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Original Article

Maternal Determinants of Prevention of Mother to Child Transmission of Human Immuno-deficiency Virus among Women in Homa Bay County Referral Hospital, Kenya

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ABSTRACT

The advent of Anti-Retroviral Therapy (ART) has resulted in remarkable improvement in the management of Human Immuno-deficiency Virus (HIV) and Acquired Immune Deficiency Syndrome (AIDS). Adherence to ART and other HIV and AIDS treatment modalities amongst HIV seropositive mothers has resulted in a reduction in the rate of Mother-To-Child Transmission (MTCT) of HIV. Nonetheless, MTCT of HIV rates remain high in Homa Bay County, Kenya, with 8.8% MTCT of HIV. This rate is higher than the World Health Organization (WHO) target of reducing MTCT of HIV to less than 5%. The study assessed maternal determinants of Prevention of Mother-to-Child Transmission (PMTCT) of HIV among HIV seropositive women on PMTCT follow-up at Homa Bay County Referral Hospital. An analytical cross-sectional design was used on a total of 274 women recruited in the study. A structured questionnaire assessed for maternal-related factors associated with PMTCT outcomes. Data on PMTCT outcomes were abstracted from files of HIV Exposed Infants (HEI) whose mothers were enrolled in the study. A total of 273 participants completed the study (response rate: 99.6%). The mean age of the study participants was 32.16 (± 5.54 SD). There was a significant association between maternal factors, reason for missed clinic visit, missed ART intake, reasons for missed ART intake, and missing to provide ART prophylaxis to infant/child and PMTCT outcome at $\alpha \leq 0.05$ ($p = 0.002$, $p = 0.005$, $p = 0.006$, and $p = 0.05$, respectively). Reason for missed clinic visit and reason for missed ART intake demonstrated 5.1 and 5.8 times increase in odds of determining PMTCT outcome (OR = 5.122, 95% CI: 0.139-189.53; $p = 0.002$) and (OR = 5.751, 95% CI: 0.615-53.781; $p = 0.006$), respectively. Maternal factors attributable to the reason for missed clinic visits and the reason for missed ART intake were the main determinants of PMTCT outcomes; hence, they are essential in the development of intervention strategies to mitigate MTCT of HIV.

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INTRODUCTION

Mother-to-child transmission (MTCT) of the human immune deficiency virus (HIV) is the main mode of HIV infection among infants and children (Yitayew et al., 2019). MTCT of HIV occurs when HIV seropositive women infect their infants or children when pregnant, during delivery, and while breastfeeding (Moncunill et al., 2020). Attainment of zero MTCT of HIV calls for concerted strategies targeting factors that augment the likelihood of MTCT of HIV. Maternal-related factors that increase the likelihood of MTCT of HIV include the absence of skilled delivery, lack of Ante-Natal Clinic (ANC) attendance during the index pregnancy, non-adherence to Anti-Retroviral Therapy (ART), missing scheduled clinic visits for treatment and management of HIV coinfections, and lack of adequate support (Tariku, 2022).

Children born by HIV seropositive mothers with high viral load and low CD4 cell count are more vulnerable to Mother-To-Child Transmission of HIV (MTCT of HIV) (Beyene et al., 2018). Maternal factors such as maternal immunological status and being on anti-retroviral treatment, maternal viral load, obstetric factors such as traumatic delivery, foetal prematurity, and breastfeeding and nutritional practices pose an influence on HIV transmission to the child (Ellington et al., 2011; Tariku, 2022). Other maternal factors include knowledge of HIV status during or before the pregnancy, adherence to ART, place of delivery, and compliance with infant feeding and prophylaxis provision guidelines (Onono et al., 2015).

Prevention of Mother-To-Child Transmission (PMTCT) occurs as a health strategy that has been adopted to minimise MTCT of HIV (Sebsibie Teshome & Maud Modiba, 2021). PMTCT entail different approaches, which include the provision of care and treatment to HIV seropositive mothers and children born from them (Hussen et al., 2022). The absence of PMTCT interventions is estimated to result in a 15%-45% chance of mothers transmitting HIV to their children when pregnant, during delivery and while breastfeeding (Gebre et al., 2021). It is further estimated that a quarter of HIV HIV-exposed infants (HEI) get infected during delivery, whereas a fifth is likely to be infected during pregnancy and breastfeeding periods (Liu et al., 2022).

The advent of ART has provided a comprehensive platform through which HIV seropositive mothers can attain positive pregnancy outcomes aligned to giving birth to healthy HIV seronegative infants (José Antonio et al., 2022). However, despite the implementation of PMTCT strategies, the rate of transmission of HIV from mother to child in Kenya is 8.3% above the WHO target of less than 5% (UNAIDS, 2016). Homa Bay County had the highest contribution to the new HIV cases among children in Kenya, according to the Kenya HIV

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estimates reports of 2016 and 2018. The county registered a contribution of 15% and 8.8% new cases of HIV among children in the year 2015 and 2017, respectively, with an MTCT rate of 8.1% (UNAIDS, 2021).

MTCT is a crucial mode of HIV transmission among children and infants and can occur through different modes, including in the uterus, intrapartum, during delivery, and during the postnatal period, especially through breastfeeding (Deynu & Nutor, 2023). Resource-rich nations have made immense progress in reducing MTCT due to the availability of comprehensive health systems structures used for testing as well as those needed to prevent MTCT (Wudineh & Damtew, 2016). As previously mentioned herein, Homa Bay County is one of the counties that report a high number of new HIV cases in Kenya. Limited studies have documented findings on maternal socio-demographic determinants that pose a risk for MCTC in the context of Homa Bay County. It is on this basis that this study sought to assess these maternal determinants. This paper documents the findings on maternal-related factors determining PMTCT outcomes in Homa Bay County, Kenya. These findings provide insights into the feasible PMTCT strategies that may be adopted by stakeholders in HIV management in the contexts of Homa Bay County and other similar contexts.

MATERIALS AND METHODS

The study adopted an analytical cross-sectional hospital-based study design assessing maternal determinants of the PMTCT outcomes for women receiving HIV treatment at Homa Bay County Referral Hospital. This study design has been successfully adopted in similar studies that assessed the barriers to uptake of PMTCT services in an Ante Natal Clinic setting in other countries such as Nigeria (Anígilájé et al., 2016) and Malawi (Van Lettow et al., 2018). Quantitative data were collected through a survey using a semi-structured questionnaire.

The desired sample size was determined using the formula of Fishers *et al*. (1998):

$$n = \frac{z^2 pq}{d^2}$$

Where n = The desired sample size (if the target population is more than 10,000); Z = the standard normal deviation, set at 1.96, which corresponds to a 95% confidence level; P = Prevalence of HIV for women in the reproductive age 15-49 = 22.1% (estimates from the Kenya HIV Estimates Report of 2018)

q = 1-p (that is 100-22.1) = 77.9% or 0.779

$$n = \frac{1.962 \times 0.221 \times 0.779}{0.05^2} = 264$$

Since the HIV-positive women of reproductive age on care and treatment at the facility target population was less than 10,000, sample adjustment was done using the following formula.

nf = n/(1+n/N)

Where nf = The desired sample size when the population is less than 10,000; n = The desired sample when the population is more than 10,000; N = The estimated population size of HIV-positive women of reproductive care and treatment at the facility.

nf = 264/ (1+264/4129) = 249

An additional 10% (25 participants) was added to cater for non-responses (Israel, 2009). Therefore, the sample size was 274 women who had babies on PMTCT follow-up at the facility.

The study adopted simple random sampling to select study participants. The two hundred and seventy-four (274) participants were randomly selected from four thousand one hundred and twenty-nine (4129) women of reproductive age at Homa Bay County Referral Hospital and who had ever been on PMTCT follow-up within the same facility with documented HIV test outcomes for their infants/children. The enrolment register was used to identify the files for these HIV seropositive women patients; unique numbers from the registers were used to identify the patient files of these women's clients, which formed the sampling frame. The patient files of these clients were then serialised, and a random number

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generator (STAT Trek) was used to generate two hundred and seventy-four (274) numbers within the range of serialised patient files and the random numbers used to pick the respective patient files.

Clients whose files had been sampled and met the eligibility criteria were then contacted via phone, the study purpose and procedure were explained to them, and their consent and permission to be included in the study were sought. In cases whereby a patient whose file had been randomly picked declined to participate in the study, the reasons for declining were sought and documented, and then the next client was sampled. This continued until the desired sample size was achieved. Upon consenting to participation in the study, a convenient date and venue for the interview were agreed upon. The option of a telephone interview was also made available for the participants.

The dependent variable was PMTCT outcome as abstracted from sampled HEI patient files, and it was measured on a binary categorical scale (HIV seropositive outcome versus HIV seronegative outcome). Independent variables were maternal-related factors assessed on a categorical scale, including adherence to ART, compliance with infant feeding guidelines, and compliance with ANC visits. On adherence to ART, a client was classified as adhering to ART treatment if they had no missed appointments and had not missed taking their ARVs. Adherence to infant ARV guidelines was defined as not missing to provide infant prophylaxis to their children during the PMTCT follow-up. Compliance with infant feeding guidelines was defined if a client exclusively breastfed their children during the first six months of birth. Compliance with ANC visits was measured based on the number of ANC visits by participants. Participants were classified as compliant with requirements if they attended the first ANC visit within the first three months of pregnancy and the client had at least four visits before delivery.

The chi-square (χ^2) test was used to assess associations between maternal factors and PMTC outcome at $\alpha \leq 0.05$. Binary logistic regression was used to measure the likelihood of maternal factors determining PMTCT outcome.

RESULTS

The study targeted 274 women on PMTCT follow-up in the study setting. All were contacted, but one (1) questionnaire was rejected for incompleteness; hence, a response rate of 99.6% (273 participants). As shown in *Table 1*, a majority of the participants (158, 57.9%) were aged between 30 to 39 years. The mean age of the study participants was 32.16 (± 5.54 SD). A majority (131, 48.0%) of the participants had completed secondary school level of education. In terms of marital status, more than three-quarters (224, 82.1%) were married, with a majority of this (175, 64.1%) reporting to be in monogamous type of marriage. In regards to occupation, most of the participants, 101 (37.0%) reported that they were self-employed.

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Table 1: Socio-demographic features of the participants

Characteristic		Frequency (f)	Percentage (%)
Age in Years	18 to 29	90	33.0
	30 to 39	158	57.9
	40 to 49	25	9.2
Mean age	32.16 (± 5.54 SD)		
Highest Level of Education Attained	Never went to school	7	2.6
	Primary	114	41.8
	Secondary	131	48.0
	Tertiary	21	7.7
Marital Status	Single	17	6.2
	Married	224	82.1
	Divorced/Separated	12	4.4
	Widowed	19	7.0
Marriage Type	Married Monogamous	175	64.1
	Married Polygamous	49	17.9
Occupation	Employed	57	20.9
	Self-employed	101	37.0
	Casual Jobs	92	33.7
	Not Employed	23	8.4

As shown in *Table 2*, significant associations did not exist between the time when the participants knew of their HIV status, missing scheduled clinic appointments, the reason for missing providing ART prophylaxis to the infant during the HEI follow-up period, infant feeding option, barriers to EBF, planning pregnancy with a partner, attended ANC clinic during last pregnancy, the month of pregnancy when started ANC, number of ANC visits, given ART prophylaxis for the infant during ANC visits, and place of delivery with PMTCT outcome ($p = 0.303$, $p = 0.136$, $p = 0.158$, $p = 0.428$, $p = 0.354$, $p = 0.120$, $p = 0.490$, $p = 0.643$, $p = 0.252$, $p = 0.649$, and $p = 0.740$) respectively. However, the study observed significant associations between the reason for missing scheduled clinic visits, missing to take ART medications during pregnancy and breastfeeding period, the reason for missing to take ART medications during pregnancy and breastfeeding period, and missing to provide ART prophylaxis to the infant during the HEI follow-up period with PMTCT outcome ($p = 0.002$, $p = 0.005$, $p = 0.006$, $p = 0.050$) respectively.

Table 3 provides results for binary logistic regression analysis performed on factors that demonstrated significant associations with the chi-square test. The reason for missing scheduled visits had a five times likelihood of determining PMTCT outcome (OR = 5.122, 95% CI: 0.139-189.53; $p = 0.002$). Similarly, the reason for missing to take ART during pregnancy and breastfeeding period presented with a higher likelihood of determining PMTCT outcome (OR = 5.751, 95% CI: 0.615-53.781; $p = 0.006$). However, missing to take ART medications during pregnancy and breastfeeding period and missing to provide ART prophylaxis to the infant at some point during the HEI follow-up period presented with a lower likelihood of determining PMTCT outcome (OR = 0.085, 95% CI: 0.010-0.698; $p = 0.005$) and (OR = 0.553, 95% CI: 0.095-3.211; $p = 0.050$) respectively.

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Table 2: Associations between maternal determinants and PMTCT outcomes

		PMTCT Outcome (HIV seropositive or HIV Negative)				
		Total n (%)	**Positive n (%)**	**Negative n (%)**	**(χ^2)**	**p-value**
When they knew of their HIV status	Before conceiving this child	207(75.8)	8(2.9)	199(72.9)	3.639	0.303
	During pregnancy	53(19.4)	1(0.4)	52(19.0)		
	Labour and delivery	6(2.2)	1(0.4)	5(1.8)		
	After delivery	7(2.6)	0(0.0)	7(2.6)		
Missed going to scheduled clinic visit	Yes	128(46.9)	7(2.6)	121(44.3)	2.227	0.136
	No	145(53.1)	3(1.1)	142(52.0)		
Reason for missing scheduled clinic visit	Lack of transport (fare)	23(8.4)	0(0.0)	23(8.4)	19.53	0.002*
	Forgot	46(16.8)	4(1.4)	42(15.4)		
	Had other engagements	49(17.9)	1(0.4)	48(17.5)		
	Was Unwell	8(2.9)	1(0.4)	7(2.6)		
	Others	2(0.7)	1(0.35)	1(0.35)		
Missed ART at some point during pregnancy and breastfeeding	Yes	64(23.4)	6(2.2)	58(21.2)	7.729	0.005*
	No	209(76.6)	4(1.4)	205(75.2)		
Reason for missing ART at some point during pregnancy and breastfeeding	Forgot	36(13.2)	2(0.7)	34(12.5)	14.52	0.006*
	Felt better	2(0.7)	0(0.0)	2(0.7)		
	Run out of drugs	11(4.0)	1(0.4)	10(3.6)		
	Was Unwell	15(5.5)	3(1.1)	12(4.4)		
Missed providing infant with ART prophylaxis during HEI follow-up period	Yes	30(11.0)	3(1.1)	27(9.9)	3.835	0.050*
	No	243(89.0)	7(2.6)	236(86.4)		
Reason for missing ART prophylaxis during HEI follow-up period	Away from home	16(5.9)	1(0.4)	15(5.5)	5.202	0.158
	Run out of drugs	7(2.6)	1(0.4)	6(2.2)		
	Forgot	7(2.6)	1(0.4)	6(2.2)		
Infant feeding option in the first six months	Breastmilk only (EBF)	260(95.2)	9(3.3)	251(91.9)	0.628	0.428
	Breastmilk and other foods	13(4.8)	1(0.4)	6(2.2)		
Barrier to EBF	Fear of infecting baby	2(0.7)	0(0.0)	2(0.7)	5.533	0.354
	Insufficient milk	4(1.5)	1(0.4)	3(1.1)		
	Job engagement	3(1.1)	0(0.0)	3(1.1)		
	Sick	2(0.7)	0(0.0)	2(0.7)		
	Was in school	2(0.7)	0(0.0)	2(0.7)		
Planned last pregnancy with partner	Yes	184(67.4)	9(3.3)	175(64.1)	2.413	0.12
	No	89(32.6)	1(0.4)	88(32.2)		
Attended ANC clinic during last pregnancy	Yes	261(95.6)	10(3.7)	251(91.9)	0.477	0.49

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	No	12(4.4)	0(0.0)	12(4.4)		
Month when the ANC	0 to 3 months	49(17.9)	1(0.4)	48(17.5)	1.675	0.643
	4 to 6 months	200(73.3)	9(3.3)	191(70.0)		
	7 to 9 months	12(4.4)	0(0.0)	12(4.4)		
Number of ANC visits	Two	16(5.9)	0(0.0)	16(5.9)	4.09	0.252
	Three	76(27.8)	2(0.7)	74(27.1)		
	Four	133(48.7)	8(2.9)	125(45.8)		
	More than Four	36(13.2)	0(0.0)	36(13.2)		
Given ART prophylaxis for infants during ANC visits	Yes	252(92.3)	10(3.7)	242(88.6)	0.477	0.49
	No	9(3.3)	0(0.0)	9(3.3)		
Place of birth	Hospital	258(94.5)	10(3.7)	248(90.8)	0.604	0.74
	Traditional birth attendant	10(3.7)	0(0.0)	10(3.7)		
	Other	5(1.8)	0(0.0)	5(1.8)		

**: Significant at $\alpha \leq 0.05$.; n = 273*

Table 3: Binary logistic regression model showing Odds Ratio and 95% Confidence Interval for maternal-related determinants of PMTCT outcome

Variable	P –value	Odds Ratio	95% C.I. for EXP(B)	
			Lower Limit	Upper Limit
Reason for missing scheduled clinic visit	0.002	5.122	0.139	189.353
Missed to take ART medications during pregnancy and breastfeeding period	0.005	0.085	0.010	0.698
Reason for missing to take ART during pregnancy and breastfeeding period	0.006	5.751	0.615	53.781
Missed to provide ART prophylaxis to the infant during the HEI follow-up period	0.050	0.553	0.095	3.211

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DISCUSSION

Based on the present study findings, the reason for missing scheduled clinic visits exhibited a significant association with PMTCT outcome (p = 0.002). Similar findings were observed in a Cameroonian study by Bigna et al. (2014), which reported the existence of significant associations between missed clinic visits and the effectiveness of PMTCT interventions (p = 0.04). This study, as it is with Bigna et al. (2014), shows that missed clinic visits, regardless of the reason for missing the visits, hinder the realisation of the goal of eliminating MTCT of HIV. This is because when HIV seropositive women on PMTCT follow-up miss scheduled clinic visits, it results in non-adherence issues, which enhances attrition of PMTCT interventions (Ndaimani et al., 2017).

This study further established that there was a significant association between the failure to provide ART prophylaxis to infants and PMTCT outcome (p = 0.050). This conforms with findings from a previous study done in Kenya by Okoko et al. (2017), which reported that poor adherence, failure to access ART, and failure to provide ART prophylaxis to infants significantly contributed to the MTCT of HIV. An Ethiopian study using a case-control approach Ethiopia by Hussen et al. (2022) further reports that maternal failure to provide ART prophylaxis and overall non-adherence continually had higher odds of predicting MTCT of HIV (AOR: 4.89, 95% CI: 1.34 to 17.88). Deductively, non-adherence to ART medication is the primary factor that lowers maternal viral load, hence providing a viable platform for minimal MTCT of HIV.

On the other hand, the current study reports that the time when participants knew of their status did not depict any significant associations (p = 0.303). This finding is contrary to findings from a study done in Western Kenya by Onono et al. (2015), who observed that mothers knowing their status during pregnancy presented with higher chances of mothers transmitting HIV infection to their infants. The Western study is similar to the current study in that both settings are situated in the Western Kenyan regions. This shows that there are other factors other than knowledge of HIV status that may predict the associations with MTCT to HIV outcomes, factors which may be explored further by future studies. In an ideal situation, an HIV seropositive mother knowing their HIV status prior to conception enhances participation in PMTCT processes, hence determining PMTCT outcome (Dionne-Odom et al., 2016). However, this was not the case in the current study.

The type of infant feeding option adopted for infants aged 0 to 6 months by participants in this study did not exhibit any association with PMTCT outcome (p = 0.428). This contradicts the views expressed by Beyene et al. (2018) and Yah and Tambo (2019), who report that Exclusive Breastfeeding (EBF) lowers the risk of MTCT of HIV by three (3) to four (4) times. Despite most of the participants, 260 (95.2%) practising EBF, there were no significant associations with PMTCT outcome. The apparent variations in associations between infant feeding options and MTCT to HIV outcomes are a result of variations in the assessment of infant feeding options (Beyene et al. 2018). However, the observation of non-significant associations should not water down proven evidence on the colossal role played by EBF in averting the MTCT of HIV.

Ante-natal clinic attendance was examined as part of the potential maternal determinants of PMTCT outcome. The study did not observe significant associations between the number of ANC visits made by the PMTCT mothers and PMTCT outcomes (p = 0.252). This finding contradicts findings from a study done in Lodwar County Referral Hospital, Kenya, by Ongaki et al. (2019), which reported a significant association between PMTCT outcome and attending one or more ANC visits (OR = 2.8, 95% CI: 1.3-6.2). Significant associations between ANC attendance and PMTCT outcome vary depending on maternal factors such as age. In a study done in Kwa-Zulu Natal in South Africa, higher ANC clinic attendance did not guarantee a reduction in MTCT risk (Horwood et al., 2013). This finding is similar to those of this study even though Horwood et al.

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(2013) study was done amongst adolescent HIV seropositive mothers contrary to adult HIV seropositive mothers investigated by the current study. This means that similarities in determinants of PMTCT outcomes may be noted even in cases of socio-demographic differences in the population under study.

Maternal determinants are often multifactorial, with each posing a varying influence on PMTCT outcomes. The presence of significant associations between some of the maternal factors investigated by the study does not mean that factors that did not show significance should be accorded lesser consideration in matters of PMTCT. This is because the achievement of elimination of MTCT of HIV calls for concerted consideration of potential determinants, which, as previously connoted herein, are multifactorial (Anigilaje et al., 2016). Deductively, maternal factors determine the intention of HIV seropositive women on PMTCT follow-up to sustainably partake in PMTCT interventions. Sustained participation in PMTCT interventions entails pursuing PMTCT interventions during pregnancy, delivery, and breastfeeding periods. While it is true that a host of PMTCT interventions are domiciled in health settings, individual maternal factors determine the adoption of practices recommended by such health system structures (Moses et al., 2021). Overall, maternal factors work in tandem with health systems factors/structures to ensure the success of PMTCT.

CONCLUSIONS

Knowledge of maternal determinants of MTCT of HIV is crucial to the development of adequate strategies needed to eliminate MTCT of HIV. We examined maternal determinants that demonstrated odds of predicting PMTCT outcome. From the study findings, there are certain maternal-related factors that pose a likelihood of determining PMTCT outcome. As such, there is a need to integrate maternal attributes in the PMTCT care continuum to optimise PMTCT outcomes. Integration of such attributes would contribute to remarkable progress in the quest to eliminate MTCT of HIV across different HIV and AIDS care contexts.

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Availability of Data and Materials

As per the privacy and confidentiality provisions in the informed consent, the dataset generated and analysed for the study is not available publicly. However, data can be obtained from the corresponding author (kenkipton@gmail.com) upon reasonable request.

Author's Contributions

The author's responsibilities were as follows: ROO developed the research protocol, KKT reviewed/revised the study protocol, and data collection approaches. KKT performed data entry, cleaning, and analysis and developed the manuscript. ALL the authors made equal contributions to the development of the manuscript.

Ethics Approval and Consent to Participate in The Study

A research permit was sought from the National Commission for Science, Technology, and Innovation. Ethical clearance was obtained from Maseno University Scientific and Ethical Review Committee for ethical clearance Approval Number: MSU/DRPI/MUERC/01046/2022. Informed written and voluntary consent was obtained from all the participants, and data was anonymised to ensure confidentiality.

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