

Double burden of fatigue and poor sleep quality and their predictors among patients with cancer in northwest Ethiopia: an institutional-based cross-sectional study

Gebreeyesus Abera Zeleke^{1*}, Astewil Moges Bazezew², Birtukan Atena Negash³, Desalegn Getachew Ayele⁴, Yalemwork Getahun Azanaw⁴, Alamirew Enyew Belay³ & Alebachew Ferede Zegeye⁴

¹ Department of Surgical Nursing, School of Nursing, College of Medicine and Health Science, University of Gondar, Gondar, Ethiopia.

² Department of adult health nursing, college of medicine and health science, Bahir Dar university, Bahir Dar, Ethiopia.

³ Department of Medical Nursing, School of Nursing, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia.

⁴ Department of Surgical Nursing, School of Nursing, College of Medicine and Health Science, University of Gondar, Gondar, Ethiopia.

***Corresponding author:** Gebreeyesus Abera Zeleke, Department of Surgical Nursing, School of Nursing, College of Medicine and Health Science, University of Gondar, Gondar, Ethiopia.

Submitted: 28 January 2026 **Accepted:** 09 February 2026 **Published:** 16 February 2026

Citation: Zeleke, G. A., Bazezew, A. M., Negash, B. A., Ayele, D. G., Azanaw, Y. G., Belay, A. E., & Zegeye, A. F. (2026), Double burden of fatigue and poor sleep quality and their predictors among patients with cancer in northwest Ethiopia: an institutional-based cross-sectional study. *J of Clin Nur Rep*, 5(1), 01-11.

Abstract

Background: Cancer-related fatigue and poor sleep quality are among the most prevalent and distressing symptoms experienced by patients with cancer. It affects the physical, emotional, and cognitive functioning of patients with cancer. Despite the high prevalence and predictors factor on quality of life, the comorbidity of fatigue and poor sleep remains underexplored, particularly in low-resource settings where access to comprehensive oncology care such as limited psychosocial services, lack of routine screening is limited. However, existing research predominantly focuses on either fatigue or poor sleep quality separately, highlighting a critical gap in evidence regarding their combined effect in patients with cancer.

Methods: Institution-based cross-sectional study was conducted among adult cancer patients attending the oncology unit from April to June 2025. Systematic random sampling technique was used to select 422 participants. Data were collected using a structured interviewer-administered questionnaire, and Epi Data version 4.6, and exported to Stata version 14 for analysis. Model fitness was assessed using the Hosmer Lem show goodness of fit. Descriptive statistics such as, frequencies and percentage were computed and presented by using tables and texts. Bivariable and multivariable logistic regression analysis was employed considering $p < 0.05$ to be statistically significant.

Results: In this study, 46.67% of participants experienced comorbidity of fatigue and poor sleep quality. Age 61-89 years (AOR=2.79, 95% CI: 1.02, 7.62), rural residency (AOR =2.03, 95% CI: 1.02, 4.01), married & divorced (AOR=2.65, 95% CI:1.01, 6.90) and (AOR=3.54, 95% CI: 1.10, 11.40), inpatient (AOR=2.84, 95% CI: 1.63, 4.95), Stage II and Stage IV (AOR=3.92, 95% CI: 1.89, 8.12) and (AOR= 2.52, 95% CI: 1.04, 6.15), respectively, cancer duration (AOR=2.70, 95% CI: 1.14, 6.39), anxiety (AOR=1.93, 95% CI: 1.06, 3.51), depression (AOR=2.10, 95% CI: 1.19, 3.70).

Conclusions: The comorbidity of fatigue and poor sleep quality is highly prevalent among patients with cancer. Multiple sociodemographic, clinical, and psychosocial factors have been identified as significant predictors. Routine screening and integrated supportive care are essential to effectively address these comorbid symptoms and improve overall patient outcomes.

Keywords: Cancer Related Fatigue, Sleep Quality, Comorbidity, Cancer Patients, Amhara Region.

Introduction

The comorbidity of cancer-related fatigue and poor sleep quality represents a debilitating symptom cluster that markedly worsens functional capacity, increases clinical burden, and reduces quality of life among patients with cancer. Cancer is major public health challenge, with nearly 20 million new cases and 9.7 million cancer-related deaths reported globally in 2022[1]. Beyond the rising prevalence of cancer, fatigue and poor sleep quality persist as among the most prevalent and distressing symptom clusters, representing a major source of symptom burden and significantly impairing patients' quality of life[2, 3].

Evidences from the U.S. Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO) indicate that these symptoms significantly impact psychological health, physical functioning, treatment compliance, and overall quality of life in patients with cancer[4, 5]. Longitudinal and systematic reviews repeatedly show that fatigue and poor sleep quality are not only highly prevalent but also commonly co-occur, exacerbating each other's symptoms and making patients' suffering worse[6, 7].

Furthermore, meta-analyses studies reveal that 40 to 80 percent of patients experience cancer-related fatigue (CRF), and 50% to 70% experience poor sleep quality, varying by disease stage and treatment approach[8]. When these conditions co-occur, patients face declines in quality of life, reduced functional status, and poor survival outcomes[9]. Additionally, longitudinal data demonstrates that untreated poor sleep quality and fatigue can last for years after treatment, severely reducing the chances of surviving. The intensity of this comorbidity has been linked to psychological morbidity, such as anxiety and depression, lower productivity, and higher healthcare burden[10].

Consequently, the combined burden of fatigue and poor sleep quality constitutes a significant public health burden globally. Tremendous clinical, sociodemographic, and psychological factors have been found to predict the comorbidity of poor sleep quality and cancer related fatigue. Higher risks of these symptoms are consistently linked to advanced cancer stage, diagnosis duration and treatment modalities like chemotherapy and radiation[11,12]. Biological factors, including anemia, systemic inflammation, and poor nutritional status, further exacerbate symptom severity[13].

Depression and anxiety are key predictors, alongside low physical activity, poor social support, and rural residency, particularly in LMIC settings [14]. This complex etiology underscores the need for integrated, context-specific management strategies; however, the comorbidity of cancer-related fatigue and poor sleep quality remains poorly studied in sub-Saharan Africa, particularly in Ethiopia, despite growing international attention. The majority of Ethiopia's current study has focused on these symptoms separately. Studies carried out in Ethiopia's Amhara area and elsewhere, for instance, have found a high frequency of CRF and poor sleep quality independently, and correlations between these outcomes and variables like depression, advanced cancer stage, anemia, pain, and inpatient status have been found[15-17]. However, to our knowledge, no prior study in northwest Amhara region has quantified the combined burden of fatigue and poor sleep quality as a binary comorbidity outcome. This represents

a critical knowledge gap, as simultaneous evaluation provides more comprehensive insights into patient symptom clusters and may better inform integrated care strategies.

In light of this evidence gap, there is an urgent need for studies that establish both the magnitude and determinants of fatigue sleep comorbidity in Ethiopian oncology settings. Such evidence is particularly relevant to Ethiopia, where late-stage presentation, limited access to specialized care, and high psychosocial burden may amplify the prevalence and impact of these symptoms. Therefore, this study aimed to estimate the magnitude of comorbid fatigue and poor sleep quality and its predictors among adult cancer patients attending oncology unit in the northwest Amhara region, Ethiopia[18].

Methods

Study Design, and period

Institutional-based cross-sectional study was conducted among adult cancer patients receiving cancer treatment at an oncology unit and Data collection was carried out from April to June 2025.

Study Area

The study was conducted in cancer treatment hospitals within the Amhara region of Northwest Ethiopia, which contains eight comprehensive hospitals. Among these, four have dedicated oncology units: University of Gondar Comprehensive Specialized Hospital (UOGCSH), Felegehiwot Comprehensive Specialized Hospital (FCSH), Tibebeqion Comprehensive Specialized Hospital (TCSH), and Dessie Comprehensive Specialized Hospital (DCSH). Each hospital serves approximately 3.5 to 5 million people and provides both inpatient and outpatient oncology services. The capacities of their oncology units are as follows: FCSH has 28 beds, UOGCSH has 32 beds, DCSH has 20 beds, and TCSH has 25 beds. These services are delivered by a multi-disciplinary team that includes nurses, oncologists, and general practitioners[19].

Study Population

All adult cancer patients (≥ 18 years) attending oncology clinics during the study period were eligible, with participants selected randomly [20].

Eligibility Criteria

Inclusion Criteria

Eligible participants included all adult patients (≥ 18 years) with a confirmed diagnosis of any type of cancer. Patients must be either currently receiving active cancer treatment (such as chemotherapy, radiotherapy, immunotherapy, or surgery) or undergoing follow-up care. Additionally, participants must be willing and able to provide informed consent and demonstrate sufficient cognitive and communicative ability to complete the study questionnaire reliably [21].

Exclusion Criteria

Patients who are critically ill, unable to communicate, or diagnosed with psychiatric disorders or cognitive impairments that hinder reliable self-reporting should be excluded, along with those with pre-existing sleep disorders to prevent potential confounding [22].

Sample Size Determination

The sample size was calculated using the single population proportion formula. The 50% of prevalence rate was assumed due to a lack of local data, which maximizes variability in sample size calculations and ensures robustness in our findings

$$n = \frac{(Z\alpha/2)^2 p(1-p)}{d^2}$$

Where n= minimum sample size required for the study
Z= standard normal distribution (Z=1.96) with CI of 95% and $\alpha=0.05$

P=population proportion (p=0.5)

d= is a tolerable margin of error (d=0.05)

$$n = 1.96(1.96) (0.5(1-0.5))/0.05(0.05) = 384.$$

By adding a 10% non-response rate the final sample size was calculated to be 422

Sampling Technique

The systematic random sampling technique was implemented in clear steps for improved clarity. First, the sampling interval was calculated by dividing the total population of cancer patients receiving treatment (1,500) by the sample size (422), resulting in an interval of approximately 3. The first participant was randomly selected using a lottery method, and subsequent participants were chosen at regular intervals. To avoid duplication, data collectors ensured that previously selected individuals were not sampled again (figure 1).

FHCSH: Felege Hiwot Comprehensive Specialized Hospital

TGCSH: Tibebe Gion Comprehensive Specialized Hospital

DCSH: Dessie Comprehensive Specialized Hospital

UoGCSH: University of Gondar Comprehensive Specialized Hospital

Data Collection Tools and Procedures

Data were collected using a structured, interviewer-administered questionnaire with open-ended and closed-ended questions. There are eight parts to the data collection tool. Part I contains sociodemographic data, part II disease and treatment-related signs and symptoms, part III sleep quality assessment, part IV Brief Fatigue Inventory. The tools for socio-demographic and clinical factors were adapted from the review of different pieces of literature. Anxiety and depression were assessed using the Hospital Anxiety and Depression Scale (HADS) [19] which was also validated in Ethiopian cancer patients. Performance status was assessed by the single item Eastern Cooperative Oncology Group (ECOG) performance status scale [23].

Social support was assessed by the three-item Oslo social support scale (OSSS-3) [24]. Sleep quality was assessed by a standardized and validated Pittsburgh Sleep Quality Index (PSQI). The PSQI was designed to evaluate the subjective quality of sleep in the past month. It contains 18 self-rated questions, including seven subscale components (subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleep medication, and daytime dysfunction). The global PSQI score ranges from 0 (no difficulty) to 21 (severe difficulties in all areas). Each component score ranges from 0 (no difficulty) to 3 (severe difficulty). Higher global and component scores indicate more severe complaints and a higher level of poor sleep quality. A global PSQI score greater than 5 yielded a diagnostic sensitivity of 89% and specificity of 86.5% (kappa

= 0.75, $P \leq 0.001$) in distinguishing “poor” from “good” sleepers [25]. The construct validity and internal consistency are further evaluated and supported in cancer patients with a Cronbach’s α value of 0.81 [26]. For present study, the internal consistency measurement of the PSQI subscales found a Cronbach’s alpha coefficient of 0.761 from the pretest data which was acceptable for this study. Brief Fatigue Inventory scale (BFI): Cancer patients who scored greater than or equal to four (≥ 4) moderate to severe in BFI measurement scale was considers fatigue whereas, < 4 in BFI scale was considers not fatigue[27-29].

Data Collection Procedure

Data collectors (trained BSc nurses) conducted face-to-face interviews in a private setting to ensure confidentiality and comfort. Medical records were reviewed to obtain clinical data. The questionnaires were first translated into the local language (Amharic) and then back-translated into English to ensure accuracy. A pretest of the instruments was carried out on 5% of the sample at Debre Berihan Comprehensive Specialized Hospital in a similar population to identify and address potential issues.

Outcome Variable

The outcome variable was the comorbidity of cancer-related fatigue and poor sleep quality among patients with cancer. Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), where a global score above 5 indicates poor sleep quality. Fatigue was measured with the Brief Fatigue Inventory (BFI), with scores of 4 or higher classified as clinically significant fatigue. Participants were classified as comorbid (coded as 1) if they met both criteria (PSQI > 5 and BFI ≥ 4); otherwise, they were coded as 0, indicating the absence of the comorbid condition[30].

Comorbidity of fatigue and poor sleep quality: Defined as the presence of both clinically significant fatigue and poor sleep in the same individual. Fatigue was measured using Brief Fatigue Inventory, with a score of ≥ 4 , indicating clinically significant fatigue. Sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI), with a global score > 5 indicating poor sleep. Participants meeting the criteria for both were coded as “1” (comorbidity); all others were coded as “0” (No comorbidity)[31].

Independent Variables

Sociodemographic such as Age, sex, residence, marital status, education, occupation. Clinical factors: Cancer type, cancer stage, duration since diagnosis, treatment modality, Behavioral and psychosocial factors: depression/anxiety [32].

Operational Definition

Comorbidity fatigue and poor sleep quality: is defined as the simultaneous presence of poor sleep quality and fatigue

Good sleep quality: a global PSQI score of ≤ 5

Poor sleep quality: a global PSQI score of > 5

Anxiety and depression: A patient with more than 10 points on the Hospital Anxiety and Depression Scale (HADS) has anxiety and depression problem.

Good performance: if Eastern Cooperative Oncology Group performance status which ranges from 0-4 (ECOG-PS). Patient score 0-1.

Poor performance: if Eastern Cooperative Oncology Group

performance status (ECOG-PS) patient score 2-4.

Social support: by using the three-item Oslo social support scale (OSSS-3), a score of 3–8 represents ‘poor support’, 9–11 ‘moderate support’, and 12–14 ‘strong support’[33, 34].

Data Quality Assurance

Supervisors and data collectors received training on interviewing techniques, ethical considerations, and study objectives. To guarantee accuracy and consistency, completed surveys were supervised and reviewed every day. To reduce entry errors, data entry was done twice. Scales such as the PSQI and BFI were tested for internal consistency using Cronbach's alpha [35].

Data Processing and Analysis

Data were coded and entered into Epi Data and then exported to Stata version 14 for analysis. Descriptive statistics were used to summarize sociodemographic and clinical characteristics as well as the prevalence of comorbid fatigue and poor sleep quality. Bivariate analyses using Chi-square tests were conducted to assess associations between independent variables and comorbidity. Variables with a p-value < 0.25 in the bivariate analysis were included in the multivariable logistic regression model to identify independent predictors of comorbidity, and adjusted odds ratios

(AOR) with 95% confidence intervals (CIs) were reported [36].

Ethical Consideration

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval was obtained from the Research and Ethical Review Committee of the University of Gondar, College of Medicine and Health Sciences, School of Nursing (Reference No.S/N 237/2017). The committee approved the study on behalf of the Institutional Ethical Review Committee of the University of Gondar. The objectives and significance of the study were clearly explained to all participants, and written informed consent was obtained from each participant prior to data collection [37].

Results

In this study, a total of 405 patients participated, resulting in a response rate of 97%. Nearly two-thirds of the participants (60.74%) were female. The mean age of the participants was 46.43 years (SD:15.43). Approximately one-third of the participants (32%) were diagnosed with stage II cancer. Regarding residency, slightly more than half of the participants (62.96%) resided in rural areas. Additionally, nearly half of the participants (45.43%) had not received any formal education (Table 1).

Table 1: Frequency distribution of the characteristics of study participants attending oncology units in Amhara region comprehensive socialized hospitals, northwest Ethiopia. 2025 (n=405)

Variable	Fatigue & poor sleep quality comorbidity		Frequency	percent (%)
	Yes	No		
Age				
18-30	42	31	73	18.2
31-43	50	45	95	23.45
44-60	73	93	166	4.98
61-89	24	47	71	17.53
Sex	75	84	159	39.25
Male	114	132	246	60.74
Female				
Residency	82	68	152	37.53
Urban	107	148	255	62.96
Rural				
Marital status	108	147	255	62.96
Married	20	24	44	10.86
Divorced	38	21	59	14.56
Single	23	24	47	11.60
Widowed				
Educational status	74	110	184	45.43
Not education	80	64	144	35.55
Primary education	20	28	48	11.85
Secondary education	15	14	29	7.16
College and above				
Occupational status	22	15	37	9.13
Unemployed	25	15	40	9.87
Employed	95	136	231	57.03
Farmer	47	50	97	23.95
Marchant				

Clinical characteristics of the study participants

The most frequent malignancies were breast cancer (22.71).

among 405 patients with cancer, more than half of the patient were stage I and Stage II (63.70)

Table 2: Frequency distribution table for clinical characteristics of study participants attending oncology units in Amhara region hospitals, 2022 (n=405)

Variable	Fatigue & poor sleep quality comorbidity		Frequency	percent (%)
Admission status				
Inpatient	77	140	217	53.58
Outpatient	112	76	188	46.41
Cancer types				
Breast cancer	46	46	92	22.71
Colorectal cancer	28	31	59	14.56
Cervical cancer	40	42	82	2.24
Lung cancer	21	28	49	12.9
Skin cancer	23	18	41	10.12
prostate cancer	14	9	23	5.67
Stage of cancer				
Stage I	80	47	127	31.35
Stage II	43	88	131	32.34
Stage III	29	35	64	15.8
Stage IV	37	46	83	20.49
Cancer therapy				
Medical therapy	124	160	284	284
Surgical therapy	65	55	120	120
Metastasis History				
Yes	69	92	161	39.75
No	120	124	244	60.24
Cancer duration				
< 1 years	43	16	59	14.56
≥1years	146	200	346	85.43

Notably, higher proportions of fatigue and poor sleep quality comorbidity were observed among participants with poor social support (55.55%), poor performance status (56.56%), the presence of anxiety (56.04%), and the absence of depression (56.70%).

Table 3: Frequency distribution table for behavioral and psychosocial characteristics of study participants attending oncology units in Amhara region hospitals, 2022 (n=405).

Variable	Fatigue & poor sleep quality comorbidity		Frequency	percent (%)
Cigarette Smoking				
Yes	37	19	56	13.82
No	152	197	349	86.17
Social support status				
poor	100	125	225	55.55
Moderate	80	77	157	38.76
Strong	9	14	23	5.67
Performance status				
Good	99	77	176	43.45
poor	90	139	229	56.56
Anxiety				
No	104	74	178	43.95
Yes	85	142	227	56.04
Depression status				
No	131	99	230	56.70
Yes	58	117	175	43.20

Magnitudes of comorbidity fatigue and poor sleep quality among adult cancer patient were 46.67% [95% CI: (41.8–51.6)] (figure 2).

Figure 2: Magnitude of Comorbidity fatigue and poor sleep quality and its predictors among cancer patient in Amhara re-

gion, northwest Ethiopia.

Association factors with comorbidity of fatigue and poor sleep quality among cancer patient Amhara region, northwest, Ethiopia

In the final multivariable logistic regression model, age, marital

status, place of residence, admission status, duration of cancer, cancer type, cancer stage, as well as anxiety and depression status were all identified as factors significantly associated with the outcome. The odds of fatigue and poor sleep quality comorbidity were 2.79 times higher among cancer patient aged 61 to 89 years compared to women aged 18 to 30 years [AOR = 2.79, 95% CI: [1.02, 7.62]]. The odds of fatigue and poor sleep quality comorbidity were 2.03 times higher among cancer patient living in rural residency compared to urban resident [AOR = 2.03 95%, CI: [1.02, 4.01]].

The odds of fatigue and poor sleep quality comorbidity were 2.65 and 3.54 times higher among cancer patient who are married and divorced respectively compared to single cancer patient [AOR= 2.65 95%, CI: (1.01, 6.90)] and [AOR= 3.54 95% CI: (1.10, 11.40)]. The odds of fatigue and poor sleep quality co-

morbidity were 2.84 times higher among cancer patient who are inpatient compared to outpatient [AOR=2.84, 95%, CI: (1.63, 4.95)]. The odds of fatigue and poor sleep quality comorbidity were 3.92 & 2.52 times higher among Stage II and Stage IV of cancer patient compared to stage I [AOR=3.92, 95%, CI: ([1.89, 8.12] and [AOR= 2.52, 95% CI: (1.04, 6.15)] respectively. The odds of fatigue and poor sleep quality comorbidity were 2.70 times higher among ≥ 1 -year cancer duration compared to < 1 year cancer duration [AOR=2.70, 95% CI: (1.14, 6.39)]. The odds of fatigue and poor sleep quality comorbidity were 1.93 times higher among cancer patient who had an anxiety compared to No anxiety [AOR= 1.93, 95% CI: (1.06, 3.51)]. The odds of fatigue and poor sleep quality comorbidity were 2.10 times higher among cancer patient who had depression compared to No depression [AOR= 2.10, 95% CI: (1.19, 3.70)] (table 2).

Table 4: Final bivariable and multivariable logistic regression analysis of factors associated with the comorbidity of fatigue and poor sleep quality among cancer patients, Amhara region, northwest Ethiopia

Variable	COR [95% CI]	AOR [95% CI]
Age	1	1
18-30	1.21 [0.65,2.25]	0.88 [0.38, 2.06]
31-43	1.72 [0.98, 3.01]	0.99 [0.44, 2.24]
44-60	2.65 [1.34, 5.21]	2.79 [1.02, 7.62] *
61-89		
Sex	1	1
Female	0.96 [0.64, 1.44]	0.71 [0.37, 1.37]
Male		
Residency	1	2.03 [1.02, 4.01] *
Urban	1.66 [1.11, 2.50]	
Rural		
Marital status	1	1
Single	2.46 [1.36, 4.43]	2.65 [1.01, 6.90] *
Married	2.17 [0.97, 4.82]	3.54 [1.10, 11.40] *
Divorced	1.88 [0.86, 4.12]	1.12 [0.35, 3.61]
Widowed		
Educational status	1	1
No education	0.538 [0.34, 0.83]	0.85 [0.43, 1.71]
Primary education	0.94 [0.49, 1.79]	1.88 [0.70, 5.00]
Secondary educan	0.62 [0.28, 1.37]	1.81 [0.55, 5.99]
College& above		
Occupational status	1	1
Employed	1.13 [0.45, 2.84]	0.74 [0.19, 2.94]
Unemployed	2.38 [1.19, 4.76]	1.27 [0.43, 3.76]
Farmer	1.77 [0.83, 3.76]	1.95 [0.64, 5.99]
Marchant		
Admission status	1	1
Outpatient	2.67 [1.79, 4.00]	2.84 [1.63, 4.95] *
Inpatient		
Cancer types	1	1
Breast cancer	0.90 [0.46, 1.73]	1.80 [0.75, 4.34]
Colorectal cancer	0.94 [0.48, 1.85]	0.91 [0.43, 1.92]
Cervical cancer	1.20[0.56, 2.58]	3.15 [1.23, 8.03] *
Lung cancer	0.70 [0.31, 1.57]	1.24 [0.48, 3.22]
Skin cancer	0.58 [0.21, 1.54]	1.14 [0.33,3.88]
Prostate cancer		

Stage of cancer	1	1
stage I	3.48 [2.08, 5.81]	3.92 [1.89, 8.12] *
Stage II	2.05 [1.11, 3.78]	2.33 [0.91, 5.93]
Stage III	2.11 [1.20, 3.71]	2.52 [1.04, 6.15] *
Stage IV		
Cancer therapy	1	1
Medical therapy	0.65 [.42, 1.00]	0.69 [0.39, 1.24]
Surgical therapy		
Metastasis History	1	1
No	1.29 [0.86, 1.92]	1.05 [0.58, 1.90]
Yes		
Cancer duration	1	1
< 1 year	3.68 [1.99, 6.79]	2.70 [1.14, 6.39] *
≥1 year		
Cigarette Smoking	1	1
Yes	2.52 [1.39, 4.56]	2.06 [0.88, 4.83]
No		
performance status	1	1
Good	0.77 [0.50, 1.12]	0.55 [0.31, 0.98]
Poor	1.24 [0.19, 7.13]	1.45 [0.12, 16.88]
Anxiety status	1	1
No	2.34 [1.57, 3.50]	1.93 [1.06, 3.51] *
Yes		
Depression	1	1
No	2.66 [1.77, 4.01]	2.10 [1.19, 3.70] *
Yes		

Discussion

The purpose of this study to determine the prevalence of comorbid fatigue and poor sleep quality among adult cancer patients in Northwest Amhara Region, northwest Ethiopia.

In this study, comorbidity of cancer related fatigue and poor sleep quality were 46.67% (95% CI: 41.8, 51.6) among patients with cancer. Our findings are in line with the larger body of research showing that both symptoms are quite common and frequently co-occur in oncology populations, even though no prior studies have specifically recorded this comorbidity as a single outcome. For instance, studies conducted in similar settings have reported that cancer-related fatigue affects approximately 50–60% of patients[38], while poor sleep quality has been observed in 53–61% of patients [39]. The strong associations were previously reported between fatigue and poor sleep quality such as correlation coefficients around 0.6, adjusted odds ratios >2) support the likelihood of a high degree of cooccurring between the two symptoms[40]. Numerous interrelated factors, including the burden of the disease, adverse drug reactions, psychological stress, disease stage, and restricted access to supportive care, may contribute to this. The results highlight the necessity for cancer care teams and doctors to test poor sleep quality and cancer related fatigue simultaneously, rather than separately, and to think about integrated therapies that treat both symptoms at the same time. However, this findings is somewhat lower than reports from Iran 69.3%, Arab countries 77.5-78%, and study conducted in Egypt, prevalence fatigue and poor sleep were in and 87.4-99.2% patients, respectively[39] and 77-93% in America [41,42].

Although prior research has repeatedly shown that cancer-related fatigue and poor sleep quality are significantly correlated,

most of these studies did not report comorbidity as a single combined prevalence estimate, which makes it difficult to directly compare our findings with those of other studies. Our study's comparatively lower prevalence could be due to variances in healthcare settings, cultural views of symptoms, study populations, or evaluation instruments. Because fatigue and poor sleep quality can significantly decrease quality of life and may necessitate integrated management techniques in cancer therapy, it is clinically important to recognize their coexistence. The research is still lacking in longitudinal data on the long-term interactions between these two symptoms and if addressing both at the same time with focused therapies can enhance patient outcomes[43].

In this study, the odds of comorbidity of fatigue and poor sleep quality were 2.79 times higher among patients with cancer aged 61 to 89 years compared to women aged 18 to 30 years. This association was consistent with study conducted in university of California[44], Brazil[45]. Age-related physiological changes including reduced sleep efficiency and more overnight awakenings, higher susceptibility to treatment-related adverse effects, and the existence of numerous comorbidities could all contribute to this outcome. Anxiety, social isolation, and a lack of coping mechanisms are examples of psychosocial issues that can make fatigue and sleep disturbance worse. The combined impact of these variables emphasizes the necessity of focused treatments to enhance sleep and lessen fatigue in elderly cancer patients. And cancer patients living in rural areas had 2.03 times higher odds of comorbid fatigue and poor sleep quality compared to urban residents. This finding is consistent with prior research indicating that rural residency is associated with poorer symptom management, higher fatigue, and greater sleep disturbances among cancer patients[46]. Lower health literacy, longer travel

times to clinics, fewer specialized cancer care resources, and restricted access to healthcare services are some potential causes, all of which could lead to a higher cumulative symptom burden and delayed symptom management. Environmental and social variables may make fatigue and sleep issues worse, such as a lack of social support and higher levels of stress in rural areas [47].

The odds of fatigue and poor sleep quality comorbidity were 2.65 and 3.54 times higher among cancer patient who are married and divorced respectively compared to single cancer patient. This finding is consistent with study conducted Rabat, Morocco[48]. Married couples may benefit from psychological and social support, such as emotional support, and encouragement to adhere to treatment, which may have a protective effect on cancer patients' sleep quality. Support of this kind help in the reduction of stress, worry, and depression symptoms, all of which are closely related to fatigue and sleep quality. On the other hand, cancer patients who are widowed, divorced, or single frequently experience higher levels of psychosocial stress and less coping mechanisms, which raises their risk of fatigue and poor sleep quality[49]. The odds of fatigue and poor sleep quality comorbidity were 2.84 times higher among cancer patient who are inpatient compared to outpatient [AOR=2.84, 95%, CI: (1.63, 4.95)]. This finding was consistent with study conducted in Ethiopia, Iran, systematic review and meta-analysis[50]. Comorbid fatigue and sleep disturbances are more common in inpatient cancer patients because of the advanced stage of the disease, unmanaged symptoms, and more intense therapy. Sleep is further disrupted and weariness is increased by pain, dyspnea, nausea, and hospital procedures including noise and midnight monitoring. In addition, polypharmacy and psychological discomfort[51, 52].

The odds of fatigue and poor sleep quality comorbidity were 3.92 & 2.52 times higher among Stage II and Stage IV of cancer patient compared to stage I [AOR=3.92, 95%, CI: (1.89, 8.12)] and [AOR= 2.52, 95% CI: (1.04, 6.15)] respectively. This finding was concurrent in study conducted in Ethiopia, systematic review and meta-analysis. The higher disease load and physiological stress in patients with more advanced cancer stages increases the likelihood of fatigue and restless nights. Tumor growth in stage II frequently results in elevated inflammatory activity, which throws off circadian rhythm and energy management, making fatigue and sleep quality worse. In stage IV, metastases and widespread disease increase the burden of symptoms, the necessity for intense therapy, and psychological distress, all of which independently affect sleep and cause fatigue. Extensive reviews consistently demonstrate that fatigue and poor sleep quality are strongly predicted by tumor stage, symptom burden, and treatment severity [53]. The odds of fatigue and poor sleep quality comorbidity were 2.70 times higher among ≥ 1 -year cancer duration compared to < 1 year cancer duration [AOR=2.70, 95% CI: (1.14, 6.39)].

This finding was concurrent with study conducted in USA[53], Netherlands, Ethiopia. Patients who have had cancer for more than a year are far more likely than those who have had it for less time to suffer from concomitant fatigue and poor sleep quality. Long-term exposure to the disease and its treatments might result in cumulative adverse effects from radiation, chemotherapy, or surgery, which can worsen sleep problems and exhaustion.

Furthermore, extended cancer duration is frequently linked to higher levels of psychological distress, such as anxiety and depression, as well as a greater load of symptoms, such as pain and discomfort, all of which worsen energy and sleep quality. The odds of fatigue and poor sleep quality comorbidity were 1.93 times higher among cancer patient who had an anxiety compared to No anxiety [AOR= 1.93, 95% CI: (1.06, 3.51)]. This associate was similar with study done in China, Ethiopia, meta-analysis studies in multiple countries[54]. Cancer patients' comorbidity of fatigue and poor sleep quality is greatly influenced by anxiety through both physiological and psychological factors. It causes the hypothalamic-pituitary-adrenal (HPA) axis to become dysregulated and hyperarousal, which interferes with sleep and results in non-restorative slumber. Consequently, this makes cancer-related fatigue worse, which is a prevalent and enduring symptom in oncology populations. Additionally, anxiety exacerbates fatigue and sleep disruptions by reducing adaptive coping mechanisms [55].

The odds of fatigue and poor sleep quality comorbidity were 2.10 times higher among cancer patient who had depression compared to No depression [AOR= 2.10, 95% CI: (1.19, 3.70)]. This finding concurrent with study conducted in Ethiopia and Egypt [56].

There are several interrelated biological and psychological processes via which depression in cancer patients can worsen fatigue and interfere with sleep. Increased exhaustion results from neurochemical imbalances linked to depression, such as changed serotonin and dopamine levels, which interfere with sleep regulation and decrease restorative sleep. Moreover, depression frequently entails dysregulation of the hypothalamic-pituitary-adrenal (HPA) axis and increased inflammatory responses, which exacerbate fatigue and poor sleep quality. On a psychological level, depression symptoms make people less motivated and energetic, which makes it harder for them to take care of themselves and keep up good sleep habits. This makes the symptoms worse. All of these processes work together to explain why depressed cancer patients have been shown to have higher risks of experiencing fatigue and poor sleep comorbidities [59].

Strengths and Limitations

The major strengths of this study its novel focus on comorbidity, addressing a research gap by assessing the combined prevalence of fatigue and poor sleep in a resource-limited setting. Additionally, the use of validated assessment tools for both fatigue and sleep quality enhances the reliability of our findings. The study's relatively large and diverse sample drawn from multiple facilities in the Northwest Amhara Region improves its representativeness and relevance to clinical practice. However, several limitations should be acknowledged; the reliance on self-reported data may introduce recall bias, particularly in the subjective evaluation of symptoms, the absence of biochemical or clinical staging data limits the ability to assess the influence of disease severity or treatment modality on symptom burden, while we used a binary outcome to capture comorbidity, more nuanced analyses such as symptom cluster modeling or longitudinal tracking may yield deeper insights into symptom interactions over time.

Clinical Implications

Nearly half of adult cancer patients in the region experience both

fatigue and poor sleep quality, highlighting the need for routine screening of concurrent symptoms. These comorbidities intensify each other's effects, leading to impaired functioning, reduced quality of life, and lower treatment adherence. Integrated management strategies ranging from CBT and physical activity programs to basic sleep hygiene counseling are essential, especially in resource-limited settings.

Conclusions

Comorbid fatigue and poor sleep quality are highly prevalent among adult cancer patients in the Northwest Amhara Region, significantly affecting functional status and quality of life. These findings underscore the need for routine screening and integrated management of concurrent symptoms within oncology care. Simple interventions such as sleep hygiene counseling, psychoeducation, and targeted therapies can improve patient outcomes, especially in resource-limited settings. Future research should explore longitudinal trajectories and contributing factors to inform tailored, effective interventions.

Declaration

Clinical trial number

Not applicable

Competing interest

Authors Declared that, there is no competing interest.

Funding

Not applicable

Data Availability Statement

The manuscript contains all of the data that is crucial to our findings. Request for additional information on the data set and questions about data sharing will be treated in accordance with a reasonable request to

Author's Contributions

GAZ: involved data collection, data analysis, interpretation, report and manuscript writing.

AMB: involved in analysis, and result interpretation

BAN: involved in data analysis, interpretation, and, and manuscript writing.

DGA: involved in discussion and drafting proposal and interpretation of result.

YGB: involved in conceptualization, validation, writing original draft.

AEB: involved in data collection and writing original draft

AFZ: involved in designing and preparing manuscript.

Reference

1. Sung, H., Ferlay, J., Siegel, R. L., Laversanne, M., Soerjomataram, I., Jemal, A., & Bray, F. (2021). Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA: a cancer journal for clinicians*, 71(3), 209-249.
2. Berger, A. M., Mitchell, S. A., Jacobsen, P. B., & Pirl, W. F. (2015). Screening, evaluation, and management of cancer-related fatigue: Ready for implementation to practice?. *CA: a cancer journal for clinicians*, 65(3), 190-211..
3. Strebkova, R. (2020). Cancer-related fatigue in patients with oncological diseases: causes, prevalence, guidelines for assessment and management. *Folia Medica*, 62(4), 679-689..
4. Stefan, D. C., Dangou, J. M., Barango, P., Mahamadou, I. D., & Kapambwe, S. (2022). The World Health Organization targets for cervical cancer control by 2030: A baseline assessment in six African countries—Part I. *ecancermedicalscience*, 16, 1453..
5. Kang, Y. E., Yoon, J. H., Park, N. H., Ahn, Y. C., Lee, E. J., & Son, C. G. (2023). Prevalence of cancer-related fatigue based on severity: a systematic review and meta-analysis. *Scientific reports*, 13(1), 12815..
6. Wu, I. H., Balachandran, D. D., Faiz, S. A., Bashoura, L., Escalante, C. P., & Manzullo, E. F. (2022). Characteristics of cancer-related fatigue and concomitant sleep disturbance in cancer patients. *Journal of Pain and Symptom Management*, 63(1), e1-e8.
7. ANCOLI-ISRAEL, S., Moore, P. J., & Jones, V. (2001). The relationship between fatigue and sleep in cancer patients: a review. *European journal of cancer care*, 10(4), 245-255..
8. Asefa, T., Bitew, G., Tezera, H., & Tesfaye, W. (2024). Prevalence of cancer-related fatigue, associated factors and adult cancer patients' experiences at Hawassa University Comprehensive Specialized Hospital in Ethiopia: a mixed methods study. *Frontiers in Oncology*, 14, 1480246..
9. Animaw, L., Woldegiorgis Abate, T., Endeshaw, D., & Tsegaye, D. (2023). Fatigue and associated factors among adult cancer patients receiving cancer treatment at oncology unit in Amhara region, Ethiopia. *Plos one*, 18(1), e0279628.
10. Endeshaw, D., Biresaw, H., Asefa, T., Yesuf, N. N., & Yohannes, S. (2022). Sleep quality and associated factors among adult cancer patients under treatment at oncology units in Amhara region, Ethiopia. *Nature and Science of Sleep*, 1049-1062.
11. KERAGA, M. G. (2019). ACCEPTABILITY AND UTILIZATION OF IMMEDIATE POSTPARTUM INTRAUTERINE CONTRACEPTIVE DEVICE AND ASSOCIATED FACTORS AMONG WOMEN WHO GAVE BIRTHS AT GOVERNMENT HOSPITALS OF GAMO ZONE, SOUTHERN ETHIOPIA (Doctoral dissertation, MESFIN GEBREMEDHIN KERAGA).
12. Chelf, J. H., Agre, P., Axelrod, A., Cheney, L., Cole, D. D., Conrad, K., ... & Weaver, C. (2001, August). Cancer-related patient education: an overview of the last decade of evaluation and research. In *Oncology nursing forum* (Vol. 28, No. 7).
13. Sanft, T., Day, A., Ansbaugh, S., Armenian, S., Baker, K. S., Ballinger, T., ... & Freedman-Cass, D. A. (2023). NCCN guidelines® insights: Survivorship, version 1.2023: Featured updates to the NCCN guidelines. *Journal of the National Comprehensive Cancer Network*, 21(8), 792-803.
14. Stoller, J. K., Michota, F. A., & Mandell, B. F. (Eds.). (2009). *The Cleveland Clinic Foundation intensive review of internal medicine*. Lippincott Williams & Wilkins.
15. Al Maqbali, M., Hughes, C., Rankin, J., Dunwoody, L., Hacker, E., & Gracey, J. (2021). Fatigue and sleep disturbance in Arabic cancer patients after completion of therapy: prevalence, correlates, and association with quality of life. *Cancer Nursing*, 44(5), 378-387.
16. Zeleke, G., Worku, W. Z., & Ayele, D. (2024). Prevalence and associated factors of cancer-related fatigue among

- adult patients with cancer attending oncology units: an institution-based cross-sectional study design in the Amhara region, Ethiopia, 2022. *BMJ Public Health*, 2(2)..
17. Al Maqbal, M., Al Sinani, M., Alsayed, A., & Gleason, A. M. (2022). Prevalence of sleep disturbance in patients with cancer: a systematic review and meta-analysis. *Clinical nursing research*, 31(6), 1107-1123.
 18. Alebachew, A. and C.J.H.r.f.h.r. Waddington, Ethiopia, Improving health system efficiency. 2015.
 19. Zigmond, A.S. and R.P. Snaith, The hospital anxiety and depression scale. *Acta psychiatrica scandinavica*, 1983. 67(6): p. 361-370.
 20. Wondie, Y., A. Mehnert, and A. Hinz, The Hospital Anxiety and Depression Scale (HADS) applied to Ethiopian cancer patients. *PloS one*, 2020. 15(12): p. e0243357.
 21. Oken, M. M., Creech, R. H., Tormey, D. C., Horton, J., Davis, T. E., McFadden, E. T., & Carbone, P. P. (1982). Toxicity and response criteria of the Eastern Cooperative Oncology Group. *American journal of clinical oncology*, 5(6), 649-656.
 22. Meltzer, H., A. Nosikov, and C. Gudex, Developing common instruments for health surveys. 2003.
 23. Buysse, D. J., Reynolds III, C. F., Monk, T. H., Ber- man, S. R., & Kupfer, D. J. (1989). The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry research*, 28(2), 193-213.
 24. Beck, S. L., Schwartz, A. L., Towsley, G., Dudley, W., & Barsevick, A. (2004). Psychometric evaluation of the Pittsburgh Sleep Quality Index in cancer patients. *Journal of pain and symptom management*, 27(2), 140-148.
 25. Tian, L., Lin, L., Li, H. L., Chen, K. J., Zhang, X. J., Qian, S. J., & Hu, Y. (2016). Prevalence and associated factors of cancer-related fatigue among cancer patients in eastern China. *The oncologist*, 21(11), 1349-1354..
 26. Iwase, S., Kawaguchi, T., Tokoro, A., Yamada, K., Kanai, Y., Matsuda, Y., ... & Yamaguchi, T. (2015). Assessment of cancer-related fatigue, pain, and quality of life in cancer patients at palliative care team referral: a multicenter observational study (JORTC PAL-09). *PloS one*, 10(8), e0134022.
 27. Fabi, A., Bhargava, R., Fatigoni, S., Guglielmo, M., Horneber, M., Roila, F., ... & ESMO Guidelines Committee. (2020). Cancer-related fatigue: ESMO Clinical Practice Guidelines for diagnosis and treatment. *Annals of oncology*, 31(6), 713-723.
 28. Amarsheda, S., & Bhise, A. R. (2022). Systematic review of cancer-related fatigue instruments in breast cancer patients. *Palliative & supportive care*, 20(1), 122-128.
 29. Piper, B. F., Borneman, T., Sun, V. C. Y., Koczywas, M., Uman, G., Ferrell, B., & James, R. L. (2008). Assessment of cancer-related fatigue: role of the oncology nurse in translating NCCN assessment guidelines into practice. *Clinical journal of oncology nursing*, 12(5 0), 37.
 30. Buysse, D. J., Reynolds III, C. F., Monk, T. H., Ber- man, S. R., & Kupfer, D. J. (1989). The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry research*, 28(2), 193-213..
 31. Wondie, Y., Mehnert, A., & Hinz, A. (2020). The hos- pital anxiety and depression scale (HADS) applied to Ethiopian cancer patients. *PloS one*, 15(12), e0243357.
 32. Velinova, S., Kazlauskaitė, R., Aguirre, R., Zarei, K., Hussein, L. P., Rogowski, W., ... & Lad, T. E. (2013). The relationship between performance status and sleep quality in cancer patients.
 33. Bower, J. E. (2014). Cancer-related fatigue—mecha- nisms, risk factors, and treatments. *Nature reviews Clinical oncology*, 11(10), 597-609.
 34. Zhou, T., Wang, Z., Qiao, C., Wang, S., Hu, S., Wang, X., ... & Hou, W. (2023). Sleep disturbances and the risk of lung cancer: a meta-epidemiological study. *BMC cancer*, 23(1), 884.
 35. Basharpour, S., Darzi, A. N., Muslimi, D., Daneshvar, S., & Jobson, L. (2025). Mindfulness-Based Cancer Recov- ery (MBCR) training: the efficacy on fatigue and sleep qual- ity of Iranian female patients with cancer. *Supportive Care in Cancer*, 33(1), 53.
 36. Dhruva, A., Miaskowski, C., Abrams, D., Acree, M., Cooper, B., Goodman, S., & Hecht, F. M. (2012). Yoga breathing for cancer chemotherapy-associated symptoms and quality of life: results of a pilot randomized controlled trial. *The journal of alternative and complementary medi- cine*, 18(5), 473-479.
 37. Momayyezi, M., Fallahzadeh, H., Farzaneh, F., & Mo- mayyezi, M. (2021). Sleep quality and cancer-related fa- tigue in patients with cancer. *Journal of Caring Sciences*, 10(3), 145.
 38. Dunwoody, L., AFBPsS, C., & Hacker, E. Fatigue and Sleep Disturbance in Arabic Cancer Patients Following Completion of Therapy: Prevalence, Correlates and Associ- ation with Quality of Life.
 39. Hendy, A., Ibrahim, R. K., Darwish, A., Al Sabbah, S., Shalby, A. Y. M., Khubrani, R., ... & Wahba, N. M. I. (2025). Sleep disturbance, cancer-related fatigue, and depression as determinants of quality of life among breast cancer patients undergoing chemotherapy: a cross-sectional study. *BMC cancer*, 25(1), 1122.
 40. Lankes, H. A., Roscoe, J., Morrow, G. R., Banerjee, T. K., Issel, B., & Kirshner, J. J. (2006). The relationship between sleep disturbance and cancer-related fatigue in breast cancer patients receiving chemotherapy. *Cancer Epi- demiology Biomarkers & Prevention*, 15(12_Supplement), B56-B56.
 41. Liu, L., Rissling, M., Natarajan, L., Fiorentino, L., Mills, P. J., Dimsdale, J. E., ... & Ancoli-Israel, S. (2012). The longitudinal relationship between fatigue and sleep in breast cancer patients undergoing chemotherapy. *Sleep*, 35(2), 237-245.
 42. Bischel, L. E., Ritchie, C., Kober, K. M., Paul, S. M., Cooper, B. A., Chen, L. M., ... & Miaskowski, C. (2016). Age differences in fatigue, decrements in energy, and sleep disturbance in oncology patients receiving chemotherapy. *European Journal of Oncology Nursing*, 23, 115-123..
 43. Mansano-Schlosser, T. C., & Ceolim, M. F. (2012). Factors associated with sleep quality in the elderly receiving chemotherapy. *Revista latino-americana de enfermagem*, 20, 1100-1108..
 44. Bhatia, S., Landier, W., Paskett, E. D., Peters, K. B., Merrill, J. K., Phillips, J., & Osarogiagbon, R. U. (2022). Rural-urban disparities in cancer outcomes: opportunities for future research. *JNCI: Journal of the National Cancer Institute*, 114(7), 940-952.
 45. Page, L. L., Kahn, C. J., Severson, J., Kramer, A. F.,

- McAuley, E., & Ehlers, D. K. (2023). Physical activity and cognitive function: A comparison of rural and urban breast cancer survivors. *PloS one*, 18(4), e0284189.
46. Rafie, C., Ning, Y., Wang, A., Gao, X., & Houlihan, R. (2018). Impact of physical activity and sleep quality on quality of life of rural residents with and without a history of cancer: findings of the Day and Night Study. *Cancer management and research*, 5525-5535.
 47. Echchikhi, Y., El-Abbassi, S., Touil, A., Kacemi, H., El-Majjaoui, S., Kebdani, T., & Benjafaar, N. (2017). Sleep disorders and sleep quality in Moroccan adult patients with cancer during treatment. *J Cancer Sci Ther*, 9(09), 637-643.
 48. Cui, C., & Wang, L. (2024). Role of social support in the relationship between resilience and sleep quality among cancer patients. *Frontiers in Psychiatry*, 15, 1310118.
 49. Kirca, N., Adibelli, D., Toptas, T., & Yilmaz, S. (2025). Perceived social support, fatigue, and sleep quality in women treated for gynecological cancer: a cross-sectional study. *Supportive Care in Cancer*, 33(7), 1-14.
 50. Abebe, E., Giru, B. W., & Boka, A. (2023). Sleep quality and associated factors among adult cancer patients on treatments at tikur anbessa specialized hospital oncology unit, Addis Ababa, Ethiopia, 2021. *Cancer Control*, 30, 10732748231160129.
 51. Hu, Y., Xiao, L. D., Tang, C., Cao, W., & Wang, Y. (2024). Prevalence and risk factors of sleep disturbances among patients with lung cancer: systematic review and meta-analysis. *Supportive care in cancer : official journal of the Multinational Association of Supportive Care in Cancer*, 32(9), 619. <https://doi.org/10.1007/s00520-024-08798-4>
 52. Al-Habsi, Z.R.S., Sleep Quality, Cancer-Related Fatigue and Health-Related Quality of Life Among Hospitalized Patients with Cancer in Oman. 2020, Sultan Qaboos University (Oman).
 53. Yarosh, R.A., Sleep disturbances among cancer survivors. 2023. 87: p. 102471.
 54. Burch, J. B., Delage, A. F., Zhang, H., McLain, A. C., Ray, M. A., Miller, A., Adams, S. A., & Hébert, J. R. (2024). Sleep disorders and cancer incidence: examining duration and severity of diagnosis among veterans. *Frontiers in oncology*, 14, 1336487. <https://doi.org/10.3389/fonc.2024.1336487>
 55. He, C., He, Y., Yang, T., Wu, C., Lin, Y., Yan, J., Chang, W., Chang, F., Wang, Y., Wu, S., & Cao, B. (2023). Relationship of sleep-quality and social-anxiety in patients with breast cancer: a network analysis. *BMC psychiatry*, 23(1), 887. <https://doi.org/10.1186/s12888-023-05262-1>
 56. Kanter, N. G., Cohen-Woods, S., Balfour, D. A., Burt, M. G., Waterman, A. L., & Koczwara, B. (2024). Hypothalamic-Pituitary-Adrenal Axis Dysfunction in People With Cancer: A Systematic Review. *Cancer medicine*, 13(22), e70366. <https://doi.org/10.1002/cam4.70366>.
 57. Huang, C.-Y., Resilience, coping styles, sleep disturbances, depression and anxiety in females with breast cancer. 2016.
 58. Ayalew, M., Deribe, B., Duko, B., Geleta, D., Bogale, N., Gemechu, L., Gebretsadik, A., & Bedaso, A. (2022). Prevalence of depression and anxiety symptoms and their determinant factors among patients with cancer in southern Ethiopia: a cross-sectional study. *BMJ open*, 12(1), e051317. <https://doi.org/10.1136/bmjopen-2021-051317>
 59. Javan Biparva, A., Global depression in breast cancer patients: Systematic review and meta-analysis. 2023. 18(7): p. e0287372.