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High Seroprevalence and Factors Associated with Syphilis Infection: A Snapshot from the HIV-Infected Pregnant Women Population in Mtwara, Tanzania

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Abstract:-

Background:Syphilis is a chronic systemic infection caused by the spirochete Treponema pallidum, which can be transmitted sexually and during a blood transfusion (acquired syphilis), and vertically (congenital syphilis) through the mother's placenta to the foetus. Pregnant women who are infected with syphilis can transmit the infection to their foetus, causing congenital syphilis. Several studies in different parts of the world have shown that syphilis in pregnancy continuing as a public health concern, leading to perinatal morbidity and mortality in most of the developing countries including Tanzania and is one of the most important public health problems. However; the availability of the study on syphilis and its associated factors is limited in Tanzania and especially among pregnant women population living with HIV/AIDS (PWLHIV) and on antiretroviral therapy (ART).

Objectives: To determine the seroprevalence and factors associated with Syphilis infection among pregnant women living with HIV/AIDS attending Prevention of mother to child transmission (PMTCT) in selected health facilities in Mtwara region.

Methodology:This was a health facility-basedcross-sectional study conducted among pregnant women living with HIV/AIDS (LWHIV) attending PMTCT in selected health facilities in Mtwara region. The study was conducted for 3 months. A structured questionnaire was used to collect demographics and socio-economic characteristics, clinical, socio-cultural and laboratory information. A total of 4 mls of blood was collected for Syphilis screening and confirmatory tests using rapid diagnostic tests and automated ELISA test (Abbot ARCHITECT PLUS® i2000SR immunoassay analyzer,U.S.A.), respectively. Bivariate and Multivariate logistic regression was done, variables with a p-value <0.05 was considered as significant factors associated with Syphilis infection in pregnant women LWHIV.

Results: Two hundred and twenty (n=220) pregnant women living with HIV/AIDS were enrolled in this study. The median age of the participants was 32.7 years (IQR: 27.6-37.6). The majority (45.5%) of the participants were married, 71.4% had primary education, 47.7% were unemployed , 77.7% were multigravida and 40.5% were in the second trimester. The seroprevalence of Syphilis infection and Syphilis-hepatitis B co-infection is 10.9% and 5.9 respectively.In this study,being in the second trimester of gestation period [aOR=5.69: 95% CI 1.44-22.46, p=0.013] and being infected with hepatitis B[aOR=31.39: 95% CI 9.45-104.23, p<0.001]were independently associated with HBV infection among pregnant women living with HIV/AIDS in Mtwara region.

Conclusion: This study revealed that the seroprevalence of Syphilis infection and Syphilis-hepatitis B co-infection is 10.9% and 5.9 respectively. Furthermore, the study revealed that being in the second trimester of gestation period and being infected with hepatitis B are significant factors associated with Syphilis infection among pregnant women LWHIV in Mtwara region. Therefore, routine screening of Syphilis and other infections including hepatitis B in pregnant women LHIV and especially those in second trimester of their pregancy is crucial to reduce the burden, and prevent vertical transmission to the neonates.

Word counts:
Abstract: 460 words

Keywords:- *Influenza, Seroprevalence, Syphilis infection, Hepatitis B infection, Human immunodeficiency virus.*

I. INTRODUCTION

Syphilis is a chronic systemic infection caused by the spirochete Treponema pallidum, which can be transmitted sexually and during a blood transfusion (acquired syphilis), and vertically (congenital syphilis) through the mother's placenta to the foetus[1]. Pregnant women who are infected with syphilis can transmit the infection to their foetus, causing congenital syphilis. The majority of pregnant women with syphilis are not detected and treated early enough to avoid the adverse effects of infection on their pregnancy. It remains an important global public health problem, and its incidence is increasing in different parts of the world [2,3].

In 2016, more than half a million cases of congenital syphilis were recorded globally, which resulted in more than 200, 000 stillbirths and neonatal deaths. As long as effective diagnosis and treatment are provided in an early stage of pregnancy, congenital syphilis and other adverse syphilis-related pregnancy outcomes are efficiently preventable and treatable[4]. However, congenital syphilis remains themost

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common cause of preventable stillbirth, only surpassed by malaria, and disproportionally affects women in low-resource settings[5].

In 2007, the WHO started a global initiative for the elimination of congenital syphilis [5]. Even though syphilis screening of pregnant women at their first antenatal care (ANC) contact is recommended in almost all countries globally, the transmission of syphilis from mother-to-child remains a public health problem, and pregnant women often undiagnosed and untreated, despite low costs of efficient diagnosis and medications [5,6]. Furthermore, syphilis disproportionally affects women in low-resource settings where prevalence rates are high and testing rates are extremely low. For example, in the Democratic Republic of Congo, where more than 3% of women are infected with syphilis but only 16% arescreened[7]. Therefore, it is vital to scale up syphilis screening programs for pregnant women, particularly those living with HIV/AIDS and in low-resource settings including Tanzania.

Early diagnosis and treatment of syphilis in pregnancy are well-recognized as an effective strategy to reduce syphilis transmission and adverse pregnancy outcomes. In endemic countries, antenatal screening for syphilis detection and treatment can reduce the number of stillbirths by 82%, preterm birth by 64%, and neonatal deaths by 80%[8,9].

Maternal age, residence, educational level, educational level of the husband, occupational status, occupational status of the husband, number of pregnancies, history of abortion, history of STI, and HIV/AIDS status have been some of the factors studied and reported in different epidemiologic studies as they affect the magnitude of syphilis serostatus. However, there are important contributing factors like HIV viral load status, gestation age, HBV status, and having two or more sexual partners which were given little attention and thus are not well studied and understood [10–12].

Several studies in different parts of the world have shown that syphilis in pregnancy continues as a public health concern, leading to perinatal morbidity and mortality in most of developing countries including Tanzania, and is one of the most important public health problems. A study done in Tanzania revealed that 2.5% of pregnant women attending ANC were seropositive for syphilis[13]. Therefore, a proper understanding of associated factors may give evidence to plan an intervention on these factors, improve treatment, and improve health promotion strategies.

To the best of our knowledge, the availability of the study on syphilis and its associated factors is limited in Tanzania and especially among pregnant women population living with HIV/AIDS (PWLHIV) and on antiretroviral therapy (ART). And at present, there is no study on the burden and associated factors of syphilis among pregnant women in the Mtwara region. This study aimed to fill this gap by assessing the magnitude of syphilis in pregnant women LWHIVand identifying associated factors among the target women in Mtwara region, SouthernTanzania.

II. MATERIALS AND METHODS

A. Study design

This was a health facility-basedcross-sectional study on seroprevalence and factors associated with HBV infection among pregnant women LWHIV attending PMTCT in selected health facilities in the Mtwara region conducted between February and April, 2022.

B. Study Area

The study was conducted in Mtwara region. Mtwara is one of the 31 regions of Tanzania located in the southern part of Tanzaniawith a population of 1,270,854 according to the 2012 census and 16,710 kilometers square[14]. Mtwara region is found in Latitude. -10.31°S, Longitude. 40.18° E.There are 221 health facilities that provide PMTCT services in the Mtwara region. In this study Likombe health center, Ndanda hospital, Mangaka hospital, and Mkomaindo hospital were selected. These facilities were selected purposefully because they provide PMTCT services to a large number of clients compared to the other facilities in Mtwara region[14].

C. Study Population

All pregnant women living with HIV/AIDS attending PMTCT clinics at Mkomaindo district hospital, Ndanda hospital, Mangaka hospital, and Likombe health center in Mtwara region and who met the selection criteria were included in the study.

D. Inclusion criteria

Pregnant women (≥18 years old) of any gestation age (first, second or third trimester) living with HIV/AIDS and on ART attending PMTCT clinic in selected study sites and who provided consent to participate in the study.

E. Exclusion criteria

HIV-infected pregnant women who have a confirmed diagnosis of syphilis infection and have started treatment.

F. Sample size estimation

The sample size was estimated to be 229 participants, using Kish and Leslieformula (1965) for calculatingsamplesize forcrosssectional studies, with assumptions that included; Standarddeviation ofthe normal distribution (Z) = 1.96 (confidence level at95%), non-response rate of 10%, marginal error of 3% and seroprevalence of syphilis infection of 5.1% froma previous study[15].

G. Sampling method and data collection procedures

Study participants were selected using a systematic probability sampling approach based on their attendance at the PMTCT clinic for their scheduled antenatal clinic follow up. Probability Proportional to size (PPS) was used to calculate the sample size for each health facility. Once the number of pregnant women LWHIV to be sampled in each facility was obtained, the list of pregnant women attending PMTCT clinic (sampling frame) was asked and assigned numbers.The sampling fraction was determined by dividing the total number of pregnant women attending PMTCT clinic (sampling frame) to sample size in each health

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facility, allocating randomly from 1 to the obtained factor to determine the starting unit and arrange the study participants based on their order of coming to the clinic for each health facility. Each study participant was selected at every defined interval (obtained factor) using systematic random sampling. If an attendant declined to participate, the next attendant in a defined interval after her was selected.

A structured questionnaire was used to solicit demographic and socio-economic characteristics (age, marital status, occupation, place of residence, education status and income per day), clinical information (sexual history, gestation age, obstetrics history (gravidity, parity), history of sexually transmitted infections (STI's)) from the study participants. Some clinical parameters such as recent HIV viral load, WHO clinical staging of HIV, ART regimen type and recent CD4 count results were obtained from CTC2 (Care and treatment center) cards of the study participants and CTC2 database

H. Laboratory procedures

A total of 4mls of blood sample from each participant was collected into a plane vacutainer tube (red-top tubes), labelled with a special patient identification number and then sent to the laboratory at the selected study site (hospital). In the laboratory, the sample was processed into serum by centrifugation at 3000 revolutions/minute for 10 minutes by using centrifuge machine (Thermo Scientific™ 75004503 Megafuge 40 Centrifuge, Cole-ParmerPvt.Ltd. India). The processed serum was transferred in to two cryogenic tubes and stored temporally at -80^{o} C until adequate for testing was obtained.

Screening of syphilis was done using, a non-treponemal test (Bioline syphilis 3.0 test; Standard diagnostics Inc. (SD). Korea) at the laboratory of each health facility selected. SD Bioline syphilis 3.0 tests are lateral flow chromatographic immunoassays (with relative sensitivity and specificity of 99.3% and 99.5% respectively and lower detection limit of 2ng/ml=1.66 IU/ml), that qualitatively detects treponemal antibodies in human serum or plasma.The tests were done according to manufacturer's instruction, briefly, a plastic pipette was used to draw about 0.5ml of the serum and one drop was put unto the test cassette and the result was read in 15 minutes. A test was classified as positive if both the control (C) and test (T) bands on the test cassette developed and negative if only the C band developed and invalid if the C band did not develop. All syphilis positive samples from the selected sites' laboratories were confirmed using an automated Enzyme linked immunosorbent assay (ELISA) (Abbot ARCHITECT PLUS® i2000SR immunoassay analyzer, U.S.A) at National Blood Transfusion Services (NBTS)-Southern zone laboratory (SADCAS accredited) in Mtwara region.

All results were recorded carefully before data entry and the data were double-checked by different personnel before analysis. The Standard Operating Procedures (SOPs) were strictly followed to ensure that all the procedures done produces quality results. The expiry date of all reagents and consumables were checked before being used for testing and quality controls of each test were done and reviewed prior to testing of samples from the study participants.

I. Data processing and analysis

After data collection, the data were entered, cleaned, counter checked for errors to ensure completeness and then double-entered in excel spreadsheet version 2019 and then exported to Stata version 15.1 for analysis. Frequency and proportion for categorical variables were calculated, where continuous variables were summarized using median (interquartile range) as a measure of central tendency. Bivariate and multivariate logistic regression models were used to predict the relationships between dependent and independent variables. Bivariate analysis was conducted primarily to check association of each independent variable (e.g., CD4, WHO stage, etc.) with dependent variable (Syphilis infection). Variables found to have the association with p-value ≤ 0.2 between the dependent and independent variables in bivariate analysis were subjected to multivariate logistic regression. Crude odds ratio (cOR) and adjusted odds ratios (aOR) with their 95% CI was used to determine the significance of the independent variables. In multivariate logistic regression, variables with a p value < 0.05 were considered as significant, 95% CI was used to assess the strength of the association.

J. Ethical considerations

The ethical approval of the study was obtained from the Institutional Review Board (IRB) of the Muhimbili University of Health and Allied Sciences (MUHAS). Permission to conduct the study was requested from Regional administrative secretary office (RAS-Mtwara) and District Medical Officers of all selected districts as well as the medical officer in charge of Mkomaindo hospital, Ndanda hospital, Mangaka hospital and Likombe health center. Written informed consent was obtained from every participant prior to inclusion in the study. Data were anonymized before being accessed and all respondents provided informed, written consent and were assured of confidentialitythrough the use of special identification codes. Data were protected and kept by the principal investigator and were accessed only by authorized personnel, and for any necessary transfer, permission was given by the principal investigator. Seropositive results were communicated within 48-72 hours to the clinicians or nurses at the respective hospitals.

III. RESULTS

A. Characteristics of the study participants

In this study, a total of 220 pregnant women living with HIV/AIDS in Mtwara region were enrolled.The study participants' median age was 32.7 years (IQR:27.6- 37.6). The majority34.1% (75/220) of the participants were from Mkomaindo hospital, and the majority 71.4% (157/220) of all participants attained only primary school level of education; 47.7% (105/220) were unemployed, 51.8% (114/220) were living in urban area and 45.5% (100/220) were married (Table 1**).**

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Characteristic	Syphilis infection status		Total (N=220)
	Negative (n=196)	Positive (n=24)	
Facility name			
Likombe health center	35 (17.9)	4 (16.7)	39 (17.7)
Mangaka hospital	33 (16.8)	3 (12.5)	36 (16.4)
Mkomaindo hospital	67 (34.2)	8 (33.3)	75 (34.1)
Ndanda hospital	61 (31.1)	9 (37.5)	70 (31.8)
Age (in years)			
Median (IQR)	32.5 (27.4-37.4)	34.7(30.8-37.9)	32.7(27.6-37.6)
18-39 (Young adults)	58 (29.6)	9 (37.5)	67 (30.5)
40-59 (Mid-aged adults)	138 (70.4)	15 (62.5)	153 (69.5)
Marital status			
Married	92 (46.9)	8 (33.3)	100 (45.5)
Single	46 (23.5)	7 (29.2)	53 (24.0)
Cohabiting	39 (19.9)	6 (25.0)	45 (20.5)
Divorced	17 (8.7)	3 (12.5)	20 (9.1)
Widow	2 (1.0)	0 (0.0)	2 (0.9)
Residence			
Rural	94 (48.0)	12 (50.0)	106 (48.2)
Urban	102 (52.0)	12 (50.0)	114 (51.8)
Occupation			
Employed	12 (6.1)	0 (0.0)	12 (5.5)
Self-employed	91 (46.4)	12 (50.0)	103 (46.8)
Unemployed	93 (47.5)	12 (50.0)	105 (47.7)
Number of sexual partners			
One	122 (62.2)	14 (58.4)	136 (61.8)
Two	32 (16.3)	5 (20.8)	37 (16.8)
More than two	42 (21.5)	5 (20.8)	47 (21.4)
Number of pregnancies			
Primigravida	30 (15.3)	3 (12.5)	33 (15.0)
Multigravida	151 (77.0)	20 (83.3)	171 (77.7)
Grand multigravida	15 (7.7)	1 (4.2)	16 (7.3)
Current gestation age			
First trimester	67 (34.2)	3 (12.5)	70 (31.8)
Second trimester	75 (38.3)	14 (58.3)	89 (40.5)
Third trimester	54 (27.5)	7 (29.2)	61 (27.7)
Income per day (in Tsh)			
Less than 2400	109 (55.6)	15 (62.5)	124 (56.4)
2400 to 12,000	78 (39.8)	8 (33.3)	86 (39.1)
More than 12,000	9 (4.6)	1 (4.2)	10 (4.5)
History of blood transfusion			
No	159 (81.1)	19 (79.2)	178 (80.9)
Yes	37 (18.9)	5 (20.8)	42 (19.1)
CD4 count (cells/mm^3)			
< 200	27 (13.8)	4 (16.7)	31 (14.0)
200-499	77 (39.3)	11 (45.8)	88 (40.0)
≥500	52 (26.5)	4 (16.7)	56 (25.5)
Missing	40 (20.4)	5 (20.8)	45 (20.5)
HVL status (copies/ml)			
<50	177 (90.4)	21 (87.4)	198 (90.0)
50-999	11 (5.6)	1 (4.2)	12 (5.4)
≥1000	4 (2.0)	1 (4.2)	5 (2.3)
Missing	4 (2.0)	1 (4.2)	5 (2.3)
WHO clinical stage of HIV			

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Stage 1	170 (86.7)	20 (83.3)	190 (86.4)
Stage 2	23 (11.7)	4 (16.7)	27 (12.3)
Stage 3	3 (1.6)	0 (0.0)	3 (1.3)
ART regimen			
First -line regimen	192 (98.0)	24 (100.0)	216 (98.2)
Second-line regimen	4 (2.0)	0 (0.0)	4 (1.8)
Duration on ART (in months)			
Less than 6	7 (3.6)	0 (0.0)	7 (3.2)
6 to 12	16 (8.2)	3 (12.5)	19 (8.6)
More than 12	173 (88.2)	21 (87.5)	194 (88.2)
Hepatitis B status			
Negative	186 (94.9)	11 (45.8)	197 (89.5)
Positive	10 (5.1)	13 (54.2)	23 (10.5)

Table 1: Proportion of syphilis infection in socio-demographic and clinical characteristics of the study participants (N=220)

The seroprevalence of syphilis and syphilis-hepatitis B co-infection was 10.9% and 5.9% respectively among the study participants.

The highest seroprevalence of Syphilis was 10.9%, 9.5%, and 9.1%, seen among pregnant women who were on first-line ART regimen, with HIV-1 viral load of less than 50 copies/ml and multigravida respectively (Table 2).

Characteristic	**Seroprevalence of syphilis infection**
Facility name	**n (%)**
Likombe health center	4 (1.8)
Mangaka hospital	3 (1.4)
Mkomaindo hospital	8 (3.6)
Ndanda hospital	9 (4.1)
Age (in years)	
18-39 (Young adults)	9 (4.1)
40-59 (Mid-aged adults)	15 (6.8)
Marital status	
Married	8 (3.6)
Single	7 (3.2)
Cohabiting	6 (2.7)
Divorced	3 (1.4)
Widow	0 (0.0)
Residence	
Rural	12 (5.5)
Urban	12 (5.5)
Occupation	
Employed	0 (0.0)
Self-employed	12 (5.5)
Unemployed	12 (5.5)
Number of sexual partners	
One	14 (6.4)
Two	5 (2.3)
More than two	5 (2.3)
Number of pregnancies	
Primigravida	3 (1.4)
Multigravida	**20 (9.1)**
Grand multigravida	1 (0.5)
Current gestation age	
First trimester	3 (1.4)
Second trimester	14 (6.4)
Third trimester	7 (3.2)
Income per day (in Tsh)	
Less than 2400	15 (6.8)
2400 to 12,000	8 (3.6)
More than 12,000	1 (0.5)

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History of blood transfusion	
No	19 (8.6)
Yes	5 (2.3)
CD4 count (cells/mm^3)	
< 200	4 (1.8)
200-499	11 (5.0)
≥500	4 (1.8)
Missing	5 (2.3)
HVL status (copies/ml)	
<50	**21 (9.5)**
50-999	1 (0.5)
≥1000	1 (0.5)
Missing	1 (0.5)
WHO clinical stage of HIV	
Stage 1	20 (9.1)
Stage 2	4 (1.8)
Stage 3	0 (0.0)
ART regimen	
First -line regimen	**24 (10.9)**
Second-line regimen	0 (0.0)
Duration on ART (in months)	
Less than 6	0 (0.0)
6 to 12	3 (1.4)
More than 12	**21 (9.5)**
Hepatitis B status	
Negative	11 (5.0)
Positive	13 (5.9)

Table 2:Seroprevalence of syphilis infection in socio-demographic and clinical characteristics of the study participants (N=220)

IV. FACTORS ASSOCIATED WITH SYPHILIS INFECTION AMONG PREGNANT WOMEN LIVING WITH HIV/AIDS IN MTWARA REGION

The results of the multivariate logistic regression showed that those pregnant women living with HIV/AIDS and on ART who were in second trimester of their pregnancy were 5 times more likely to be infected with syphilis as compared to those who were in first trimester (Table 3).

Characteristic	Syphilis infection status		Bivariate		Multivariate	
	Negative n (%)	Positive n (%)	cOR (95% CI)	P value	aOR (95% CI)	P-value
Age (in years)						
18-39 (Young adults)	58 (86.6)	9 (13.4)	1 (Ref)		1 (Ref)	
40-59 (Mid-aged adults)	138 (90.2)	15 (9.8)	0.70 (0.29-1.69)	0.429	0.51 (0.18-1.46)	0.211
Marital status						
Married	92 (92.0)	8 (8.0)	1 (Ref)		1 (Ref)	
Single	46 (86.8)	7 (13.2)	1.75 (0.60-5.12)	0.307	1.89 (0.58-6.15)	0.293
Cohabiting	39 (86.7)	6 (13.3)	1.77 (0.58-5.44)	0.319	1.85 (0.50-6.86)	0.357
Divorced	17 (85.0)	3 (15.0)	2.03 (0.49-8.43)	0.330	1.66 (0.38-7.32)	0.505
Residence						
Rural	94 (88.7)	12 (11.3)	1 (Ref)		1 (Ref)	
Urban	102 (89.5)	12 (10.5)	0.92 (0.39-2.15)	0.850	1.29 (0.42-4.01)	0.654
Occupation						
Self-employed	91 (88.3)	12 (11.7)	1.02 (0.44-2.39)	0.960	1.30 (0.50-3.42)	0.589
Unemployed	93 (88.6)	12 (11.4)	1 (Ref)		1 (Ref)	
Number of sexual partners						
One	122 (89.7)	14 (10.3)	1 (Ref)		1 (Ref)	
Two	32 (86.5)	5 (13.5)	1.36 (0.46-4.06)	0.580	1.33 (0.37-4.75)	0.658
More than two	42 (89.4)	5 (10.6)	1.04 (0.35-3.05)	0.947	0.98 (0.30-3.17)	0.969
Number of pregnancies						
Primigravida	30 (90.9)	3 (9.1)	1 (Ref)		1 (Ref)	
Multigravida	151 (88.3)	20 (11.7)	1.32 (0.37-4.74)	0.666	1.25 (0.32-4.93)	0.748

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Grand multigravida	15 (93.8)	1 (6.2)	0.67 (0.06-6.97)	0.735	0.72 (0.06-9.14)	0.803
Current gestation age						
First trimester	67 (95.7)	3 (4.3)	1 (Ref)		1 (Ref)	
Second trimester	75 (84.3)	14 (15.7)	4.17 (1.15-15.14)	0.030	5.69 (1.44-22.46)	**0.013**
Third trimester	54 (88.5)	7 (11.5)	2.90 (0.71-11.73)	0.136	2.97 (0.66-13.42)	0.157
Income per day (in Tsh)						
Less than 2400	109 (87.9)	15 (12.1)	1.24 (0.15-10.48)	0.844	1.87 (0.18-19.93)	0.604
2400 to 12,000	78 (90.7)	8 (9.3)	0.92 (0.10-8.25)	0.943	1.22 (0.12-12.26)	0.863
More than 12,000	9 (90.0)	1 (10.0)	1 (Ref)		1 (Ref)	

Table 3: Logistic regression on socio-demographic and behavioral characteristics of the study participants on syphilis infection (N=220)

The results of the multivariate logistic regression showed that the pregnant women living with HIV/AIDS who were infected with hepatitis B were 31 times more likely to acquire syphilis infection as compared to those with no hepatitis B infection (Table 4).

Characteristic	**Syphilis infection status**		**Bivariate**		**Multivariate**	
	Negative n (%)	**Positive n (%)**	**cOR (95% CI)**	**P value**	**aOR (95% CI)**	**P-value**
History of blood transfusion						
No	159 (89.3)	19 (10.7)	1(Ref)		1(Ref)	
Yes	37 (88.1)	5 (11.9)	1.13 (0.40-3.23)	0.818	2.12 (0.61-7.36)	0.238
CD4 count (cells/mm^3)						
< 200	27 (87.1)	4 (12.9)	1.93 (0.45-8.31)	0.380	1.44 (0.25-8.45)	0.685
200-499	77 (87.5)	11(12.5)	1.86 (0.56-6.15)	0.311	1.66 (0.40-6.95)	0.486
≥500	52 (92.9)	4 (7.1)	1 (Ref)		1 (Ref)	
HVL status (copies/ml)						
<50	177 (89.4)	21 (10.6)	1 (Ref)		1 (Ref)	
50-999	11 (91.7)	1 (8.3)	0.77 (0.09-6.24)	0.803	0.38 (0.03-4.17)	0.429
≥1000	4 (80.0)	1 (20.0)	2.11 (0.22-19.74)	0.514	0.38 (0.02-7.66)	0.526
WHO clinical stage of HIV						
Stage 1	170 (89.5)	20 (10.5)	1 (Ref)		1 (Ref)	
Stage 2	23 (85.2)	4 (14.8)	1.48 (0.46-4.71)	0.508	0.80 (0.17-3.85)	0.781
Duration on ART (in months)						
6 to 12	16 (84.2)	3 (15.8)	1.54 (0.42-5.75)	0.517	1.95 (0.38-9.96)	0.423
More than 12	173 (89.2)	21 (10.8)	1 (Ref)		1 (Ref)	
Hepatitis B status						
Negative	186 (94.4)	11 (5.6)	1 (Ref)		1 (Ref)	
Positive	10 (43.5)	13 (56.5)	21..98 (7.89-61.23)	<0.001	31.39 (9.45-104.23)	**<0.001**

Table 4: Logistic regression of clinical and immunological characteristics of the study participants and syphilis infection (N=220)

V. DISCUSSION

The findings from this study shows that the seroprevalence of syphilis among pregnant women living with HIV/AIDS in Mtwara region is 10.9%. This prevalence is relatively higher compared to the previous study conducted in southern Ethiopia which found the seroprevalence of Syphilis to be 5.1% among the pregnant women population[1]. The obtained higher prevalence of Syphilis infection among the pregnant women living with HIV/AIDS in Mtwara region alerts of the need for prompt interventions including scaling up routine screening services at PMTCT clinics. The lower seroprevalence of Syphilis infection was also found in Brazil (4.4%),Jinka town public health facilities, in Ethiopia (4.1%) and Northwest Ethiopia (3.7%)[2,3]

In this study, pregnant women living with HIV/AIDS and on ART who were in second trimester of their pregnancy were 5 times more likely to be infected with syphilis as compared to those who were in first trimester. This could occur due to declining body's immunity as gestation age increases. Furthermore, similar studies have also shown the increase in syphilis infection among pregnant women living with HIV/AIDS and who are in second trimester of their pregnancy[1].

Additionally, the study found that pregnant women living with HIV/AIDS who were infected with hepatitis B were 31 times more likely to acquire syphilis infection as compared to those with no hepatitis B infection. This could occur since hepatitis B infection like any other opportunistic infections deteriorate the body immunity and therefore permits other pathogens such as Syphilis to infect the body. Several previous studies have shown to concur with these findings. For example the previous studies conducted in Northern Ethiopia and Sudan showed that HBV infection was also associated with HIV-syphilis co-infection[1,4].

VI. CONCLUSION

This study revealed that the seroprevalence of Syphilis infection and Syphilis-Hepatitis B co-infection is 10.9% and 5.9 respectively. Furthermore, the study revealed that being in the second trimester of gestation period and being infected with hepatitis Bvirus are significant factors associated with Syphilis infection among pregnant women LWHIV in Mtwara region. Therefore, routine screening of Syphilis and other infections including hepatitis B virus in pregnant women LWHIV and especially those in second trimester of their gestation period is crucial to reduce the burden, and prevent vertical transmission to the neonates.

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- **Authors' contributions**
  All authors have read and approved the manuscript and take responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design*: Vulstan Shedura, GeofreyMchau, Doreen Kamori*interviewing of the study participants and software use:* Vulstan Shedura, GeofreyMchau; *Data cleaning, analysis and interpretation*: Vulstan Shedura, Doreen Kamori, Ally Hussein;*Drafting of manuscript*: Vulstan Shedura, GeofreyMchau, Doreen Kamori

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- **Competing interests**
  All authors declare that they have no commercial or other associations that may pose a conflict of interest.

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