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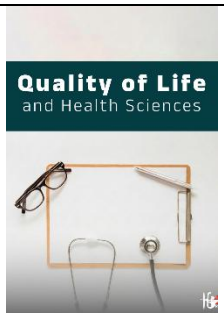

Depression, Sleep Quality, and Quality of Life Among Patients With Cancer: A Structural Equation Modeling Study With Sleep Quality as a Mediator

Ivana. Radonjić[1], Budi. Santoso[2*], Carlos. Menjívar[3]

[1] Department of Psychology, University of Montenegro, Podgorica, Montenegro
[2] Department of Environmental Psychology, Universitas Indonesia, Depok, Indonesia
[3] Department of Psychology, University of El Salvador, San Salvador, El Salvador

*** Corresponding author email address**: budi.santoso@ui.ac.id

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A B S T R A C T

Objective: This study aimed to examine the relationship between depression and quality of life among patients with cancer in Indonesia and to determine whether sleep quality mediates this relationship.

Methods and Materials: This cross-sectional correlational study was conducted using a structural equation modeling approach. The participants were 386 adult patients with confirmed cancer diagnoses who were receiving oncology services in Indonesia. Participants were selected through convenience sampling based on inclusion and exclusion criteria. Depression was assessed using the Patient Health Questionnaire-9, sleep quality was measured using the Pittsburgh Sleep Quality Index, and quality of life was evaluated using the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Core 30. Data were analyzed using SPSS version 27 and AMOS version 24. Pearson correlation analysis was used to examine bivariate associations among the main variables, and structural equation modeling was applied to test the hypothesized mediation model. The indirect effect of depression on quality of life through sleep quality was examined using bootstrapping with 5,000 resamples and 95% bias-corrected confidence intervals.

Findings: The inferential findings showed that depression was significantly and positively associated with poor sleep quality and significantly and negatively associated with global quality of life. Sleep quality was also significantly and negatively associated with global quality of life. The structural model demonstrated good fit to the data, $\chi^2/df = 2.14$, CFI = 0.96, TLI = 0.94, RMSEA = 0.054, and SRMR = 0.041. Depression had a significant positive direct effect on sleep quality ($\beta = 0.61$, $p < 0.001$), sleep quality had a significant negative direct effect on quality of life ($\beta = -0.47$, $p < 0.001$), and depression had a significant negative direct effect on quality of life ($\beta = -0.30$, $p < 0.001$). The indirect effect of depression on quality of life through sleep quality was significant ($\beta = -0.29$, $p < 0.001$), confirming partial mediation.

Conclusion: Sleep quality is therefore an important modifiable mechanism in the relationship between depressive symptoms and quality of life. Integrating depression screening and sleep-focused interventions into oncology care may improve patients' overall well-being and functioning.

Keywords: *Cancer; Depression; Sleep Quality; Quality of Life; Structural Equation Modeling; Mediation; Psycho-oncology.*

1. Introduction

Cancer is not only a life-threatening physical disease but also a multidimensional condition that disrupts psychological stability, sleep regulation, daily functioning, interpersonal roles, and overall quality of life. Advances in diagnosis and treatment have improved survival for many cancer types, yet patients frequently continue to experience persistent psychological and behavioral symptoms across the disease trajectory. These symptoms may begin at diagnosis, intensify during active treatment, and continue into survivorship or palliative phases. Among the most common and clinically important concerns are depression, poor sleep quality, fatigue, pain, anxiety, cognitive changes, and reduced health-related quality of life. Contemporary psycho-oncology therefore emphasizes the need to understand cancer not only through biological markers and treatment response, but also through the subjective experiences that shape adaptation, functioning, and well-being. Psychological and behavioral interventions have increasingly been recognized as essential components of comprehensive cancer care because emotional distress, sleep disturbance, and impaired quality of life can influence treatment adherence, symptom burden, social functioning, and recovery expectations (Andersen et al., 2025).

Depression is one of the most prevalent psychological problems among patients with cancer and is often associated with greater symptom severity, poorer treatment tolerance, reduced motivation for self-care, and impaired quality of life. The experience of cancer may generate depressive symptoms through multiple pathways, including fear of disease progression, uncertainty about survival, treatment-related adverse effects, body image concerns, financial burden, family role disruption, pain, fatigue, and loss of perceived control. Depression in oncology populations is rarely isolated from other symptoms; rather, it often appears as part of a broader symptom cluster involving sleep problems, anxiety, fatigue, pain, and cognitive complaints. Studies in patients with breast cancer have shown that anxiety and depression are associated with clinical and genetic factors, suggesting that depressive symptoms in cancer are shaped by both psychosocial and biological vulnerabilities (Hajj et al., 2021). Similarly, low resilience has been identified as a factor influencing anxiety, depression, and quality of life in patients with cancer, highlighting the importance of psychological resources in determining how patients respond to illness-related stressors (Li et al., 2025).

Sleep disturbance is another highly prevalent and clinically meaningful problem among patients with cancer. Sleep problems in this population may include difficulty initiating sleep, frequent nighttime awakening, early morning awakening, non-restorative sleep, irregular sleep-wake patterns, daytime dysfunction, and sleep dissatisfaction. Systematic evidence indicates that sleep disorders are common across cancer populations and may be influenced by tumor-related factors, treatment effects, psychological distress, pain, endocrine changes, hospitalization, and lifestyle disruption (Büttner-Teleagă et al., 2021). Cancer patients may sleep poorly for multiple reasons, including physical discomfort, treatment toxicity, emotional arousal, fear, nocturnal symptoms, medication effects, and changes in daily activity patterns (Strik et al., 2021). In breast cancer, patient-reported outcomes have shown that sleep disturbances are frequent and clinically relevant, supporting the need to include sleep assessment in routine oncology care (Faiz et al., 2024). Sleep disorder in breast cancer has also been conceptualized as a complex clinical phenomenon involving subjective sleep dissatisfaction, physiological dysregulation, emotional distress, and functional impairment (Aini et al., 2022).

The association between cancer and sleep disturbance is further complicated by treatment-related and hormonal mechanisms. Women surviving breast and gynecological cancers may experience insomnia related to hormonal alterations, premature menopause, endocrine therapy, vasomotor symptoms, and reproductive health changes (Martella et al., 2025). Insomnia has also been identified as a modifiable but underestimated factor in ovarian cancer, where sleep disturbance may interact with fatigue, depression, and morbidity (Palagini, Miniati, Riemann, et al., 2021). In prostate cancer, androgen deprivation therapy has been discussed in relation to mood and cognitive function, indicating that cancer treatment may affect psychological and neurocognitive domains beyond tumor control (Reiss et al., 2023). Longitudinal analysis of brain functions in men with prostate cancer under androgen deprivation therapy further supports the relevance of treatment-related neuropsychological changes in oncology care (Sánchez-Martínez et al., 2021). These findings collectively show that sleep quality and psychological symptoms are embedded within complex biological, hormonal, and treatment-related processes.

Circadian disruption provides an important explanatory framework for understanding why sleep problems are closely connected to psychological symptoms and quality of

life in cancer. Circadian rhythms regulate sleep-wake timing, endocrine secretion, immune activity, metabolism, mood, and cognitive performance. Cancer and its treatments can disrupt circadian organization through inflammation, hospitalization, reduced daylight exposure, physical inactivity, medication schedules, stress, and treatment-related fatigue. Circadian disruption has been linked with cancer- and treatment-related symptoms, suggesting that sleep and circadian rhythm disturbances may contribute to broader symptom burden among patients with cancer (Amidi & Wu, 2022). Circadian, hormonal, and sleep rhythms may also have implications for cancer progression and treatment response, further demonstrating that sleep is not merely a secondary complaint but a biologically meaningful dimension of cancer care (Jagielo et al., 2023). From this perspective, sleep quality can be understood as both an outcome of cancer-related distress and a potential mechanism through which psychological distress affects quality of life.

A growing body of research has examined the relationship between depression and sleep quality among oncology patients. Among Iranian women with breast cancer, depression and sleep quality were found to be closely related, suggesting that depressive symptoms may be accompanied by poorer sleep and greater functional burden (Shorofi et al., 2021). In patients with head and neck squamous cell carcinoma, pain, anxiety, and depressive symptoms have been associated with sleep outcomes, indicating that sleep quality is influenced by both physical symptoms and psychological distress (Kayahara et al., 2025). In oral cancer survivors, sleep disorders have been linked with psychological profiles, further confirming the interaction between emotional distress and sleep disturbance in cancer survivorship (Gasparro et al., 2021). Insomnia symptoms have also been observed over several years among premenopausal women with breast cancer, with evidence that sleep disturbance may persist beyond the immediate treatment period (Hery et al., 2023). Therefore, sleep disturbance in cancer is not simply an acute reaction to diagnosis or treatment; it may become a continuing problem that shapes long-term quality of life.

The relationship between sleep quality and quality of life is especially important in oncology because poor sleep can impair daytime functioning, emotional regulation, pain tolerance, fatigue recovery, social engagement, and perceived health. Research outside oncology also supports the broader association between insomnia severity and reduced quality of life, indicating that sleep disturbance has transdiagnostic consequences for functioning and well-being (Li & Wei, 2025). Among hospice family caregivers, insomnia symptoms have been associated with mental health, physical health, quality of life, and burden, illustrating that sleep disturbance affects not only patients but also the broader care environment surrounding serious illness (Starr et al., 2022). In perimenopausal and postmenopausal women, anxiety and depression have been shown to mediate the relationship between vasomotor symptoms and sleep quality, suggesting that psychological mechanisms may explain how physical symptoms influence sleep and well-being (Zhou et al., 2021). These findings reinforce the need to examine sleep quality within an integrated biopsychosocial model rather than as an isolated symptom.

Several studies and reviews have emphasized the importance of developing targeted interventions for insomnia and psychological distress in cancer care. Internet-based cognitive behavioral therapy has been discussed as a promising approach for improving psychological states in patients with cancer, particularly because digital interventions may increase accessibility for patients who face treatment fatigue, transportation barriers, or limited psychosocial services (Bai, 2023). Cognitive-behavioral therapy may also contribute to improved quality of life after breast cancer treatment, especially when educational components help patients understand and manage their symptoms (Majcher et al., 2023). Telehealth programs have shown potential benefits for the mental health of women with breast cancer, supporting remote psychosocial support as a clinically relevant strategy in modern oncology care (Koç et al., 2022). Cancer survivor support services have similarly been associated with reduced distress in South Korea, first in pilot work and later in a nationwide prospective study, indicating the value of structured survivorship support systems for psychological adjustment (Lee et al., 2021; Lee et al., 2022).

Non-pharmacological and pharmacological approaches to sleep and mood management also provide important context for studying depression, sleep quality, and quality of life. Non-pharmacological approaches to insomnia management, including behavioral and cognitive strategies, have been emphasized because they may reduce sleep problems without adding medication burden (Chan et al., 2021). Newer intervention models, such as bilateral transcutaneous auricular vagus nerve stimulation, have also been explored for insomnia in breast cancer, reflecting increasing interest in innovative methods for improving

sleep among oncology patients (Do et al., 2025). The prediction of sleep quality in cancer survivors based on arousal, pain, and worry, with dysfunctional beliefs and attitudes about sleep as mediators, further highlights the cognitive and emotional processes that may maintain poor sleep after cancer diagnosis and treatment (Amani et al., 2025). Although not specific to oncology, symptom-management literature in severe chronic illness has also considered treatments such as mirtazapine for co-occurring physical and psychological symptoms, showing clinical interest in integrated management of sleep, mood, appetite, and distress in medically vulnerable populations (Evoh et al., 2024). Hypothetical models have likewise proposed multi-target approaches for insomnia, depression, and related biological risks in postmenopausal women, reinforcing the conceptual overlap among sleep, mood, and physical health (Yardımcı et al., 2021).

The psychosocial impact of cancer is not limited to adult patients; it also affects families and caregivers. Pediatric leukemia, for example, has been shown to influence maternal anxiety, depression, sleep quality, and physical activity, demonstrating that cancer-related distress can extend beyond the patient and shape family health patterns (Dąbrowska et al., 2025). This broader family context is important because patients' quality of life is often embedded in caregiving relationships, family support, and household adaptation to illness. At the same time, psychometric research on sleep measures, such as the Pittsburgh Sleep Quality Index among childhood cancer survivors, indicates the continuing need for valid tools to assess sleep quality across cancer-related populations and cultural contexts (Ho et al., 2021). Accurate measurement is particularly important in structural equation modeling because the validity of conclusions about mediation depends on reliable assessment of depression, sleep quality, and quality of life.

Despite increasing attention to depression and sleep disturbance in cancer, important conceptual and methodological gaps remain. Many studies examine depression, insomnia, or quality of life separately, while fewer studies test integrated explanatory models that clarify how these variables interact. Theoretical and clinical work has proposed a self-reinforcing feedback loop among insomnia, fatigue, and depression in cancer, suggesting that poor sleep may intensify emotional distress while depression may worsen sleep regulation, producing cumulative impairment in daily functioning and quality of life (Palagini, Miniati, Massa, et al., 2021). Real-world evidence also indicates that insomnia among cancer patients requires optimized and tailored treatment approaches, which depends on understanding the pathways linking sleep disturbance with psychological and functional outcomes (Pinucci et al., 2023). Moreover, population-based evidence has linked insomnia, depressive disorders, and mood disorders with breast cancer risk, further emphasizing the close epidemiological relationship among sleep, mood, and oncology-related outcomes (Liu et al., 2021).

Quality of life is a central outcome in cancer research because it reflects the patient's subjective evaluation of physical functioning, emotional well-being, social participation, symptom burden, and global health. Depression can reduce quality of life directly by diminishing hope, motivation, emotional stability, self-efficacy, and perceived control. However, depression may also reduce quality of life indirectly by worsening sleep quality. Poor sleep can increase fatigue, pain sensitivity, irritability, cognitive difficulty, and daytime dysfunction, thereby creating an additional pathway from emotional distress to reduced quality of life. A mediation framework is therefore appropriate because it allows researchers to determine whether sleep quality explains part of the relationship between depression and quality of life. Structural equation modeling is particularly useful for this purpose because it enables simultaneous estimation of direct and indirect effects and provides a comprehensive test of the hypothesized model.

In Indonesia, where cancer care is delivered across diverse clinical, cultural, geographic, and socioeconomic contexts, understanding psychological and sleep-related determinants of quality of life is especially important. Patients may face barriers related to access to psychosocial services, financial stress, transportation, family responsibility, and variability in supportive care resources. These contextual factors make it necessary to identify modifiable mechanisms that can guide screening and intervention. If sleep quality significantly mediates the association between depression and quality of life, then sleep assessment and sleep-focused intervention may become essential components of psycho-oncology care. Such evidence would support integrated clinical pathways in which depressive symptoms and sleep disturbance are assessed together rather than separately. It would also provide a stronger empirical basis for interventions designed to improve quality of life by targeting both emotional distress and sleep regulation.

The aim of this study was to examine the relationship between depression and quality of life among patients with

cancer in Indonesia and to test the mediating role of sleep quality in this relationship using structural equation modeling.

2. Methods and Materials

2.1. Study Design and Participants

This study was conducted using a cross-sectional correlational design with a structural equation modeling approach to examine the direct and indirect relationships among depression, sleep quality, and quality of life in patients with cancer. Sleep quality was considered as the mediating variable in the relationship between depression and quality of life. The study population consisted of adult patients with confirmed cancer diagnoses who were receiving outpatient or inpatient oncology services in Indonesia. Participants were recruited from oncology wards and chemotherapy clinics affiliated with major public hospitals in Jakarta and Surabaya between March and July 2025. A total of 386 patients with cancer participated in the study. This sample size was considered adequate for structural equation modeling because it exceeded the recommended minimum ratio of participants to estimated parameters and provided sufficient statistical power for testing direct and mediated pathways.

Participants were selected through convenience sampling based on predetermined eligibility criteria. The inclusion criteria were being 18 years of age or older, having a confirmed diagnosis of cancer by an oncologist, being aware of the diagnosis, receiving active treatment or follow-up care, having the ability to read and understand Bahasa Indonesia, and providing written informed consent. Patients were included regardless of cancer type or stage in order to obtain a clinically heterogeneous sample reflecting the diversity of cancer experiences in oncology care settings. The exclusion criteria were severe cognitive impairment, acute psychiatric crisis, severe physical deterioration preventing questionnaire completion, documented neurological disorders affecting sleep or communication, and unwillingness to continue participation. Before data collection, the objectives and procedures of the study were explained to all eligible patients, and participants were assured that their responses would remain confidential and would not affect their treatment. Participation was voluntary, and patients were informed that they could withdraw from the study at any stage without any consequences for their medical care.

2.2. Measures

A demographic and clinical information form was used to collect background characteristics of the participants. This form included age, gender, marital status, educational level, employment status, cancer type, cancer stage, duration since diagnosis, current treatment modality, history of surgery, chemotherapy or radiotherapy status, and presence of comorbid medical conditions. Clinical information was obtained through patient self-report and, where necessary, was confirmed using available medical records. The purpose of collecting these variables was to describe the sample and to control for clinically relevant factors that could influence depression, sleep quality, and quality of life among patients with cancer.

Depression was measured using the Patient Health Questionnaire-9. The PHQ-9 was developed by Kroenke, Spitzer, and Williams in 2001 as a brief self-report instrument for assessing depressive symptoms based on diagnostic criteria for major depressive disorder. The questionnaire contains 9 items evaluating the frequency of depressive symptoms during the previous two weeks, including low mood, loss of interest, sleep disturbance, fatigue, appetite changes, feelings of worthlessness or guilt, concentration problems, psychomotor changes, and suicidal ideation. Each item is scored on a four-point Likert scale from 0 to 3, where 0 indicates “not at all” and 3 indicates “nearly every day.” The total score ranges from 0 to 27, with higher scores indicating more severe depressive symptoms. Conventional score categories classify depression severity as minimal, mild, moderate, moderately severe, and severe. In the present study, the total PHQ-9 score was used as the observed indicator of depression severity in the structural model. The PHQ-9 has demonstrated acceptable validity and reliability in medical and oncology populations and has been widely used in studies involving chronic illness and cancer patients.

Sleep quality was assessed using the Pittsburgh Sleep Quality Index. The PSQI was developed by Buysse and colleagues in 1989 to evaluate subjective sleep quality and sleep disturbances over the previous month. The instrument consists of 19 self-rated items that generate seven component scores, including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. Each component is scored from 0 to 3, and the sum of the seven components produces a global score ranging from 0 to 21. Higher scores indicate poorer sleep

quality. A global score greater than 5 is commonly interpreted as indicating poor sleep quality. In this study, the global PSQI score was used to represent sleep quality, with higher scores reflecting greater sleep problems. The PSQI was selected because sleep disturbance is common among patients with cancer and because the instrument provides a comprehensive evaluation of both nocturnal sleep characteristics and daytime consequences of poor sleep. Previous studies have confirmed the psychometric adequacy of the PSQI in clinical populations, including patients with cancer and other chronic diseases.

Quality of life was measured using the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Core 30. The EORTC QLQ-C30 was developed by Aaronson and colleagues in 1993 as a cancer-specific instrument for evaluating health-related quality of life among patients with cancer. The questionnaire includes 30 items and assesses a global health status/quality of life scale, five functional domains, three symptom scales, and several single-item symptom and financial difficulty measures. The functional domains include physical functioning, role functioning, emotional functioning, cognitive functioning, and social functioning. The symptom domains include fatigue, pain, nausea and vomiting, dyspnea, insomnia, appetite loss, constipation, diarrhea, and financial difficulties. Most items are scored on a four-point Likert scale from 1 to 4, while the global health status items are scored on a seven-point scale from 1 to 7. Scores are linearly transformed to a scale from 0 to 100 according to the scoring manual. Higher scores on the global health status and functioning scales indicate better quality of life and better functioning, whereas higher scores on the symptom scales indicate greater symptom burden. In the present study, the global health status/quality of life score was used as the primary outcome variable in the structural equation model. The EORTC QLQ-C30 was chosen because it is specifically designed for cancer populations and has shown strong validity and reliability across different cultural and clinical settings.

2.3. Data Analysis

Data were analyzed using SPSS version 27 and AMOS version 24. Before conducting the main analyses, all questionnaires were screened for completeness, missing values, outliers, and response inconsistencies. Cases with extensive missing data were excluded from the analysis, while minor missing values were handled using expectation-maximization procedures when the pattern of missingness was random. Descriptive statistics, including frequency, percentage, mean, standard deviation, minimum, and maximum, were calculated to summarize demographic characteristics, clinical variables, depression scores, sleep quality scores, and quality of life scores. The normality of the main study variables was examined using skewness and kurtosis indices, histogram inspection, and the Kolmogorov–Smirnov test. Multicollinearity was assessed using tolerance and variance inflation factor values. Pearson correlation coefficients were calculated to examine the bivariate associations among depression, sleep quality, and quality of life before testing the structural model.

Structural equation modeling was used to evaluate the hypothesized mediation model in which depression was specified as the independent variable, sleep quality as the mediator, and quality of life as the dependent variable. The model tested the direct effect of depression on quality of life, the effect of depression on sleep quality, the effect of sleep quality on quality of life, and the indirect effect of depression on quality of life through sleep quality. Maximum likelihood estimation was used to estimate model parameters. Model fit was evaluated using several standard fit indices, including the chi-square statistic divided by degrees of freedom, the comparative fit index, the Tucker–Lewis index, the goodness-of-fit index, the root mean square error of approximation, and the standardized root mean square residual. A chi-square divided by degrees of freedom value below 3, comparative fit index and Tucker–Lewis index values of 0.90 or higher, root mean square error of approximation values below 0.08, and standardized root mean square residual values below 0.08 were considered indicators of acceptable model fit.

The mediating role of sleep quality was examined using the bootstrapping method with 5,000 resamples and 95% bias-corrected confidence intervals. The indirect effect was considered statistically significant when the confidence interval did not include zero. Standardized regression coefficients were reported to determine the strength and direction of the relationships among the study variables. The level of statistical significance was set at $p < 0.05$ for all analyses. In addition, internal consistency reliability was evaluated using Cronbach's alpha coefficients for the PHQ-9, PSQI, and EORTC QLQ-C30 scales. Ethical approval for the study was obtained from the relevant institutional ethics committee in Indonesia, and all procedures were conducted in accordance with ethical principles for research involving human participants.

3. Findings and Results

The final sample consisted of 386 patients with cancer who were receiving oncology-related services in Indonesia. The mean age of the participants was 52.46 years with a standard deviation of 11.38, and the age range was from 21 to 78 years. In terms of gender distribution, 225 participants were women, representing 58.3% of the sample, and 161 participants were men, representing 41.7%. Regarding marital status, 301 participants were married, 39 were single, 28 were widowed, and 18 were divorced. In terms of educational level, 64 participants had primary education, 112 had secondary education, 138 had diploma or undergraduate education, and 72 had postgraduate education. With respect to employment status, 139 participants were employed, 97 were unemployed, 86 were retired, and 64 were homemakers. The most frequently reported cancer types were breast cancer, colorectal cancer, lung cancer, gynecological cancers, hematological malignancies, head and neck cancers, and other cancer diagnoses. Specifically, 96 participants had breast cancer, 73 had colorectal cancer, 54 had lung cancer, 52 had gynecological cancers, 39 had hematological malignancies, 30 had head and neck cancers, and 42 had other forms of cancer. Regarding cancer stage, 47 participants were in stage I, 113 were in stage II, 146 were in stage III, and 80 were in stage IV. The mean duration since diagnosis was 27.83 months with a standard deviation of 18.64. In terms of treatment status, 227 participants were receiving chemotherapy, 65 had undergone surgery with adjuvant follow-up treatment, 49 were receiving radiotherapy, and 45 were receiving targeted therapy, hormonal therapy, immunotherapy, or combined treatment regimens. These demographic and clinical characteristics indicate that the sample included patients with diverse cancer diagnoses, disease stages, and treatment experiences, thereby providing an appropriate basis for examining psychological symptoms, sleep quality, and quality of life in a heterogeneous oncology population.

Table 1

Descriptive Statistics, Distribution Indices, and Internal Consistency of the Main Study Variables

Variable	Possible score range	Observed range	Mean	Standard deviation	Skewness	Kurtosis	Cronbach's alpha
Depression	0–27	0–26	11.84	5.76	0.42	-0.38	0.89
Sleep quality	0–21	1–19	8.91	3.62	0.31	-0.49	0.86
Global quality of life	0–100	16.67–100.00	57.36	19.84	-0.22	-0.57	0.88
Physical functioning	0–100	13.33–100.00	61.27	21.16	-0.29	-0.64	0.84
Role functioning	0–100	0.00–100.00	54.79	25.43	-0.18	-0.72	0.81
Emotional functioning	0–100	8.33–100.00	55.68	22.37	-0.16	-0.61	0.83
Cognitive functioning	0–100	16.67–100.00	64.12	20.75	-0.34	-0.46	0.79
Social functioning	0–100	0.00–100.00	58.44	24.18	-0.25	-0.69	0.82
Fatigue	0–100	0.00–100.00	48.71	23.62	0.19	-0.74	0.80
Pain	0–100	0.00–100.00	42.93	26.15	0.27	-0.86	0.78
Insomnia symptom score	0–100	0.00–100.00	51.64	29.37	0.12	-0.91	—

Table 1 presents the descriptive statistics, distribution characteristics, and internal consistency coefficients for the main psychological, sleep-related, and quality-of-life variables. The mean depression score was 11.84, indicating that, on average, participants experienced depressive symptoms in the mild-to-moderate range. The mean PSQI score was 8.91, which was above the commonly used cut-off point for poor sleep quality, suggesting that sleep problems were frequent among the patients. The mean global quality of life score was 57.36 on the transformed 0–100 scale, indicating a moderate level of perceived quality of life. Among the functioning dimensions of the EORTC QLQ-C30, cognitive functioning had the highest mean score, whereas role functioning showed the lowest mean score, suggesting that cancer and its treatment may have had a stronger impact on patients' ability to perform daily roles than on perceived cognitive functioning. The symptom scores also showed clinically meaningful levels of fatigue, pain, and insomnia-related complaints. Skewness and kurtosis values were within the acceptable range of -2 to +2 for all variables, indicating that the distribution of the variables did not substantially violate the assumption of normality. The Cronbach's alpha coefficients ranged from 0.78 to 0.89, demonstrating acceptable to excellent internal consistency reliability for the measurement instruments and their major domains. Overall, the descriptive findings indicate that the participants experienced notable depressive

symptoms and sleep disturbance, while reporting moderate impairments in global quality of life and functioning.

Table 2

Pearson Correlation Matrix Among Depression, Sleep Quality, and Quality of Life Variables

Variable	Depression	Sleep quality	Global quality of life	Physical functioning	Role functioning	Emotional functioning	Social functioning
Depression	1.00						
Sleep quality	0.61***	1.00					
Global quality of life	-0.58***	-0.64***	1.00				
Physical functioning	-0.46***	-0.51***	0.63***	1.00			
Role functioning	-0.43***	-0.48***	0.59***	0.56***	1.00		
Emotional functioning	-0.62***	-0.55***	0.66***	0.49***	0.52***	1.00	
Social functioning	-0.41***	-0.46***	0.57***	0.50***	0.54***	0.51***	1.00

Table 2 shows the Pearson correlation coefficients among depression, sleep quality, global quality of life, and selected functional dimensions of quality of life. Depression had a positive and statistically significant correlation with poor sleep quality, indicating that patients with higher depressive symptoms tended to report poorer sleep quality. Depression was also significantly and negatively correlated with global quality of life and all functional domains, meaning that higher depression was associated with lower perceived quality of life, poorer physical functioning, weaker role functioning, lower emotional functioning, and poorer social functioning. The strongest negative association between depression and quality-of-life dimensions was observed for emotional functioning, which is theoretically expected because depressive symptoms directly affect mood regulation, emotional stability, motivation, and psychological adjustment to illness. Sleep quality was also significantly and negatively correlated with global quality of life and all functional domains. Since higher PSQI scores indicate poorer sleep quality, these negative correlations show that poorer sleep was associated with lower global quality of life and reduced functioning. The strongest association involving sleep quality was observed with global quality of life, suggesting that sleep disturbance may be a central mechanism through which psychological distress is linked to diminished well-being in patients with cancer. The correlation matrix therefore supports the hypothesized direction of the structural model and provides preliminary evidence for examining sleep quality as a mediator between depression and quality of life.

Table 3

Model Fit Indices for the Structural Equation Model

Fit index	Obtained value	Recommended criterion	Interpretation
Chi-square	68.42	Lower values indicate better fit	Acceptable
Degrees of freedom	32	—	—
Chi-square/df	2.14	< 3.00	Good fit
Comparative Fit Index	0.96	≥ 0.90	Good fit
Tucker–Lewis Index	0.94	≥ 0.90	Good fit
Goodness-of-Fit Index	0.95	≥ 0.90	Good fit
Adjusted Goodness-of-Fit Index	0.92	≥ 0.90	Good fit
Root Mean Square Error of Approximation	0.054	< 0.08	Good fit
90% confidence interval for RMSEA	0.037–0.071	Lower bound and upper bound < 0.08 preferred	Acceptable
Standardized Root Mean Square Residual	0.041	< 0.08	Good fit

Table 3 presents the fit indices for the structural equation model examining the mediating role of sleep quality in the relationship between depression and quality of life. The chi-square value was statistically evaluated in relation to degrees of freedom, and the chi-square divided by degrees of freedom was 2.14, which is below the recommended threshold of 3.00 and indicates an acceptable level of model fit. Incremental fit indices also supported the adequacy of the

model, with the comparative fit index equal to 0.96 and the Tucker–Lewis index equal to 0.94. Both values exceeded the minimum recommended criterion of 0.90, suggesting that the hypothesized model provided a substantially better representation of the data than a null model. The goodness-of-fit index and adjusted goodness-of-fit index were 0.95 and 0.92, respectively, further confirming that the proposed model had an acceptable empirical structure. The root mean square error of approximation was 0.054, with a 90% confidence interval ranging from 0.037 to 0.071, indicating a good approximation of the model to the population covariance matrix. The standardized root mean square residual was 0.041, which was also below the recommended cut-off of 0.08. Taken together, these indices demonstrate that the hypothesized mediation model had good overall fit and was suitable for interpreting the direct and indirect pathways among depression, sleep quality, and quality of life.

Table 4

Standardized Direct Effects in the Structural Equation Model

Path	Unstandardized estimate	Standard error	Critical ratio	Standardized estimate	p-value	Interpretation
Depression → Sleep quality	0.38	0.027	14.07	0.61	<0.001	Significant positive effect
Sleep quality → Global quality of life	-2.58	0.224	-11.52	-0.47	<0.001	Significant negative effect
Depression → Global quality of life	-1.03	0.154	-6.69	-0.30	<0.001	Significant negative effect

Table 4 reports the standardized and unstandardized direct effects in the structural equation model. Depression had a significant positive direct effect on sleep quality, with a standardized coefficient of 0.61. Because higher scores on the PSQI indicate poorer sleep quality, this finding means that higher levels of depressive symptoms were associated with greater sleep disturbance among patients with cancer. The magnitude of this coefficient indicates a strong relationship between depression and sleep quality. Sleep quality also had a significant negative direct effect on global quality of life, with a standardized coefficient of -0.47. This result indicates that poorer sleep quality was associated with lower quality of life, even after accounting for depression. In practical terms, patients who reported more severe sleep problems were more likely to experience diminished overall health-related quality of life. Depression also maintained a significant negative direct effect on global quality of life, with a standardized coefficient of -0.30. This indicates that depressive symptoms continued to predict poorer quality of life even when the mediating role of sleep quality was included in the model. Therefore, the direct pathways suggest that depression affects quality of life both independently and through its association with sleep disturbance. The model explained 37% of the variance in sleep quality and 47% of the variance in global quality of life, demonstrating that depression and sleep quality together accounted for a substantial proportion of quality-of-life differences among patients with cancer.

Table 5

Bootstrap Analysis of the Indirect and Total Effects of Depression on Quality of Life Through Sleep Quality

Effect pathway	Unstandardized effect	Standardized effect	Standard error	95% lower confidence interval	95% upper confidence interval	p-value	Mediation result
Depression → Sleep quality → Global quality of life	-0.98	-0.29	0.126	-1.24	-0.75	<0.001	Significant indirect effect
Depression → Global quality of life	-1.03	-0.30	0.154	-1.34	-0.73	<0.001	Significant direct effect
Total effect of depression on global quality of life	-2.01	-0.59	0.181	-2.36	-1.66	<0.001	Significant total effect

Table 5 presents the results of the bootstrap mediation analysis using 5,000 resamples and bias-corrected 95% confidence intervals. The indirect effect of depression on global quality of life through sleep quality was statistically

significant, with an unstandardized indirect effect of -0.98 and a standardized indirect effect of -0.29. The 95% confidence interval for the indirect effect ranged from -1.24 to -0.75 and did not include zero, confirming that sleep quality significantly mediated the relationship between depression and quality of life. This finding indicates that part of the negative effect of depression on quality of life occurred because patients with higher depressive symptoms experienced poorer sleep quality, which in turn was associated with lower global quality of life. The direct effect of depression on global quality of life remained statistically significant after sleep quality was entered into the model, with a standardized coefficient of -0.30. The total effect of depression on global quality of life was also significant, with a standardized coefficient of -0.59. Since both the direct and indirect effects were significant, the findings support a partial mediation model rather than a full mediation model. This means that sleep quality explains an important portion of the association between depression and quality of life, but depressive symptoms also have an additional direct relationship with reduced quality of life that is not fully explained by sleep disturbance.

Figure 1

Standardized Structural Model of the Mediating Role of Sleep Quality in the Relationship Between Depression and Quality of Life Among Patients With Cancer

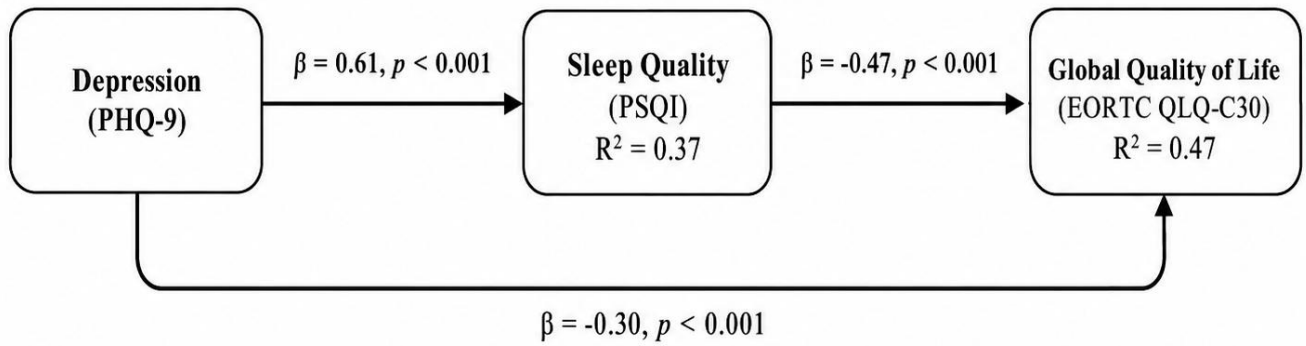

Figure 1 illustrates the standardized structural model tested in the study. In this model, depression was specified as the independent variable, sleep quality was specified as the mediating variable, and global quality of life was specified as the dependent variable. The standardized path from depression to sleep quality was positive and significant, showing that higher depressive symptoms predicted poorer sleep quality. The standardized path from sleep quality to quality of life was negative and significant, showing that poorer sleep quality predicted lower quality of life. The direct path from depression to quality of life was also negative and significant, indicating that depression had an independent adverse effect on quality of life even after the mediating role of sleep quality was considered. The figure therefore provides a visual representation of the partial mediation model and confirms that sleep quality is a meaningful mechanism linking depressive symptoms to reduced quality of life in patients with cancer. Overall, the findings demonstrate that depression, sleep quality, and quality of life are strongly interconnected in oncology patients, and that interventions targeting both depressive symptoms and sleep problems may be important for improving health-related quality of life in this population.

4. Discussion

The present study examined the relationship between depression, sleep quality, and quality of life among patients with cancer in Indonesia, with sleep quality tested as a mediating variable using structural equation modeling. The findings showed that patients experienced mild-to-moderate depressive symptoms, poor sleep quality, and moderate impairment in global quality of life. Correlation analysis indicated that depression was positively associated with poor sleep quality and negatively associated with global quality of life and functional domains. Sleep quality was also negatively associated with global quality of life, indicating that patients with poorer sleep reported lower perceived well-being and functioning. The structural model demonstrated good fit to the data, and all hypothesized paths

were statistically significant. Depression had a strong positive effect on poor sleep quality, poor sleep quality had a significant negative effect on quality of life, and depression retained a significant direct negative effect on quality of life. The bootstrap mediation analysis confirmed that sleep quality partially mediated the relationship between depression and quality of life. Therefore, the findings support a model in which depressive symptoms reduce quality of life both directly and indirectly by worsening sleep quality.

The significant association between depression and poor sleep quality is consistent with previous oncology research showing that emotional distress and sleep disturbance frequently co-occur in patients with cancer. Depression may increase sleep problems through rumination, physiological hyperarousal, illness-related worry, reduced daytime activity, hopelessness, and dysregulated sleep-wake routines. These mechanisms are compatible with evidence that arousal, pain, worry, and dysfunctional beliefs about sleep predict sleep quality among cancer survivors (Amani et al., 2025). The present findings also align with research among women with breast cancer showing a close relationship between depression and sleep quality (Shorofi et al., 2021). Similarly, studies in head and neck cancer and oral cancer survivors have reported that depressive symptoms, anxiety, pain, and psychological profile are associated with sleep outcomes, supporting the view that sleep disturbance in cancer is shaped by both psychological and somatic processes (Gasparro et al., 2021; Kayahara et al., 2025). In this regard, the strong path from depression to sleep quality in the present model confirms that depressive symptoms are not merely parallel symptoms but may represent a central psychological driver of sleep disruption in oncology patients.

The finding that poor sleep quality predicted lower quality of life is also supported by previous studies and theoretical models. Sleep disturbance may reduce quality of life by increasing fatigue, pain sensitivity, irritability, cognitive inefficiency, emotional instability, and daytime dysfunction. In cancer care, these effects are particularly important because patients already face treatment-related physical limitations and social role disruption. Systematic evidence has shown that sleep disorders are frequent among patients with cancer and are associated with a broad range of clinical and functional problems (Büttner-Teleagă et al., 2021). Other work has emphasized that cancer patients often sleep poorly because of multiple concurrent causes, including treatment effects, emotional distress, physical symptoms, and altered routines (Strik et al., 2021). Patient-reported outcome studies among patients with breast cancer further confirm that sleep disturbances are clinically meaningful and should be understood as part of the overall symptom burden that affects daily functioning and perceived health (Faiz et al., 2024). The present result therefore reinforces the importance of sleep quality as a key determinant of health-related quality of life in cancer populations.

The partial mediating role of sleep quality is one of the most important findings of this study. The significant indirect effect indicates that depression contributes to poorer quality of life partly through its adverse effect on sleep quality. Patients with higher depressive symptoms may experience greater insomnia, fragmented sleep, poor sleep efficiency, or daytime dysfunction, and these sleep problems may then intensify the decline in quality of life. This finding is consistent with theoretical and clinical perspectives describing insomnia, fatigue, and depression as part of a self-reinforcing feedback loop in cancer, in which emotional distress worsens sleep, poor sleep aggravates fatigue and functional impairment, and these consequences further intensify distress (Palagini, Miniati, Massa, et al., 2021). Evidence from ovarian cancer also supports the view that insomnia and circadian sleep disorders are underestimated modifiable factors that may contribute to morbidity and impaired well-being (Palagini, Miniati, Riemann, et al., 2021). Moreover, real-world research on insomnia among cancer patients highlights the need for tailored treatment approaches because sleep disturbance is often intertwined with psychological and physical symptoms (Pinucci et al., 2023). The present mediation result adds to this literature by showing statistically that sleep quality is a meaningful explanatory mechanism linking depression to quality of life.

At the same time, the persistence of a significant direct effect of depression on quality of life after including sleep quality suggests partial rather than full mediation. This means that sleep quality explains an important portion of the depression–quality-of-life relationship, but depression also affects quality of life through other pathways. Depressive symptoms may directly impair motivation, hope, emotional functioning, social participation, self-care, treatment engagement, and perception of illness burden. Prior research has shown that psychological resources such as resilience influence anxiety, depression, and quality of life in patients with cancer, supporting the idea that the effect of depression on quality of life cannot be reduced to sleep disturbance alone (Li et al., 2025). The relevance of psychological and

behavioral interventions in cancer care also supports the need to address depression as an independent clinical target rather than only as a cause of sleep problems (Andersen et al., 2025). Therefore, the present findings indicate that both depressive symptoms and sleep disturbance should be considered when designing strategies to improve quality of life.

The results are also consistent with broader evidence showing that sleep, mood, and cancer-related functioning are influenced by biological and treatment-related mechanisms. Circadian disruption has been identified as a contributor to cancer- and treatment-related symptoms, and disruption in circadian rhythms may affect sleep, fatigue, mood, and quality of life (Amidi & Wu, 2022). Circadian, hormonal, and sleep rhythms may also have implications for cancer progression and treatment, suggesting that sleep disturbance may reflect deeper biological dysregulation rather than simple nighttime discomfort (Jagielo et al., 2023). In women surviving breast and gynecological cancers, hormonal factors may contribute to insomnia and related distress (Martella et al., 2025). Similarly, treatment-related neuropsychological effects have been reported in prostate cancer, particularly in relation to androgen deprivation therapy, mood, and cognitive functioning (Reiss et al., 2023; Sánchez-Martínez et al., 2021). These findings help explain why cancer patients with depression may experience poorer sleep and lower quality of life through combined psychological, endocrine, circadian, and treatment-related pathways.

The present findings also align with evidence from specific cancer and survivorship populations. Sleep disorder in breast cancer has been conceptualized as a complex condition involving subjective sleep problems, emotional burden, and functional consequences (Aini et al., 2022). Longitudinal research among premenopausal women with breast cancer has shown that insomnia symptoms may persist over several years, indicating that sleep problems can continue beyond active treatment (Hery et al., 2023). Studies of cancer survivor support services have demonstrated positive effects on distress, suggesting that structured psychosocial support can reduce emotional burden among cancer survivors (Lee et al., 2021; Lee et al., 2022). The findings of the current study extend this evidence by showing that quality of life may be improved not only by reducing depression directly but also by identifying and treating sleep disturbance as a mediator. In addition, psychometric evidence supporting the Pittsburgh Sleep Quality Index among cancer-related populations reinforces the appropriateness of assessing sleep quality systematically in oncology research and practice (Ho et al., 2021).

The clinical implications of this mediation model are strengthened by intervention literature. Internet-based cognitive behavioral therapy has been described as a useful approach for improving psychological states among cancer patients, and cognitive-behavioral methods may improve quality of life after breast cancer treatment (Bai, 2023; Majcher et al., 2023). Telehealth programs have also shown potential for improving the mental health of women with breast cancer, which is particularly relevant for patients who face geographical, financial, or treatment-related barriers to face-to-face care (Koç et al., 2022). Non-pharmacological approaches to insomnia management have been recommended because they can target sleep behaviors and cognitions without increasing medication burden (Chan et al., 2021). Emerging approaches such as transcutaneous auricular vagus nerve stimulation have also been explored for insomnia in breast cancer, reflecting growing interest in innovative sleep-focused interventions (Do et al., 2025). These studies collectively support the practical interpretation of the present findings: sleep quality is a modifiable clinical target that may improve quality of life, especially when addressed alongside depressive symptoms.

Although the present study focused on patients with cancer, its findings are also coherent with broader research on insomnia, depression, and quality of life in related medical and caregiving contexts. Insomnia severity has been associated with lower quality of life in psychiatric outpatients, indicating that the sleep–quality-of-life relationship is transdiagnostic and clinically robust (Li & Wei, 2025). Among hospice family caregivers, insomnia symptoms have been associated with mental and physical health, quality of life, and caregiver burden, suggesting that sleep disturbance can affect the broader ecology of cancer care (Starr et al., 2022). Pediatric leukemia has also been shown to affect maternal anxiety, depression, sleep quality, and physical activity, demonstrating that cancer-related psychological and sleep disturbances extend beyond the patient and influence family systems (Dąbrowska et al., 2025). Moreover, research on menopausal symptoms has shown that anxiety and depression may mediate associations between physical symptoms and sleep quality, further supporting the interconnected nature of physical symptoms, emotional distress, and sleep disturbance (Zhou et al., 2021).

The results should also be interpreted in light of pharmacological and multi-target symptom management perspectives. Some models have proposed multi-target

treatments for overlapping insomnia, depression, and other health risks, indicating that mood and sleep are often best understood as interconnected clinical targets (Yardımcı et al., 2021). Symptom-management discussions in severe chronic illness have also considered medications such as mirtazapine for combined physical and psychological symptoms, reflecting the clinical need for integrated approaches when patients experience sleep problems, mood symptoms, appetite changes, or distress together (Evoh et al., 2024). Population-based evidence has further linked insomnia, depressive disorders, and mood disorders with breast cancer risk, suggesting that sleep and mood disturbances may have broader epidemiological importance in oncology-related health (Liu et al., 2021). These lines of evidence support the conclusion that depression and sleep quality should be assessed together in cancer care rather than treated as separate and unrelated concerns.

5. Conclusion

Overall, the present study contributes to psycho-oncology literature by empirically supporting a structural model in which sleep quality partially mediates the association between depression and quality of life among patients with cancer. The findings clarify that depression is associated with poorer quality of life directly and also indirectly through poorer sleep quality. This pattern provides evidence for an integrated clinical model in which emotional distress, sleep disturbance, and quality of life are mutually connected dimensions of the cancer experience. In practical terms, the results suggest that improving quality of life in oncology patients may require simultaneous attention to depressive symptoms and sleep quality. Screening for depression without assessing sleep may overlook an important pathway of impairment, while treating sleep problems without addressing depression may leave a major source of distress unresolved.

6. Limitations & Suggestions

This study had several limitations that should be considered when interpreting the findings. First, the cross-sectional design limits causal inference, and although structural equation modeling allows the testing of theoretically based pathways, it cannot establish temporal order among depression, sleep quality, and quality of life. Second, the study relied on self-report questionnaires, which may be influenced by recall bias, social desirability, current mood, fatigue, or misunderstanding of some items. Third, the sample was recruited from selected oncology care settings in Indonesia using convenience sampling, which may limit generalizability to all patients with cancer, particularly those in rural areas, private care settings, advanced palliative care, or different cultural and socioeconomic contexts. Fourth, the sample included heterogeneous cancer types, stages, and treatment modalities, which improves clinical diversity but may also obscure cancer-specific patterns of depression, sleep disturbance, and quality-of-life impairment.

Future studies should use longitudinal designs to clarify the temporal and causal relationships among depression, sleep quality, and quality of life across diagnosis, active treatment, survivorship, and palliative care phases. Researchers should also examine whether the mediating role of sleep quality differs according to cancer type, disease stage, treatment modality, gender, age, pain intensity, fatigue, social support, and resilience. Future research may benefit from combining subjective sleep measures with objective sleep assessments such as actigraphy or sleep diaries to provide a more comprehensive understanding of sleep disturbance. Intervention studies are also needed to test whether improving sleep quality can reduce the negative impact of depression on quality of life and whether combined depression-focused and sleep-focused interventions produce stronger effects than interventions targeting only one domain.

The findings suggest that oncology care teams should routinely assess depressive symptoms, sleep quality, and quality of life as interconnected clinical concerns rather than isolated problems. Nurses, physicians, psychologists, and supportive care providers should pay particular attention to patients who report both depressive symptoms and poor sleep, because this combination may place them at greater risk for impaired functioning and reduced well-being. Sleep education, behavioral sleep strategies, psychological counseling, stress management, pain control, and referral for specialized mental health care should be integrated into routine cancer care when needed. In clinical practice, improving sleep quality may represent a practical and modifiable pathway for enhancing quality of life, especially when sleep-focused care is combined with appropriate assessment and management of depression.

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Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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Authors' Contributions

All authors equally contributed to this article.

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