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Systematic Review

Nutritional status and dietary adequacy in people living with HIV: a systematic review

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ABSTRACT

HIV infection adversely affects nutritional status by increasing metabolic demands, impairing nutrient absorption, and reducing dietary intake. Malnutrition and dietary inadequacy among people living with HIV (PLHIV) contribute to immune suppression, poor treatment response, and accelerated disease progression, yet nutrition remains an underemphasized component of HIV care. This systematic review aimed to assess the nutritional status and dietary adequacy of PLHIV by synthesizing evidence from Indian and international studies. A systematic literature search was conducted using PubMed, Google Scholar, and Scopus for studies published between 2010 and 2025. Observational and cross-sectional studies evaluating dietary intake, nutritional status, anthropometric parameters, dietary diversity, and related clinical outcomes among PLHIV were identified using predefined inclusion criteria and synthesized narratively following PRISMA reporting guidelines. Most studies reported inadequate energy and protein intake among PLHIV, with intakes frequently below recommended levels. Micronutrient deficiencies, anemia, and poor dietary diversity were common. Anthropometric findings revealed a dual burden of malnutrition, with both undernutrition and emerging overweight observed. Poor dietary diversity, food insecurity, and socioeconomic factors were consistently associated with adverse nutritional and clinical outcomes. PLHIV remain vulnerable to nutritional inadequacy and malnutrition, with energy and protein intakes consistently below recommended levels and dietary diversity scores below five food groups in most populations studied. Both undernutrition and emerging overweight represent a dual burden requiring individualized assessment. Integrating structured nutritional screening, counselling, and food supplementation into routine HIV care programs is essential to improve immunological recovery, reduce opportunistic infections, and enhance quality of life.

Keywords: PLHIV, Nutritional status, Dietary adequacy

INTRODUCTION

Human immunodeficiency virus (HIV) is a pathogen that compromises the body's immune system and, at its most advanced stage, leads to acquired immunodeficiency syndrome (AIDS). HIV primarily targets white blood cells, particularly CD4+ T lymphocytes, thereby weakening immune function and increasing susceptibility to opportunistic infections such as tuberculosis and certain malignancies.[1] Since the onset of the epidemic, approximately 91.4 million (73.4–116.4 million) individuals have been infected with HIV globally.[2] Furthermore, an estimated 44.1 million (37.6–53.4 million) people have died from AIDS-related illnesses.[2] By the end of 2024, about 40.8 million (37.0–45.6 million) people were living with HIV worldwide, including 1.4 million (1.1–1.8 million) children aged 0–14 years and 39.4 million (35.7–44.0 million) adults aged 15 years and above. Approximately 65% of these individuals resided in the WHO African Region. In 2024 alone, an estimated 630,000 people died from HIV-related causes, while around 1.3 million individuals acquired new HIV infections.[3]

In India, despite a relatively low adult HIV prevalence of 0.20% in 2023, the HIV burden remains significant. An estimated 25.44 lakh people were living with HIV (PLHIV) in 2023. Women aged 15 years and above made up 44% (11.22 lakh) of the total PLHIV population, while children accounted for nearly 3% (0.63 lakh). During the same year, approximately 68.45 thousand individuals were newly infected with HIV. The states of Punjab (9.10 thousand), Bihar (8.27 thousand), and Uttar Pradesh (7.84 thousand) reported the highest number of new infections in 2023. Along with Maharashtra, Andhra Pradesh, Rajasthan, and Karnataka, these states contributed nearly 58% of the country's total annual new HIV infections. According to the 2023 HIV estimates, approximately 35.87 thousand PLHIV died from AIDS-related causes.[4]

Nutrition among PLHIV is a critical yet often neglected aspect of care. HIV adversely affects nutritional status from the early stages of infection through disease progression by impairing immune function, increasing metabolic demands, and reducing dietary intake. Inadequate nutrition among PLHIV contributes to poor nutritional status, reduced survival, and diminished quality of life. Dietary inadequacy can result in weight loss and increased vulnerability to opportunistic infections such as tuberculosis, as well as symptoms including anorexia and nausea. Moreover, HIV and associated infections may interfere with food intake, digestion, and nutrient absorption, further weakening immune defenses and accelerating progression to AIDS. In India, limited data are available on dietary adequacy among PLHIV. Nutritional management in this population focuses on maintaining body weight, preserving lean body mass, and enhancing resistance to infections.

According to established guidelines, energy requirements for PLHIV should be increased by approximately 10% above the recommended dietary allowance (RDA). In individuals with HIV who have concurrent infections, energy intake should be increased by 20–30% to meet the heightened metabolic demands.[5]

Objective

This review critically evaluates the nutritional status and dietary adequacy of PLHIV by synthesizing and appraising evidence from Indian and international observational studies published between 2010 and 2025. Specifically, the review aims to characterize the magnitude and patterns of macronutrient and micronutrient deficiencies among PLHIV, assess anthropometric and clinical nutritional outcomes including anaemia, dietary diversity, and body composition, identify key socioeconomic, geographic, and clinical determinants of nutritional inadequacy and highlight evidence gaps and propose actionable, evidence-informed recommendations for integrating nutritional support into comprehensive HIV care programmes at national and international levels.

METHODS

This review followed the preferred reporting items for systematic reviews and meta-analyses (PRISMA) 2020 guidelines as a reporting framework. We conducted a structured electronic literature search covering the period from January 2010 to December 2025 using three major databases: PubMed/MEDLINE, Google Scholar, and Scopus.

The search strategy employed a combination of Medical Subject Headings (MeSH) terms and free-text keywords, including: "HIV," "AIDS," "people living with HIV," "PLHIV," "nutritional status," "dietary intake," "dietary adequacy," "dietary diversity," "malnutrition," "antiretroviral therapy," "food security," and "micronutrient deficiency." Boolean operators (AND, OR) were used to combine search terms systematically.

Inclusion criteria

Inclusion criteria observational studies (cross-sectional, cohort, or case-control designs) or structured narrative reviews, studies enrolling adult or adolescent PLHIV, reporting at least one nutritional outcome including dietary intake, anthropometry, haemoglobin, CD4 count, or dietary diversity score, published in English between January 2010 and December 2025.

Exclusion criteria

Editorials, commentaries, conference abstracts, and case reports, studies without quantitative nutritional data, studies exclusively focused on HIV-negative populations. Reference lists of selected articles were reviewed and hand searches were conducted to identify additional relevant studies. Study quality was appraised using the Newcastle-Ottawa Scale (NOS) for observational studies, with high-quality evidence (NOS≥6) prioritised in the synthesis.

RESULTS

Indian studies

Dietary status

The mean nutrient intake among sedentary males included 1805 kcal/day of energy, 51 g/day of protein, 57 g/day of fat, and 271 g/day of carbohydrates. In contrast, heavily active males had lower average intakes, with 1547 kcal/day of energy, 39.9 g/day of protein, 47.9 g/day of fat, and 239 g/day of carbohydrates.[12] Indian studies consistently report that energy and nutrient intakes are below the recommended levels. Only a minority of patients meet their energy and protein requirements, while many exceed the recommended fat intake. Socioeconomic factors, dependency, and lack of antiretroviral therapy are associated with dietary inadequacy.

Table 1: Characteristics of Indian studies.

Author, Year	Place of study	Study setting	Study period	Study design	Sample size	Sampling	Method	Results: Sociodemographic	Results: Nutritional status	Conclusions
Sachdeva, 2010[16]	Chandigarh, India	Immunodeficiency Clinic of a tertiary care teaching and research institute, Postgraduate Institute of Medical Education & Research (PGIMER)	July 2009 to October 2009	Cross-sectional study	n= 100	Consecutive	24 h recall method	Mean age 36.1±8.3 (range 23 - 62) yr.	• Mean weight: 58.6±11.7 (range, 34 - 94) kg • Mean BMI: 21.5±3.7 (range, 13.6 - 36.7) kg/m^2 • Mean total calories: 1713±292.8 (860 - 2525) calories/day • Mean difference in the calories: 249.5±190.7 (10.6 - 967.5) calories/day • Mean carbohydrate: 246.7±39.7 (130 - 389) g/day • Mean protein:48.6±10.3 (21 - 77) g/kg/day • Mean Fat: 41.3±10.5 (20 - 65) g/day	• In HIV-infected individuals the energy intake was significantly lower than the recommended average intake (RDA)
Anand, 2013[7]	Delhi, India	ART centre of Guru Teg Bahadur Hospital, Shahadra	12 Weeks	Cross-sectional study	n= 400	-	• A close-ended, pretested questionnaire comprising three sections: knowledge, attitude, and practices used.	• 82.7%- 21-40 years • Major HIV transmission (76.5%)- Heterosexual contact	• Mean scores: - • Knowledge-8.3±2.2 • Attitude-34.4±3.7 • Practices-8.1±2.3 • Total-50.8±5.5	• PLHIV had good knowledge of the importance of nutrition during infection and a positive attitude toward the disease, but this knowledge was poorly translated into practice.
Anand, 2014[8]	Delhi, India	ART centre of Guru Teg Bahadur Hospital, Shahadra	3 months	Cross-sectional study	n= 400	-	• Anthropometric data • 24-h dietary recall • Mini Nutritional	-	• Mean BMI: 19.73±3.55 kg/m^2 • 40%- BMI <18.5 kg/m^2	• Risk of malnutrition together with poor nutrient intakes over a long period of time could

Continued.

Author, Year	Place of study	Study setting	Study period	Study design	Sample size	Sampling	Method	Results: Sociodemographic	Results: Nutritional status	Conclusions
							Assessment (MNA)			contribute to further worsening of the nutritional status.
Bimolata Devi, 2014[9]	Imphal city, India	Two hospitals: Regional Institute of Medical Sciences (RIMS), & Jawaharlal Nehru Institute of Medical Sciences (JNIMS)	April 2009-October 2012.	Cross sectional study	n= 442	-	Anthropometric assessment 24 hours recall method Hb level	• mean age - 37.62 years.	• Mean height 154.74 cm • Mean weight- 49.66kg, • Average BMI- 21.04. • Average W: H- 0.84. • Mean Hemoglobin- 10.36 g/dl • 55.9%- mild anemia. • Deficiency in intake of iron, carotene, thiamin, riboflavin and niacin- highly significant P<0.001) compared to recommender levels (ICMR/NIN)	• Certain food intakes & other information may be over or under presented, which may have resulted in the less significant pictures in certain expected areas. Use of Actual food weighment method would've revealed truer picture and realistic results.
Baghel, 2015[10]	Haldwani, Uttarakhand	ART centre of Susheela Tiwari Hospital,	August 2013 to October 2013.	Cross sectional study	n= 110	-	• Blood examination for CD4 count and Hb. • 24-hour recall method	• Male- 47.27 and female- 52.73 • 55.45 % age groups- 30-60 years. • Heterosexual transmission- 82.73%	• Mean Hb- 10.88±2.15 g/dl • Mean CD4 count- 303.05±133.5 cells mm^3 • Mean energy intake of • sedentary and moderate male subjects was 1907±467 and 2043±454 kcal/day which is 74.75 and 68.06 per cent of energy RDA • Female subjects mean energy sedentary and moderate were 1570±434 and 1844±288 kcal/day • Protein intake of male and female subjects	• Dietary intake was inadequate and mean Hb was low.

Continued.

Author, Year	Place of study	Study setting	Study period	Study design	Sample size	Sampling	Method	Results: Sociodemographic	Results: Nutritional status	Conclusions
									was 54.73±12.33 and 45.24±11.59 gm which was 54.39% and 35.19% of the RDA for protein respectively.	
Hiremanth, 2018[11]	Maharashtra	ART center of a tertiary care institution in Maharashtra.	-	Cross-sectional study	n= 104	-	• Anthropometric assessment, • Investigations and questions to assess the role of diet and important nutritional aspects	• 51.92%-female • Average age-38.5±9.6	• Mean Hb before and after ART-10.45±2.13 and 10.64±2.16 • Mean CD4 count before and after ART-177.26±146.52 and 413.69±266.25. • Mean after BMI-20.55±3.07.	• There exists a wide gap in PLHAs knowledge regarding nutritional aspects, although the study shows that good nutrition has good influence on CD4 count.
Kumari, 2025[12]	Delhi	ART center of Safdarjung hospital.	August 2023 to May 2024	Cross-sectional Study	n= 100	Purposive	• Anthropometric measurement • 24-hour dietary recall method.	• mean age-28.98 years • 61%- male and 39%-female.	• Mean BMI-22.49±3.52. • Sedentary male- 1805 Kcal/day, protein-51g/day, fat- 57g/day and carbohydrate-271g/day • Male (heavy active) energy- 1547Kcal/day, Protein- 39.9g/day, fat- 47.9g/day and carbohydrate-239g/day. • Sedentary Females: - Mean energy intake-1789±240.06 kcal. • Mean protein intake-50.7±11 g. • Mean total fat intake - 60.2±9.8 g.	• Sedentary males demonstrated adequate nutrient intake, heavily active males showed poor intake, and sedentary females exceeded recommended levels.

Table 2: Characteristics of studies other than India.

Author, Year	Place of study	Study setting	Study period	Study design	Sample size	Sampling	Method	Results: Sociodemographic	Results: Nutritional status	Conclusions
Belaynew, 2010[13]	Northwest Ethiopia	University of Gondar Referral Hospital	October 01 to November 30, 2007,	Cross-sectional study	n= 331	Systematic sampling	• Anthropometric assessment • Clinical assessment • Interview	• Mean (+SD) age-33.9 + 8.2 years • Malnutrition (BMI < 18.5) was significantly associated with income, ART duration, eating problems, and nutritional support.	• BMI<18.5kg/m^2) in 27.8% • Body weight lost (BWL>5% in 60.9%. • Severe malnutrition (BWL>20%) in 10.1%.	• A high burden of malnutrition in PLHIV. Income, eating problems, duration of ART, and current clinical condition were associated with malnutrition in this group of patients.
Liu, 2011[14]	Tanzania	ART centre	First 3 months of antiretroviral therapy	Cross-sectional study	n= 18,271	-	• BMI • Middle upper arm circumference (MUAC) • Hemoglobin	-	• Weight loss increased mortality risk in all BMI categories except overweight (BMI ≥25 kg/m^2). •	• Weight loss during the first three months of antiretroviral therapy was associated with increased mortality across all BMI categories except overweight individuals.
Christina A., 2012[15]	Koforidua, Eastern Regional capital in Ghana	Koforidua Central Hospital	HIV adults attending clinic for the first time during the study	Cross-sectional study	n= 110	-	• Food Frequency Questionnaire • 24-hour-recall method • Weights and heights measurements • Knowledge	• 54.5%- females • 45.5%-males.	• 91%- fair to adequate knowledge of nutrition • 91.8%- rated fair to poor diets • 50% had poor diets • Negative correlation between the quality of diet of respondents and their nutritional status which was statistically significant (r = - 0.242; p = 0.011)	• Nutrition knowledge did not influence the quality of respondents 'diets to a, but diet quality determined nutritional status.
Lwanga, 2015[16]	Uganda	TASO (HIV &	August and	Cross-sectional	n=205	-	• BMI-for-Age (BAZ) and	-	• Prevalence of stunting-36.2% (72/199) with	• Prevalence of stunting and thinness was high

Continued.

Author, Year	Place of study	Study setting	Study period	Study design	Sample size	Sampling	Method	Results: Sociodemographic	Results: Nutritional status	Conclusions
		AIDS Support Organization) centers across Ugand	September 2014.	study			Height-for-age (HAZ) as measures of thinness and stunting		11.1% (22/199) of adolescents being severely stunted. • Risk factors for stunting included being male (AOR: 4.0; 95% CI: 1.81-7.02) and residence in rural settings (AOR: 6.0; 95% CI 2.70-12.16). • 18% adolescents (36/200) thin, 8% (16/200) severely thin. • Males were more likely to be stunted than females (p=0.002). • Adolescents living in rural areas were more likely to be stunted than those from the urban setting (p<0.001).	among the HIV infected adolescents. Male adolescents and residing in rural settings are important risk factors of malnutrition among the HIV infected adolescents.
Thuppal, 2017[17]	USA	National Center for Health Statistics (NCHS), CDC	NHANES 2003 to 2014	Cross-sectional survey	-	Complex multistage sampling design	• Two 24-h dietary recalls	• Men higher prevalence of HIV than women (77% compared with 23%) • Mean age of HIV-positive individuals (37.7 y)	• HIV- 34.3±2.3) • HIV-positive women intakes of fiber (mean±SEM: 9.2±1.5 g) compared with (14.7±0.2 g) and protein (83.5±6.1 g compared with 71.3±0.5 g) than did HIV-negative women.	• HIV infection is associated with poorer markers of some nutritional status indicators
Dzinamarira, 2020[18]	Kigali, Rwanda	Kigali City Province is the Capital City of Rwanda.	July – August 2019	Cross-sectional study	n=204	Systematic random sampling.	• Food frequency questionnaire (FFQ)	• Average age- 30.3 and majority (55%) being female • 61%-educated up to primary level • 38%-worked in the past 12 months.	• Poor dietary status- 15% based on FFQ responses • Association between dietary status and HIV status disclosure (AOR 2.5; CI 1.25 - 4.83; p=0.014	• Poor dietary status among people living with HIV (PLWH) remains a concern, with a strong association observed between dietary status and body mass index .

Continued.

Author, Year	Place of study	Study setting	Study period	Study design	Sample size	Sampling	Method	Results: Sociodemographic	Results: Nutritional status	Conclusions
								• 18%-married	• Association between dietary status and BMI (AOR 10.2; CI 8.30 – 16.0; p<0.001).	(BMI).
Khatri, 2020[19]	Kathmandu, Nepal	Sukraraj Tropical and Infectious Disease Control hospital	July to December 2017	Cross-sectional study	n=350	Systematic random sampling	• Dietary diversity score	• Mean age- 38.9 years with SD 9.1 years	• Underweight- 18.3% (95% CI: 14.3–22.6). • Overweight/obese (39.1%)	• Overweight/obesity is an emerging problem among people living with HIV.
Nanewortor, 2021[20]	Ghana	Public hospital in Ho Municipality of the Volta Region	2019	Cross-sectional study	n=152	Simple random sampling	• Semi-structured questionnaire largely adapted form Abgaryan	• Mean age- 39.3 years (S.D. = 12.6) • Females constituted 77.6%.	• 42%- malnourished (underweight = 13.8%, and overweight = 28.3%)	• high prevalence of malnutrition among clients
Ezenwosu, 2022[21]	Enugu, Nigeria	HIV centers of the University of Nigeria Teaching Hospital (UNTH) and Enugu State University Teaching Hospital (ESUTH) in Enugu State	-	Cross-sectional analytical study	n=370	Systematic random sampling	• Dietary diversity score • Regional center for quality of healthcare (RCQHC)	• Mean age of 41.1±10.5 years • 73.8% of the HIV patients were females.	• Mean overall knowledge score- 7.8±1.5. Secondary educational level (AOR: 0.54; 95% CI: 0.29-0.97 • Family monthly income of 31,000-60,000 (AOR: 2.12; 95% CI: 1.11-4.06 • Number of children in a household (AOR:2.09; 95% CI: 1.19-3.67) • Mean dietary diversity score- 4.86±1.30.	• Education and family income predict nutrition knowledge, while the number of children in a household predicts dietary diversity.
Shallangwa, 2023[22]	Maiduguri Metropolitan	ART at Muhammad Shuwa	March to May 2022	Cross-sectional study	n= 384	Convenience sampli	• Dietary diversity score	• Females (65.1%) and over 30 years old (77.9%).	• 76%- inadequate dietary diversity	• Prevalence of both undernutrition and overweight or obesity,

Continued.

Author, Year	Place of study	Study setting	Study period	Study design	Sample size	Sampling	Method	Results: Sociodemographic	Results: Nutritional status	Conclusions
	Council (MMC), Borno state, Nigeria	Memorial Hospital (MSMH).				ng	• Household Food Insecurity Access Scale (HFIAS)		• 38.5%-mildly food insecurity • Prevalence of undernutrition (13%), normal nutrition (56.8%), and overnutrition (30.2%) • Highest prevalence of undernutrition was among male (64%) • Undernutrition was more common among those in WHO clinical stage I (74%), with viral load <1000 copies/ml (86%), on ART for less than 5 years (74%) • 11.2% - classified as food secure inadequate dietary diversity (AOR = 0.200; 95% CI: 0.105–0.371) were associated with overnutrition.	food insecurity observed
Abdulai, 2024[23]	Cape Coast Metropolis in the Central Region of Ghana.	Two healthcare facilities: Cape Coast Teaching Hospital and University of Cape Coast Hospital	15th September 2021 to 30th to October, 2021	Cross-sectional study	n=220	Random sampling method	• 24-hour recall • Dietary diversity scores	• 60.5% within the age group of 40–59 years. • Females-86.8% • Smoking 4.1% • Alcohol consumption 76.4% • Regular physical activity 26.8%	• 33.2% low dietary diversity score • 40 to 59 years higher dietary diversity (adjusted odds ratio (AOR) = 1.966, 95% Confidence Interval (CI): 1.045–4.987). • Meals at least three times daily have a high IDDS (AOR = 1.641, 95% CI: 1.221, 8.879).	• Dietary diversity and undernutrition are significantly influenced by factors such as age, sex, occupation, physical activity, meal frequency, duration of antiretroviral therapy, and treatment regimen.

Continued.

Author, Year	Place of study	Study setting	Study period	Study design	Sample size	Sampling	Method	Results: Sociodemographic	Results: Nutritional status	Conclusions
Nebayeng, 2024[24]	Lawra, Ghana	Antiretroviral therapy (ART) site located in the Municipal Hospital Lawra Municipal Hospital.	December 2020 to February 2021	Cross-sectional study	n= 269	Systematic random sampling	• 24-hr food recall method • Dietary diversity score	• Mean age- 43.3 ± 11.0 years • 65.1%- females.	• 36 (13.4%) have diversified diet • Mean dietary diversity score of 3.7 ± 0.99. • Starchy staple foods (96.7%) and flesh food (92.9%) were the most consumed foods	• Low dietary diversity and possible food insecurity are highly prevalent among HIV/AIDS-infected persons in Lawra Municipality.
Belete, 2025[25]	Southern Ethiopia	Public health facilities of Game zone, a zonal administration	10 May 2022 to 10 June 2022.	Cross-sectional study	n=406	Randomly selected	• Global Physical Activity Questionnaire Analysis Guide • Dietary Diversity Score • 24-hour recall	• 51.5%- men • Mean age- 39.3±10.9 years, with (52.7%) belonging to the age group 30–44 years.	• Undernutrition - 28% (95% CI 24.0 to 33) • Poor ART drug adherence (AOR 3.6, 1.815 to 7.428) • Consuming <5 food groups (AOR 4.8, 2.901 to 8.265) • 265 (65.3%) were food insecure • 320 (78.8%) participants had <600 MET physical activity	• Poor drug adherence was significantly associated with undernutrition

Anthropometric measurements

The mean body weight was 58.6±11.7 kg, with values ranging from 34 to 94 kg, and the mean BMI was 21.5±3.7 kg/m².[1] Another study reported a mean BMI of 19.73±3.55 kg/m², with 40% of participants having a BMI below 18.5 kg/m², indicating undernutrition.[8] Among women, the mean height was 154.74 cm, the mean body weight was 49.66 kg, and the average BMI was 21.04 kg/m², with a mean waist-to-hip ratio of 0.84.[4] Additional findings showed a post-intervention mean BMI of 20.55±3.07 kg/m², while another study reported a mean BMI of 22.49±3.52 kg/m².[11,12]

It is estimated that up to 50% of the Indian population is at risk of malnutrition, with approximately 34% classified as malnourished. Inadequate nutrient intake and sustained dietary deficiencies contribute to declining nutritional status and increase susceptibility to opportunistic infections.

Knowledge, attitude, and practices related to nutrition

The mean scores were 8.3±2.2 for knowledge, 34.4±3.7 for attitude, and 8.1±2.3 for practices, with an overall KAP score of 50.8±5.5, indicating moderate nutrition-related awareness.[7]

Clinical parameters

Haemoglobin levels

The mean haemoglobin level was 10.36 g/dl, with 55.9% of participants having mild anaemia.[9]

Haemoglobin and CD4 count

The mean haemoglobin level was 10.88±2.15 g/dl, ranging from 4.4 to 16.2 g/dl.

The mean CD4 count was 303.05±133.5 cells/mm³, with a range of 39 to 983 cells/mm³.[10]

Changes before and after ART initiation

The mean haemoglobin level before and after ART was 10.45±2.13 g/dl and 10.64±2.16 g/dl, respectively.

The mean CD4 count increased from 177.26±146.52 cells/mm³ before ART to 413.69±266.25 cells/mm³ after ART.[11]

International studies

Dietary status

Consistent with findings from India, international studies also report inadequate energy and micronutrient intake among people living with HIV.

Malnutrition prevalence

A total of 27.8% of participants had a BMI <18.5 kg/m². Body weight loss greater than 5% was observed in 60.9%, while severe malnutrition (body weight loss >20%) was present in 10.1% of participants.[13]

Participants with a BMI <17 kg/m² had a significantly higher risk of adverse outcomes (relative risk: 7.9; 95% CI: 4.4–14.4).[14]

The prevalence of stunting was 36.2% (72/199), with 11.1% (22/199) of adolescents being severely stunted. Stunting was significantly associated with male sex (AOR: 4.0; 95% CI: 1.81–7.02) and rural residence (AOR: 6.0; 95% CI: 2.70–12.16). Additionally, 18% (36/200) of adolescents were thin, and 8% (16/200) were severely thin. Males and adolescents from rural areas were significantly more likely to be stunted (p=0.002 and p<0.001, respectively).[16]

The prevalence of underweight was 18.3% (95% CI: 14.3–22.6), while 39.1% of participants were overweight or obese.[19]

Overall, 42% of participants were malnourished, comprising 13.8% underweight and 28.3% overweight individuals.[20]

Dietary diversity

The mean dietary diversity score (DDS) was 4.86±1.30.[21]

Inadequate dietary diversity was observed in 76% of participants, while 38.5% experienced mild food insecurity.[22]

Low dietary diversity was reported by 33.2% of participants. Individuals aged 40–59 years were more likely to have higher dietary diversity (AOR: 1.97; 95% CI: 1.05–4.99). Consuming three or more meals per day was also significantly associated with a higher individual dietary diversity score (IDDS) (AOR: 1.64; 95% CI: 1.22–8.88).[23]

Another study reported a mean dietary diversity score of 3.7±0.99, with starchy staple foods (96.7%) and flesh foods (92.9%) being the most commonly consumed food groups.[24]

Consumption of fewer than five food groups was significantly associated with adverse nutritional outcomes (AOR: 4.8; 95% CI: 2.90–8.27).[25]

Knowledge related to nutrition

The study population comprised 54.5% females and 45.5% males, with 91% of participants demonstrating fair to adequate knowledge of nutrition.[15]

The mean overall nutrition knowledge score was 7.8±1.5, indicating a generally satisfactory level of nutritional awareness among participants.[21]

DISCUSSION

Synthesis of key findings on nutritional status and dietary adequacy in PLHIV

The evidence presented in this review reveals a consistent and concerning pattern of inadequate nutritional status and dietary inadequacy among people living with HIV (PLHIV), spanning both Indian and international contexts. The findings underscore nutrition as a critical yet understudied dimension of comprehensive HIV care that requires urgent policy and programmatic attention.

Energy and macronutrient intake: a persistent gap

Across Indian studies, the mean daily energy intake of PLHIV ranges from 1713 to 1805 kcal, consistently falling short of the recommended dietary allowance, with caloric deficits averaging 249.5 kcal/day.[6] This pattern is particularly concerning given that current WHO guidelines recommend 10% higher energy intake for PLHIV and 20-30% increases for those with concurrent infections.[5] The data demonstrates that only a minority of PLHIV meet their energy requirements that further widens up among heavily active males.[10]

Protein intake presents an even more alarming picture. Both Indian and international studies document severe protein deficiency, with males and females meeting only 54.39% and 35.19% of the recommended daily allowance, respectively.[10] While HIV-positive women in the United States paradoxically showed higher absolute protein intake (83.5 g)) compared to HIV-negative women, this represents the exception rather than the norm, likely reflecting socioeconomic differences in the developed versus resource-limited settings predominating in this review's study populations.[17]

The inadequacy of micronutrient intake—particularly iron, carotene, thiamine, riboflavin, and niacin—reported as highly significant ($p<0.001$) in Indian studies, suggests that even when total energy intake approaches recommendations, the quality and diversity of dietary intake remain suboptima.[9] This distinction between quantity and quality of dietary intake is crucial, as it indicates that addressing malnutrition in PLHIV requires not merely increasing caloric intake but ensuring access to nutrient-dense, diverse foods.

Dietary diversity

Dietary diversity scores emerging from international studies reveal a striking pattern of inadequacy—76% of PLHIV in Nigeria, 33.2% in Ghana, and only 13.4% with truly diversified diets in Ghana demonstrated low dietary diversity.[22,24] The mean dietary diversity scores globally range from 3.7 to 4.86 food groups out of the recommended 6-8 groups for optimal nutrition.[24] These findings are particularly significant because dietary diversity is increasingly recognized as a more nuanced and actionable nutritional indicator than traditional anthropometric measures, as it captures both nutrient density and food security.

The association between dietary diversity and health outcomes is substantiated by evidence showing that consumption of fewer than five food groups was significantly associated with undernutrition (AOR: 4.8; 95% CI: 2.90-8.27).[25] Furthermore, consuming three or more meals daily was associated with higher individual dietary diversity scores (AOR: 1.64; 95% CI: 1.22-8.88), suggesting that meal frequency and food diversity are interconnected and amenable to intervention.[23] The consistent dominance of starchy staples (96.7%) and flesh foods (92.9%) in dietary patterns, with marked underrepresentation of fruits, vegetables, and legumes among Indians , indicates a narrowing of dietary intake that predisposes PLHIV to micronutrient deficiencies despite adequate macro-caloric intake.[24]

Anthropometric indicators

The anthropometric data reveal a complex and heterogeneous nutritional landscape. Indian studies report mean BMI values ranging from 19.73 to 22.49 kg/m², with alarming proportions classified as underweight—40% in one study with BMI <18.5 kg/m².[8] At the international level, the prevalence of underweight varies considerably, from 13.8% in Ghana to 36.2% as stunting prevalence in adolescents in Uganda, suggesting substantial variation by geographic region, age group, and stage of disease progression.[16,20]

A particularly important observation is the emerging pattern of overweight and obesity among PLHIV in some populations (39.1% in Nepal, 28.3% in Ghana), suggesting a nutritional transition within this vulnerable population.[19,20] This dual burden of malnutrition—simultaneous occurrence of both underweight and overweight individuals within the same population—reflects differing access to food, varying adherence to antiretroviral therapy (ART), and potentially differential inflammatory responses to HIV and ART. The occurrence of overnutrition in resource-limited settings challenges conventional assumptions about malnutrition in PLHIV and necessitates individualized nutritional assessment and intervention rather than one-size-fits-all approaches.

The severity of malnutrition is underscored by findings of body weight loss exceeding 5% in 60.9% of participants in one study, with severe malnutrition (>20% weight loss) in 10.1%.[13] Notably, a BMI <17 kg/m² conferred a relative risk of 7.9 (95% CI: 4.4-14.4) for adverse outcomes, establishing low body weight as a significant predictor of mortality and morbidity independent of other clinical markers.[14]

Anemia and CD4 recovery: nutritional biomarkers

Hemoglobin levels documented across Indian studies ranged from 10.36 to 10.88 g/dl, with 55.9% of participants experiencing mild anemia.[9] This finding is particularly noteworthy given that anemia in PLHIV is multifactorial, arising from HIV-related bone marrow suppression, opportunistic infections, chronic inflammation, and nutritional deficiencies, particularly of iron, vitamin B12, and folate. The elevated prevalence of anemia in the study population likely reflects the combined effect of inadequate micronutrient intake and ongoing immunosuppression.

The relationship between ART and CD4 recovery is illustrated by one Indian study demonstrating an increase in mean CD4 count from 177.26±146.52 cells/mm³ pre-ART to 413.69±266.25 cells/mm³ post-ART—a substantial rise that, while reflecting ART efficacy, also suggests potential contributions of concurrent nutritional status, as studies indicate that baseline nutritional status independently influences CD4 recovery kinetics.[11] The observation that hemoglobin levels remained relatively stable post-ART (10.64±2.16 g/dl) despite CD4 recovery suggests that anemia in PLHIV may be partially independent of immune reconstitution, with dietary factors playing a more prominent role than previously appreciated.[11]

Socioeconomic and contextual determinants

The studies reveal that nutritional status and dietary adequacy in PLHIV are not determined by HIV disease stage or ART status alone but are deeply embedded within socioeconomic, geographic, and social contexts. Male sex and rural residence emerged as significant risk factors for malnutrition and stunting (AOR: 4.0-6.0 for males and rural dwellers, respectively, in Ugandan adolescents), suggesting that gender and geographic disparities in income, food access, and healthcare infrastructure substantially influence nutritional outcomes.[16]

Comparison between Indian and international contexts

Malnutrition and dietary inadequacy are universal challenges for PLHIV, but their distribution and severity vary. Indian studies show a higher prevalence of absolute caloric and protein deficiency due to resource constraints and lower socioeconomic status. International studies, especially from sub-Saharan Africa, highlight dietary diversity and food insecurity as primary concerns. Emerging data from higher-income countries (the US, Nepal) show the dual burden of undernutrition and overweight.

Indian populations have a high prevalence of anaemia (55.9% with mild anaemia), possibly due to concurrent infections, micronutrient deficiencies, and inconsistent access to supplementation.[9] Conversely, international studies show higher rates of severe malnutrition (27.8% with BMI <18.5 in Ethiopia) compared to most Indian studies, suggesting that absolute poverty and food insecurity are more severe limiting factors globally than in India's vulnerable PLHIV populations.[13]

Limitations of current evidence and research gaps

Despite the breadth of observational data synthesized, several methodological limitations merit consideration. First, the predominance of cross-sectional study designs across both Indian and international studies prevents causal inference about the temporal relationship between nutritional status and clinical outcomes such as CD4 count recovery or mortality. Second, the most commonly used dietary assessment tool—the single 24-hour dietary recall—is susceptible to recall bias, social desirability bias, and fails to capture day-to-day intra-individual dietary variability; multiple-day recalls or validated food frequency questionnaires would provide more robust estimates.

Third, substantial heterogeneity across studies in population characteristics (age, sex, ART status, disease stage), geographic settings (rural vs. urban; sub-Saharan Africa vs. South Asia vs. North America), and nutritional outcome definitions limits the comparability of findings and precludes formal meta-analysis. Fourth, several included studies used convenience or purposive sampling, which may introduce selection bias and limit generalizability to broader PLHIV populations. Fifth, India lacks prospective longitudinal data on nutritional trajectories in PLHIV, representing a significant evidence gap given the country's substantial burden of approximately 25.44 lakh PLHIV.[4] Finally, the absence of standardised nutritional assessment protocols across studies—some relying solely on BMI, others on dietary diversity scores or recall methods—further limits synthesis and cross-study comparisons.

CONCLUSION

PLHIV face persistent challenges in achieving adequate nutrition and dietary diversity, both in India and globally. Evidence shows PLHIV are at higher risk of malnutrition, with energy and nutrient intakes often below recommended levels. Socioeconomic constraints, limited access to nutritional counselling, and the direct impact of HIV on immune function exacerbate poor dietary adequacy.

Malnutrition and low dietary diversity negatively affect health outcomes, increase vulnerability to opportunistic infections, and accelerate disease progression. Targeted nutritional counselling and education have shown promise in improving dietary practices and overall health status among PLHIV.

To address these challenges, integrated approaches combining medical management with comprehensive

nutritional support are required. Strengthening awareness, improving access to balanced and diverse diets and tailoring interventions to the specific needs of PLHIV can contribute to improved health outcomes and enhanced quality of life. Interventions must address the underlying determinants such as food insecurity, economic constraints and social barriers that prevent the translation of nutritional knowledge into dietary practice. This may require coordination with livelihood programmes, food supplementation schemes and community health worker networks. Continued research and policy efforts are essential to address existing gaps in dietary adequacy and ensure holistic, person-centred care for this vulnerable population.

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