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Research article

Food insecurity and the risk of sleep disorders in people living with HIV/AIDS as a neglected health concern: A national survey in Iran

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ABSTRACT

Food insecurity (FI) and sleep problems are major modifiable health issues among people living with HIV/AIDS (PLWH), and there is limited knowledge about their prevalence among this underrepresented population. Our study aimed to assess the relationship between FI and sleep problems as important environmental factors affecting PLWH in Iran.

The national survey was conducted on 1185 confirmed HIV-positive patients who attended consulting centers in 15 geographically diverse provinces in Iran, during 2021–2022. Standard questionnaires were used to measure FI and sleep problems (Insomnia, Obstructive Sleep apnea (OSA), Excessive Daytime Sleepiness (EDS), and Poor sleep quality), and a logistic regression model was used to assess the association between FI and the odds of experiencing sleep problems.

About 764 (The prevalence of FI = 64.47 %) of the participants had insecure status, with a mean score of 11.73 (SE = 0.34). Those with FI had a higher prevalence of insomnia, EDS, and poor sleep quality (54.84 %, 31.79 %, and 55.17 %, respectively) compared to those without FI (30.69 %, 17.03 %, and 40.42 %, respectively). FI increased the odds of being at risk for Insomnia (OR = 2.39, 95 % CI: 1.81–3.15), EDS (OR = 1.44, 95 % CI: 1.04–2.01), and poor sleep quality (OR = 1.79, 95 % CI: 1.29–2.48) in the multiple regression model. The results highlight the strong association between FI and a broad range of sleep problems in PLWH. Considering the impact of FI and impaired sleep health on PLWH, more attention is needed for at-risk groups for screening and intervention purposes.

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1. Introduction

As of 2021, nearly 38.4 million people were living with the human immunodeficiency virus (HIV), of whom 1.5 million were newly infected, and 650000 people died of HIV worldwide. According to estimations, approximately 0.7 % of these adults were 15–49 years old, globally [1]. More than half of HIV-infected people live in low- and middle-income countries [2]. In Iran, according to estimates by the ministry of health, 54850 people were living with HIV, of whom 22684 were alive, and 15799 adults were reported to be accessing antiretroviral therapy in 2021 [3]. Through major advances in the management and treatment of HIV and increased survival of patients, HIV/AIDS has turned into a chronic condition with lower mortality and morbidity, and concerns about increasing life expectancy have changed to improve their quality of life [4,5]. In patients with HIV-positive tests, the quality of life can influence adherence to therapy and prevent progression to later stages [6]. Indeed, a higher quality of life leads to the benefits of HIV services, care, and treatment [7]. FI as a public health concern is defined as a disruption in food and nutrient intake that results in an unhealthy lifestyle [8,9]. FI among PLWH contributes to physical illness, anxiety, and depression in other quality-of-life domains [7,10]. Studies have shown that FI may increase susceptibility and HIV seropositivity and increased prevalence of HIV risk factors [11–13], and it leads to a lower adherence to antiretroviral therapy (ART) [14]. It is well known that improving FI is essential for prevent the disease progression and controlling the HIV epidemic [15,16].

Sleep is a primitive and ancestral behavior that is needed by everyone every day [17]. FI is cited as an associated factor in the quality of sleep [18]. PLWH usually suffers from sleep disorders [19]. Also, poor sleep quality, changes in sleep patterns, and sleep disturbances can impair the quality of life and adherence to therapy among PLWH [20] and cause HIV to progress [21]. The high prevalence of sleep disturbances among PLWH experiencing FI can be explained by a multitude of sociocultural determinants. Factors such as economic deprivation, heightened psychological stress, mental health considerations, and the presence of social support systems collectively contribute to the augmented incidence of sleep-related issues within this population [22,23].

Although sleep problems is prevalent among people with FI [24], there are limited data on the association between FI and sleep problems in the HIV context. The present study is the first national study to investigate the relationship between FI and sleep problems in PLWH in Iran. The objective of the present study was to examine the association between FI and various sleep issues, such as obstructive sleep apnea, a low sleep quality, insomnia, and Excessive Daytime Sleepiness. Given the knowledge based on several studies that gender [25,26], health behaviors, including obesity [27] and psychological distress, depression, and anxiety [28], showed an effective impact on this issue, we controlled the main sociodemographic confounders to access the effect of FI on sleep problems in HIV-infected patients.

2. Methods and materials

2.1. Study population and sampling method

The present study was part of a national study investigating the status of food security and its relationship with sleep problems in PLWH at the national level. We included 1185 confirmed cases, aged ≥18, between April 2021 and March 2022.

In each of the five geographical parts of the country (North-East, North-West, Central, South-East, and South-West), three provinces were randomly selected. Two voluntary counselling and testing (VCT) centers were randomly selected in each province, and PLWH who visited these centers to receive care and treatment services were invited to participate in the study by using the convenience sampling method.

Patients aged ≥18 years, who had been diagnosed for at least three months, were invited to participate in the study. The completion of the questionnaires was done without any personal information, including name and address. Before conducting the interview, explanations were given to the patients regarding the objectives of the study, and verbal informed consent was granted. Also, the participants were assured that their information would remain confidential and that they could withdraw from the study at any time. All questionnaires were collected by trained and skilled health workers in behavioral counselling centers, with experience working with PLWH.

2.2. Physical examination

The physical examination included measuring the height, weight, and neck circumference. The height of the patients was measured using a caliper mounted on a wall. A digital scale was used to measure the weight; and the scale was placed on a flat and firm surface. The person should wear the least clothes and take off their shoes. To measure the neck circumference, a meter was used in such a way that the person was standing, and the meter was placed around the widest part of the neck, on the protrusion of the throat area (Adam's apple). The measurement was read, and the neck circumference was recorded. The body mass index (BMI) was calculated as weight in kilograms divided by height per square meter (kg/m2).

3. Data collection

The data includes background information (age, sex, education, marital status, and occupation) and information related to the disease (duration of HIV infection, duration of receiving medication, way of disease transmission, presence of concurrent infectious diseases such as tuberculosis, Hepatitis B, and Hepatitis C) collected through asking patients and from medical files available in VCT.

Education was classified into three categories: under diploma, diploma, and upper diploma. For the occupation of individuals, they were categorized into two groups: those who were employed and had income, as employed, and those who were unemployed and had no job. The laboratory findings of CD4 and viral load at the time of diagnosis and the last three months were extracted from the files. The history of receiving neuropsychiatric and sleeping medication was collected by asking patients. Information related to sleep, food security, and psychiatric disorders of depression, anxiety, and stress was also collected based on the personal reports of people using validated Persian questionnaires.

3.1. Measures of sleep problems

3.1.1. Pittsburgh Sleep quality index

The Pittsburgh Sleep Quality Index (PSQI), created in 1989 by Buysse et al. to evaluate sleep quality over the previous month at the Pittsburgh Psychiatric Institute, is one of the best tools in the field of measuring sleep quality. Buysse and colleagues estimated the reliability of the questionnaire using a Cronbach's alpha of 0.83 [29]. In the Persian version of this questionnaire, validity and reliability were 0.86 and 0.89, respectively [30]. This questionnaire has seven components: subjective quality of sleep, delay in falling asleep, sleep duration, sleep efficiency, sleep disorders, use of sleeping pills, and daily dysfunction, whose scores are obtained through 19 items. The items are scored on a 4-point Likert scale from 0 to 3. Then the scores of the seven components are summed, ranging from 0 to 21. Higher scores indicate worse sleep quality. A total score higher than 5 means poor sleep quality [31].

3.1.2. Epworth sleepiness scale

The Epworth Sleepiness Scale (ESS) is designed to assess excessive daytime sleepiness. The validity and reliability of this questionnaire have been confirmed by other studies. In this questionnaire, the level of sleepiness of people in eight everyday situations is scored from 0 to 3. The daily life situations include: sitting and reading, watching television, sitting passively in a public place, sitting in a car as a passenger for an hour without interruption, lying down to rest in the afternoon if conditions allow, sitting and talking with someone, sitting quietly after lunch, and being in a vehicle while it is stopped in traffic for a few minutes. The overall score of the questionnaire ranges from 0 to 24, and a score of 10 and above is a sign of excessive daytime sleepiness (EDS) [32].

3.1.3. Insomnia severity index

This questionnaire assesses the symptoms of insomnia and its negative effects on life in the last two weeks. It includes seven questions based on the difficulty of falling asleep, staying asleep, and waking up, as well as the person's satisfaction with the form of their recent sleep, its impact on individual lives, the level of concern of the person regarding this problem, and the level of influence of this problem on the person's daily performance. Each question is scored on a 5-point Likert scale from 0 to 4. The total score of the questionnaire is calculated from 0 to 28. After the final sum of the obtained points, the person is placed in one of the following classifications: 0–7 normal range, 8–14 mild disorder, 15–21 moderate clinical insomnia, and 22–28 severe clinical insomnia [33].

3.1.4. Berlin Sleep apnea questionnaire

The Berlin Sleep Apnea Questionnaire is designed to screen for obstructive sleep apnea (OSA). The validity and reliability of this questionnaire have been confirmed in the study of Sharma et al. (2006) with a Cronbach's alpha coefficient of 0.92 [34] and the study of Amra et al. (2013) with a Cronbach's alpha coefficient of 0.70 and 0.50 [35]. This questionnaire has 10 items consisting of three parts that examine the associated factors of OSA, including snoring, excessive daily fatigue and sleepiness, obesity, and high blood pressure. If a person gets a positive score in only one group out of the three parts of the questions, he is at low risk for developing sleep apnea. If he gets a positive score in two or all three groups of questions, he or she is considered at high risk for developing OSA [36].

3.1.5. Household food insecurity access scale questionnaire

This questionnaire measures FI in different dimensions. It has nine questions that include the dimension related to the quality of food (questions 1–4) and the dimension of insufficient food intake (question 5–9). It is scored on a 4-point Likert scale, and the score will have a range from 0 to 27. Finally, to interpret the score obtained, a score of 0–1 is food security, a score of 2–7 is mild insecurity, a score of 8–14 is moderate insecurity, and a score of 15–27 is severe FI. The validity and reliability of the questionnaire have been confirmed with a Cronbach's alpha coefficient of 0.95 [37].

3.1.6. Statistical analysis

The data has been analyzed using the STATA software version 17. The main variables of the study, including sleep problems and FI, were checked for any missing data, and people with missing data were excluded from the study. Then, the rest of the variables with missing data were imputed using the single imputation method. The complex survey methods were utilized for conducting all analyses, accounting for cluster sampling and sample weight. The data were weighted based on the age and sex categories of the 15-year-old national Iranian PLWH population in 2021. The characteristics of the individuals were initially reported using the weighted mean with standard error (SE) and weighted percentages. In the complex survey approach, a *t*-test analysis was used to assess differences in sociodemographic information, duration of HIV diagnosis, CD4 count, and viral load between two groups with and without FI, and a chi-square test was used for other qualitative variables.

Logistic regression has been used to investigate the relationship between FI and different sleep problems. The factors related to sleep (poor sleep quality, insomnia, EDS, and OSA) were considered as outcome variables, and FI was considered an independent variable. Three statistical models were used to investigate the associations. Model 1 was fitted for crude OR, model 2 was adjusted for

age and gender, and model 3 was adjusted for other confounders (age, sex, education, marital status, employment status, HIV transmission routes, depression, anxiety, and stress status, sleeping medication, mental medication, coinfection of HIV with HBV, HCV, TB, and duration of HIV diagnosis). The statistical significance was determined for p-values<0.05.

4. Results

Overall, 1185 (80.66 % men and 19.34 % women) patients with confirmed HIV/AIDS, with a mean age of 35.36 years (SE = 0.06) were included in the analysis. Among these patients, 13.16 % were under sleeping medication, and 8.74 % were under mental disorders medication. All patients were on HIV/AIDS treatment. The median and interquartile range of the duration of HIV diagnosis in participants was 84.5 (92.23) months, with 93.17 months among patients with FI and 79.51 months among patients without FI.

About 764 (the prevalence of FI = 64.47 %) participants had a global FI score of more than 421 as food secure, with a mean score of 11.73 (SE = 0.34).

Patients with FI had higher values of age, duration of HIV diagnosis, and lower values of CD4 count and duration of ART (months) as indicated in Table 1, which provides a detailed comparison of sociodemographic characteristics between the two groups.

About 21.15 % of patients in the FI group experienced coinfection, compared with 14.27 % in the non-FI group. Of the patients with FI, 47.88 % have had sexual contact, while the similar prevalence in patients without FI was 59.21 %. Patients with FI were more employed (55.94 %) compared with patients without FI (41.82 %). The prevalence of obesity among FI patients and those without FI was 7.09 % and 7.71 %, respectively. Additional demographics and clinical characteristics for both groups are detailed in Table 1.

Table 2 shows the sleep problem characteristics of patients by FI status. Patients with FI had a higher prevalence of insomnia, EDS, and poor sleep quality (54.84 %, 31.79 %, and 55.17 %, respectively) compared with patients without FI (30.69 %, 17.03 %, and 40.42

Table 1
Demographics and clinical characteristics between the two groups defined by food in security among positive HIV participants.

Variables	Total (n = 1185)	With food insecurity (n = 764)	Without food in security (n = 421)	*P*-value
	Mean (SE)	Mean (SE)	Mean (SE)	
Age, (years)	35.36 ± 0.06	36.50 ± 0.38	33.79 ± 0.41	0.200
CD4 cell count (cells/mm2)	426.16 ± 17.82	402.33 ± 18.59	458.87 ± 33.63	0.471
>500	32.02(343)	27.59(213)	38.01(130)	/0.075
200≤CD4 cell<500	41.35(496)	44.72(323)	36.8(173)	
<200	26.63(346)	27.69(228)	25.19(118)	
Time since HIV diagnosis, month (median, IQR)	84.5 (92.23)	93.17 (95.4)	79.51 (89.78)	0.046
ART treatment duration, months (Med, IQR)	55(60)	51 (58)	57 (59)	0.563
	No (Percent)	**No (Percent)**	**No (Percent)**	
Gender category				
Male	717 (80.66)	440(77.73)	277(84.69)	0.006
Marital situation				
Single	264(42.8)	144 (34.64)	120(53.96)	<0.0001
Married	614(41.59)	401 (47.51)	213(33.47)	
Divorced/widow	307(15.61)	219 (17.82)	88 (12.57)	
Education[a]				
Under diploma	754(50.21)	552 (63.31)	202 (32.22)	<0.0001
Diploma	342(37.72)	184 (33.14)	158 (44.02)	
Upper diploma	89(12.07)	28 (3.55)	61 (23.76)	
BMI category (kg/m2)				
<25	717 (66.24)	460 (67.63)	257 (64.32)	0.747
25–30	301 (21.26)	192 (20.87)	109 (21.8)	
≥ 30	167(12.5)	112 (11.5)	55 (13.88)	
Job status				
Employed	584(57.26)	320 (50.54)	264 (66.34)	0.001
Method of transmission or HIV Transmission				
Sexual contact[b]	605 (52.65)	387 (47.88)	218 (59.21)	<0.0001
Injection drug use	404 (33.51)	288 (41.04)	116 (23.18)	
Blood products	10 (0.6)	6 (0.41)	4 (0.87)	
Unknown[c]	166 (13.23)	83 (10.67)	83 (16.75)	
Co-infection[d]				
Yes	264 (18.25)	192 (21.15)	72 (14.27)	0.027
Sleeping medication				
Yes	164 (13.16)	128 (15.4)	36 (10.08)	0.108
Mental medication				
Yes	115 (8.74)	87 (9.38)	28 (7.87)	0.644

*The data were weighted based on the age and sex categories of the 15-year-old national Iranian PLWH population in 2021.

[a] Due to the limited number of individuals with university education and the majority of people falling into the upper diploma category, education was classified into three categories: under diploma, diploma, and upper diploma.

[b] Transmission from Homosexual, Heterosexual, High Risk Spouse and Infected Spouse were defined as Sexual contact.

[c] Transmission from mother to child and Occupational Transmission were defined as unknown.

[d] Coinfections of HIV with HBV, HCV, TB.

%, respectively).

Fig. 1 shows an increasing trend in the percentage of insomnia, sleepiness, and poor sleep quality with increasing FI severity across 4 categories: food safe, slight unsafe, medium unsafe, and severe unsafe (all p for trend <0.0001).

To evaluate whether FI was associated with the increase in sleep problems, we investigated the correlations between FI and insomnia, OSA, EDS, and poor sleep quality using multiple-adjusted logistic regression. As shown in Table 3, applying multiple analysis showed that FI increased the odds of being at high risk for Insomnia (OR = 2.39, 95 % CI: 1.81–3.15), EDS (OR = 1.44, 95 % CI: 1.04–2.01), and poor sleep quality (OR = 1.79, 95 % CI: 1.29–2.48) in the multiple regression model. However, there was no statistically significant difference between FI and OSA.

5. Discussion

The present study assessed FI among PLWH and its effect on sleep health and sleep problems as the first national study in the country. Based on the official guidelines on PLWH care and treatment, counselling and lifestyle modification are the first lines of treatment for this group of patients. It is expected that different aspects of lifestyles, such as food and sleep intervention will be included in the care and treatment protocol for PLWH. However, our study found a high prevalence of FI and its strong association with different sleep problems in PLWH.

Despite the growing body of research on the effects of diet on sleep, there is still less attention paid to the effects of FI on sleep problems. Researchers have shown that dietary patterns can affect patterns of daytime alertness and nighttime sleep [38].

The results of a study emphasize the significance of examining the underlying causes of sleep disorders in PLWH to enhance their quality of life [39]. During the initial stages of infection, certain immunological changes may contribute to the development of sleep disorders [40]. Among HIV-positive individuals, the most prevalent sleep issue is poor sleep quality, primarily attributed to the impact of the virus and infection on the central nervous system [41,42].

Three mechanisms have the potential to elucidate the correlation between FI and sleep difficulties. Firstly, FI might contribute to mental conditions such as depression [43] and anxiety, as compromised mental well-being is commonly linked with disrupted sleep patterns [44]. Secondly, malnutrition and nutritional deficiencies caused by FI could influence sleep through calorie restriction and affect Rapid Eye Movement (REM) sleep [38]. Lastly, the association between FI and obesity can resulted in sleep apnea and poor sleep quality [45].

In our study, sleep duration did not show a significant difference between FI and food secure (FS) individuals. However, a prior study in the United States found that women with lower FI had lower sleep duration than their FS counterparts. Additionally, the general population with FI is at an increased risk of sleep complaints and shorter sleep duration [22]. Another investigation demonstrated a connection between insufficient sleep duration and lower income levels, along with an increase in reported sleep-related problems [46]. Liu et al. also demonstrated a higher prevalence of FI in people with greater insufficient sleep duration (<7 h) [47]. In a study by Troxel et al., FI had a significant association with shorter sleep duration and poor sleep quality after adjusting for covariates [48]. Furthermore, sleep duration could be associated with HIV-positive status [49].

In this study, FI was associated with different sleep problems in PLWH. A systematic review and meta-analysis found a significant association between FI and sleep disorders, and the odds of sleep disorders were about 80 % higher in FI adults than in food-secure adults [50]. Another study by Lee et al. indicated more sleep problems in food-insecure individuals [9]. Additionally, Nagata et al. found that FI was cited as a risk factor for falling and staying asleep [45].

In the present study, FI was associated with poor sleep quality. This finding was also suggested in a study by Hagedorn et al., where college students with FI had higher scores for poor sleep quality [51]. Sleep quality is a common indicator of mental health, physical health, and well-being [45]. FI and poor sleep quality can result in glycemic control disruption, low energy, weight issues, and circadian rhythm disruption causing sleep apnea and snoring as a consequence [52]. Poor sleep quality affects 40–70 % of individuals with HIV who suffer from sleep disorders [53,54]. In the present study, nearly 48.95 % of PLWH met the criteria for poor sleep quality.

A substantial body of literature indicates that poor sleep outcomes among adults with FI could lead to OSA, possibly due to poor mental health, psychological distress, or risk of obesity [44,55,56]. A recent study found that the prevalence of comorbidity of sleep apnea with non-communicable disease was 10.26 % [57]. Additionally, a meta-analysis by O'Brien et al. demonstrated that chronic

Table 2
Sleep problem characteristics of patients infected with HIV by food insecurity status.

Variables	Total (n = 1185)	With food insecurity (n = 764)	Without food insecurity (n = 421)	*P*-value
	Mean (SE)	Mean (SE)	Mean (SE)	
Sleep duration	7.33 ± 0.07	7.28 ± 0.10	7.40 ± 0.11	0.547
	No (percent)	**No (percent)**	**No (percent)**	
OSA	526 (39.68)	159 (33.39)	367 (44.26)	0.029
Insomnia	503 (44.66)	384 (54.84)	119 (30.69)	<0.0001
EDS	302 (25.57)	223 (31.79)	79 (17.03)	0.001
Poor Sleep Quality	587 (48.95)	436 (55.17)	151 (40.42)	<0.0001

OSA: obstructive sleep apnea.
EDS: Excessive Daytime Sleepiness.
*The data were weighted based on the age and sex categories of the 15-year-old national Iranian PLWH population in 2021.

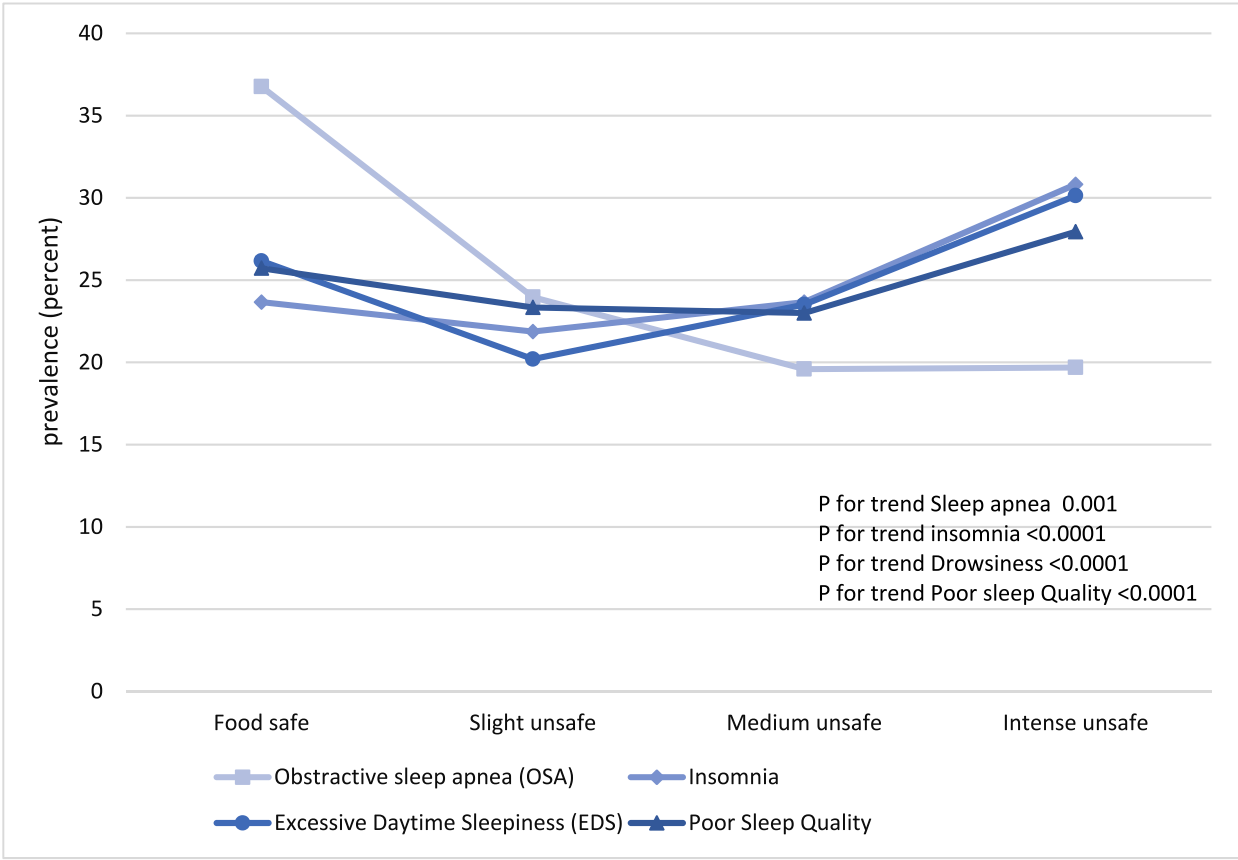

Fig. 1. Sleep problems by Food insecurity in HIV infected patients.

Table 3
Multivariable-adjusted Odds ratios and confidence intervals of food in security as variables for different sleep problems.

Outcome	OR	95 % CI	*P*-VALUE
Insomnia			
Model 1	2.56	1.98 to 3.31	<0.0001
Model 2	2.56	1.98 to 3.31	<0.0001
Model 3	2.39	1.81 to 3.15	<0.0001
Obstructive Sleep apnea			
Model 1	1.52	1.19 to 1.94	0.001
Model 2	1.51	1.18 to 1.94	0.001
Model 3	1.13	0.85 to 1.50	0.37
Excessive Daytime Sleepiness			
Model 1	1.78	1.33 to 2.38	<0.0001
Model 2	1.84	1.37 to 2.47	<0.0001
Model 3	1.44	1.04 to 2.01	0.02
Poor Sleep Quality			
Model 1	2.58	1.96 to 3.40	<0.0001
Model 2	2.59	1.97 to 3.42	<0.0001
Model 3	1.79	1.29 to 2.48	<0.0001

Model 1: crude odds ratio, **Model 2:** age and sex-adjusted, **Model 3:** multivariable adjusted (adjusted for other confounders; Age, Sex, Education, Marital Status, Employment status, Duration of HIV diagnosis, Route of transmission, Coinfection with HBV, HCV, and TB, Sleeping medication, Mental medication, Depression, Anxiety, Stress.

immune activation in HIV-positive patients can increase the risk of OSA [40]. Also, according to the increase in ageing in PLWH, sleep apnea needs more attention. Prior evidence has demonstrated that the prevalence of sleep apnea in PLWH ranged from 6 to 72 % [58, 59]. In the present study, 39.68 % of PWH were affected by sleep apnea. However, there was no association between FI and OSA in PLWH. The Kunisaki et al. study has shown that there was no significant association between sleep apnea and human

immunodeficiency virus status. It is important to note that the logistic model for evaluating this association was different from our study, and mental components were assessed separately [59].

HIV-infected patients are at potential risk for insomnia due to antiretroviral therapy [60]. In the present study, the prevalence of insomnia was approximately 54.84 % in HIV-positive patients with FI. A study by Milinkovic et al. found that 22 % of patients with HIV were affected by insomnia, with no difference by age [61].

The findings of a recent cohort study revealed a very high prevalence (67 %) of insomnia in PLWH [62], which was significantly than our initial estimate of insomnia prevalence. Also, prior evidence has confirmed a higher prevalence of insomnia in PLWH compared to the general population [63]. In the investigation by Grandner et al., a significant relationship between insomnia (specifically difficulty falling asleep) and FI was observed in females [64]. According to Becerra et al., FI influences daytime sleepiness and breathing issues during sleep [52]. Garrido et al. found that the odds of insomnia in people with FI were 43 % [65]. Our study also strongly supports the association between FI and insomnia in HIV-positive participants. Notably, insomnia was 2.39 times more common in adults with FI than in food-secure adults.

Our study results revealed that 31.79 % of HIV-positive patients with FI experience EDS, while a separate study proposed that the prevalence of EDS in HIV-positive patients is nearly 21 % [61]. Additionally, a study found that HIV-positive men with sleep disordered breathing had a lower prevalence of sleepiness than HIV-negative patients with the same condition, possibly due to higher BMI and age in the HIV-negative group [58]. Notably, body mass index (BMI) was identified as a key factor affecting the sleep quality and food security of PLWH in a recent study [66]. Fewer researchers have studied the relationship between HIV and EDS. The present study showed that the risk of EDS in FI individuals was significantly higher than in those with FS.

One of the key strengths of this study is use of nationally collected data to identify FI and its relationship with sleep disorders among PLWH. Additionally, the study stands out for its comprehensive approach, utilizing validated and standard questionnaires to assess various sleep problems and FI at a national level within this patient group, a unique aspect not previously explored in other studies on PLWH.

As a limitation of the present study, the study measures outcomes based on self-reported symptoms of sleep problems, so it can be faced with recall bias. Also, due to the coincidence of the COVID-19 epidemic, we had to use convenience sampling based on the regular visits of HIV patients to VCTs to get their own antiretroviral regimens. To address any potential biases resulting from this sampling method, we used complex survey methods, and all data was from the PLWH population in 2021. In this study, due to the fact that the subjects were HIV-positive patients, it was difficult to classify them in terms of occupation, and we did not measure the subjects' occupations. We simply classified them in two groups: Employed and Unemployed.

6. Conclusion

Providing knowledge about the prevalence of FI and related outcomes, such as sleep problems in PLWH is crucial due to the relatively scarce available evidence. Our study aimed to contribute to the existing literature by investigating this context. The main findings of our study were: firstly, the high prevalence of FI and sleep problems in PLWH, and secondly, the strong association between FI and sleep problems in PLWH, even after adjusting for demographic and potential confounders.

Considering the impact of FI and sleep problems on PLWH, it is crucial to pay more attention to at-risk groups for screening and intervention purposes. To address these issues, healthcare providers and support organizations should implement routine screenings for FI and sleep problems during regular HIV care visits. Specialized interventions, such as access to food assistance programs, nutritional counselling, and sleep hygiene education, can be integrated into HIV care plans to effectively address these challenges. Moreover, collaborative efforts between healthcare providers, social services, and community organizations are crucial in identifying and supporting at-risk individuals to improve their health outcomes and overall quality of life.

Ethical statement

According to the approval granted by the Tehran University of Medical Sciences Ethics Committee under the code IR.TUMS.FNM.REC.1399.066, each participant provided their consent verbally subsequent to receiving information about the study.

Data availability

The datasets generated and/or analyzed during the current study are not publicly available but are available from the corresponding author on reasonable request.

CRediT authorship contribution statement

Fatemeh Hadavandsiri: Writing – review & editing, Writing – original draft, Formal analysis, Data curation. **Safieh Mohammad nejad:** Writing – review & editing, Investigation, Formal analysis, Data curation. **Marziyeh Mahboobi:** Writing – review & editing, Data curation. **Arezu Najafi:** Writing – review & editing, Conceptualization. **Mohammad Ebrahimzadeh Mousavi:** Writing – review & editing. **Sayed Hassan Faghihi:** Writing – review & editing. **Narges Abdolmohamadi:** Writing – review & editing. **Samaneh Akbarpour:** Supervision, Project administration, Methodology, Investigation, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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