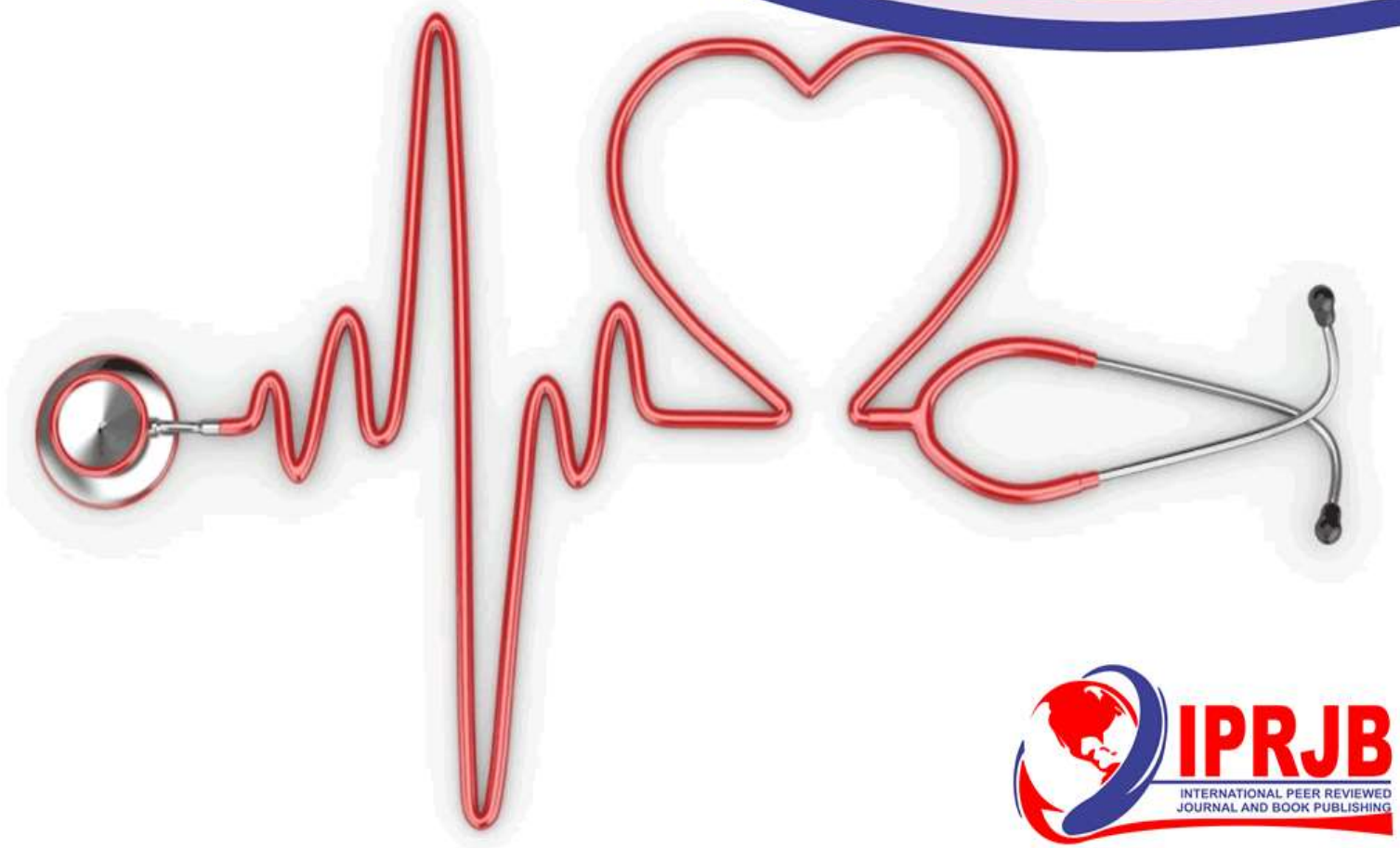


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**Clinical Factors Associated with Under-Nutrition among Adult Tuberculosis Patients in Nairobi County, Kenya**

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**Clinical Factors Associated with Under-Nutrition among Adult Tuberculosis Patients in Nairobi County, Kenya**



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**Abstract**

**Purpose:** The purpose of this study is to determine clinical factors associated with under-nutrition among adult Tuberculosis patients in Nairobi, county, Kenya.

**Methodology:** A cross-sectional study was conducted in Nairobi City County, Kenya, across ten health centers providing TB diagnostic and treatment services. A total of 367 adult TB patients were selected through stratified random sampling. Data collection involved structured questionnaires (socio-demographics and clinical record reviews (TB type, treatment duration, co-morbidities. The questionnaire was pre-tested at Kariobangi North Health Centre. Data analysis included descriptive statistics and inferential tests (Chi-square, logistic regression) to assess associations between clinical factors and under-nutrition, with significance set at  $p < 0.05$ .

**Findings:** The multivariate logistic regression analysis identified treatment phase, adherence, disease duration, and comorbidities as significant determinants of under-nutrition, aligning with and extending previous research on the interplay between TB and malnutrition. Patients in the continuation phase of TB treatment were significantly more likely to be under-nourished than those in the intensive phase (AOR = 2.80, 95% CI: 1.30–6.00,  $p = 0.007$ ). Poor treatment adherence also emerged as a strong predictor of under-nutrition, with affected patients showing nearly triple the risk compared to those with good adherence (AOR = 2.90, 95% CI: 1.30–6.60,  $p = 0.009$ ). The presence of comorbidities dramatically increased the likelihood of under-nutrition (AOR = 3.90, 95% CI: 1.80–8.50,  $p < 0.001$ ).

**Unique contribution to Theory, Practice and Policy:** This study finding points out the important of incorporating regular assessment of nutritional status into TB protocols. The study recommends screening for HIV and other co-morbidities early and consistently, monitoring of patients with advanced TB disease closely for nutritional decline, counseling into TB treatment plans. Finding of this study may contribute to formulation of policies to promote collaboration between TB programs, HIV programs, and nutrition services to ensure continuity of care.

**Keywords:** *Human Immunodeficiency Virus, Tuberculosis, Nutrition*

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## **INTRODUCTION**

Globally, tuberculosis (TB) remains one of the leading infectious diseases, posing a significant public health challenge, particularly in low- and middle-income countries (LMICs) (WHO, 2024b). Under-nutrition, characterized by insufficient intake of nutrients to meet an individual's physiological needs, is a major public health concern worldwide, contributing to increased morbidity and mortality (WHO, 2024a). The global prevalence of under-nutrition affects over 820 million people, especially in regions with high food insecurity and poverty, such as sub-Saharan Africa and South Asia (FAO, 2022; United Nation, 2024). The bidirectional relationship between TB and under-nutrition is well-documented: malnutrition compromises immunity, increasing susceptibility to TB, while TB exacerbates malnutrition through reduced appetite, increased metabolic demands, and malabsorption of nutrients (Darnton-Hill et al., 2022). This dual burden leads to prolonged recovery, complications, and elevated mortality rates, underlining the urgent need for integrated interventions to address both issues simultaneously.

Regionally, sub-Saharan Africa (SSA) bears a disproportionately high burden of both TB and under-nutrition. The region accounts for approximately 25% of global TB cases, driven by factors such as poverty, HIV/AIDS, food insecurity, and inadequate healthcare systems (Atake, 2023; Fuseini et al., 2021). Undernutrition is a significant determinant of TB treatment outcomes in SSA, as it is associated with delayed treatment response, increased complications, and higher mortality rates (Sinha et al., 2023).

Nationally, Kenya is among the 30 high TB-burden countries, with an estimated TB incidence of 292 cases per 100,000 population annually (WHO, 2023). TB remains a leading cause of morbidity and mortality in the country, and under-nutrition is a key contributor to the severity of the disease. In Kenya the prevalence of undernutrition is known, the relative weight of specific clinical predictors in urban informal settlements remains under-explored.

### **Statement of the Problem**

Tuberculosis (TB) remains one of the leading public health hurdles in Kenya with its capital, Nairobi County, contributing a substantial share of the national TB burden due to the heavy congestion and wide spread poverty. In spite of free health services being offered in public facilities, positive outcomes are overshadowed by high rates of under nutrition among the TB patients. Not only does under nutrition expose individuals to TB infection by weakening one's immune system but also worsens treatment response increasing the risk of relapse which contributes to elevated mortality and morbidity. Studies show that 30-60% of TB patients across sub-Saharan Africa are undernourished were in Kenya, nearly half experience moderate to severe malnutrition especially those in informal urban settlement. In Nairobi county Kenya 40% of TB patients were undernourished at the time of diagnosis according to 2021 report (MoH, 2021).

Although both TB and malnutrition are recognized as closely intertwined conditions, clinical factors assessment and support remain poorly integrated in TB care. Studies conducted tend to lean more on outcomes of the treatment overlooking specific clinical factors such as disease severity, co-morbidity among other effects that contribute to under nutrition during treatment. This has created an urgent need to examine the clinical factors associated with undernutrition among adult patients in Nairobi County to formulate evidence-based policies and practices that can enhance recovery and improve treatment outcomes.

## LITERATURE REVIEW

### Clinical Factors Associated with Under-Nutrition

Globally under-nutrition is a significant health challenge among tuberculosis (TB) patients, driven by the interplay of clinical factors such as treatment regimens and their side effects (Sinha et al., 2023). Anti-TB medications, particularly those used in multidrug-resistant TB (MDR-TB) regimens, often cause adverse effects like nausea, vomiting, anorexia, and hepatotoxicity, which impair food intake and nutrient absorption, heightening the risk of malnutrition (CDC, 2016). Prolonged treatment durations, extending up to 18–24 months for MDR-TB, exacerbate these side effects, as highlighted by (Taylor et al., 2022). Similarly, Fu *et al.*, (2023) reported that gastrointestinal distress and hepatotoxicity significantly reduced appetite and nutrient uptake among TB patients.

In sub-Saharan Africa, studies like Fuseini *et al.*, (2021) in Zambia have documented higher rates of under-nutrition among patients on second-line drugs, attributed to extended treatment durations and toxic side effects. However, these findings often overlook the compounded challenges faced by urban populations, where socioeconomic disparities and food insecurity amplify nutritional risks. In Kenya, particularly in urban settings like Nairobi, there is limited research on how specific TB regimens impact nutritional outcomes, despite the prevalence of TB-HIV co-infection and the added burden of poverty and inadequate healthcare access in informal settlements. This gap underscores the need for targeted studies addressing the nutritional implications of TB treatment in these vulnerable urban populations. Adherence to TB treatment is a key determinant of nutritional outcomes, with non-adherence linked to prolonged illness, drug resistance, and under-nutrition. Failure to follow prescribed regimens extends disease duration, intensifies chronic inflammation, and heightens metabolic demands, depleting nutritional reserves (Lemma Tirore et al., 2024). Globally, non-adherence is consistently associated with poor nutritional status, driven by persistent disease activity, physiological stress, and psychological burdens like anxiety and reduced appetite (Pradipta et al., 2021). In Africa, socio-economic and cultural factors such as poverty, stigma, and limited healthcare access further exacerbate adherence challenges (Msoka et al., 2021). For instance, a Ugandan study Ter Beek *et al.*, (2021) found significantly lower BMIs among patients missing over 20% of their doses, emphasizing that adherence is shaped by food insecurity and social support. In Kenya, the issue is particularly acute in urban slums like Nairobi, where approximately 15% of TB patients are non-adherent (NTLD-P, 2020). Despite this, limited research has explored the specific role of non-adherence in contributing to under-nutrition in these settings, underscoring a critical knowledge gap.

The duration of illness is another important clinical factor that impacts the nutritional status of TB patients. TB, particularly when left untreated or poorly managed, leads to prolonged illness characterized by systemic inflammation, increased metabolic demands, and muscle wasting, all of which contribute to under-nutrition (Wagnew, Alene, et al., 2024). Chronic inflammation resulting from prolonged illness increases the body's energy expenditure, while decreased food intake due to reduced appetite exacerbates the risk of malnutrition. This relationship between disease duration and under-nutrition has been well-documented, that patients who were symptomatic for more than three months before diagnosis had a 40% higher risk of being undernourished, due to the energy expenditure associated with prolonged illness and reduced dietary intake. (Park et al., 2022).

Comorbidities such as HIV, diabetes, and chronic respiratory diseases are also critical determinants of nutritional status among TB patients (Girishbhai Patel et al., 2024). HIV, in particular, is known to exacerbate under-nutrition in TB patients due to its impact on the immune system, appetite, and metabolism (WPF, 2023). TB-HIV co-infection is prevalent in sub-Saharan Africa, and studies have consistently shown that patients who are co-infected with TB and HIV are more likely to be undernourished than those with TB alone (Fuseini et al., 2021). The immune-compromising effects of HIV, coupled with the metabolic demands of TB, create a perfect storm for nutritional deficiencies.

Diabetes is another important comorbidity that influences the nutritional outcomes of TB patients. A study by Adane *et al.*, (2023) in Ethiopia found that TB patients with diabetes were twice as likely to be undernourished compared to those without diabetes. The authors attributed this to the dual burden of managing both diseases, which often leads to poor dietary adherence and metabolic imbalances, further exacerbating nutritional deficits.

In Kenya, the dual burden of TB-HIV co-infection is particularly prevalent, with approximately 30% of TB patients living with HIV (NTLD-P, 2020). However, research on the combined impact of HIV, diabetes, and other comorbidities on the nutritional status of TB patients in Nairobi is limited. Addressing this gap is crucial for understanding the full scope of factors that affect the nutritional outcomes of TB patients and for developing targeted interventions that address these challenges comprehensively. Ultimately, clinical factors such as TB treatment regimens, adherence to therapy, duration of illness, and comorbidities play a significant role in determining the nutritional status of TB patients. Although studies from various regions have highlighted the critical impact of these factors on under-nutrition, there is a notable lack of research that explores these relationships in urban settings like Nairobi. Understanding how these factors interact and influence nutritional outcomes in TB patients in Kenya is essential for developing effective interventions aimed at improving both clinical and nutritional outcomes. Further research is needed to fill these gaps and provide a more comprehensive understanding of the factors that contribute to under-nutrition in TB patients.

### Theoretical and Conceptual Framework

This study is grounded in biomedical theory, which conceptualizes undernutrition among TB patients as a clinical outcome of disease-related pathophysiological processes

#### Independent Variables

- TB disease severity
- Duration of Tb Treatment
- Presence of comorbidities
- Adverse drug reaction
- Access to health care
- Availability of TB specific Nutrition counselling

#### Dependent Variables

Under nutrition among TB patients.  
 BMI<18.5kg/M<sup>2</sup>

- Wasting
- Stunting

underweight

Figure 1: Conceptual Framework

## **Conceptual Framework**

This framework underscores the multifactorial determinants of nutritional status among TB patients and provides a structured approach to identifying key areas for intervention to improve both treatment outcomes and overall patient well-being. This study focuses on clinical factors associated with undernutrition among TB patients such as TB disease severity measured by chest x ray and sputum smear microscopy, Duration of Tb Treatment, Presence of comorbidities, Adverse drug reaction, Access to health care, Availability of TB specific and Nutrition counseling

## **Research Gaps**

Studies show that 30-60% of TB patients across sub-Saharan Africa are undernourished were in Kenya, nearly half experience moderate to severe malnutrition especially those in informal Nairobi urban settlement. Although both TB and malnutrition are recognized as closely intertwined conditions, nutrition assessment and support remains poorly integrated in TB care. Studies conducted tend to lean more on outcomes of the treatment overlooking specific clinical factors such as disease severity, co-morbidity among other effects that contribute to under nutrition during treatment. This has created an urgent need to examine the clinical factors associated with undernutrition among adult patients in Nairobi County to formulate evidence-based policies and practices that can enhance recovery and improve treatment outcomes.

## **METHODOLOGY**

### **Study Design**

This was a cross-sectional study designed to determine the prevalence of under-nutrition and its associated determinants among adult tuberculosis (TB) patients who attended 10 chosen clinics in Nairobi City County, Kenya.

### **Study Area**

The study was conducted in Nairobi City County, Kenya, a metropolitan region and the country's capital, characterized by a diverse socio-economic landscape and a significant proportion of its population residing in urban informal settlements. The study focused on ten health centers providing TB diagnostic and treatment services: Kangemi, Chandaria, Ngong Road, Westlands, Waithaka, AMURT, Mathare North, Ngaira, Baba Dogo, and Riruta Health Centers.

### **Study Population**

The target population consisted of adult ( $\geq 18$  years) TB patients attending the selected health centers for treatment within the study period.

The sample size for this study was determined using Fischer's formula, where 367 adult TB patients were calculated.

A stratified random sampling method was employed to ensure adequate representation of TB patients across the health centers. Each health center was treated as a stratum, and the number of participants recruited from each health center was proportional to the number of TB patients registered at that facility.

## **Data Collection**

A structured questionnaire and clinical record review was done to collect clinical data such as the type of TB, duration of treatment, and co-morbidities, and socio-demographic characteristics (age, gender, marital status, education level, employment status, etc.).

## **Data Analysis**

Clinical factors associated with under-nutrition, including the duration of TB treatment, disease severity (pulmonary vs. extrapulmonary TB), smear positivity, co-morbidities such as HIV or diabetes, and history of TB treatment, were assessed using bivariate and multivariable logistic regression analyses. These analyses identified significant clinical predictors of under-nutrition. Statistical significance was set at  $P < 0.05$ .

## **Ethical Consideration**

Ethical approval for this study was obtained from the Jomo Kenyatta University of Agriculture and Technology (JKUAT) Ethical Review Committee, and a research license was granted by the National Commission for Science, Technology, and Innovation (NACOSTI). The study adhered to the principles outlined in the Belmont Report. Respect for persons was upheld by obtaining informed consent from all participants after providing clear information about the study's purpose, procedures, and potential risks or benefits. Beneficence was ensured by minimizing any potential harm to participants and maximizing the benefits of the study findings for the target population. Justice was addressed by selecting participants equitably without bias, ensuring that the benefits and burdens of the research were fairly distributed. Confidentiality and privacy were maintained by securely handling participant data, limiting access to authorized personnel, and anonymizing identifying information. The study was conducted with transparency and integrity, aligning with ethical guidelines to safeguard the rights and welfare of all participants.

## **FINDINGS**

### **Demographic Characteristics of the Participants**

The majority of participants were in the 31-45 years age group 152 (41.4%), while majority were males 223(60.8%). The participants were mainly married 197 53.7%). The majority of participants were earning less than Kshs.10,000. Table 1.

**Table 1: Demographic Characteristics of Participants (n=367)**

Characteristic	Frequency (n = 367)	Percentage (%)
<b>Age (Years)</b>		
18-30	112	30.5
31-45	152	41.4
46-60	78	21.3
>60	25	6.8
<b>Gender</b>		
Male	223	60.8
Female	144	39.2
<b>Marital status</b>		
Single	98	26.7
Married	197	53.7
Divorced/separated	45	12.3
Widowed	27	7.4
<b>Level of education</b>		
No formal education	34	9.3
Primary	147	40.1
Secondary	129	35.1
Tertiary	57	15.5
<b>Occupation</b>		
Unemployed	103	28.1
Employed	264	71.9
<b>Monthly income (KES)</b>		
<10,000	167	45.5
10,000-20,000	113	30.8
20,001-50,000	64	17.4
>50,000	23	6.3

### Clinical Factors Associated With Under-Nutrition among TB Patients

#### Univariate Logistic Regression Analysis of Clinical Factors Associated With Under-Nutrition among TB Patients

The following clinical factors were significantly associated with under-nutrition in univariate logistic regression analysis ( $p < 0.1$ ) and were included in multivariate logistic regression: participants in the continuation phase of TB treatment had higher odds of under-nutrition compared to those in the intensive phase (OR = 2.90, 95% CI: 1.80–5.60,  $p < 0.001$ ), while Non-adherence to treatment was also associated with increased odds (OR = 3.20, 95% CI: 1.70–6.10,  $p < 0.001$ ). A disease duration of  $\geq 6$  months was linked to higher odds of under-nutrition compared to  $< 6$  months (OR = 2.95, 95% CI: 1.50–5.90,  $p = 0.002$ ), and the presence of comorbidities further increased the risk (OR = 5.00, 95% CI: 2.73–9.15,  $p < 0.001$ ). Among comorbid conditions, HIV/AIDS (OR = 4.19, 95% CI: 2.30–7.30,  $p < 0.001$ ), diabetes (OR = 2.10, 95% CI: 1.00–4.40,  $p = 0.049$ ), chronic liver disease (OR = 3.56, 95% CI: 1.10–11.50,  $p = 0.035$ ), COPD (OR = 3.10, 95% CI: 1.20–7.90,  $p = 0.018$ ), cancer/malignancy (OR = 2.20, 95% CI: 0.67–7.20,  $p < 0.001$ ), and chronic kidney disease (CKD) (OR = 5.13, 95% CI: 1.70–

15.50,  $p = 0.004$ ) were significantly associated with under-nutrition, while hypertension showed a near-significant association (OR = 2.27, 95% CI: 0.88–5.00,  $p = 0.096$ ) Table 2.

**Table 2: Univariate Logistic Regression Analysis of Clinical Factors Associated With Under-Nutrition**

Factor	OR	95% CI	P-value
<b>TB Treatment Regimen</b>			
Intensive	1.00 (Ref)		
Continuation	2.90	1.80–5.60	<0.001
<b>Adherence to treatment</b>			
Adherence	1.00(Ref)		
Non- adherence	3.20	1.70–6.10	<0.001
<b>Disease duration</b>			
<6months	1.00(Ref)		
≥6months	2.95	1.50–5.90	0.002
<b>Comorbidities</b>			
Yes	1.00 (Ref)		
No	5.00	2.73–9.15	<0.001
<b>Comorbidities</b>			
<b>HIV/AIDS</b>			
Yes	4.19	2.30–7.30	<0.001
No	1.00 (Ref)		
<b>Diabetes</b>			
Yes	2.10	1.00–4.40	0.049
No	1.00 (Ref)		
<b>CVDs</b>			
Yes	2.34	0.81–6.75	0.116
No	1.00 (Ref)		
<b>Chronic liver disease</b>			
Yes	3.56	1.10–11.50	0.035
No	1.00 (Ref)		
<b>COPD</b>			
Yes	3.10	1.20–7.90	0.018
No	1.00 (Ref)		
<b>Cancer/malignancy</b>			
Yes	2.20	0.67–7.20	<0.001
No	1.00 (Ref)		
<b>CKD</b>			
Yes	5.13	1.70–15.50	0.004
No	1.00 (Ref)		
<b>Hypertension</b>			
Yes	2.27	0.88–5.00	0.096
No	1.00 (Ref)		
<b>Rheumatoid arthritis</b>			
Yes	2.80	0.58–13.50	0.198
No	1.00 (Ref)		

## **Multivariate Logistic Regression Analysis of Clinical Factors Associated With Under-Nutrition**

The multivariate logistic regression analysis highlights several clinical factors associated with under-nutrition among tuberculosis (TB) patients, providing crucial insights into the interplay of treatment phases, adherence, disease duration, and comorbidities. Patients in the continuation phase of TB treatment were significantly more likely to be under-nourished than those in the intensive phase, likely due to prolonged illness and metabolic demands, emphasizing the importance of nutritional support during this phase (AOR = 2.80, 95% CI: 1.30–6.00,  $p = 0.007$ ). Poor treatment adherence also emerged as a strong predictor of under-nutrition, with affected patients showing nearly triple the risk compared to those with good adherence (AOR = 2.90, 95% CI: 1.30–6.60,  $p=0.009$ ), underscoring the necessity of adherence-enhancing strategies. Furthermore, patients with a disease duration of six months or more had significantly higher odds of under-nutrition compared to those with a shorter duration (AOR = 3.34, 95% CI: 1.92–5.81,  $p < 0.001$ ), suggesting that early detection and timely intervention are critical. The presence of comorbidities dramatically increased the likelihood of under-nutrition (AOR = 3.90, 95% CI: 1.80–8.50,  $p < 0.001$ ), with specific conditions such as HIV/AIDS (AOR = 3.50, 95% CI: 1.70–7.10,  $p < 0.001$ ), cancer (AOR = 3.02, 95% CI: 1.20–8.41,  $p < 0.001$ ), and chronic kidney disease (AOR = 3.90, 95% CI: 1.10–13.80,  $p = 0.030$ ) significantly associated with worsened nutritional outcomes. While other comorbidities, including diabetes and COPD, showed elevated odds, their associations were not statistically significant Table 3.

**Table 3: Multivariate Logistic Regression Analysis of Clinical Factors Associated With Under-Nutrition**

<b>Factor</b>	<b>AOR</b>	<b>95% CI</b>	<b>P-value</b>
<b>TB Treatment Regimen</b>			
Intensive	1.00(Ref)		
Continuation	2.80	(1.30–6.00)	0.007
<b>Presences of comorbidities</b>			
Adherence	1.00(Ref)		
Non-adherence	2.90	(1.30–6.60)	0.009
<b>Disease duration</b>			
<6months	1.00(Ref)		
≥6months	3.34	(1.92–5.81)	<0.001
<b>Comorbidities</b>			
Yes	1.00(Ref)		
No	3.90	(1.80–8.50)	<0.001
<b>Comorbidities</b>			
<b>HIV/AIDS</b>			
Yes	3.50		
No	1.00(Ref)	(1.70–7.10)	<0.001
<b>Diabetes</b>			
Yes	1.80		
No	1.00(Ref)	(0.80–4.10)	0.155
<b>Chronic liver disease</b>			
Yes	2.90	(0.80–10.40)	0.024
No	1.00(Ref)		
<b>COPD</b>			
Yes	2.50	(0.90–7.10)	0.081
No	1.00(Ref)		
<b>Cancer/malignancy</b>			
Yes	3.02	(1.20–8.41)	<0.001
No	1.00(Ref)		
<b>CKD</b>			
Yes	3.90	(1.10–13.80)	0.030
No	1.00(Ref)		

AOR; adjusted odds ratio, 95%CI; 95% confidence interval, COPD; chronic obstructive pulmonary disease, CKD; chronic kidney disease

## Discussion

### Clinical Factors Associated With Under-Nutrition among TB Patients

This study's findings underscore the critical role of clinical factors in influencing under-nutrition among tuberculosis (TB) patients, with implications for the integrated management of TB and nutritional status. The multivariate logistic regression analysis identified treatment phase, adherence, disease duration, and comorbidities as significant determinants of under-nutrition, aligning with and extending previous research on the interplay between TB and malnutrition.

Patients in the continuation phase of TB treatment were significantly more likely to be under-nourished than those in the intensive phase (AOR = 2.80, 95% CI: 1.30–6.00,  $p = 0.007$ ). This finding is consistent with studies by Burusie *et al.*, (2024) which reported that the nutritional status of TB patients often deteriorates as treatment progresses due to sustained metabolic stress and inadequate nutritional replenishment. Unlike the intensive phase, where patients may benefit from focused interventions such as food supplements provided during directly observed therapy (DOTS), the continuation phase often lacks equivalent support, leaving patients vulnerable. The higher prevalence of under-nutrition observed in this study could reflect the need for sustained nutritional interventions throughout the treatment course (Seid and Ayele, (2020).

Poor adherence to TB treatment was strongly associated with under-nutrition (AOR = 2.90, 95% CI: 1.30–6.60,  $p = 0.009$ ). This relationship corroborates findings from (Endalkachew *et al.*, 2022b) and (Islam *et al.*, 2024), who demonstrated that non-adherence compromises recovery and exacerbates weight loss through prolonged disease activity and untreated metabolic disruptions. However, the adherence rates in this study appear lower than those in comparable studies conducted in urban South Africa (Charalambous *et al.*, 2024). This difference could be attributed to variations in health system capacity and patient support mechanisms in Kenya, where socio-economic barriers and stigma may impede adherence.

A longer disease duration (six months or more) was strongly linked to under-nutrition (AOR = 3.34, 95% CI: 1.92–5.81,  $p < 0.001$ ). This finding aligns with evidence from (Miller, 2024) in Ethiopia which showed that prolonged TB infection amplifies the risk of nutritional depletion. Extended disease duration is known to exacerbate cachexia due to chronic inflammation, elevated metabolic demands, and reduced intake from illness-related appetite loss. However, unlike study by Seid and Ayele, (2020) which observed a bidirectional relationship between the duration of TB disease and under-nutrition which indicated increased nutritional decline with longer disease durations, on the other hand, under-nutrition can increase the risk of TB development.

The presence of comorbidities was a significant predictor of under-nutrition (AOR = 3.90, 95% CI: 1.80–8.50,  $p < 0.001$ ). Among specific conditions, HIV/AIDS (AOR = 3.50, 95% CI: 1.70–7.10,  $p < 0.001$ ), cancer (AOR = 3.02, 95% CI: 1.20–8.41,  $p < 0.001$ ), and chronic kidney disease (AOR = 3.90, 95% CI: 1.10–13.80,  $p = 0.030$ ) were significantly associated with under-nutrition. These findings are consistent with evidence from Shifera and Yosef, 2024b), which showed that HIV-induced immunosuppression and systemic inflammation exacerbate malnutrition among TB patients, cancer and chronic illnesses further compromise appetite, nutrient absorption, and energy metabolism, compounding nutritional deficits. The difference could stem from variations in disease burden and management practices, where Kenyan health systems may provide relatively better support for these conditions or where their prevalence among the study population was lower than in other settings.

The findings emphasize the need for comprehensive strategies to mitigate under-nutrition among TB patients. Sustained nutritional support, particularly during the continuation phase, is vital to prevent cumulative nutritional decline. Adherence support mechanisms, including education, counseling, and community-led interventions, are crucial for reducing disease duration and improving nutritional outcomes. Effective comorbidity management, prioritizing integrated care models that address TB alongside conditions like HIV and cancer, can further enhance nutritional status. Additionally, early detection and intervention are essential to reduce

the duration of active disease and associated metabolic depletion. These multi-faceted approaches can help bridge the observed gaps and ensure holistic care for TB patients.

The study also assesses the clinical factors linked to under-nutrition, such as disease severity, co-infections (e.g., HIV), and the side effects of TB medication. This aspect is critical in understanding how TB-related physiological changes and treatment regimens impact nutritional status. Identifying these clinical factors can lead to improved screening protocols, early nutritional interventions, and personalized dietary recommendations that enhance patient recovery and overall treatment success.

## **CONCLUSION AND RECOMMENDATION**

### **Conclusion**

Clinical factors such as advanced disease stage, HIV co-infection, and prolonged TB treatment duration were strongly associated with under-nutrition among TB patients. These findings underline the necessity for comprehensive clinical assessments and integrated TB-HIV management strategies that prioritize nutritional support as part of routine care. Identifying these clinical factors can lead to improved screening protocols, early nutritional interventions, and personalized dietary recommendations that enhance patient recovery and overall treatment success.

### **Recommendation**

Healthcare providers at Tuberculosis (TB) clinics should adopt integrated clinical management protocols that combine TB and HIV care with nutritional support. Regular screening for malnutrition, co-morbidities, and advanced disease stages should be incorporated into clinical workflows. This includes training healthcare workers on the importance of nutritional interventions as part of holistic TB care.

### **Implication to Theory, Practice and Policy**

The clinical factors such as advanced TB disease stage, HIV co-infection, and under-nutrition supports theories where the disease–nutrition interaction model, which states that infections contribute to malnutrition while malnutrition weakens immune response hence worsening disease progression. This study finding points out the important of incorporating regular assessment of nutritional status into TB protocols. The study recommends screening for HIV and other co-morbidities early and consistently, monitoring of patients with advanced TB disease closely for nutritional decline, counseling into TB treatment plans. Finding of this study may contribute to formulation of policies to promote collaboration between TB programs, HIV programs, and nutrition services to ensure continuity of care.

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