



## The Effects of Educational Intervention Based on the Pender's Health Promotion Model on Lifestyle and Fatigue of Patients with Cancer: An Experimental Study

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### Abstract

**Background:** One of the prevalent side effects of cancer treatment is fatigue, which can significantly impact patients' lifestyle and quality of life. The aim of this study was to investigate the effectiveness of Pender's health model on the level of fatigue and lifestyle of cancer patients.

**Materials & Methods:** This experimental study involved 78 cancer patients selected through convenience sampling in 2023 and then randomly allocated to intervention and control groups using block randomization. All participants in both groups completed demographic information forms, the Cancer Fatigue Scale, and the health-Promotion Lifestyle Profile Questionnaire to assess demographic characteristics, fatigue levels, and lifestyle before and after the intervention. Data were analyzed using independent and paired t-tests, and non-parametric tests including the Mann-Whitney U and Wilcoxon tests. All analyses were conducted using SPSS20 ( $p=0.05$ ).

**Results:** The intervention and control groups were homogeneous in terms of demographic indices, fatigue level, and quality of life before the intervention ( $P<0.1$ ). After the intervention, the results indicated an improvement in all dimensions of lifestyle and a reduction in fatigue levels in the intervention group compared to the control group ( $P<0.05$ ).

**Conclusion:** This study provides evidence for the effectiveness of Pender's health model intervention in improving the level of fatigue and improving the quality of life of cancer patients and facilitates support for clinical trials and future work.

### Keywords:

Cancer, Pender Model, Health Promotion, Lifestyle, Fatigue



## Introduction

Cancer is a group of diseases characterized by uncontrolled cell proliferation, which can affect any part of the body. A defining feature of cancer is the rapid production of abnormal cells that grow beyond their usual boundaries, invading adjacent parts of the body and spreading to other organs.<sup>1</sup> Despite significant advances in medical science, cancer remains one of the most critical diseases of the present century and the second leading cause of death after cardiovascular diseases.<sup>2</sup> In 2020, cancer accounted for approximately 10 million deaths, or nearly one in six deaths. It is projected that by 2040, the number of new cancer cases and deaths will reach 27.5 million and 16.3 million, respectively.<sup>3</sup>

Currently, a wide range of therapeutic strategies exist for managing cancer, including chemotherapy, radiotherapy, combination therapy, hormone therapy, and immunotherapy.<sup>4</sup> One of the primary treatments for cancer is chemotherapy. Although the survival rate of these patients has dramatically improved due to the development of chemotherapy,<sup>5</sup> side effects such as renal complications, febrile neutropenia, neuropathies, fatigue, oral mucositis, nausea and vomiting, fatigue, and anorexia<sup>6-10</sup> affect their quality of life.<sup>11</sup>

One of the side effects of chemotherapy that impacts patients' quality of life is fatigue.<sup>12</sup> Cancer-related fatigue is the most common symptom throughout treatment, from diagnosis to the end of life. It is defined as a distressing, persistent sense of physical, mental, emotional, and/or cognitive tiredness related to cancer or its treatment, which is disproportionate to recent physical activity and interferes with usual functioning.<sup>13</sup> Nearly all cancer patients experience cancer-related fatigue during initial treatments, and about one-third of these patients suffer from moderate to severe fatigue as a long-term effect of the disease months and years after treatment.<sup>14</sup> Fatigue is a common and concerning symptom that negatively impacts quality of life at all stages of treatment and disease in cancer patients.<sup>15</sup> The impacts of fatigue on patients include reduced functional ability, feelings of severe tiredness or exhaustion, and a lack of energy, which may be related to the cancer diagnosis or its treatment.<sup>16</sup>

Health promotion is a concept and process aimed at encouraging individuals to enhance, maintain, and improve their health.<sup>17</sup> Health-promoting behaviors are part of a healthy



lifestyle in which individuals or groups actively respond to their environment and maintain optimal well-being not only for disease prevention but also for better health, self-awareness, and personal satisfaction.<sup>18</sup> Health-promoting behavior, coupled with a healthy lifestyle, provides opportunities to improve health and enhance quality of life at every stage of growth.<sup>19</sup> Healthy lifestyle habits, including regular physical activity, a balanced diet, and avoidance of smoking and excessive alcohol consumption, have been shown to reduce overall mortality from chronic and non-communicable diseases.<sup>20</sup> Numerous studies have indicated that lifestyle can alter cancer risk factors.<sup>21</sup>

Nursing models can provide an appropriate guidance for improving the quality of care for patients.<sup>22</sup> The Nola Pender Health Promotion Model is one of the widely used models to explain supportive and health-promoting behaviors. This model includes six domains of health promotion: nutrition, physical activity, health responsibility, stress management, interpersonal relations, and spiritual growth.<sup>23</sup> Predictive factors and constructs explaining health behaviors in the Pender Model include perceived benefits, barriers, self-efficacy, and interpersonal and situational influences.<sup>24</sup> This model influences the selection of self-care behaviors and consequently improves the quality of life by impacting individual behaviors. The aim of this model is not to prevent disease or disability but to enhance health, or in other words, to increase the overall health and well-being of the individual. The health promotion model has been effectively used to improve health behaviors in various chronic diseases due to its comprehensive and applicable approach to understanding determinants of behavior. Since self-care must be performed automatically and continuously, learning self-care activities can lead individuals to maintain health, increase adaptability to disease, enhance self-care capacity, and reduce disability and healthcare costs.<sup>25-27</sup> Various studies have demonstrated the impact of education based on the Pender Health Promotion Model on improving lifestyle and self-care behaviors in chronic diseases. Javadzadeh et al. (2024) examined the effects of web-based education on the self-care behaviors of cardiovascular patients. They showed that the educational intervention based on the health promotion model was beneficial in improving the self-care behaviors of cardiac patients undergoing angioplasty.<sup>28</sup> Abdelazim et al. (2024) indicated the positive impact of an educational program based on the Pender Model on enhancing social adaptation and healthy lifestyle among international students and reducing cultural stress.<sup>29</sup> In a meta-analysis study conducted by Jalili et al. (2023), it was shown that the combined results of the studies indicated a significant increase in self-efficacy in the intervention group compared to the



control group.<sup>30</sup> Amiri et al. (2023) also recommended the Pender Health Promotion Model for improving nutritional behaviors.<sup>31</sup> Simsek et al. (2024) found that a health education program based on the health promotion model was an effective method for increasing health-promoting behaviors, smoking cessation rates, and controlling LDL levels in patients with acute coronary syndrome.<sup>25</sup> The results of the study by Asiri et al. (2023) provided compelling evidence supporting the use of the Pender Health Promotion Model in improving health-promoting behaviors among nursing students with chronic diseases.<sup>32</sup>

Given that various studies have shown that fatigue is one of the most significant symptoms in cancer patients undergoing chemotherapy and that the lifestyle of these patients changes during chemotherapy<sup>28-31</sup>, necessitating strategies for improvement, it appears that using an educational method based on the Pender Health Promotion Model could serve as an effective educational approach and non-pharmacological process to enhance health and reduce fatigue. Consequently, the researchers aimed to determine the effects of education based on the Pender Health Promotion Model on the lifestyle and fatigue of cancer patients.

## Materials and Methods

This experimental study was conducted using a pretest-posttest control group design with random allocation, single-blinding during the allocation to groups, and a 50-day follow-up period. The study population included all cancer patients undergoing chemotherapy who were referred to Taleghani Hospital of Kermanshah University of Medical Sciences in 2023. Inclusion criteria for participants were a confirmed diagnosis of cancer within the last six months, undergoing chemotherapy, being over 18 years of age, having literacy skills, the ability to communicate, no psychological disorders, and not being employed in or graduated from health-related fields, and not having participated in fatigue reduction and lifestyle improvement educational courses. Exclusion criteria included the death of the patient and their unwillingness to continue participating in the study.

In this study, the sample size was determined using the formula from previous studies, resulting in 55 participants per group, for a total of 110 participants with Including 10% of



attributing rate. These individuals were allocated into two equal groups based on a randomized block design with blocks of 10, created using the Random Allocation Software (1:1 allocation ratio). To randomly allocate 110 patients into intervention and control groups, initially, 11 different blocks of 10 letters (A and B), representing the intervention and control groups respectively, were created. These blocks were then numbered from 1 to 11. In the next step, each block was randomly selected by drawing numbers 1 to 11, 11 times. This process resulted in 11 combinations of 10 letters (A for the intervention group and B for the control group). These combinations were individually placed in 110 sealed envelopes. As each patient was enrolled, an envelope was opened sequentially to determine the group allocation. To maintain blinding during the study, only the researcher was aware of the randomization process and the codes corresponding to each group, while the experimenter responsible for enrolling and allocating the participants to groups was blinded to the group assignments. At the beginning of the study, all participants in both groups completed demographic information forms, the Cancer Fatigue Scale, and the Health Promotion Lifestyle Profile questionnaire to provide baseline assessments of demographic characteristics, fatigue levels, and lifestyle. The demographic information form included: age, gender, marital status, education, number of hospitalizations, duration of illness, comorbidities, number of chemotherapy sessions, cancer type, financial status, insurance status, and place of residence.

The Health Promotion Lifestyle Profile Questionnaire (Walker et al., 1987), consists of 52 items measuring lifestyle across six dimensions: nutrition, physical activity, health responsibility, stress management (identification of stress sources and stress management actions), interpersonal support (maintaining relationships with a sense of closeness), and self-actualization (having a sense of purpose, pursuing personal growth, and experiencing self-awareness and satisfaction). Responses are rated on a Likert scale: never (1), sometimes (2), often (3), and always (4). To obtain the score for each dimension, the total scores of the questions related to that dimension were summed. The overall score of the questionnaire was obtained by summing the scores of all the questions. The range of scores is between 52 and 208. A higher score indicates a better lifestyle. The Cronbach's alpha for the overall score of this questionnaire is 0.94.<sup>33</sup> In this questionnaire, scores above 196 indicate a positive health-promoting lifestyle, while scores below 49 indicate a negative health-promoting lifestyle.<sup>34</sup>

The Cancer Fatigue Scale (Okuyama et al., 2000) consists of three subscales: physical, emotional, and cognitive, and includes 15 items. It is formatted on a five-point Likert scale.



Each question is scored between 0 (not at all) and 4 (very much), reflecting the patient's recent status on the questionnaire. To calculate the score for each subscale, the sum of the scores of individual items related to that subscale is calculated. To calculate the total score of the questionnaire, the sum of the scores of all the items in the questionnaire is calculated. The minimum and maximum scores of this questionnaire are 0 and 60, respectively. A higher score indicates a greater level of fatigue, and vice versa. Consequently, the probable fatigue levels range from 0 to 28 for the physical dimension, 0 to 16 for the emotional dimension, 0 to 16 for the cognitive dimension, and 0 to 60 for the overall fatigue score. Yusefi et al.<sup>35</sup> reported that the face validity of this instrument was confirmed by experts, and its reliability was reported using Cronbach's alpha method as 0.90 for the overall questionnaire, and 0.88, 0.92, and 0.85 for the subscales.

After conducting the baseline assessments, individuals in the first group (intervention group) received training based on Pender's Health Promotion Model alongside chemotherapy, while the second group (control group) only underwent chemotherapy treatment. The intervention process for the intervention group was as follows: initially, the members of the intervention group were contacted to schedule the dates, times, and duration of the four intervention sessions, as well as the location. To prevent informational contamination of the control group, a session was held before allocating the research samples to the control and intervention groups, during which the research objectives were explained, and the importance of preventing informational contamination of the control group and its impact on the research results were clarified. The intervention was conducted alongside the routine training common to both groups. In the intervention group, the training was conducted in a question-and-answer format using an educational booklet encompassing the dimensions of Pender's model, including nutrition, exercise, health responsibility, stress management (identifying sources of stress and stress management actions), interpersonal support (maintaining relationships with a sense of closeness), and self-actualization (having a sense of purpose, pursuing personal development, and experiencing self-awareness and satisfaction). The educational intervention was delivered in a question-and-answer format to the intervention group. Initially, the intervention group received training related to Pender's Health Promotion Model using a whiteboard and PowerPoint in the cancer clinic over four sessions, each lasting two hours and held over two weeks. At the end of the educational program, each participant received an educational booklet. After the four sessions, the researcher conducted follow-up phone calls



every 15 days to ask participants about the educational material (the researcher made three phone calls over 50 days after the test). After 50 days, a session was held with the participants, coordinated via phone calls, and the participants revisited the treatment centers on the dates arranged by the researcher. The aforementioned tools were completed again by the test group, and their fatigue levels and lifestyle were reassessed. The relevant assessments of the patients were conducted at two time points (the start of the study and the end of the 50 days) during the 50-day follow-up period. After completing the mentioned forms, the control group received standard training from clinic staff before discharge. This standard training included information about warning signs and symptoms, instructions on medication use at home, the timing of follow-up appointments with the doctor, and pending test results. This group also returned to the clinic after 50 days, coordinated in advance, to complete the forms again. Finally, the educational booklet was provided to this group as well, and they received the same training as the intervention group.

The number of sessions for the intervention (four sessions) and the 50-day follow-up period was based on previous research and the recommendations of the research team.<sup>36</sup> It should also be mentioned that during the follow-up period, 16 patients from each group withdrew from the study due to death, unwillingness to continue participation, or seeking treatment at other medical centers, reducing the number of patients in each group to 39. After completing the implementation stages of the project, demographic information, along with the results of the two stages of assessing fatigue and lifestyle over the follow-up period, were analyzed using the relevant statistical methods. It is noteworthy that this study was financially supported by Kurdistan University of Medical Sciences and was conducted after obtaining an ethics code from the Ethics Committee of Kurdistan University of Medical Sciences. Sampling was conducted after providing the necessary explanations regarding the research objectives, obtaining participants' consent, and securing written informed consent. The participants were assured that their information would remain confidential and that they could withdraw from the study at any time.

To determine the distribution of demographic information and self-reported personal history, descriptive statistics methods including frequency and percentage were used. The Chi-square test and, if necessary, the Fisher exact test was used to examine the relationship among the grouped factors. For determining the mean current age of the patient, the number of hospitalizations, the duration of illness, the number of chemotherapy sessions, and the





average fatigue and lifestyle scores, descriptive statistical methods such as count, minimum, maximum, median, interquartile range, mean, and standard deviation were employed. The Kolmogorov-Smirnov test was used to assess the normal distribution of the data. If the normality assumption was confirmed, the independent samples t-test was used for inter-group comparisons, and the paired samples t-test for within-group comparisons. Otherwise, non-parametric tests such as the Mann-Whitney U and Wilcoxon tests were applied. Line charts were also used to graphically display the trends of the mean scores of the mentioned concepts over the follow-up period and between groups. All analyses were conducted using SPSS (v20), with a significance level of 0.05.

## ■ Results

This study was conducted as a experimental design with random allocation, a control group, and a 51 day follow-up period, involving two-stage assessments of 78 cancer patients with a mean age of 44.73 years and a standard deviation of 13.81 years, ranging from 18 to 73 years. The detailed results are listed in Table 1.

**Table 1- Demographics and clinical history of the participants**

Table2 lists the results of comparing the distribution of factors such as patient age, number of hospitalizations, duration of illness, and number of chemotherapy sessions between the intervention and control groups. According to these results, the normality test of variables such as age, number of hospitalizations, duration of illness, and number of chemotherapy sessions was assessed using the Kolmogorov-Smirnov test. Only the age distribution of patients in the intervention and control groups was confirmed to be normal. The independent samples t-test results showed that the average age of patients between the two groups was not statistically significantly different ( $P > 0.05$ ). Additionally, the Mann-Whitney U non-parametric test results indicated that the median number of hospitalizations, duration of illness, and number of chemotherapy sessions did not show a statistically significant difference between the intervention and control groups ( $P > 0.05$ ).

**Table 2: Descriptive statistics comparison of age, number of hospitalizations, duration of illness, and number of chemotherapy sessions between the intervention and control groups**



According to the results listed in the table below, a comparison of the subcomponents of physical fatigue, emotional fatigue, cognitive fatigue, and the total cancer-related fatigue score between the intervention and control groups at baseline revealed that at the beginning of the study, the average physical, emotional and cognitive fatigue score was higher in the control group than in the intervention group. The results of these comparisons indicated that at baseline, none of the components of physical fatigue, emotional fatigue, cognitive fatigue, and total cancer-related fatigue showed a statistically significant difference between the intervention and control groups ( $P > 0.05$ ).

However, at the final assessment, after 51 days of the study, the results of comparing physical fatigue, emotional fatigue, cognitive fatigue, and the total cancer-related fatigue score between the intervention and control groups showed that at the end of the study, the mean physical fatigue, emotional fatigue, cognitive fatigue, and the total cancer-related fatigue score in the intervention group was significantly lower than in the control group ( $P < 0.0001$ ), meaning that fatigue levels were reported to be lower in the intervention group compared to the control group. Further results are displayed in the table below (Table 3).

**Table 3. Descriptive statistics of the subcomponents of fatigue to cancer among patients in the intervention and control groups, separated by baseline and secondary assessment time points.**

The results of the evaluation and comparison at the baseline of the study, the results for the subcomponents of self-actualization, responsibility, interpersonal support, stress management, exercise, nutrition, and the overall lifestyle score between the intervention and control groups indicated that at the start of the study, the mean scores for all subcomponents in the intervention group were higher than in the control group. These findings indicated that the relationships mentioned above were consistent for the median scores of all the concepts, except for stress management and exercise, between the intervention and control groups. Specifically, at baseline, the mean scores for self-actualization, responsibility, interpersonal support, and the overall lifestyle score had statistically significant differences between the two groups with differences of 5.49, 3.97, 3.20, and 15 units, respectively (all  $P < 0.05$ ).



However, the differences in stress management, exercise, and nutrition were not statistically significant (all  $P > 0.05$ ).

In the final assessment, the comparison of the scores for self-actualization, responsibility, interpersonal support, stress management, exercise, nutrition, and the overall lifestyle score between the intervention and control groups revealed that at the end of the study, the scores for all these concepts were significantly different between the two groups ( $P < 0.0001$ ). The difference in the mean scores for these concepts at the end of the study was significantly greater than the differences observed at the start of the study. For example, the difference in the mean self-actualization score between the two groups at the start of the study was 5.49 units, whereas at the end of the study, this difference increased to 13.46 units. Overall, the mean overall lifestyle score in the intervention group ( $148.97 \pm 20.99$ ) was significantly higher than in the control group ( $104.21 \pm 13.95$ ). Further results are listed in the table below (Table 4).

**Table 4. Descriptive statistics of the health-Promotion Lifestyle score among patients in the intervention and control groups, separated by baseline and secondary assessment time points.**

The results of comparing physical fatigue, emotional fatigue, cognitive fatigue, and overall cancer-related fatigue scores among patients throughout the follow-up period are presented in Table 5. The mean scores for all fatigue concepts—physical, emotional, cognitive, and overall cancer-related fatigue—in the intervention group demonstrated a significantly decreasing trend throughout the study period (from the start to the end of the study) (all  $P < 0.05$ ). Conversely, the mean scores for these concepts in the control group showed a significant increase during the follow-up period (all  $P < 0.05$ ). This indicates that, in the intervention group, the fatigue scores reported at the start of the study were higher compared to those at the end, whereas in the control group, the scores reported at the start of the study were lower compared to those at the end. Thus, the control group experienced an increase in fatigue over the follow-up period, unlike the intervention group. These results underscore the significant effectiveness of the Pender's Health Promotion Model-based education in reducing patient fatigue throughout the study period. Further details are provided in the table below (Table 5 and Figure 2).

**Table 5. Descriptive statistics of the subcomponents fatigue score due to cancer among patients during the study follow-up period, separated by study groups.**



The results of comparing self-actualization, responsibility, interpersonal support, stress management, exercise, nutrition, and overall lifestyle scores among patients throughout the follow-up period, segmented by study groups, are presented in Table 6. According to these results, in the intervention group, the mean scores for all concepts—self-actualization, responsibility, interpersonal support, stress management, exercise, nutrition, and overall lifestyle—showed a significantly increasing trend throughout the study period (from the start to the end of the study) (all  $P < 0.05$ ). Conversely, in the control group, the mean scores for all these concepts showed a significant decrease from the start to the end of the study ( $P < 0.05$ ). These results highlight the significant effectiveness of the Pender's Health Promotion Model-based education in improving patients' lifestyles throughout the follow-up period. Further details are provided in the table below (Table 6).

**Table 6. Descriptive statistics of the health promotion subcomponents score among patients during the study follow-up period, separated by study groups.**

## ■ Discussion

As for fatigue levels and lifestyle scores, and their dimensions among cancer patients in the intervention and control groups, before and 50 days after the intervention, the findings revealed that the mean scores for all concepts demonstrated a significantly positive trend throughout the follow-up period in the intervention group. Conversely, in this group, the mean scores for all fatigue concepts showed a significantly negative trend during the follow-up period. These results indicate an improvement in fatigue levels and an enhancement in lifestyle quality in the intervention group compared to the control group.

Khodayari et al. (2017) conducted a quasi-experimental study to examine the impact of the Pender's Health Promotion Model on improving dietary behaviors among overweight and obese women. The findings indicated that education based on the Pender model improved dietary behaviors.<sup>37</sup> In another study, Noshirovani et al. (2018) evaluated the quality of life in diabetic patients based on the Pender's Health Promotion Model compared to the Health Belief Model. Their results showed an increase in the quality of life in both patient groups,



with no significant superiority of one educational model over the other.<sup>38</sup> Khani et al. (2018) conducted a study on HIV patients and found that lifestyle education based on the Pender model led to the adoption of health-promoting behaviors among HIV patients.<sup>39</sup> Yavuz et al. (2018) investigated the impact of a health promotion model-based educational program on lifestyle behaviors and quality of life in obese adolescents, revealing that the educational program significantly affected the adolescents' lifestyle.<sup>40</sup>

Chehri et al. (2018) demonstrated that the use of a healthcare program based on Pender's Health Promotion Model significantly improved the quality of life for patients with heart failure.<sup>41</sup> Similarly, Masoudi et al. (2020) conducted a study on hemodialysis patients and found that Pender's Health Promotion Model had positive effects on self-efficacy and adherence to treatment in these patients.<sup>42</sup> Vakilian et al. (2021) investigated 74 patients with diabetic foot ulcers using Pender's Health Promotion Model. The patients were divided into control and intervention groups, and the results after the intervention showed that the model improved the quality of life in these individuals.<sup>43</sup> Farooqi et al. (2021) conducted a study to determine the impact of an educational intervention based on Pender's Health Promotion Model on treatment adherence in patients with coronary artery disease and confirmed that the model was more effective than conventional methods in improving adherence.<sup>44</sup> Chen et al. (2021) showed that Pender's Health Promotion Model was useful in providing information to predict and identify important factors related to elderly participation in community-based health promotion activities.<sup>45</sup> Habibzadeh et al. (2021) examined 80 patients with heart failure and demonstrated that Pender's model improved the quality of life in heart failure patients, except in the physical dimension, and enhanced health-promoting behaviors in all dimensions except physical activity.<sup>46</sup> Beijani et al. (2022) investigated the impact of peer education based on the model on quality of life, stress management, and self-efficacy in patients with multiple sclerosis and confirmed the model's effectiveness.<sup>47</sup> Sadeghi et al. (2022) showed that an educational intervention based on Pender's model increased healthy lifestyle scores among women of reproductive age.<sup>48</sup> Aligned with the present study, Seyed et al. (2022) found that an educational intervention aimed at examining COVID-19 preventive behaviors in women led to an increased perceived benefits, perceived self-efficacy, and preventive behaviors, while perceived barriers decreased after the intervention.<sup>49</sup> Khodaveisi et al. (2022) conducted a clinical trial on 96 patients undergoing angioplasty and found statistically significant differences between the control and intervention groups in terms of health responsibility, physical activity, nutrition, spiritual growth, personal self-actualization,



interpersonal relations, and stress management. The study concluded that education based on the model positively impacted health-promoting behaviors in patients undergoing coronary angioplasty.<sup>50</sup>

Zhang et al. (2022) confirmed that Pender's model can effectively improve health knowledge and the adaptation of prenatal health behaviors related to heart disease, reducing cardiac burden and improving maternal and child outcomes.<sup>51</sup> In a quasi-experimental study conducted by Zinozadeh et al. (2023), 160 colorectal cancer patients were divided into two groups of 80 (intervention and control). The results showed that the educational intervention based on Pender's model effectively enhanced self-care behaviors in colorectal cancer patients.<sup>52</sup> Similarly, Abedi et al. (2023) confirmed the positive impact of Pender's model in improving oral health behaviors in adult cancer patients.<sup>53</sup> Considering that the present study and other studies demonstrated significant statistical correlations in all dimensions between the intervention and control groups, indicating the positive effects of this model on promoting health-related behaviors in various groups and populations, it is noteworthy that none of the reviewed studies had shown positive effects of this model on patients with chronic diseases such as cancer. The present study significantly fills this gap, as its results highlighted the positive impact on improving health-promoting behaviors and reducing fatigue in these patients. Contrary to the present study, Eghtedar et al. (2022) found that education based on Pender's Health Promotion Model did not improve health in terms of independence and autonomy, or purpose in life for hemodialysis patients.<sup>54</sup> Similarly, Radmehr et al. (2013) demonstrated that education based on Pender's Health Promotion Model had no effect on responsibility and spirituality in patients with obsessive-compulsive disorder.<sup>55</sup>

The different results of these two studies may be attributed to variations in the selection of study groups. Here, the participants were cancer patients suffering from fatigue and decreased lifestyle standards, whereas the type of education and the study groups in the reviewed studies were different.

The primary aim of this study was to determine and compare fatigue scores among cancer patients in the intervention and control groups, both before and after a 50-day period. The findings revealed that the mean scores for all aspects of fatigue, as well as the overall cancer-related fatigue score showed a strongly significant decrease in the intervention group over the follow-up period. These results indicated an improvement in fatigue levels among patients undergoing the Pender Health Promotion Model training compared to the control group.



Similarly, Pourbahrami et al. (2019) and Beckerman et al. (2013) conducted studies examining the effects of cognitive-behavioral therapy on fatigue severity in MS patients, demonstrating a significant reduction in fatigue following the intervention (56, 57). Additionally, Choi et al. (2007) found a positive and significant correlation between fatigue in cancer patients and physical symptoms and depression, while family support and health-promoting behaviors were negatively correlated with fatigue (58). Hasanvand et al. (2014) reported that, given the association of fatigue with quality of life and functional status, efforts to reduce fatigue and thereby enhance the quality of life and functional status of cancer patients seem necessary (59).

Conversely, Kangas et al. (2008), in a systematic review and meta-analysis of 119 studies assessing non-pharmacological interventions for cancer-related fatigue, reported that these approaches yielded a small to moderate effect size in reducing fatigue among cancer patients, based on both clinical trial and non-clinical trial evidence (60).

The variability in study outcomes can be attributed to the multifaceted nature of fatigue. Different approaches have been explored in the literature to reduce or eliminate fatigue, yet a theory-driven approach to fatigue reduction in cancer patients may hold particular significance. Health-promotion theories, in particular, could positively impact all dimensions of fatigue. Therefore, considering the importance of addressing fatigue in cancer patients, theory-based approaches can be effectively utilized alongside other routine educational interventions.

## ■ Limitations

According to the longitudinal nature of the study, the obtained results to a large extent can correctly express the effectiveness of this educational model. However, this study included limitations such as the examination of different types of cancer with different origins, and due to the small volume of patients in these subgroups, it was not possible to examine the relationships in these classes. Therefore, the findings of this study cannot be related to a specific group of cancer. The impossibility of investigating causal relationships in the age subgroups of patients was another consequence of the low sample size in age subgroups. However, previous studies also showed that Pender's health model has an effect on improving the lifestyle and increasing the life expectancy of patients.

## Practice Implications



This research investigated simultaneously the changes in the two factors of lifestyle and fatigue over time and under the training of Pender's health model in cancer patients, which was able to provide a better understanding of the heterogeneous course of these two factors in the two control and control groups.

Using the results of this study, it can be suggested that by taking examples from advanced societies and adjusting the impact of cultural factors and the level of mental health of patients, measures should be taken to promote the use of Pender's health model and other related interventions with the aim of better understanding cancer patients and identifying factors, It was effective in improving patients' conditions, improving their quality of life and increasing their life expectancy, and took effective steps to reduce the difficulties of cancer treatment, develop self-management skills, comply with recommended follow-ups, and provide more support to these patients.

## ■ Conclusion

Education based on Pender's Health Promotion Model had a significant impact on the lifestyle and fatigue of cancer patients in the teaching hospitals of Kermanshah University of Medical Sciences. The model significantly reduced patient fatigue and significantly enhanced a health-promoting lifestyle, improving variables such as self-actualization, responsibility, interpersonal support, stress management, exercise, and nutrition. The study also showed that education based on Pender's Health Promotion Model significantly reduced physical, emotional, and cognitive fatigue during the follow-up period. Therefore, nurses can effectively use this model in their care processes to improve the health of cancer patients undergoing chemotherapy and reduce their fatigue, which is a side effect of chemotherapy. Further research is needed to examine the long-term and side effects of this care program.

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## Conflict of interest:

The authors declare no conflict of interest in this study.

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Tables :

**Table 1- Demographics and clinical history of the participants**

Factor	Study groups frequency (%)			Chi Square (sig.)	
	Intervention group )N=39(	Control group )N=39(	Total		
Gender	F	17 (43.6)	21 (53.8)	38 (48.7)	0.821 (0.249)
	M	22 (56.4)	18 (46.2)	40 (51.3)	
Marital status	Unmarried	9 (23.1)	6 (15.4)	15 (19.2)	0.743 (0.283)
	Married	30 (76.9)	33(84.6)	63 (80.8)	
Education	Junior high school	17 (43.6)	20 (51.3)	37. (47.7)	2.472 (0.291)
	High school	9 (23.1)	12 (30.8)	21 (26.9)	
	College degree	13 (33.3)	7 (17.9)	20 (25.6)	
Monthly income (million Tomans)	4>	11 (28.2)	8 (20.5)	19 (24.4)	5.942 (0.114)
	4-6	10 (25.6)	5 (12.8)	15 (19.2)	
	6-8	3 (7.7)	10 (25.6)	13 (16.7)	
	8<	15 (38.5)	16 (41.0)	31 (39.7)	
Residence condition	Home owner	19 (48.7)	20 (51.3)	39 (50.0)	2.488 (0.288)
	Rented	17 (43.6)	12 (30.8)	29 (37.2)	



Medical and clinical history	Medical insurance	Mortgaged	3 (7.7)	7 (17.9)	10 (12.8)	3.656 (0.600)
		Salamat	10 (26.3)	9 (23.1)	19 (24.7)	
		Social security	15 (39.5)	11 (28.2)	26 (33.8)	
		Armed forces	2 (5.3)	2. (5.1)	4 (5.2)	
		Medical services	7 (18.4)	7 (17.9)	14 (18.2)	
		Janbazan	1 (2.6)	1 (2.6)	2 (2.6)	
		Rural	3 (7.9)	9 (23.1)	12 (15.6)	
	Background disease	Metabolic	4 (50.0)	8 (80.0)	12(66.7)	1.80 (0.201)
		Nonmetabolic	4 (50.0)	2 (20.0)	6 (33.3)	
	Cancer type	Digestive system	15 (38.5)	12 (30.8)	27 (34.6)	4.043 (0.775)
		Respiratory system	3 (7.7)	3 (7.7)	6 (7.7)	
		Endocrine	1 (2.6)	0. (0.0)	1 (1.3)	
		Blood	12 (30.8)	11 (28.2)	23 (29.5)	
		Chest	4 (10.3)	8 (20.5)	12 (15.4)	
		Urinary	1 (2.6)	3 (7.7)	4 (5.1)	
		Nervous system	1 (2.6)	1 (2.6)	2 (2.6)	
		Soft tissue	2 (5.1)	1 (2.6)	3 (3.8)	
Total		39 (100.0)	39 (100.0)	72 (100.0)		





**Table 2:** Descriptive statistics comparison of age, number of hospitalizations, duration of illness, and number of chemotherapy sessions between the intervention and control groups

concept	Group	Max -Min	Mean (SD)	Median ( $Q_3 - Q_1$ )	KS (sig.)	Mean difference	Result (sig.)
Clinical and medical history	Age (year)	Case	18-73	44.35 (12.80)	42 (53-38)	0.112 (0.200)	-0.74 (0.814) a
		Control	18-72	45.10 (14.91)	48 (57-31)	0.090 (0.200)	
	Hospitalization frequency	Case	100-3	29.56 (36.80)	12 (25-17)	***0.326 (0.0001>)	12.33 (0.976) b
		Control	100-4	17.23 (16.55)	14 (20-17)	***0.212 (0.0001>)	
	Term of hospitalization (months)	Case	72-6	15.79 (14.59)	10 (24-6)	***0.269 (0.0001>)	-1.53 (0.628) b
		Control	60-6	17.33 (15.05)	12 (24-7)	***0.305 (0.0001>)	
	Chemotherapy sessions	Case	100-2	13.03 (17.21)	9 (13-6)	***0.329 (0.0001>)	-1.31 (0.055) b
		Control	3-40	14.33 (9.08)	13 (20-6)	0.119 (0.174)	

\* -Significant at the 0.05 error level.

\*\* -Significant at the 0.01 error level.

\*\*\* -Significant at the 0.001 error level.

a: Parametric test statistic for independent samples t-test, b: Non-parametric test statistic for Mann-Whitney U tes..





**Table 3. Descriptive statistics of the subcomponents of fatigue to cancer among patients in the intervention and control groups, separated by baseline and secondary assessment time points.**

Concept	Occasion	Group	Max -Min	Mean (SD)	Median ( $Q_3 - Q_1$ )	KS (sig.)	Mean differenc e	Result (sig.)
<b>Physical</b>	1	Case	11.3 1	21.15 (5.19 )	22 (17- 25)	0.087 (0.200 )	-1.95	-1.73 (0.088)a
		Contro l	12- 31	21.11 (4.77 )	24 (27- 20)	0.139 (0.056 )		
<b>Emotiona l</b>	1	Case	6-19	11.56 (3.46 )	11 (14-9)	0.113 (0.200 )	-0.583	-1.253 (0.210)b
		Contro l	7.16	12.10 (2.50 )	13 (14- 11)	*0.153 (0.022 )		
<b>Cognitive</b>	1	Case	5-20	11.23 (3.61 )	11 (13-9)	0.132 (0.082 )	0.179	-0.181 (0.856)b
		Contro l	6-16	11.05 (2.72 )	11 (13-9)	*0.147 (0.032 )		
<b>Total score of fatigue</b>	1	Case	70- 22	43.95 (11.0 )	44 (52- 36)	0.080 (0.200 )	-2.31	-1.235 (0.21)b
		Contro l	60- 26	46.26 (9.59 )	47 (53- 40)	*0.146 (0.035 )		
<b>Physical</b>	2	Case	10- 28	17.74 (3.99 )	17 (20- 15)	0.112 (0.200 )	-7.41	***-8.07 (0.0001>) a
		Contro l	16- 31	25.15 (4.11 )	26 (28- 22)	0.111 (0.200 )		
<b>Emotiona l</b>	2	Case	4.15	8.74 (2.24)	9 (10-7)	0.117 (0.196)	-3.97	*** -5.875 (0.0001>)

Cancer Fatigue Scale



								b
Cognitive	2	Contro 1	8-16	12.72 (2.20 )	13 (14- 11)	** 0.182 (0.002 )		
		Case	5-15	8.61 (2.22 )	8 (10-7)	* 0.148 (0.032 )		
	2	Contro 1	8-16	12.31 (2.45 )	13 (15- 10)	0.124 (0.135 )	-3.69	*** -5.500 (0.0001>) b
		Case	20- 56	35.11 (8.03 )	35 (40- 30)	0.095 (0.200 )		
Total score of fatigue	2	Contro 1	32- 62	50.18 (8.16 )	52 (57- 45)	*0.142 (.047)	-15.08	*** -5.975 (0.0001>) b
		Case	20- 56	35.11 (8.03 )	35 (40- 30)	0.095 (0.200 )		

\* -Significant at the 0.05 error level.

\*\* -Significant at the 0.01 error level.

\*\*\* -Significant at the 0.001 error level.

a: Parametric test statistic for independent samples t-test, b: Non-parametric test statistic for Mann-Whitney U test.

-Time 1: Start of the study (before the intervention), Time 2: End of the study (end of the third month of the study).



**Table 4. Descriptive statistics of the health-Promotion Lifestyle score among patients in the intervention and control groups, separated by baseline and secondary assessment time points.**

Concept	Occasi on	Grou p	Max- Min	Mean (SD)	Median ( $Q_3 - Q_1$ )	KS (sig.)	Mean differen ce	Result (sig.)
Health-Promotion Lifestyle Profile Questionnaire	1	Case	21-51	33.93 (8.22)	32 (39-25)	0.115 (0.200)	5.49	**3.594 (0.001)a
		Contr ol	16-39	27.43 (4.83)	26 (31-24)	0.130 (0.097)		
	1	Case	16-43	28.38 (6.51)	28 (33-23)	0.083 (0.200)	3.97	**3.245 (0.002)a
		Contr ol	16-31	24.41 (4.01)	24 (28.-1)	0.100 (0.200)		
	1	Case	8-24	15.03 (4.39)	15 (18-11)	0.092 (0.200)	3.20	**_ 3.262 (0.001)b
		Contr ol	7-18	11.82 (3.24)	11 (14-10)	**0.174 (0.004)		
	1	Case	10-33	19.17 (5.74)	17 (24.14)	*0.160 (0.013)	1.13	-0.546 (0.585)b
		Contr ol	12-23	18.05 (2.84)	18 (21-15)	*0.141 (0.049)		
	1	Case	6-23	9.84 (4.4)	9 (12-6)	***0.242 (0.0001>)	0.256	-0.853 (0.394)b
		Contr ol	6-19	9.59 (2.76)	9 (11-8)	***0.200 (0.0001>) - (0.0001>) ***0.200		
Nutrition	1	Case	10-27	17.47 (4.66)	17 (20-14)	0.123 (0.144)	0.948	1.062 (0.291)a
		Contr ol	11-24	16.79 (3.07)	16 (19-14)	0.123 (0.144)		
Healthy style total score	1	Case	81-194	123.10 (27.85)	117 (142-101)	0.115 (0.200)	15.00	**3.006 (0.004)a
		Contr ol	75.1-42	108.10 (13.99)	115 (105-	0.115 (0.200)		



100)								
Self-actualization	2	Case	26-52	9.00 (7.06)	38 (45-33)	0.110 (0.200)	13.46	***9.91 2 (0.0001 >)a
		Contr ol	17-34	25.54 (4.70)	25 (30-22)	0.116 (0.200)		
Responsibility	2	Case	25-44	34.20 (4.67)	34 (38-30)	0.133 (0.080)	9.95	***10.5 2 (0.0001 >)a
		Contr ol	17.3 3	24.26(3. 62)	25 (27-21)	0.121 (0.155)		
Inter-personal support	2	Case	9.24	17.28 (3.41)	17 (20-15)	0.134 (0.076)	6.56	***_ 6.600 (0.0001 >)b
		Contr ol	6-18	10.72 (2.75)	10 (13-8)	*0.141 (0.048)		
Stress management	2	Case	16-36	24.41 (4.18)	24 (28-21)	0.129(0.101)	7.00	***8.55 (.0001>)a
		Contr ol	12-24	17.41 (2.91)	17 (20-15)	0.100 (0.200)		
Exercise	2	Case	6-24	13.31 (3.67)	13 (5-11)	*.143 (0.043)	3.59	***_ 4.847 (0.0001 >)b
		Contr ol	7-16	9.72 (2.45)	9 (11-8)	***.0231 (0.0001>)		
Nutrition	2	Case	4-28	20.80 (3.34)	21 (23-19)	**0.165 (0.009)	4.21	***_ 5.099 (0.0001 >)b
		Contr ol	12-25	16.56 (3.05)	17 (18-14)	*0.161 (0.12)		
Healthy style total score	2	Case	105-208	148.97 (20.99)	146 (164-135)	0.122 (0.152)	44.77	***11.0 93 (0.0001 >)a
		Contr ol	74-139	104.21 (13.95)	103 (111-96)	0.083 (0.200)		

\* -Significant at the 0.05 error level.

\*\* -Significant at the 0.01 error level.

\*\*\* -Significant at the 0.001 error level.

a: Parametric test statistic for independent samples t-test, b: Non-parametric test statistic for Mann-Whitney U test.

-Time 1: Start of the study (before the intervention), Time 2: End of the study (end of the third month of the study).



**Table 5. Descriptive statistics of the subcomponents fatigue score due to cancer among patients during the study follow-up period, separated by study groups.**

Questionnaire	Concept	Occasion	Group	Max - Min	Mean (SD)	Median ( $Q_3 - Q_1$ )	KS (sig.)	Mean difference	Result (sig.)
Cancer Fatigue Scale	Physical	1	1	11-31	21.15 (5.19)	22 (25-17)	0.087 (0.200)	3.41	***5.521 (0.001>)c
			2	10.2-8	17.74 (3.99)	17 (20-15)	0.112 (0.200)		
	Emotional	1	1	6-19	11.56 (3.46)	11 (14-9)	0.113 (0.200)	2.82	***6.661 (0.0001>)c
			2	5-14	8.74 (2.24)	9 (10-7)	0.117 (0.196)		
	Cognitive	1	1	5-20	11.23 (3.61)	11 (13-9)	0.132 (0.082)	2.61	***_4.317 (0.0001)_d
			2	5-15	8.61 (2.21)	8 (10-7)	*0.148 (0.032)		
	Total score of fatigue	1	1	22-70	43.95 (11.50)	44 (52-36)	0.080 (0.200)	8.85	***6.637 (0.0001>)c
			2	20-56	35.10 (8.03)	35 (40-30)	0.095 (0.200)		
	Physical	2	1	12-31	23.10 (4.77)	24 (27-20)	0.139 (0.056)	-2.05	***-5.761 (0.0001>)c
			2	16-31	25.15 (4.11)	26 (28-22)	0.111 (0.200)		
	Emotional	2	1	7-16	12.10 (2.50)	13 (14-11)	*0.153 (0.022)	-0.62	-2.224 (0.026_d)
			2	8-16	12.72	13 (14-	**0.1		



					(2.19)	11)	82 (0.002 )		
Cognitive	2	1	6-16	11.05 (2.72)	11 (13- 9)	*0.14 7 (0.032 )	-1.26	***_ 4.140 (0.0001> )d	
		2	8-16	12.31 (2.45)	13 (15- 10)	0.124 (0.135 )			
Total score of fatigue	2	1	26- 60	46.26 (9.59)	47 (53- 40)	*.014 6 (0.035 )	-3.92	***_ 4.747 (0.0001> )d	
		2	32- 62	50.18 (8.16)	52 (45- 57)	*.014 2 (0.047 )			

\* -Significant at the 0.05 error level.

\*\* -Significant at the 0.01 error level.

\*\*\* -Significant at the 0.001 error level.

c: Parametric test statistic for paired samples t-test, d: Non-parametric test statistic for Wilcoxon test.

-Group 1 (Intervention group): Group receiving education based on the Pender health promotion model, Group 2 (Control group): Control group.

-Time 1: Start of the study (before the intervention), Time 2: End of the study (end of the second month of the study).

**Table 6. Descriptive statistics of the health promotion subcomponents score among patients during the study follow-up period, separated by study groups.**

Concept	Occasion	Group	Max-Min	Mean (SD)	Median ( $Q_3 - Q_1$ )	KS (sig.)	Mean difference	Result (sig.)
<b>Self-actualization</b>	1	1	21-51	32.92(8.21)	32 (39-25)	0.115 (0.200)	-6.08	***10.95 (0.0001> )c
		2	26-52	39.00	38 (45-57)	0.110 (0.200)		



				(7.06)	33)			
<b>Responsibility</b>	1	1	16-43	28.38 (6.51)	28 (3-23)	0.083 (0.200)	-5.82	***-9.51 (0.0001>) c
		2	25-44	34.20(4.6 7)	34 (38- 30)	0.133 (0.080)		
<b>Inter-personal support</b>	1	1	8-24	15.03(4.3 9)	15 (18- 11)	0.092 (0.200)	-2.25	***-4.81 (0.0000>) c
		2	9-24	17.28 (3.41)	17 (20- 15)	0.134 (0.076)		
<b>Stress management</b>	1	1	10-33	19.17 (5.76)	17 (24- 14)	*.160 (0.013)	-5.23	***-5.138 (0.0001>) d
		2	16-36	24.41 (4.18)	24 (28- 21)	0.129 (0.101)		
<b>Exercise</b>	1	1	6-23	9.85 (4.45)	9 (12-9)	*** 0.242 (0.0001>)	-3.46	***-5.047 (0.0001>) d
		2	4-24	13.31 (3.67_	13 (15- 11)	*0.143 (0.043)		
<b>Nutrition</b>	1	1	10-27	17.74 (4.65)	17 (20- 14)	0.123 (0.144)	-3.03	***-4.422 (0.0001>) d
		2	14-28	20.77 (3.34)	21 (23- 19)	**0.165 (0.009)		
<b>Healthy style total score</b>	1	1	81- 194	123.11 (27.85)	117 (142- 101)	0.115 (0.200)	- 25.8 7	****- 11.67 (0.0001>) c
		2	105- 208	148.97 (20.99)	146 (164- 135)	0.122 (0.152)		
<b>Self-actualization</b>	2	1	16-39	27.43 (4.83)	26 (31- 24)	0.130 (0.097)	1.89	3.58 (0.001)c
		2	17-34	25.54 (4.71)	25 (30- 23)	0.116 (0.200)		
<b>Responsibility</b>	2	1	16-31	24.41 (4.01)	24 (28- 21)	0.100 (0.200)	0.15 4	0.448 (0.657)c
		2	17-33	24.26 (3.61)	25 (27- 21)	0.121 (0.155)		
<b>Inter-personal support</b>	2	1	7-18	11.82 (3.24) (3.24) 11.82	11 (14- 10)	** 0.174 (0.004)	1.10	**-2.761 (0.006)d
		2	6-18	10.72 (2.75)	10 (13-8)	* 0.141 (0.048)		
<b>Stress manage</b>	2	1	12-23	18.05 (2.83)	18 (21- 15)	*0.141 (0.049)	0.64 1	-1.723 (0.085)d



<b>ment</b>	2	12-24	17.41 (2.96)	17 (20- 15)	0.100 (0.200)		
<b>Exercise</b>	1	6-19	9.58 (2.76)	9 (11-18)	*** 0.200 (0.0001>)	-	-0.557
	2	7-16	9.72 (2.45)	9 (11-8)	*** 0.231 (0.0001>)	0.13 0	(0.577)d
<b>Nutrition</b>	1	11-24	16.79 (3.07)	16 (19- 14)	0.123 (0.144)		
	2	12-25	16.56 (3.05)	17 (18- 14)	*0.161 (0.012)	0.23 1	-0.907 (0.365)d
<b>Healthy style total score</b>	1	75- 142	108.10 (13.99)	107 (115- 100)	0.115 (0.200)	3.89	3.389
	2	74- 139	104.20 (13.94)	10.3 (111- 96)	0.083 (0.200)	7	(0.002)c

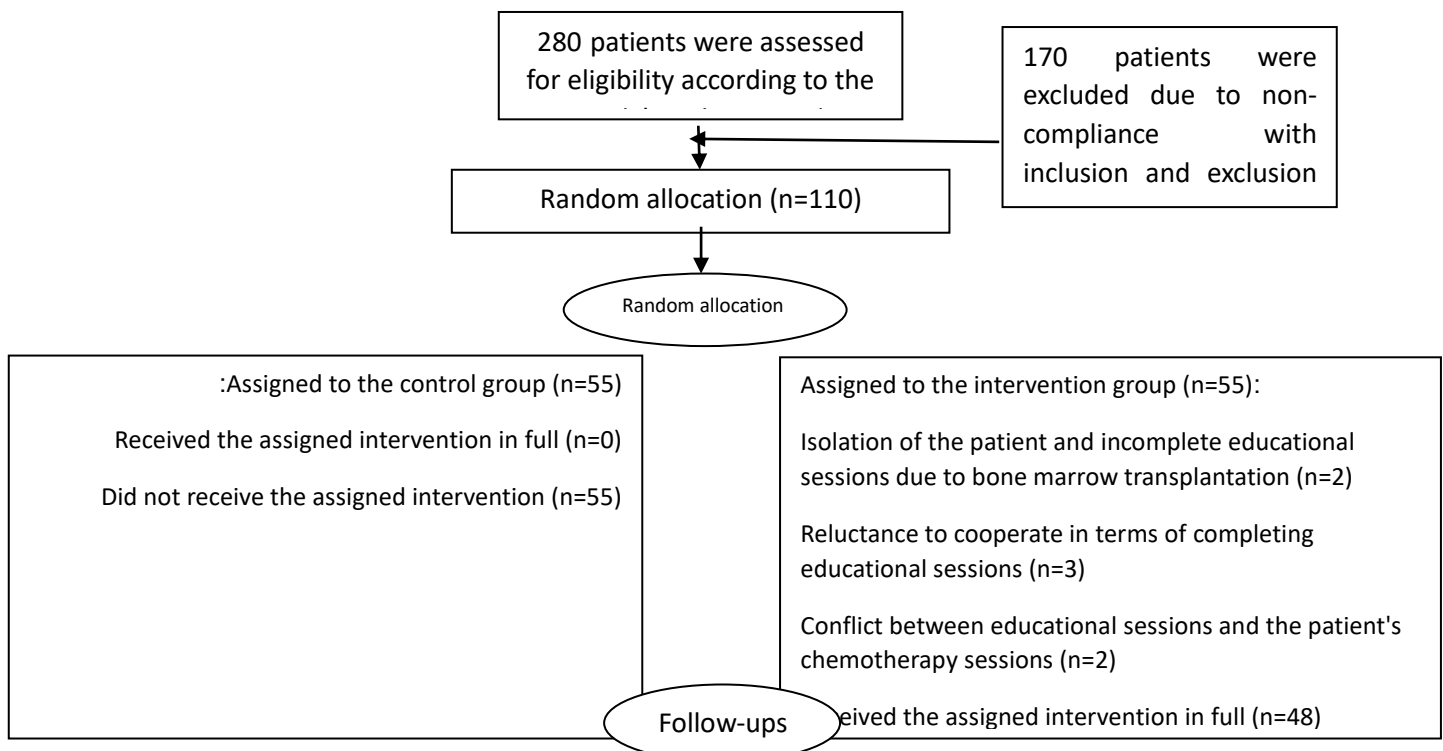
\* -Significant at the 0.05 error level.

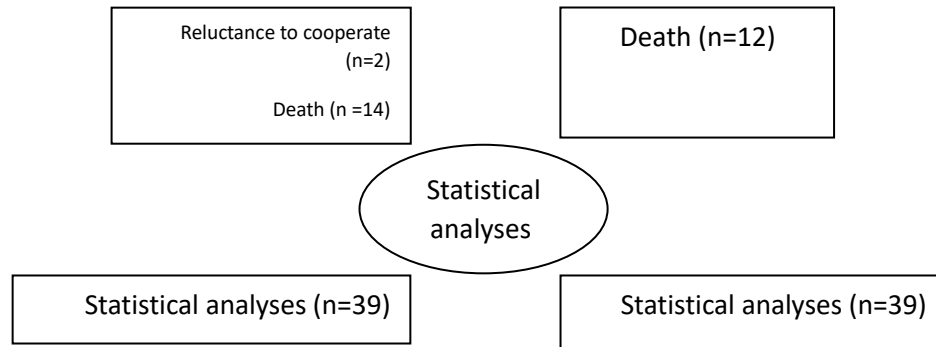
\*\* -Significant at the 0.01 error level.

\*\*\* -Significant at the 0.001 error level.

a: Parametric test statistic for independent samples t-test, b: Non-parametric test statistic for Mann-Whitney U test.

-Time 1: Start of the study (before the intervention), Time 2: End of the study (end of the third month of the study).





**Diagram 1 - CONSORT diagram**