World Journal of AIDS, 2025, 15(4), 103-114
https://www.scirp.org/journal/wja
ISSN Online: 2160-8822
ISSN Print: 2160-8814

# Frequency and Presumptive Factors of Undernutrition among People Living with HIV Hospitalized

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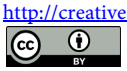
**How to cite this paper:** Wili-Koé, P., Padou, F., Dertinou, C., Pamall, S., Ebereyo, D., Fikouma, V. and Tekpa, G. (2025) Frequency and Presumptive Factors of Undernutrition among People Living with HIV Hospitalized. *World Journal of AIDS*, **15**, 103-114.
https://doi.org/10.4236/wja.2025.154006

**Received:** October 10, 2025
**Accepted:** December 26, 2025
**Published:** December 29, 2025







## Abstract

**Background:** The objective of this study was to determine the prevalence and presumptive factors of undernutrition among people living with HIV on antiretroviral therapy in the CAR. **Methods:** This was a cross-sectional, descriptive and analytical study. The study population is made up of PLHIV on antiretrovirals, followed by three care centres in CAR. Undernutrition was defined as Body Mass Index (BMI) of less than 18.5 kg/m$^2$. **Results:** A total of 205 patients were included. There was a predominance of women (60.5%). The mean age was 37.8 ± 10.6 years. Undernutrition was observed in 123 PLVIH, a frequency of 60.0%. Presumptive factors were: age < 36 years (p = 0.02; OR = 2 [1.1 - 3.5]); duration of antiretroviral therapy < 12 months (p = 0.03; OR = 2 [1.1 - 3.4]); WHO HIV stage III and IV (p = 0.03; OR = 3.3 [1.1 - 10]); tuberculosis (p = 0.01; OR = 2.1 [1.2 - 3.9]); haemoglobin < 12 g/dl (p = 0.02; OR = 2.3 [1.2 - 4.5]), severe immunosuppression, HIV viral load suppressed (p = 0.00; OR = 6.5 [1.7 - 24.5]), HIV viral load detectable (p = 0.00; 105 [28.4 - 388.4]). **Conclusion:** Undernutrition is a public health problem among PLHIV on antiretroviral therapy in CAR, hence the need for active screening.

## Keywords

Central African Republic, Undernutrition, Epidemiology, HIV

## 1. Introduction

HIV remains a major global public health problem. According to World Health

Organization (WHO), there are 40.4 million people living with HIV in the world. On the African Continent, there are an estimated 25.6 million PLHIV [1].

The CAR, a resource-limited-country, remains among the most affected by the HIV pandemic in west and central Africa. HIV prevalence among 15 to 49 years olds was estimated at 3.4% in 2022 [2]. According to the literature, the nutritional status of PHAs has a direct influence on their health [3]. Nutritional disorders are recurrent clinical situations found in PLHIV [4] [5]. Indeed, there is an interaction between HIV and nutrition. To this end, a healthy and balanced diet makes it possible to compensate for energy losses due to infection and to keep the organs in good working order [6]. In recent years, considerable progress has been made in understanding the biological mechanisms responsible for these relationships, in order to identify nutritional interventions that can improve the quality and lifespan of PLHIV [3]. Undernutrition affects approximately 800 million people worldwide [7]. In sub-Saharan Africa, it is particularly undervalued in hospital settings where there is no food and nutrition liaison committee, although it should be part of the baseline systematic evaluation [8]. According to a study carried out in Ethiopia in 2016, the prevalence of malnutrition among PLHIV in hospitals was estimated at 46.8% [9]. In 2021 in Guinea Conakry, a study on the factors associated with undernutrition among PLHIV hospitalized in the Infectious and Tropical Disease Department reported a prevalence of 79.4% of which the main factors associated with undernutrition were: household size 6, number of meals < 3, diarrhoea, fever, WHO clinical stage III and IV, HIV viral load detectable, not ARV treatment [10]. Our study was conducted on the assumption that, in CATR, there are multiple presumptive factors of undernutrition in PLHIV hospitalized on ARV treatment. Through this study, we try to answer two essential questions, namely 1) What are the sociodemographic and clinical profiles of malnourished patients on ARV treatment? 2) What are the main presumptive factors of undernutrition encountered in PLHIV hospitalized on ARV treatment in the Central African context? Our general objective was to determine in a multicenter way the presumptive factors of undernutrition among PLHIV hospitalized in the three care centers in CAR.

## 2. Patients and Methods

### 2.1. Site and Type of Study

The study was carried out in the internal medicine departments of the Carnot District Hospital, the Infectious and Tropical Diseases Department of the Friendship University Hospital and the Internal Medicine Department of the Bangui Community Hospital. It was a descriptive and analytical cross-sectional study, covering the period from 1st March 2021 to 30th September 2021.

### 2.2. Study Population and Sampling

It consisted of all PLHIV admitted to hospital during the study period. The sampling was exhaustive, we included all patients under ARV treatment dated at least

1 month and hospitalized in the three care centers.

### 2.3. Case Inclusion

We included all PHAS aged 18 years and older, who had been treated with ARVs for one month or more and admitted to hospital during the study period. Malnourished patients are defined by body mass index (BMI) < 18.5 kg/m$^2$.

### 2.4. Case Not Included

Hospitalized HIV-positive people whose medical records did not contain either the CD4 count or the HIV CV were not included in the study.

### 2.5. Data Collection and Data

Data were collected using an anonymous questionnaire following the interview, the clinical examination of the patient and the use if the medical record following informed consent. For each patient included, we collected sociodemographic, clinical and biological data. The dependent variable was the occurrence of malnutrition in PLHIV, and the independent variables were the sociodemographic characteristics of the patients (age, sex, level of education, profession, and origin), clinical parameters (history/background, BMI, ART line, duration under ARV treatment) and paraclinical parameters (CD4, blood count, viral load).

### 2.6. Data Entry and Data

The implementation of the study has received prior authorization from the Ethics and Scientific Committee of the Faculty of Health Sciences of the University of Bangui. Data entry and analysis were carried out using the EPI-info 7 software. The Odds Ratio (OR) with 95% confidence interval (CI) was used to measure the strength of the association.

## 3. Results

### 3.1. General Characteristics of the Study Population and Frequency of Malnutrition and PLVIH

During our study, 123 malnourished PLHIV were collected out of a total of 205 hospitalized PLHIV, representing a prevalence of 60%. The frequencies of malnutrition were 38% in women, versus 22% in men. The average age of our sample was 37.8 ± 10.6 years. This average age was 36.7 ± 10.3 years for the group of malnourished PLHIV. The sex ratio was 0.7. The average household size was 5 people. The average BMI of patients was 17.6 ± 3.1 kg/m$^2$. The median CD4 count was 208 cells/mm$^3$. The median duration of infection since diagnosis was 36 months. Data on sociodemographic and clinical characteristics are reported in Table 1 and Table 2.

### 3.2. Presumptive Factors of Malnutrition

There were statistically significant associations between the occurrence of

malnutrition, age < 36 years (p = 0.02; OR = 2 [1.1 - 3.4]), duration of antiretroviral treatment < 12 months (p = 0.03; OR = 2 [1.1 - 3.4]), WHO VIH stage III and IV (p = 0.03; OR = 3.3 [1.1 - 10]), tuberculosis (p = 0.01; OR = 2.1 [1.2 - 3.9]), hemoglobin < 12 g/dl (p = 0.02; OR = 2.3 [1.2 - 4.5]). We observed a significant difference between the occurrence of malnutrition and neuromeningeal cryptococcosis (p = 0.01), TCD4 Lymphocytes 0 - 49/mm$^3$ (p = 0.00; OR = 2.4 [1.5 - 3.5]), 50 - 199/mm$^3$ (p = 0.00; OR = 3.6 [1.6 - 8.2]), 350 - 499 mm$^3$ (p = 0.00; OR = 5.6 [1.7 - 17.8]), HIV viral load deleted (p = 0.00; OR = 6.5 [1.7 - 24.5]), HIV viral load detectable(p = 0.00; OR = 105 [28.4 - 388.4]). The frequency of malnutrition is very high in HIV-positive people who have been put on a combination based on 2INRT + DTG or EFV than those on 2INRT + LPV-r or ATV-r without significant difference (Table 3).

**Table 1.** Sociodemographic characteristics of study participants, recruited during hospitalization in the infectious and tropical diseases departments of the Amitié University Hospital and the Internal Medicine Departments of Carnot District Hospital and the Bangui Community University Hospital from March 1st, 2021 to September 30th, 2021.

| Sociodemographic characteristic | Effective (N = 205) | Percentage (%) |
|---|---|---|
| **Sex** | | |
| Male | 81 | 39.5 |
| Female | 124 | 60.5 |
| **Marital status** | | |
| Couple | 112 | 54,6 |
| Lives alone | 93 | 45.4 |
| **Person in charge** | | |
| <5 | 126 | 61.5 |
| ≥5 | 79 | 38.5 |
| **Level of education** | | |
| Not in school | 10 | 4.9 |
| Primary | 68 | 33.2 |
| Secondary | 95 | 46.3 |
| Superior | 32 | 15.6 |
| **Professional activity** | | |
| Unemployed | 104 | 50.7 |
| Informel sector | 70 | 34.2 |
| Formal | 31 | 15.1 |

**Table 2.** Clinical characteristics of study participants, recruited during hospitalization in the infectious and tropical diseases departments of the Amitié University Hospital and the Internal Medicine Departments of Carnot District Hospital and the Bangui Community University Hospital from March 1st, 2021 to September 30th, 2021.

| Clinical characteristic | Effective (N = 205) | Percentage (%) |
|---|---|---|
| History of opportunistic infections | 47 | 22.9 |
| Eating habit | | |
| Tobacco | 11 | 5.4 |
| Alcohol | 108 | 52.7 |
| WHO HIV stage | | |
| Stage II | 15 | 7.3 |
| Stage III | 105 | 51.2 |
| Stage IV | 85 | 41.5 |
| ARV treatment line | | |
| 2 INRT + DTG or EFV | 171 | 83.4 |
| 2 INRT + LPV/r or ATV/r | 34 | 16.6 |
| BMI (kg/m$^2$) | | |
| Malnourished (<18.5) | 123 | 60.0 |
| Standard-fed (18.5 - 24.9) | 78 | 38.8 |
| Overweight | 4 | 2.0 |
| Evolution | | |
| Favorable | 170 | 82.9 |
| Death | 35 | 17.1 |

Possible combinations of 2INRT according to the national CAR protocol: TDF + 3TC or TDF + FTC or ABC + 3TC.

**Table 3.** Relationship between the occurrence of malnutrition and the sociodemographic, clinical and paraclinical characteristics of the study participants, recruited during hospitalization in the infectious and tropical diseases departments of the Amitié University Hospital and the Internal Medicine Departments of Carnot District Hospital and the Bangui Community University Hospital from March 1st, 2021 to September 30th, 2021.

| Settings | BMI (kg/m$^2$) | | OR [IC95%] | p |
|---|---|---|---|---|
| | <18.5 (%) | ≥18.5 (%) | | |
| **Sociodemographic Characteristics** | | | | |
| Age (Olds) | | | | |
| <36 (n = 98) | 67 (68.4) | 31 (31.6) | **2 [1.1 - 3.5]** | **0.02** |
| ≥36 (n = 107) | 56 (47.7) | 51 (52.3) | 1 | |

**Continued**

| | | | | |
|---|---|---|---|---|
| Sex | | | | |
| Female (n = 124) | 78 (58) | 46 (42) | 1.4 [0.8 - 2.4] | 0.3 |
| Male (n = 81) | 45 (55.6) | 36 (44.4) | 1 | |
| Level of education | | | | |
| Secondary and superior | 72 (55.8) | 57 (44.2) | 0.6 [0.3 - 1.1] | 0.11 |
| Primary and not in school | 51 (70.8) | 25 (29.2) | 1 | |
| Marital status | | | | |
| Couple (n = 112) | 63 (56.2) | 49 (43.8) | 1.4 [0.8 - 2.5] | 0.2 |
| Lives alone (n = 93) | 60 (64.5) | 33 (35.5) | 1 | |
| Person in charge | | | | |
| ≥5 (n = 79) | 41 (51.9) | 38 (48.9) | 1.7 [1 - 3] | 0.06 |
| <5 (n = 126) | 82 (65.1) | 44 (34.9) | 1 | |
| **Clinical features** | | | | |
| ARV duration (months) | | | | |
| <12 (n = 78) | 54 (69.2) | 24 (30.8) | **2 [1.1 - 3.4]** | **0.03** |
| ≥12 (n = 127) | 69 (54.3) | 58 (45.7) | 1 | |
| History of opportunistic infectious | | | | |
| Yes (n = 47) | 28 (59.6) | 19 (40.4) | 1 [0.5 - 2] | 0.9 |
| No (n = 158) | 95 (60.1) | 63 (39.9) | 1 | |
| ARV treatment | | | | |
| 2 NRTI + DTG or EFV (n = 171) | 102 (59.6) | 69 (40.4) | 0.9 [0.4 - 1.9] | 0.8 |
| 2 NRTI + LPV/r or ATV/r (n = 34) | 21 (61.8) | 13 (38.2) | 1 | |
| Alcohol | | | | |
| Yes (n = 108) | 67 (62) | 41 (48) | 1.2 [0.7 - 2.1] | 0.5 |
| No (n = 97) | 56 (57.7) | 41 (42.3) | 1 | |
| Tobacco | | | | |
| Yes (n = 11) | 7 (63.6) | 4 (36.4) | 1.2 [0.3 - 4.2] | 0.8 |
| No (n = 194) | 116 (59.8) | 78 (39.2 | 1 | |
| WHO VIH stage | | | | |
| Stages III and IV (n = 190) | 118 (62.1) | 72 (37.9) | **3.3 [1.1 - 10]** | **0.03** |
| Stages I and II (n = 15) | 5 (33.3) | 10 (66.7) | 1 | |

**Continued**

| | | | | |
|---|---|---|---|---|
| Tuberculosis | | | | |
| Yes (n = 136) | 90 (66.2) | 46 (33.8) | **2.1 [1.2 - 3.9]** | **0.01** |
| No (n = 69) | 33 (47.8) | 36 (52.8) | 1 | |
| Neuromeningeal cryptococcosis | | | | |
| Yes (n = 15) | 4 (26.7) | 11 (73.3) | 0.2 [0.1 - 0.7] | 0.01 |
| No (n = 190) | 119 (62.6) | 71 (37.4) | 1 | |
| Chronic diarrhea | | | | |
| Yes (n = 23) | 16 (69.6) | 7 (30.4) | 1.6 [0.6 - 4.1] | 0.3 |
| No (n = 182) | 107 (58.8) | 75 (41.2) | 1 | |
| Cerebral toxoplasmosis | | | | |
| Yes (n = 4) | 2 (50) | 2 (50) | 0.7 [0.1 - 4.8] | 0.7 |
| No (n = 201) | 121 (60.2) | 80 (39.8) | 1 | |
| **Biological characteristics** | | | | |
| Hemoglobin(g/l) | | | | |
| <12 (n = 162) | 104 (64.2) | 58 (35.4) | **2.3 [1.2 - 4.5]** | **0.02** |
| ≥12 (n = 43) | 19 (44.2) | 24 (55.8) | 1 | |
| CD4 T cells (/mm$^3$) | | | | |
| 0 - 49 (n = 21) | 19 (90.5) | 2 (9.5) | **2.4 [1.5 - 3.6]** | **0.00** |
| 50 - 199 (n = 75) | 52 (69.3) | 23 (30.7) | **3.6 [1.6 - 8.2]** | **0.00** |
| 200 - 349 (n = 48) | 20 (41.7) | 28 (58.3) | 1.1 [0.6 - 1.8] | 0.4 |
| 350 - 499 (n = 22) | 17 (77.3) | 5 (22.7) | **5.4 [1.7 - 17.8]** | **0.00** |
| ≥500 (n = 39) | 15 (38.5) | 24 (61.5) | 1 | |
| HIV viral load (/mm$^3$) | | | | |
| <50 (undetectable) (n = 42) | 3 (7.1) | 39 (92.9) | 1 | |
| 50 - 999 (deleted) (n = 45) | 15 (33.3) | 30 (66.4) | **6.5 [1.7 - 24.5]** | **0.00** |
| ≥1000 (detectable) (n = 118) | 105 (89.0) | 13 (11.0) | **105 [28.4 - 388.4]** | **0.00** |

## 4. Discussions

### 4.1. General Characteristics of the Population and Frequency of Malnutrition among Hospitalized HIV-Positive People

In CAR, given the excessive cost of caring for PLHIV, a policy to facilitate access to care has been implemented. This is based on free medication and partial subsidy of biological monitoring tests [11]. However, it is not uncommon to observe

malnutrition in PLHIV despite antiretroviral treatment [12]. Our study aimed to determine in a multicenter manner the factors associated with malnutrition in hospitalized PLVIH undergoing ARV treatment. In our study, it appears that malnutrition was in 60% of patients. This situation constitutes a major public health problem care in a country where the majority of the population lives on less than a dollar a day and where social security is almost non-existent. Our prevalence was higher than those reported in Brazil Nigeria and Benin by 5.5%, 5.8% and 7.87%, respectively [13]-[15]. This frequency was observed, lower than that reported in Guinea by 79.6%. This difference could be explained by the variation in the endemicity of the disease from one region to another and the disparity of the selection criteria used in the different series. We noted a predominance in women (60.5%). Our frequency is higher than that reported in Brazil of 7.6% [13]. These results confirm those of the MICS 2018-2019 survey in CAR, which reported a female predominance in 45.5%. According to the same survey, just over one in ten women aged 15 - 49 (12.3%) have in-depth knowledge of HIV. Added to this are the natural anatomical predispositions of women to a higher risk, frequent genital infections and the higher HIV screening rate for women compared to men. [16]. The patients were mostly young adults with an average age of 37.8 years. The predominance of young adults is probably explained by the precocity of sexual intercourse in adolescence. This situation can be explained by the fact that the Central African population is essentially young with 61% of the population under 20 years old [16]. In CAR, HIV infection is a generalized epidemic affecting all social classes. The average household size in our study was 5. These results are close to the national average, which was 5.6 according to the MICS survey. In our series, more than half (54.6%) of patients lived as a couple. This result confirms that of the 2018-2019 MICS survey which showed a predominance of couples in 68.5% [16]. This could be explained by the early marriage among young people who constitute the highest age group.

### 4.2. Presumptive Factors of Malnutrition

It is possible to reduce the proportion of PLVIH in state of malnutrition by combatting the factors associated with it. According to the literature, there are several factors associated with malnutrition in PLHIV, namely: low socioeconomic and educational level, poor eating habit, insufficient food intake and opportunistic infections [17]. In our study, the presumptive factors for malnutrition were: age < 36 years, duration of antiretroviral treatment less than one year, WHO stages III and IV, tuberculosis, hemoglobin level less than 12 g/dl, profound immunosuppression and detectable viral load. On the other hand, we found a difference between the occurrence of malnutrition and neuromeningeal cryptococcosis. Regarding age, Kenyan and Senegalese authors had reported an association between younger age and malnutrition [18] [19]. This situation could be correlated with the essentially young population exposing the latter to a high risk of extreme poverty with consequent malnutrition. The association between treatment duration

of less than one year and malnutrition was also found by authors in sub-Saharan Africa in Benin [15]. In our study, we observed that patients with WHO stages III and IV had 3 times more risk of malnutrition. On the other hand, the Guinean, Senegalese and Ethiopian authors had found WHO stage IV [10] [20]. According to the literature, infection or inflammation secondary to malnutrition leads to secretion of TNF and IL-6 which causes a decrease in erythropoiesis as well as a possible decrease in erythropoietin secretion [21]. The risks of malnutrition were higher in cases of immunosuppression. This trend has been reported in several studies [3] [10] [20]. This could be explained by the fact that the decrease in immunity exposes HIV-positive people more to opportunistic infections including diarrhea, esophageal candidiasis responsible for a decrease in intestinal intake and absorption but also intense inflammatory activity. We also observed that detectable HIV viral load is a risk factor for the occurrence of malnutrition. This situation can be explained by the fact that an acceleration of viral replication leads to an invasion of cells in the intestine, brain and other organs of the body. This situation affects nutritional status by decreasing food intake and absorption of nutrients and increasing the use and excretion of proteins and micronutrients [7].

### 4.3. Limitations

Our study was conducted in resource-limited context where access to certain biological tests is problematic, especially in rural areas, making it impossible to perform certain biological markers of malnutrition. Our study concerns hospitalized HIV-positive people, sometimes in a comatose state, whose questioning is problematic. According to the literature, many authors report household size, education level and number of meals as the main factors of malnutrition among PLHIV. The financial difficulties in carrying out certain biological tests (transaminases, creatinine, CD4 T cells and sedimentation rates) did not allow for exhaustive data to be obtained. This resulted in limiting the number of patients to those who had a strict minimum of data to be included. Despite these difficulties, our objective was achieved with the determination of the main factors causing malnutrition in PLHIV.

## 5. Conclusions

The prevalence of malnutrition among hospitalized PLHIV remains very high in CAR factors which associated with malnutrition were: age < 36 years, duration of antiretroviral treatment less than one year, WHO stages III and IV, tuberculosis and hemoglobin level less than 12 g/dl, immunosuppression and detectable HIV viral load.

Active screening for opportunistic infections, the establishment of a food and nutrition liaison committee and the creation of income-generating activities for our PLHIV would improve the quality of life of our patients.

Further studies are needed to confirm these results by combining a battery of biological tests and a community sample to increase the generalizability of the

results.

## Acknowledgements

We would like to thank the academic authorities of the faculty of health Sciences for authorizing this study to be conducted and the staff of the infectious and tropical diseases department, the medical department of the Bangui Community University Hospital and the Carnot District for their support in organizing the study.

## Authors' Contributions

All authors contributed to the conduct of the research. All authors have read and approved the final version of the manuscript.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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## Survey Form

File number: _____ Survey date: /___/___/2021

**I. Sociodemographic**

Age/___/years Sex: M☐ F☐ Marital status: In a relationship☐ Single☐ Divorced ☐ Widowed ☐ Occupation: Housewife ☐ Civil servant ☐ Unemployed☐ Farmer☐ Worker☐ Other: _____ Level of education: Primary☐ Secondary☐ Higher☐ Not in school☐ Number of dependents: /__/ Financial condition: With income☐ without income ☐

**II. History of the disease**

Mode of transmission: Sexual☐ Blood☐ Childbirth ☐ History of opportunistic infection: Yes☐ No☐ If yes, specify: 1-_____ 2-_____ 3-_____ Dietary habits: Alcohol☐ Tobacco☐

Date of start of ARV treatment: /__/__/_____ Therapeutic line: 1st line☐ 2nd line☐ 3rd line☐ Current therapeutic protocol: _____

**III. Clinics**

Date of admission: /__/___/2021 Date of discharge: /___/___/2021

Weight: ____kg Height: ___ m BMI: _____Kg/$m^2$

WHO stage: At hospitalization: Stage1☐ Stage2☐ Stage3☐ Stage4 ☐

**IV. Paraclinics**

CD4 count: At hospitalization: _____/$mm^3$ NFS: Hb: ___g/dl GB: _____/$mm^3$ PL: ____/$mm^3$ PN: _____/$mm^3$ Platelets: _____/$mm^3$ Creatininemia (clearance): _____ml/min, ALAT: _____UI., ASAT: _____UI, _____; CRP: _____g/l HIV Viral load: Undetectable☐ detectable☐ if detectable specify the value: _____ copy/ml

**V. Associated pathologies:**

Tuberculosis: yes ☐ no ☐ if yes specify the clinical form: _____ Neuromeningeal cryptococcosis ☐ Kaposi's sarcoma ☐ HIV encephalitis ☐ Cerebral toxoplasmosis ☐ Purulent meningitis ☐ Unknown ☐

Others: _____

Evolution: Death ☐ Favorable ☐

Observations: _____

_____