AIDS Behav
DOI 10.1007/s10461-015-1210-z

ORIGINAL PAPER

The Relationship Between Distance and Post-operative Visit Attendance Following Medical Male Circumcision in Nyanza Province, Kenya

Ginger Golub[1] · Amy Herman-Roloff[2,3] · Susie Hoffman[1,4] · Walter Jaoko[5] · Robert C. Bailey[2,3]

Abstract To date, there is no research on voluntary medical male circumcision (VMMC) catchment areas or the relationship between distance to a VMMC facility and attendance at a post-operative follow-up visit. We analyzed data from a randomly selected subset of males self-seeking circumcision at one of 16 participating facilities in Nyanza Province, Kenya between 2008 and 2010. Among 1437 participants, 46.7 % attended follow-up. The median distance from residence to utilized facility was 2.98 km (IQR 1.31–5.38). Nearly all participants (98.8 %) lived within 5 km from a facility, however, 26.3 % visited a facility more than 5 km away. Stratified results demonstrated that among those utilizing fixed facilities, greater distance was associated with higher odds of follow-up non-attendance ($OR_{5.01–10km \text{ vs. } 0–1km} = 1.71$, 95 % CI 1.08, 2.70, $p = 0.02$; $OR_{>10km \text{ vs. } 0–1 \text{ km}} = 2.80$, 95 % CI 1.26, 6.21, $p = 0.01$), adjusting for age and district of residence. We found 5 km marked the threshold distance beyond which follow-up attendance significantly dropped. These results demonstrate distance is an important predictor of attending follow-up, and this relationship appears to be modified by facility type.

Keywords Voluntary medical male circumcision Spatial analysis of catchment Post-operative follow-up Facility attendance Kenya

Introduction

Results from three randomized controlled trials in three sub-Saharan African countries demonstrated that male circumcision—the surgical removal of the foreskin from the penis—reduces the incidence of HIV acquisition for males by 60 % [1–3]. These findings prompted the World Health Organization (WHO) and the Joint United Nations Programme on HIV/AIDS (UNAIDS) to endorse voluntary medical male circumcision (VMMC) as an important HIV prevention strategy in 2007 for communities in which prevalence of HIV is high and that of male circumcision is low [4]. Fourteen sub-Saharan African countries with these characteristics are aiming to achieve 80 % coverage among men aged 15–49 years by 2016. Although a challenging target, if it is achieved and maintained, an estimated 3.4 million HIV infections would be prevented [5].

By 2012, VMMC scale-up activities were credited with circumcising approximately 1.3 million men in sub-Saharan Africa, representing 6.5 % of the 2016 target [5]. Among the challenges in scaling-up VMMC are: overcoming cultural barriers [6, 7], effectively utilizing limited human resources, commodity management, and patient adherence to post-operative follow-up [8]. This study addresses the last challenge.

In Kenya, standard operating procedures for VMMC recommend that clients attend a follow-up visit 7 days

✉ Ginger Golub
gingermariegolub@gmail.com

1 Department of Epidemiology, Columbia University Mailman School of Public Health, New York, NY, USA

2 Division of Epidemiology and Biostatistics, University of Illinois at Chicago, Chicago, IL, USA

3 Nyanza Reproductive Health Society, Kisumu, Kenya

4 HIV Center for Clinical and Behavioral Studies, NYS Psychiatric Institute and Columbia University, New York, NY, USA

5 Department of Medical Microbiology, University of Nairobi, Nairobi, Kenya

Published online: 30 September 2015

post-procedure, during which providers observe the wound, identify and manage adverse events (AEs), and reinforce messages of abstinence during healing and condom use during sexual intercourse once healing is complete [9]. In previous studies in sub-Saharan African settings, including Kenya, client-specific barriers to follow-up compliance included perceived lack of an AE and distance to the facility [10–12].

Distance has been identified as a primary barrier to healthcare utilization in sub-Saharan Africa for indications such as HIV and tuberculosis, in which care and treatment requires regular follow-up [13, 14]. In rural South Africa, one cross-sectional mapping study found the average straight-line distance traveled to reach primary care—including HIV and other chronic care services—was 4.72 km (km), and that beyond 8 km, facility utilization declined dramatically [15]. Similarly, another cross-sectional study in the same rural location found a steep decrease in the odds of accessing anti-retroviral treatment (ART) as distance to the facility increased, with those living 4.78 km from the facility having a 50 % lower odds of being on ART than those residing next to the facility [16].

Because VMMC is a one-time procedure with only one recommended follow-up visit, patients may be willing to travel greater distances than they are for ongoing services [17], thereby allowing for a larger catchment area, defined as the geographic area where a facility serves clients effectively. For example, a study of intrauterine device (IUD) uptake in Egypt found that women who lived at least 4 km from a family planning facility compared with those who lived less than 4 km away were equally likely to take up the services in their adjusted model [18]. Similarly, therefore, the association between distance and likelihood of follow-up for VMMC may be weaker and the catchment area for VMMC greater compared to that for chronic care or reproductive health services. However, little data exist to evaluate the association between distance and VMMC follow-up.

This study draws on data from an ongoing VMMC program in Kenya, which is one of the countries prioritized by WHO for VMMC scale-up. In Kenya, Nyanza Province—home to the Luo tribe who do not traditionally practice circumcision—has an HIV prevalence of 15.1 %, compared with the national prevalence of 5.6 % [19]. The Ministry of Health began active scale-up of VMMC for HIV prevention in 2008. By 2011, 341,000 men had been circumcised under this initiative, reaching approximately 40 % of its 2013 target of 860,000 men. Yet, of these, only 27.5 % were found to have attended the recommended follow-up visit scheduled 7–12 days post-procedure [20].

In this study, we [1] defined the catchment area for VMMC facilities, and [2] assessed whether greater distance to facility was associated with lower follow-up attendance. Results from this research will increase understanding of VMMC catchment areas and barriers to follow-up, thus providing guidance to VMMC programs on how to improve uptake and safety of the services.

Methods

Study Population

Data were drawn from a study conducted by Nyanza Reproductive Health Society and University of Illinois at Chicago (UIC) between 2008 and 2010, which assessed male circumcision scale-up in three districts in Nyanza Province, Kenya. Participants in the evaluation study were recruited upon self-seeking VMMC services at one of 16 participating facilities in Kisumu East, Kisumu West, and Nyando Districts in Nyanza Province, Kenya. Eligible participants were males at least 12 years old at the time of initial visit. After providing parental written informed consent and assent from those less than 18 years of age, a sub-sample of enrolled participants was randomly selected to participate in an active surveillance system, which comprised the study population of this analysis. More details describing the study procedures can be found in a previous publication [21].

Ethical Considerations

The original protocol and all source documents were approved by the UIC Institutional Review Board (IRB) and Kenyatta National Hospital Ethics and Research Committee in Nairobi, Kenya. This secondary analysis was approved by the Columbia University Medical Center IRB.

Data Sources

Data sources included [1] demographic information obtained on paper forms by a research assistant during the consultation visit; [2] clinical and procedural information collected by health providers on paper forms during any consultation visit, which included the visit prior to circumcision, the visit in which the circumcision was performed and any post-procedural follow-up visit; and [3] spatial data verifying residence location obtained during home visits 28–45 days post-procedure on a personal digital assistant (PDA) equipped with a global positioning system (GPS). Demographic, clinical, and procedural data, including the date of each visit, were entered into an electronic database by research assistants hired and trained specifically to perform study procedures. GPS data were automatically transferred from the PDA into a dataset and linked to other data using a unique identifier. At the time of

the study, there were no national forms associated with VMMC so all forms were developed primarily for the study, but similar forms were subsequently adapted for routine data collection by the Ministry of Health.

Measures

Outcome

Post-operative follow-up attendance (yes/no)—defined as attendance any time post-procedure—was the main outcome of interest. Attendance was documented by a clinician or nurse at the facility.

Exposure

The main exposure investigated was distance from residence to facility where VMMC services were performed. Straight-line distance from each participant's residence to the facility was calculated using ArcGIS version 10.1. Straight-line distance is a measure that Siedner et al. [22] have validated as a proxy for exact route distance and a better measure than self-reported travel distance. Distance was analyzed as a categorical variable because plotting the betas for each distance category demonstrated non-linearity in the log odds of distance. Categories (0–1, 1.01–3, 3.01–5, 5.01–10 and >10 km) were determined by splitting the data into quartiles and finding distance intervals that roughly fit the quartiles, and then dividing the last interval into two categories to more closely investigate the effects of greater distances. In order to understand the relationship of straight-line distance to other travel-related indicators, comparisons were made between distance category and the number of modes of transportation (foot, bicycle, motorcycle, public vehicle, private vehicle) used to reach the facility, as well as the self-reported time it took to travel to the facility (<15, 15–30, 30–60, and >60 min).

Covariates

Factors associated with distance to VMMC facilities and VMMC follow-up attendance are not well established; thus a wide range of potentially confounding variables was considered a priori. These included age in years (continuous variable); district of residence (Kisumu East, Kisumu West, Nyando, and other); highest level of school completed (none, primary, secondary, and post-secondary); employment status (yes/no); employment type (unemployed, self-employed, and salaried); monthly income in Kenyan shillings (none, 1–2,000 ($0.01–$27.82), 2000–9999 ($27.83–$139.06), ≥10,000 (≥$139.07); marital status (not-married/married); having a regular live-in partner (yes/no); religion (Catholic, Protestant, and other); district of facility visited (Kisumu East, Kisumu West, and Nyando); reported and/or confirmed HIV status (negative, positive, and unknown); and provider type (clinician/nurse).

Facility type (fixed/mobile) was assessed as a potential confounder and potential effect measure modifier of the relationship between distance to facility and follow-up attendance. Fixed facilities are those that have a permanent structure and staff, while mobile facilities are smaller permanent facilities (usually 1–2 rooms), but have staff who move from one facility to the next.

Statistical Analysis

ArcGIS version 10.1 was used to map the geospatial coordinates of participant residences and VMMC facilities and to calculate the straight-line distance from each residence to the VMMC facility utilized. To determine the average catchment area of VMMC facilities among the study population, pre-set buffers of each distance category were used to create concentric rings around each facility. The percentage of clients living within each buffer was calculated.

Power was calculated post hoc to be 85 %, with the ability to detect a risk ratio (risk of not attending follow-up among those living >10 km from the VMMC facility compared to those living 0–1 km away) of 1.4 based on these data.

Participant descriptive statistics were calculated; bivariate analyses using Wald χ^2 tests were performed to examine the association between participant characteristics and distance, and between participant characteristics and attendance at follow-up. Variables that were associated with both predictor and outcome at $p \leq 0.20$ were considered potential confounders of the association between distance and follow-up attendance. They were included in a multivariable logistic regression model along with distance, and were removed one-by-one and jointly. Those variables that alone or in combination with other variables changed the beta value for the effect estimate of distance by 10 % or more were retained in the model. An interaction term between distance and facility type was introduced to the adjusted regression model to determine if there was significant multiplicative interaction in the full model ($p \leq 0.05$). These bivariate and multivariable logistic regression analyses were conducted using SAS version 9.3.

Results

Characteristics of the Study Population

Of the 4010 VMMC clients across 16 facilities in Kisumu East, Kisumu West, and Nyando Districts enrolled in the

parent study, 1449 were randomly selected to participate in active surveillance. In this sub-sample, 12 were excluded from analysis because neither a nurse nor clinician performed the circumcision. Among these 1437 participants, the median age was 20 years (range 12–76), and nearly all (98.1 %) identified as Luo (Table 1). Overall, approximately one-third (34.4 %) of the study population lived within 1 km of a VMMC facility whether it was the one utilized for circumcision or not; 80.1 % lived within 3 km, and 98.8 % lived within 5 km of a VMMC facility (data not shown).

Of all participants, 46.7 % attended a post-operative follow-up visit. A similar proportion of participants accessed fixed (48 %) and mobile (52 %) sites (Table 1). The median distance from participant residence to the VMMC facility utilized was 2.98 km, ranging from 0.01 to 52.67 km (inter-quartile range 1.31–5.38 km). Few participants (5.9 %) resided outside the district where the facility was located. Approximately 26.3 % of participants (n = 378) utilized a facility more than 5 km from their residence. Most participants used one mode of transportation (71.8 %) to reach a facility. Figure 1 is an example that illustrates the spatial distribution of VMMC clients who utilized one participating facility, Chemelil Dispensary, where 21.6 % traveled more than 5 km to reach this facility, despite living closer to other VMMC facilities.

Bivariate Associations

A smaller proportion of participants attended follow-up among those who utilized facilities more than 5 km from their residences compared to those who utilized facilities within 1 km from home ($\chi^2_{5.01–10km\ vs.\ <1km} = 8.46$, $p < 0.01$ and $\chi^2_{>10km\ vs.\ <1km} = 8.86$, $p < 0.01$), as shown in Table 1. The percentage of those who attended follow-up by distance category was as follows: 0–1 km: 52.6 %; 1.01–3 km: 48.1 %; 3.01–5 km: 48.4 %; 5.01–10 km: 40.5 %; >10 km: 35.6 %. A smaller proportion of clients attended follow-up among mobile facilities compared to fixed facilities (41.5 vs. 52.5 %, respectively; $\chi^2 = 17.25$, $p < 0.01$). Other significant bivariate associations with follow-up attendance included age ($\chi^2 = 7.03$, $p < 0.01$), employment status ($\chi^2 = 5.36$, $p = 0.02$), income ($\chi^2_{1–2000\ shillings\ vs.\ none} = 3.05$, $p = 0.08$), live-in partner ($\chi^2 = 3.06$, $p = 0.08$), district of residence ($\chi^2_{Kisumu\ West\ vs.\ East} = 4.12$, $p = 0.04$), and district of facility used ($\chi^2_{Kisumu\ West\ vs.\ East} = 4.49$, $p = 0.03$). The mean number of modes of transportation used was significantly higher among clients who traveled more than 5 km to the facility versus those who traveled 5 km or less (Table 2: t = 8.59, $p < 0.001$). The median self-reported time to travel to the facility was 15–30 min among those who utilized a facility within 5 km of their residence versus 30–60 min among those living more than 5 km from the facility and the mean times between these distances proved to be significantly different (t = 6.14, $p < 0.001$).

Multivariable Associations

Facility type, age, and district of residence confounded the relationship when included in the model either singly (facility type: $\chi^2 = 16.98$, $p < 0.001$) or together (age: $\chi^2 = 5.68$, $p = 0.02$ and district of residence: $\chi^2 = 4.78$, $\chi^2 = 0.19$) and thus were included in the adjusted model (data not shown). No other covariate of interest fulfilled the previously described criteria for confounding. Facility type was also found to be an effect measure modifier based on the significant multiplicative interaction term for one of the distance categories (Wald $\chi^2 = 4.21$, $p = 0.04$) in the fully adjusted model (Table 3). Stratification by facility type demonstrated that among participants who utilized a fixed facility, those who lived farther from the facility were significantly less likely to attend follow-up compared with the reference distance category (Wald $\chi^2_{5.01–10km\ vs.\ 0–1km} = 5.30$, $p = 0.02$, $OR_{5.01–10km\ vs.\ 0–1km} = 1.71$, 95 % CI 1.08, 2.70; Wald $\chi^2_{>10km\ vs.\ 0–1km} = 6.40$, $p = 0.01$, $OR_{>10km\ vs.\ 0–1km} = 2.80$, 95 % CI 1.26, 6.21).). This association was not present among those who visited mobile facilities (Wald $\chi^2_{5.01–10km\ vs.\ 0–1km} = 3.67$, $p = 0.06$; Wald $\chi^2_{>10km\ vs.\ 0–1km} = 2.51$, $p = 0.11$).

Discussion

This study assessed whether greater distance from home to VMMC facility was associated with lower follow-up attendance among males who were circumcised in 16 facilities in Nyanza, Kenya. The vast majority of participants (98.8 %) lived within 5 km of a VMMC facility; however, 26.3 % of participants utilized a VMMC facility that was farther than 5 km from their residence. Among clients attending fixed facilities, the odds of not attending the follow-up visit were 2.80 times greater for those who lived more than 10 km from the facility, and 1.71 times greater for those who lived 5.01–10 km away compared to those living 1 km or less away. There was no significant difference in non-attendance for the smaller distance categories (1.01–3 and 3.01–5 km) compared to those who utilized a facility within 1 km of their residences. This demonstrates that there is a threshold distance of 5 km, after which VMMC follow-up attendance is significantly less likely in a fixed facility setting. No such relationship was found among those who visited mobile facilities. It is notable, however, that even among those who lived within 1 km from the utilized facility, approximately 47.4 % did

Table 1 Characteristics of males who were circumcised and actively followed-up post-circumcision in Nyanza, Kenya between 2008 and 2010

Subject Characteristic	Total (%) n = 1437 (100)[a]	Attended follow-up n (%)	Did not attend follow-up n (%)	Wald χ^2 (p-value)	OR (95% CI)
Age (years): median (IQR)	20 (7)	–	–	7.03 (<0.01)	0.98 (0.97, 1.00)
Educational background					
None (ref)	167 (11.6)	80 (47.9)	87 (52.1)	–	–
Primary	709 (49.3)	316 (44.6)	393 (55.4)	1.03 (0.31)	1.14 (0.82, 1.60)
Secondary	445 (31.0)	225 (50.6)	220 (49.4)	2.57 (0.11)	0.90 (0.63, 1.28)
Postsecondary	116 (8.1)	51 (44.0)	65 (56.0)	0.57 (0.45)	1.17 (0.73, 1.89)
Employment status					
Unemployed (ref)	951 (66.2)	424 (44.6)	527 (55.4)	–	–
Employed	486 (33.8)	248 (51.0)	238 (49.0)	5.36 (0.02)	0.77 (0.62, 0.96)
Employment type					
Unemployed (ref)	951 (66.2)	424 (44.6)	527 (55.4)	–	–
Self-employed	361 (25.1)	185 (51.3)	176 (48.8)	1.13 (0.29)	0.77 (0.60, 0.98)
Salaried	125 (8.7)	63 (50.4)	62 (49.6)	0.28 (0.60)	0.79 (0.55, 1.15)
Income in Kenyan shillings (USD)					
None (ref)	246 (17.1)	111 (45.1)	135 (54.9)	–	–
1–2000 ($0.01–$27.82)	707 (49.2)	315 (44.6)	392 (55.4)	3.05 (0.08)	1.02 (0.76, 1.37)
2001–9999 ($27.83–$139.06)	373 (26.0)	187 (50.1)	186 (49.9)	0.60 (0.44)	0.82 (0.59, 1.13)
≥10,000 (≥$139.07)	111 (7.7)	59 (53.1)	52 (46.9)	1.73 (0.19)	0.73 (0.46, 1.14)
Religion					
Catholic (ref)	415 (28.9)	204 (49.2)	211 (50.8)	–	–
Protestant	924 (64.3)	416 (45.0)	508 (55.0)	<0.01 (0.97)	0.85 (0.67, 1.01)
Other	98 (6.8)	52 (53.1)	46 (46.9)	1.29 (0.26)	0.72 (0.48, 1.10)
Marital status					
Not married (ref)	1109 (77.2)	513 (46.3)	596 (53.7)	–	
Married	328 (22.8)	159 (48.5)	169 (51.5)	0.50 (0.48)	0.92 (0.72, 1.17)
Live-in partner					
No (ref)	985 (68.6)	476 (48.3)	509 (51.7)	–	
Yes	452 (31.5)	196 (43.4)	256 (56.6)	3.06 (0.08)	1.22 (0.98, 1.53)
HIV status					
Negative (ref)	517 (36.0)	244 (47.2)	273 (52.8)	–	–
Positive	41 (2.9)	22 (53.7)	19 (46.3)	0.64 (0.43)	0.77 (0.41, 1.46)
Unknown	879 (61.2)	406 (46.2)	473 (53.8)	0.13 (0.72)	1.04 (0.84, 1.30)
District of residence					
Kisumu East (ref)	181 (12.6)	93 (51.4)	88 (48.6)	–	–
Kisumu West	404 (28.1)	171 (42.3)	233 (57.7)	4.12 (0.04)	1.44 (1.01, 2.05)
Nyando	766 (53.3)	366 (47.8)	400 (52.2)	0.76 (0.38)	1.16 (0.84, 1.60)
Other	86 (6.0)	42 (48.8)	44 (51.2)	0.15 (0.70)	1.11 (0.66, 1.85)
Facility type used					
Fixed (ref)	690 (48.0)	362 (52.5)	328 (47.5)	–	–
Mobile	747 (52.0)	310 (41.5)	437 (58.5)	17.25 (<0.01)	0.64 (0.52, 0.79)
Provider type seen[a]					
Clinician (ref)	1010 (70.3)	490 (48.5)	520 (51.5)	–	–
Nurse	427 (29.7)	182 (42.6)	245 (57.4)	4.18 (0.04)	1.27 (1.01, 1.59)
District of facility used					
Kisumu East (ref)	187 (13.0)	94 (50.3)	93 (49.7)	-	-
Kisumu West	443 (30.8)	182 (41.1)	261 (58.9)	4.49 (0.03)	1.45 (1.03, 2.04)
Nyando	807 (56.2)	396 (49.1)	411 (50.9)	0.09 (0.77)	1.05 (0.76, 1.44)

Table 1 continued

Subject Characteristic	Total (%) n = 1437 (100)[a]	Attended follow-up n (%)	Did not attend follow-up n (%)	Wald χ^2 (p-value)	OR (95% CI)
Distance from home to utilized facility					
0–1 km (ref)	304 (21.2)	160 (52.6)	144 (47.4)	–	–
1.01–3 km	420 (29.2)	202 (48.1)	218 (51.9)	1.45 (0.23)	1.20 (0.89, 1.61)
3.01–5 km	335 (23.3)	162 (48.4)	173 (51.6)	1.16 (0.28)	1.19 (0.87, 1.62)
5.01–10 km	274 (19.1)	111 (40.5)	163 (59.5)	8.46 (<0.01)	1.63 (1.17, 2.27)
>10 km	104 (7.2)	37 (35.6)	67 (64.4)	8.86 (<0.01)	2.01 (1.27, 3.19)
Self-reported travel time (minutes)[b]					
Median (Q1, Q3)	15–30 (15–30, 30–60)	–	–	–	–
Number of modes of transport used[b]					
Mean (standard deviation)	1.28 (0.46)	–	–	–	–

[a] There were 12 participants excluded from analyses, as they were seen by 'Other' provider types including students, laboratory technicians and local anesthesiologists

[b] Not investigated as a covariate; rather this variable used to determine if correlated with distance

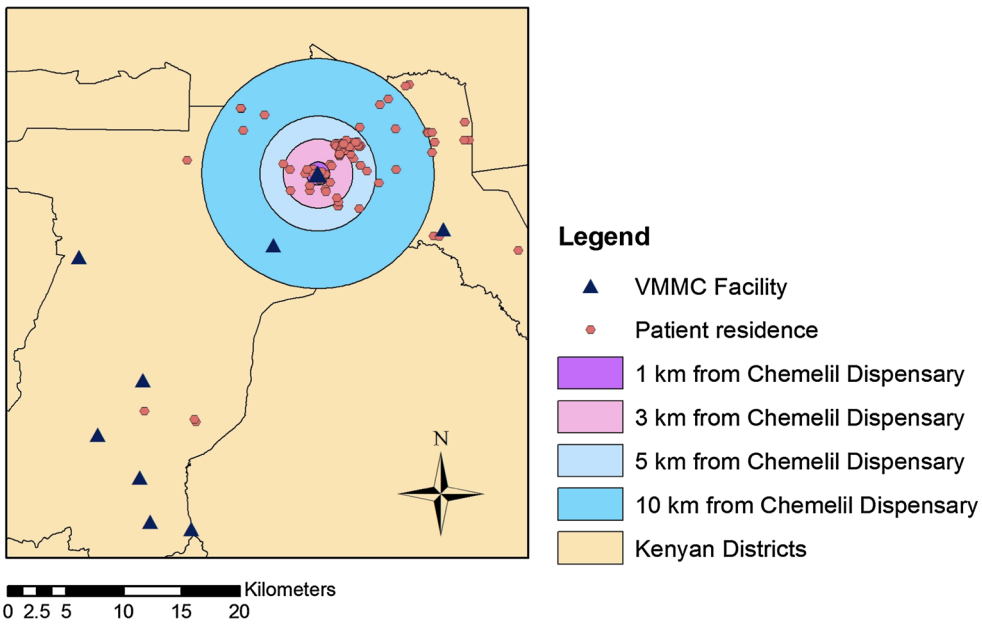

Fig. 1 VMMC catchment area in Nyanza, Kenya among participating males circumcised at Chemelil Dispensary between 2008 and 2010

Table 2 Bivariate associations of characteristics of travel with distance from client residence to utilized facility among male VMMC clients (n = 1437)

Variable	Distance to utilized facility		t-statistic, *p*-value
	≤5 km n = 1059	>5 km n = 378	
Mean number of modes of transport used	1.22	1.47	8.59, <0.001
Median self-reported time to reach facility	15–30 min	30–60 min	6.14, <0.001

not attend a follow-up visit. While this analysis demonstrates that distance is an important predictor of post-procedure follow-up for VMMC, a low attendance across distance categories may imply that there are other correlates that also affect attendance.

Studies have found distance to be an important predictor in health-seeking behavior and follow-up attendance, and this study supports these findings [13, 16, 23, 24]. Tanser et al. [15] and Conley et al. [13] found 5 km to be a threshold distance for seeking primary care (including HIV

Table 3 Adjusted associations between distance and non-attendance at post-circumcision follow-up visit among all male VMMC clients and results stratified by facility type (n = 1437)

Variable	Fully adjusted model: interaction of distance and facility type, adjusting for confounders		Fully adjusted model stratified by facility type			
			Fixed		Mobile	
	OR (95% CI)	Wald χ^2, p-value	OR (95% CI)	Wald χ^2, p-value	OR (95% CI)	Wald χ^2, p-value
Distance to utilized facility (ref: 0–1 km)						
0–1 km	–	–	–	–	–	–
1.01–3 km	0.92 (0.61, 1.40)	0.15, 0.70	0.89 (0.58, 1.36)	0.29, 0.59	1.63 (1.04, 2.54)[a]	4.61, 0.03
3.01–5 km	0.75 (0.45, 1.22)	1.37, 0.24	0.72 (0.44, 1.18)	1.68, 0.19	1.52 (0.98, 2.34)	3.55, 0.06
5.01–10 km	1.70 (1.08, 2.68)[a]	5.19, 0.02	1.71 (1.08, 2.70)[a]	5.30, 0.02	1.62 (0.99, 2.66)	3.67, 0.06
>10 km	3.24 (1.47, 7.11)[a]	8.54, <0.01	2.80 (1.26, 6.21)[a]	6.40, 0.01	1.63 (0.89, 2.97)	2.51, 0.11
Facility type (ref: fixed)	1.27 (0.80, 1.99)	1.04, 0.31	–	–	–	–
Age	0.98 (0.96, 1.00)[a]	6.95, <0.01	1.00 (0.97, 1.02)	0.18, 0.67	0.96 (0.94, 0.99)[a]	10.61, <0.001
District of residence (ref: Kisumu East)						
Kisumu East (ref)	–	–	–	–	–	–
Kisumu West	1.35 (0.94, 1.95)	2.62, 0.11	1.27 (0.77, 2.11)	0.87, 0.35	1.51 (0.89, 2.56)	2.29, 0.13
Nyando	1.05 (0.75, 1.48)	0.08, 0.78	0.89 (0.55, 1.44)	0.24, 0.63	1.31 (0.81, 2.13)	1.19, 0.28
Other	0.77 (0.45, 1.31)	0.93, 0.33	1.09 (0.30, 3.97)	0.02, 0.90	0.82 (0.44, 1.55)	0.36, 0.55
Facility type × distance						
Facility type × 1.01–3 km	1.76 (0.96, 3.23)	3.34, 0.07	–	–	–	–
Facility type × 3.01–5 km	1.99 (1.03, 3.82)[a]	4.21, 0.04	–	–	–	–
Facility type × 5.01–10 km	0.92 (0.47, 1.80)	0.05, 0.82	–	–	–	–
Facility type × >10 km	0.53 (0.20, 1.41)	1.63, 0.20	–	–	–	–

[a] Wald X^2 significant ($p < 0.05$)

care) in rural South Africa, and for follow-up compliance among HIV discordant couples in Kenya, respectively. However, some studies investigating conditions with infrequent or non-chronic follow-up requirements have not found distance to be a significant predictor of uptake or return; rather, factors attributed to utilization and visit compliance included quality of services and insurance type [18, 23, 25, 26]. Although transportation allowances are part of some programs in order to improve follow-up attendance, they were not included in this program. Our results show that approximately half of participants returned for follow-up if they lived 5 km or less from the utilized facility, but this proportion dropped to 40.5 % among those living 5.01–10 km, and to 35.6 % among those living more than 10 km from the VMMC facility. The number of modes of transportation was significantly higher among those traveling more than 5 km compared to those traveling within 5 km, as was the self-reported times it took to travel to the facility. It is likely that both the number of modes of transport and the time to reach the facility are correlated with the cost of transport, as well. Although most national VMMC programs do not require more than one follow-up visit 7 days post-procedure, these findings suggest that residing more than 5 km from a facility providing VMMC services likely serves as a deterrent for complying with this follow-up visit.

These findings have implications for defining VMMC catchment areas. Follow-up attendance is crucial in the monitoring of adverse events and the reinforcement of hygiene and abstinence during the healing process. Understanding why or how participants chose a facility may be integral to predicting whether VMMC clients will attend the recommended follow-up. Deciding to visit a more distant facility could be explained by clients being unaware of a nearer option, or by intentional decision-making such as seeking care at a facility with high quality services, longer facility hours, permanent staff presence (i.e. fixed facility), and/or renowned clinicians, as seen in other studies [27, 28]. Furthermore, as revealed by qualitative research, circumcision may still hold stigma in Kenya, motivating some clients to purposely choose more distant facilities to avoid recognition by health providers and discovery of their circumcision by community members [6, 7, 29–31]. Although qualitative research has investigated how these factors inform choice of VMMC facility, more research must be geared specifically towards factors influencing VMMC follow-up attendance.

Our stratified findings may have various explanations. Herman-Roloff, et al. [32] found that men in Kenya who had an adverse event following male circumcision were more likely to seek care, but not always from the provider directly. Mobile sites—which had lower overall attendance compared with fixed sites in this analysis (41.5 vs. 52.5 %, respectively)—do not have staff permanently stationed at the facility. Thus, it is possible that clients sought care from a source outside the VMMC team since no one was available to conduct follow-up, or that clients attended follow-up, but a dedicated staff was not available to receive clients and document their attendance. These results could also be explained if we assume that follow-up is more difficult at mobile facilities because it is influenced by factors such as management of teams, outreach events, weather complications, and political events, all of which would have less impact at fixed sites. In contrast to mobile facilities, fixed facilities have a team on site at all times and clients know they can visit the facility whenever it is convenient. Therefore, distance—especially when living more than 5 km from a facility—may play a larger role in attending follow-up when utilizing a fixed facility.

In order to improve attendance at VMMC follow-up visits and overall quality of VMMC services, program maintenance and expansion must take into account the underlying client population (i.e. demand) and ensure that (1) facilities are accessible, as defined by being within the 5 km catchment area, and that (2) transportation be made available for those who cannot be reached by a dedicated facility. Follow-up rates are likely to be improved if VMMC programs adequately support clients who live farther from a dedicated facility. Strategies could include a free national hotline for VMMC follow-up and enquiries, a dedicated mobile nurse whom clients could contact to conduct at-home check-ins, and/or trained community health workers assigned to specific geographic areas who are responsible for triaging AEs. Mobile technologies could be marshalled to assist lower cadre health workers to handle AEs (e.g., use mobile phones to transmit photos or brief videos to surgical consultants). Such approaches may offer clients the support they need to seek follow-up advice and care despite geographic barriers. More research must be done to determine the most effective and feasible strategy(ies).

There were several limitations to this study that should be considered. Without the availability of properly mapped roads and paths in rural Kenya, straight-line distance was utilized as a proxy for distance traveled from residence to VMMC facility. This method was validated by Siedner et al. [22], who characterized straight-line distance as a less laborious measurement that is highly correlated with GPS-tracked distance in relation to HIV clinic attendance. In this study, straight-line distance was significantly correlated with self-reported travel time. This approach addresses the problem of quantifying distances based on client estimations; however, in a context like Kenya, travel time to the facility may also be affected by variable road conditions and the modes of transport used, neither of which was accounted for in the straight-line distance measurement. Thus, this proxy for distance may be imprecise without such considerations. Another limitation is that utilization of services, including follow-up compliance, may be affected by healthcare worker attitudes, patient wait time, transport cost to facility, and availability of services, among other factors; however, these were not accounted for in this analysis. Next, two self-reported variables (number of modes of transportation used to reach the facility and time taken to reach the facility) were investigated in the bivariate analyses. It should be noted that such self-reported variables are subject to various biases. In addition, although the study population was randomly selected from among subjects self-selecting to be circumcised, this group may differ from the general population since they were early adopters of VMMC. Therefore, our results can be generalized to males in Nyanza seeking male circumcision, but not beyond. Furthermore, this study follows a program in one Province with many operating sites and outreaches; the implications of these findings may or may not apply to larger programs with fewer sites. The use of a random sample to create the study population, however, was a strength in the study design, as it increased internal validity.

Conclusion

This is the first study investigating the relationship between VMMC follow-up attendance and distance, and we found that greater distance to facility was significantly associated with lower follow-up attendance in services delivered at fixed facilities, but not through mobile services. In fixed facilities, a threshold effect was observed at 5 km, above which follow-up attendance significantly dropped. Spatial analysis revealed that the catchment area for VMMC facilities in which almost all participants resided was 5 km. Therefore, accessibility to VMMC facilities in Kenya seems adequate, but clients do not always visit the closest facility. Although distance may not be the most important predictor in choosing a facility, it is an important predictor of attending follow-up at fixed facilities. These results suggest that distance from the facility should be considered by VMMC programs seeking to optimize program safety through post-operative monitoring and treatment of adverse events.

Acknowledgments Support for this study was provided by a grant to FHI from the Bill & Melinda Gates Foundation to support the Male Circumcision Consortium (MCC), a partnership between FHI, University of Illinois at Chicago working closely with the Nyanza Reproductive Health Society (NRHS), and Engender Health. Dr. Hoffman is supported in part by a center grant from the National Institute of Mental Health [P30-MH43520; Principal Investigator: Robert H. Remien, Ph.D.] to the HIV Center for Clinical and Behavioral Studies at the New York State Psychiatric Institute and Columbia University. The content of this article is solely the responsibility of the authors and does not necessarily represent the official views of the Bill and Melinda Gates Foundation, the MCC partners, the National Institute of Mental Health, or the HIV Center for Clinical and Behavioral Studies. We express our sincere thanks to those who participated in the study and making this research possible.

References

1. Auvert B, Taljaard D, Lagarde E, Sobngwi-Tambekou J, Sitta R, Puren A. Randomized, controlled intervention trial of male circumcision for reduction of HIV infection risk: the ANRS 1265 Trial. PLoS Med. 2005;2(11):e298.
2. Bailey RC, Moses S, Parker CB, Agot K, Maclean I, Krieger JN, et al. Male circumcision for HIV prevention in young men in Kisumu, Kenya: a randomised controlled trial. Lancet. 2007;369(9562):643–56.
3. Gray RH, Kigozi G, Serwadda D, Makumbi F, Watya S, Nalugoda F, et al. Male circumcision for HIV prevention in men in Rakai, Uganda: a randomised trial. Lancet. 2007;369(9562):657–66.
4. World Health Organization, UN Joint Programme on HIV/AIDS. New data on male circumcision and HIV prevention: policy and programme implications; 2007.
5. World Health Organization. Voluntary medical male circumcision for HIV prevention. Geneva: WHO; 2012.
6. Khumalo-Sakutukwa G, Lane T, van-Rooyen H, Chingono A, Humphries H, Timbe A, et al. Understanding and addressing socio-cultural barriers to medical male circumcision in traditionally non-circumcising rural communities in sub-Saharan Africa. Cult Health Sex. 2013;15(9):1085–100.
7. Scott BE, Weiss HA, Viljoen J. The acceptability of male circumcision as an HIV intervention among a rural Zulu population, Kwazulu-Natal, South Africa. AIDS Care. 2005;17(3):304–13.
8. World Health Organization. Joint strategic action framework to accelerate the scale-up of voluntary medical male circumcision for HIV prevention in Eastern and Southern Africa (2012–2016). Geneva: UNAIDS; 2011.
9. National AIDS and STI Control Programme (NASCOP). PEPFAR's best practices for voluntary medical male circumcision site operations. In: USAID, editor. PEPFAR; 2012.
10. Moïsi JC, Nokes DJ, Gatakaa H, Williams TN, Bauni E, Levine OS, et al. Sensitivity of hospital-based surveillance for severe disease: a geographic information system analysis of access to care in Kilifi district, Kenya. Bull World Health. 2011;89(2):102–11.
11. Danso-Appiah A, Stolk WA, Bosompem KM, Otchere J, Looman CW, Habbema JDF, et al. Health seeking behaviour and utilization of health facilities for schistosomiasis-related symptoms in Ghana. PLoS Negl Trop Dis. 2010;4(11):e867.
12. Odeny TA, Bailey RC, Bukusi EA, Simoni JM, Tapia KA, Yuhas K, et al. Text messaging to improve attendance at post-operative clinic visits after adult male circumcision for HIV prevention: a randomized controlled trial. PLoS ONE. 2012;7(9):e43832.
13. Conley NJ, Pavlinac PB, Guthrie BL, Mackelprang RD, Muiru AN, Choi RY, et al. Distance from home to study clinic and risk of follow-up interruption in a cohort of HIV-1-discordant couples in Nairobi, Kenya. PLoS ONE. 2012;7(8):e43138.
14. Needham DM, Bowman D, Foster SD, Godfrey-Faussett P. Patient care seeking barriers and tuberculosis programme reform: a qualitative study. Health Policy. 2004;67(1):93–106.
15. Tanser F, Hosegood V, Benzler J, Solarsh G. New approaches to spatially analyse primary health care usage patterns in rural South Africa. Trop Med Int Health. 2001;6(10):826–38.
16. Cooke GS, Tanser FC, Bärnighausen TW, Newell M-L. Population uptake of antiretroviral treatment through primary care in rural South Africa. BMC Public Health. 2010;10(1):585.
17. Chumnijarakij T, Sunyavivat S, Onthuam Y, Udomprasertgul V. Study on the factors associated with contraceptive discontinuations in Bangkok. Contraception. 1984;29(3):241–9.
18. Hong R, Montana L, Mishra V. Family planning services quality as a determinant of use of IUD in Egypt. BMC Health Serv Res. 2006;6(1):79.
19. Kenya AIDS Indicator Survey 2012: Preliminary Report. In: National AIDS and STI Control Programme (NASCOP), editor. Ministry of Health, Kenya; 2013.
20. Centers for Disease Control and Prevention. Progress in voluntary medical male circumcision service provision-Kenya, 2008-2011. MMWR Morb Mortal Wkly Rep. 2012;61(47):957.
21. Herman-Roloff A, Bailey RC, Agot K. Factors associated with the early resumption of sexual activity following medical male circumcision in Nyanza Province, Kenya. AIDS Behav. 2012;16(5):1173–81.
22. Siedner MJ, Lankowski A, Tsai AC, Muzoora C, Martin JN, Hunt PW, et al. GPS-measured distance to clinic, but not self-reported transportation factors, are associated with missed HIV clinic visits in rural Uganda. AIDS. 2013;27(9):1503.
23. Lohela TJ, Campbell OM, Gabrysch S. Distance to care, facility delivery and early neonatal mortality in Malawi and Zambia. PLoS ONE. 2012;7(12):e52110.
24. Bigogo G, Audi A, Aura B, Aol G, Breiman RF, Feikin DR. Health-seeking patterns among participants of population-based morbidity surveillance in rural western Kenya: implications for calculating disease rates. Int J Infect Dis. 2010;14(11):e967–73.
25. Kyei NN, Campbell OM, Gabrysch S. The influence of distance and level of service provision on antenatal care use in rural Zambia. PLoS ONE. 2012;7(10):e46475.
26. Moses RA, Dagrosa LM, Hyams ES, Steinberg PL, Pais VM. Failing to follow up: predicting patients that will" no-show" for medically advised imaging following endourologic stone surgery. Can J Urol. 2013;20(5):6939–43.
27. Kruk ME, Mbaruku G, Rockers PC, Galea S. User fee exemptions are not enough: out-of-pocket payments for 'free'delivery services in rural Tanzania. Trop Med Int Health. 2008;13(12):1442–51.
28. Andaleeb SS. Service quality perceptions and patient satisfaction: a study of hospitals in a developing country. Soc Sci Med. 2001;52(9):1359–70.
29. Herman-Roloff A, Otieno N, Agot K, Ndinya-Achola J, Bailey RC. Acceptability of medical male circumcision among uncircumcised men in Kenya one year after the launch of the national male circumcision program. PLoS ONE. 2011;6(5):e19814.
30. Bailey R, Muga R, Poulussen R, Abicht H. The acceptability of male circumcision to reduce HIV infections in Nyanza Province, Kenya. AIDS Care. 2002;14(1):27–40.
31. Westercamp M, Agot KE, Ndinya-Achola J, Bailey RC. Circumcision preference among women and uncircumcised men prior to scale-up of male circumcision for HIV prevention in Kisumu, Kenya. Aids Care. 2012;24(2):157–66.
32. Herman-Roloff A, Bailey RC, Agot K. Factors associated with the safety of voluntary medical male circumcision in Nyanza province, Kenya. Bull World Health Organ. 2012;90(10):773–81.