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Factors Associated with Preference for Early Infant Male Circumcision Among a Representative Sample of Parents in Homa Bay County, Western Kenya

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Abstract Several countries scaling-up adult medical male circumcision (MMC) for HIV prevention intend to introduce early infant male circumcision (EIMC). To assess preference for EIMC in a community with a mature adult MMC program, we conducted a cross-sectional survey of a representative sample of mothers (n = 613) and fathers (n = 430) of baby boys ("index son") at 16 health facilities in western Kenya. Most (59 %) were for EIMC, generally. Just 29 % were for circumcising the index son. Pain and protection from HIV were the most frequently cited barrier and facilitator to EIMC, respectively. In multivariable logistic regression, ever talking with the partner about EIMC and positive serostatus were associated with preference for EIMC for the index son. Attitudes towards EIMC are favorable. Willingness to circumcise an infant son is modest. To facilitate EIMC uptake, education about EIMC pain management and encouraging discussion between parents about EIMC during pregnancy should be integrated into programs.

Resumen Varios de los países que están incrementando la circuncisión masculina médica (CMM) adulta para la prevención del VIH, pretenden presentar la circuncisión masculina infantil prematura (CMIP). Para evaluar la preferencia para la CMIP dentro de una comunidad con un programa de CMM desarrollado para adultos, realizamos una encuesta transversal de una muestra representativa de madres (n = 613) y padres (n = 430) de niños varones ("hijo índice") en instalaciones de salud en Kenia occidental. La mayoría (el 59 %) se manifestó a favor de la CMIP en general. Solamente el 29 % estuvo a favor de la circuncisión del hijo índice. El dolor y la protección contra el VIH fueron la barrera y el facilitador más citados, respectivamente. En la regresión logística multivariable, el sólo hablar con la pareja acerca de la CMIP y del estado seropositivo se asociaron con una preferencia hacia la CMIP para el hijo índice. Las actitudes hacia la CMIP fueron favorables. La disposición para circuncidar a un niño es modesta. Para facilitar la adopción de la CMIP, la educación sobre el manejo del dolor del CMIP y el fomento del discurso entre los padres acerca de la CMIP durante el embarazo deberían integrarse en los programas.

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Keywords Early infant male circumcision · HIV prevention · Kenya · Acceptability

Introduction

Medical male circumcision (MMC) is a proven HIV prevention intervention. In three randomized controlled trials MMC reduced the risk of heterosexual acquisition in men

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by 57–67 % (Ref 1–3] and effectiveness was maintained at 4–6 years post circumcision (Ref 4–6]. Scale-up of adolescent and adult MMC is currently underway in 14 countries in east and Southern Africa, including Kenya (Ref 7]. There are several advantages of early infant male circumcision (EIMC) relative to circumcising at later ages, including: reduced expense, fewer adverse events, the procedure is less technically challenging, and EIMC services could be integrated into existing perinatal health services (Ref 8–10]. After a "catch-up" period of circumcising adolescent and adult males who are at highest risk of acquiring HIV in the short term, several governments including the Government of Kenya, intend to scale-up EIMC for cost-efficient HIV prevention (Ref 11]. EIMC studies and/or service provision have begun in Botswana, Kenya, Lesotho, Swaziland, Uganda, Zambia and Zimbabwe (Ref 8, 12–16]. Previous acceptability studies have indicated several common barriers to EIMC services in east and Southern Africa including: fear of pain, bleeding, death and other adverse events associated with the procedure, and cultural opposition to EIMC (Ref 17]. The most frequent facilitators reported are parental belief in protection from HIV and STI acquisition and improved hygiene (Ref 15, 18, 19]. Limitations of acceptability studies published to date include: small sample size, data collection when adult MMC programs were nascent, only mothers included, and convenience sampling.

As part of a larger prospective implementation study comparing methods of delivering EIMC services in the community, we conducted a baseline survey of a representative sample of parents from peri-urban and rural communities in Homa Bay County, western Kenya. The predominant tribe in Homa Bay County is the Luo, a Sudanic-speaking people who do not traditionally practice male circumcision (MC). Adult MMC has been widely available in this area as an HIV prevention intervention since 2008. EIMC services were not available (outside of religious Muslim circumcision) at the time of the survey. The aim of the current analysis is to assess preference for EIMC and describe beliefs and attitudes about EIMC in a representative sample of parents from a rural and peri-urban traditionally non-circumcising community, where adult MMC has been well established but EIMC was not yet available.

Methods

This survey was conducted between July and November, 2013 at 14 Government of Kenya health facilities and two private facilities in two Divisions of Homa Bay County, Kenya. Women aged at least 16 years who had a male child receiving the first Oral Polio Vaccine (OPV-1) were eligible for participation. Because 96 % of infants receive

the OPV-1 in Homa Bay County (Ref 20], a random sample of mothers bringing their babies for vaccination should be representative of mothers delivering a baby boy. Mothers were screened for study eligibility as they registered for vaccination services. At the two largest health facilities (the District Hospitals), vaccinations are administered Monday through Friday, and research assistants (RAs) screened and enrolled women nearly every weekday during the study period. At smaller facilities, vaccinations are offered on a designated weekday. Study enrollment days at the smaller facilities were generated at random so that recruitment times could not be anticipated.

After undergoing informed consent procedures, mothers were interviewed in a private location at the health facility in the language of choice (English, KiSwahili, or DhoLuo) by RAs fluent in all three languages using netbook computers. Research assistants counseled mothers that the survey would ask questions about infant circumcision, but that EIMC services were not yet available. Mothers were asked for consent to contact the father of the baby for an interview and, if she agreed, provided locator information for the father. RAs traced the father and attempted to interview him in the location of his choice. All participants were given 200 Kenya Shillings (approximately USD 2.50) in compensation for their time.

Distribution of the OPV-1 vaccine is centralized by the Kenyan Ministry of Health, regardless of whether the facility is public or privately funded (Ref 21]. We used publicly available data from the Kenya Health Information System (Ref 22] to determine the number of OPV-1 vaccines administered at each facility in the calendar year prior to the survey. Based on this information, the facilities from which we drew the sample accounted for 63 and 91 % of division-wide OPV-1 in their respective areas. We used facility-based stratified sampling weighted by the proportion of OPV-1 vaccines administered. For example, since 19 % of the divisional OPV-1 doses were administered at the Kendu District Hospital, we recruited approximately a fifth of our division sample from that facility.

Statistical Analysis

The main outcome variable of interest was preference for EIMC for the son receiving OPV-1 vaccination (i.e., the index son). For parents whose sons were older than 2 months at the time of vaccination, this item was measured using the question, "If we had offered circumcision for your baby before he turned 2 months, how likely is it you would have taken it up?" We categorized the participant as preferring circumcision if they answered "likely" and as not preferring circumcision if they answered "unlikely" or "neither likely nor unlikely." Among parents with children 2 months of age or less, preference was

measured using the question, "If we offered circumcision for your baby today, would you take it up?." We categorized the participant as preferring circumcision if they answered "yes" and as not preferring circumcision if they answered "no" or "not sure".

Independent variables of interest included demographic variables, household characteristics, perinatal variables (e.g., location of delivery), variables associated with decision-making (e.g., having consulted the spouse about EIMC), HIV status of the parent (HIV status of infants less than 60 days would be unknown), and general endorsement of MC. Endorsement of MC was measured as a scale variable constructed from five variables regarding the relationship between MC status and: susceptibility to STIs, susceptibility to AIDS, penile hygiene, sexual pleasure for men, and sexual pleasure for women. Response categories included: "circumcised men", "uncircumcised men", "no difference", and "not sure". One point was added to the endorsement score for each question the participant answered favorably towards the circumcised state. The scale ranges from zero to five with higher values indicating greater endorsement of MC. This scale variable was created a priori and has been used in prior studies by our group in western Kenya and found to be statistically associated with a man's decision to undergo male circumcision (Ref [4]).

Differences in independent variables between parents who preferred EIMC for their son and those who did not were computed using odds ratios (ORs), Pearson's Chi squared test for independence or the Wilcoxon–Mann–Whitney test for continuous variables.

Logistic regression modeling using only maternal data was applied to identify factors associated with maternal preference for EIMC. A separate analysis employed the actor partner independence model (APIM) framework (Ref [23, 24]) with couples as the unit of analysis to identify individual-level (e.g., a person's age or their partner's age) and couple-level (e.g., a couple's marital status) factors associated with an individual's preference for EIMC. The APIM model is a mixed-effects multivariate logistic regression model that includes fixed effects and a random intercept term to account for the non-independence of dyad partners. A given individual is termed a "parent" and that person's spouse is referred to as the "partner".

All variables significant at the $p < 0.20$ level in bivariate regression were entered into multivariate regression models. We employed a "change-in-estimate" approach to empirically select confounding variables (Ref [25]). One by one, each variable was removed and those variables whose removal from the model changed the odds ratio of other exposures by more than 10 % were retained in the multivariable model. Model fit was assessed by examining the Hosmer and Lemeshow Goodness-of-fit statistic from the final models. Unless otherwise specified, a predetermined significance level of $p \leq 0.05$ was used to assess significance for all tests. Stata/IC v12.1 for Mac (StataCorp 2011, College Station, TX, USA) was used for analyses.

By design, we aimed to recruit 1080 participants (approximately 600 women and 480 of their male partners), with half in each of the two divisions. Sample size estimates were based on calculations that assumed the proportion of participants preferring infant circumcision for their son would be between 30 and 40 %. Under these conditions, we would have ≥ 80 % power to detect an odds ratio of ≥ 1.7 for a binary explanatory variable whose prevalence is between 35 and 55 % if the linear relationship between the explanatory variable and other variables is modest (R-squared 0.10, alpha = .05, two-sided significance test, PASS logistic regression power analysis (Ref [26, 27]).

The Kenyatta National Hospital/University of Nairobi Ethics and Research Committee and the University of Illinois at Chicago Office for the Protection of Research Subjects provided ethical approval for this study.

Results

Out of 7699 mothers who registered for vaccination services, 651 (8.5 %) were mothers of baby boys accessing OPV-1. Of these, 8 mothers (1.2 %) were less than 16 years of age, 15 women (2.3 %) declined participation, three women (<1 %) lacked the capacity to consent, and there was insufficient information documented for 12 women (1.8 %) to determine the reasons they were not enrolled. A total of 613 mothers were consented and interviewed.

Of the 613 mothers, 529 (86 %) provided consent for us to contact the father of the child. We were able to trace and enroll 430 fathers (81 % of those eligible, 70 % of all partners of the interviewed woman). Six invited fathers (1 %) declined participation in the research. Mothers whose partners were enrolled were: more likely to be employed (22 vs. 14 %; χ^2 4.78; $p = 0.029$), earn some income (62 vs. 49 %; χ^2 9.48; $p = 0.002$), be non-Luo (9 vs. 4 %; χ^2 4.40; $p = 0.036$), and live with their partner (89 vs. 46 %; χ^2 129.13; $p < 0.001$). There was no association between partner participation and MC status of the father, MC preference for the index son, endorsement of MC or educational attainment.

Characteristics of Study Population

The median age of mothers and fathers was 24 and 31 years, respectively. Most of the index babies (93 %) were less than 2 months of age, and therefore would be eligible for EIMC services under the current Kenyan national guidelines. Most participants (>90 % of mothers

and fathers) were of Luo ethnicity; 39 % of fathers reported they were circumcised. Twenty one percent of mothers and 36 % of fathers completed high school. Seventeen percent of mothers and 15 % of fathers self-reported they were HIV positive. Other characteristics of parents and couples are listed in Table 1.

Knowledge and Attitudes About MC

Most parents (>90 %) reported receiving information about adult MC, but just a quarter reported receiving information about EIMC. More than half (59 %) of parents reported being in favor of EIMC generally. However, a minority of parents (23 % of mothers and 38 % of fathers) were in favor of circumcising the baby who was receiving OPV-1 at the time of the interview. Nearly all parents felt protection from HIV/STIs was a reason to circumcise babies (95 %) and most felt pain was a reason not to circumcise a baby (84 %). General attitudes towards circumcision were favorable, with a median MC endorsement of 4 on a 5-point scale. However, there was little consensus about the best age for MC, with opinions divided between preferring when the baby is less than 8 weeks (33 %), when the baby is older but less than 1 year (18 %), when the boy is a young child 1–9 years (32 %), 10–17 years (23 %) and after he reaches adulthood (8 %; parents could choose more than one age category). Most parents (72 %) felt the decision about EIMC should be made between both parents equally.

Factors Associated with Preference for EIMC: Mothers (see Table 2)

We first fit a model that included only maternal data. In multivariate analysis, factors associated with being in favor of EIMC for the index son were: circumcised partner (OR 1.64; 95 % CI 1.09, 2.45; p = 0.019), ever having talked with the father about EIMC for the index baby (OR 1.94; 95 % CI 1.14, 3.31; p = 0.015) and higher endorsement of adult MC (OR for one-unit increase 1.25; 95 % CI 1.05, 1.48; p = 0.013). Ever having been given information about EIMC (OR 1.48; 95 % CI 0.95, 2.31; p = 0.083), and having delivered with a clinician present (OR 1.61; 95 % CI 0.99, 2.61; p = 0.053) were marginally significant but were retained in the final model as their removal changed other estimates by ≥10 %.

Factors Associated with Parental Preferences for EIMC: APIM Model (see Table 2)

The second model included data from couples for which both the mother and father interview results are available. Because of missing data, 430 couples and 840 individuals

were included in the final model. In APIM multivariate regression, the following factors were associated with parent preference for EIMC: belief that the index baby is very much at risk of acquiring HIV in the future (OR 1.96; 95 % CI 1.23, 3.12; p = 0.005), having electricity in the home (OR 2.54; 95 % CI 1.42, 4.54; p = 0.002), having higher endorsement of MC (OR for one-unit increase in scale 1.52; 95 % CI 1.26, 1.82; p < 0.001), ever having talked with the partner about EIMC (OR 2.81; 95 % CI 1.72, 4.58; p < 0.001), and self-reported HIV positive status (OR 1.88; 95 % CI 1.05, 3.37; 0.034). There was an interaction term between father's reported circumcision status and parent sex and we therefore created a composite variable. Using mothers with an uncircumcised partner as the reference group, mothers with a circumcised partner had higher odds of preferring EIMC for the child (OR 1.98; 95 % CI 1.09, 3.62; p = 0.026), as did uncircumcised fathers (OR 2.96; 95 % CI 1.78, 4.93; p < 0.001) and circumcised fathers (OR 2.66; 95 % CI 1.43, 4.94; p = 0.002).

Discussion

Our results highlight the importance of HIV in EIMC preference: HIV seropositive status and perceiving the index baby is at high risk of future HIV infection were independently associated with preferring circumcision for the index child. Moreover, a majority of participants (86 % of mothers and 83 % of fathers) stated protection from HIV and STIs is the single most important reason to circumcise an infant. Applying an endorsement scale, we found that adults in this population have high endorsement of MC, and this was a significant predictor of favoring EIMC. Although the magnitude of the OR (1.52) seems moderate, this is a per-unit increase. These findings in a population of adults with 5 years of exposure to MMC scale-up indicate that MC messaging has been successful in conveying the protective effect of circumcision on HIV and STI acquisition.

A majority (59 %) are for EIMC, generally. However, only a minority of all participants (38 % of fathers and just 23 % of mothers) are for circumcising the index baby. These proportions are similar to the actual uptake of EIMC we are now observing as we introduce EIMC services in this community (27 % uptake, unpublished data). The single most frequently cited barrier to accepting EIMC is fear of pain, with 75 % of mothers and 68 % of fathers stating this is the most important reason not to circumcise an infant. Specific messaging to address this concern, including that the procedure is provided under local anesthesia and post-op pain is managed with paracetamol syrup, should be emphasized. Concern about risk of the procedure

Table 1 Characteristics of parents of infant males accessing OPV-1 vaccination services at public and private health facilities in Rachuonyo, western Kenya

Characteristic	Mothers (N = 613)		Fathers (N = 430)		Couples (N = 430)	
	N	(%)	N	(%)	N	(%)
District						
Rachuonyo North	286	47	187	43		
Rachuonyo South	327	53	243	57		
Age						
Years [median (IQR)]	24	(20, 29)	31	(27, 37)		
Difference, years (median (IQR))					6	(3, 10)
Baby age (months)						
≤2	573	93				
>2	40	7				
Ethnicity						
Luo	569	93	413	96		
Other	44	7	17	4		
Both parents Luo					385	90
Both parents non-Luo					9	2
Ethnically discordant					36	8
Circumcision status of father/self						
Circumcised	207	34	168	39		
Uncircumcised	350	57	260	60		
Not sure	56	9	2	0		
Age at circumcision of father/self						
Birth to 8 week	1	0	4	2		
>8 week to <1 year	3	1	2	1		
1 to 9 year	10	5	23	14		
10 to 17 year	25	12	31	18		
18+ year	113	55	108	64		
Not sure	54	26	0	0		
Educational level						
<Primary	167	27	104	24		
Finished primary	201	33	114	27		
Some high school	118	19	59	14		
High school or more	127	21	153	36		
Currently employed						
No	493	80	199	46		
Yes	120	20	231	54		
Earned any money in past month						
No	255	42	16	4		
Yes	357	58	412	96		
Current marital status						
Does not live with spouse/partner	142	23	53	12		
Lives with spouse/partner	464	77	376	88		
Religion						
Christian	597	98	405	96		
Nomiya	6	1	6	1		
Muslim	9	1	12	3		
Both parents Christian					403	95
One or both parents Nomiya/Muslim					19	5

Table 1 continued

Characteristic	Mothers (N = 613)		Fathers (N = 430)		Couples (N = 430)	
	N	(%)	N	(%)	N	(%)
Polygamous marriage						
No	528	87	376	88		
Yes	79	13	52	12		
Self-reported HIV status						
Negative	484	83	305	85		
Positive	102	17	53	15		
Concordant negative					271	79
Concordant positive					33	10
Discordant					40	12
Perception of index baby's risk of acquiring HIV in the future						
Not at all/not very much at risk	123	20	76	18		
Somewhat at risk	348	57	233	55		
Very much at risk	139	23	118	28		
Ever been given information about adult MC						
No	39	6	10	2		
Yes	569	94	419	98		
Ever been given information about EIMC						
No	472	77	320	75		
Yes	138	23	107	25		
For or against EIMC, generally						
Against/not sure	248	41	177	41		
For	362	59	250	59		
For or against EIMC for index baby						
Against/not sure	467	77	259	62		
For	143	23	158	38		
Both parents for					62	15
Both parents against/not sure					213	51
Mother for, father against/not sure					45	11
Father for, mother against/not sure					94	23
Reasons to circumcise a baby boy[a]						
Protection against HIV/STI	581	95	407	95		
Protection against UTI	236	39	194	45		
Penile hygiene/cleanliness	226	37	234	55		
Improved cosmetic appearance of penis	69	11	66	15		
Less pain than when done later	43	7	44	10		
Single most important reason to circumcise a baby boy						
Protection against HIV/STI	521	86	353	83		
Protection against UTI	20	3	13	3		
Penile hygiene/cleanliness	36	6	37	9		
Other reason	32	5	24	6		
Reasons not to circumcise a baby boy[a]						
Pain	522	86	352	82		
Bleeding	165	27	151	35		
Going against cultural tradition	73	12	90	21		
Better to wait until the baby is older	61	10	53	12		
Injury to the penis	59	10	65	15		

Table 1 continued

Characteristic	Mothers (N = 613)		Fathers (N = 430)		Couples (N = 430)	
	N	(%)	N	(%)	N	(%)
Single most important reason not to circumcise a baby boy						
Pain	456	75	292	68		
If the father is against it	22	4	n/a	n/a		
Going against cultural tradition	22	4	31	7		
It is better to wait until boy is older	22	4	25	6		
There is no reason not to circumcise	30	5	32	7		
Other reason	58	10	47	11		
Best age for male circumcision[a]						
Birth to 8 week	213	35	128	30		
9 week to <1 year	109	18	75	18		
1–9 year	183	30	144	34		
10–17 year	146	24	94	22		
18+ year	48	8	35	8		
No good age for male circumcision	16	3	6	1		
Any age is good for male circumcision	14	2	16	4		
Who should decide about circumcision for a baby boy?						
Mother	65	11	10	2		
Father	96	16	101	24		
Both parents equally	438	72	306	72		
Other person	9	1	7	2		
Endorsement of circumcision scale [median (IQR)]	4	(3, 5)	4	(3, 5)		

IQR interquartile range, *MC* male circumcision, *OPV* oral polio vaccine, *UTI* urinary tract infection

[a] Not mutually exclusive, respondents could choose >1 reason

(especially bleeding and injury to the penis) and belief that it is better to wait until the child is older were also commonly cited. These barriers should also be targeted with specific educational messaging, including emphasizing that the procedure is safer in early infancy than when offered later in life (Ref 8, 28]. Twelve percent of mothers and 21 % of fathers expressed the belief that EIMC goes against cultural tradition. Though modest in magnitude, these proportions are similar to what we found among parents declining EIMC in an earlier study in western Kenya (Ref 15] conducted when adult MMC programs had been ongoing for just 2 years. This likely reflects both that male circumcision is not traditionally practiced by the Luo ethnic group and that EIMC is not widely practiced in the region, as ethnic groups in East and southern Africa that do traditionally circumcise typically do so at adolescence.

Despite 35 % of mothers and 30 % of fathers stating the best age for male circumcision is before the baby reaches 60 days, mothers with uncircumcised partners were less likely than fathers (regardless of circumcision status) to be for EIMC for the index son. Remarkably, the circumcision status of the father did not greatly affect his preference for circumcising the index baby. In adjusted analysis,

uncircumcised fathers and circumcised fathers both had higher odds (of similar magnitude) of preferring EIMC for the index son relative to mothers with uncircumcised partners. That mothers with uncircumcised partners are less likely than fathers to be for EIMC differs from our previous research in western Kenya (Ref 15] and from other parts of sub-Saharan Africa (Ref 29–31]. It is possible that even men who do not accept circumcision for themselves (i.e., because of fear of pain or lost income after the procedure) will still desire the procedure for their sons, whereas the mother's support of EIMC may be more greatly affected by the circumcision status of the father. Previous research in sub Saharan Africa and elsewhere indicates circumcision status of the father is associated with maternal desire for the procedure (Ref 13, 15, 32]. Given just twelve percent of mothers had talked with her partner about EIMC, it is possible that, in the absence of discussion, mothers assume an uncircumcised father will not desire circumcision for his son.

Both mothers and fathers are clearly important in the EIMC decision; three quarters of participants felt the EIMC decision should be made equally between parents. Eighty six percent of mothers provided consent for us to contact

Table 2 Multivariable logistic regression model results predicting preference for EIMC for index child among mothers (Model 1) and multivariable mixed-effects logistic regression model results predicting preference for EIMC for index child among parents (Model 2)

Variable	Crude OR	Adjusted OR	Adjusted OR 95 % CI	Z	p
Model 1: mothers only (N = 609)					
Father circumcised (vs. uncircumcised/not sure)	2.00	1.64	1.09, 2.45	2.40	0.019
Ever been given information about EIMC	1.68	1.48	0.95, 2.31	1.74	0.083
Clinician (nurse/midwife/physician) assisted with birth	1.79	1.61	0.99, 2.61	1.94	0.053
Ever talked with father about circumcision for the baby	2.49	1.94	1.14, 3.31	2.46	0.015
Higher endorsement of circumcision (1-unit increase)	1.33	1.25	1.05, 1.48	2.51	0.013
Model 2: APIM with couples as unit of analysis (N = 430 couples, 840 individuals)					
Parent believes baby at high risk of acquiring HIV in future	2.16	1.96	1.23, 3.12	2.84	0.005
Parent lighting source electrical power (versus candles/kerosene lamp/solar battery)	2.07	2.54	1.42, 4.54	3.15	0.002
Parent higher endorsement of circumcision (1-unit increase)	1.52	1.52	1.26, 1.82	4.48	<0.001
Parent ever talked with partner about EIMC (yes vs. no)	3.41	2.81	1.72, 4.58	4.13	<0.001
Parent HIV positive (vs. negative)	1.28	1.88	1.05, 3.37	2.11	0.034
Father's circumcision status and parent sex					
Mother, uncircumcised partner	Ref	Ref			
Mother, circumcised partner	2.83	1.98	1.09, 3.62	2.23	0.026
Father, uncircumcised	2.66	2.96	1.78, 4.93	4.17	<0.001
Father, circumcised	4.76	2.66	1.43, 4.94	3.08	0.002

APIM actor partner interdependence model, *EIMC* early infant male circumcision, *HIV* human immunodeficiency virus, *OR* odds ratio, *ref* reference

the father, and ever discussing EIMC with the partner was associated with 2.81 higher odds of preferring EIMC for the index child. A previous study in western Kenya showed only 13 % of mothers who elected for circumcision did not consult the father (Ref 15). Similarly, in Botswana, just 10 % of mothers stated they would be willing to make the decision about infant circumcision by themselves (Ref 18). In light of this, it is important to recognize mothers are the primary contact with the health care system for maternal child health services, such as vaccinations. Providing information about EIMC during pregnancy and specifically encouraging the mother to discuss the procedure with her partner before birth is likely to encourage uptake. This encouragement could take the form of providing educational materials to the mother to facilitate discussion with the father at home, asking the father to attend a prenatal visit with the mother, or adopting broader population messaging encouraging parents to discuss EIMC during pregnancy.

Women who delivered with a skilled provider (clinical officer, nurse or midwife) were more likely to prefer EIMC for the index son. Mothers who delivered with a clinician had higher educational attainment and were more likely to be employed, have a lighting source other than candles and a fuel source other than firewood, and more likely to report a problem with their birth (data not shown). Women who

deliver with a skilled provider may have higher socioeconomic status, which is consistent with the finding that having electricity in the home was associated with preference for EIMC in the APIM model. Delivery with a skilled provider may also reflect a higher-risk pregnancy, or greater access to or trust in the healthcare system. Integrating EIMC messaging into other maternal child health education that encourages safe delivery with a skilled provider in a healthcare setting could prove to be synergistic.

Limitations of our study include that parents were not actually offered circumcision, though we tried to mitigate bias by asking about EIMC preference generally and by asking if the parent would accept circumcision for the male infant who was present at the time of the interview. In addition, we were able to enroll only 70 % of fathers. Mothers whose partners we enrolled were more likely to be employed and earn some income in comparison to those whose partners were not enrolled. There has been no clear and consistent association between socioeconomic status variables and acceptability of EIMC (Ref 15, 19), and the differential enrollment of fathers by these variables could have resulted in biased estimates of paternal attitudes either in favor or against EIMC. For this reason, we analyzed the entire sample of mothers separately from the APIM couple model and present both results.

Strengths of our study include: large sample size, enrolling both mothers and fathers of infant males, a sampling strategy designed to be representative of the general population of parents in the study area, and robust statistical modeling allowing us to elucidate complexities of decision-making for both members of a dyad. Kenya has a well-developed adult MMC program. Beliefs and attitudes about EIMC have likely evolved as a greater proportion of adult males have become circumcised. For this reason, our results should be of interest to other sub-Saharan African countries considering scale-up of EIMC services as their adult MMC programs mature.

Conclusion

Attitudes about MMC and EIMC are generally favorable among participants and messaging surrounding the protective effect of MMC on HIV acquisition has been successful. However, endorsement of EIMC for an infant son was modest. Education surrounding risks of EIMC and pain management and encouraging discussion between parents about the EIMC decision during pregnancy may facilitate higher endorsement of the procedure.

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