Caloric and Protein Deficits and Their Association with Socio-demographic Factors Among Adults Living with HIV in Northern India

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Abstract

Background: Adults living with HIV (ALHIV) are vulnerable to nutritional inadequacy due to increased metabolic demands and socio-economic constraints. However, Indian evidence quantifying calorie and protein intake relative to recommended dietary allowances (RDA) remains limited. This study assessed the adequacy of calorie and protein intake and examined their socio-demographic determinants among ALHIV. **Material & Methods:** A cross-sectional study was conducted among 400 ALHIV aged 18-60 years attending an ART centre in Northern India (2024-2025), selected using simple random sampling. Dietary intake was assessed using a 24-hour recall method. Energy and protein intake were calculated and compared with ICMR-NIN 2020 RDA values; intake <100% RDA was considered inadequate. Associations were analysed using appropriate statistical tests, with $p<0.05$ considered significant. **Result:** A high prevalence of dietary inadequacy was observed: 94.7% of participants had inadequate calorie intake and 93.7% had inadequate protein intake. Severe deficits (<70% RDA) were present in 57.5% for calories and 64.8% for protein. Calorie inadequacy was significantly associated with educational status ($p<0.001$) and socio-economic class ($p=0.011$). In multivariable analysis, illiteracy independently predicted calorie inadequacy (AOR=4.27; 95% CI: 1.01-18.02; $p=0.048$). Protein inadequacy was significantly associated with socio-economic class ($p=0.038$). **Conclusion:** There is an alarmingly high burden of calorie and protein inadequacy among ALHIV in this setting. Educational disadvantage independently influences calorie intake, highlighting a critical gap in current HIV care. Routine dietary assessment and targeted nutritional counselling should be integrated into ART services.

Keywords: ALHIV, Dietary adequacy, Antiretroviral therapy, Calorie intake, Protein intake

Introduction

Human immunodeficiency virus (HIV) infection continues to remain a major global public health challenge despite substantial advances in diagnosis and antiretroviral therapy (ART). The adult HIV prevalence in India is estimated to be 0.20% in 2023, with a slightly higher prevalenceamong males (0.22%) compared to females (0.19%). [1] With increasing access to ART, survival among adults living with HIV (ALHIV) has improved considerably; however, nutritional problems continue to adversely affect disease progression and treatment outcomes. Nutrition plays an essential role in maintaining immune function, preserving lean body mass, improving quality of life, and enhancing the effectiveness of ART among adults living with HIV (ALHIV). [2]

HIV infection is associated with multiple metabolic and physiological alterations that predispose affected individuals to nutritional inadequacy. Chronic immune activation, increased resting energy expenditure, opportunistic infections, malabsorption, anorexia, and altered nutrient metabolism contribute to increased nutritional requirements and poor dietary status among ALHIV. The World Health Organization (WHO) has reported that energy requirements increase by approximately 10% among asymptomatic HIV-infected adults and by 20-30% among symptomatic individuals in order to maintain body weight and physical activity.[3] Inadequate calorie and protein intake under such conditions may result in weight loss, reduced muscle mass, impaired immune recovery, greater susceptibility to opportunistic infections, and poor treatment response.[4] However, despite these increased physiological requirements, HIV-specific dietary reference values for the Indian population are not available, and nationally recommended dietary allowances remain the only standardized reference for evaluating dietary intake in this setting.

Although ART has significantly reduced HIV-related morbidity and mortality, dietary inadequacy remains highly prevalent, particularly in low- and middle-income countries where food insecurity and socio-economic deprivation are common. Previous studies from India have demonstrated inadequate dietary intake among HIV-infected individuals. Sachdeva et al., in a cross-sectional study from North India, reported

significantly lower calorie and protein intake among HIV-infected adults compared to recommended dietary allowances (RDA). [5] Similarly, previous studies among ALHIV in India have highlighted the influence of socio-demographic and socio-economic factors on nutritional status or dietary intake, , highlighting the importance of comprehensive care that includes nutritional assessment and support. [6,7]

Socio-demographic factors such as educational status, occupation, residence, and socio-economic status may substantially influence dietary intakeand nutritional adequacy among ALHIV. Limited educational attainment may reduce nutritional awareness and the ability to understand dietary counselling, while economic disadvantage may restrict access to nutritionally adequate food. Previous evidence has shown that socio-economic and educational disparities are important determinants of nutritional vulnerability among ALHIV.[7] However, evidence examining the socio-demographic determinants of calorie and protein inadequacy among ALHIV in Northern India remains limited.

Against this background, the present study was undertaken to assess the adequacy of calorie and protein intake among adults living with HIV attending an ART centre in Northern India and to examine its association with selected socio-demographic factors.

Aims and Objectives

1. To assess the adequacy of calorie intake among adults living with HIV in relation to the recommended dietary allowance (RDA).
2. To assess the adequacy of protein intake among adults living with HIV in relation to the recommended dietary allowance (RDA).
3. To determine the association of calorie and protein intake adequacy with socio-demographic factors among adults living with HIV.

Materials and Methods

Study design and setting

A hospital-based cross-sectional study was conducted among adults living with HIV (ALHIV) attending the Antiretroviral Therapy (ART) Centre of a tertiary care teaching hospital in Northern India during 2024-2025.

Study population

The study population comprised ALHIV aged 18-60 years who were registered at the ART centre and receiving antiretroviral therapy during the study period.

Inclusion criteria

- Adults living with HIV aged 18-60 years
- Registered at the ART centre and receiving ART
- Willing to participate in the study and provided written informed consent

Exclusion criteria

- Seriously ill or bedridden individuals
- Pregnant women
- Individuals unwilling to participate in the study

Sample size and sampling technique

The sample size was calculated using the formula for estimation of a proportion: $n=Z^2PQ/L^2$

Assuming the prevalence of undernutrition among adults living with HIV to be 40%, based on the study conducted by Anand and Puri.[8] with 95% confidence level, 5% absolute precision, and 10% non-response rate, the final sample size was calculated to be 400 participants.

Participants were selected using simple random sampling from the ART centre registration records. A sampling frame comprising all eligible adults living with HIV registered at the ART centre during the study period was prepared from the ART centre registration records. Each eligible individual was assigned a unique identification number, and participants were selected using a computer-generated random number list until the required sample size was achieved.

Data collection tool and procedure

Data were collected using a pre-tested semi-structured questionnaire developed after an extensive review of the literature and consultation with experts in HIV nutrition. The questionnaire was pre-tested among approximately 10% of the estimated sample size in a setting similar to the study population to assess clarity, comprehensibility, and feasibility. Necessary modifications were incorporated based on the findings of the pre-test before commencement of the study. Information regarding socio-demographic characteristics including age, sex, residence, marital status, religion, educational status, occupation, and socio-economic status was obtained from the participants.

Dietary intake assessment was carried out using the 24-hour dietary recall method. Participants were asked to recall all food items and beverages consumed during the preceding 24 hours. Portion sizes were estimated using standardized household utensils and measures to improve the accuracy of dietary assessment. The socio-economic status of the study population was assessed as per the Modified B.G. Prasad Classification (2025). [9]

Assessment of calorie and protein intake adequacy

Daily calorie and protein intake of participants were calculated using standard Indian food composition tables. The calculated intake values were compared with the Recommended Dietary Allowances (RDA) prescribed by the Indian Council of Medical Research-National Institute of Nutrition (ICMR-NIN), 2020.[10] Intake less than 100% of the recommended RDA was considered inadequate.

For descriptive analysis, intake adequacy was further categorized as:

- Adequate intake: ≥100% RDA
- Mild deficit: 90-99% RDA
- Moderate deficit: 70-89% RDA
- Severe deficit: <70% RDA

Statistical analysis

Data were entered into Microsoft Excel and analysed using IBM SPSS Statistics version 20. Categorical variables were expressed as frequencies and percentages. Associations between socio-demographic characteristics and calorie/protein intake adequacy were assessed using Chi-square test. Variables found statistically significant in bivariate analysis and epidemiologically relevant variables were included in binary logistic regression analysis. Adjusted odds ratios (AOR) with 95% confidence intervals (CI) were calculated. A p-value of less than 0.05 was considered statistically significant.

Ethical considerations

Ethical approval was obtained from the Institutional Ethics Committee of the study institution (Ref. No.: IECJNMC/1067). Written informed consent was obtained from all participants prior to enrolment in the study. Confidentiality and anonymity of the collected information were maintained throughout the study.

Results

Socio-demographic characteristics

A total of 400 ALHIV were included in the study. The mean age of participants was 41.1 ± 10.8 years. The largest proportion belonged to the 31-40 years age group (35.0%), followed by 41-50 years (29.5%), 51-60 years (19.5%), and 18-30 years (16.0%).

Males constituted 52.5% (n=210) of the study population. The majority of participants were from rural areas (74.8%). Most participants were married (64.8%), while 25.6% were divorced/widowed and 9.8% were single.

Regarding education, 35.8% were illiterate, 26.8% had primary education, 26.5% had secondary education, and 11.0% had education at college level or above. Nearly half of the participants were unemployed (46.0%), followed by unskilled workers (32.3%). In terms of socio-economic status, the largest proportion belonged to Class IV (37.0%), followed by Class III (21.3%), Class II (16.0%), Class V (15.3%), and Class I (10.5%) (Table 1).

Table 1: Socio-demographic characteristics of study participants (N = 400)

Characteristic	Category	Total n (%)
Age group (years)	18-30	64 (16.0)
	31-40	140 (35.0)
	41-50	118 (29.5)
	51-60	78 (19.5)
Mean age = 41.1 ± 10.8 years		
Sex	Male	210 (52.5)
	Female	190 (47.5)
Residence	Rural	299 (74.8)
	Urban	101 (25.3)
Marital status	Single	39 (9.8)
	Married	259 (64.8)
	Divorce/Widowed	102 (25.6)
Religion	Hindu	338 (84.5)
	Muslim	62 (15.5)
Education	Illiterate	143 (35.8)
	Primary school	107 (26.8)
	Secondary school	106 (26.5)
	College & above	44 (11.0)
Occupation	Semi-professional	67 (16.8)
	Skilled worker	12 (3.0)
	Semi-skilled worker	8 (2.0)
	Unskilled worker	129 (32.3)
	Unemployed	184 (46.0)
Socio-economic class	Class I	42 (10.5)
	Class II	64 (16.0)
	Class III	85 (21.3)
	Class IV	148 (37.0)
	Class V	61 (15.3)

Calorie intake adequacy

Only 5.3% (n=21) of participants had adequate calorie intake (≥100% RDA). Mild deficit (90-99% RDA) was observed in 6.8% (n=27), moderate deficit (70-89%) in 30.5% (n=122), and severe deficit (<70%) in 57.5% (n=230).

Overall, 94.7% of participants had inadequate calorie intake (<100% RDA)(Figure 1).

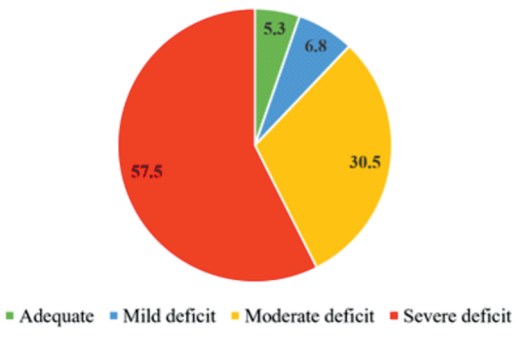

Figure 1: Calorie Intake Adequacy among the study participants (N = 400)

Protein intake adequacy

Adequate protein intake was observed in 6.3% (n=25) of participants. Mild deficit was present in 6.3% (n=25), moderate deficit in 22.8% (n=91), and severe deficit in 64.8% (n=259). Overall, 93.7% of participants had inadequate protein intake (Figure 2).

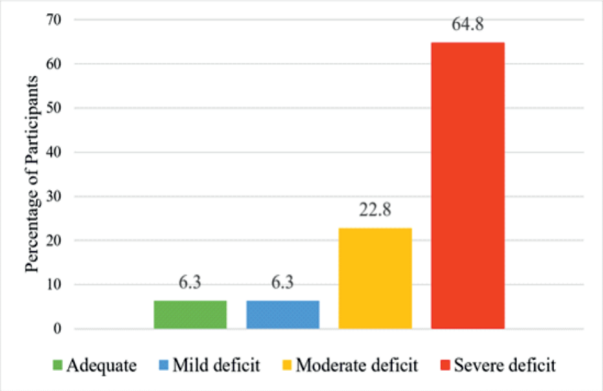

Figure 2: Protein Intake Adequacy among the study participants (N = 400)

Association of socio-demographic factors with calorie intake adequacy

Calorie intake adequacy was significantly associated with educational status (χ^2 = 21.86, p < 0.001). The proportion of adequate/mild intake increased with higher educational attainment.

Socio-economic class also showed a significant association (χ^2 = 13.15, p = 0.011), with relatively higher adequacy observed in higher socio-economic classes (Table 2).

Table 2: Association of socio-demographic characteristics with calorie intake adequacy (N = 400)

Characteristic	Category	Adequate/Mild deficit n (%)	Moderate/ Severe deficit n (%)	x^2 (df)	p-value
Age group (years)	18–30	7 (10.9)	57 (89.1)	6.82 (3)	0.078
	31–40	21 (15.0)	119 (85.0)		
	41–50	17 (14.4)	101 (85.6)		
	51–60	3 (3.8)	75 (96.2)		
Sex	Male	23 (11.0)	187 (89.0)	0.46 (1)	0.498
	Female	25 (13.2)	165 (86.8)		
Residence	Rural	34 (11.4)	265 (88.6)	0.44 (1)	0.506
	Urban	14 (13.9)	87 (86.1)		
Marital status	Single	4 (10.3)	35 (89.7)	0.89 (2)	0.641
	Married	34 (13.1)	225 (86.9)		
	Divorced/ Widowed	10 (9.8)	92 (90.2)		
Religion	Hindu	42 (12.4)	296 (87.6)	0.38 (1)	0.540
	Muslim	6 (9.7)	56 (90.3)		
Education	Illiterate	5 (3.5)	138 (96.5)	21.86 (3)	**<0.001**
	Primary school	12 (11.2)	95(88.8)		
	Secondary school	24 (22.6)	82 (77.4)		
	College & above	7 (15.9)	37 (84.1)		
Occupation	Semi-professional	10 (14.9)	57 (85.1)	7.87 (4)	0.096
	Skilled worker	2 (16.7)	10 (83.3)		
	Semi-skilled	1 (12.5)	7 (87.5)		
	Unskilled worker	7 (5.4)	122 (94.6)		
	Unemployed	28 (15.2)	156 (84.8)		
Socio-economic class	Class I	7 (16.7)	35 (83.3)	13.15 (4)	**0.011**
	Class II	15 (23.4)	49 (76.6)		
	Class III	10 (11.8)	75 (88.2)		
	Class IV	13 (8.8)	135 (91.2)		
	Class V	3 (4.9)	58 (95.1)		

No statistically significant association was observed between calorie adequacy and the other tested socio-demographic characteristics.

Independent predictors of calorie adequacy

Variables found significant in bivariate analysis (education and socio-economic class) were included in multivariable logistic regression.

Using college education and above as reference, illiterate participants had significantly higher odds of calorie inadequacy(AOR = 4.273; 95% CI: 1.013-18.024; p = 0.048).However, the wide confidence interval indicates considerable uncertainty around the magnitude of this association.

Primary education (AOR = 1.261; p = 0.704) and secondary education (AOR = 0.34; p = 0.056) were not statistically significant (Table 3).

Table 3: Multivariable logistic regression analysis of factors associated with calorie inadequacy (N = 400)

Characteristic	Adequate/Mild deficit n (%)	Moderate/Severe deficit n (%)	AOR (95% CI)	P-value
Education				
Illiterate	5 (3.5)	138 (96.5)	4.273 (1.013–18.024)	**0.048**
Primary school	12 (11.2)	95 (88.8)	1.261 (0.382–4.169)	0.704
Secondary school	24 (22.6)	82 (77.4)	0.340 (0.113–1.027)	0.056
College & above	7 (15.9)	37 (84.1)	1.00	–
Socio-economic class				
Class I	7 (16.7)	35 (83.3)	1.00	–
Class II	15 (23.4)	49 (76.6)	0.483 (0.146–1.606)	**0.235**
Class III	10 (11.8)	75 (88.2)	1.658 (0.471–5.842)	0.431

Class IV	13 (8.8)	135 (91.2)	1.953 (0.585–6.522)	0.277
Class V	3 (4.9)	58 (95.1)	2.820 (0.557–14.275)	0.210

For socio-economic class (reference: Class I), none of the categories showed statistically significant association after adjustment.

Association of socio-demographic factors with protein intake adequacy

Protein intake adequacy showed a statistically significant association only with socio-economic class (χ^2 = 10.167, p = 0.038).

No significant association was observed with the other socio-demographic factors (Table 4).

Table 4: Association of Socio-demographic characteristics with Protein Intake Adequacy (N = 400)

Characteristic	Category	Adequate/Mild deficit n (%)	Moderate/Severe deficit n (%)	χ^2 (df)	P value
Age group (years)	18–30	7 (10.9)	57 (89.1)	0.823 (3)	**0.910**
	31–40	18 (12.9)	122(87.1)		
	41–50	17 (14.4)	101 (85.6)		
	51–60	8 (10.3)	70 (89.7)		
Sex	Male	29 (13.8)	181 (86.2)	0.693 (1)	**0.405**
	Female	21 (11.1)	169 (88.9)		
Residence	Rural	35 (11.7)	264 (88.3)	0.683 (1)	**0.409**
	Urban	15 (14.9)	86 (85.1)		
Marital status	Single	7 (17.9)	32 (82.1)	1.338 (2)	**0.512**
	Married	32 (12.4)	227 (87.6)		
	Divorced/Widowed	11 (10.8)	91 (89.2)		
Religion	Hindu	40 (11.8)	298 (88.2)	0.883 (1)	**0.347**
	Muslim	10 (16.1)	52 (83.9)		
Education	Illiterate	12 (8.4)	131 (91.6)	3.846 (3)	**0.279**
	Primary school	17 (15.9)	90 (84.1)		
	Secondary school	14 (13.2)	92 (86.8)		
	College & above	7 (15.9)	37 (84.1)		
Occupation	Semiprofessional	8 (11.9)	59 (88.1)	1.403 (4)	**0.844**
	Skilled worker	2 (16.7)	10 (83.3)		
	Semiskilled	2 (25.0)	6(75.0)		
	Unskilled worker	16 (12.4)	113 (87.6)		
	Unemployed	24 (13.0)	160 (87.0)		
Socio-economic class	Class I	7 (16.7)	35 (83.3)	10.167 (4)	**0.038**
	Class II	8 (12.5)	56 (87.5)		
	Class III	17 (20.0)	68 (80.0)		
	Class IV	16 (10.8)	132 (89.2)		
	Class V	2 (3.3)	59 (96.7)		

Independent predictors of protein adequacy

Variables found significant in bivariate analysis (socio-economic class) and epidemiologically relevant variables included in the model (education) were entered into logistic regression.

Using college education and above as reference, education was not found to be independently associated with protein inadequacy. Illiterate participants (AOR = 2.109; 95% CI: 0.727–6.116; p = 0.170), those with primary education (AOR = 1.015; 95% CI: 0.369–2.794; p = 0.977), and secondary education (AOR = 1.362; 95% CI: 0.489–3.796; p = 0.555) did not show statistically significant associations.

For socio-economic class (reference: Class I), participants belonging to Class V had significantly higher odds of protein inadequacy (AOR = 5.408; 95% CI: 1.044–28.025; p = 0.044), whereas other socio-economic classes did not show statistically significant association after adjustment(Table 5).

The overall regression model was statistically significant (Omnibus p = 0.035) and demonstrated good fit (Hosmer–Lemeshow p = 0.474).

Table 5: Logistic Regression Analysis of Education and Socio-Economic Class with Protein Adequacy

Characteristic	Adequate/ Mild deficit n (%)	Moderate/ Severe deficit n (%)	AOR with 95% CI	P value
Education				
Illiterate	12 (8.4)	131 (91.6)	2.109 (0.727–6.116)	0.170
Primary school	17 (15.9)	90 (84.1)	1.015 (0.369–2.794)	0.977
Secondary school	14 (13.2)	92 (86.8)	1.362 (0.489–3.796)	0.555
College & above	7 (15.9)	37(84.1)	1	–
Socio-economic class				
Class-I	7 (16.7)	35 (83.3)	1	–
Class-II	8 (12.5)	56 (87.5)	1.375 (0.454 – 4.166)	0.573
Class-III	17 (20.0)	68 (80.0)	0.709 (0.259–1.942)	0.504
Class-IV	16 (10.8)	132 (89.2)	1.432 (0.527–3.890)	0.481
Class-V	2 (3.3)	59 (96.7)	5.408 (1.044–28.025)	**0.044**

Discussion

In this cross-sectional study conducted among adults living with HIV (ALHIV) attending a tertiary care ART centre in Northern India, a high proportion of participants had calorie and protein intakes below the recommended dietary allowance (RDA) when assessed against the age- and sex-specific ICMR–NIN reference values. Nearly 95% of participants consumed less than the recommended RDA for calories, while more than 93% had protein intake below the recommended RDA. Furthermore, severe deficits (<70% RDA)

were observed in more than half of the participants for both calorie and protein intake. These findings suggest a considerable burden of dietary inadequacy in this study population despite ongoing access to ART services.

Our findings are consistent with previous studies demonstrating inadequate dietary intake among ALHIV. In North India, Sachdeva et al. reported significantly lower energy and protein intake compared with recommended levels among HIV-infected individuals using 24-hour dietary recall methods.[5] Similar observations have been reported from Kenya, where Onyango et al. documented generally inadequate nutrient intake among HIV-seropositive adults, with both energy and protein intake remaining below recommended dietary allowances.[11] Likewise, Tonui et al. found that dietary intake among HIV-seropositive clients was unsatisfactory, with only about half of the participants meeting recommended energy requirements and substantial proportions failing to meet protein requirements.[12] Collectively, these findings suggest that inadequate macronutrient intake remains a persistent challenge among ALHIV across diverse geographical settings. However, the prevalence of calorie and protein deficits observed in our study appears substantially higher, particularly with regard to severe dietary inadequacy. This comparatively higher prevalence may be attributed to differences in the study population, dietary assessment methods, and the operational definition of dietary inadequacy. In the present study, dietary intake was evaluated against the age- and sex-specific ICMR–NIN Recommended Dietary Allowances, and participants consuming <100% of the recommended RDA were classified as having inadequate intake. Additionally, socio-economic characteristics of the study population and regional dietary practices may have contributed to the observed differences.

The high prevalence of dietary inadequacy relative to the recommended dietary allowances observed in the present study should be interpreted in the context of the complex interaction between HIV infection and nutritional status. HIV infection is known to increase resting energy expenditure and metabolic demands, even among clinically stable individuals. The World Health Organization has estimated that energy requirements increase by approximately 10% among asymptomatic ALHIV and by 20–30% among symptomatic individuals [3]. In addition, HIV infection contributes to nutritional deterioration through reduced food intake, malabsorption of nutrients, chronic inflammation, opportunistic infections, and increased metabolic stress.[13] Hsu et al. described inadequate dietary intake, malabsorption, and increased energy expenditure as the principal mechanisms underlying malnutrition in ALHIV.[13] Similarly, Cheah emphasized that HIV and malnutrition exist in a vicious cycle, whereby inadequate intake and nutrient deficiencies accelerate disease progression while advancing HIV infection further compromises nutritional status.[14] Consequently, even dietary intake that may appear adequate for the general population can become insufficient among ALHIV because of their elevated physiological requirements.

Educational status emerged as an independent predictor of calorie inadequacy in our study. Participants with no formal education had significantly higher odds of inadequate calorie intake compared with those having college-level education. Education may influence nutritional status through improved health literacy, greater awareness regarding balanced diets, better understanding of dietary counselling, and enhanced capacity to make informed food choices. Similar findings have been reported by Fentie et al., who observed significantly higher odds of chronic energy deficiency among adults living with HIV who had no formal education compared with those having secondary education or higher.[15] Educational attainment may also influence employment opportunities and household income, thereby indirectly affecting food security and dietary quality. These findings underscore the importance of considering educational disparities while designing nutritional interventions for ALHIV.

Socio-economic status demonstrated a significant association with protein inadequacy in bivariate analysis. Protein-rich foods such as pulses, milk, eggs, meat, and fish are generally more expensive than cereal-based staples and may therefore be less accessible to economically disadvantaged households. In resource-constrained settings, households often prioritize quantity of food over nutritional quality, resulting in diets that are energy-dense but protein-deficient. Hsu et al. highlighted poverty and food insecurity as important contributors to nutritional vulnerability among ALHIV.[13] Similarly, Fathima et al. emphasized that economic hardship remains a major barrier to achieving adequate dietary intake among ALHIV, particularly in low- and middle-income countries.[7] The socio-demographic profile reported by Baghel et al. also demonstrated that many ALHIV belonged to lower socio-economic strata and had limited educational attainment, factors that may adversely affect nutritional well-being.[6] Although socio-economic status did not retain significance in multivariable analysis in our study, its association in bivariate analysis suggests that financial constraints remain important determinants of dietary quality.

Notably, we did not observe significant associations between dietary inadequacy and age, sex, or place of residence. Based on our findings, dietary inadequacy appeared to be widespread across the study population and was not confined to specific demographic groups. The uniformly high prevalence of inadequate calorie and protein intake observed across participant categories indicates that nutritional vulnerability among ALHIV may be a pervasive problem requiring universal rather than selectively targeted interventions.

The public health implications of these findings are substantial. Adequate nutrition plays a crucial role in maintaining lean body mass, preserving immune function, enhancing treatment adherence, and improving overall quality of life among ALHIV.[3] Ganesan et al. highlighted that poor nutritional status contributes to disease progression and poorer health outcomes even in the ART era, while appropriate nutritional support can improve treatment effectiveness and quality of life [16] Similarly, Cheah advocated routine nutritional screening, individualized dietary assessment, and integration of nutrition services into HIV care as essential components of comprehensive HIV management.[14] Fentie et al. also recommended strengthening nutritional assessment and support within HIV treatment programmes to reduce the burden of chronic energy deficiency among ALHIV.[15] Therefore, integrating routine dietary assessment, nutritional counselling, and food-support interventions into ART services may help address the substantial nutritional deficits identified in the present study. A similar emphasis on nutritional assessment, counselling, and support has been incorporated into tuberculosis care, where the World Health Organization recommends integrating nutritional care as an essential component of routine TB management to improve clinical outcomes.[17]

The present study has several strengths. It included a relatively large sample size, employed random sampling, and assessed dietary intake using standardized methods with direct comparison against nationally recommended RDA values prescribed by ICMR–NIN 2020.[8] Nevertheless, certain limitations should be acknowledged. Dietary intake assessment relied on a single 24-hour dietary recall, which may be subject to recall bias and may not fully reflect habitual intake patterns. Although standardized procedures were used to improve recall accuracy, repeated dietary recalls or validated food frequency questionnaires would have provided a more reliable estimate of usual intake. Additionally, the cross-sectional design limits causal interpretation of the observed associations.

Conclusion

This study identified a high prevalence of calorie and protein intake below the recommended dietary allowance among adults living with HIV attending a tertiary care ART centre in Northern India. Lower educational status was independently associated with calorie inadequacy, while socio-economic disadvantage was associated with poor protein intake in bivariate analysis. These findings highlight the need for routine nutritional assessment, individualized dietary counselling, and appropriate nutritional support as part of comprehensive HIV care. However, further longitudinal studies using repeated dietary assessments are warranted to better characterize habitual dietary intake and its determinants among adults living with HIV.

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