

# Prevalence of Mycobacterium Tuberculosis and Dermatophytes Co-Infection in Human Immunodeficiency Virus (HIV) Patients

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**Abstract:** The syndemic interaction between the Human Immuno Deficiency Virus (HIV) and opportunistic infections can have far reaching consequences on a person's health. HIV associated dermatophytic infections result in extensive skin lesions which can be difficult to treat due to poor response to conventional antifungal therapy. HIV-associated tuberculosis especially also contributed substantially to the burden of tuberculosis-associated morbidity and mortality. The Aim of this research was to study the co-infection of mycobacterium tuberculosis and dermatophytosis in a HIV positive population visiting the HIV clinics in some hospitals around Anyigba, Kogi State, Nigeria. Skin scrap samples were collected from nine hundred and seventy six (976) HIV positive persons within six (6) months for analysis. Out of these, 56 patients had dermatophytes infection, the skin lesions and skin scrap samples were further analyzed to identify the dermatophytes. Descriptive analysis, Student T tests and one way ANOVA were carried out to understand the various relationships. Most patient presented to the clinic with cough, fever, weight loss and multiple symptoms, and with CD4 values less than 200 cells/μl and substantially between 200-349 cells/μl and 350-499 cells/μl. The Predominant age of patients with HIV co-infected with tuberculosis and dermatophytosis was between 25-34 years and 35-44 years respectively. Dermatophytes were mostly found in patients with CD4 values which were equal or lower than 200 cells/μl irrespective of their age group. The predominant dermatophyte was Trichophyton species with Trichophyton tonsurans being the commonest species isolated followed by Trichophyton rubrum, Trichophyton mentagrophytes and Trichophyton gallinae. The finding of this study revealed that the prevalence of HIV infection led to higher progression rate of 10% active tuberculosis. It also revealed that Trichophyton species were the predominant dermatophytes in the environment with Trichophyton tonsurans being the most common isolate. Most patients visiting the hospital were already in the stage II and III of HIV infection in this area and the most common opportunistic infection is Tuberculosis.

**Keywords:** HIV Infection, Tuberculosis, Opportunistic Infections, Dermatophytes, Coinfection

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## 1. Introduction

The Human Immunodeficiency Virus (HIV) was unknown until the early 1980's, but it has since infected millions of persons across the globe, resulting in a worldwide pandemic. The prevalence of HIV in Nigeria is relatively low (1.5%) but the large population means that over 1.8 million people are living with HIV as at 2019. [1] All HIV infected persons are at risk for illness and death from opportunistic infections and neoplastic complications as a result of the inevitable

manifestations of AIDS. [2] The widespread use of Anti-Retroviral Therapy (ART) starting in the mid-1990s has had the most profound influence on reducing opportunistic infections-related mortality in HIV-infected persons in places where these therapies are accessible and affordable [3, 4].

Studies have shown that owing to the weakened immune states, people living with HIV/AIDS are more vulnerable to infections. [5] These opportunistic infections may not be fatal in a person without HIV infection. However, they are the major causes of morbidity and death among patients with low CD4+

counts or who are in advanced stages of AIDS. Some of the opportunistic infections are those caused by bacteria (e.g. *Mycobacterium tuberculosis*, Bacteria pneumonia); Fungi (e.g. *Candida albicans*, Dermatophytes, Cryptococcosis, Pneumocystic, Jiroveci pneumonia or Pneumocystic carinii pneumonia PCP), Protozoan parasites (e.g. Toxoplasmosis, Cryptosporidiosis) and viruses (e.g. Herpes. Hepertitis). In view of the above, it is therefore imperative for the clinicians to identify and have a high index of suspicion of the common organisms implicated in HIV co-infection in their locality, especially in patients with low CD4 counts as prompt diagnosis will lead to prompt institution of therapy, and invariably, a better outcome. This research therefore aims to identify these opportunistic pathogens in this group of patients in a locality in North Central Nigeria, to aid the clinician in resource poor settings like Africa make a more rational diagnosis as well as to add to the existing body of knowledge about HIV co-infections.

## 2. Methodology

### 2.1. Study Design

In order to obtain a representative sample, the HIV clinics of most utilized health facilities (Grimard Catholic Hospital, Anyigba, Christian Hospital, Ika and Holly Memorial Hospital, Ochadamu) were used for the study. Ethical approval was obtained from the managements of the selected hospitals. The calculated number of participants was rounded off to 976. This number was then spread over the 3 hospitals in the ratio 3:2:1 (Grimard Catholic Hospital, Anyingba:Holly Memorial Hospital, Ochadamu:Christian Hospital, Ika), based on therecorded average patient population in the HIV clinic of these hospitals. The 976 participants were chosen by simple random sampling over a six month period. Informed consent was then obtained from them. Blood, Sputum and Skin scrap samples were collected from the study subjects and sent to the microbiology laboratory of the Grimard Catholic Hospital. They were analyzed for the presence of dermatophytes and Tuberculosis to establish the presence or absence of these co-infections. The different dermatophytes species were identified after culture (see Appendices) and documented. The socio demographic characteristic of each participant was also recorded at recruitment.

### 2.2. Data Analysis

Descriptive analysis, student's t-test, Chi-square and one way ANOVA were carried out for the variables. P value was set at less than 0.05 for significance.

## 3. Result

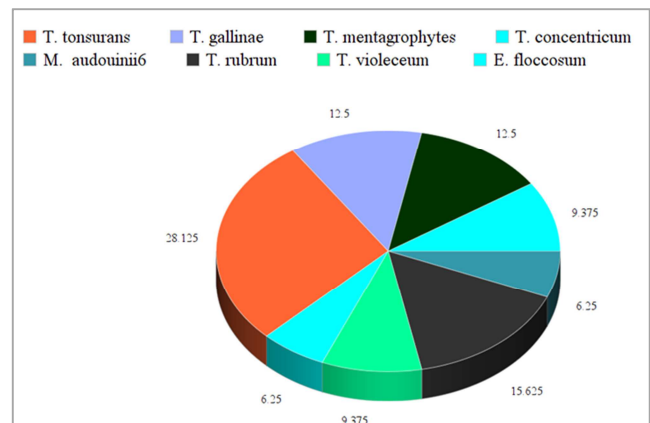
The results show that 30.5% of the study subjects were within the age of range of 25-30 years, 26.4% were within the age range of 31-36 years, while 13.1% fell within the age range of 37-42 years.

The prevalence of HIV/ tuberculosis/ dermatophytes co-

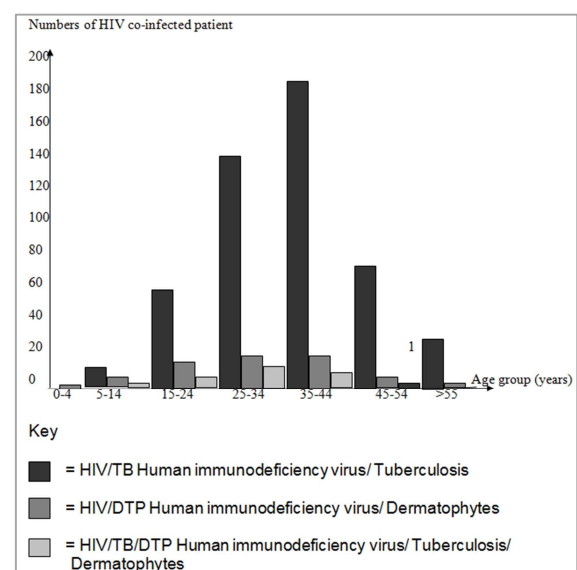
infection was studied for a period of 6 months; Nine hundred and seventy six (976) patients were recruited out of which 565 (57.9%) patients had HIV/TB/Dermatophytosis. Four hundred and eighty three (483) (43.87%) had HIV/TB co-infection, 56 (5.7%) had HIV/dermatophytosis while 286 (29.3%) participants had opportunistic infections other than TB/Dermatophytosis and 125 (11.35%) subjects had only Tuberculosis.

The male to female ratio of patients with HIV co-infected with tuberculosis and dermatophytosis was 2:3 but statistical analysis showed no significant difference between the sex ratio in the study ( $P > 0.05$ ) while significant difference was observed between HIV/TB and HIV/Dermatophytes co-infection in the study.

Clinical manifestation in relation to CD4 values showed that 24.3% of the participants within the period of study had fever, 17.8% had chronic cough while 13.6% complained of weight loss. Those who presented with multiple complaints constituted 14.2%. Out of the 976 study subjects, 34.9% presented with a CD4 count of less than 200 cells/ $\mu$ , while 31.5% presented with CD4 counts between 200-349 cells/ $\mu$ l.



**Figure 1.** Pie chart showing the percentage of different species of dermatophytes co-infecting HIV patients.



**Figure 2.** Bar chart showing the distribution of HIV co-infections.

Regarding dermatophytes, the results showed that Trichophyton were abundant in this environment and essentially found in all anatomical sites where skin was scraped. *T. tonsurans* appeared most commonly than any species of dermatophytes isolated followed by *T. rubrum*, *T. metagrophytes*/ *T. gallinae* then *T. concentricum*/*T. violaceum*. However, *E. floccosum* was mainly gotten from perineum and *M. audouinii* were found only in the head. In all, Trichophyton species were found in every part of the body with Microsporum in only the head and Epidermophyton in only the perineum.

The percentage of species of dermatophytes isolate and the prevalence of *T. tonsurans* was found to be high (28.12%), followed by *T. rubrum* (15.62%) *T. metagrophytes* (12.50%), *T. gallinae* (12.50%). Considerable numbers of *T. concentricum* and *T. violaceum* were found and the less common was *F. floccosum* and *M. audouinii*.

## 4. Discussion

The male/female ratio of subjects affected with HIV and co-infected with Tuberculosis and skin lesion is ratio 2:3. This agrees with the findings of a study on Gender and Health inequalities published in 2017 which reported that the women were at higher risk of HIV infection because of their inability to negotiate condom use, or to reject forced sex and non-consensual sex. [6] In addition, a similar study on gender and TB/HIV co-infection, presentation and treatment outcome in Nigeria reported a higher rate TB/HIV co-infection in females (57.3%) as compared to men (42.7%). [7] However these findings are in contrast with the outcome of a Brazilian study which reported that most HIV / Tuberculosis co-infection (81%,  $p=0.0006$ ) were found in men. [8] This variation could likely be due to social and environmental determinants of co-infection in HIV patients as reported by Oliveira and Gonçalves in their study conducted in 2013. [9]

Findings from this study also reveal that of the nine hundred and seventy six (976) participants screened, 565 representing 57.9% of patients had HIV/TB/Dermatophytosis in addition, 483 patients representing 43.87% of the study population had HIV/TB co-infection. This high prevalence agrees with the findings of a study on the prevalence of tuberculosis in HIV-seropositive patients which reported that the overall prevalence rate of TB in HIV to be 33.9%. [10] Another study reported the prevalence of HIV/TB in the North Central State of Nassarawa to be 34.5%. [11] These findings align with the report of the World Health Organization which stated that up to 70% of patients with sputum smear-positive pulmonary tuberculosis are HIV-positive in some countries in sub-Saharan Africa. [12] In contrast, a study conducted in Benue, North Central Nigeria reported a much lower HIV/TB co-infection rate of 19.8%. This variation could be due to the studied population which was mostly children. [13]

South Africa and Nigeria rank among the worst affected by tuberculosis in Sub-Saharan Africa (SSA) and globally, despite comprising just 0.7% of the world's population,

resulting in the largest burden in Africa. [14] In absolute terms, Nigeria remains among the world's highest TB burden countries, accounting annually for about 4% of the world's incident TB cases with an estimated incidence rate of 219/100,000 people. [15] However, result from this study showed an increase to 608/1101 from the previous burden of 311/100,000 reported by USAID in 2010 implying an increase in tuberculosis burden due to HIV in Nigeria.

The result of the prevalence of dermatophytes in this study indicates that 56 subjects representing 5.7% of the study population had HIV/dermatophytosis. This finding is similar to the result obtained in a study on mucocutaneous manifestations in Human Immunodeficiency Virus (HIV)-infected patients published in the International Journal of Dermatology which reported the prevalence of dermatophyte infections in HIV patients to be 16.3%. [16] This is however in contrast with another study on the subject matter which reported that 33.3% of patients with Human Immunodeficiency Virus infection had dermatophytosis. [17] The finding from this study did not also agree with the finding published in the Seminars in Dermatology which reported that up to 20% of HIV infected person developed dermatophytes typically stage 11 and 111 of HIV. [18] These disparities are likely due to environmental factors and stages presented in the hospital.

Results from this study indicate that dermatophytes appeared more than other skin lesion in a ratio of 3:2 respectively. The isolates of dermatophytes were 32, out of which *T. tonsurans* accounted for 28.12% followed by *T. rubrum* with 15.63%. The dermatophytes isolated in this study were *T. tonsurans* followed by *T. rubrum* and *T. concentricum*, *E. floccosum*, *M. audouinii*, *T. gallinae*, *T. metagrophyte* and *T. violaceum*. The predominant dermatophyte was Trichophyton species with Trichophyton tonsurans being the commonest species isolated followed by Trichophyton rubrum, Trichophyton mentagrophytes and Trichophyton gallinae. These findings agree with the results of a study on HIV patients published in 2019 which reported that among dermatophytes isolated, *T. tonsurans* was the commonest cause of infection. [19] In contrast, another study reported that Trichophyton rubrum (33.33%), Trichophyton mentagrophytes (33.33%), *Candida albicans* (16.67%) and *Aspergillus* species (10.00%) were the important species isolated from HIV patients with dermatophyte infections. [20]

Variation in the population of dermatophytes isolated from HIV infected patients is not uncommon. [21] These differences have been reported to be related to conditions, such as host immune response against dermatophytes, and the infected area of the body where samples were taken. [22, 23]

Patients with HIV/TB and or dermatophytes were seen mostly at CD4+ counts of < 200 cells/ $\mu$ l. This group constituted 34.94% of all the cases, this was closely followed by patients with CD4 count range of between 200-349 cells/ $\mu$ l which accounted for 31.56% of cases. Patients with CD4 count range of 350-499 cells/ $\mu$ l accounted for 25.72% of the cases, and the least was CD4 > 500 cells/ $\mu$ l. The above shows that patients with co-infections of HIV with TB and dermatophytes come to hospital with very low CD4 counts.

Most patients with dermatophytes in HIV/TB co-infected patients visited the clinics with CD4 counts of < 200 cells/ $\mu$ l and 200-349 cells/ $\mu$ l. This finding is similar to the results from other studies including a study published in the Asian Journal of Research In Infectious Diseases which reported that the highest rate of dermatophytosis in HIV seropositive group (41.65%) were found among those with CD4 cell counts of less than 200. [24, 25] In contrast, a study published in 2014, reported that CD4+ counts and CD4+/CD8+ ratios were not associated with a higher risk of dermatophytosis but viral load greater than 100 000 copies/ml was associated with a higher frequency of dermatophytosis. [26] This variation could be due to dietary variation in the two study location as HIV negatively affects nutritional status, and poor nutrition further weakens the body's defence system, increasing susceptibility to opportunistic infections. Studies have shown that malnutrition was a significant predictor of opportunistic infections. Malnourished and undernourished HIV patients were associated with high risk and early development of opportunistic infections. [27]

## 5. Conclusion

The finding of this study revealed that the prevalence of HIV infection led to higher progression rate of active tuberculosis. It also revealed that Trichophyton species were the predominant dermatophytes in the environment with Trichophyton tonsurans being the most common isolate. Most patients visiting the hospital were already in the stage II and III of HIV infection in this area and the most common opportunistic infection is Tuberculosis.

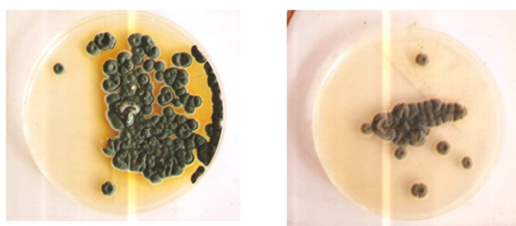
## 6. Further Research Needs

This research has shown that HIV positive patients often present to the hospitals in stages II and III in the studied area, there may be need to study the attitudes of these people further to understand why this is so.

This research also has reported that trichophyton species is the most predominant dermatophyte isolated from HIV positive patients, there may also be need to repeat same study in other localities to know if this still holds in these places

There is also need to study other opportunistic infections in HIV like bacteria and other systemic fungal infections, to give a more holistic view of HIV co-infections

## Appendix



*Trichophyton violaceum*

**Figure 3.** Petri dishes showing cultured *Trichophyton violaceum*.



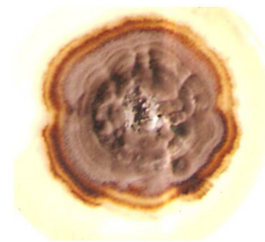
*Trichophyton tonsurans*

**Figure 4.** Petri dishes showing cultured *Trichophyton tonsurans*.



*Microsporum audouinii*

**Figure 5.** Petri dish showing cultured *Microsporum audouinii*.



*Trichophyton concentricum*

**Figure 6.** Petri dish showing cultured *Trichophyton concentricum*.



*Trichophyton soudanense*

**Figure 7.** Petri dish showing cultured *Trichophyton Soudanese*.



*Trichophyton rubrum*

**Figure 8.** Petri dish showing cultured *Trichophyton rubrum*.





*Epidemophyton floccosum*

Figure 9. Petri dish showing cultured *Trichophytonfloccosum*.

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