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Incidence of Abscess and Predictors of Time to Abscess among Individuals in HIV Discordant Relationships in Zambia

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Bachelor of Science

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2015

ABSTRACT

Incidence of Abscess and Predictors of Time to Abscess among Individuals in HIV Discordant Relationships in Zambia

By Nekabari Sigalo

Background: Dermatologic manifestations are very common among individuals with HIV. An abscess is a pus-filled sack that can occur anywhere in the body, which is usually caused by bacterial infection. Abscesses can also occur in otherwise healthy individuals and among people of all ages. We develop a predictive model of time to abscess among HIV-negative and HIV-positive individuals in Zambia.

Methods: We analyzed data from a longitudinal cohort from the Zambia Emory HIV Research Project (ZEHRP) in Lusaka. Abscess incidence and significant differences between incidence of abscess for each abscess among HIV-positive and HIV-negative individuals was assessed with Mid-p exact tests. We assessed bivariate associations between covariates and time to abscess, stratified by abscess type and HIV status. We performed a repeated outcomes survival analysis to assess multivariate associations between covariates and time to abscess, stratified by abscess type and HIV status. The final model was determined using backward selection.

Results: Since HIV status modified the association of the exposures with the outcomes of interest, the 5038 participants were divided into two groups: HIV positive and HIV negative. There was no significant difference in abscess incidence (by abscess type) between HIV-positive and HIV-negative individuals. Among HIV positive individuals, 66% of deep tissue, furuncle, or skin abscesses were treated by a clinician. Among HIV negative individuals, 74% of abscesses were treated by a clinician. Bivariate and multivariable Cox regression models showed that among HIV positive individuals, a per year increase in age, per unit increase in sedimentation rate, being a male, and HIV stage 2, 3, or 4 (versus HIV stage 1) were associated with increased incidence of abscess. Among HIV negative individuals, being a male was associated with increased incidence of abscess.

Conclusion: Age, sedimentation rate, gender, and HIV stage can be used to predict risk of abscess among HIV-positive individuals. Only gender was predictive among HIV-negative individuals. Further studies examining other risk factors of abscess, such as co-infections, environmental stressors, and other factors that were not measured in this analysis are needed.

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Background

Dermatologic manifestations have been known to affect more than 90% of individuals infected with Human Immunodeficiency Virus (HIV) (1). Abscesses often affect individuals infected with HIV, but this skin manifestation also occurs in otherwise healthy individuals and among people of all ages (2, 3). An abscess is a pus-filled sack that can occur anywhere in the body, which is usually caused by *Staphylococcus aureus* (4). The body's immune response to an infection causes this inflammation, as white blood cells begin to accumulate within the infected tissue (4).While most abscesses are easily detected and treated, some abscesses that occur deep within the body can lead to life-threatening complications, such as organ damage (4).

Relevant findings on abscess burden in Sub-Saharan Africa are extremely limited. However, studies have shown that abscesses make up a great deal of the number of emergency room visits in the United States each year (5). In fact, in 2005 approximately 3 million emergency room visits in the United States were attributed to some type of abscess (6). The most common cause of abscesses in emergency room patients in the United States is methicillin-resistant *Staphylococcus aureus* (MRSA), a highly infectious strain of bacteria (6).

Whether infectious or non-infectious, these skin manifestations are a key indicator of the weakening of the immune system and recurring abscesses in an otherwise healthy individual may indicate something more serious (2). Skin manifestations, like abscess, are extremely common among individuals with HIV (7). Data from a previous study on a cohort of HIV discordant couples from the Zambia Emory HIV Research Project (ZEHRP) (8) in Lusaka showed that the prevalence of abscesses, categorized as

furuncles, deep tissue abscess, or skin abscess, were significantly higher among HIV positive participants compared to HIV negative participants.

The abscesses described in this study include furuncle, deep tissue, and skin abscess. A furuncle, also known as a boil, is an infection of hair follicles and nearby skin tissue(9). As the hair follicles within the infected region undergo further damage, the infection progresses; affecting nearby tissues (9). While a furuncle can occur anywhere on the body, this infection typically arises in the buttocks, thigh, face, armpit, or neck (9).

Skin abscess occurs when pus collects on the skin as a result of an infection (3). This type of abscess is superficial, and can occur anywhere on the body (3). Skin abscesses may occur as the result of an injury, bacterial infection, folliculitis, or boil, among people of all ages (3). This type of infection can potentially spread through the blood, to other parts of the body (3).

Unlike superficial abscesses, such as furuncles and skin abscesses, deep tissue abscesses form close to mucosal sites which are rich in bacteria (10). These bacteria cause a fluid-filled inflammatory capsule to form within the tissue, as a result of the immune system's response to the infection (10). Since these are subcutaneous infections, deep tissue abscesses cannot be treated or drained topically (10).

Dermatologic complications and other skin manifestations can serve as clinical indicators of illnesses that compromise the immune system. Research has shown that as CD4 cell count depletes, patients are more likely to experience recurrent skin manifestations (11). Some researchers actually consider certain skin conditions in HIV-infected individuals to be an indicator of AIDS progression (1).

Several studies have examined the association between dermatologic complications and HIV, citing immunodeficiency progression as the key factor in patients who present with these skin problems (1). Some of the most commonly reported skin manifestations in HIV infected individuals include herpes zoster, herpes simplex, dermatophytosis, scabies, and skin boils, also known as abscesses (1). Although the association between these skin manifestations and HIV is known, the predictors of abscess among HIV positive versus negative persons have not been well defined. Factors such as age, sex, sedimentation rate, and other infections, such as tuberculosis, may possibly serve as predictors of abscess incidence in HIV infected individuals.

Examination of the predictors of abscess is an important objective in this study to inform targeted abscess prevention, identification, and treatment efforts among all persons, whether HIV positive or negative (8). As patients continue to present with skin manifestations, whether infectious or non-infectious, dermatologic examination is becoming increasingly important in HIV detection and identifying AIDS progression (12). Additionally, a deeper understanding of these predictors would prove beneficial in clinical settings because once a patient not known to be HIV positive presents with a predictor of abscess in HIV positive persons, clinicians can be prompted to recommend HIV testing (8).

Early detection of HIV is extremely beneficial to the patient and may improve the overall quality of life. Additionally, if HIV testing is done early enough, the patient may receive early treatment and possibly prevent future abscesses that would have occurred had the patient not started antiretroviral treatment (8). Examining the predictors of

abscesses among HIV discordant pairs can prove beneficial in prevention programs that stress the benefits of couples testing and counseling.

To address the gaps in literature, herein we report the incidence of abscess and results of a model which predicts time to abscess among HIV-negative and HIV-positive individuals in Zambia.

Methods

Ethics

This study was approved by the Office for Human Research Protections-registered Institutional Review Boards at Emory University and the University of Zambia. Written informed consent was obtained from all participating couples.

Study design and participants

A longitudinal cohort of married or cohabiting discordant (one partner HIV positive, one partner HIV negative) couples were recruited from a couples' HIV counseling and testing service offered by the Zambia Emory HIV Research Project (ZEHRP) in Lusaka and followed prospectively. CVCT promotions and services, including community-based promotions, pre-HIV test group counseling, rapid HIV testing, and post-HIV test couples counseling, have been described previously (13-17). Participants included in this analysis were enrolled and followed from 1994 to 2012, and couples were seen at quarterly visits with lab and medical data collection, including physical examinations and risk reduction counseling. Couples were censored if either partner died, the couple separated, the HIV-positive partner started antiretroviral treatment (ART), or either partner was lost to follow-up. Because they are discordant couples, the individuals were split equally between HIV positive at baseline and HIV negative at baseline. All individuals included in this analysis had at least one follow-up visit.

Exposures of interest

Exposures of interest captured at baseline were participant age, gender, year of enrollment, monthly household income, and clinical stage of HIV if they were positive. The latter variable used WHO clinical staging guidelines (18) with some modifications (using body mass index instead of weight loss, classifying all cases of tuberculosis as clinical stage 4) (19). Time-varying measures of erythrocyte sedimentation rate (ESR) were collected for all individuals at quarterly follow-up visit.

Outcome of interest

A skin examination was performed for each participant at the clinic. The location and categorization of the abscesses were recorded on a reporting form. Abscesses were categorized as deep tissue, furuncles, or skin abscesses. Diagnoses were based on clinical appearance and/or self-reporting, and more severe abscesses were treated at the clinic. Multiple abscesses of different types could occur in a given individual – thus, abscess is considered a repeated outcome.

Data Analysis

All statistical analyses were performed with SAS, version 9.4 (Cary, NC).

Abscess incidence. Incidence of abscess was calculated as the number of incident abscesses occurring during follow-up per person-year (PY) of follow-up. PYs of follow-up were calculated from enrollment until either an outcome of interest occurred or the couple was censored. Incidence rates (reported per 10,000 PY) were calculated for all abscesses and individually by abscess type (deep tissue, furuncle, skin) stratified by the HIV status of the individual. Significant differences between incidence of abscess between HIV-positive and HIV-negative persons for each abscess type was assessed with

Mid-p exact tests. Confidence intervals were calculated using Byar's Method. The proportion of study intervals with abscess, classified as treated or self-reported, stratified by abscess type were also compared for positive versus negative individuals using Mid-p exact tests.

Description of exposures of interest. Age, gender, ESR, year of enrollment, clinical HIV stage, and monthly household income were described using counts and percentages (for categorical variables) or means and standard deviations (for continuous variables) stratified by whether a person experienced an abscess during follow-up or not. These descriptive statistics are reported separately for HIV-positive and HIV-negative individuals.

Unadjusted and multivariate analyses. Andersen-Gill models using a counting process approach with robust estimation accounting for our repeated abscess outcomes and for the correlation of observations for a given individual over time (20) were used to determine the association between exposures of interest and time to any and each type of abscess. HIV status was assessed as a potential modifier of the exposures of interest, and results are presented stratified by HIV status.

Multivariate repeated outcomes survival analysis was then performed to determine the factors that were independently associated with the outcomes of interest. Multivariate models were built using backward selection, and model variables were assessed for multi-collinearity (using condition index cutoffs of >30 and variance decomposition proportion cutoffs of >0.5). The proportional hazards assumption was confirmed for time-independent variables via graphical methods and statistical tests.

Crude hazards ratios (cHRs) and adjusted hazards ratios (aHRs) are presented for univariate and multivariate associations, respectively.

Results

Study Participant Characteristics

Since HIV status modified the association of the exposures with the outcomes of interest, the 5038 participants included in this analysis were divided into two groups: HIV positive and HIV negative.

Incidence rates per 10^4 person-years showed no significant differences between HIV positive and HIV negative individuals for any abscess (p=0.6981), deep tissue abscess (p=0.4517), furuncle (p=.6024), and skin abscess (p=0.5496) [Table 1].

Among HIV positive individuals, 66% of any abscess incidence (deep tissue, furuncle, or skin) were treated by a clinician. Among HIV negative individuals, 74% of any abscess incidence (deep tissue, furuncle, or skin) were treated by a clinician. The proportion of any abscess responses (yes, treated; yes, self-reported but not treated; and no abscess) were significantly different for HIV positive and HIV negative participants [Table 2].

Among HIV positive participants with any abscess present during follow-up, the mean age of participants was 33 years; the mean erythrocyte sedimentation rate was 71.87 mm/hour; mean monthly family income was 61 USD; 54% were male; and more than 50% had at least Stage 3 (symptomatic infection) or Stage 4 HIV infection (progression from HIV to AIDS). Among HIV positive participants without any abscess during follow-up, the mean age was 31 years; the mean erythrocyte sedimentation rate was 64.76 mm/hour; mean monthly family income was 67 USD; 42% were male; and 42% had at least Stage 3 or Stage 4 HIV infection. Sedimentation rate (p<0.0001), gender

($p=0.0003$), HIV stage ($p<0.0001$), and family income ($p<0.0001$) differed significantly between HIV-positive individuals with and without any abscess.

Among HIV negative participants with any abscess during follow-up, the mean age of participants was 31 years; the mean erythrocyte sedimentation rate was 60.51 mm/hour; mean monthly family income was 61 USD; and 49% were male. Among HIV negative participants without any abscess during follow-up, the mean age was 32 years; the mean erythrocyte sedimentation rate was 54.46 mm/hour; mean monthly family income was 69 USD; and 52% were male. Year of enrollment ($p=0.0131$) and family income ($p<0.0001$) differed significantly between HIV-negative individuals with and without any abscess [Table 3].

Bivariate Analyses

Among HIV positive participants, factors independently associated with increased incidence of any abscess, deep tissue, furuncle, and skin abscess were age (per year increase), sedimentation rate (per unit increase), being a male, and HIV stage 2 (asymptomatic HIV infection), 3 (symptomatic HIV infection) or 4 (AIDS progression) versus HIV stage 1 (primary HIV infection). Year of enrollment from 1995-1998 versus year of enrollment from 1999-2002 and 2003-2006 was associated with increased incidence of any abscess and furuncle abscess.

Among HIV negative participants, the only factor independently associated with increased incidence of any abscess, furuncle abscess, and skin abscess was being a male [Table 4].

Multivariate analyses

In multivariable analyses [Table 5], factors associated with increased rates of any abscess, deep tissue, furuncle, and skin abscess among HIV positive individuals were age (per year increase), sedimentation rate (per unit increase), being a male, and HIV stage 2 (asymptomatic HIV infection), 3 (symptomatic HIV infection) or 4 (AIDS progression) versus HIV stage 1 (primary HIV infection). Year of enrollment from 1995-1998 versus year of enrollment from 1999-2002 and 2003-2006 was associated with increased incidence of any abscess, skin abscess, and furuncle abscess. Income (per USD increase) was associated with increased incidence of skin abscess.

Among HIV negative participants, the only factor independently associated with increased incidence of any abscess, furuncle abscess, and skin abscess was being a male.

Discussion

These data suggest that the incidence rates for any abscess (furuncle, deep tissue, or skin abscess) are not significantly different between HIV positive and HIV negative individuals. However, bivariate and multivariate models showed significant associations between certain variables of interest among HIV positive individuals but not HIV negative individuals.

A per year increase in age was associated with incidence of any abscess, deep tissue abscess, and furuncle abscess in HIV positive individuals. This finding suggests that as an individual ages, their body is slower to respond to opportunistic agents, which increases the risk of sickness or infection (21).

A per unit increase in sedimentation rate was significantly associated with increased abscess incidence among HIV positive individuals. Sedimentation rate is a measure of inflammation in the body, which is examined by the speed of erythrocytes falling in a tube (22). As expected, mean sedimentation rate was significantly higher among individuals with an abscess present during follow-up compared to those with no abscess during follow-up, regardless of HIV status. This finding suggests that a high or abnormal sedimentation rate is an indication of an autoimmune disorder or infection.

Sex was significantly associated with higher incidence of abscess in both HIV positive and HIV negative individuals. More specifically, being a female appears to be a protective factor against abscess incidence, regardless of abscess type (deep tissue, furuncle, or skin). The adjusted hazard ratio suggests that HIV positive men have 1.5

times the chance of getting any abscess compared to HIV positive women. HIV negative men have 1.6 times the chance of getting any abscess compared to HIV negative women.

HIV stage was also significantly associated with higher incidence of abscess in HIV positive individuals. More specifically, participants with HIV stage 2, 3 or 4 had a higher incidence of abscess compared to participants with stage 1 infection. This finding suggests that as immunosuppression progresses, an individual is more vulnerable to opportunistic infections, such as abscess.

Limitations

This study had several limitations. These data were collected from HIV-discordant pairs in the capital city of Zambia, so these findings may not be generalizable to a very different population. Additionally, allowing self-reporting of abscesses by study participants to be included in the case definition could possibly have led to misclassification of cases. We do not have consistent individual data on potentially important clinical variables, such as CD4 cell count, which could be associated with incidence of abscess, and thus could not examine the independent effects on abscess incidence among study participants. Lastly, being that this was a cohort study, bias may be introduced as a result of loss to follow-up.

Significance and Conclusions

Based on these findings, abscess prevention, identification, and treatment efforts in the clinical setting can be better addressed among all persons, whether HIV positive or negative. If an individual presents with any of the predictors of abscess as determined in this study, the clinician can be prompted to test for abscess in the early stages of

development or initiate preventative measures so abscess does not develop, particularly in HIV positive individuals. For example, if a patient is found to have one of the predictors of abscess found in this study, such as elevated or abnormal sedimentation rate, is an older individual, is male, and has late-stage HIV, the clinician may be prompted to initiate preventive measures or identify abscess formation and treat early-on. Treating an abscess in its early stages decreases the number of serious abscess cases. Additionally, identifying an abscess (or risk for developing abscess) early-on can reduce the burden and morbidity associated with HIV infection.

As previously stated, this study found a number of factors that were associated with incidence of abscess in HIV positive individuals but not HIV negative individuals. Age, sex (being a male) and elevated sedimentation rate were associated with abscess in HIV positive individuals, but only sex was associated with incidence of abscess in HIV negative individuals. In a clinical setting, once a patient not known to be HIV positive presents with an abscess *in addition to* one of these predictors of abscess in HIV positive persons, clinicians can be prompted to recommend HIV testing (8) because they now know that these factors are predictors of abscess *among HIV positive persons.*

Other risk factors of abscess, such as co-infections, environmental stressors, and other factors that were not measured in this analysis warrant further study.

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Table 1. Incidence of abscess presentation, by HIV status.

Abscess Type	Number of abscesses	Person-years of follow-up time	Abscess incidence per 10,000 PY	95% CI		P-value*
HIV-Positive (N=2940)						
Any Abscess	1157	1917017	6.04	5.69	6.39	0.6981
Deep Tissue	324	491778	6.59	5.89	7.35	0.4517
Furuncle	521	885517	5.88	5.39	6.41	0.6024
Skin Abscess	436	699099	6.24	5.66	6.85	0.5496
HIV-Negative (N=2098)						
Any Abscess	453	767029	5.91	5.37	6.48	Reference
Deep Tissue	121	199076	6.08	5.04	7.26	Reference
Furuncle	187	304149	6.15	5.30	7.10	Reference
Skin Abscess	182	307761	5.91	5.09	6.84	Reference

*Comparing HIV-positive individuals to HIV-negative individuals

Abbreviations: CI, Confidence Interval; PY, person-years

Table 2. Distribution of abscess occurrence, by HIV status and abscess type.

	Any Abscess					Deep Tissue				
	HIV-Positive (N=17191 intervals)		HIV-Negative (N=16063 intervals)		P-value	HIV-Positive (N=16046 intervals)		HIV-Negative (N=15615 intervals)		P-value
	N	%	N	%		N	%	N	%	
Yes, Treated or Self-Report	1163	7	453	3	<0.0001	324	2	121	1	<0.0001
Yes, Treated	770	66	336	74	<0.0001	246	76	111	92	<0.0001
Yes, Self-Report	393	34	117	26	<0.0001	78	24	10	8	<0.0001
No Abscess	16028	93	15610	97	0.0188	15722	98	15494	99	0.1969
	Furuncle					**Skin Abscess**				
	HIV-Positive (N=16046 intervals)		HIV-Negative (N=15615 intervals)		P-value	HIV-Positive (N=16046 intervals)		HIV-Negative (N=15615 intervals)		P-value
	N	%	N	%		N	%	N	%	
Yes, Treated or Self Report	521	3	187	1	<0.0001	436	3	182	1	<0.0001
Yes, Treated	322	62	130	70	<0.0001	303	69	128	70	<0.0001
Yes, Self-Report	199	38	57	30	<0.0001	133	31	54	30	<0.0001
No Abscess	15525	97	15428	99	0.5814	15610	97	15433	99	0.3151

Table 3. Characteristics of study participants, by HIV status and abscess incidence.

	HIV-Positive (N=2940)					HIV-Negative (N=2098)				
	Any abscess present during follow-up (N=208)		No abscess during follow-up (N=2,732)			Any abscess present during follow-up (N=85)		No abscess during follow-up (N=2013)		
	Mean/N	SD/%	Mean/N	SD/%	P-value	Mean/N	SD/%	Mean/N	SD/%	P-value
Age	33.04	7.88	31.18	7.48	0.2881	30.65	8.97	31.56	8.67	0.6285
Sedimentation Rate	71.87	50.41	64.76	41.98	<0.0001	60.51	164.20	54.46	164.11	0.9640
Gender					0.0003					0.7401
Female	95	45.67	1599	58.53		43	50.59	974	48.39	
Male	113	54.33	1133	41.47		42	49.41	1039	51.61	
Year of Enrollment					0.4081					0.0131
1995-1998	70	33.65	872	19.56		49	57.65	928	19.56	
1999-2002	36	17.31	422	6.03		14	16.47	286	6.03	
2003-2006	102	49.04	1438	16.84		22	25.88	799	16.84	
HIV Stage					<0.0001					--
Stage 1	15	7.21	493	18.05		--	--	--	--	
Stage 2	74	35.58	1058	38.73		--	--	--	--	
Stage 3	88	42.31	898	32.87		--	--	--	--	
Stage 4	31	14.9	283	10.36		--	--	--	--	
Income*	61.41	60.57	67.33	86.27	<0.0001	61.36	48.62	68.67	94.55	<0.0001

*All reported income is in United States dollars (USD)

Abbreviations: SD, standard deviation

Table 4a. Univariate associations between covariates and time to abscess, HIV-Positive.

	HIV-Positive							
	Any abscess present during follow-up				Deep abscess present during follow-up			
	cHR	95% CI		P-value	cHR	95% CI		P-value
Age (Per year increase)	1.0190	1.0090	1.0280	<0.0001	1.0230	1.0090	1.0370	0.0012
Sedimentation Rate (Per unit increase)	1.0020	1.0010	1.0030	<0.0001	1.0030	1.0020	1.0040	<0.0001
Gender								
Man	1.5760	1.3410	1.8530	<0.0001	1.4720	1.1360	1.9080	0.0034
Woman (Reference)	--	--	--	--	--	--	--	--
Income (Per USD increase)	1.0010	0.9990	1.0020	0.3262	0.9990	0.9980	1.0010	0.6000
Year of Enrollment								
1995-1998 (Reference)	--	--	--	--	--	--	--	--
1999-2002	0.5850	0.4300	0.7950	0.0006	0.6990	0.4300	1.1350	0.1480
2003-2006	0.6240	0.4670	0.8340	0.0014	0.8280	0.5180	1.3230	0.4298
Stage								
Stage 1 (Reference)	--	--	--	--	--	--	--	--
Stage 2	1.2990	1.0140	1.6640	0.0380	1.3260	0.9260	1.8980	0.1236
Stage 3	1.5730	1.2300	2.0120	0.0003	1.7010	1.1700	2.4730	0.0054
Stage 4	1.8410	1.3360	2.5390	0.0002	2.3550	1.4300	3.8780	0.0008
	Furuncle abscess present during follow-up				Skin abscess present during follow-up			
	cHR	95% CI		P-value	cHR	95% CI		P-value
Age (Per year increase)	1.0160	1.0030	1.0280	0.0147	1.0170	1.0030	1.0300	0.0152
Sedimentation Rate (Per unit increase)	1.0010	1.0000	1.0020	0.0313	1.0020	1.0010	1.0030	0.0002
Gender								
Man	1.6430	1.3120	2.0570	<0.0001	1.6760	1.3390	2.0970	<0.0001
Woman (Reference)	--	--	--	--	--	--	--	--
Income (Per USD increase)	1.0000	0.9990	1.0010	0.9244	1.0010	1.0000	1.0030	0.0915
Year of Enrollment								
1995-1998 (Reference)	--	--	--	--	--	--	--	--
1999-2002	0.5690	0.3610	0.8990	0.0156	0.0209	0.6160	0.4090	0.9290
2003-2006	0.6000	0.4010	0.8990	0.0132	0.0269	0.5990	0.3810	0.9430
HIV Stage								
Stage 1 (Reference)	--	--	--	--	--	--	--	--
Stage 2	1.1930	0.8600	1.6530	0.2901	1.5620	1.0840	2.2500	0.0167
Stage 3	1.4740	1.0700	2.0290	0.0174	1.6670	1.1570	2.4040	0.0062
Stage 4	1.9350	1.3220	2.8340	0.0007	2.1200	1.2710	3.5380	0.0040

Abbreviations: cHR, Crude Hazard Ratio; USD, United States dollar

Table 4b. Univariate associations between covariates and time to abscess, HIV-Negative.

	HIV-Negative							
	Any abscess present during follow-up				Deep abscess present during follow-up			
	cHR	95% CI		P-value	cHR	95% CI		P-value
Age (Per year increase)	1.0060	0.9940	1.0190	0.3290	0.9840	0.9610	1.0080	0.1977
Sedimentation Rate (Per unit increase)	1.0000	1.0000	1.0010	0.1812	1.0020	0.9980	1.0060	0.3140
Gender								
Man	1.5500	1.2220	1.9670	0.0003	1.1220	0.7480	1.6850	0.5777
Woman (Reference)	--	--	--	--	--	--	--	--
Income (Per USD increase)	0.9990	0.9970	1.0010	0.5523	0.9980	0.9930	1.0030	0.4763
Year of Enrollment								
1995-1998 (Reference)	--	--	--	--	--	--	--	--
1999-2002	0.6970	0.4180	1.1620	0.1658	0.5940	0.2030	1.7360	0.3411
2003-2006	0.8410	0.5000	1.4160	0.5147	1.0780	0.3720	3.1270	0.8904
	Furuncle abscess present during follow-up				Skin abscess present during follow-up			
	cHR	95% CI		P-value	cHR	95% CI		P-value
Age (Per year increase)	1.0130	0.9970	1.0300	0.1194	1.0100	0.9940	1.0270	0.2308
Sedimentation Rate (Per unit increase)	1.0000	1.0000	1.0010	0.3649	1.0000	0.9990	1.0010	0.5514
Gender								
Man	2.1550	1.4630	3.1740	0.0001	1.4410	1.0360	2.0050	0.0300
Woman (Reference)	--	--	--	--	--	--	--	--
Income (Per USD increase)	1.0000	0.9970	1.0020	0.8301	0.9990	0.9970	1.0020	0.4849
Year of Enrollment								
1995-1998 (Reference)	--	--	--	--	--	--	--	--
1999-2002	0.5390	0.2400	1.2070	0.1328	1.0120	0.5530	1.8530	0.9691
2003-2006	0.7690	0.3360	1.7600	0.5337	0.8600	0.4210	1.7590	0.6799

Abbreviations: cHR, Crude Hazard Ratio; USD, United States dollar

Table 5a. Multivariate associations between covariates and time to abscess, HIV-Positive.

	HIV-Positive							
	Any abscess present during follow-up				Deep abscess present during follow-up			
	aHR	95% CI		p-value	aHR	95% CI		P-value
Age (Per year increase)	1.009	1.001	1.017	0.020	1.017	1.002	1.031	0.022
Sedimentation Rate (Per unit increase)	1.002	1.001	1.003	<0.0001	1.003	1.002	1.004	<0.0001
Gender								
Man	1.442	1.264	1.646	<0.0001	1.320	1.029	1.694	0.029
Woman (Reference)	--	--	--	--	--	--	--	--
Year of Enrollment								
1995-1998 (Reference)	--	--	--	--	--	--	--	--
1999-2002	0.615	0.493	0.766	<0.0001	--	--	--	--
2003-2006	0.606	0.482	0.763	<0.0001	--	--	--	--
Stage								
Stage 1 (Reference)	--	--	--	--	--	--	--	--
Stage 2	1.271	1.072	1.507	0.006	1.303	0.939	1.810	1.303
Stage 3	1.538	1.290	1.833	<0.0001	1.552	1.111	2.166	1.552
Stage 4	1.591	1.265	2.001	<0.0001	1.962	1.298	2.967	1.962
	Furuncle abscess present during follow-up				Skin abscess present during follow-up			
	aHR	95% CI		p-value	aHR	95% CI		P-value
Age (Per year increase)	--	--	--	--	--	--	--	--
Sedimentation Rate (Per unit increase)	--	--	--	--	--	--	--	--
Gender								
Man	1.532	1.279	1.835	<0.0001	1.532	1.279	1.835	<0.0001
Woman (Reference)	--	--	--	--	--	--	--	--
Year of Enrollment								
1995-1998 (Reference)	--	--	--	--	--	--	--	--
1999-2002	0.594	0.431	0.817	0.001	0.594	0.431	0.817	0.001
2003-2006	0.596	0.431	0.826	0.002	0.596	0.431	0.826	0.002
HIV Stage								
Stage 1 (Reference)	--	--	--	--	--	--	--	--
Stage 2	1.146	0.889	1.476	0.293	1.146	0.889	1.476	0.293
Stage 3	1.484	1.146	1.921	0.003	1.484	1.146	1.921	0.003
Stage 4	1.800	1.298	2.496	0.000	1.800	1.298	2.496	0.000

Abbreviations: aHR, Adjusted Hazard Ratio; USD, United States dollar

Table 5b. Multivariate associations between covariates and time to abscess, HIV-Negative.

	HIV-Negative							
	Any abscess present during follow-up				Deep abscess present during follow-up			
	HR	95% CI		P-value	HR	95% CI		P-value
Gender								
Man	1.570	1.295	1.903	<0.0001	--	--	--	--
Woman (Reference)	--	--	--	--	--	--	--	--
	Furuncle abscess present during follow-up				Skin abscess present during follow-up			
	HR	95% CI		P-value	HR	95% CI		P-value
Gender								
Man	2.128	1.555	2.912	<0.0001	1.507	1.110	2.045	0.0085
Woman (Reference)	--	--	--	--	--	--	--	--

Abbreviations: aHR| Adjusted Hazard Ratio