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Prevalence and risk factors associated with low CD4 count (<200 cells/µl) among HIV patients attending the ART clinic at Arua regional Referral hospital in Arua district. A cross-sectional study.

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Abstract

Background:

Low CD4 count (<200 cells/µl) is a critical indicator of advanced HIV disease and is associated with increased risk of opportunistic infections and mortality. This study assessed the prevalence and risk factors associated with low CD4 count among HIV patients attending the ART clinic at Arua Regional Referral Hospital.

Methodology:

A cross-sectional study was conducted among 101 HIV-positive patients selected through random sampling. Data were collected using structured questionnaires, patient records, and interviews. CD4 counts were determined using flow cytometry. Data were analyzed using SPSS version 21 and Microsoft Excel, employing descriptive statistics such as frequencies and percentages, and associations between variables were assessed.

Results:

The prevalence of low CD4 count was high at 66.0%. The majority of participants were male (56.4%), aged 28–35 years (40.6%), married (67.3%), and residing in rural areas (72.3%). Significant risk factors associated with low CD4 count included having multiple sexual partners (77.2%), longer duration of HIV infection (>3 years) (48.5%), and undernutrition. A proportion of participants had co-morbid conditions such as syphilis (18.8%) and diabetes mellitus (29%). Although most participants (94.1%) were on ART, delayed initiation and poor adherence were suspected contributors to low CD4 levels.

Conclusion:

The study revealed a high prevalence of low CD4 count among HIV patients, indicating persistent challenges in early diagnosis, timely treatment initiation, and adherence to ART. Socio-demographic and behavioral factors significantly contribute to immune suppression among patients.

Recommendations:

Strengthening early HIV testing, improving ART adherence, and enhancing community awareness are essential. Nutritional support, routine screening for co-infections, and targeted interventions addressing high-risk behaviors should be prioritized to improve immune outcomes among HIV patients.

Keywords: *HIV, CD4 count, Antiretroviral therapy (ART), Immunosuppression, Opportunistic infections, Arua Regional Referral Hospital.*
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Background.

In a simple explanation, HIV is an infection that attacks the body's immune system, specifically, the white blood cells.HIV destroys these CD4 cells, weakening a person's immunity against opportunistic infections, such as tuberculosis and fungal infections, severe bacterial infections, and some cancers (WHO, 2020). CD4+ T-cell count is a critical marker for assessing immune function in HIV-infected individuals. A low CD4 count that is < 200 cells/µL is indicative of advanced HIV disease and increases the risk of opportunistic infections and mortality. Though solidarity in the global AIDS response has yielded health gains (UNAIDS, 2013). According to UNAIDS (2021) reported that globally 38.4 million people were living with

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HIV, 1.5 million people became newly infected with HIV, 650,000 people died from AIDS-related illnesses, 8.7 million people were accessing antiretroviral therapy and also 84.2 million people have become infected with HIV since the start of the epidemic and 40.1 million people have died from AIDS- related illnesses since the start of the epidemic. Though there was a reported decline in new infection rates, the African continent and, in particular, Sub-Saharan Africa, remains the most affected, with nearly 1 in 20 adults (49%) living with HIV and accounting for 69% of the total population living with HIV globally. In North Africa and the Horn of Africa, HIV prevalence is lower than in the South, which is the worst affected. At least 10% of the population aged 15-45 years in most South African countries is infected. (UNAIDS, 2013).

CD4 T lymphocyte cells play a central role in the immune system, and their count is a key indicator of immune function in individuals infected with HIV. A CD4 count < 200 cells/mm³ is considered severely immune-compromised and marks the threshold for an AIDS diagnosis. Patients with such low counts are at increased risk of opportunistic infections, disease progression, and death. Early diagnosis and prompt initiation of antiretroviral therapy (ART) are critical in preventing the decline of CD4 cells and improving patient outcomes. (UNAIDS, 2023). From research that was done in Sub-Saharan Africa, six in seven new HIV infections among adolescents aged 15-19years are among girls. It also included that young women aged 15-24years are twice as likely to be living with HIV as men. Around 4200 adolescent girls and young women aged 15-24 years became infected with HIV every week in 2020. Women and girls accounted for 63% of all new HIV infections in 2020. In 2020, 84% of the PLWH knew their HIV status. Among the people who knew their status, 87% were accessing treatment, and among people accessing treatment; 90% were virally suppressed (UNAIDS 2021). In Uganda, data sources state that HIV & AIDS are recognized as a serious health and development concern fueled by poverty, gender, and socio-economic inequality, and a lack of information on the preventive measures. From a study that was done in Uganda in 2018, an estimated 1.4 million people were living with HIV, and an estimated 23,000 people died of AIDS-related illnesses. During the same year, the estimated HIV prevalence among adults (aged 15 to 49) stood at 5.7 % (Lasry et al., 2019). Adolescence is a period of vulnerability with the onset of multiple risky behaviors such as smoking, inappropriate alcohol consumption, and drug use, with the consequences of an increased risk of engaging in unprotected, multiple sexual experiences. This further exposes the adolescent to HIV/AIDS and other sexually transmitted diseases, and as such, they are central to the prevention and control of the HIV/AIDS epidemic with respect to the degree of their vulnerability, transmission, and potential for behavioral change. Despite expanded HIV testing and treatment programs in Uganda, many patients continue to present late to health facilities with advanced disease and low CD4 counts. Several studies have highlighted socio-demographic factors such as age, sex, education, and socioeconomic status as key determinants of late presentation and low CD4 count. These factors may influence an individual's health-seeking behavior, access to care, and adherence to treatment. Arua Regional Referral Hospital, serving as a major referral center for the West Nile region, provides HIV care to thousands of patients annually. However, clinical reports and observations suggest that a considerable proportion of HIV-positive patients present to the hospital's ART clinic with critically low CD4 levels. This trend raises concerns about ongoing gaps in early HIV detection, linkage to care, and retention in treatment programs within the region. Understanding the prevalence of low CD4 count and the socio-demographic characteristics of affected individuals is essential for informing targeted interventions aimed at early diagnosis, timely treatment initiation, and improved patient outcomes. This study assessed the prevalence and risk factors associated with low CD4 count among HIV patients attending the ART clinic at Arua Regional Referral Hospital.

Methods.

Study design

This study used a cross-sectional study design, which was conducted in a short, specified period of time. Data was collected during a single encounter with each participant and was thereafter analyzed to yield results. This design was therefore suitable because, since the study required only a single encounter with the respondent, the data required was obtained in the available time, and there was no need for follow-up. To determine the prevalence of low CD4 count below 200cells/µl among HIV patients.

Study area.

This study was conducted at Arua Regional Referral Hospital, located in the Northern region, Arua city, Uganda. ARRH was the study area because it is a regional hospital and therefore has a large and more convenient ART facility and programme to accommodate a number of HIV patients, and this resulted in more reliable and efficient results.

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Study population.

The study population was HIV patients attending the ART clinic at ARRH. This population was used because of the increasing cases of low CD4 and its consequences among HIV patients at ARRH.

Sample size determination.

The sample size was determined using a standard formula of Kish and Leslie as stated below;

$$n= \frac{^2P(1-P)}{d2}$$

n=Sample size

Where p is the prevalence of low CD4 in the target population, and taking p as 7.1%=7.1%/100%, which is 0.071. (Eric *et a*l., 2023)

Z is the score at 95% confidence interval, and it is a constant denoted as 1.96. D is the acceptable error at 95% confidence interval, which is 0.05.

Therefore;

$$n=\frac{96^2*0.071(1-0.071)}{0.05^2}$$

n = 101 respondents.

The study used a sample of 101 participants from the population.

Sampling technique.

The study used a random sampling method to collect data. This was to enable the researcher to acquire unbiased data and draw conclusive results. The sampling technique was also convenient for all the respondents who were available.

Sampling procedure.

The research began with the HIV patients who were available on the first day in the facility. The participants were approached randomly, and those found in the study area were sampled after reading the consent form and understanding it, and recruited into the study in order to obtain the required sample size. After accepting to be in the study, the participants were given a questionnaire to answer the questions in it, and later collected. Points were awarded according to the answers and data collected.

Data collection method

An interview method was used, and participants were provided with questionnaires that were filled out under the supervision of the researcher. This involved open-ended questions, which gave the respondent a chance to explain more on the topic of study, and also closed-ended questions, which gave a set of answers the respondent could choose from.

Data collection tools

The instruments to be used included the questionnaires, the patient register book, and interviews.

Data collection procedure

The researcher obtained an introductory letter from the School of Medical Laboratory Technology, Mildmay Institute, and was taken to the City Health Officer and the research committee of ARRH for approval and acceptance to carry out the research. The topic, procedures, significance, and intentions of the research were explained to the respondents, including the benefits, ethical considerations such as confidentiality and consent. The content of the questionnaires as well was explained prior, so that they gave consent before any data collection procedure, knowing what they were going to do. The flow cytometry test was performed on patient blood {Volumetric flow cytometry}. Principle of test: It stated that it utilizes fluorescence-based technology, which works by measuring the fluorescence intensity of labeled antibodies that bind to CD4 + T cells in the sample. Which was then used to calculate the CD4 count

Procedure

-Assemble all necessary requirements.
-Turn on the analyser and mix the anticoagulated blood.
-Using the pipette, dispense the blood into the cassette and allow the blood to flow through the cassette.
-Insert the cassette into the analyser. Wait till the analyzer reads the cassette, then enter patient details.
-Give time for the analyser to process the sample and read the result from the screen. Interpretation of results: A CD4 count of less than 200 cells/µl is indicative of a low CD4 count.

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Test	Normal Range
CD4 cell count	600–1,200 cells/mm^3
High	Above 500 cells/mm^3
Medium	200–500 cells/mm^3
Low	Below 200 cells/mm^3
Treatment guidelines threshold	350 cells/mm^3
CD8 cell count	200–1,000 cells/mm^3
CD4 cell percentage	30–60%
CD8 cell percentage	15–40%
CD4/CD8 cell ratio	0.9–3.0

Study variable

Dependent variable

The dependent variable of this study was the prevalence of low CD4 among HIV patients.

Independent variable

The independent variable of the study was socio-demographic and associated risk factors of low CD4 count among HIV patients.

Quality control

The research report was under supervision from the School of Laboratory Technology, Mildmay Institute of Health Sciences. A well-structured questionnaire was taken to the research supervisor to check for errors, and where necessary, modifications were made to the questions to ensure quality results. Adjustments to the methodology and tools were made, and interviews were developed according to the objectives of the study. The research assistants were trained and briefed before data collection. The researcher also adhered to SOPs in order to maintain the quality of the results obtained.

Data analysis and presentation

Data was analyzed using Microsoft Excel software and a scientific calculator; data analysis also used SPSS version 21 and presented in tabular and graphic form for easy interpretation. Descriptive data analysis was used in the form of frequencies and percentages. The levels of significance were attained by finding the relationship between each independent and dependent variable.

Ethical consideration

The introduction letter was obtained from the School of Medical Laboratory Technology. Forwarded to the City Health Officer for acceptance, which will then be forwarded to the research committee of ARRH for approval. Informed consent was obtained from the participants willing to enroll in the study after explaining to them the nature and purpose of the study. It was clearly explained that participation is at one's free will, and confidentiality was paramount. Therefore, participants had a choice to withdraw at any time during the study.

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Results.

Socio-demographic characteristics of the respondents

Table 1: A table showing socio-demographic characteristics of the respondents

Variables	Category	Frequency n=101	Percentage %
Sex	Male	57	56.44%
	Female	44	43.56%
TOTAL		101	100
Age	<18	13	12.87 %
	18-27	12	11.88 %
	28-35	41	40.59 %
	>35	35	34.65 %
TOTAL		101	100
Occupation	Civil servant	27	26.73 %
	Business woman	16	15.84 %
	House wife	47	46.53 %
	Others	11	10.89 %
TOTAL		101	100
Education Level	None	42	41.58 %
	Primary	33	32.67 %
	Tertiary	26	25.74 %
TOTAL		101	100
Marital Status	Married	68	67.33 %
	single	33	32.67 %
TOTAL		101	100
Residence	Rural	73	72.28 %
	Urban	28	27.72 %
TOTAL		101	100

Results from Table 1 indicate that, regarding sex, the majority of the respondents were male, 57(56.44%), followed by females, 44 (43.56%). With respect to Age, the majority were within the age bracket of 28-35 years 41, 40.59%), followed by >35 years and above 35 (34.65%), then those under 18 years 13, (12.87%), and lastly those 18-27 years 12(11.88%).

In relation to occupation, majority were house wife 47(46.53%), followed by civil servants 27(26.73%), then business women 16(15.84%) and lastly others 11(10.89%).

Pertaining to the level of education, the majority had not gone to school, 42(41.58%), followed by primary level, 33(32.67%), and lastly tertiary level, 26(25.74%).

Concerning marital status, the majority were married, 68(67.33%), followed by single, 33(32.67%). In accordance with residence, the majority were from rural areas,

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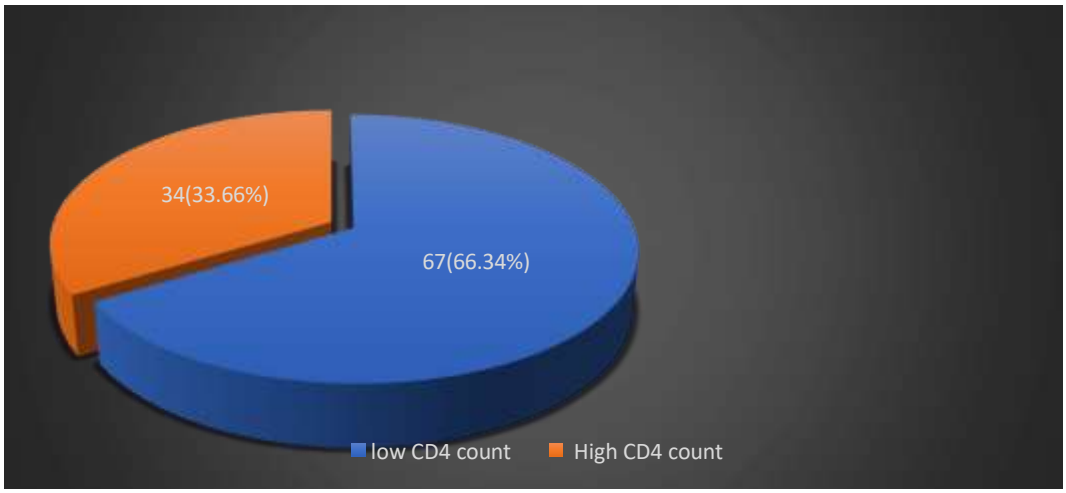
73(72.28%), and urban areas, 28(27.72%).

Prevalence of low CD4 among HIV patients

Table 2: A table showing the prevalence of CD4 counts among HIV patients

Variable	Frequency N=101	Percentage (%)
Low CD4 count	34	33.66
High CD4 count	67	66.34

Figure 1 shows the prevalence of CD4 among the HIV patients.



Source: primary data (2025)

From the figure, the research study found that from the 101 respondents, 67 (66.0%) had low CD4 count and 34(34.0%) had high CD4 count.

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Risk factors associated with low CD4 among HIV patients.

Table 3: showing sexual pattern, syphilis status, smoking status, and being on ARV treatment of the respondents

Variables	**Category**	**Frequency** *N=101*	**Percentage** **%**
Body weight	18.5-24.9 kg	52	51.49
	<18.5 kg	33	32.67
	>30	28	27.72
TOTAL		101	100
Duration of being infected with HIV	1 year	16.	15.84
	2-3 years	36	35.64
	> 3years	49	48.51
TOTAL		101	100
Number of sexual partners	one	23	22.77
	more than one	78	77.23
TOTAL		101	100
Has syphilis	Yes	19	18.81
	No	82	81.19
TOTAL		101	100
Treated Syphilis	Yes	13	68.42
	No	6	31.58
TOTAL		101	100
Does smoke	Yes	16	15.84
	No	85	84.16
TOTAL		101	100
Diagnosed with diabetes mellitus	Yes	29	29.0
	No	72	71.0
TOTAL		101	100

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On ARV treatment	Yes	95	94.06
	No	6	5.94

Source: primary data (2025)

From the table, the research study found that from the 101 respondents, the majority had a body weight bracket of 18.5-24.9 kg, 52(51.49%), followed by <18.5 kg, 33(32.67%), and lastly >30 kg, 28(27.72%). Results from Table 2 indicate that, regarding the number of sexual partners, the majority of the respondents had more than one sexual partner, 78 (77.23%), and 23 (22.77%) had only one partner. The research study found that from the 101 respondents, the majority had a duration of > 3years being infected with HIV, 49 (48.51%), followed by 2-3 years of infection with HIV, 36(35.64%), and lastly 1 year of infection, 16 (15.84%). In relation to syphilis status, the majority did not have syphilis 82, (81.19%), and 19(18.81%) had syphilis. And out of 19 who had it, only 13(68.42%) had been treated, and 6(31.58%) had not been treated. Concerning smoking, the majority did not smoke 85, 84.16%), and 16(15.84%) smoked. The majority, 72(71%), had not been diagnosed with diabetes mellitus, while 29(29%) had been diagnosed with it. And with respect to being on ARV treatment, the majority were on ARV treatment, 95(94.06%), and 6(5.94%) were not on ARV treatment.

Discussions.

Prevalence of low CD4 among HIV patients attending the ART clinic at Arua Regional Referral Hospital.

The first objective of my study was to determine the prevalence of low CD4 among HIV patients attending the ART clinic at Arua Regional Referral Hospital. Data analysis and interpretation revealed that low CD4 count was a significant risk factor for infection among HIV positive patients, with an overall prevalence of 66.0%. This is probably because in the study findings, there were new registries; however, it shows that adherence is poor due to the therapy being started late, hence viral load increases, leading to immune suppression, and also side effects and stigma of the drugs cause poor adherence. Patients who acquire HIV and remain untreated for years often have very low baseline CD4 counts.

Findings agree with findings from a similar study, which showed that the prevalence of OIs was found to be highest (n = 41/ 71, 57.7%) among HIV infected patients with CD4 count less than 200/mm3. (Damtie *et al*., 2013). This can probably be because the virus affects mainly the lymphocytes, thus weakening the immune response, and thus HIV attacks and destroys CD4 cells, a type of immune cell, by using them to replicate itself. The virus binds to, enters, and takes over the CD4 cell's machinery to make copies of itself, ultimately leading to the infected cell's destruction. HIV can also kill uninfected CD4 cells through processes like pyroptosis, leading to a rapid decline in the body's ability to fight infections. However, the finding disagreed with findings from a similar study by (Baluku *et al*., 2020) which indicated that the prevalence of CD4+ T-lymphocytopenia was 25% among HIV-negative patients with bacteriologically confirmed TB in Uganda, and also (Nanteza *et al*., 2014) which revealed that Most respondents had CD4+ count greater than 350 cells/mm3 (88.1%, n = 296). This was so because in this study, the research was carried out among HIV negative patients, where their immunity or CD4 cells are not destroyed, thus the CD4 count will thereby not be reduced or affected in any way.

Risk factors associated with low CD4 among HIV patients attending the ART clinic at Arua Regional Referral Hospital.

This objective was aimed at investigating the risk factors associated with low CD4 among HIV patients attending the ART clinic at Arua Regional Referral Hospital. Data analysis and interpretation revealed that out of the 101 participants, low CD4 count was most prevalent at **66%. The** majority had a body weight bracket of 18.5-24.9 kg, 52(51.49%), 78 (77.23%) had more than one sexual partner, and the majority had a duration of > 3years being infected with HIV, 49 (48.51%). This can be because of being underweight due to malnutrition, especially protein-energy and micronutrient deficiencies) Weakens immune cell production and function, reduces thymic output, and impairs cytokine production. Slow CD4 recovery, malnutrition can also increase viral replication, accelerating CD4 decline, and also a higher number of sexual partners increases the risk of recurrent exposure to new HIV strains (superinfection) and sexually transmitted infections (STIs) such as HSV, HPV, gonorrhea, and syphilis. However, these STIs cause chronic immune activation and inflammation, creating more target CD4 cells for HIV infection. In relation to syphilis status, 19(18.81%) had syphilis. And out of 19 who had it, only 13(68.42%) had been treated, and 6(31.58%) had not been

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treated; 72(71%) had been diagnosed with it. This can probably be because Chronic immune activation and *inflammation* persist even with antiretroviral therapy (ART), leading to slower CD4 recovery in long-term infections. Diabetic patients have higher oxidative stress and systemic inflammation, leading to increased immune activation. However, the findings of this study were in line with a similar study that was conducted by Izudi *et al*. (2016), Nasuuna *et al.* (2020), and Gunda *et al*. (2017). A study conducted by Chaiyasin & Sungkanuparph (2016) was in disagreement with the findings of this study, where Gender, comorbid disease, risk of HIV infection, duration of HIV diagnosis, and body weight were not associated with rapid CD4 decline. This is so because there is no justification that clarifies the statement to be true, since the statement is not correct, thereby there is a need to do more research on the factors so as to make it conclusive that they lead to a high CD4 count.

Conclusion.

This study specifically sought to determine the prevalence and associated risk factors of low CD4 (<200 cells /µl) among HIV patients attending OPD at Arua Regional Referral Hospital. The study established that the overall prevalence of low CD4 count among HIV patients was high at 66%. The study findings revealed that low CD4 was most prevalent among those majority had body weight bracket of 18.5-24.9 kg 52(51.49%), majority of the respondents had more than one sexual partner 78 (77.23%), majority had a duration of > 3years being infected with HIV 49 (48.51%), most of them did not have syphilis 82(81.19%), majority did not smoke 85(84.16%) and few were diagnosed with diabetes mellitus 72(71%).

Study limitations.

The study was expected to come along with various challenges, such as withdrawal of some participants from the study before it was fully completed, rainy weather that may interrupt the participants' appearance at the facility, a negative attitude of the participants towards the topic of study, and access to the study area.

Recommendation.

Based on the findings and conclusions regarding the socio-demographic factors, the researcher feels the following:

Should be put in place to lower the prevalence of low CD4 counts among HIV patients, that is, on education, empowerment, stigma reduction, and equitable access to care. Conduct community sensitization to reduce HIV-related stigma and discrimination, which often delays treatment-seeking.

Encourage early HIV testing and clinic attendance, as men often present late for care. Use schools, social media, and community leaders for targeted messaging. And in relation to the Risk factor–based strategies should tackle malnutrition, co-infections, unhealthy lifestyles, and metabolic diseases, provide nutritional assessment and counseling at HIV clinics, supply micronutrient supplements and therapeutic foods where needed.

Promote balanced diets rich in protein, vitamins, and minerals.

Strengthen early diagnosis through community testing campaigns and self-testing, implement community-based HIV education campaigns, and routine screening for blood glucose and metabolic disorders in HIV patients.

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I take this opportunity to thank God for strength and life, my family, for their support and advice rendered to me during my studies.

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I am grateful to the entire management of ARRH because of their contribution in the form of support towards this work and good management.

Lastly but not least, to my classmates, you were great, and I will cherish the moments we shared in our struggle, and the contributions of the people not specifically mentioned here are equally appreciated.

List of abbreviations

AIDS – acquired immunodeficiency syndrome
ART – Antiretroviral Therapy
ARRH – Arua Regional Referral Hospital
CD4 – Cluster of Differentiation 4
HIV – Human Immunodeficiency Virus
OIs – Opportunistic Infections
SPSS – Statistical Package for the Social Sciences
UNAIDS – Joint United Nations Programme on HIV/AIDS
WHO – World Health Organization
OPD – Outpatient Department
PLWH – People Living with HIV
STIs – Sexually Transmitted Infections
TB – Tuberculosis

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Conflict of interest.
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Availability of data
Data used in this study are available upon request from the corresponding author.

Authors contribution.
FF designed the study, conducted data collection, cleaned and analyzed data, and drafted the manuscript.
FS supervised all stages of the study from conceptualization of the topic to manuscript writing and submission.
AS supervised the research process
HN supervised the research process
FS supervised the entire research process.
JFN supervised the research process.

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