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Coverage of Early Infant Diagnosis of HIV infection and its determinants among HIV exposed children in Njombe Region, Tanzania

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Abstract

Background: Early Infant Diagnosis (EID) of HIV infection remains a public health concern. The World Health Organization recommends Polymerase chain reaction (PCR) HIV testing within 6 weeks after birth. This is to determine early initiation of antiretroviral therapy to prevent rapid disease progression and death in infected infants. Despite of many efforts, EID coverage is still low in Sub-Saharan Africa due to individual factors. This study aimed to investigate determinants of EID coverage among HIV exposed children in Njombe region, Tanzania.

Methods: A cross-sectional study was conducted in July 2021 among HIV exposed children aged 0-18 months and their biological mother attending reproductive and child health clinics in two districts of Njombe region of Tanzania. Swahili translated questionnaires were used to collect demographics, reproductive characteristics, HIV information, HIV related stigma, HIV disclosure and partner social support after obtaining consent. Multivariable logistic regression was used to determine factors associated with coverage of EID.

Results: A total of 400 HIV exposed children and their biological mothers were enrolled in this study. Median age of the mothers was 30 years (Interquartile Range, IQR 26-34) and majority had informal and primary education 307 (76.8%). Median age of the children was 10 months (IQR 7-14) and most of them were females 226 (56.2%). The proportion of children who received EID within 4 to 6 weeks was 85%. Living in rural areas was associated with lower odds of testing (AOR = 0.37, 95% CI: 0.20-0.68). Parents who reported higher level of HIV-related stigma and discrimination had a higher odd of testing (AOR = 2.96, 95% CI: 1.56-5.60).

Conclusion and Recommendation: This study found an improvement of EID coverage in Njombe region which might have resulted from Health system improvements in urban areas. More efforts in equipping NAT technology in rural health facilities and addressing individual factors need to be considered to improve EID coverage to national target. The region had successes toward addressing negative impact of HIV Stigma which is no longer barrier toward HIV testing. Multiple level HIV stigma reduction interventions should be directed toward Stigma rather than its outcomes.

Keywords: Coverage; Determinants; Early Infant Diagnosis; HIV exposed children; HIV infection; Tanzania

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1. Introduction

HIV/AIDS remain a public concern with estimated 37.6 million cases globally (1). More than 84% of HIV infections occur in sub-Saharan Africa (2). About 1.8 millions of HIV infections occur in children below 15 years of age (2). About 90% of HIV infection in children are through mother to child transmission during pregnancy, delivery and breast feeding (3). HIV accounts about 160 000 new infections in children annually. The risk of transmission among children range from 5% to 20% and can rise to 45% without prevention of mother to child transmission (PMTCT) including EID (4). PMTCT provides interventions to pregnant women, breast feeding women and their infants. These include regular routine testing and counseling, comprehensive antenatal care, and lifelong antiretroviral therapy(ARV) for HIV positive women, ARV prophylaxis and treatment for exposed and infected infants, safe delivery practice, safe infant feeding, postpartum care, EID and treatment**,** partner and family involvement and family planning (5). EID of HIV is the extent to which HIV exposed infants are diagnosed within 4 to 6 weeks after birth by quantitative nucleic acid test (NAT) which detect HIV total nucleic acid (TNA) in dried blood spot (DBS). This involves amplification of target HIV pro-viral DNA or RNA using polymerase chain reaction (PCR) (6).

In 2008 the WHO recommended EID using virological test of HIV using DNA/RNA PCR within 4 to 6 weeks (7–9)After a decade of investment and expansion of laboratory network in 2017 the WHO recommend nucleic acid testing (NAT) technologies (10). This was due to increased number of newly HIV infection in children which occurred between 2007 to 2016, high mortality rate due untreated HIV, high rate of lost follow up and long turnaround time (TAT) for results (8). TAT is critical important link between testing and initiation of ARV treatment or prophylaxis among HIV infected or non-infected children (6). Most sub-Saharan Africa countries including Tanzania adopted EID as integrated part of PMTCT packages (11). This is done by using NAT testing early at 4 to 6 weeks followed by test at 12 months, 18 months and rapid antibody test at 3 months after cessation of breastfeeding (12).

EID is essential step to determine lifesaving early initiation of antiretroviral therapy (ART) for HIV positive infants and decide on type of feeding among HIV positive infants to prevent rapid disease progression and early death of infected infants (13,14). EID contributes toward improved treatment outcome and achievement of the 95–95–95 target of Sustainable Development goals number 3.3 to end HIV/AIDS through testing, viral suppression and treatment by 2030, ultimately reducing short term and long term treatment, economic and productivity costs for care givers, family, and the health care system (15).

EID Coverage varies across different countries globally (16). Only 51% of estimated 1.2 million of HIV exposed children from 21 priority Sub-Saharan countries received EID in 2017(17). About 49% of HIV infected children were not receiving ART as per guidelines due to lack of access to early HIV diagnosis (18). Despite the current expansion of EID services its coverage is still low in most of Sub-Saharan Africa ranging from 3% to 58% with the exception to Eswatini, Lesotho and South Africa who increased early diagnosis to 81%, 93% and 95% respectively(19,20).

Tanzania adopted the WHO recommendation for EID in 2013 as an integrated part of PMTCT care during routine reproductive and child health care and immunization (4,11,21,22). The national target was 95% testing for all HIV exposed infants within 4 to 8 months (23). Tanzania reported a significant drop in coverage of EID from 79% (2015) to 58.1% (2019) which was behind the national target of 95% EID coverage by 2025(15,24). The government of Tanzania in collaboration with stakeholders have been improving EID laboratory capacity, staff training and provision of guidelines for Dried Blood Spots (DBS) collection, transportation and testing and closely monitoring of EID coverage (4,11,22).

Majority of the challenges of coverage of EID are related to individual, community and health facility factors (17,25–27). Health system factors include: delay in collecting DBS sample, shortage of laboratory equipment and reagents, prolonged turnaround time for results, late delivery of information from health care workers, poor referral and networking of specimen (20,28,29). Although there have been many Studies done on determinants of EID, the extent to which each individual factor such as transport to health facility, education level, and stigma, waiting time, social support, disclosure, acceptance and depression contribute to EID coverage are not well documented (4,11,21,22).

In (2019) Dar es Salaam, Mbeya and Kilimanjaro Regions of Tanzania, the proportion of infants tested for HIV within the recommended time was below the global and national target, 69.2%, 70% and 80% respectively (4,30). Reasons for lower coverage included poor knowledge and living in rural areas (4,19). EID coverage is low in Njombe Region (38.6%) due to both individual, community and health system factors (14,31,32). Here we report individual factors associated with EID of HIV infection among HIV exposed children in Njombe region, Tanzania.

2. Methods

2.1. Study design and study settings

A facility-based cross-sectional study was conducted in July 2021 in Njombe Region located in the southern highlands of Tanzania. Njombe Region is comprised of four districts: Njombe, Ludewa, Makete, and Waging'ombe with a total area of 21,347 km^2 and an estimated population of 702,097 (14,33,34). The region was chosen based on highest HIV prevalence (11.4%), highest proportional HIV exposed infant (2.9%), lowest EID coverage (35%) and largest number of HIV positive pregnant and breastfeeding women (5.2 %) (33,35).

2.2. Study population and eligibility criteria.

This study enrolled 400 HIV exposed children from 2 to 18 months. Mother-children pair attending PMTCT services in July 2021 who had dried blood sample collected were identified and enrolled in this study. We excluded infants below the age of 2 months who haven't received HIV DNA testing because they have not completed their time frame for EID.

2.3. Enrolment of study participants

We enrolled eligible mother-children pair by convenience sampling. We selected Njombe district and Waging'ombe district because they were easiest to reach, they have highest number of EID services and highest proportional of study participants. From these two districts, eight health facilities were selected from both rural and urban. Four health facilities: Kibena, Njombe, Makambako health centres and makambako Roman Catholic dispensary were selected from urban. Four health facilities: Lupembe, Ilembula, Mtwango and Waging'ombe health centres were selected from rural. All hospital was selected based on similar criteria of easy accessibility, availability of EID services and highest number of study participants (14,24,31,33). Potential eligible participants were identified and approached by trained researchers for data collection.

2.3.1. Data collection

Data were collected by lead author as Principal Investigator (PI) and five trained Research Assistants using questionnaires. Questionnaires were translated from English to Swahili and pretested to verify consistence and accuracy of data collection tool. Questionnaires were administered by researcher administered method to ensure data quality and correct targeted study participants.

2.3.2. Study variables

The dependent variable in this study was EID defined as the proportion of HIV exposed children that were diagnosed within 6 weeks after birth using HIV NAT polymerase chain reaction(6). Early Infant Diagnosis was coded as "Yes" if mother reported the child received virological testing for HIV within 6 weeks and "No" if children received testing after 6 weeks (36). EID was measured by mothers' self-reported response and triangulated with children RCH cards.

The independent variables included children, maternal and clinical characteristics. Child characteristics include age, sex, model of delivery, place of delivery, type of feeding, HIV status risk classification and turnaround time for results. Maternal characteristics include age, level of education, occupation, number of living children, number of deliveries, accessibility of heath care, PMTCT knowledge, HIV acceptance, stigma and discrimination, depression, HIV disclosure, family and partner support. Maternal clinical variables include HIV status, WHO clinical stage and turnaround time for results. Long turnaround time for PCR results contributes to success of EID coverage and PMTCT of HIV through deciding on timely initiation of ART and psychological benefit of mothers to engage in PMTCT care (4,11,21,22).

HIV stigma and disclosure were measured using modified Berger stigma scale with three self-stigma questions, three personal and public stigma questions and 3 disclosure questions. Any positive response to stigma and disclosure questions were regarded as presence of stigma and disclosure and vice versa. This tool was adopted and modified from similar study conducted in Kenya among postpartum women attending PMTCT services. (37, 38,39)

Partner and social support was assessed using the Multidimensional Scale of Perceived Social Support (MSPSS) with 12 questions which was answered in seven-point scale (1 to 7) and summed up to 12-84 interpreted as low support (12-35), medium support (36-60) and high support (40)

PMTCT knowledge was evaluated using a modified Blooms cut off point among 14 points whereby each point scored 1 and was graded as good knowledge (70%-100%), moderate knowledge (50%-74%) and poor knowledge (<50%) (41)

HIV level of depression was measured using Edinburgh Postnatal Depression Scale (EPDS). The measure contains 10 items rated from 0 to 3 summed to up get a possible total score of 0 to 30 with higher scores (greater than 10) indicating higher likelihood of having depression (42)

HIV status acceptance was measured using acceptance subscale of the Illness Cognition Questionnaire (ICQ) containing six questions that measure HIV acceptance. Participants responded to four-point scale (1 to 4). Items was summed up for a total possible score of 6 to 24 with higher score indicating higher HIV acceptance (43)

2.3.3. Data analysis

Data collected were cleaned and analyzed using SPSS version 20 for descriptive analysis. Variable were grouped and categorized for coding. Numerical variables were summarized using measure of central tendency and their corresponding measure of dispersion while categorical variables were coded and summarized into frequency and percentage. Chi square test was used to examine the difference in EID coverage between demographic, reproductive and clinical characteristics. Bivariate logistic regression was used to identify factors associated with EID. Factors that were significantly associated with EID including area of residence, HIV stigma and discrimination, HIV disclosure and acceptance were included in multivariable logistic regression to determine the association with EID with p value of < 0.05 being statistically significant.

2.3.4. Ethical approval

Ethical approval to conduct the study was obtained from KCMU College and Research Ethics Review Committee **(certificate no. PG 03/2021).** The permission to carry out the study was obtained from regional, district and health facility authorities. **(No. AB.301/326/011/12)**. Written consent was obtained from the study participants and parent/husband consent and assent for participants under the age of 18years. Study participants' information was kept confidential and anonymized.

3. Results

3.1. Background characteristics of study participants

A total of 400 participants were enrolled. Age of women ranged from 15-49 years with median of 30 years (IQR 26-34). Most were aged 25-49 years 328 (82.0%), married 336 (84.0%), living in urban areas 305 (76.2%) and their partner have the same HIV status 194 (48.5%). Majority had informal and primary education 307 (76.8%) and were not employed 378 (94.5%). In addition, child age ranged from 0-18 months with median of 10 months (IQR 7-14). Most children were female 226 (56.2%) and received exclusive breastfeeding 388 (97.0%) within first six months of life.

Most HIV positive women 361 (90.2%) had attended the recommended antenatal visits during pregnancy (≥4) while 220 (55.0%) attended less than the recommended postnatal visit (<3) within 42 days after delivery. About 33 (8.2%) women had one child infected with HIV infection. Of the 400 participants, 300 (75%) of women had established HIV diagnosis during their current pregnancy.

The mean time for EID was 6 weeks (SD: ±2.5) and majority 340 (85%) of children received EID within 4 to 6 weeks. Mean time for receiving results (turnaround time) was 6 weeks (SD: ±3.4) and majority 313 (96.3 %) had long turnaround time for NAT results. Most children 357 (89.2%) were classified as high-risk group. High-risk group defined as children whose mother was first identified as HIV-infected at delivery or in the postpartum, infected during pregnancy or breastfeeding, started ART late in pregnancy, or did not achieve viral suppression by the time of delivery (45). PMTCT services were accessible within 30 minutes travel time by walking and bicycle 250 (52.5%). About 155 (38.8%) had experienced HIV related stigma and discrimination 73 (18.2%) had HIV related depression and 266 (66.5%) had never disclosed their HIV status to a friend, partner, or family. Majority 397 (99.3%) of women had good PMTCT knowledge. **(Table 01).**

Table 1 Background characteristics of study participants (N=400)

Variable	**n**	**%**
Maternal characteristics		
Age (years)		
Median (IQR) 30 (26-34)		
15-24	72	18.0
25-49	328	82.0
Marital status		
Not married	64	16.0
Married	336	84.0
Residence		
Urban	305	76.2
Rural	95	23.8
Education level		
No formal and primary	307	76.8
Secondary and high	93	23.2
Occupation		
Employed	22	5.5
Not employed	378	94.5
Partner HIV status		
HIV positive	194	48.5
HIV negative	147	36.8
Unknown	59	14.7
Children characteristics		
Age (months)		
Median (IQR) 10 (7-14)		
0-12	269	67.3
13-18	131	32.7
Sex		
Male	174	43.5
Female	226	56.5
Feeding practice within 6 months		
Exclusive breastfeeding	388	97.0
Mixed feeding	12	3.0
Number of ANC visit		
< 4	39	9.8
≥4	361	90.2

Number of PNC visit (0-42 days)		
< 3	220	55.0
≥3	180	45.5
Number of delivery		
1	68	17.0
2-3	257	64.2
4+	75	18.8
Number of living children		
0-2	217	54.2
3+	183	45.8
Children with HIV		
0 (None)	367	91.8
Yes	33	8.2
Diagnosis status in index pregnancy		
Newly diagnosis	100	25.0
Established diagnosis	300	75.0
EID (weeks)		
Mean(±SD) 6 (±2.5)		
No	60	15.0
Yes	340	85.0
Turnaround time for results (weeks n=325) *		
Mean (SD) 6 (±3.4)		
≤2	12	3.7
>2	313	96.3
Mother duration on ART (Months)		
Median (1QR) 29 (18-58)		
0-12	55	13.8
13-24	132	33.0
25+	213	53.2
Risk group (infant)		
High risk	43	10.8
Low risk	357	89.2
Mother WHO clinical stage		
1	345	86.2
2	27	6.8
3	19	4.8
4	9	2.2
Accessibility of heath care/PMTCT		

No	190	47.5
Yes	250	52.5
HIV stigma and discrimination		
No	235	61.2
Yes	155	38.8
HIV status disclosure		
No	266	66.5
Yes	134	33.5
Family and social support		
No	34	8.5
Yes	366	91.5
Possible depression		
No	327	81.8
Yes	73	18.2
PMTCT knowledge		
Good knowledge	397	99.3
Poor knowledge	3	0.7
HIV acceptance		
No	100	25.0
Yes	300	75.0

*15 Children had not yet received their PCR results

3.2. EID by characteristics of study participants

EID coverage was higher among children whose mothers were urban residents (88.2%); p-value =0.001. and those who experienced HIV stigma and discrimination (89.7%); p-value=0.032. EID coverage was higher among children whose mothers had disclosed their HIV status (91%) compared to counterpart (82%); p-value=0.016.

EID coverage was higher among children whose mothers had accepted HIV status (87.3%) compared to those whose mothers had not accepted HIV status (78%); p-value=0.024 **(Table 02).**

Table 2 EID by background characteristics of study participants (N=400)

Maternal characteristics	Total (n)	EID		P-value
		Yes (%)	No (%)	
Age (years)				
15-24	72	63 (87.5)	9 (12.5)	0.512
25-49	328	277 (84.5)	51 (15.6)	
Marital status				
Not married	64	53 (82.8)	11 (17.2)	0.593
Married	336	287 (85.4)	49 (14.6)	
Residence				
Urban	305	269 (88.2)	36 (11.8)	0.001

Rural	95	71 (74.7)	24 (25.3)	
Education level				
No formal and primary	307	258 (84.0)	49 (16.0)	0.328
Secondary and high	93	82 (88.2)	11 (11.8)	
Occupation				
Employed	22	19 (86.4)	3 (13.6)	0.854
Not employed	378	321 (84.9)	57 (15.1)	
Partner HIV status				
HIV positive	194	164 (84.5)	30 (15.5)	0.508
HIV negative	147	128 (87.1)	19 (12.9)	
HIV stigma and discrimination				
No	245	201 (82.0)	44 (18.0)	0.037
Yes	155	139 (89.7)	16 (10.3)	
Diagnosis status in index pregnancy				
Newly diagnosis	100	83 (83.0)	17 (17.0)	0.518
Established diagnosis	300	257 (85.7)	43 (14.3)	
Number of ANC visit				
<4	39	31 (79.5)	8 (20.5)	0.310
≥4	361	309 (85.6)	52 (14.4)	
Received HIV/MTCT counselling				
No	9	6 (66.7)	3 (33.3)	0.119
Yes	391	334 (85.4)	57 (14.6)	
HIV status disclosure				
No	266	218 (82.0)	48 (18.1)	0.016
Yes	134	122 (91.0)	12 (9.0)	
Number of deliveries				
1	68	55 (80.9)	13 (19.1)	0.510
2-3	257	222 (86.4)	35 (13.6)	
4+	75	63 (84.0)	12 (16.0)	
Number of living children				
0-2	217	181 (83.4)	36 (16.6)	0.332
3+	183	159 (86.9)	24 (13.1)	
Children with HIV				
0	367	313 (85.3)	54 (14.7)	0.593
≥1	33	27 (81.8)	6 (18.2)	
Child characteristics				
Age (months)				
0-12	269	231 (85.9)	38 (14.1)	0.483

13-18	131	109 (83.2)	22 (16.8)	
Sex				
Male	174	152 (87.4)	22 (12.6)	0.247
Female	226	188 (83.2)	38 (16.8)	
Feeding practice within 6 months				
Exclusive breastfeeding	388	332 (85.6)	56 (14.4)	0.071
Mixed feeding	12	8 (66.7)	4 (33.3)	
Number of PNC visit				
<3	220	185 (84.1)	35 (15.9)	0.573
≥3	180	155 (86.1)	25 (13.9)	
Model of delivery				
Spontaneous delivery	333	284 (85.3)	49 (14.7)	0.722
Caesarean Section	67	56 (83.6)	11 (16.4)	
Turnaround time for results (weeks)***				
≤2	12	10 (83.3)	2 (16.7)	0.720
>2	313	272 (86.9)	41 (13.1)	
Mother duration on ART (years)				
0-12	55	44 (80.0)	11 (20.0)	0.521
13-24	132	114 (86.4)	18 (13.6)	
25+	213	182 (85.5)	31 (14.6)	
Risk group				
High	43	36 (83.7)	7 (16.3)	0.804
Low	357	304 (85.2)	53 (14.9)	
WHO clinical stage				
1	345	294 (85.2)	51 (14.8)	0.881
2	27	23 (85.2)	4 (14.8)	
3	19	15 (79.0)	4 (21.1)	
4	9	8 (88.9)	1 (11.1)	
PMTCT accessibility				
Poor	190	159 (83.7)	31 (16.3)	0.483
Good	210	181 (86.2)	29 (13.8)	
Family and social support				
No	34	30 (88.2)	4 (11.7)	0.581
Yes	366	310 (84.7)	56 (15.3)	
Possible depression				
No	327	276 (84.4)	51 (15.6)	0.480
Yes	73	64 (87.7)	9 (12.3)	
PMTCT knowledge				

Poor Good	3 397	2 (66.7) 338 (85.1)	1 (33.3) 59 (14.9)	0.372
HIV acceptance				
No	100	78 (78.0)	22 (22.0)	0.024
Yes	300	262 (87.3)	38 (12.7)	

3.3. Bivariate analysis of characteristics associated with EID

In crude analysis, children whose mothers were rural residents had a significant lower odd of EID (COR 0.4, 95% CI: 0.22-0.71) compared to urban residents. While other factors such as marital status, maternal age, education level, occupation, number of deliveries, number of living children, PMTCT counselling and child sex were not significantly associated with EID

In crude analysis, children whose mothers' experienced HIV stigma and discrimination (COR 1.09, 95% CI: 1.03-3.51), HIV status disclosure (COR 2.24, 95% CI: 1.15-4.38), and HIV acceptance (COR 1.94, 95% CI: 1.09-3.48) had a significantly higher odds of EID compared to their counterparts **(Table 03).**

Table 3 Bivariate analysis of background characteristics associated with EID

Maternal characteristics	COR (95%CI)	P-value
Maternal age		
15-24	1.00	
25-49	0.77 (0.36-1.66)	0.513
Marital status		
Not married	1.00	
Married	1.22 (0.59-2.49)	0.593
Residence		
Urban	1.00	
Rural	0.40 (0.22-0.71)	0.002
Education level		
No formal and primary	1.00	
Secondary and high	1.42 (0.70-2.85)	0.330
Occupation		
Employed	1.00	
Not employed	0.89 (0.25-3.10)	0.854
Partner HIV status		
HIV positive	1.00	
HIV negative	1.23 (0.66-2.29)	0.509
HIV stigma and discrimination		
No	1.00	
Yes	1.90 (1.03-3.51)	0.039
Diagnosis status in index pregnancy		
Newly diagnosis	1.00	

Established diagnosis	1.22 (0.66-2.26)	0.518
Number of ANC visit		
< 4	1.00	
≥4	1.53 (0.67-3.52)	0.313
Received HIV/MTCT counseling		
No	1.00	
Yes	0.34 (0.08-1.40)	0.136
HIV status disclosure		
No	1.00	
Yes	2.24 (1.15-4.38)	0.018
Number of deliveries		
1	1.00	
2-3	1.50 (0.74-3.02)	0.258
≥4	1.24 (0.52-2.94)	0.624
Number of living children		
0-2	1.00	
≥3	1.32 (0.75-2.30)	0.333
Children with HIV		
0	1.00	
≥1	0.77 (0.31-1.97)	0.594
Child characteristics		
Age (months)		
0-12	1.00	
13-18	0.82 (0.46-1.44)	0.484
Sex		
Male	1.00	
Female	0.72 (0.41-1.26)	0.248
Number of PNC visit		
< 3	1.00	
≥3	1.17 (0.67-2.04)	0.574
Turnaround time for results (weeks)		
≤2	1.00	
>2	1.33 (0.28-6.27)	0.721
Mother duration on ART (Months)		
0-12	1.00	
13-24	1.58 (0.69-3.62)	0.276
≥25	1.47 (0.68-3.15)	0.324

Risk group		
High	1.00	
Low	1.12 (0.47-2.64)	0.804
Mother WHO clinical stage		
1	1.00	
2	0.99 (0.33-3.00)	0.996
3	0.65 (0.21-2.04)	0.461
4	1.39 (0.17-11.33)	0.760
PMTCT accessibility		
Poor	1.00	
Good	1.22 (0.70-2.11)	0.484
Family and social support		
No	1.00	
Yes	0.74 (0.25-2.18)	0.582
Possible depression		
No	1.00	
Yes	1.31 (0.62-2.81)	0.481
PMTCT knowledge		
Poor	1.00	
Good	2.86 (0.26-32.09)	0.393
HIV acceptance		
No	1.00	
Yes	1.94 (1.09-3.48)	0.025

*COR-Crude odds ratio

3.4. Multivariable analysis of risk factors associated with EID

In adjusted analysis, children whose mothers were rural residents remained with lower odds of EID (AOR = 0.37, 95% CI: 0.20-0.68; p = 0.001) compared to mothers from urban areas. While mothers who experienced HIV stigma and discrimination had higher odds of EID coverage (AOR = 2.96, 95% CI: 1.56-5.60; p = 0.001) compared to their counterpart. **(Table 04).**

Table 4 Multivariable analysis of risk factors associated with EID

Variable	**AOR (95% CI)**	**P-value**
Residence		
Urban	1	
Rural	0.37 (0.20-0.68)	0.001
HIV stigma and discrimination		
No	1	
Yes	2.96 (1.56-5.60)	0.001
HIV status disclosure		

No	1	
Yes	1.84 (0.77-4.41)	0.174
HIV acceptance		
No	1	
Yes	1.59 (0.71-3.54)	0.26

*AOR-Adjusted: *Adjusted for residence, HIV stigma and discrimination, HIV status disclosure and HIV acceptance

4. Discussion

This study aimed to investigate the factors associated with EID coverage among HIV exposed children in Njombe region. The proportion of HIV exposed children who received EID was 85%. Njombe Region still lags behind the national target of EID. This means that there is still 15% of children with delayed EID hence missed opportunity for early and timely initiation of ART for those found positive. This results in poor viral suppression, rapid disease progression and challenges for HIV/AIDS epidemic control(1,8,13,17,44). The proportional of EID observed in this study was lower compared to similar studies done in Lesotho (93%) and South Africa (95%), countries who have met the WHO recommended target for EID coverage (13,17,45–47). The proportion is higher compared to a similar hospital based cross sectional study done in Njombe (38.6%) (14).

The differences in findings might be explained by the introduction of a testing algorithm and improved EID quality service delivery through integration of NAT machines in four visited sites, Makambako, Kibena, Njombe and Makete Health Centres.(14,48,49). In the previous study sample collection and processing was only done at Njombe Reginal Referral Hospital. This improved EID coverage, early initiation of ART and survival for HIV exposed infants through viral suppression, reduction of risks for rapid viral replication, drug-resistant, disease progression and infant mortality (6,17,28,50). Scale up of PMTC sites supplied with adequate reagents and human resources for DBS collection improved testing. According to Njombe Regional Office about 60.0% of all primary health care facilities were offering EID services through DBS collection which were sent to reference hospitals for testing compered to previously when the region had no capacity to manage DBS collection and all sample were sent to a neighboring region, Mbeya Zonal Referral Hospital for testing. (12,21,51,52)

In addition, improved knowledge of health care workers and client may have contributed toward higher coverage of EID compared to previously when poor knowledge contributed to lost to follow up and poor retention of mother-baby pairs in HIV care(53–55)

There was a significant association between EID and living in urban areas. Children residing in rural areas were less likely to receive EID care and this could be due poor PMTCT knowledge, accessibility and availability of PMTC care and few skilled health care providers compared to urban areas where all reference laboratories were located in urban areas (4,19,56). Rural facilities were supplied with only DBS collection reagents for sample collection and processing (4,53). Similar findings were observed in the same study done in South Africa and Tanzania (4,17,57).

We found HIV related stigma associated with higher coverage of EID. Children whose mothers experienced stigma and discrimination were likely to be tested. This reflect that, the region had taken important steps toward addressing negative impact of HIV Stigma which is no longer barrier to HIV testing (58,59). This improvement was due to implementation of Integrated Stigma and Discrimination Reduction in HIV Programs in Njombe region which was directed to mass media campaigns, participatory education and empowerments using health care providers, home based care providers, faith based leaders and patient living with HIV (14,59–64)

The findings for stigma are contradicting to previous study done in Ghana and South Africa where stigma was major barrier toward accessing diagnosis, treatment and care of HIV exposed infants (19,65). The reasons for contradictory findings could be due to experiences of stigma which differ across geographical areas due to individual experience, knowledge, confidence, attitude, beliefs and behavior in living with HIV which may results to positive or negative impact toward accessing EID services through psychosocial consequences like shame, guilt, fear and denial (60,66–68). Also community and institutional policy and procedures directed toward protecting safety of the patient living with HIV and prohibiting stigma and descrimination in Tanzania might have contributed to significant different in EID coverage (62–64,66). Under this policy any personal or health care provider who contravene any form of stigma and descrimination commit an offence and is liable to fine or imprisonment (69).

Other factors previously found to be associated with EID like HIV status disclosure, HIV acceptance, HIV related depression, mode of delivery, place of delivery, accessibility to PMTCT services, poor knowledge, duration on ART, ANC visit and WHO clinical staging were not significant in our study (4,12,17,19,20,27–29,56)

4.1. Study strengths and limitations

Most information were obtained direct from mother and triangulated with children and parental CTC and RCH card. Our study findings should be interpreted with caution due to the following reasons. Some of adopted assessment tools such (i.e. EPDS and MPSS) have not validated in Tanzania and might have impacted our findings through cut off point and scores based on Tanzanian norms. Despite of using standardized assessment rating scale we cannot rule out social desirability and participants bias in reporting HIV stigma, HIV disclosure and family and social support. (56,59,70,71) Selection bias with regards to study sites and participants might have impacted our findings to be generalized to study population. This study design is cross-sectional; hence cannot determine the temporal relationship between EID and the associated factors.(4,11,28,56)

5. Conclusion and recommendation

This study found an improvement of EID coverage in Njombe region. Health system improvments may have likely contributed including the testing algorithm, implementation of NAT technologies at health facilities, and increasing the number of PMTC sites offering DBS collection. We recommend more efforts in equipping NAT technology in rural health facilities, improving education, awareness and support for women to improve EID coverage to national target. Individual factors need to be considered in designing programs to improve quality of EID services and life of HIV exposed children. Further studies addressing community and health facility factors should be conducted.

This study had shown successful steps toward addressing negative impact of HIV stigma which is no longer barrier to EID testing. We recommend implementation of multiple level stigma and discrimination reduction interventions like education, public campaigns, contacts, peer services advocacy and policy change rather than addressing its outcomes. The findings of Stigma in association with EID is contradicted with previous studies, we recommend further exploratory studies in Njombe region for better explanation and understanding. Most individual factors previously found to be associated with EID have no significant association in this study, we recommend further studies addressing health system factors in association with EID.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that they have no conflict of interest relevant to the content of this article.

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Statement of informed consent

Informed consent was obtained from the study participants and parents' consent and assent for participants under the age of 18 years. The aim, objectives and importance of this study were explained to study participants before invitation to participate in this study. .

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