7.1	561363	8.3
2-6 days a week	255	7.0	471278	7.0
Every day of the week	649	17.7	1164591	17.2
Missing	36	1.0	52389	0.8
Total	**3662**	**100**	**6767057**	**100**

4.3 Estimation of the levels of male circumcision in South Africa by type of circumcision

One of the objectives of the research was to determine the levels of male circumcision by type of circumcision in South Africa. This analysis was done at the univariate analysis level. Tabulation of the outcome variable in Stata revealed that the majority of the respondents (53.5%) had traditional male circumcision and 46.4% had VMMC. The statistics are presented in graph 1 below.

Figure 3: Levels of male circumcision in South Africa by type of circumcision in South Africa (Weighted data)



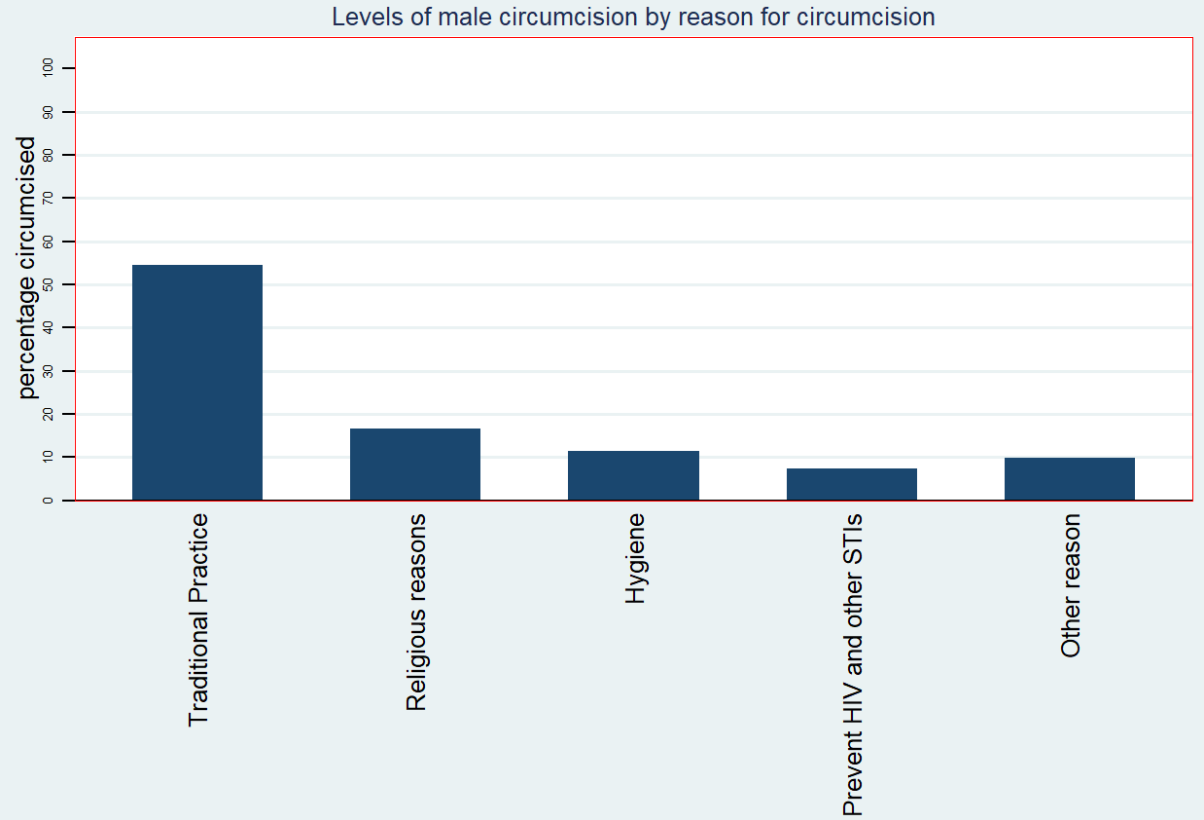
4.4 Estimation of the levels of male circumcision in South Africa by reason for circumcision

Analysis of the level of male circumcision by type of circumcision showed that 60.1% of the males are circumcised as part of traditional practice. Circumcising for hygienic reason (12.1%) is the second most popular reason for undergoing male circumcision.

Table 3: Weighted Levels of male circumcision in South Africa by reason of circumcision in South Africa

Dependent Variable	*Frequency*	*Percentage (%)*
Traditional practice	4068312	60.1
Religious reasons	637281	9.4
Hygiene	819216	12.1
Prevent HIV and other STIs	579114	8.6
Other reason	663135	9.8
Total	**6767057**	**100**

Figure 4: Levels of male circumcision in South Africa by type of circumcision in South Africa (Weighted data)



4.5 Association between type of circumcision and socio-demographic factors, reason for male circumcision and perception factors

Data was analysed to test the chi square association between type of circumcision and socio-demographic characteristics, reason for circumcising and perception variables. The results are tabulated in table 4 below.

Table 4: Results showing the Chi square association between type of circumcision and socio-demographic characteristics, reason for male circumcision and perception factors (weighted data)

Variable	*Traditional (#)*	*VMMC (#)*	*Traditional % (CI)*	*VMMC% (CI)*	*P Value*
Reason for circumcision					
Traditional	3574713	493599	87.9 (84.0 – 90.9)	12.1 (9.08 – 16.0)	P=0.000*
Religious	225264	412017	35.3 (27.9 – 43.6)	64.7 (56.4 – 72.1)	
Hygiene	95067	724150	11.6 (7.07 – 18.5)	88.4 (81.5 – 92.9)	
Prevention of STIs	55770	523344	9.6 (5.89 – 15.4)	90.4 (84.6 – 94.1)	
Other Reasons	267508	395627	40.3 (31.6 – 49.8)	59.7 (50.2 – 68.4)	
Socio-Demographic Variables					
Race					
African	4111764	2106473	66.1 (61.6 – 70.4)	33.9 (29.6 – 38.4)	P=0.0000*
White	5296	129240	3.9 (1.36 – 10.8)	96.1 (89.2 – 98.6)	
Coloured	74746	188449	28.4 (2.0 – 3.9)	71.6 (61.4 – 80.0)	
Indian/Asian	26515	124574	17.5 (10.3 – 28.3)	82.5 (71.7 – 89.7)	
Age					
15-19	305082	377725	44.7 (35.6 – 54.1)	55.3 (45.9 – 64.4)	P=0.0001*
20-24	547147	403610	57.5 (50.3 – 71.3)	42.5 (35.5 – 49.7)	
25-59	657173	352934	65.1 (58.3 – 71.3)	34.9 (28.7 – 41.7)	
30-34	576136	261426	68.8 (58.9 – 77.2)	31.2 (22.8 – 41.1)	
35-39	467332	385171	54.8 (42.8 – 66.3)	45.2 (33.7 – 57.2)	
40+	1665451	767870	68.4 (63.5 – 73.0)	31.6 (27.0 – 36.5)	
Age at circumcision					
0-14	901309	728501	55.3 (49.2 – 61.3)	44.7 (38.7 – 50.8)	P=0.0000*
15-19	1488603	575713	72.1 (66.5 – 77.1)	27.9 (22.9 – 33.5)	
20-24	968990	449975	68.3 (58.8 – 76.5)	31.7 (23.5 – 41.2)	
25-59	179526	172329	51 (40.0 – 62.0)	49 (38.0 – 60.0)	
30-34	64694	108473	37.4 (22.6 – 54.8)	62.6 (45.2 – 77.4)	
35-39	25509	56398	31.1 (14.4 – 54.8)	68.9 (45.2 – 85.6)	
40+	16594	50280	24.8 (10.3 – 48.6)	75.2 (51.4 – 89.7)	
Marital/Relationship Status					
Single	867678	593639	59.4 (52.2 – 66.1)	40.6 (33.9 – 47.8)	P=0.1044
Married/In Sexual Union	1805582	1080812	62.6 (57.2 – 67.7)	37.4 (32.3 – 42.8)	
Widowed/Divorced/separated	225470	89076	71.7 (61.8 – 79.8)	28.3 (20.2 – 38.2)	
Other relationship	1263899	778503	61.9 (55.4 – 68.0)	38.1 (32.0 – 44.6)	
Employment Status					
Unemployed	2428718	1353592	64.2 (59.2 – 69.0)	35.8 (31.0 – 40.8)	P=0.1598
Employed	1789603	1195145	60 (54.6 – 65.1)	40 (34.9 – 45.4)	
Education Level					
primary	876714	185925	82.5 (77.3 – 86.7)	17.5 (13.3 – 22.7)	P=0.000*
secondary	2462839	1572292	61.0 (56.7 – 65.2)	39 .0(34.8 – 43.3)	
tertiary	210486	436151	32.6 (22.5 – 44.5)	67.4 (55.5 – 77.5)	

Variable	**Traditional (#)**	**VMMC (#)**	**Traditional % (CI)**	**VMMC% (CI)**	**P Value**
Province					
Western Cape	425257	217033	66.2 (53.1 – 77.2)	33.8 (22.8 – 46.9)	P=0.000*
Eastern Cape	1405715	184288	88.4 (80.5 – 93.4)	11.6 (6.63 – 19.5)	
Northern Cape	34146	25886	56.9 (38.9 – 73.2)	43.1 (26.8 – 61.1)	
Free State	172422	157015	52.3 (41.1 – 63.4)	47.7 (36.6 – 58.9)	
Kwa-Zulu Natal	165322	401159	29.2 (19.8 – 40.7)	70.8 (59.3 – 80.2)	
North West	233787	157617	59.7 (50.1 – 68.6)	40.3 (31.4 – 49.9)	
Gauteng	667991	998496	40.1 (32.1 – 48.6)	59.9 (51.4 – 67.9)	
Mpumalanga	493062	127198	79.5 (71.5 – 85.7)	20.5 (14.3 – 28.5)	
Limpopo	620620	280043	68.9 (59.8 – 76.8)	31.1 (23.2 – 40.2)	
Place of Residence					
Rural informal	2071568	664740	75.7 (69.8 – 80.8)	24.3 (19.2 – 30.2)	P=0.000*
Rural formal	190854	135116	58.5 (27.9 – 83.7)	41.5 (16.3 – 72.1)	
Urban informal	520210	177048	74.6 (66.6 – 81.2)	25.4 (18.8 – 33.4)	
Urban formal	1435689	1571833	47.7 (41.5 – 54.1)	52.3 (45.9 – 58.5)	
Perceived VMMC benefits					
No	1229336	760380	61.8 (56.0 – 67.3)	38.2 (32.7 – 44.0)	P=0.000*
Yes	1861019	1432939	56.5 (50.7 – 62.1)	43.5 (37.9 – 49.3)	
Don't Know	1083423	342276	76.0 (70.2 – 81.0)	24.0 (19.0 – 29.8)	
Perceived threat of HIV					
No	2889924	1751712	62.3 (58.1 – 66.2)	37.7 (33.8 – 41.9)	P=0.0155*
Yes	803620	618410	56.5 (46.7 – 65.9)	43.5 (34.1 – 53.3)	
Don't Know	490165	166098	74.7 (67.8 – 80.5)	25.3 (19.5 – 32.2)	
Perceived Susceptibility					
Definitely no	167807	39948	80.8 (67.0 – 89.7)	19.2 (10.3 – 33.0)	P=0.0269*
Probably wont	952125	521703	64.6 (57.8 – 70.9)	35.4 (29.1 – 42.2)	
Probably will	1741258	1044655	62.5 (56.0 – 68.6)	37.5 (31.4 – 44.0)	
Definitely yes	1319145	936367	58.5 (53.3 – 63.5)	41.5 (36.5 – 46.7)	
Access to television					
Never	859280	201343	81.0 (75.7 – 85.4)	19.0 (14.6 – 24.3)	P=0.0000*
Once a week	343695	115732	74.8 (64.1 – 83.1)	25.2 (16.9 – 35.9)	
2-6 days a week	592517	291741	67.0 (60.1 – 73.2)	33.0 (26.8 – 39.9)	
Every day of the week	2416693	1936840	55.5 (50.5 – 60.4)	44.5 (39.6 – 49.5)	
Access to a Cell phone					
Never	593339	127628	82.3 (76.1 – 87.1)	17.7 (12.9 – 23.9)	
Once a week	57457	37019	60.8 (37.4 – 80.1)	39.2 (19.9 – 62.6)	
2-6 days a week	135838	69918	66.0 (53.5 – 76.6)	34.0 (23.4 – 46.5)	
Every day of the week	3409116	2305850	59.7 (55.2 – 63.9)	40.3 (36.1 – 44.8)	
Access to Internet					
Never	3293187	1224249	72.9 (68.8 – 76.6)	27.1 (23.4 -31.2)	P=0.0000*
Once a week	259714	301649	46.3 (36.8 – 56.0)	53.7 (44.0 - 63.2)	
2-6 days a week	207370	263909	44.0 (33.8 – 54.7)	56.0 (45.3 - 66.2)	
Every day of the week	423489	741102	36.4 (28.2 – 45.4)	63.6 (54.6 - 71.8)	
Access to Radio					
Never	877723	315627	73.6 (68.2 – 78.3)	26.4 (21.7 – 31.8)	P=0.0001*
Once a week	584802	279180	67.7 (59.9 – 74.6)	32.3 (25.4 – 40.1)	
2-6 days a week	724232	491127	59.6 (51.5 – 67.2)	40.4 (32.8 – 48.5)	
Every day of the week	1919283	1418408	57.5 (52.1 – 62.7)	42.5 (37.3 – 47.9)	

Variable	**Traditional (#)**	**VMMC (#)**	**Traditional % (CI)**	**VMMC% (CI)**	**P Value**
Access to Newspaper					
Never	1638365	526497	75.7 (70.5 – 80.2)	24.3 (19.8 – 29.5)	P=0.0000*
Once a week	1161412	650923	64.1 (58.4 – 69.4)	35.9 (30.6 – 41.6)	
2-6 days a week	682024	632185	51.9 (44.9 – 58.8)	48.1 (41.2 – 55.1)	
Every day of the week	726673	731408	49.8 (41.5 – 58.2)	50.2 (41.8 – 58.5)	
Access to Magazine					
Never	2229763	949816	70.1 (64.5 – 75.2)	29.9 (24.8 – 35.5)	P=0.0000*
Once a week	1076946	767733	58.4 (52.4 – 64.2)	41.6 (35.8 – 47.6)	
2-6 days a week	485828	533521	47.7 (39.8 – 55.6)	52.3 (44.4 – 60.2)	
Every day of the week	412681	292486	58.5 (47.8 – 68.5)	41.5 (31.5 – 52.2)	

** relationship is significant the 5% level*

All the predictor variables were significantly associated with type of circumcision except for marital/ relationship status, employment status and perceived susceptibility to HIV infection. The majority of males (87.9%) who reported circumcising for traditional reasons had traditional circumcision. The majority of respondents who reported circumcising for hygiene and prevention of HIV and STIs had VMMC (88.4% and 90.4% respectively). Among those who were circumcised for religious reasons, 64.7% had VMMC. Overall, the relationship between type of circumcision and reason for circumcision was significant ($p<0.01$). Race was significantly related to type of circumcision ($p<0.01$). Traditional circumcision is more common among the African population, 66.1% circumcised African males reported had traditional circumcision. The majority of Whites, Indians or Asians and coloured had VMMC (96.1%, 82.5% and 71.6% respectively). VMMC is more common among the 15-19-year age group (55.3%) and tends to decrease with an increase in age between the ages 20-34. The decrease is interrupted among the 35-39-year age group were there is an increase in VMMC to 45.2% from 31.2% among the 30-34-year age group. TMC is most common among the 30-34-year age group (68.8%). Overall, there was a significant association between age and type of circumcision (P=0.0001)

TMC is more common among males who were circumcised between the ages 0-29 years. The percentages of TMC were 55.3%, 72.1%, 68.3% and 51% for those who were circumcised in the 0-14, 15-19, 20-24 and 25.29 age groups respectively. VMMC is more common among the males who are

30 years or older. About 72% of males who were circumcised when they were age 15-19 years had TMC and about 75.2% of males who were circumcised when they were aged 40 years or older had VMMC. There was an overall significant relationship between age at circumcision and type of circumcision (p=0.0000).

TMC is the most common type of circumcision amongst all the categories of marital/relationship status although the relationship was not statistically significant (p=0.1044). Education status had a no significant association with type of circumcision. TMC was the most common type of circumcision for both categories of the employment status variable. About 64.2% of the unemployed males had TMC and 60% of those employed had TMC. TMC is more common among the respondents with primary and secondary education (82.5% and 61% respectively). Among the respondents with tertiary education, about 67.4% are circumcised through VMMC. Education had a significant relationship with type of circumcision (p=0.0000). VMMC is most common in KwaZulu-Natal (70.8%) and Gauteng (59.9%) and the relationship between province and type of circumcision was significant (p=0.0000). Males residing in urban formal settings are mostly circumcised VMMC (52.3%) and the relationship is significant (p=0.0000)

Although 56.5% of the circumcised males reported that they believe VMMC has HIV transmission reduction benefits, the participants had traditional circumcision. The majority of those who do not know if VMCC has any HIV reduction benefits had TMC (76%). The relationship is significant (p=0.0155). Of the males who reported that AIDS is curable (perceived HIV as a threat), 56.5% had traditional circumcision. Of those who reported not knowing if AIDS is curable, 74.7% had TMC. Of those who perceived themselves as definitely not going to be infected by HIV, 80.8% had TMC. About 41.5% of those who perceived themselves as definitely going to be infected by the HIV virus had VMMC. The relationship between perceived susceptibility and HIV was significant (p=0.0269. About 81% of those who reported never having access to the television had TMC. Males who reported having access to some internet were circumcised via VMMC and relationship was significant. About 63.6% of

the males who have access to the internet everyday are circumcised via VMMC. About 50.2% of males who report having access to the newspaper every day of the week had VMMC. The majority of males who reported not having access to any form of media were circumcised via TMC. About 82.3% of the respondents who reported not having access to a cell phone were circumcised vis TMC, and the proportion of males who had no access to the internet, radio, newspaper and magazine and circumcised via TM was 72.9%, 73.6%, 75.7% and 70.1% respectively. All access to media variables were significantly associate with type of circumcision ($p<0.05$).

4.6 Analysis of variations in socio-demographic factors by reason for circumcision

All the predictor variables, except for perceived threat of HIV, are significantly related to reason of circumcision. The majority of circumcised African circumcise for traditional reasons (64.4%). Whites circumcise mostly for other unspecified reasons (48.5%) and few very small proportion circumcise for prevention of HIV ad STIs (0.3%). The majority of Indians or Asians circumcise for religious reasons (73.2%). Coloureds also circumcise mainly for religious reasons (40.1%).

Although circumcision was found to be the most common reason for circumcising across all the age groups, about a fifth of the circumcised 15-19 year olds indicate circumcising for HIV and STI prevention reasons (19.7%). About 15% of the circumcised 20-24 year olds indicated circumcising for HIV or STI prevention. A big proportion of men who circumcise when they are 40 years or older indicated that they circumcise for HIV or STI prevention and the relationship is statistically significant.

Married men are mostly circumcising for traditional reasons, 16.5% reported circumcising for hygienic reasons. Among those with a tertiary education, the majority of the respondent's reported circumcising for hygienic reasons (37.1 %), traditional reasons (27%) and other reasons (17.1%). A greater proportion of circumcised men in Kwa-Zulu Natal circumcise for HIV and STI prevention (34.9%). In Gauteng, men are circumcised mainly for traditional reasons (38.5%) but 26.6% are circumcised for hygienic reasons.

Table 5: Variations in reason for circumcision by socio-demographic factors and perception variables

	Reason for circumcising and socio-demographic factors					
Variable	**Tradition %**	**Religious %**	**Hygiene %**	**STI/HIV prevention %**	**Other %**	**P Value**
Race						
African	64.4	6.45	11.1	9.1	8.9	P=0.0000
White	2.91	14.7	33.6	0.3	48.5	
Coloured	18.7	40.1	22.8	4.0	14.4	
Indian/Asian	6.3	73.2	14.1	0.9	5.4	
Age						
15-19	48.3	11.6	12.1	19.7	8.3	P=0.0014
20-24	59.1	8.1	7.4	15.2	10.2	
25-59	58.6	9.2	11.7	9.8	10.7	
30-34	64.5	8.8	11.2	4.9	10.5	
35-39	57.5	8.8	20.5	5.5	7.6	
40+	63.8	9.8	11.5	4.6	10.2	
Age at circumcision						
0-14	50.7	18.7	10.3	5.6	14.8	P=0.0000
15-19	70.8	6.4	8.3	9.3	5.2	
20-24	67.6	4.3	11.6	8.3	8.1	
25-29	49.4	2.1	27.1	7.8	13.5	
30-34	33.8	9.6	39.3	2.6	14.7	
35-39	31.9	1.0	28.1	28.9	10.1	
40+	25.3	2.5	15.6	35.5	21.1	
Marital or relationship status						
Single	62.7	10.8	7.6	11.9	7	P=0.0006
Married/In Sexual Union	56.8	11.1	16.5	5.2	10.4	
Widowed/Divorced/separated	61.9	8.6	10.1	8.9	10.5	
Other relationship	62.1	6.3	9.7	11.1	10.7	
Employment status						
Unemployed	64	8.0	8.5	9.9	9.7	P=0.0002
Employed	55.3	11.2	16.6	6.9	10.0	
Education level						
primary	78.3	6.2	4.0	5.6	5.9	P=0.0000
secondary	60	9.4	11.5	9.8	9.3	
tertiary	27	10.8	37.1	7.8	17.1	
Province						
Western Cape	62.1	19.6	9.1	0.9	8.4	P=0.0000
Eastern Cape	89.9	2.6	1.0	0.7	0.6	
Northern Cape	54.6	17.1	13.7	6.9	7.6	
Free State	40.5	11.8	22.1	12.4	13.2	
Kwa-Zulu Natal	22.0	14.5	16.1	34.9	12.5	
North West	58.4	6.1	13.9	10.6	11.0	
Gauteng	38.5	11.2	26.6	10.1	13.6	
Mpumalanga	74.0	5.7	6.3	4.8	9.2	
Limpopo	68.7	10.4	4.1	8.9	7.8	
Place of residence						*P=0.0000*
Rural informal	75.7	6.0	3.8	7.0	7.5	
Rural formal	56.2	6.4	24.0	3.7	9.6	
Urban informal	69.1	6.6	8.6	8.3	7.4	
Urban formal	44.3	13.5	19.2	10.5	12.5	
Perceived VMMC benefits						
No	62.0	9.9	9.2	7.6	11.4	P=0.0000
Yes	53.8	9.3	15.5	11.7	9.6	
Don't Know	71.6	9.3	8.3	3.0	7.9	

Variable	**Tradition %**	**Religious %**	**Hygiene %**	**STI/HIV prevention %**	**Other %**	**P Value**
Perceived threat of HIV						
No	60.4	9.3	11.9	9.2	9.1	P=0.1443
Yes	53.8	10.4	15.1	8.8	11.9	
Don't Know	70.7	8.2	7.4	3.7	10	
Perceived Susceptibility**						
Definitely no	71.1	8.2	8.9	5.0	6.8	P=0.0002
Probably wont	59.7	4.7	11.5	10.4	13.8	
Probably will	61.7	8.1	14.7	8.4	7.1	
Definitely yes	57.0	14.4	9.7	7.9	10.9	
Access to Media						
Access to tv**						
Never	78.4	5.9	3.7	3.8	8.2	P=0.0000
Once a week	73.8	8.2	5.3	4.4	8.3	
2-6 days a week	62.6	8.0	8.4	10.3	10.6	
Every day of the week	53.8	10.7	15.6	9.8	10.1	
Access to a Cell phone**						
Never	79.5	7.6	2.6	5.0	5.3	P=0.0000
Once a week	55.1	14.4	4.0	24.5	1.9	
2-6 days a week	61.6	11.2	7.1	9.4	10.6	
Every day of the week	57.6	9.5	13.7	8.7	10.4	
Access to Internet**						
Never	69.5	7.3	6.7	7.4	9.1	P=0.0000
Once a week	47.8	8.9	15.8	12.2	15.3	
2-6 days a week	40.4	15.8	24.0	10.4	9.4	
Every day of the week	37.7	15.4	26.9	10.4	9.6	
Access to Radio**						
Never	71.0	6.6	6.1	5.7	10.6	P=0.0003
Once a week	64.6	11.1	8.9	8.4	7.0	
2-6 days a week	64.5	8.0	7.9	7.8	11.7	
Every day of the week	53.3	10.7	16.8	9.8	9.4	
Access to Newspaper**						
Never	72.9	8.0	5.4	5.2	8.4	P=0.0000
Once a week	63.7	8.8	10.4	7.7	9.5	
2-6 days a week	51.4	9.9	13.9	11.8	13.1	
Every day of the week	44.8	12.1	22.7	11.5	9.0	
Access to Magazine**						
Never	67.6	8.9	9.0	6.2	8.3	P=0.0002
Once a week	57.2	9.4	12.2	10.2	10.9	
2-6 days a week	48.5	12.3	14.3	10.3	14.7	
Every day of the week	50.9	7.6	22.9	12.6	6.0	

***significant at p <0.01* **significant at p <0.05*

4.7 Analysis of socio-demographic predictors of type of circumcision

In the bivariate logistic regression model, all the predictor variables, except for employment status, had a significant relationship with type of circumcision ($p<0.05$). Whites have 47.6 times the odds of being circumcised via VMMC when compared to Africans (OR=47.63, $p<0.01$, CI:15.77 – 143.89). Indians have also had 9.17 times higher odds of being circumcised through VMMC than African (OR=9.17, $p<0.01$, CI: 4.82 -17.45). The odds of being circumcised via VMMC are 4.12 times higher for coloureds when compared to Africans (OR=4.92, $p<0.01$, CI:2.94 – 8.22). For males aged 20-30 years, there is significant relationship between age and type of circumcision. The odds of being circumcised through VMMC decreases with an increase in age for this age group. Males who are 20-24 years old have 0.6 less odds of being circumcised through VMMC when compared to those 15-19 years old (OR=0.60, $p<0.05$, CI: 0.40 - 0.89). Males 30-34 years old and 40 years or older have a 63% lower likelihood (1 - 0.37) of being circumcised via VMMC compared to those aged 15-19 years (OR=1 - 0.37, $p<0.37$, CI:0.21 -0.65 and OR=0.37, $p<0.01$, CI: 0.25 -0.55 respectively). The odds of being circumcised through VMMC compared to TMC increases with an increase in age at circumcision. Men who were circumcised when they 15-19 years old had a 52% lower likelihood (1 - 0.48) of being circumcised via VMMC when compared to those circumcised when they were less than 15 years old (OR=1 - 0.48, $p<0.01$, CI: 0.34 – 0.67). Men who were circumcised when they were 20-24 years old had a 43% lower likelihood (1 - 0.57) of being circumcised via VMMC when compared to those circumcised when they were 0-14 years (OR=1 - 0.57, $p<0.05$, CI: 0.37 - 089). Men who were circumcised when they were 40 years or older have 3.75 times higher odds of being circumcised via VMMC when compared to those circumcised when they were 0-14 years (OR=3.75, $p<0.05$, CI: 1.27 – 11.06).

Men who are widowed, divorced or separated had a 60% lower likelihood (1 - 0.40) of being circumcised through VMMC when compared to those who are single (OR=1 - 0.040, $p<0.05$, CI: 0.34 – 0.98). The odds of being circumcised via VMMC increase with an increase in educational attainment. Men with secondary school level education have 3 times higher odds of being circumcised through

VMMC when compared to those with a primary level education (OR=3.01, p<0.01, CI: 2.20 – 4.11). The odds are 9.77 times higher for those who have tertiary level education (OR=9.77, p<0.01, CI: 5.44 – 17.55). Being from the Eastern Cape, Kwa-Zulu Natal and Gauteng provinces was significantly associated with type of circumcision. Men from Kwa-Zulu Natal have 4.75 times higher odds of being circumcised through VMMC when compared to men from the Western Cape (OR=4.75, p<0.01, CI: 0.11 – 0.58). Men from Gauteng have 2.93 times higher odds of being circumcised through VMMC than those from the Western Cape (OR=2.93, p<0.01, CI: 1.53 – 5.59). Men from the Eastern Cape province have 0.26 times less odds of being circumcised via VMMC when compared to those from the Western Cape province (OR=0.26, p<0.01, CI:0.11 – 0.58).

Men from urban formal settings had 3.41 times higher odds of being circumcised through VMMC when compared to those from rural informal communities (OR=3.41, p<0.01, CI: 2.29 – 5.08). All categories of reason for circumcision were significantly related to type of circumcision. Men who circumcise for prevention of HIV and other STIs had 67.96 times higher odds of being circumcised via VMMC when compared to those who circumcise as traditional practice (OR=67.96, p<0.01, CI: 36.23 – 127.47). Men who circumcise for hygienic reasons had 55.17 times higher odds of being circumcised through VMMC when compared to those who circumcise for traditional reasons (OR=55.17, p<0.01, CI: 30.09 – 101.14).

Men who do not know whether AIDS is curable or not (perceived HIV threat) have a 44% lower likelihood (1 - 0.56) of being circumcised via VMMC when compared to those who say that AIDS is not curable (OR=1 - 0.56, p<0.36, CI: 0.39 – 0.80). Men who do not know if VMMC has HIV transmission reduction benefits (perceived VMMC benefits), have a 49% lower likelihood (1 - 0.51) of being circumcised through VMMC when compared to those who say they VMMC does not have any benefits (OR=0.51, p<0.01, CI: 0.36 – 0.72). Men who indicate that they are definitely going to be infected by the HIV virus have 2.98 times higher odds of being circumcised via VMMC when compared to those who report that they are definitely not going to be infected (OR=2.98, p<0.01, CI: 1.42 – 6.28).

The odds of being circumcised through VMMC compared to TMC increase with an increase on the frequency of television, radio, newspaper and internet access. Men who have everyday access to the internet have 4.7 times higher odds of being circumcised via VMMC when compared to those who have never access to the internet (OR=4.70, p<0.01, CI: 3.18 – 6.97). Men who have every day access to the television, radio, cell phone and newspaper have 3.42, 2.05, 3.14 and 3.13 times higher odds, respectively, of being circumcised via VMMC when compared to those who have never access to these public media mediums.

In the multivariate analysis, race, age at circumcision, marital or relationship status, education status, province, having access to a radio, magazine and internet and reason for circumcision were found to be the main predictors of male circumcision. All categories of reason for circumcising were significantly associated with type of circumcision. Being circumcised for the prevention of STIs and HIV and being circumcised for hygienic reasons increased the odds of being circumcised through VMMC when compares to being circumcised for traditional reasons (OR=57.29, p<0.001, CI: 27.77–18.19 and OR=33.02, p<0.01, CI: 16.15 – 67.48 respectively). Being circumcised for other unspecified reason has 7.13 times the odds of being circumcised through VMMC when compared to being circumcised for traditional reasons (OR=7.13, p<0.01, CI: 3.90 – 13.01). Men circumcised for religious reason also have greater odds of being circumcised through VMMC than being circumcised for traditional reasons (OR=8.87, p<0.01, CI: 4.90 – 16.08).

Whites and Coloureds have higher odds of being circumcised through VMMC that Africans. White men have about 12 times the odds of being circumcised through VMMC than African men (OR=11.78, p <0.01, CI: 3.20 – 43.37). Coloured men have about 5 times the odds of being circumcised through VMMC than African men (OR=5.01, p <0.01, CI: 1.87 – 13.40). Indians or Asians also have greater odds of being circumcised through VMMC than African men but the relationship was not significant (OR=3.08, p=0.094, CI: 0.83 – 11.46).

Being from Kwa-Zulu natal, North West and Gauteng provinces increases the odds of being circumcised through VMMC when compared to being from the Western Cape province. Men from North West have about 5 times the odds of being circumcised through VMMC compared to being from western cape (OR=4.96, p<0.01, CI: 2.22 – 11.07). Men from Kwa-Zulu natal have 4.6 times the odds of being circumcised through VMMC when compared to those from Western Cape (OR=4.56, p<0.01, CI: 2.04 – 10.21). Men from Gauteng also have 3.6 times the odds of being circumcised through VMMC compared to being from Western Cape (OR=3.62, p<0.01, CI: 1.69 – 7.76).

Compared to having only primary education, the odds of being circumcised through VMMC increases with an increase in educational attainment. Respondents with secondary and tertiary education were more likely circumcised through VMMC than those who only have primary education. Compared to men with primary level education, men with secondary education have 1.57 times odds of being circumcised through VMMC (OR=1.57, p<0.05, CI: 1.02 – 2.41). Men with tertiary education have 1.84 times odds of being circumcised via VMMC but the relationship was not significant with P>0.05.

The odds of being circumcised through VMMC increases with an increase in age at circumcision. Men who are circumcised when they are 25-29 years have higher odds of being circumcised through VMMC than those circumcised younger than 15 years (OR=3.41, p<0.05, CI: 1.59 – 7.32). The odd increase to 4.93 times for men who are 40 years or older (OR=4.93, p<0.05, CI: 1.54 – 15.75). Men who are married or in a sexual union also have less odds of being circumcised through VMMC than those who are single (OR=0.42, p<0.05, CI: 0.22 – 0.81).

In the multivariate analysis, there was no relationship between all the perception variables and type of circumcision. Type of circumcision was not significantly associated with perceived threat of HIV/AIDS, perceived susceptibility to HIV infection and also perceived benefits of VMMC. Access to a television 2-6 days of the week had 1.89 timed higher odds of being circumcised via VMMC when compared to those who have never had access to a TV (OR=1.89, p<0.05, CI: 1.26 – 5.87). Men who have access to a magazine every day of the week had a 64% lower likelihood (1 - 0.36) of being

circumcised through VMMC when compared to those who have never had access to a magazine (OR=1 - 0.36, p<0.05, CI: 0.16 – 0.82). Men who have access to the internet every day of the week had 2.64 times higher odds of being circumcised through VMMC when compared to those who have never had access to VMMC (OR=2.64, p<0.05, CI: 1.51 – 4.62). Men who have access to the internet once a week have 1.87 times higher odds of being circumcised through VMMC when compared to those who have never had access to the internet (OR=1.87, p<0.05, CI: 1.01 – 3.45).

After controlling for other predictors, the study did not find a significant association between having tertiary education and male circumcision (p>0.05). There was also no significant relationship between all the perception variables and type of circumcision. Knowing the HIV preventive benefits of VMMC (p=0.198) and knowing whether AIDS is curable was not significantly related to type of circumcision (p>0.05). There was no significant association between place of residence and type of residence. Age was also not significantly related to type of circumcision.

Table 6: Unadjusted and adjusted odds ratios of predictors of type of circumcision in South Africa

		95% CI			95% CI	
	uOR	**(Lower – Upper)**	**pValue**	**aOR**	**(Lower - Upper)**	**pValue**
Race						
African =(RC)						
White	47.63	(15.77 – 143.89)	0.000**	11.78	(3.20 – 43.37)	0.000**
Coloured	4.92	(2.94 – 8.22)	0.000**	5.01	(1.87 – 13.40)	0.001**
Indian/Asian	9.17	(4.82 – 17.45)	0.000**	3.08	(0.83 – 11.46)	0.094
Age						
15-19 =(RC)						
20-24	0.60	(0.40 – 0.89)	0.012*	1.02	(0.55 – 1.90)	0.949
25-59	0.43	(0.28 – 0.67)	0.000**	0.68	(0.30 – 1.55)	0.363
30-34	0.37	(0.21 – 0.65)	0.001**	0.63	(0.26 – 1.51)	0.298
35-39	0.67	(0.38 – 1.17)	0.158	1.74	(0.53 - 5.68)	0.359
40+	0.37	(0.25 – 0.55)	0.000**	0.87	(0.40 – 1.91)	0.731
Age at circumcision						
0-14 =(RC)						
15-19	0.48	(0.34 – 0.67)	0.000**	1.03	(0.63 – 1.68)	0.899
20-24	0.57	(0.37 – 0.89)	0.013*	1.30	(0.71 – 2.38)	0.396
25-59	1.19	(0.72 – 1.97)	0.504	3.41	(1.59 – 7.32)	0.002**
30-34	2.07	(0.98 – 4.40)	0.057	4.60	(1.80 – 11.71)	0.001**
35-39	2.73	(1.01 – 7.39)	0.047*	4.79	(1.37 – 16.77)	0.014*
40+	3.75	(1.27 – 11.06)	0.017*	4.93	(1.54 – 15.75)	0.007**
Marital or relationship status						
Single = (RC)						
Married/In Sexual Union	0.87	(0.64 – 1.19)	0.395	0.42	(0.22 – 0.81)	0.010**
Widowed/Divorced/separated	0.58	(0.34 – 0.98)	0.040*	0.27	(0.07 – 1.09)	0.066
Other relationship	0.90	(0.66 – 1.24)	0.515	0.79	(0.47 – 1.36)	0.400

		95% CI			95% CI	
	uOR	**(Lower – Upper)**	**pValue**	**aOR**	**(Lower - Upper)**	**pValue**
Employment status						
Unemployed (RC)						
Employed	1.20	(0.93 – 1.54)	0.160	0.85	(0.49 – 1.49)	0.578
Education status						
Primary = (RC)						
Secondary	3.01	(2.20 – 4.11)	0.000**	1.57	(1.02 – 2.41)	0.042*
Tertiary	9.77	(5.44 – 17.55)	0.000**	1.84	(0.99 – 3.45)	0.055
Province						
Western Cape = (RC)						
Eastern Cape	0.26	(0.11 – 0.58)	0.001**	1.70	(0.80 – 3.61)	0.164
Northern Cape	1.48	(0.59 – 3.69)	0.394	1.81	(0.69 – 4.71)	0.224
Free State	1.78	(0.88 – 3.63)	0.110	2.05	(0.88 – 4.76)	0.097
Kwa-Zulu Natal	4.75	(2.25 – 10.04)	0.000**	4.56	(2.04 – 10.21)	0.000**
North West	1.32	(0.68 – 2.58)	0.415	4.96	(2.22 – 11.07)	0.000**
Gauteng	2.93	(1.53 – 5.59)	0.001**	3.62	(1.69 – 7.76)	0.001**
Mpumalanga	0.50	(0.25 – 1.02)	0.056	1.49	(0.65 – 3.39)	0.344
Limpopo	0.88	(0.45 – 1.74)	0.721	1.82	(0.71 – 4.66)	0.209
Place of residence						
Rural informal = (RC)						
Rural formal	2.21	(0.58 – 8.34)	0.243	0.91	(0.27 – 3.06)	0.875
Urban informal	1.06	(0.65 – 1.74)	0.816	0.57	(0.29 – 1.13)	0.107
Urban formal	3.41	(2.29 – 5.08)	0.000**	1.21	(0.69 – 2.13)	0.513
Reason for circumcising						
Traditional practice =(RC)						
Religious reasons	13.25	(8.33 – 21.07)	0.000**	8.87	(4.90 – 16.08)	0.000**
Hygiene	55.17	(30.09 – 101.14)	0.000**	33.02	(16.15 – 67.48)	0.000**
Prevent HIV and other STIs	67.96	(36.23 – 127.47)	0.000**	57.29	(27.77 – 118.19)	0.000**
Other reason	10.71	(6.59 – 17.39)	0.000**	7.13	(3.90 – 13.01)	0.000**
Perceived HIV threat						
No = (RC)						
Yes	1.27	(0.86 – 1.87)	0.225	0.99	(0.55 – 1.78)	0.974
Don't Know	0.56	(0.39 – 0.80)	0.001**	0.65	(0.36 – 1.19)	0.162
Perceived VMMC benefits						
No = (RC)						
Yes	1.24	(0.94 – 1.66)	0.132	0.71	(0.41 – 1.20)	0.198
Don't Know	0.51	(0.36 – 0.72)	0.000**	0.40	(0.20 – 0.82)	0.12
Perceived susceptibility HIV						
Definitely no = (RC)						
Probably wont	2.30	(1.06 – 4.99)	0.035*	3.97	(0.75 – 20.95)	0.105
Probably will	2.52	(1.21 – 5.26)	0.014*	3.01	(0.67 – 13.46)	0.149
Definitely yes	2.98	(1.42 – 6.28)	0.004*	3.85	(0.74 – 19.95)	0.108
Access to tv						
Never = (RC)						
Once a week	1.44	(0.85 – 2.43)	0.174	1.50	(0.53 – 4.23)	0.444
2-6 days a week	2.10	(1.37 – 3.22)	0.001**	0.67	(0.34 – 1.32)	0.247
Every day of the week	3.42	(2.38 – 4.90)	0.000**	1.02	(0.61 – 1.69)	0.939
Access to radio						
Never = (RC)						
Once a week	1.33	(0.91 – 1.94)	0.142	1.93	(0.86 – 4.33)	0.112
2-6 days a week	1.89	(1.28 – 2.77)	0.001**	2.72	(1.26 – 5.87)	0.011*
Every day of the week	2.05	(1.51 – 2.79)	0.000**	1.76	(0.94 – 3.29)	0.078
Access to cellphone						
Never = (RC)						
Once a week	2.99	(1.09 – 8.26)	0.034*	0.73	(0.20 – 2.73)	0.640
2-6 days a week	2.39	(1.31 – 4.36)	0.004**	1.35	(0.56 – 3.25)	0.499
Every day of the week	3.14	(2.15 – 4.60)	0.000**	1.28	(0.72 – 2.28)	0.407

		95% CI			95% CI	
	uOR	**(Lower – Upper)**	**pValue**	**aOR**	**(Lower - Upper)**	**pValue**
Access to newspaper						
Never = (RC)						
Once a week	1.74	(1.28 – 2.37)	0.000**	0.89	(0.52 – 1.53)	0.682
2-6 days a week	2.88	(1.98 – 4.20)	0.000**	0.88	(0.51 – 1.54)	0.662
Every day of the week	3.13	(2.15 – 4.56)	0.000**	0.84	(0.43 – 1.63)	0.599
Access to Magazine						
Never = (RC)						
Once a week	1.67	(1.22 – 2.29)	0.001**	1.07	(0.65 – 1.76)	0.803
2-6 days a week	2.58	(1.76 – 3.78)	0.000**	1.26	(0.73 – 2.19)	0.401
Every day of the week	1.66	(1.03 – 2.67)	0.036*	0.36	(0.16 – 0.82)	0.015*
Access to internet						
Never = (RC)						
Once a week	3.12	(2.12 – 4.60)	0.000**	1.87	(1.01 – 3.45)	0.045*
2-6 days a week	3.42	(2.14 – 5.47)	0.000**	1.68	(0.84 – 3.38)	0.144
Every day of the week	4.70	(3.18 – 6.97)	0.000**	2.64	(1.51 – 4.62)	0.001**

********significant at p <0.01; ******* significant at p< 0.05; ***RC*** = Reference Category; ***uOR*** - unadjusted odds ratio; ***aOR*** – adjusted odds ratio; ***CI*** – Confidence Interval

4.8 Multivariate diagnostics

The multi-collinearity test found no correlations between the variables. The Hosmer and Lemeshow's goodness-of-fit test found a p-value of .36, which indicates that our model fits the data well. The test for model specification (linktest). The *_hatsq* variable was not significant (p=0.947) and the *_hat* variable was significant (p=0.000) showing that our model was correctly specified. See Appendix A, B and C attached for STATA output for these diagnostics.

CHAPTER 5: DISCUSSION

The study found that 53.6% of the circumcised male population in South Africa is circumcised mostly through TMC and a significant proportion of men in the Eastern Cape (88.4%) were circumcised through TMC. This is in line with the cultural beliefs in the Eastern Cape province were TMC is considered a rite of passage and men are expected to go through TMC as part of the transition from boyhood to manhood. TMC is also undertaken for the desire to conform to societal norms and expectations, social recognition, status and social acceptance that comes with the ritual and procedure (Douglas et al., 2018; Ntozini & Ngqangweni, 2016). The proportion of men circumcised through TMC is also high in the Mpumalanga (79.5%) and Limpopo (68.9%) were TMC is also part of cultural tradition among the Ndebele and Venda tribes respectively. The findings of the study are in line with findings from other studies which have shown that ethnic groups known to practice TMC were less likely to choose VMMC (Thaele, 2016). Traditional male circumcision is conducted in South African mainly by the Ndebele's, Northern Sotho, Tshivenda and Xitsonga as part of a rite of passage (Mark et al., 2012).

A greater proportion of the Kwa-Zulu Natal circumcised male population has been circumcised through VMMC (70.8%). The high proportions of VMMC in Kwa-Zulu Natal could be explained by the fact that the Zulu culture did not practice male circumcision as part of their tradition for close to 2 centuries and so when the VMMC programme started, the majority opt for VMMC (Mckie, 2010). It also important to note that VMMC uptake in Kwa-Zulu was very low at the onset of the VMMC programme, as many Zulu men said it was not part of their culture. However, on 5 December 20009, the Zulu King Goodwill Zwelithini ka Bhekuzulu came out to say that he was in support of the practice and announced his intention to revive the long-abandoned cultural practice of circumcision (*ukusoka*) (Timbs, 2018). The argument was that Zulu men had previously practised circumcision but had stopped circumcising in the 1870 during the time of Shaka Zulu (Timbs, 2018). After the announcement, the KwaZulu-Natal (KZN) government implemented a programme of mass

circumcision of Zulu males (McQuoid-Mason, 2013). VMMC subsequently increased drastically, given that it had the approval of the king.

Bivariate analysis found no significant relationship between perceived susceptibility to HIV infection and type of circumcision. This is in contrast with more recent findings which have showed that respondents who perceive themselves as susceptible to HIV infections where more likely to undergo VMMC (George et al., 2017). The contracts could be explained by the fact that the data used for the study was collected in 2012 when the South African VMMC programme was still in its infancy and was still gathering momentum. Tram and Bertrand (2014) noted that as the VMMC scale-up intensifies in countries across Eastern and Southern Africa, the correlates of VMMC are likely to change. Information becomes more widely available with time and knowledge levels are more likely to improve with improved demand creation strategies. In the multivariate analysis race, age at circumcision, marital or relationship status, education status, province, having access to a radio, magazine and internet and reason for circumcision were found to be the main predictors of male circumcision. All categories of reason for circumcising were significantly associated with type of circumcision. As expected, the odds of being circumcised via VMMC were higher among whites and coloureds when compared to Africans. The review done for this study found no other studies that have explored type of circumcision by racial categories. The majority of Whites and Coloureds in South Africa do not circumcises for traditional reasons and most of the circumcision are medical, hygienic and other reasons (Cockburn, 2016). Most studies have focused on ethnicity as a determinant and have neglected race (Thaele, 2016). The neglect of race is also apparent in the target population of the VMMC programme. The programme targets black and poor communities at the expense of other racial groups and upper social classes.

The study did not find an association between age and type of circumcision. This is contrary to other findings which have found relationship between older men and being more likely to circumcise (Tram & Bertrand, 2014). Other studies have found the opposite, they found that older men were less likely

to go for circumcision (Gasasira et al., 2012). Although these studies found a significant relationship between age and circumcision, these studies did not make a distinction by type of circumcision. However, the study found that the odds of male circumcision through VMMC increase with an increase in the age at circumcision. This is in line with other studies which have found that most of TMC rituals and procedures are conducted when the males early adolescence and early adulthood (Johnson, Dorrington, & Moolla, 2017). Other studies have found usual age of traditional circumcision to be 16-20 years (Muhangi, 2010). A study looking at economic determinants related to traditional circumcision of boys 12 to 18 years of age found that boys preferred traditional male circumcision for attainment of community respect and attainment of social manhood values (Douglas & Hongoro, 2018). This could explain why the study found an increase in the odds of male circumcision through VMMC with an increase in the age at circumcision. The majority of males who circumcise when they are older than 24 years have higher odds of being circumcised through a medical facility through VMMC. Awareness of the HIV-prevention benefit and perceptions of cleanliness and enhanced attractiveness to women have been shown to be drivers of VMMC in older men (Plotkin et al., 2013). Other studies have suggested that older age group comprises individuals who are independent and can make personal decisions about their own health from a well-informed perspective (Mangombe & Kalule-Sabiti, 2018).

This study found a relationship between being marred and being circumcised through VMMC. This has been supported by other studies which have showed that married women are more likely to support their partners to go for VMMC and are more likely to encourage their partners to undergo VMMC (Mati, Adegoke, & Salihu, 2016). A study in Zimbabwe found that 60% of women (including married women) with uncircumcised partners indicated willingness for their counterparts to undergo VMMC (Mavhu et al., 2011). Other studies have shown that women are supportive of male circumcision and are capable of bearing a positive influence on their men to circumcise (Muhangi, 2010). This support could be linked to the proven protective benefits of VMMC and how people associate it with improved sexual performance. Other studies have found most female partners report increased sexual pleasure

after their partners undergo circumcision (Zulu, Jones, Chitalu, Cook, & Weiss, 2015). The study found no significant association between the other categories of marital relationship status and type of male circumcision. A plausible explanation for this finding could be that, status such as being widowed divorced or separated, might occur after circumcision has already been done. The analysis of variations ion socio-demographic factors by reason of circumcision found that most married men reported circumcising for traditional reasons with 16.5% reporting circumcising for hygienic reasons. It should be noted that this is most likely to have changed. More recently programmes and demand creation has been done specifically targeting wives/partners/mothers and couples (Semeere et al., 2016; Pepfar, n.d.).

The study found that having secondary education increased the odds of being circumcised through VMMC. Similar findings have reported in Eastern and Southern Africa (Lau, Jayakumar, & Sgaier, 2015; Mangombe & Kalule-Sabiti, 2018). However, the study found no statistically significant relationship between tertiary education and type of circumcision. This finding is different from the results of other studies. Studies have found that men with higher educational attainment are more likely to opt for VMMC (Nyaga, Mbugua, Muthami, & Gikunju, 2014). The lack of association found by this study could be due the VMMC programme targeting poor communities where tertiary education is minimal. In addition, other studies looked at general determinants of circumcision and did not make a distinction between TMC and VMMC. As mentioned under the discussion of age at circumcision, most circumcisions happen in early and late adolescence. The lack of association between tertiary education and type of circumcision found by this study might be related to the finding that education plays a significant role in determining type of circumcision when at the secondary school levels when males are in adolescence. The study found that most males in South Africa are circumcised around this age. It is at this age that a decision is made about the type of circumcision to opt for. By the time they reach tertiary institutions, most would have already been circumcised. This also speaks to the limitations of the dataset in that it is cross sectional in nature and cannot be used to determine the chain of events

or causality. If tertiary education comes after circumcision then its power to influence decision on type of circumcision is eroded.

The study found a significant relationship between being from Kwa-Zulu Natal, North West and Gauteng and type of circumcision. The odds of being circumcised via VMMC are higher in these provinces. The HIV prevalence in these provinces is high with 27% HIV prevalence reported in Kwa-Zulu Natal, 13.9% HIV prevalence reported in North West and 17.6% HIV prevalence reported in Gauteng (HSRC, 2018). Gauteng is multicultural and Zulu people who are the most populous tribe in Kwa-Zulu Natal do not have a tradition of circumcising. This combined with intensive campaigns aimed at reducing HIV infection might explain this finding. It's interesting to note that although the bivariate analysis found a relationship between residing in Eastern Cape and type of circumcision, the relationship was not significant in the multivariate analysis.

As expected there was a significant relationship between the different categories of reason for circumcising and type of circumcision. A study in Kenya found that medical and hygiene reasons for male circumcision were significantly associated with uptake of VMMC (Nyaga et al., 2014). A study among the coloured population of the Western Cape province found that males were circumcising mostly to improve hygiene, reducing contraction of STIs and HIV (Cockburn, 2016). Similar findings were also found in Kwa-Zulu Natal were an association was found between STI and HIV reduction and circumcision among adolescents (George et al., 2017). Various research studies have found a relationship between circumcision and prevention of HIV and VMMC (Bailey et al., 2007; Auvert et al., 2005; Gray et al., 2007). It has been shown that TMC does not have the same protective benefits as VMMC in reduction of HIV transmission (Maffioli, 2017). Given the benefits on VMMC, men who opt for circumcision for prevention of HIV and other STIs are more likely to circumcise through VMMC (Kironde, 2016). Studies in Kwa-Zulu Natal found knowledge of the benefits of VMMC is a key motivating factor for learners to undergo VMMC (George et al., 2017).

Access to the radio, magazine and internet were found to be predictors of male circumcision. Males who had access to the radio have higher odds of being circumcised via VMMC. Studies have shown the effectiveness of public media such as print media, billboards, radio and television in promoting male circumcision. A study looking at motivating factors for VMMC found that 71% of the respondents who listened to the radio were circumcised (Hatzold et al., 2014). Another study which evaluated the Brothers for Life campaign found that exposure to the campaign increased the likelihood of being circumcised (Mahlasela, Goldblatt, Delate, & Pearce, 2016). This study also found that found that every day internet access and even accessing the internet once a week is associated with increased odds of being circumcised via VMMC. Keeping in mind that the data used for the study was collected in 2012, a plausible explanation for this link could be that internet access is linked to social class due to the cost of data access and purchase of an internet enabled device. A study found that higher income class within the study sample made more use of the internet (Khan, Rahman, & Qazi, 2016). Internet usage is also realted to literacy levels. Studies have demonstrated a positive correlation between education level and internet penetration (Unver, 2014). Other studies have found a correlation between adoption of information and communication technology use and increased literacy (Deen-Swarray, 2016).. Access to the internet for a variety of reasons increases information access and possibility of knowing the benefits of VMMC and thereby opting for VMMC in place of TMC.

Studies have shown that perceiving VMMC as having protective benefits is more likely to increase the odds of being circumcised via VMMC. A study in Kwa-Zulu Natal found that learners who perceived VMMC as having health benefits such as HIV and STIs transmission reduction and increased penile hygiene were more likely to undergo VMMC (George et al., 2014; George et al., 2017). Other studies have found that knowledge about a disease and the benefits of preventive measures has been associated with uptake of preventive measures such as circumcision (Kironde, 2016). However, this study found no significant relationship between perceived benefits of VMMC and type of circumcision opted for. Other scholars have noted that knowledge alone may not be enough to generate HIV related health seeking behaviour, such as male circumcision (Mangombe & Kalule-Sabiti, 2018).

Positive attitudes towards the behaviour also play a crucial role. In this case, it will be having a positive attitude towards VMMC. The discrepancy in the findings could also be linked to the nature of the data that was used for this study. In order for perceived knowledge of VMMC to have an impact on the type of circumcision there needs to be a causal link between the two variables. Although the study assumes this link, the challenge is that the data is cross national in nature and therefore we cannot extrapolate what came first, knowledge of VMMC benefits or circumcision. This is applies to all the perception variables that were used for this study. The study found no significant relationship between perceived HV threat and perceived susceptibility to HIV infection and type of circumcision. Lack of significant relationship between the perception variables and type of circumcision could be explained by the cross sectional nature of the data. It is not possible to determine what came first, circumcision or the reported perception.

The study found no relationship between type of residence and circumcision. This differs from the findings of other studies which found a link between residing in urban areas and VMMC across eleven voluntary medical male circumcision priority countries in south eastern Africa (Lau et al., 2015). However most of these studies only categorise place of residence as urban areas and rural areas and do not make a distinction between formal and informal rural and urban areas. Most of the studies also look at determinants or correlates on male circumcision status in general and do not explore the correlates by type of circumcision (TMC vs VMMC) (Lau et al., 2015; Mangombe & Kalule-Sabiti, 2018). Studies with contrasting results explored above were also based on data that is much more recent. This study was based on data that was collected in 2012. Changes have occurred since then. The initial VMMC programme was very heavily based in urban areas and TMC has been associated with communities in rural areas. Another plausible explanation for this lack of a significant relationship could be linked to the fact that most informal areas and also urban areas are a function of migration and they are multicultural in nature.

The study did not find a relation between employment status and type of circumcision. This differs from other studies that found that employed men were less likely to be circumcised (Herman-Roloff, Otieno, Agot, Ndinya-Achola, & Bailey, 2011). The lack of a significant association between employment status and type of circumcision could be linked to the fact that employment status is not a fixed characteristic. It is susceptible to change. Employment, in SA, also does not mean gainful or full-time employment.

CHAPTER 6: CONCLUSION RECOMMENDADTIONS AND LIMITATIONS

6.1 Conclusion

The study used national cross sectional survey data to investigate the predictors of type of male circumcision in South Africa. The study found race, age at circumcision, marital or relationship status, education status, province, reason for circumcising and having access to a radio, magazine and internet to be the main predictors of type of male circumcision. These findings go a long way in helping us identify modifiable factors to target in developing context relevant interventions for increasing uptake of VMMC for HIV prevention. It is hoped that targeting factors such as race, age at circumcision, marital or relationship status, education status, province, reason for circumcising and having access to a radio, magazine and internet will help increase the number of males who opt for VMMC which increases the chances of South Africa attaining herd immunity (whereby an increase in the prevalence of VMMC lowers HIV transmission rates in susceptible populations) (Kim et al., 2011). This will help in decreasing the threat of HIV/AIDS.

6.2 Recommendations

From the study findings, it is apparent that VMMC campaigns should be mainly targeted among black South Africans since uptake of VMMC is low among this racial group. Interventions should however not neglect other racial groups like whites and Indians or Asians. At the moment, the main target has been black South African males in poor communities. The focus should also not be biased to one social class, it should extend to other social classes. Although uptake of VMMC is higher among males older than 24 years, more effort needs to be put into reaching those younger than 25 years. One of the main concerns is that as countries near 80% VMMC coverage in 15–49-year old they are getting closer to reaching saturation (Lane et al., 2018). The focus should shift to scaling up early infant and adolescent circumcision. The study found that TMC is the most preferred type of circumcision among South African men. It has been shown that traditional Xhosa circumcision is dynamic and has been

changing with time (Vincent, 2008). This presents an opportunity to engage the traditional community to implement changes that favour incorporating VMMC as part of the male initiation rituals.

It will be more effective to put more effort in reaching men and women who are in marriage or sexual unions. The study found a significant association of type of male circumcision with secondary education. Including male circumcision in the secondary school life skills curriculum might also be beneficial in promoting and exposing young males and females to the advantages of male circumcision. Although concentrating effort in Kwa-Zulu Natal, North West and Gauteng provinces might yield faster results in terms of VMMC uptake, there should also be a drive to target VMMC promotion in the other provinces to increase uptake. Promotion of VMMC for prevention of HIV and STIs is the most effective way of promoting VMMC, and the messaging for VMMC campaigns should also include messaging on penile hygiene. VMMC campaigns should also prioritise reaching the male audience by developing algorithms to target internet users.

In addition, it is recommended that future interventions need to consider tracking improvements by using this study's findings as a baseline profile to compare changes in future profiles. The baseline profile is useful for trend analysis which is important in checking success of campaigns and interventions.

6.3 Limitations

One of the main limitation of the study was that it used data that was collected in 2012. This was 2 years after the VMMC programme had started in South Africa. Due to the nature of the questionnaire design, the study assumes that circumcision is sought for one reason. The questionnaire did not allow for multiple responses for the reasons why the respondent was circumcised. The study is also based on cross sectional data which rules out the possibility of checking for causal links between the independent and dependent variables. Although the study used the Pearson chi-squared test for

bivariate anlaysis, some scholars have raised concerns on its appropriateness due to correlation among units within the same cluster (Lipsitz et al., 2015). The study is also based on secondary data which means the variables used in the analysis are limited to what was collected during the survey. Other variables omitted by the survey that could be included in the model to explain the relationship can potentially be left out. The study is also based on a dataset that was collected in 2012. Although this is a weakness given that it has been 9 years since South Africa initiated the VMMC programme, the dataset can help us baseline develop a baseline profile against which we can compare future profiles. Tram and Bertrand (2014) note that as the VMMC scale-up intensifies in countries across Eastern and Southern Africa, the correlates of VMMC are likely to change.

6.4 Suggestions for Further Studies

Socio-demographic predictors are susceptible to temporal changes, therefore, there is need to do analysis using data from recent studies and also exploring other factors that were not included in this analysis. There is also need to conducti mixed method studies looking at the reason why traditional male circumcision continues to be the preferred method of circumcision even among those who are aware of the proven benefits of VMMC. In other words, why is the messaging being ignored?

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APPENDICES

Appendix A

```
. pwcorr race age marital_relationship_status employment_status education_status /*
> */perceived_VMMC_benefits perceived_HIV_threat Province place_of_residence /*
> */reason_for_circumcising age_circumcision tv_access radio_access cellphone_acess       /*
> */ newspaper_access magazine_access internet_access, sig star (0.5)

             |     race      age marita~s employ~s educat~s percei~s percei~t
-------------+------------------------------------------------------------------
        race |   1.0000
             |
             |
         age |   0.0738*  1.0000
             |   0.0000
             |
marital_re~s |  -0.1418* -0.1199*  1.0000
             |   0.0000   0.0000
             |
employment~s |   0.1582*  0.2634* -0.0154*  1.0000
             |   0.0000   0.0000   0.3539
             |
education_~s |   0.1614* -0.1364*  0.0468*  0.1399*  1.0000
             |   0.0000   0.0000   0.0094   0.0000
             |
perceived_~s |  -0.0359*  0.0299* -0.0175* -0.0630* -0.0609*  1.0000
             |   0.0306   0.0723   0.2935   0.0001   0.0007
             |
perceived_~t |  -0.0247*  0.0896* -0.0309* -0.0654* -0.0805*  0.1246*  1.0000
             |   0.1369   0.0000   0.0641   0.0001   0.0000   0.0000
             |
    Province |  -0.0822* -0.0475* -0.0527*  0.0083   0.0963* -0.1095* -0.0766*
             |   0.0000   0.0041   0.0015   0.6138   0.0000   0.0000   0.0000
             |
place_of_r~e |   0.4288*  0.0775* -0.0530*  0.1998*  0.2182* -0.0470*  0.0157*
             |   0.0000   0.0000   0.0014   0.0000   0.0000   0.0047   0.3432
             |
```

```
reason_for~g |   0.2031* -0.0749* -0.0044   0.0516*  0.1912* -0.0558* -0.0535*
             |   0.0000   0.0000   0.7891   0.0018   0.0000   0.0008   0.0013
             |
age_circum~n |  -0.1792*  0.2786*  0.0266*  0.0471* -0.0565*  0.0295*  0.0244*
             |   0.0000   0.0000   0.1378   0.0082   0.0033   0.0995   0.1728
             |
   tv_access |   0.1708* -0.0331* -0.0100   0.0493*  0.2142* -0.0504* -0.0598*
             |   0.0000   0.0453   0.5480   0.0029   0.0000   0.0024   0.0003
             |
radio_access |   0.0715*  0.0671* -0.0033   0.1029*  0.1147* -0.0366* -0.0630*
             |   0.0000   0.0001   0.8439   0.0000   0.0000   0.0294   0.0002
             |
cellphone_~s |   0.0396* -0.0697*  0.0515*  0.1899*  0.2199* -0.0649* -0.1220*
             |   0.0168   0.0000   0.0020   0.0000   0.0000   0.0001   0.0000
             |
newspaper_~s |   0.2428* -0.0105   0.0151*  0.1841*  0.3552* -0.0691* -0.0613*
             |   0.0000   0.5261   0.3639   0.0000   0.0000   0.0000   0.0002
             |
magazine_a~s |   0.1693* -0.0814*  0.0068   0.0969*  0.2947* -0.0469* -0.0531*
             |   0.0000   0.0000   0.6852   0.0000   0.0000   0.0048   0.0014
             |
internet_a~s |   0.2970* -0.2069* -0.0295*  0.1452*  0.3897* -0.0615* -0.0992*
             |   0.0000   0.0000   0.0778   0.0000   0.0000   0.0002   0.0000
             |

             | Province place_~e reason~g age_ci~n tv_acc~s radio_~s cellph~s
-------------+------------------------------------------------------------------
    Province |   1.0000
             |
             |
place_of_r~e |  -0.1577*  1.0000
             |   0.0000
             |
reason_for~g |   0.1020*  0.1881*  1.0000
             |   0.0000   0.0000
             |
age_circum~n |  -0.2035*  0.0080   0.0879*  1.0000
             |   0.0000   0.6525   0.0000
             |
   tv_access |  -0.0076   0.2320*  0.1253* -0.0329*  1.0000
             |   0.6443   0.0000   0.0000   0.0651
             |
radio_access |   0.0161*  0.0934*  0.0896*  0.0101   0.2682*  1.0000
             |   0.3350   0.0000   0.0000   0.5775   0.0000
             |
cellphone_~s |   0.0687*  0.0986*  0.0880* -0.0272*  0.1843*  0.1602*  1.0000
             |   0.0000   0.0000   0.0000   0.1279   0.0000   0.0000
             |
newspaper_~s |   0.1047*  0.2997*  0.1926* -0.0456*  0.2933*  0.2178*  0.2236*
             |   0.0000   0.0000   0.0000   0.0105   0.0000   0.0000   0.0000
             |
magazine_a~s |   0.0105   0.2292*  0.1417* -0.0374*  0.2474*  0.2032*  0.1874*
             |   0.5249   0.0000   0.0000   0.0363   0.0000   0.0000   0.0000
             |
internet_a~s |   0.0614*  0.3085*  0.1826* -0.1433*  0.2305*  0.1574*  0.2309*
             |   0.0002   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
             |

             | newspa~s magazi~s intern~s
-------------+---------------------------
newspaper_~s |   1.0000
             |
             |
magazine_a~s |   0.6123*  1.0000
             |   0.0000
             |
internet_a~s |   0.3458*  0.3501*  1.0000
             |   0.0000   0.0000
             |
```

Appendix B

```
. linktest
(running logit on estimation sample)

Survey: Logistic regression

Number of strata   =         9                  Number of obs      =      2,533
Number of PSUs     =       715                  Population size    =  4,705,055
                                                Design df          =        706
                                                F(   2,    705)    =     159.78
                                                Prob > F           =     0.0000
```

type_of_circumcision	Coef.	Linearized Std. Err.	t	P>|t|	[95% Conf.	Interval]
_hat	1.000829	.0602497	16.61	0.000	.8825391	1.119119
_hatsq	.0019019	.02847	0.07	0.947	-.0539941	.0577979
_cons	-.0053707	.1717755	-0.03	0.975	-.3426227	.3318813

Appendix C

```
. lfit, group(10) table
```

Logistic model for type of circumcision, goodness-of-fit test

(Table collapsed on quantiles of estimated probabilities)

Group	Prob	Obs_1	Exp_1	Obs_0	Exp_0	Total
1	0.0303	7	4.9	247	249.1	254
2	0.0509	10	10.3	243	242.7	253
3	0.0757	20	16.0	234	238.0	254
4	0.1221	14	24.5	239	228.5	253
5	0.2428	46	44.0	208	210.0	254
6	0.5594	98	96.3	155	156.7	253
7	0.8038	175	177.9	79	76.1	254
8	0.9016	224	217.9	29	35.1	253
9	0.9547	234	236.1	20	17.9	254
10	0.9980	247	247.0	6	6.0	253

```
number of observations =      2535
      number of groups =        10
Hosmer-Lemeshow chi2(8) =      8.73
            Prob > chi2 =      0.3657
```