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Prevalence and risk factors for skin diseases among antiretroviral-naïve HIV-infected pregnant women in Dar es Salaam, Tanzania

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Abstract

Background—Reduced cell-mediated immunity associated with pregnancy may cause a flaring or exacerbation of some skin conditions. Little is known about the magnitude of and risk factors for skin diseases among human immunodeficiency virus (HIV)-infected antiretroviral therapy-naïve pregnant women.

Methods—Cross-sectional study of 1078 HIV-infected antiretroviral therapy-naïve pregnant women was conducted in Dar es Salaam, Tanzania. Skin diagnoses were mainly clinical. Log-binomial regression models were used to explore factors associated with the outcomes.

Results—About 84% of the women were in World Health Organization (WHO) HIV stage I. Median CD4⁺ count was 405×10^6 cells/l. The prevalence of any skin disease was 18%. Fungal infections (11%), genital ulcers (7%), and viral infections (5%) were the most common skin conditions. Skin infections were 2.64 times more common in HIV stage III (95% CI 1.51–4.62)

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compared to stage I. Fungal infections were 1.77 times common among single, divorced, and widowed women than among married women (95% CI 1.16–2.69), 2.8 times common among women in HIV stage III (95% CI 1.18–6.64) compared to stage I. Genital ulcers were significantly more common among women whose source of income was their own compared with those who got full support from partners, and among WHO HIV stage III disease compared to stage I.

Conclusion—The burden of skin diseases was relatively low. Advanced HIV stage was associated with a range of skin conditions. CD4⁺ cell count was not related to skin infection prevalence.

Introduction

Human immunodeficiency virus (HIV) infection is associated with numerous skin manifestations such as fungal, bacterial, and viral infections, protozoan infestations, neoplastic lesions, inflammatory conditions, noninfectious conditions, and drug reactions. These conditions may be less responsive to treatment.¹ The pathogenesis of skin disorders in HIV-infected patients is not well understood. Some of the available explanations to the pathogenesis include a decline in CD4⁺ T-cell counts,² which predisposes an individual to various skin infections and conditions. Compared to HIV uninfected individuals with skin conditions, it has been found that skin lesions of HIV-infected patients have increased expression of interleukin-4, interleukin-5, eotaxin, and RANTES (Regulated on Activation, Normal T Expressed and Secreted) chemokines. These chemokines are believed to play roles in skin disease causation.³ Other pathological mechanisms include molecular mimicry and immunomodulation by endogenous retroviruses (ERVs) such as human ERV-K or a human T-cell lymphotropic virus⁴ and overexpression of bacterial super antigens/xenobiotics.⁵ Race, age, sex, and the environment may influence the pattern of skin diseases in HIV-infected patients.⁶

Studies conducted in sub-Saharan Africa among HIV-infected people have shown that skin infections, drug reactions, and neoplasms were common.^{7,8} In HIV-negative women, reduced cell-mediated immunity associated with pregnancy may cause a flaring or exacerbation of some skin conditions such as candidal vaginitis, seborrheic dermatitis, condyloma accuminata, herpes simplex, varicella zoster, and leprosy.⁹ The risk of flaring of these conditions might therefore be higher in an HIV-infected pregnant woman. This study was conducted to determine the prevalence and risk factors for skin diseases and conditions in antiretroviral (ARV)-naïve HIV-infected pregnant women. We hypothesized that the prevalence of skin diseases would be high in this population because of the coexistence of HIV infection and physiological immunosuppression due to pregnancy.

Materials and methods

Study design and population

Participants were pregnant women enrolled between April 1995 and July 1997 in a double-blind placebo-controlled trial of multivitamins. The study design has been described in detail elsewhere.¹⁰ In brief, pregnant women (12–28 weeks' gestation) from four antenatal clinics in Dar es Salaam were randomized to receive a daily oral dose of one of four regimens: (1)

vitamin A and β -carotene alone; (2) multivitamins (excluding vitamin A) and β -carotenes; (3) multivitamins + vitamin A and β -carotene; or (4) placebo. All women received antenatal supplements of folic acid (5 mg) and iron (120 mg) according to the standard of prenatal care. At the time of the study, ARV therapy was not available to most women in Tanzania, and thus all the women in this trial were naïve to ARVs. Participants were followed through monthly visits to a study clinic where physicians performed a physical examination. A study nurse inquired about the health of the women in the preceding period. Women were requested to provide a blood specimen at baseline and at 6-month intervals thereafter, for the measurement of hemoglobin concentrations, CD4⁺, CD8⁺, and CD3⁺ T-cell counts.

Data collection

Data were collected on demographics, including age, educational level, occupation, source of income, marital status, and money spent on food. Anthropometrics, including weight, height, and mid-upper arm circumference (MUAC), were measured by trained research assistants using standardized procedures and calibrated instruments.¹⁰ Skin condition diagnoses were mainly clinical, and no skin biopsies, microscopy, or cultures were done except for tests for syphilis and high vaginal swab cultures for *Neisseria gonorrhea*. Laboratory tests included HIV screening, CD4⁺ count, plasma vitamin A and E levels, hemoglobin (Hb), and tests for sexually transmitted infections (STIs). Absolute CD4⁺, CD8⁺, and CD3⁺ T-cell counts were evaluated with the FACSCount system (Becton-Dickinson, San Jose, CA, USA). Hb levels were assessed either by a complete blood count machine CBC5 Coulter Counter (Coulter Corporation, Miami, FL, USA) or by the cyanmethemoglobin method using a colorimeter (Corning Inc, Corning, NY, USA). The HIV-1 serostatus was determined by the Enzygnost anti-HIV-1/2 Plus assay (Dade Behring, Marburg, Germany) followed by the Wellcozyme HIV-1 recombinant test (Murex Biotech Ltd, Dartford, Kent, UK). Discordant results were resolved using the Western blot test (Bio-Rad Laboratories Ltd., Hemel Hempstead, Hertfordshire, UK).¹¹ Syphilis tests were performed using the venereal disease research laboratory test (Murex Biotech, Dartford, UK) and *Treponema pallidum* hemagglutination assay (Fujirebio Inc, Tokyo, Japan). Standard laboratory procedures were used to test endocervical and high vaginal swabs for *Neisseria gonorrhoea*, *Candida albicans*, and *Trichomonas vaginalis*. STIs were treated at the time of diagnosis according to the Tanzanian Ministry of Health standards for prenatal care.

Definitions and study variables

Skin diseases were grouped into four major groups as follows: (1) infections of the skin, which was further grouped into bacterial infections, including folliculitis; viral infections, including common warts (*verruca vulgaris*), herpes simplex, and herpes zoster (shingles) infections; fungal infections, including candida infection of all kinds (oral, angular cheilitis [perleche] and vulvovaginal), tinea of all kinds, and infestations, including scabies; (2) papulosquamous disorders, including seborrheic dermatitis; (3) malignancies, such as Kaposi's sarcoma; and (4) other conditions such as unspecified gingival erythema and oral ulcers.¹² We also grouped as a major category all genital ulcers regardless of their cause.

The World Health Organization (WHO) HIV disease staging was used to categorize patients into stage I, II, III, or IV disease.¹³ Anemia was defined as hemoglobin < 11.0 g/dl¹⁴ and

severe anemia as hemoglobin < 8.5 g/dl. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared and was categorized according to WHO standards as underweight when BMI was < 18.5 kg/m², normal weight when BMI was 18.5–< 25 kg/m², overweight or obese when BMI was ≥ 25 kg/m².¹⁵

Statistical analysis

Proportions or median (interquartile range) values were calculated for characteristics at the time of enrollment. Prevalence ratios (PR) and 95% confidence intervals were estimated using binomial regression with the log-link function for skin outcomes.¹⁶ When the log-binomial model failed to converge, log-Poisson models, which provide consistent but not fully efficient estimates of the risk ratio and its confidence intervals, were used.¹⁷ All potential risk factors with $P < 0.20$ in the univariate analyses were included in the multivariate models.¹⁸ Tests for trend used the median score test for ordinal variables, and likelihood ratio tests were used to assess the statistical significance of nominal polytomous variables. The missing indicator method was used for variables with missing values.¹⁹ A two-sided $P < 0.05$ was considered statistically significant. All statistical analyses were performed using the statistical software package SAS, Release 9.2 (Cary, NC, USA).

Ethical issues

All women gave informed consent to participate in the study. The study protocol was approved by the institutional review boards of Muhimbili University of Health and Allied Sciences, the Tanzania Ministry of Health and Social Welfare National AIDS Control Program, and the Harvard School of Public Health. None of the sponsors of the study had any role in the study design, data collection, data analysis, data interpretation, or writing of the report.

Results

Of the 1078 women who were enrolled, 1075 had complete dermatological data and were included in this study. The sociodemographic and clinical characteristics of HIV-infected pregnant women are shown in Table 1. Fifty-three percent of the study population was aged < 25 years. The median gestational age (interquartile range) at enrollment was 24 weeks (21–28). The majority of the women (82%) attained primary education, while 89% were married or cohabiting. Seventy-three percent of the women were housewives. Women who had full financial support from their partners were the majority (75%). Only 12% of the women had CD₄ counts below 200×10^6 cells/l. Majority of the women (84%) were in WHO HIV stage I. More than half of the women (58%) were not wasted (MUAC ≥ 25 cm).

The prevalence of skin disorders among HIV-infected pregnant women is shown in Table 2. The prevalence of any skin disease was 18%. The most common skin conditions were fungal infections (11%). Of the fungal infections, tinea infections of any kind and vaginal thrush were the most common. Genital ulcers were seen in 7% of the women, while 3% of the women had genital ulcers clinically related to herpes simplex virus (HSV). Viral infections of all types were seen in 5% of women, genital warts were seen in 3%. Eleven women (1%) had a herpetic scar. Scabies infestation was seen in 0.5% of the women, while 0.1%

presented with Kaposi's sarcoma. Vulval excoriations of unknown cause were seen in 52 (5%) women. Seborrheic dermatitis was found in one woman. The remaining skin conditions were each seen in < 1% of the women.

Table 3 presents the univariate and multivariate PR estimates for any skin disease. Age was inversely related to the risk of any skin disease. Women aged 30 years or older had a 42% lower risk of any skin disease, compared to women aged 20–24 and below 20 years (trend test $P = 0.01$). Advanced WHO HIV stages were significantly independently associated with an increased risk of any skin disease as compared to WHO HIV stage I (trend test $P < 0.0001$). Compared to women with MUAC of 25 cm or greater, the risk for any skin disease was lower with MUAC < 25 cm, approaching statistical significance (PR = 0.78, [95% CI 0.58–1.03]; $P = 0.05$).

In Table 4, we present the univariate and multivariate prevalence risk estimates for fungal infections. Fungal infections were 1.77 times common among single, divorced, and widowed women than among married women (95% CI 1.16–2.69). Compared with patients with Hb 10 g/dl, the risk for fungal infections was lower by 50% when Hb was 8.5–10 g/dl, and by 38% with Hb < 10 g/dl ($P = 0.03$). The risk for fungal infections was significantly independently higher with advancing WHO HIV stage; being a twofold increased risk with stage II disease and about 2.8-fold with stage III disease ($P < 0.0001$). The risk for fungal infections was lower in patients with malaria parasitemia of 1000 trophozoites or more, approaching statistical significance ($P = 0.05$). There was no association between the prevalence of fungal infections and other risk factors.

Univariate and multivariate PRs for genital ulcers in relation to various risk factors are shown in Table 5. Compared to women aged 20–24 years, the risk for genital ulcers among those aged 30 years or more was significantly reduced by 58% ($P = 0.03$). Women who had partial support from partners or who depended on their own source of income had a 3.1-fold increased prevalence of genital ulcers, compared to those who received full support from partners ($P < 0.001$). The risk for genital ulcers was increased by twofold in WHO HIV stage II disease and by 3.1-fold in WHO HIV stage III disease compared to stage I ($P < 0.001$). CD4⁺ counts and plasma vitamin A and E levels were not associated with the prevalence of genital ulcers; neither was BMI, MUAC, occupation, and amount of money spent on food per day (Table 5).

Discussion

The prevalence of any skin disease in this study is lower than in other studies conducted in patients with HIV. The prevalence was above 40% in other studies in sub-Saharan Africa.^{7,20} The lower prevalence in the present study may be explained by the fact that more than 80% of the study population was in WHO HIV stage I, which is usually an asymptomatic stage. The other studies had moderate to severe immunosuppressed populations. Fungal and viral infections and genital ulcers of any etiological cause were the most common conditions. Fungal infections and viral infections have also been reported to be the three most common conditions in other studies among HIV-infected people.^{1,7} Fungal infections were specifically common in patients with anemia and in advanced HIV stage. Genital ulcers,

regardless of the etiological cause, were common in women younger than 24 years of age, those who had partial or no support from partners, and in advanced HIV stage. Women of age < 30 years, in HIV stage II or higher, and having MUAC above 25 cm were associated with a high prevalence of skin diseases. Herpes zoster, which tends to occur even with high CD₄ levels and well understood to be a marker of HIV infection, was not common in the present study. This may be best explained by the fact that probably those who had herpes zoster in the past might have decided not to become pregnant having known that they were HIV infected. Skin diseases associated with severe immunosuppression such as pruritic papular eruption and molluscum contagiosum were not found, again likely because of the high immune status of the study population.

In the present study, vaginal thrush was more common than oral thrush. It is well known that oral thrush is common in patients with CD₄⁺ count < 200 cells × 10⁶/l. The median CD₄ count in this study was 405 cells × 10⁶/l. Asymptomatic vulvovaginal candida colonization occurs in 10–20% of HIV negative non-pregnant women, and the frequency has been observed to be 15–30% in pregnant women, declining substantially in postmenopausal women.²¹ Although vaginal colonization is significantly increased in HIV-infected women compared to HIV-negative women, it cannot be used as an indicator of the presence of HIV infection.²²

A MUAC of 25 cm or more was marginally associated with high prevalence of any skin disease. Overweight and obese people, who are likely to present with MUAC ≥ 25 cm, have been found to be at increased risk for yeast and bacterial infections, especially on skin folds (intertriginous dermatitis) because of retention of moisture in these areas.²³ An advanced WHO HIV stage was also associated with an increased prevalence of skin diseases; HIV stage may correspond to the severity of immunosuppression and can explain the increased prevalence.^{3,24}

A low hemoglobin level was associated with an increased prevalence for both fungal infections and genital ulcers. Though it was beyond the scope of this study to identify the type of anemia, aplastic anemia has been associated with certain fungal infections²⁵ and anemia of chronic diseases with cutaneous ulcers.²⁶ The prevalence for genital ulcers was significantly higher in women who had partial support from their partners or who depended on their own source of income compared to those who received full support from partners. These higher risk women might have been engaged in risky behaviors to muddle through life hardships. Such behaviors could have exposed them to STIs known to cause genital ulcers, for instance HSV type 2 viral infections. Studies conducted in Tanzania have found that more than 62% of genital ulcers are caused by HSV type 2.^{27–29} Advanced WHO HIV stage was also significantly associated with genital ulcers. There was no association between skin diseases and CD₄⁺ counts probably because the majority of women had relatively high CD₄ counts.

The study had two limitations. The available dermatological data were collected by different clinicians; thus, at least some heterogeneity in the dermatologic precision of diagnosis is expected. The diagnoses were mainly clinical, and this may have led to over- or underestimation of some conditions. The strengths of this study include the fact that it is one

of its kind, studying skin conditions in the early stages of HIV infection and a big sample size.

Conclusions

The prevalence of skin diseases was low in this group of ARV-naïve pregnant women who attended health facilities for no reason other than antenatal care. Women with advanced HIV disease, those who had normal nutritional status as assessed by MUAC, those who were anemic, or those who did not receive financial support from their partners were more prone to different skin conditions than others. Advanced WHO HIV stage was particularly associated with a high prevalence of genital ulcers. CD4⁺ cell count had no independent influence on skin diseases in this population, who presented with modest immunosuppression. Further studies on skin diseases are needed among pregnant women with moderate to severe immunosuppression in sub-Saharan Africa.

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Table 1

Sociodemographic and clinical characteristics of HIV-infected antiretroviral therapy-naïve pregnant women ($n = 1075$)

Characteristic	%
Age (years)	
<20	13
20–24	40
25–29	30
30+	16
Education (years)	
None	8
Primary 1–4	5
Primary 5–7	77
Secondary+	10
Marital status	
Married	64
Cohabiting	25
Single, divorced, widowed	11
Occupation	
Housewife	73
Professional	3
Small business and other	24
Source of income	
Fully supported by partner	75
Own income or partial support	25
Money spent on food per day (Tanzania shillings)	
< 500 ^a	41
500	59
CD4 count ($\times 10^6$ cells/l)	
< 100	3
100–199	9
200–349	25
350+	62
Hemoglobin (g/dl)	
< 8.5	28
8.5–< 10	34
10+	39
WHO stage	
I	84
II	14
III	1
Body mass index (kg/m^2)	

Characteristic	%
< 18.5	3
18.5–< 25	70
25+	27
MUAC (cm)	
< 22	6
22–< 25	36
25+	58
Plasma vitamin A ($\mu\text{mol/L}$)	
< 20	35
20	65
Plasma vitamin E ($\mu\text{mol/L}$)	
< 8	25
8	75

^aOne US dollar $\approx$ 500 Tanzanian shillings in 1995.

Table 2Prevalence of skin disorders among HIV-infected antiretroviral therapy-naïve pregnant women ($n = 1075$)

Condition	Number ^a	%
Any skin disease	194	18
Fungal infection of any kind	115	11
Tinea of all kinds	56	5
Vaginal thrush	53	5
Dermatophytosis	6	0.6
Angular cheilitis	5	0.5
Genital ulcers of any kind	72	7
Viral infections	55	5
Genital warts	30	3
Vulval herpes simplex	30	3
Bacterial infections (folliculitis)	8	0.7
Infestations (scabies)	5	0.5
Papulosquamous disorders	4	0.4
Nonspecific dermatitis	3	0.3
Seborrheic dermatitis	1	0.1
Malignancies (Kaposi's sarcoma)	1	0.1
Others	3	0.3
Gingival erythema	2	0.2
Oral ulcer (of unknown cause)	1	0.1

^aNumbers do not add up to 194 due to multiple responses.

Table 3
Correlates of the prevalence of any skin disease among HIV-infected antiretroviral therapy-naïve pregnant women ($n/N = 194/1075$)

Characteristic	Number with skin disease/total ^a	Univariate		Multivariate	
		PR (95% CI)	P-value ^b	PR (95% CI)	P-value ^b
Age (years)					
< 20	29/140	1.04 (0.72–1.52)	0.02 ^c	1.08 (0.74–1.58)	0.01 ^c
20–24	86/433	Reference		Reference	
25–29	58/327	0.89 (0.66–1.21)		0.85 (0.63–1.14)	
30+	21/175	0.60 (0.39–0.94)		0.58 (0.37–0.91)	
Education (years)					
None	15/88	Reference	0.24 ^c		
Primary 1–4	8/54	0.87 (0.40–1.91)			
Primary 5–7	145/825	1.03 (0.64–1.67)			
Secondary+	26/108	1.41 (0.80–2.50)			
Literate					
No	15/88	Reference	0.78		
Yes	179/982	1.07 (0.66–1.73)			
Marital status					
Married	112/687	Reference	0.02 ^d	Reference	0.28 ^d
Single, divorced, widowed	33/123	1.65 (1.17–2.31)		1.33 (0.94–1.88)	
Cohabiting	49/265	1.13 (0.84–1.54)		1.06 (0.79–1.43)	
Occupation					
Housewife	125/785	Reference	0.01 ^d	Reference	0.32 ^d
Professional	7/27	1.63 (0.84–3.14)		1.54 (0.78–3.05)	
Small business and other	62/263	1.48 (1.13–1.94)		1.67 (0.87–3.21)	
Source of income					
Fully supported by partner	132/806	Reference	0.01	Reference	0.65
Own income or partial support	62/268	1.41 (1.08–1.85)		0.86 (0.45–1.65)	
Money spent on food per day (Tanzania shillings)					
500+	106/572	Reference	0.88		
< 500	71/391	0.98 (0.75–1.29)			

Characteristic	Number with skin disease/total ^d	Univariate		Multivariate	
		PR (95% CI)	P-value ^b	PR (95% CI)	P-value ^b
CD4 count ($\times 10^6$ cells/l)					
< 100	11/34	Reference	0.24 ^c		
100–199	18/95	1.85 (1.10–3.09)			
200–349	44/252	1.08 (0.69–1.70)			
350+	111/634	0.99 (0.73–1.37)			
Hemoglobin (g/dl)					
< 8.5	63/289	Reference	0.23 ^c		
8.5–< 10	48/354	0.62 (0.44–0.88)			
10+	73/408	0.82 (0.61–1.11)			
WHO stage					
I	141/907	Reference	< 0.0001 ^c	Reference	< 0.0001 ^c
II	46/152	1.95 (1.46–2.59)		1.87 (1.41–2.47)	
III	7/16	2.81 (1.58–5.01)		2.64 (1.51–4.62)	
Body mass index (kg/m ²)					
< 18.5	2/31	Reference	0.55 ^c		
18.5–< 25	134/734	2.83 (0.73–10.9)			
25+	50/278	2.79 (0.71–10.9)			
MUAC (cm)					
< 22	8/61	0.67 (0.34–1.30)	0.06 ^c	0.66 (0.34–1.28)	0.05 ^c
22–< 25	59/380	0.79 (0.60–1.05)		0.78 (0.58–1.03)	
25+	121/618	Reference		Reference	
Malaria parasitemia (trophozoites/200 WBC)					
None	161/865	Reference	0.26 ^c		
1–999	9/56	0.86 (0.47–1.60)			
1000+	21/142	0.79 (0.52–1.21)			
Plasma vitamin A (μ mol/L)					
20	98/541	Reference	0.28		
< 20	61/288	1.17 (0.88–1.56)			
Plasma vitamin E (μ mol/L)					

Characteristic	Number with skin disease/total ^d	Univariate		Multivariate	
		PR (95% CI)	P-value ^b	PR (95% CI)	P-value ^b
8.0	122/623	Reference	0.70		
< 8.0	38/207	0.94 (0.68–1.30)			

^aNumbers may not add up to the total due to missing covariate data.

^bPrevalence ratios, 95% confidence intervals, and corresponding *P*-values were estimated by log-binomial models.

^c*P*-value for trend calculated using the median score test.

^d*P*-value calculated using likelihood ratio test.

WBC, white blood cells.

Table 4
Correlates of the prevalence of fungal infections among HIV-infected antiretroviral therapy-naïve pregnant women ($n/N = 115/1075$)

Characteristic	Number with fungal infections/total ^a	Univariate		Multivariate	
		PR (95% CI)	P-value ^b	PR (95% CI)	P-value ^b
Age (years)					
< 20	13/140	0.79 (0.44–1.41)	0.32 ^c		
20–24	51/433	Reference			
25–29	40/327	1.04 (0.70–1.53)			
30+	11/175	0.53 (0.28–1.0)			
Education (years)					
None	10/88	Reference	0.88 ^c		
Primary 1–4	5/54	0.81 (0.29–2.26)			
Primary 5–7	87/825	0.93 (0.50–1.72)			
Secondary+	13/108	1.06 (0.49–2.30)			
Literate					
No	10/88	Reference	0.85		
Yes	105/982	0.94 (0.51–1.73)			
Marital status					
Married	66/687	Reference	0.04 ^d	Reference	0.03 ^d
Single, divorced, widowed	22/123	1.86 (1.20–2.90)		1.77 (1.16–2.69)	
Cohabiting	27/265	1.06 (0.69–1.62)		1.06 (0.70–1.61)	
Occupation					
Housewife	78/785	Reference	0.41 ^d		
Professional	3/27	1.12 (0.38–3.32)			
Small business and other	34/263	1.30 (0.89–1.90)			
Source of income					
Fully supported by partner	82/806	Reference	0.32		
Own income or partial support	33/268	1.21 (0.83–1.77)			
Money spent on food per day (Tanzania shillings)					
500+	61/572	Reference	0.87		
< 500	43/391	1.03 (0.71–1.49)			

Characteristic	Number with fungal infections/total ^a	Univariate		Multivariate	
		PR (95% CI)	P-value ^b	PR (95% CI)	P-value ^b
CD4 count ($\times 10^6$ cells/l)					
< 100	6/34	Reference	0.64 ^c		
100–199	11/95	1.60 (0.75–3.41)			
200–349	26/252	1.05 (0.58–1.91)			
350+	70/634	0.93 (0.61–1.43)			
Hemoglobin (g/dl)					
< 8.5	43/289	Reference	0.04 ^c	Reference	0.03 ^c
8.5–< 10	28/354	0.53 (0.34–0.83)		0.50 (0.32–0.78)	
10+	40/408	0.66 (0.44–0.99)		0.62 (0.42–0.93)	
WHO stage					
I	82/907	Reference	< 0.0001	Reference	< 0.0001
II	29/152	2.11 (1.43–3.11)		2.02 (1.39–2.93)	
III	4/16	2.77 (1.15–6.62)		2.80 (1.18–6.64)	
Body mass index (kg/m ²)					
< 18.5	1/31	Reference	0.47 ^c		
18.5–< 25	79/734	3.34 (0.48–23.20)			
25+	31/278	3.46 (0.49–24.45)			
MUAC (cm)					
< 22	5/61	0.69 (0.29–1.65)	0.10 ^c	0.61 (0.27–1.41)	0.07 ^c
22–< 25	33/380	0.74 (0.50–1.09)		0.74 (0.50–1.08)	
25+	73/618	Reference		Reference	
Malaria parasitemia (Trophozoites/200 WBC)					
None	99/865	Reference	0.11 ^c	Reference	0.05 ^c
1–999	5/56	0.78 (0.33–1.84)		0.77 (0.33–1.77)	
1000+	10/142	0.62 (0.33–1.15)		0.54 (0.29–1.03)	
Plasma vitamin A (μ mol/L)					
20	58/541	Reference	0.29		
< 20	38/288	1.23 (0.84–1.81)			
Plasma vitamin E (μ mol/L)					

Characteristic	Number with fungal infections/total ^a	Univariate		Multivariate	
		PR (95% CI)	P-value ^b	PR (95% CI)	P-value ^b
8.0	72/623	Reference	0.99		
< 8.0	24/207	1.00 (0.65–1.55)			

^aNumbers may not add up to the total due to missing covariate data.

^bPrevalence ratios, 95% confidence intervals, and corresponding *P*-values were estimated by log-binomial models.

^c*P*-value for trend calculated using the median score test.

^d*P*-value calculated using likelihood ratio test.

WBC, white blood cells.

Table 5
Correlates of the prevalence of genital ulcers among HIV-infected ARV-naïve pregnant women (n/N = 72/1056)

Characteristic	Number with genital ulcers/total ^a	Univariate		Multivariate	
		PR (95% CI)	P-value ^b	PR (95% CI)	P-value ^b
Age (years)					
< 20	9/140	0.76 (0.37–1.54)	0.14 ^c	0.90 (0.44–1.82)	0.03 ^c
20–24	36/425	Reference		Reference	
25–29	20/320	0.74 (0.44–1.25)		0.65 (0.38–1.11)	
30+	7/171	0.48 (0.22–1.06)		0.42 (0.18–0.94)	
Education					
None	8/87	Reference	0.81 ^c		
Primary 1–4	3/53	0.62 (0.17–2.22)			
Primary 5–7	49/811	0.66 (0.32–1.34)			
Secondary+	12/105	1.24 (0.53–2.90)			
Literate					
No	8/88	Reference	0.38		
Yes	64/963	0.73 (0.36–1.47)			
Marital status					
Married	44/675	Reference	0.57 ^d		
Single, divorced, widowed	11/119	1.42 (0.75–2.67)			
Cohabiting	17/262	1.00 (0.58–1.71)			
Occupation					
Housewife	45/768	Reference	0.14 ^d	Reference	0.78 ^d
Professional	2/27	1.26 (0.32–4.94)		0.50 (0.13–1.94)	
Small business and other	25/261	1.63 (1.02–2.61)		0.56 (0.28–1.14)	
Source of income					
Fully supported by partner	45/789	Reference	0.013	Reference	<0.001
Own income or partial support	27/266	1.78 (1.13–2.81)		3.14 (1.59–6.20)	
Money spent on food per day (Tanzania shillings)					
500+	42/562	Reference	0.29		
< 500	22/386	0.76 (0.46–1.26)			

Characteristic	Number with genital ulcers/total ^a	Univariate		Multivariate	
		PR (95% CI)	P-value ^b	PR (95% CI)	P-value ^b
CD4 count ($\times 10^6$ cells/l)					
<100	2/33	Reference	0.19 ^c		
100–199	10/91	1.00 (0.25–3.95)			
200–349	18/248	1.80 (0.93–3.49)			
350+	38/624	1.19 (0.69–2.05)			
Hemoglobin (g/dl)					
< 8.5	26/285	Reference	0.26 ^c		
8.5–< 10	16/346	0.51 (0.28–0.93)			
10+	27/401	0.74 (0.44–1.24)			
WHO stage					
I	51/891	Reference	<0.001 ^c	Reference	<0.001 ^c
II	18/149	2.11 (1.27–3.51)		2.07 (1.25–3.41)	
III	3/16	3.28 (1.14–9.40)		3.12 (1.08–9.05)	
Body mass index (kg/m ²)					
< 18.5	2/30	Reference	0.94 ^c		
18.5–< 25	49/720	1.02 (0.26–4.00)			
25+	19/274	1.04 (0.25–4.25)			
MUAC (cm)					
< 22	2/61	0.42 (0.11–1.70)	0.07 ^c	0.41 (0.10–1.60)	0.07 ^c
22–< 25	20/373	0.69 (0.42–1.15)		0.69 (0.40–1.17)	
25+	47/606	Reference		Reference	
Malaria parasitemia (Trophozoites/200 WBC)					
None	56/849	Reference	0.97 ^c		
1–999	5/54	1.40 (0.59–3.36)			
1000+	9/141	0.97 (0.49–1.91)			
Plasma vitamin A (μ mol/L)					
20	42/529	Reference	0.30		
< 20	17/286	0.75 (0.43–1.29)			
Plasma vitamin E (μ mol/L)					

Characteristic	Number with genital ulcers/total ^a	Univariate		Multivariate	
		PR (95% CI)	P-value ^b	PR (95% CI)	P-value ^b
8.0	47/610	Reference	0.51		
< 8.0	13/206	0.82 (0.45–1.48)			

^aNumbers may not add up to the total due to missing covariate data.

^bPrevalence ratios, 95% confidence intervals, and corresponding *P*-values were estimated by log-binomial models.

^c*P*-value for trend calculated using the median score test.

^d*P*-value calculated using likelihood ratio test.

WBC^c, white blood cells.