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RESEARCH

The level of fatigue, insomnia, depression, anxiety, stress, and the relationship between these symptoms following allogeneic hematopoietic stem cell transplantation: a cross-sectional study

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Abstract

Purpose This study investigated the incidence of fatigue, insomnia, depression, anxiety, and stress symptoms in patients after allogeneic hematopoietic stem cell transplantation (AHSCT), as well as explored potential relationships among these symptoms.

Methods A total of 126 patients who had undergone transplantation at a university hospital at least one month prior to the study's commencement were included. The study was conducted as a cross-sectional and relational research, and data were collected using the "Personal Information Form," "Brief Fatigue Inventory," "Insomnia Severity Index," and "Depression Anxiety Stress Scale." Statistical analyses included descriptive statistics, parametric and nonparametric tests, and correlation analyses using the Spearman Correlation Coefficient. Additionally, mediation analyses were conducted using a Structural Equation Model to explore potential causal relationships among the variables.

Results The incidence of fatigue was high among patients, with 94% experiencing this symptom following transplantation. Additionally, 52% had anxiety, 47% had insomnia, 47% had depression, and 34% had stress. Moderate relationships were observed between these symptoms. Regression analysis revealed that one-point increase in fatigue was associated with increases in stress 1.065 points, depression 0.937 points, anxiety 0.956 points, and insomnia 0.138 points ($p<0.001$). Similarly, one-point increase in insomnia was associated with increases in fatigue 3.342 points, stress 0.972 points, depression 0.885 points, and anxiety 0.816 points ($p<0.001$).

Conclusion After AHSCT, fatigue was the most frequent symptom experienced by patients, followed by insomnia, depression, anxiety, and stress. There was a relationship between these symptoms. Additionally, evidence suggested that insomnia was more strongly associated with fatigue compared to the other symptoms.

Keywords Allogeneic hematopoietic stem cell transplantation · Fatigue · Insomnia · Depression · Anxiety · Stress

Introduction

Allogeneic hematopoietic stem cell transplantation (AHSCT) is a therapeutic procedure that is increasingly being used to treat various diseases, particularly hematological malignancies [1]. However, AHSCT may lead to severe and persistent symptoms such as infections, fatigue, nausea and vomiting, mucositis, diarrhea, skin reactions, and acute or chronic Graft-versus-Host Disease (GVHD). Apart from acute side effects during the transplantation procedure, patients may experience persistent symptoms such as fatigue, insomnia, depression, anxiety, stress, and psychiatric conditions for months or even years following the procedure. Of the symptoms that occur as a result of cancer, fatigue is the most prevalent [2]. Reports have indicated that following

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AHSCT, fatigue can develop in 26% to 82.5% of patients [3–5]. The study by Costanzo et al. investigated both allogeneic and autologous hematopoietic stem cell transplantation (allo and auto HSCT) patients and found that 83.9% of patients experienced clinically significant fatigue in the first month, 68.4% in the third month, and 64.7% in the sixth month after AHSCT [4]. In studies examining individuals who underwent AHSCT transplantation, insomnia was observed in 34.3%-78.9% [3, 5, 6], depression in 13.6%-43.3% [7–9], anxiety in 14.9%-63% [5, 8–10], and stress in 17%-28.4% during or following transplantation [7–9].

According to a report by the National Institutes of Health Hematopoietic Cell Transplantation Late Effects Initiative Working Group, significant levels of fatigue, sleep disturbance, and depression have been reported following transplantation [10]. Based on the report's findings, the working group recommended that both disease-related and treatment-related symptoms, such as fatigue, insomnia, depression, and pain, should be evaluated before transplantation to better manage symptoms related to AHSCT and reduce its adverse effects. Furthermore, evaluations should also take place on the 100th day and one year after transplantation. The working group also recommended annual follow-up evaluations after the first year [10]. The study by Kuba et al. highlights the importance of understanding the interrelated symptoms that occur after allo and auto HSCT, in order to effectively plan care for the prevention, early recognition, and management of these symptoms [11]. Dodd et al. defined a symptom cluster as "the association of three or more simultaneous symptoms (such as pain, fatigue, insomnia)". This is essential for better understanding and managing symptoms reported in cancer patients [12]. The definition of a symptom cluster proposed by Kim et al. is "the coexistence of two or more related, co-occurring symptoms." [13]. Studies have indicated that cancer patients often experience multiple symptoms, and some of these symptoms are experienced together as clusters of symptoms (SCs) [14–16]. Chen et al. defined four symptom clusters as "Psychological SC", "pain-fatigue-sleep SC", "dry mouth-constipation SC", and "nutrition disorder SC" in adult acute leukemia patients undergoing chemotherapy. It has been reported that psychological symptom cluster is the most common and stressful among cancer patients [15]. The study by Pasyar et al. revealed a significant relationship between anxiety and pain, fatigue, nausea, and vomiting in allo and auto HSCT patients. Additionally, the study found that fatigue and pain were predictors of anxiety in these patients [17].

The primary goal of AHSCT is to increase patient survival and enhance their quality of life. However, complications and symptoms that may arise during and after the transplantation process may have a negative impact on the patient's quality of life. The role of nurses is crucial in managing patients' symptoms (such as nausea and vomiting, mucositis, and fatigue) and complications, providing patient education, ensuring safe drug use, and supporting palliative care during and after allo and auto HSCT [16]. The focus of this study was to investigate the occurrence and severity of fatigue, insomnia, depression, anxiety, and stress, as well as the potential interrelations between these symptoms in patients who underwent AHSCT.

Research questions

1. What is the incidence and severity of fatigue, insomnia, depression, anxiety, and stress one month or more following AHSCT?
2. Is there a relationship between fatigue, insomnia, depression, anxiety, and stress level?
3. Does the increase in the severity of insomnia increase the severity of fatigue, depression, anxiety, and stress?
4. Does the increase in the severity of fatigue increase the severity of insomnia, depression, anxiety, and stress?

Methods

Study type and sample

The study was conducted as a cross-sectional and correlational study from April 10 to May 10, 2022. The study population comprised 232 patients who underwent AHSCT and were treated in the Hematopoietic Stem Cell Transplantation Unit of a University Hospital Hematology Department between January 2010 and March 2022 and had at least 30 days of follow-up after transplantation. The entire population was attempted to be reached, and data were collected from a total of 126 patients who agreed to participate in the study, which constituted 54.3% of the population.

Study setting

The study was performed in the Hematopoietic Stem Cell Transplantation Unit of a university hospital in Turkey. This unit performed its first transplantation in 1992 and is a department that conducts an average of 75 AHSCTs and 70 autologous HSCTs each year. The unit has a total of 12 beds, and it is staffed with 18 physicians, 25 hematology and transplantation clinic nurses, two blood collection nurses, and one biopsy nurse. Every day, patients undergo evaluations that include physical examinations to assess findings such as nausea, vomiting, and mucositis. Additionally, their nutrition, any drug side effects, signs and symptoms of infection are carefully monitored. Based on these evaluations, physicians and nurses work together to plan and provide the

necessary care and treatment. Regular in-service training sessions are conducted to ensure that the healthcare team's knowledge and skills are up-to-date.

Inclusion criteria

The study included patients who had undergone AHSCT, were discharged from the hospital at least one month after transplantation, were over 18 years old, had no communication problems, and volunteered to participate in the study.

Exclusion criteria

The study excluded patients who were hospitalized for any reason after transplantation.

Data collection tools

The data collection tools used in the study included the 'Personal Information Form,' 'Brief Fatigue Inventory,' 'Insomnia Severity Index,' and 'Depression Anxiety Stress Scale' (DASS-21).

Personal information form

The form was developed by the researcher based on the relevant literature. The form comprises 21 questions that cover the patient's socio-demographic characteristics (such as age, gender, education, profession, work status), transplantation process (including diagnosis and time after transplantation), and chronic disease status [3, 8, 18]. To assess the comprehensibility of the data collection form, five patients who were not included in the sample were invited to answer the questions. The answers provided to the questions were reviewed, and the final version of the data collection form was established.

Brief Fatigue Inventory (BFI)

The inventory used in the study was developed by Mendoza et al. [19], and it assesses the level of fatigue experienced in the past 24 hours and the impact of this fatigue on daily activities. The BFI comprises nine items, including three items that assess current fatigue, three items that evaluate usual fatigue, and six items that evaluate the impact of fatigue on daily activities. The participants rated all the items on a scale from 0 (indicating no fatigue) to 10 (indicating the most severe fatigue experienced) based on their experiences within the past 24 hours. Regarding the evaluation of fatigue, a score of 0 indicated no experience of fatigue, scores between 1 and 3 indicated low levels of fatigue, scores between 4 and 6 indicated moderate fatigue, scores between 7 and 9 indicated excessive fatigue, and a score of 10 indicated the highest level of fatigue. The Cronbach's alpha value for the scale was reported as 0.98 [18], and in the current study, the Cronbach's alpha value was calculated to be 0.94.

Insomnia Severity Index (ISI)

The seven-item scale developed by Bastien et al. [20] is a five-point Likert-type scale used to assess the severity of insomnia. Each item on the scale is scored from 0 to 4, with a total score range of 0 to 28 points. A score of 0-7 indicates no clinical insomnia, 8-14 indicates subthreshold insomnia, 15-21 indicates moderate clinical insomnia, and 22-28 indicates severe clinical insomnia. Boysan et al. conducted a Turkish validity and reliability study of the scale, reporting a Cronbach's Alpha value of 0.79 [21]. In the current study, the Cronbach's Alpha value was calculated as 0.883.

Depression Anxiety Stress Scale (DASS 21)

The scale was developed by Lovibond and Lovibond with 42 items and three sub-dimensions [22]. The scale was arranged as 21 items by Brown et al. in 1997 [23]. The Turkish validity and reliability of the scale were established by Yılmaz et al., and the scale is a 4-point Likert-type scale, scored between 0, "not at all" and 3, "completely." To calculate the score of DASS-21, each sub-dimension (depression, anxiety, and stress) is summed separately, and the sum of each sub-dimension is multiplied by 2. In the Turkish adaptation study of the scale, Cronbach's Alpha values for the sub-dimensions ranged from 0.75 to 0.81 [24]. In this study, the Cronbach's Alpha value was 0.938 for the depression sub-dimension, 0.889 for the anxiety sub-dimension, and 0.922 for the stress sub-dimension, indicating high internal consistency and reliability of the scale.

Data collection procedure

The researcher contacted AHSCT patients who met the inclusion criteria by phone to explain the purpose and scope of the study and invited them to participate. The researcher provided an online link to the AHSCT patients who agreed to participate in the study. The online questionnaire sent to the patients included information about the study, and those who volunteered were able to answer additional questions after accepting the study participation option. The form took approximately 15-20 minutes to complete.

Statistical analysis

The statistical package program used to evaluate the data was SPSS 25 (IBM Corp. Released 2017). IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp., Armonk, NY).

Descriptive statistics, including measures of central tendency (mean), variability (standard deviation), range (minimum and maximum values), count (number of observations), and percentile ranks, were used to analyze both categorical and continuous variables in the study. The Levene test was used to determine if the variances were homogeneous. The normality assumption was tested using the Shapiro-Wilk test. Nonparametric tests, specifically the Mann-Whitney U Test and Kruskal-Wallis H Test, were applied for variables that did not follow a normal distribution. The strength and direction of the association between two continuous variables were evaluated using the Spearman correlation coefficient. The Structural Equation Model (SEM) was used to analyze the mediating effect. In this study, two mediator models were created. In Model 1, the study examined the effect of the independent variable, fatigue, on the dependent variables of depression, anxiety, and stress, as well as the mediating role of the insomnia variable. In Model 2, the study examined the effect of the independent variable of insomnia on the dependent variables of depression, anxiety, and stress, and the mediating role of the variable of fatigue. IBM SPSS Statistics for Windows (Version 25.0) and Amos (Version 24.0) software packages were used to analyze the mediating effect. The $p<0.05$ level was considered statistically significant.

Ethical considerations

To carry out the research, ethical approval was obtained from the KTO Karatay University (Decision number: 2021/016), and institutional permission was obtained from the university hospital where the research was conducted. The researcher contacted AHSCT patients who fulfilled the inclusion criteria to provide them with information regarding the purpose and scope of the study and invited them to participate. The researcher provided an online link to the AHSCT patients who agreed to participate in the study. The online questionnaire included information about the study, and patients who volunteered were able to answer additional questions after accepting the option to participate.

Results

Table 1 presents the distribution of patients with AHSCT according to their sociodemographic and clinical characteristics. The study found that among the 126 participants, the mean age was 42.08 years (SD 12.60), with 53% being male and 66% being married. 32% of the participants were housewives, while 33% were working. In terms of financial status, 40% had less income than their expenses. Regarding the diagnosis, 75% of the participants had leukemia, and it was found that 77% had a period of one year or more after transplantation. Furthermore, 31% of the patients had chronic diseases other than cancer. It was found that the mean BFI fatigue score of patients with AHSCT was 4.13 (SD 4.94) and the mean ISI score was 7.65 (SD 5.60). The DASS 21 scale scores revealed that the mean depression score for the patients with AHSCT was 10.19 (SD 10.52), the mean anxiety score was 9.62 (SD 8.94), and the mean stress score was 14.17 (SD 11.09). (Table 2). In a study of patients who received AHSCT, 43% reported experiencing the most severe level of fatigue possible. Insomnia problems were found to affect 47% of the patients. The study found that 35% of the patients had a moderate or higher depression score, 43% had a moderate or higher anxiety score, and 28% had a moderate or higher stress score, as indicated in Table 3.

It was found that there was a moderate relationship between insomnia and fatigue scores ($p<0.01$). It was determined that there was a moderately positive relationship between ISI and anxiety, depression, and stress ($p<0.01$). There was a positive, moderately statistically significant relationship between fatigue and anxiety, depression, and stress ($p<0.01$). It was observed that there was a moderately positive relationship between anxiety with depression, and stress ($p<0.01$). There was a positive high-level relationship between depression and stress ($p<0.01$) (Table 4).

In Model 1; The effect of fatigue independent variable on depression, anxiety, stress, and the mediating role of insomnia variable were investigated (Fig. 1). According to Model 1, when fatigue increased by one-point, stress increased by 1.065 points positively (B=1.065 $p<0.001$), depression increased by 0.937 points positively (B=0.937 $p<0.001$) and anxiety increased 0.956 points positively (B=0.956 $p<0.001$). It was determined that when fatigue increased by one-point, insomnia increased by 0.138 points positively (B=0.138 $p<0.001$) (Table 5). In Model 2; The effect of insomnia independent variable on depression, anxiety, stress, and the mediating role of insomnia variable were investigated (Fig. 2). According to Model 2, when insomnia increased by one-point, stress increased by 0.972 points positively (B=0.972 $p<0.001$), depression increased 0.885 points positively (B=0.885 $p<0.001$) and anxiety increased 0.816 points positively (B=0.816 $p<0.001$). The results indicated that there was a positive relationship between insomnia and fatigue, with a one-point increase in insomnia associated with a 3.342-point increase in fatigue (B=3.342, $p<0.001$) (Table 6).

Discussion

AHSCT patients may experience symptoms such as fatigue, insomnia, and depression as a result of cancer treatment, in addition to the effects of cancer itself. These symptoms may persist even after cancer treatment is completed [9, 10, 17].

Table 1 Distribution of patients with AHSCT according to sociodemographic and clinical characteristics (n=126)

		n	%
Age	20-39 years	54	43
	40-54 years	48	38
	≥55 years	24	19
	M±SD (Min-Max)	42.08±12.60	(20-71)
Gender	Female	59	47
	Male	67	53
Marital status	Married	83	66
	Single	43	34
Education	Primary education	32	25
	Secondary education	49	39
	Bachelor's degree	34	27
	Master's degree	11	9
Profession	Housewife	40	32
	Civil servant	21	17
	Self-employment	65	51
People living with	Alone	8	6
	Not alone	118	94
Work status	Working	41	33
	Not working	85	67
Income status	Income less than the expense	50	40
	Income equals expenditure	61	48
	Income over expense	15	12
Diagnosis	Lymphoma	12	10
	Leukemia	95	75
	Other (Multiple myeloma, Anemia, Myelofibrosis, Langerhans cell histiocytosis)	19	15
Time after transplantation	<1 year	29	23
	1-3 years	34	27
	3-5 years	16	13
	>5 years	47	37
Chronic disease status	No	87	69
	*Having one disease	27	21
	*Having 2 or more disease	12	10

*Hypertension, Diabetes Mellitus, Heart Failure, COPD

Table 2 Distribution of the mean scores of the patients' BFI, ISI, and DASS-21 scale following AHSCT (n=126)

	Mean±SD	Min-Max	Cronbach's Alpha
BFI-Fatigue now	4.13±4.943	0-10	0.850
BFI-Fatigue worst	12.99±8.716	0-30	0.937
BFI- General Activity	22.10±16.598	0-58	0.908
BFI Fatigue usual	39.22±27.636	0-98	0.941
Insomnia Severity Index (ISI)	7.65±5.608	0-21	0.883
DASS 21 Depression	10.19±10.524	0-42	0.938
DASS 21 Anxiety	9.62±8.940	0-38	0.889
DASS 21 Stress	14.17±11.097	0-42	0.922

This study provides evidence for the effect and relationship among fatigue, insomnia, depression, anxiety, and stress symptoms after AHSCT.

In the present study, it was found that the mean BFI score of the patients with AHSCT was closer to the medium level and most patients experienced fatigue.

Table 3 Categorical distribution of the patients' BFI, ISI, and DASS-21 scale following AHSCT (*n*=126)

		n	%
Brief Fatigue Inventory (BFI)	Did not experience	8	6
	Minor level	25	20
	Moderate level	16	13
	Excessive level	23	18
	The highest level	54	43
Insomnia Severity Index (ISI)	Not in the insomnia range	67	53
	Subthreshold insomnia	41	33
	Clinical insomnia	18	14
Depression	Did not experience	67	53
	Minor level	15	12
	Moderate level	27	22
	Excessive level	4	3
	The highest level	13	10
Anxiety	Did not experience	61	48
	Minor level	10	8
	Moderate level	28	22
	Excessive level	4	3
	The highest level	23	18
Stress	Did not experience	83	66
	Minor level	8	6
	Moderate level	9	7
	Excessive level	16	13
	The highest level	10	8

According to study of Jim et al., it was reported that nearly half of patients experienced moderate to severe fatigue even long after allo and auto HSCT [25]. One of the most significant problems experienced by patients after allo and auto HSCT is fatigue [3, 4, 17, 26–28]. Consistent with the existing literature, the results of this study highlight the importance of managing fatigue as a critical symptom allo and auto HSCT. These results suggest that to prevent and reduce fatigue, fatigue should be evaluated routinely, starting from the pre-transplantation period, and approaches should be taken to prevent it.

The current study found that 47% of the patients experienced insomnia, with severity levels ranging from mild to moderate. According to study of Nelson et al. regarding insomnia in patients allo and auto HSCT, it was determined that the average insomnia severity was mild and moderate. Clinical insomnia was experienced by 41% of participants [29]. Jim et al. reported that 42% of allo and auto HSCT patients had clinically significant sleep problems [30]. Rentscher et al. determined that insomnia, similar to fatigue, continued as a problem in half of the transplantation patients even years after the transplantation [28].

Along with fatigue and insomnia, depression, anxiety and stress are symptoms that negatively affect the quality of life which should be managed after AHSCT. The patients experienced fatigue [28], insomnia [28], depression [11, 25], anxiety [17] and stress [7] for years, although it is more common in the first years after AHSCT. However, fatigue, insomnia, depression, anxiety and stress affect each other negatively after AHSCT [3]. Dean evaluated that patients' fatigue decreased when sleep quality improved [31]. According to randomized controlled study by Chan et al., it is found the psychoeducational intervention was effective in the anxiety, shortness breath, and tiredness in the lung cancer patients [32]. In a study by Hammer et al., fatigue, sleep disturbance, pain, and depression levels were examined by forming a symptom cluster in patients with breast cancer. More than 55% of chemotherapy patients have a moderate to high symptom load related to these four symptoms cluster [33]. In the study of Pasyar et al., it is stated that the most important factors in predicting the state and trait anxiety of the participants are fatigue and pain [17]. Ulrich et al. determined that fatigue after allo and auto HSCT associated with anxiety, depression, and sleep problems [34].

According to this study, fatigue, insomnia, depression, anxiety and stress are seen in the post-transplant period in AHSCT patients even after many years. The most common symptoms are fatigue and insomnia in these patients. In addition, fatigue, insomnia, depression, anxiety and stress are related together. In addition to previous studies, in this study, when fatigue severity level increases, the increasing

Table 4 Evaluation of the relationship between BFI, ISI, and DASS-21 scale scores of patients following AHSCT (*n*=126)

	ISI	Fatigue now	Fatigue worst	General Activity	Fatigue usual	Anxiety	Depression
Fatigue now	0.510 **						
Fatigue worst	0.654 **	0.654 **					
General Activity	0.656 **	0.599 **	0.802 **				
Fatigue usual	0.697 **	0.741 **	0.912 **	0.961 **			
Anxiety	0.532 **	0.342 **	0.490 **	0.576 **	0.570 **		
Depression	0.482 **	0.337 **	0.372 **	0.476 **	0.463 **	0.696 **	
Stress	0.474 **	0.320 **	0.398 **	0.516 **	0.493 **	0.650 **	0.778 **

*$p<0.05$; **$p<0.01$; Test statistics: Spearman Correlation Coefficient (r)

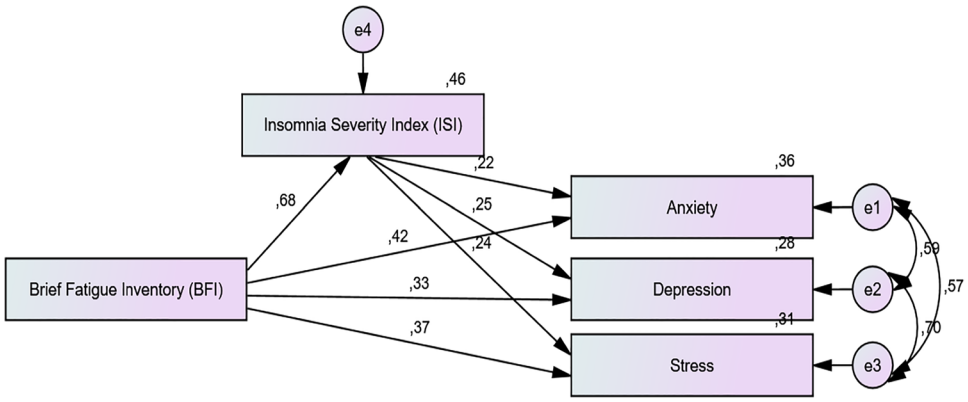

Fig. 1 Model of the Fatigue. Brief Fatigue Inventory (BFI): Fatigue severity, Insomnia Severity Index (ISI): İnsomnia severity e1, e2, e3, e4: error terms

Table 5 Evaluation of the direct and indirect effects of fatigue on stress, depression, and anxiety

	Variables							
	ISI		Stress		Depression		Anxiety	
	B	SH	B	SH	B	SH	B	SH
BFI			1.065 **	0.158 **	0.937 **	0.153	0.956 **	0.121
R^2			0.267		0.230		0.331	
BFI	0.138 **	0.013						
R^2	0.460							
BFI			0.147 **	0.040	0.126 **	0.039	0.137 **	0.032
UŞİ			0.480 **	0.199	0.465 **	0.194	0.358 **	0155
R^2			0.314		0.282		0,359	
Indirect effect			0.066 (0.005;0.128) **		0.064 (0.012;0.129) **		0.049 (0.006;0.106) **	

*p<0.05; **p<0.01

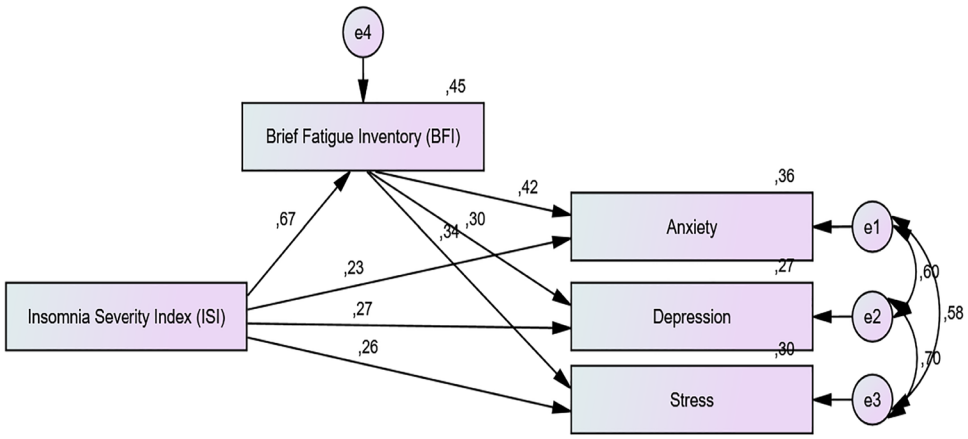

Fig. 2 Model of the İnsomnia. Insomnia Severity Index (ISI): İnsomnia severity, Brief Fatigue Inventory (BFI): Fatigue severity, e1, e2, e3, e4: error terms

level of severity of insomnia, depression, anxiety, and stress was observed. In the same time, when insomnia severity level increases, the increasing level of severity of fatigue, depression, anxiety, and stress was detected. The most important result in this study is that when insomnia increases, fatigue increases much more than other symptoms. According to the result of this study decreasing fatigue is an important parameter to decrease insomnia. Additionally, the level of fatigue, insomnia, depression, anxiety, and stress are related to each other. That is to say by decreasing or increasing level one of them, the other level decrease or increases as well. Therefore, it is important to evaluate of these symptoms in relation together before and after AHSCT.

Table 6 Evaluation of the direct and indirect effects of insomnia on stress, depression, and anxiety

	Variables							
	BFI		Stress		Depression		Anxiety	
	B	SH	B	SH	B	SH	B	SH
ISI			0.972 **	0.154	0.885 **	0.148	0.816 **	0.122
R^2			0.241		0.223		0.262	
ISI	3.342 **	0.324						
R^2	0.460							
ISI			0.480 **	0.199	0.645 **	0.194	0.358 **	0.324
KYE			0.147 **	0.040	0.126 **	0.039	0.137 **	0.032
R^2			0.314		0.282		0.359	
Indirect effect			0.492 (0.206;0.813) **		0.421 (0.136;0.703) **		0.458 (0.201;0.687) **	

*p<0.05; **p<0.01

Brief Fatigue Inventory (BFI): Fatigue severity, Insomnia Severity Index (ISI): İnsomnia severity e1, e2, e3, e4: error terms

Limitations of the Research

The fact that the study's data was obtained from a single transplantation center indicates that our findings cannot be generalized to other patients. In this study, the fatigue, insomnia, depression, anxiety, and stress levels experienced by patients before transplantation were unknown. The study's results may have been affected if patients had encountered these symptoms at a high level prior to transplantation. The patients included in this study varied in the time after they received AHSCT treatment (duration from 1 month to 12 years after treatment), which may have created heterogeneity as the side effects decreased as the time after AHSCT increased. Therefore, it is recommended that future research should identify patients' symptoms prior to transplantation and conduct prospective longitudinal studies to examine the development of these symptoms during the transplantation process.

Conclusions

As a consequence of the study, it was revealed that patients suffered fatigue, insomnia, depression, anxiety, and stress, after AHSCT. It was determined that these symptoms continued to be seen after AHSCT transplantation and were related. It was observed that as the severity of insomnia increased, the severity of fatigue, depression, anxiety, and stress increased. As the severity of fatigue increased, the severity of insomnia, depression, anxiety, and stress increased. According to the results of this study, it is recommended that the healthcare team responsible for the care of patients with AHSCT should consider these symptoms together in their research to reduce fatigue or insomnia, and further studies should be conducted, including evaluating the effects on depression, anxiety, and stress.

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Data availability All data and materials are available on request.

Authors' contributions All authors contributed to the study's conception and design. Material preparation, data collection, and analysis were performed by SN, FG, and SCB. The first draft of the manuscript was written by SN, FG and SCB and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Declarations

Ethics approval and consent to participate This study was performed in line with the principles of the Declaration of Helsinki. Permission was granted by the Ethics Committee of KTO Karatay University (Date: October 13, 2021/ No 2021/016). Consent was obtained from all participants.

Consent for publication Not applicable. The manuscript does not contain any individual images or videos.

Conflicts of interest/Competing interests The authors declare that they have no conflict of interest.

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