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ORIGINAL RESEARCH

Factors Associated with Low Uptake of Voluntary Medical Male Circumcision as HIV-Prevention Strategy among Men Aged 18–49 Years from Nyanza District, Rwanda

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Background: Voluntary medical male circumcision (VMMC) is an effective biomedical intervention against HIV in developed and developing countries. However, there is low uptake of VMMC due to various factors, which hinders achievement of health-policy goals to increase uptake. Numerous campaigns offering the procedure free of charge exist in developing countries, but such initiatives seem to bear little fruit in attracting men to these services. This study assessed risk factors associated with the low uptake of VMMC among men in Nyanza district, Southern Province, Rwanda.

Methods: A cross-sectional study was conducted among adult males in Nyanza. A total of 438 men participated in individual interviews. Bivariate and multivariate logistic regression models were used with 95% confidence intervals and $p \leq 0.05$ was taken as statistically significant.

Results: Our results indicated that a low update of VMMC was highly prevalent (35.8%). A majority (84.7%) of participants had heard about VMMC, its complications, advantages in preventiing penile cancer, sexually transmitted infections, and HIV, condom use after circumcision, abstinence for 6 weeks after circumcision, and improving penile hygiene. Religion and education were significant factors in low uptake. Catholics were less likely to undergo VMMC than Muslims (OR 7.19, 95% CI 1.742–29.659; p=0.01). Those of other faiths were less likely to undergo VMMC than Muslims (OR 6.035, 95% CI 1.731–21.039; p=0.005). Participants with secondary education were less likely to undergo VMMC than those with primary education only (OR 1.4, 95% CI 0.74–2.64; p=0.03). Having no formal education decreased the odds of being uncircumcised (OR 0.37, 95% CI 0.14–0.977; p=0.045) when compared to those with primary education.

Conclusion: Uptake of VMMC remains low in Nyanza, but most men had sufficient knowledge about it. Education, religion, and marital status were major factors in the low uptake. Programs targeting peer influences and parents need to be prioritized.

Keywords: low uptake, VMMC, HIV/AIDS, prevention, men, adult, male circumcision

Background

HIV/AIDS) is a public health burden worldwide. Strategies to prevent and treat such diseases as HIV/AIDS, malaria, tuberculosis, hepatitis, Ebola, and other communicable diseases remain an unfinished public health agenda of the UN's Sustainable Development Goals and World Health Organization (WHO).[1,2] To achieve this goal of promoting health through prevention of behavioral risks leading to HIV/AIDS, different health-care

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interventions have been developed on a global scale. The Joint United Nations Programme on HIV/AIDS (UNAIDS) and the WHO recommend the implementation of safe voluntary medical male circumcision (VMMC)as an appropriate health strategy for preventing HIV/AIDS and other sexually transmitted infections (STIs).[3] Studies have indicated that communities that use voluntary medical male circumcision (VMMC) effectively are more likely to have low rates of HIV than those that do not.[4–6]

Accessibility of VMMC in most countries, particularly in low- and middle-income countries, is influenced by religious, sociocultural, and medical factors. Low accessibility of VMMC remains in many countries of the world, and this is a grave public health concern in low- and middle-income countries. Implementation of VMMC has been reported to be a serious health problem among elders acting as guardians of community culture. Studies have documented that VMMC is an effective intervention against HIV infection — 60%.[7] Data show that 80% (20.3 million) had been provided VMMC intervention by 2015. Implementation has taken place in African countries with HIV prevalence. It is expected that 3.4 million new VMMCs could prevent the spread of HIV in the period 2015–2025.[8]

Studies conducted in Kenya, Uganda, and Tanzania have demonstrated that the prevalence of HIV/AIDS differs by community. Low sociodemographic status, age, residence, religion, and marital status are the main factors associated with this barriers to the prevention and treatment of STIs.[9,10] HIV is a public health concern in eastern and southern African countries, and it is highly prevalent in communities not providing VMMC programs.[6,11] Moreover, the household's be collectively reduced, taking into account the different involvement, having the circumcised friend or relative as well as being encouraged by the friend or family relative were found to be the cause of accessing to the VMMC.[12] Factors driving low uptake of VMMC are fear of losing family revenue, fear of pain, and fear of receiving wounds.[4]

Studies conducted in the US have shown a strong association between preference for VMMC and high socioeconomic status, whereas low uptake is associated with low socioeconomic status. In contrast, demographic and health surveys in sub-Saharan African countries have shown no consistent association with socioeconomic status.[13] For example, in Tanzania, higher rates of circumcision were observed among men with higher levels of education, higher socioeconomic status, and living in urban areas, whereas in Lesotho circumcision was a public health burden among men with no education, in the lowest wealth quartile, and living in rural areas.[14] The same factors were assessed for determining why the uptake was low. The more males possess adequate knowledge regarding VMMC and the burdens of HIV/AIDS, the more they become motivated to get circumcised. Many factors may be associated with low uptake and high prevalence of STIs. Intervening factors are those that may influence uptake indirectly when other factors play an important role in pursuing MMC for the purpose of HIV prevention.[15]

The growing problem on which this study focuses is how to increase MC uptake as an HIV-prevention strategy, given the high prevalence of HIV infection, a pressing challenge in the health sector.[4] One of the greatest impediments to MC uptake following HIV outbreaks is community reluctance to pursue otherinterventions for the prevention of heterosexually acquired HIV infection in men when HIV prevalence is high.[3,11,16] Long distance to health facilities, fear of pain, biased information from health facilities, discouragement from friends, long healing period, and mandatory HIV testing before MC is carried out are factors associated with low uptake.[4] How to address these attitudes and behaviours while encouraging healthy ones and increase MC uptake has thus become a difficult task.

To reduce HIV infection among communities, it is generally contended that prevention strategies require important supplementary approaches for the anticipation of heterosexually acquired HIV infections in men in regions where HIV prevalence is high.[7,17] In this regard, the current discourse points to solutions delivered and built from partner initiatives.[5] Notably, the particular role of VMMC is a commonly understood medical technique that has been approved by the WHO as an additional prevention strategy against HIV.[18] Empirical investigation in this regard is thus worth undertaking, notably in Rwanda, where the culture does not favor MC.[19] VMMC is considered part of a comprehensive HIV-prevention package for heterosexually acquired infections in men.[20] It is a cost-effective HIV-prevention measure, and large-scale uptake of VMMC in populations with high HIV prevalence and a low circumcision rate has a considerable impact on the HIV epidemic and provides a cost-effective strategy.[19,20] VMMC performed by well-trained clinicians among traditionally noncircumcising communitiesprevents HIV transmission by up to 60%[21]

Nyanza is one of the eight districts of Rwanda's Southern Province, and has low uptake of VMMC when compared to other provinces (17.3%). It has - the second-highest HIV prevalence after Kigali (3.2%). Nyanza has high STI prevalence on a national level, is eighth in HIV prevalence nationally, has a low MC rate (15%), and VMMC uptake is the lowest nationwide.[22] Althoughthe accessibility of VMMC in Nyanza is very low, little is known about factors influencing its uptake. This study is unique in that population from the target studies area. The results of the current study will be important in designing appropriate strategies to reinforce VMMC uptake with the objective of long-term impact on HIV control in Nyanza. Building on the aforementioned literature, this study aimed to determine the prevalence and risk factors contributing to the low uptake of VMMC in Nyanza.

Conceptual Framework

Figure 1 shows a conceptual framework that indicates the relationships among mainly independent and outcome variables. The framework of this study was designed using prior studies documenting that VMMC is associated with factors categorized into three classes namely: sociodemographic

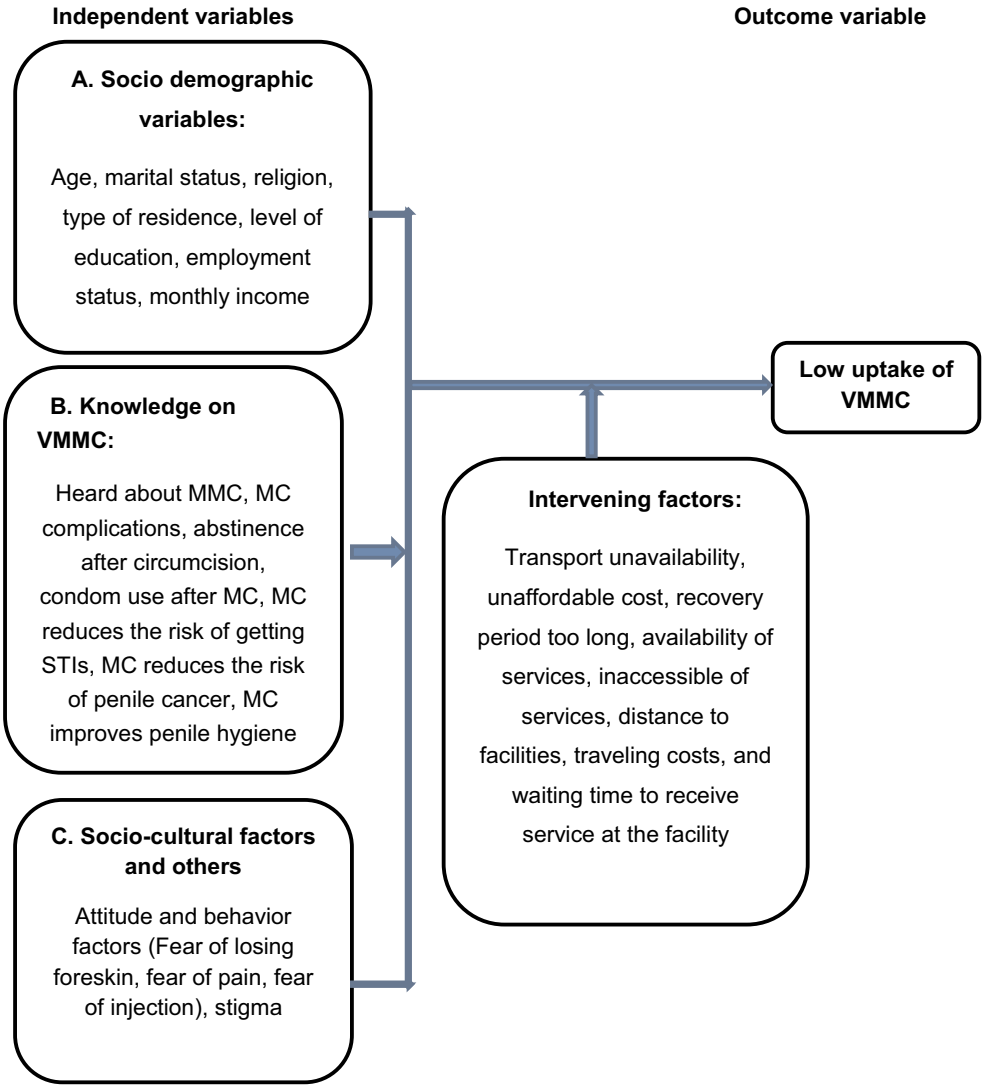

Figure 1 Conceptual framework of variables used in this study, ie, independent, intervening and outcome variables. We usedthree classes of independent variables. (**A**) Sociodemographic variables were age, education, area ofresidence, religion, marital status, and monthly income. (**B**) Knowledge on VMMC comprised subjects having heard about VMMC, MC complications, abstinence after circumcision, condom use after MC, MC reducing the risk of STIs and penile cancer, and improving penile hygiene. (**C**) socio-cultural factors and other factors including attitudes and behavior regarding MC (fear of losing foreskin, fear of pain, and stigma). Intervening variables were accessibility of services, availability of services, distance from household to health facility, transport, cost, and recovery period. The outcome variable was low uptake of VMMC.

Abbreviations: MC, male circumcision; VMMC, medical male circumcision; STIs, sexually transmited infections.

variables (age, education, residence, religion, marital status, and monthly income), knowledge on VMMC(heard about it, MC complications, need for abstinence and Mcondom use after MC, reduction of risk of getting STIsand penile cancer, and improvement in penile hygiene), and other factors, including attitudes and behavior regarding MC (fear of losing foreskin, phobia of pain and stigma). Intervening variables are accessibility of services, availability of services, distance from household to health facility, transport, unaffordability, and recovery period too long.

Methods

Study Design

The study design used was a cross-sectional survey among males aged 18–49years in Nyanza district, Southern Province, Rwanda.

Study Settings and Participants

Nyanza has low MC prevalence (17.1%) compared to other provinces of Rwanda. It has 17 health facilities: Nyanza District Hospital and 16 health centers where VMMC is carried out. It covers 672 km^2. The population of Nyanza is 323,719, (166,069 female and 157,650 males), among which 73,514 males comprised our study population. Nyanza has the highest prevalence of STIs nationwide — 18%. It is also has the eighth-highest of HIV prevalence nationwide (3.1%) and low coverage of MC (15%).[22]

The target group for the study was all men 18–49 years old present in Nyanza at the time of data collection, whether they lived in Nyanza or not. The eligibility criterion was no severe psychiatric history that could affect participation. Those unwilling toor provide consent were excluded.

Study Variables

The dependent variable was uptake of VMMC. Independent variables were sociodemographic characteristics (age, marital status, residence, monthly income, religion, and education), knowledge on VMMC (heard about it, complications related to the operation, reduction in risk of penile cancer, improvement in penile hygiene, reduction of risk of catching STIs, and abstinence required after VMMC).

Sample Size and Sampling

For-sample size calculation, we used Yamane's formula.[23] $n = \frac{N}{1+Ne^2} = \frac{73514}{1+73514x(0.05)^2} = 397.8 \approx 398$, where N is the target population (males aged 18–49 years), n the size of the sample, and e the margin error (5% or 0.05). We added 5% to the minimum sample size (398 respondents) for participants who might not take part for such reasons as withdrawal. Therefore, the total sample size was 438.

Table 1 Sectors of Nyanza

		Residents Aged 18–49 Years	Sample
1	**Busasamana**	11,167	67
2	**Busoro**	7,616	44
3	**Cyabakamyi**	4,562	28
4	**Kibirizi**	6,984	41
5	**Kigoma**	7,618	45
6	**Mukingo**	12,542	75
7	**Muyira**	7,646	46
8	**Ntyazo**	5,883	35
9	**Nyagisozi**	5,498	33
10	**Rwabicuma**	3,998	24
Total		**73,514**	**438**

Notes: Fourth Rwanda Population and Housing Census, 2012 (NISR).

Using all sectors of Nyanza that had a higher rate of population than the other seven remaining sectors, the study population was disproportionally recruited from that population.We used stratified and simple random sampling for indicating the sample of each stratum the formula. The sample was proportionally divided according to the population of each sector of Nyanza. A structured questionnaire was used for data collection. Investigators were based at health centers where we expected many recruits to meeting the inclusion criteria, and data were collected for 2 weeks (September 2–16, 2019). Table 1 indicates the sample size for each sector (stratum), computed using the of Bluman's formula:[24]

$$n = NS_1 + NS_2 + NS_3 + NS_4 + NS_5 + NS_6 + NS_7 + NS_8 + NS_9 + NS_{10};$$

$ns = \frac{N_1xn}{N}$, where n is the sample size of the stratum, NS the total population of each sector (stratum), and N the general population of the whole district.

Data Collection and Procedures

Simple random sampling was used in data collection and the structured questionnaire was utilized. Data collectors attended 2 days of training on the data-collection process and materials for data collection. The questionnaires used was adopted from previous research on knowledge of VMMC and validated by the investigators in a pilot study in Gasabo, Remera. After collecting data from the pilot, the investigators adjusted questions for better comprehension. Data collected were coded, entered into SPSS 24 to be analyzed, then stored on an external

disk. Completed questionnaires were kept in a closed cupboard to maintain confidentiality. Data were stored electronically, and password-protected software was used according to University of Rwanda rules and regulations regarding research. The time taken to complete the questionnaire was 20–30 minutes.

Data Analysis

Data were entered into Excel, categorized, then analyzed using SPSS 24. Both descriptive and analytical analyses were performed. In the descriptive analysis, frequencies and percentages were computed to summarize the sociodemographic characteristics of the participants. Based on MC prevalence, descriptive statistics were compiled and frequencies and proportions calculated. For knowledge on VMMC, participants who had answered at least four of the questions correctly were considered to have sufficient knowledge. Descriptive statistics were also computed and frequencies and proportions derived. Bivariate logistic regression was performed to indicated factors associated with VMMC uptake. Binary logistic regression analysis was performed to determine associations between dependent and independent variables. Independent variables with $p<0.2$ on bivariate logistic regression were fitted to binomial multivariate logistic regression analyses that utilized both full models, and reduced models were used with ORs to determine factors associated with VMMC uptake. Binomial multivariate regression was applied to identify the factors contributing to low VMMC uptake. Associated factors in the full model were exported to the reduced models. Statistical significance established as $p<0.05$.

Ethics

This study was carried out in accordance with the Declaration of Helsinki[25,26] Ethics approval was sought from the Institutional Review Board, College of Medicine and Health Sciences (IRB, CMHS), University of Rwanda (N^0:425/CMHS IRB/2019). After receiving this clearance, the local leaders authorized the researchers to carry out the study. Participants were informed of the purpose of the study, that there was no compensation, and asked if they would consent. They were able to withdraw from the study any time, and were informed that they would not be penalized for doing so. Confidentiality and privacy were ensured throughout the research. The right to autonomy and self-determination were taken into consideration throughout. The study team explained to the interviewees that the information wouldwas for research purposes only and would not be shared. Researcher, data collector and participants singed consent forms. Questionnaires were anonymous, numbered in order of evaluation, and did not contain identifiers of the participants.

Results

Sociodemographic Characteristics

A total of 438 participants were enrolled: >67% were married, and 20.3% aged 23–27 years. A majority (83.3%) had attended at least primary school, and >87% were Catholic. A majority (81.3%) unemployed, students, or neither self-employed nor employed ("others"), with 89.1% reporting low monthly incomes (<RWF50,000) and 96.8% residing in Nyanza (Table 2).

Table 2 Sociodemographic Characteristics (n=438)

Characteristics	frequency (n)	%
Age		
18–22 years	49	11.2
23–27 years	89	20.3
28–32 years	73	16.7
33–37 years	87	19.9
38–42 years	85	19.4
43 years and above	55	12.6
Marital status		
Single	125	28.5
Married	294	67.1
Separated/divorced	19	4.3
Religion		
Catholic	382	87.2
Muslim	13	3
Other	43	9.8
Education		
Primary	365	83.3
Secondary and higher	53	12.1
Illiterate	20	4.6
Employment		
Unemployed, student, and other	356	81.3
Self-employed	45	10.3
Employed	37	8.4
Monthly income (RWF)		
Below 50,000	391	89.3
50,000–100,000	38	8.7
100,000 and above	9	2.1
Area of residence		
Nyanza	424	96.8
Outside Nyanza	14	3.2

Prevalence of VMMC Uptake by Sociodemographic Characteristics

VMMC uptake was 35.8%, and varied based on sociodemographic status. The highest VMMC uptake (7.5%) was found in those aged 33–37 years. Concerning marital status, the highest VMMC uptake was found in those who were married. Similarly, there was high VMMC uptake among respondents who were Catholic. In sum, 53.7% of uncircumcised participants had attended primary school, and there was high VMMC uptake among the unemployed, students, and others. More than 53.2% had monthly incomes <RWF50,000, >62% were residents of Nyanza (Table 3).

Table 3 Uptake of VMMC by Sociodemographic Characteristics

Characteristics	Circumcised (n=157)		Uncircumcised (n=281)	
	n	%	n	%
Age				
18–22 years	17	3.9	32	7.3
23–27 years	32	7.3	57	13.0
28–32 years	28	6.4	45	10.3
33–37 years	33	7.5	54	12.3
38–42 years	24	5.5	61	13.9
43–49 years	23	5.3	32	7.3
Marital status				
Single	39	8.9	86	19.6
Married	114	26.0	180	41.1
Separated/divorced	4	0.9	15	3.4
Religion				
Catholic	127	29.0	255	58.2
Muslim	9	2.1	4	0.9
Other	21	4.8	22	5.0
Education				
Primary	130	29.7	235	53.7
Secondary and higher	15	3.4	38	8.7
Illiterate	12	2.7	8	1.8
Employment				
Unemployed, student, and other	123	28.1	233	53.2
Self-employed	18	4.1	27	6.2
Employed	16	3.7	21	4.8
Monthly income (RWF)				
Below 50,000	138	31.5	253	57.8
50,000–100,000	15	3.4	23	5.3
100,000 and above	4	0.9	5	1.1
Area of residence				
Nyanza	149	34.0	275	62.8
Outside Nyanza	8	1.8	6	1.4

Knowledge-Level Variables

A large majority (95.7%) of participants had heard about circumcision in different settings. In sum, 92.5% those circumcised knew that one needed to abstain from sexual activity for 6 weeks after the circumcision operation, and 89% mentioned the need for condom use after the operation. A large majority (97%) were aware of VMMC and indicated that they knew it was a medical operation that reduced the risks of catching STIs, including HIV, 89.7% of indicated that they knew VMMC contributed to reducing the risk of developing penile cancer, and 98.9% responded that VMMC was important for improving penile hygiene. Though some complications like infections, insufficient foreskin removal, and excessive foreskin removal are rare following circumcision, a majority (82%) answered that bleeding was the most complication. A majority (84.7%) were knowledgeable about VMMC (Table 4).

Knowledge Level by Sociodemographic Characteristics

Participants' knowledgedifferently varied based on sociodemographic status. Among knowledgeable participants, 19.5% were aged 33–37 years and 38%–42%, respectively, whereas among participants who were not knowledgeable, a majority were aged 18–22 years. A majority of participants were married (61%), while single men represnted 8% of the sample. A majority (78.1%) of those knowledgeable about VMMC were Catholic. The Among participants who were knowledgeable, a majority (71.2%) had had a primary education only, while among the unknowledgeable, 12.1% had had a primary education only. A majority (75.1%) of those knowledgeable about VMMC were unemployed, students, and others. Among participants not knowledgeable about MC, a majority (8%) were self-employed. Among knowledgeable participants, a majority (77.4%) had monthly incomes <RWF50,000, and among the unknowledgeable, this figure was 11.9%. The results also demonstrated that a majority (83.6%) of the knowledgeable resided in Nyanza (Table 5).

Bivariate Analysis of VMMC Uptake

Bivariate logistic analysis indicated that marital status, residence, age, monthly income, employment status, and being knowledgeable about VMMC were not significantly associated with being uncircumcised. Significant associations were found between circumcision and

Table 4 Knowledge-level Variables

Variables	n	%
Heard about VMMC		
Yes	419	95.7
No	19	4.3
Need to abstain for 6 weeks after circumcision		
Yes	405	92.5
No	33	7.5
Need for condom use after VMMC		
Yes	390	89.0
No	48	11.0
VMMC reduces the risk of STDs		
Yes	425	97.0
No	13	3.0
VMMC reduces the risk of penile cancer		
Yes	393	89.7
No	45	10.3
VMMC improves penile hygiene		
Yes	433	98.9
No	5	1.1
VMMC causes complications		
Infection	27	6.2
Bleeding	359	82.0
Insufficient foreskin removed	26	5.9
Excessive foreskin removed	16	3.7
I do not know	10	2.3
Knowledge about VMMC		
Knowledgeable	371	84.7
Not knowledgeable	67	15.3

Abbreviations: VMMC, voluntary medical male circumcision; STDs, sexually transmitted diseases.

Table 5 Knowledge by Sociodemographic Characteristics

Variables	Knowledgeable (n=371)		Not Knowledgeable (n=67)	
	n	%	n	%
Age				
18–22 years	8	1.8	41	9.4
23–27 years	77	17.6	12	2.7
28–32 years	66	15.1	7	1.6
33–37 years	84	19.2	3	0.7
38–42 years	81	18.5	4	0.9
43 years and above	55	12.6	0	0
Marital status				
Single	90	20.5	35	8.0
Married	267	61	27	6.2
Separated/divorced	14	3.2	5	1.1
Religion				
Catholics	342	78.1	40	9.1
Muslim	10	2.3	3	0.7
Others	19	4.3	24	5.5
Education				
Primary	312	71.2	53	12.1
Secondary and higher	45	10.3	8	1.8
Illiterate	14	3.2	6	1.4
Employment status				
Unemployed, student, and other	329	75.1	27	6.2
Self-employed	10	2.3	35	8
Employed	32	7.3	5	1.1
Monthly income (RWF)				
Below 50,000	339	77.4	52	11.9
50,000–100,000	24	5.5	14	3.2
100,000 and above	8	1.8	1	0.2
Area of residence				
Nyanza	366	83.6	58	13.2
Outside Nyanza	5	1.1	9	2.1

religion, as well as education. On bivariate analysis, religion was a significant predictor of low VMMC uptake. Being Catholic was significantly associated with low VMMC uptake. Similarly, educational was a significant factor in low VMMC uptake (Table 6).

Multivariate Analysis of VMMC Uptake

On multiple logistic regression, religion and education were also significantly associated with low VMMC uptake.Being Catholic increased the likelihood of low VMMC uptake compared to Muslims (OR 7.19, 95% CI (1.742–29.659; p=0.01). Followers of other religions were less likely to have low VMMC uptake thanMuslims (OR 6.035, 95% CI 1.731–21.039; p=0.005). Those with no formal education were less likely to have low VMMC uptake of than those with primary education. (OR 0.37, 95% CI 0.14–0.977; p=0.045). Those who were married were less likely to have low VMMC uptake of (OR 0.536, 95% CI 0.326–0.882; p=0.014) than those who were single (Table 7).

Discussion

VMMC uptake in Nyanza was 35.8%. This is relatively higher than the national prevalence (30%) reported in the 2014/2015 Rwanda Demographic and Health Survey,[22] but lower than that in other areas such as in north Africa

Table 6 Bivariate Analysis of VMMC Uptake

Variables	Circumcised	Uncircumcised		95% CI	*p*
	n	n	OR		
Age					
18–22 years	17	32	Ref		
23–27 years	32	57	0.946	(0.456,1.964)	0.882
28–32 years	28	45	0.854	(0.402,1.815)	0.681
33–37 years	33	54	0.869	(0.419,1.805)	0.707
38–42 years	24	61	1.350	(0.635,2.871)	0.435
43–49 years	23	32	0.739	(0.334,1.638)	0.457
Marital status					
Single	39	86	Ref		
Married	114	180	0.72	(0.46,1.12)	0.141
Separated/divorced	4	15	1.7	(0.53,5.46)	0.372
Religion					
Muslim	9	4	Ref		
Catholic	127	255	4.52	(1.36,14.95)	0.014*
Other	21	22	2.36	(0.63,8.83)	0.203
Education					
Primary	130	235	Ref		
Secondary and higher	15	38	1.4	(0.74,2.64)	0.03*
Illiterate	12	8	0.37	(0.15,0.92)	0.034*
Employment status					
Unemployed, student, and other	123	233	Ref		
Self-employed	18	27	1.443	(0.727,2.866)	0.295
Employed	16	21	1.143	(0.473,2.762)	0.767
Monthly income (RWF)					
Below 50,000	138	253	Ref		
50,000–100,000	15	23	0.84	(0.42,1.66)	0.61
100,000 and above	4	5	0.68	(0.18,2.58)	0.57
Area of residence					
Nyanza	149	275	Ref		
Outside Nyanza	8	6	0.41	(0.14,1.19)	0.101
Knowledge about VMMC					
Knowledgeable	135	236	Ref		
Not knowledgeable	22	45	1.17	(0.67,2.03)	0.577

Note: *$p \leq 0.05$.
Abbreviation: VMMC, voluntary medical male circumcision; Ref, reference.

(92%) and >62% found in sub-Saharan Africa.[22,27,28] A majority of participants were aged 23–27 years, and it was in this group that VMMC uptake was low compared to other age-groups.

VMMC uptake was significantly associated withsocio-demographic variables. Religion was significantly associated with low VMMC uptake.This result is supported by similar research indicating that religion was associated with uptake, especially in the uncircumcised, in Kenyan communities.[5] Catholics were almost 7.2 times more likely to have low VMMC uptake of than Muslims. This finding is similar to other esearch reporting that religion and sociocultural beliefs make for difficulties with VMMC uptake within uncircumcised communities.[5] Our results revealed that those with no formal education were less likely to have low VMMC uptake than those with primary education. This result is supported by prior research indicating that education had a significant influence on

Table 7 Multivariate Analysis of the of VMMC Uptake

	Full Model			Reduced Model		
	OR	**95% CI**	***p*-v**	**OR**	**95% CI**	***p*-v**
Age						
18–22 years	Ref.					
23–27 years	0.702	(0.230,2.147)	0.54			
28–32 years	0.45	(0.127,1.597)	0.22			
33–37 years	0.521	(0.145,1.869)	0.32			
38–42 years	0.759	(0.210,2.748)	0.67			
43–49 years	0.463	(0.123,1.736)	0.25			
Marital status						
Single	Ref.			Ref.		
Married	0.568	(0.333,0.969)	0.04*	0.536	(0.326,0.882)	0.014*
Separated/divorced	1.448	(0.418,5.017)	0.56	1.394	(0.419,4.634)	0.588
Religion						
Muslim	Ref.			Ref.		
Catholic	7.19	(1.742,29.659)	0.01*	6.035	(1.731,21.039)	0.005*
Other	2.581	(0.597,11.153)	0.2	2.544	(0.659,9.820)	0.175
Education						
Primary	Ref.			Ref.		
Secondary and higher	1.425	(0.702,2.895)	0.33	1.477	(0.768,2.841)	0.243
No formal education	0.353	(0.126,0.988)	0.05*	0.37	(0.140,0.977)	0.045*
Employment status						
Unemployed, student, and other	Ref.					
Self-employed	0.876	(0.267,2.881)	0.83			
Employed	0.812	(0.291,2.267)	0.69			
Monthly income (RWF)						
Below 50,000	Ref.					
50,000–100,000	1.165	(0.465,2.919)	0.74			
100,000 and above	1.046	(0.217,5.050)	0.96			
Area of residence						
Nyanza district	Ref.					
Outside Nyanza	0.445	(0.123,1.607)	0.22			
Knowledge about VMMC						
Knowledgeable	Ref.					
Not knowledgeable	1.25	(0.529,2.953)	0.61			

Note: *$p \leq 0.05$.
Abbreviation: VMMC, voluntary medical male circumcision.

circumcision,[29] and is similar to studies in sub-Saharan countries.[12,28,30]

A majority (84.7%) of participants were highly knowledgeable. This result was contradicts previous studies, wherein VMMC knowledgea was lower and led to low VMMC uptake.[31,32] The results of this study revealed no significant association between being knowledgeable and low VMMC uptake. In agreement with prior research,[31] our results revealed that being married decreased the likelihood of low VMMC uptake compared to those who were single. We found no significant associations among residence, age, or employment status. This challenges earlier researchdocumenting age, type of residence, and employment status to be significant contributing factors to low VMMC uptake.[5,33] Our results revealed that those with no formal education were less likely to have low VMMC uptake than those who had attended primacy schools, in contrast to research

indicating that those with formal education were less likely to undergo VMMC.[33–35]

Knowledge about VMMC was not found to be significantly associated with uptake; however, it was found that the majority of the participants were knowledgeable about VMMC in terms of knowing about possible VMMC complications and advantages of VMMC, such as reducing the risk of penile cancer. These results contrast with prior studies documenting that lack of adequate knowledge about VMMC was an important factor in low VMMC uptake in Botswana, heightening the risk of STI and HIV/AIDS spread.[5,36]

Limitations

The study has several limitations. First, it was limited to those aged 18–49 years. Second, it was vulnerable to bias, because the circumcision status was self-reported and respondents could not provide all circumcision information for various reasons. These expected biases were controlled by safeguarding confidential interviews, and proportional sampling was crucial in enroll a suitable sample size from each of the recruited strata from Nyanza.

Conclusion

Like other studies conducted in African countries, the current study showed that adults were mostly knowledgeable about VMMC and knew the advantages of VMMC for health. VMMC prevalence in the area was higher than the national figure, while low uptake was associated with religion and education. Accomplishing the high national VMMC targets in Rwanda will be an important contributor to furthering the HIV decline in Nyanza.

We recommend that the Ministry of Health and partner-increase the accessibility of VMMC through strong awareness and mobilization initiatives in the community of Nyanza. This goal should be achieved by creating more awareness about the safety and quality of services in government health facilities. In addition, providing health education in public and private institutions reinforcing that VMMC reduces female-to-male transmission risk of HIV and prevents STIs could lead to increased uptake of VMMC services in Nyanza. Further research is needed on uptake variables nationwide. There is a need in Rwanda for illuminating the influences of VMMC on STI and HIV prevention, treatment, and care. We recommend further research at a national level.

Abbreviations

MMC, medical male circumcision; NGO, nongovernmental organization; STIs, sexually transmitted infections; UNAIDS, Joint United Nations Programme on HIV/AIDS; VMMC, voluntary MMC; WHO, World Health Organization.

Data Sharing Statement

The data sets used in this research are available from the corresponding author. All data generalized or analyzed in this study may be shared upon permission being granted by the corresponding author.

Ethics Approval and Consent to Participate

Ethics approval with the reference number (N^0:425/CMHS IRB/2019) was granted by the Institutional Review Board of the College of Medicine and Health Sciences, University of Rwanda. District authorities provided permission to conduct data collection in their districts. Participants were informed about the aim of the study, and all provided oral and written informed consent. Confidentiality and privacy were preserved by ensuring that the interviews were performed in private spaces comfortable for the participants. Codes for the participants were safeguarded to conceal identities, and the researchers handled all records securely through the use of locked files.

Consent for Publication

Consent to publish the results from this study was obtained from the participants.

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Author Contributions

Both authors made a significant contribution to the work reported, whether in conception, study design, execution, data acquisition and interpretation, or in all these areas, took part in drafting, revising, or critically reviewing the article,

gave final approval to the version to be published, agreed on the journal to which the article has been submitted, and agree to be accountable for all aspects of the work.

Disclosure

The authors report no conflicts of interest in this work.

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