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The Effects of a Web-Based Interactive Nurse Support Program Based on the Health Promotion Model on Healthy Living Behaviors and Self-Efficacy in Patients Who Regained Weight after Bariatric Surgery: A Randomized Controlled Trial

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Abstract

Purpose This study was conducted in order to determine the effects of web-based interactive nursing support program prepared in line with Health Promotion Model (HPM) on healthy lifestyle behaviors and self-efficacy of patients who regained weight following metabolic and bariatric surgery.

Materials and Methods A total of 62 patients with a history of weight regain at least two years after metabolic and bariatric surgery were divided into intervention ($n=31$) and control ($n=31$) groups by stratified randomization. The intervention group was given a web-based interactive nurse support program based on HPM for 10 weeks and followed up by telephone 12 times (every two weeks) in 6 months. No attempt was made to the control group during the study. The data were collected a total of 3 times before the training, in the 12th week and in the 6th month.

Results In the last test after the web-based interactive nurse support program and telephone follow-up, the difference was found to be statistically significant in terms of BMI, healthy lifestyle behaviors, eating behaviors, and general self-efficacy mean scores of the patients in the intervention group ($p < 0.05$). In addition, after the study, it was determined that the physical activity, nutrition, spiritual development, emotional eating and the Dutch Eating Behavior scales total score averages and Self-Efficacy Scale total score averages of the intervention group changed positively compared to the control group, and this change was statistically significant ($p < 0.05$). There was no difference between the groups in the mean scores of health responsibility, interpersonal relationships, stress, restrictive eating, external eating and Healthy Lifestyle Behaviors-II Scale ($p > 0.05$).

Conclusion It can be stated that the web-based interactive nurse support program based on HPM is applicable in patients who regain weight after metabolic and bariatric surgery, and it contributes positively to the healthy lifestyle behaviors, BMI, eating behaviors, and general self-efficacy of these patients. In order to ensure the continuity of post-operative patient follow-up, it is recommended to increase the importance of telephone counseling and to establish follow-up program based on the HPM.

Keywords Health promotion model · Healthy living behaviors · Self-efficacy · Web-based interactive nurse support program · Weight regain after bariatric surgery

Key points

- Lifestyle change is necessary if long-term success is to be achieved after metabolic and bariatric surgery.
- Model-based nursing intervention is important to improve healthy behaviors and self-efficacy in patients undergoing metabolic and bariatric surgery.
- A web-based nurse support program is important for the long-term follow-up of patients after metabolic and bariatric surgery.

*The study has not been published elsewhere.

Extended author information available on the last page of the article

Introduction

Today, although metabolic and bariatric surgery is an effective treatment method for losing weight and maintaining weight loss, 20–30% of patients cannot achieve the weight they target or may start to gain weight starting from the postoperative 18th-24th month [1–5]. There is no generally accepted definition for substantial weight regain, and different studies use different descriptions, which are based on kilograms, body mass index (BMI) units, or percentages of

excess weight loss (EWL%) gained [6–8]. Some researchers consider regaining 15% of the extra weight lost as weight regain, while others consider regaining 25% of it as weight regain [7]. Furthermore, it is important to differentiate weight regain from insufficient weight loss. The latter is a weight loss of < 50% of EWL after surgery while the former is an increase in weight after initially successful weight loss [8]. There are a few main reasons for regaining weight following metabolic and bariatric surgery, including failure to change lifestyle, hormonal and metabolic imbalances, and anatomical/surgical methods [7, 9]. Therefore, lifestyle changes are indispensable for maintaining positive results after metabolic and bariatric surgery [10, 11]. Nurses play a significant role in providing patients with training and counseling to encourage them to adapt to the changes in lifestyle after their metabolic and bariatric surgery [12, 13]. Nurses have important roles in the period following metabolic and bariatric surgery in terms of maintaining medical follow-ups, taking responsibility for one's health, ensuring regular healthy nutrition and physical activity, setting realistic objectives, improving health, reducing anxiety, achieving self-discipline, taking back control, regulating behaviors, and encouraging new behaviors [12–15]. In this context, many models can be used in the field of nursing to ensure the long-term adaptation of patients after surgery, increase their self-efficacy, and help them adopt healthy behavioral patterns.

Pender's Health Promotion Model (HPM) emphasizes that the individual's self-efficacy perception is an important factor in activating and continuing health promoting behaviors. According to HPM, determining what meanings the individual attributes to his/her health, from what positive or negative perspectives s/he sees his/her own health behaviors, and how s/he manages these are important in terms of getting him/her to gain a new behavior [16, 17]. Hence, providing nursing education through Pender's HPM is important in terms of promoting healthy lifestyle behaviors in patients who regain weight following the metabolic and bariatric surgery and their maintenance of a long-term and high-standard life.

Maintaining counseling for patients following discharge is important, but patients may experience problems after discharge such as not being adequately informed, not remembering the information provided, needing re-education, encountering new problems not included in the education program, the absence of a bariatric surgery center in some hospitals, and experiencing difficulties in access to healthcare professionals. It has been stated that new support forms provided on the internet will provide ease of access for individuals who cannot keep up with regular medical follow-ups after bariatric surgery or those who seek additional medical support [18]. Technological developments and trends in access to information related to health over the internet have

also brought along changes in patient education. In recent years, web-based patient education has been accepted as one of the most significant innovative approaches in the profession of nursing [19]. Hence, the use of technologies such as tele-medicine is important for increasing the interaction between the patient and healthcare professionals, minimizing obstacles such as time, distance, and cost, and following patients up in the postoperative period [20, 21]. The reason for applying a web-based interactive nurse support program in this study was that obesity-related health problems have become common worldwide, and they are threatening public health. In this context, basic concepts and principles included in HPM developed by Pender provide guidance. Digital technologies also provide opportunities to patients in this regard [22]. Web-Based Training (WBT) is considered an effective tool for providing health training to nurses due to its many advantages over printed materials [21–26]. When web-based patient training programs applied in the world and Türkiye were examined, it was seen that there were studies that investigated the health outcomes of training provided in various health problems [24–30]. Besides, although a limited number of studies conducted in Türkiye were encountered in the literature in which web-based training was provided by using nursing models, no national and international study was encountered which evaluated the efficiency of web-based interactive nursing support program provided to the patients who regained weight after metabolic and bariatric surgery in line with HPM [31, 32].

Aim This study was conducted in order to determine the effect of web-based interactive nursing support program prepared in line with HPM on healthy lifestyle behaviors and self-efficacy of patients who regained weight following metabolic and bariatric surgery.

Methods

Design The study is a Randomized Controlled Trial (RCT). The present study includes the RCT part of a doctoral dissertation study conducted by using mixed method. Clinical-Trials.gov.ID: NCT04868279.

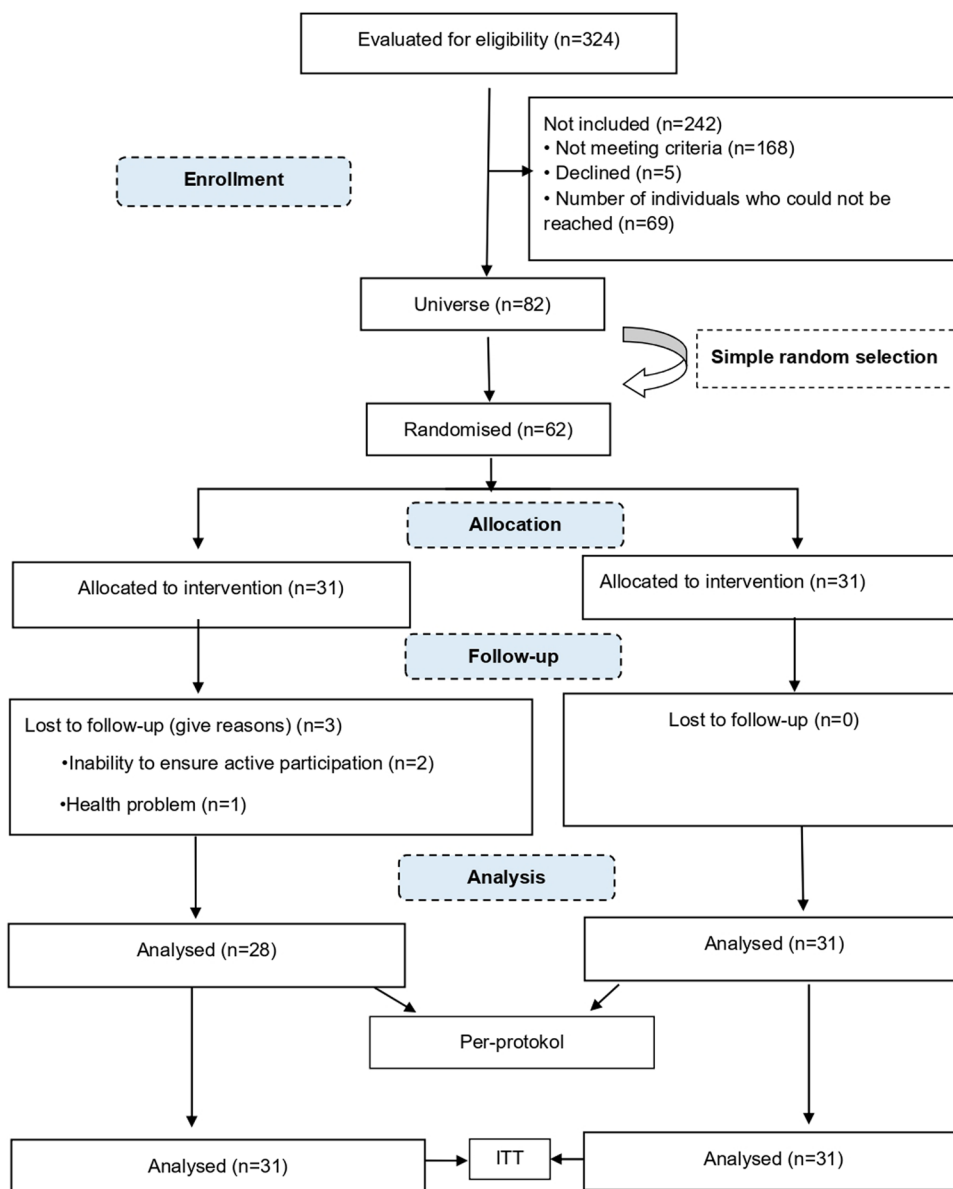
Participants The study population consisted of patients who had undergone metabolic and bariatric surgery at a university hospital and regained weight afterwards between 2015–2019. The required sample size was determined to be 56 patients with 80% impact size, 90% power, and 0.05 significance level. Considering the probability of sample loss, 10% more of the calculated sample size was included in the sample. 31 patients were assigned to each group. One patient in the intervention group was excluded from the study due to health reasons, although they had agreed to participate in the study, and 2 patients were excluded from the study as they

did not regularly participate in the web-based nurse support program despite having online access to the program.

Randomization Randomization was performed by a statistician. It was carried out after obtaining the consent of the patients and applying the first data collection tools. The sample of the study (n = 62) was randomly selected from the population (N = 82) using a simple random numbers table. In both groups, stratification was performed to ensure a balanced distribution in terms of sex. Until the interventions started, the researchers did not have information about who would be in the intervention and control groups. The CONSORT (2010) flow diagram of the study is given in Fig. 1.

Blinding Blinding in this RCT was ensured in terms of the statistical analysis of the data, data collection and the reporting of the results. The data were collected by a researcher other than the researchers who had knowledge about the research. The research data were coded and transferred to the computer without specifying the intervention and control groups (for example, group A and group B). The analysis and reporting of the data were performed by a statistician. After the statistical analyzes were made and the research report was written, the coding for the intervention and control groups was explained. This way, detection bias, statistical bias, and reporting bias were checked.

Fig. 1 Consort of Research (2010) Follow Diagram



Weight Regain Calculation In order to determine whether there was a weight regain in the patients included in the study, the formula in the literature “the case is accepted to have weight regain if the difference between the preoperative weight and the nadir weight achieved after the surgery is 15% and more” was used [10, 33–35]. In this study, weight regain was defined as gaining at least 15% of the weight that had been lost after metabolic and bariatric surgery.

Inclusion Criteria Patients who were 18 years old or older, had undergone laparoscopic sleeve gastrectomy or gastric bypass, had undergone metabolic and bariatric surgery more than two years ago, and had a history of weight regain, who could communicate in Turkish, were independent in their activities of daily living, had a computer or mobile phone with internet connection, and were literate, were included in the sample of the study.

Exclusion Criteria Patients who had chronic diseases, those who were pregnant, and those who were already included in a healthy life program were excluded from the study.

Data Collection Tools

Personal Information Form In the form, there are 9 questions that include the identifying characteristics of patients (age, sex, occupation, education level, marital status, income level, time of surgery, time to start weight regain, smoking and alcohol use, type of surgery).

Healthy Lifestyle Behaviors Scale II The scale was developed by Walker et al. in line with Pender’s HPM in order to measure individuals’ health promotion behaviors [36]. The Turkish adaptation study of the scale was conducted by Bahar et al. [37]. The scale consists of 52 items in total and consists of 6 subgroups. The scale is scored between 52–208. A high score from the HLBS- II scale indicates that the individual has more positive health behaviors in her/his life.

The scale’s Cronbach’s alpha coefficient was found as 0.93 in this study.

General Self-Efficacy Scale The scale developed by Sherer et al. and adapted to Turkish by Yildirim and Ilhan aims to measure general self-efficacy levels of adult individuals [38, 39]. The scale is scored between 17–85. An increase in the total score of the scale indicates an increase in self-efficacy belief. The scale’s Cronbach’s alpha coefficient was found as 0.72 in this study.

The Dutch Eating Behavior Questionnaire (DEBQ) The scale developed by Van Strein et al. was adapted to Turkish by Bozan [40, 41]. The scale has three subscales, which are

emotional eating, external eating, and restrained eating. High scores obtained from the scale provide information of the eating behavior of the respondent. The scale’s Cronbach’s alpha coefficient was found as 0.91 in this study.

DISCERN Measurement Tool Scale was developed by Charnock et al. and translated into Turkish by Gokdogan [42, 43]. DISCERN was developed to evaluate the quality of written educational materials and web pages. It consists of 16 questions. A total score of 15–75 can be obtained from the measurement tool. A low score indicates low quality, and a high score indicates high quality.

Web Site Usability Scale The scale was developed by Kilic Cakmak et al. to determine the usability of Web sites [44]. There are 25 questions in total in the scale. Five-point Likert type. The lowest score to be taken from the scale is 25 and the highest score is 125. A high score from the scale indicates that the usability of the website is high. The scale’s Cronbach’s alpha coefficient was found as 0.89 in this study.

Implementation of the Study The web-based interactive nursing support program based on HPM and the educational content within it were created by the researchers. The training content was supported by videos, text, and images taken by the researchers. The study was conducted over “<http://www.saglikliyasamdavranislari.com>” web link. The support of a software expert was received in the design of the web page. The prepared training content was transferred to the created website. The website prepared was presented to the opinion of experts consisting of ten people (physician, academician nurse, psychiatrist, dietitian). They were asked to evaluate using the DISCERN Measurement Tool. Afterwards, a preliminary implementation was made with 6 patients over two weeks in order to test the comprehensibility of the website. These patients were not included in the study. The web-based interactive nursing support program was applied to the intervention group for 10 weeks, while the randomized controlled trial part took 6 months. The reason why the study was planned for 6 months was that the planned behavioral change could take place within this period. According to the model developed to facilitate behavioral change, individuals can make distinctive and original changes in their problematic behaviors within six months [45, 46]. 2 weeks were allocated for each section of training content, and in the first week, the patients were allowed to have access to training content by entering the website. Starting from the time they entered the website and started the training, the period they used the website actively were recorded. In the second week, they were contacted through telephone. Telephone interviews were made by the researcher. Telephone interviews were conducted with the intervention group every two weeks for six months, lasting

an average of 15–20 min with each individual. Each interview was continued in relation to the previous interview. In these phone calls, the patients' use of the website, the technological problems and difficulties experienced during the use of the website, the training content of that week, the issues that need to be clarified in the training content, the status of healthy living behaviors, the perceived obstacles in healthy living behaviors and solution suggestions were discussed. The control group could not access the educational content during the research, and telephone conversations were not made with the individuals in this group during the research. A short message was sent to individuals' phones only to remind them to use the website to fill out data collection forms. The control group only had access to the data collection tools to compare their results to those of the intervention group. After the study was completed, a web-based interactive nurse support program was made open to the access of the individuals in the control group, and the "principle of equality" was provided in terms of ethics. During the study, no face-to-face contact was made with the patients. At the end of the study, the Web Site Usability Scale was applied to the individuals in the intervention group to evaluate the usability of the Web site.

Web-Based Interactive Nursing Support Program Training Content The content of the training program consisted of 5 parts, which are Part 1: Obesity and Bariatric Surgery, Part 2: Sufficient and Balanced Nutrition, Part 3: Regular Exercise, Part 4: Effective Coping with Stress, Part 5: Developing Positive Attitude and Problem-Solving Skills. In order to evaluate the quality and reliability of the website, expert opinions were obtained from patients experienced in the field. The content of the training consisted of written, visual and video demonstrations at a level that patients can understand. Each patient was recommended to perform brisk walking aerobic exercise for an average of 40 min 3 days a week. In addition, it was recommended to do resistance exercises for 2 days and follow-up was made in this regard. While determining the tempo of the exercise, the target heart rate formula of the Turkish Heart Foundation while exercising was taken into account and recommended to the patients [47].

Data Analysis

The data obtained in the study were analyzed by using SPSS 22 software. Independent samples t test, variance analysis, Bonferroni test, Friedman test, Wilcoxon test, Mann Whitney U test were used in data analysis. In the evaluation of quantitative data, Chi-square test, number, frequency, mean and standard deviation, impact size, and confidence interval were used. The data were evaluated with 0.05 margin of error and 95% confidence interval. In the study, since it was

possible to reach 3 patients who left the intervention group in the study process for Intention to Treat (ITT) analysis, the data collection tools were administered to them, and thus missing data were completed. Impact size was calculated through G*Power 3.1.9.7 software by using mean scores and standard deviation values. The findings obtained from ITT analysis and per-protocol analysis were similar.

Results

When Table 1 is examined, it is seen that the intervention group and the control group showed similar characteristics in terms of mean age, sex, marital status, educational status, employment status, smoking and alcohol consumption, and time of surgery, and there was no significant difference between the groups ($p > 0.05$).

The DISCERN Measurement Tool total score regarding the quality and reliability of the website was determined to be 70.00 ± 4.71 . It has been determined that the quality of the website is high. The total mean score of the Web Site Usability Scale was found to be 110.48 ± 10.22 . It has been determined that the usability and quality of the website is high.

In Table 2, the distribution of BMI mean scores of the patients in the intervention group and the control group is presented. There was loss of weight between the follow-ups in the intervention group, and the statistical analysis revealed a statistically significant difference between the 2nd and 3rd follow-up mean scores ($p < 0.05$). On the other hand, there was a weight regain in the control group between the follow-ups, and the statistical analysis showed a statistically significant difference between the 1st and 3rd follow-up mean scores ($p < 0.05$).

Table 3 shows the distribution of HLBS-II mean scores. In the intervention group, a statistically significant difference was found between the follow-ups in the subscales of health responsibility, physical activity, nutrition, and interpersonal relations and the total scale score ($p < 0.05$). When the two groups were compared, a statistically significant difference was found between them in terms of physical activity, nutrition, and spiritual development subscales ($p < 0.05$).

Table 4 presents the distribution of DEBQ mean scores. In the intervention group, a statistically significant difference was determined between the follow-ups in terms of external eating subscale score and total scale score ($p < 0.05$). When the intervention and control groups were compared, a statistically significant difference was found in terms emotional eating subscale score and total scale score ($p < 0.05$).

When Table 5 was examined, a statistically significant difference was determined between the 2nd and 3rd follow-ups in the General Self-Efficacy Scale mean scores of the intervention group ($p < 0.05$). It was determined that

Table 1 Demographic Characteristics of Patients in the Intervention and Control Group

Demographic Characteristics	Intervention Group (n = 31)	Control Group (n = 31)	Test Value and Significance
Age	$\bar{X} \pm SS$ 38.41 ± 8.23 Min–Max 22–53 n (%)	$\bar{X} \pm SS$ 37.38 ± 7.32 Min–Max 25–55 n (%)	t = 5.22 p = 0.604
Gender			
Female	19(61.3)	18(58.1)	X ² = 0.67 p = 0.796
Male	12(38.7)	13(41.9)	
Marital status			
Married	25(80.6)	26(83.9)	X ² = 0.111 p = 0.740
Single	6(19.4)	5(16.1)	
Educational Status			
Primary school graduate	4(12.9)	6(19.4)	X ² = 1.111 p = 0.774
secondary school graduate	4(12.9)	5(16.1)	
High school graduate	9(29.0)	6(19.4)	
Graduated from a Universty	14(45.2)	14(45.1)	
Working Status			
Working	19(61.3)	22(71.0)	X ² = 0.648 p = 0.421
Not working	12(38.7)	9(29.0)	
Economical situation			
Income less than expenses	5(16.1)	7(22.6)	X ² = 0.657 p = 0.720
Income equals expense	19(61.3)	16(51.6)	
Income more than expenses	7(22.6)	8(25.8)	
Smoking Status			
Yes	13(41.9)	15(48.4)	X ² = 0.261 p = 0.610
No	18(58.1)	16(51.6)	
Alcohol Use Status			
Yes	5(16.1)	7(22.6)	X ² = 0.413 p = 0.520
No	26(83.9)	24(77.4)	
Time to Have Surgery			
2–5 years ago	17(54.8)	16(51.6)	X ² = 0.065 p = 0.799
5 years and earlier	14(45.2)	15(48.4)	
Type of Surgery			
Sleeve Gastrectomy	24(77.4)	24(77.4)	--
Gastric Bypass	7(22.6)	7(22.6)	

Table 2 Body Mass Index Score Averages of Patients in the Intervention and Control Group

Body Mass Index Score Averages			
BMI Measurement Times	Intervention Group (n = 31)	Control Group (n = 31)	Intra-group Comparison
	$\bar{X} \pm SS$	$\bar{X} \pm SS$	Test Value and Significance
1 st follow-up	32.37 ± 5.26	33.23 ± 6.06	t = 0.598 p = 0.552
2 nd follow-up	32.39 ± 4.94	33.91 ± 5.71	t = 1.125 p = 0.265
3 rd follow-up	31.66 ± 4.89	34.38 ± 6.33	t = 1.887 p = 0.064
Test Value and Significance	F = 3.987 p = 0.024*	F = 4.183 p = 0.020*	
Intergroup Comparison	2–3 p = 0.002*	1–3 p = 0.049*	

* p < 0.05; BMI: Body Mass Index

Table 3 Healthy Lifestyle Behaviors-II Scale Scores of Patients in the Intervention and Control Group

	1 st follow-up	2 nd follow-up	3 rd follow-up	Intra-group Comparison	Effect Size
Health Responsibility Sub-Dimension					
Intervention Group (n = 31)	19.16 ± 5.79	20.90 ± 4.55	23.12 ± 6.96	X ² = 9.551 p = 0.008*	0.824
Control Group (n = 31)	18.77 ± 4.84	19.54 ± 5.48	19.77 ± 5.08	F = 0.810 p = 0.450	(0.286–1.363)
Intergroup Comparison	z = 0.007 p = 0.994	z = 1.378 p = 0.168	z = 1.699 p = 0.189	1-3p = 0.030* 2-3p = 0.016*	
Physical Activity Sub-Dimension					
Intervention Group (n = 31)	14.35 ± 5.38	16.83 ± 5.22	19.51 ± 7.97	X ² = 18.305 p = 0.001*	1.279 (0.688–1.870)
Control Group (n = 31)	15.70 ± 4.48	14.45 ± 4.90	15.16 ± 5.32	F = 1.377 p = 0.260	
Intergroup Comparison	z = 1.511 p = 0.131	z = 1.913 p = 0.056	z = 2.285 p = 0.022*	1-2p = 0.023* 1-3p = 0.001* 2-3p = 0.004*	
Effect Size			0.642 (0.131–1.152)		
Nutrition Sub-Dimension					
Intervention Group (n = 31)	19.29 ± 4.03	20.58 ± 2.87	23.41 ± 5.70	F = 10.104 p = 0.001*	1.136
Control Group (n = 31)	19.90 ± 3.62	20.67 ± 3.52	20.00 ± 3.60	F = 0.808 p = 0.451	(0.377–1.895)
Intergroup Comparison	t = 0.629 p = 0.532	t = 0.118 p = 0.906	t = 2.820 p = 0.007*	1-3p = 0.005* 2-3p = 0.004*	
Effect Size			0.715 (0.202–1.229)		
Spiritual Development Sub-Dimension					
Intervention Group (n = 31)	26.25 ± 4.91	26.22 ± 4.27	28.03 ± 5.60	F = 2.809 p = 0.068	
Control Group (n = 31)	25.74 ± 4.96	25.00 ± 5.16	25.12 ± 4.48	F = 0.766 p = 0.469	
Intergroup Comparison	t = 0.411 p = 0.682	t = 1.018 p = 0.313	t = 2.251 p = 0.028*		
Effect Size			0.574 (0.066–1.082)		
Interpersonal Relations Sub-Dimension					
Intervention Group (n = 31)	24.06 ± 5.34	24.64 ± 3.72	27.12 ± 5.35	F = 7.382 p = 0.001*	0.950 (0.208–1.693)
Control Group (n = 31)	24.09 ± 5.35	24.90 ± 4.55	25.96 ± 4.33	F = 2.605 p = 0.082	
Intergroup Comparison	t = 0.024 p = 0.981	t = 0.244 p = 0.808	t = 0.900 p = 0.372	1-3p = 0.011* 2-3p = 0.001*	
Stress Sub-Dimension					
Intervention Group (n = 31)	17.12 ± 4.37	18.74 ± 3.44	20.19 ± 6.41	X ² = 3.910 p = 0.142	
Control Group (n = 31)	19.61 ± 5.64	16.96 ± 4.32	17.16 ± 4.00	X ² = 4.429 p = 0.109	
Intergroup Comparison	z = 0.1.907 p = 0.057	z = 2.037 p = 0.042*	z = 1.576 p = 0.115		
Effect Size		0.450 (0.048–0.960)			
HLBS-II Total					
Intervention Group (n = 31)	120.25 ± 23.09	127.93 ± 19.54	142.80 ± 36.37	X ² = 9.534 p = 0.009*	0.824 (0.286–1.363)
Control Group (n = 31)	123.54 ± 18.84	121.54 ± 21.82	123.19 ± 20.70	F = 0.336 p = 0.716	
Intergroup Comparison	z = 1.113 p = 0.266	z = 1.246 p = 0.213	z = 1.859 p = 0.063	1-3p = 0.022* 2-3p = 0.001*	

*p < 0.05

there was a statistically significant difference between the intervention group and the control group in the 3rd follow-up in terms of the General Self-Efficacy Scale mean scores, and that the mean score of the intervention group increased in the positive direction compared to that of the control group ($p < 0.05$).

Discussion

It can be claimed that adopting effective weight management and healthy lifestyle behaviors involves practices that require time in one's social life, and therefore, it cannot

be adapted to in the short term. It can also be stated that merely providing patients with information and telling them what to do to create changes in their healthy lifestyle behaviors is not enough for them to change these behaviors and increase their self-efficacy, and it is important to maintain the communication between the nurse and the patient, as well as the follow-ups. One may argue that if patients who have undergone metabolic and bariatric surgery take personal responsibility for lifestyle changes, follow the recommendations of healthcare professionals, and use healthy coping strategies, this will help them not only gain a new perspective regarding the facilitating factors of and barriers to these changes but also become aware of their

Table 4 Dutch Eating Behavior Scale Scores of Patients in the Intervention and Control Group

Dutch Eating Behavior Scale Mean Scores					
	1 st follow-up	2 nd follow-up	3 rd follow-up	Intra-group Comparison	Effect Size
	$\bar{X} \pm SS$	$\bar{X} \pm SS$	$\bar{X} \pm SS$	Test Value and Significance	
Emotional Eating Sub-Dimension					
Intervention Group (n = 31)	39.15 ± 14.21	37.48 ± 14.93	34.09 ± 16.61	F = 2.531 p = 0.088 F = 1.433 p = 0.247	
Control Group (n = 31)	39.09 ± 13.06	40.35 ± 13.90	42.45 ± 11.29		
Intergroup Comparison	t = 0.130 p = 0.897	t = 0.783 p = 0.437	t = 2.315 p = 0.025*		
Effect Size			0.589 (0.080–1.907)		
Restrictive Eating Sub-Dimension					
Intervention Group (n = 31)	29.83 ± 7.07	30.29 ± 5.49	29.83 ± 5.92	F = 0.090 p = 0.914 F = 0.304 p = 0.739	
Control Group (n = 31)	31.06 ± 6.81	31.19 ± 6.37	31.96 ± 5.42		
Intergroup Comparison	t = 0.695 p = 0.490	t = 0.597 p = 0.552	t = 0.475 p = 0.145		
External Eating Sub-Dimension					
Intervention Group (n = 31)	29.58 ± 8.17	27.06 ± 7.03	25.09 ± 8.13	F = 5.761 p = 0.005* F = 1.227 p = 0.300 ^{1–3} p = 0.024*	0.803 (0.071–1.535)
Control Group (n = 31)	29.16 ± 8.22	30.19 ± 7.93	28.51 ± 8.67		
Intergroup Comparison	t = 0.201 p = 0.841	t = 1.643 p = 0.106	t = 1.643 p = 0.115		
Dutch Eating Behavior Scale Total					
Intervention Group (n = 31)	98.96 ± 18.42	94.83 ± 18.87	89.29 ± 22.36	F = 4.303 p = 0.018* F = 0.991 p = 0.377 ^{1–3} p = 0.042*	0.718 (0.008–1.445)
Control Group (n = 31)	99.32 ± 16.26	101.74 ± 17.27	102.93 ± 16.54		
Intergroup Comparison	t = 0.080 p = 0.936	t = 1.502 p = 0.138	t = 2.730 p = 0.008*		
Effect Size			0.694 (0.181–1.206)		

* p < 0.05

Table 5 General Self-Efficacy Scale Scores of Patients in the Intervention and Control Group

General Self-Efficacy Scale Scores				
Application Times of the Scale	Intervention Group (n = 31)	Control Group (n = 31)	Intra-group Comparison	Effect Size
	$\bar{X} \pm SS$	$\bar{X} \pm SS$	Test Value and Significance	
1 st follow-up	61.00 ± 10.03	62.80 ± 12.19	t = 0.637 p = 0.527	0.573 (0.065–1.081)
2 nd follow-up	60.93 ± 11.37	61.64 ± 11.48	t = 0.245 p = 0.808	
3 rd follow-up	66.54 ± 10.53	60.51 ± 10.51	t = 2.257 p = 0.028*	
Test Value and Significance	F = 4.655 p = 0.013*	F = 0.878 p = 0.421		
Intergroup Comparison	^{2–3} p = 0.017*	—		
Effect Size	0.718 (0.008–1.445)			

own behaviors. Additionally, it can be emphasized that the more individuals adhere to healthy living behaviors, the more likely they are to be successful in this regard. In other studies, the effect of healthy lifestyle behaviors on weight management was examined and similar results were obtained [48–51].

In the review of the relevant literature that was conducted for this study, no study which included a training program aimed at investigating the healthy lifestyle behaviors of patients who regained weight after metabolic and bariatric surgery was encountered. However, in studies conducted by providing training to individuals in order for them to develop healthy lifestyle behaviors, similar results to the results

of the present randomized controlled trial were obtained [52–55]. In national studies on individuals who were in the 5th year following bariatric surgery, HLBS mean scores were found to be at a moderate level [56].

It was determined that web-based interactive nursing support program based on HPM and follow-up through telephone positively contributed to the self-efficacy levels of the patients in the intervention group, and statistically significant difference was identified in the intergroup comparison in the last follow-up. There are studies in the literature which revealed that self-efficacy was associated with postoperative recovery, and that self-efficacy levels increased after metabolic and bariatric surgery and weight loss [57–59]. Furthermore, clinical research that support the findings of the present study showed that self-efficacy development programs were effective, and the self-efficacy levels and healthy lifestyle behaviors of the patients improved following the training [55, 60].

In the present study, emotional eating behavior according to the DEBQ was determined to be more dominant, and a statistically significant difference was found between the intervention group and the control group in the last follow-up in terms of emotional eating behavior mean score. In studies that examined emotional eating behavior in the period following bariatric surgery, emotional eating was reported to be intensively observed, which affected weight regain [10, 33, 49, 61]. In the current study, a change in the positive direction in the external eating behavior of the intervention group was observed between the 1st follow-up and 3rd follow-up ($p < 0.05$). Subramaniam et al. [62] supported the results of our research. In the intergroup and intragroup comparisons made in the present study, no significant difference was found between restraining eating behavior mean scores ($p > 0.05$). This situation can be explained by the fact that a more restrained eating behavior is common in individuals who have undergone metabolic and bariatric surgery as the surgical procedure itself leads to anatomical and physiological changes. The findings of other studies where restrained eating behaviors were evaluated in patients who had undergone metabolic and bariatric surgery also supported the results of the present study [59–64].

It was determined in the present study that the web-based interactive nursing support program provided in line with the HPM and follow-up through telephone positively contributed to BMI levels of the patients in the intervention group. The findings of the study are in parallel with the results of national and international studies [53–55, 65–67]. There is a limited number of studies in the literature on successful lifestyle or behavioral intervention regarding weight regain following metabolic and bariatric surgery. Hence, it is believed that there is a need for intervention studies on how to prevent weight regain after metabolic and bariatric surgery.

Limitations The limitations of the study included the fact that patients who did not have a computer or a mobile phone with internet connection were not able to use the web-based training program, and the patients who were included in the study measured their own weight and height.

Conclusion

In conclusion, as a result of the web-based interactive nurse program based on HPM and the follow-ups through telephone conversations, it was determined that the general self-efficacy, DEBQ, BMI, health responsibility, physical activity, nutrition, interpersonal relationships, and general healthy lifestyle behavior mean scores of the patients in the intervention group positively improved, and this change was statistically significant. Hence, it was determined that the web-based interactive nurse support program based on HPM was applicable in patients who regained weight after metabolic and bariatric surgery. The results of this study provide nurses with the information they need to support patients and provide necessary care to obese individuals. The care of patients with morbid obesity is quite complex, and it is important for nurses working with this patient group to have knowledge and skills specific to this field in order to provide holistic and systematic care. However, it should be considered that there is a need for new studies on this subject using the nursing model. In order to make comparisons in studies, it is recommended to perform ITT analyzes and calculate effect sizes and confidence intervals. In order to ensure the continuity of post-operative patient follow-up, it is recommended to increase the importance of telephone counseling and to establish a standard follow-up program based on the HPM. It is suggested that the web-based training program prepared to increase healthy living behaviors and self-efficacy in individuals undergoing bariatric surgery should be carried out with a multidisciplinary team approach by including different areas of expertise such as physicians, psychologists, dietitians, as well as nurses.

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Declarations

Ethical Approval Prior to the study, necessary permissions were taken from Sivas Cumhuriyet University Ethics Committee (Decision No:2021–04/57; Date:14.04.2021) and the hospital where the study was conducted. In addition, permissions were obtained from the authors of the scales used as data collection tools in the study through e-mail. The principles of the Declaration of Helsinki have been complied with.

Informed Consent Informed consent was obtained from the all participants included in the study.

Conflict of Interest The authors declared no conflict of interest.

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