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ORIGINAL RESEARCH

Effects of Education on Treatment Adherence and Fatigue in Individuals with Treatment-Inadherent Iron Deficiency Anemia: A Randomized Trial in Türkiye

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Purpose: This study was conducted to determine the effects of education given to individuals with iron deficiency anemia on treatment compliance and fatigue.

Methods: The study included 63 patients, divided into intervention and control groups, who were admitted to or received inpatient treatment at the State Hospital Internal Medicine and Hematology Clinic between December 2023 and June 2024. The study was designed using an intervention design with a pretest, interim, and posttest control group. Our study examined treatment compliance and fatigue levels.

Results: At pre-test, there were no significant differences between the Intervention (MMAS-4: 0.58 ± 0.76; Fatigue: 69.86 ± 18.66; Energy: 22.72 ± 8.03) and Control groups (MMAS-4: 0.56 ± 0.67; Fatigue: 74.30 ± 20.95; Energy: 23.66 ± 9.44; $p>0.05$). At interim and post-test, treatment adherence significantly improved in the Intervention group (Interim 3.35 ± 0.71; Post-test 3.65 ± 0.84) compared to the Control group (Interim 0.59 ± 0.87; Post-test 0.38 ± 0.83; $p<0.001$).

Fatigue scores decreased significantly in the Intervention group (Interim 69.86 ± 18.66; Post-test 34.38 ± 10.15) but increased in the Control group (Interim 74.30 ± 20.95; Post-test 85.32 ± 22.45; $p<0.001$). Energy scores improved in the Intervention group (Interim 22.72 ± 8.03; Post-test 37.56 ± 5.67) while declining in the Control group (Interim 23.66 ± 9.44; Post-test 20.45 ± 11.02; $p<0.001$).

Conclusion: Nurse-led education significantly improved adherence and reduced fatigue, supporting integration of structured patient education in IDA management.

Keywords: Türkiye, nursing education, randomized controlled trial, treatment adherence, fatigue

Introduction

Iron Deficiency Anemia (IDA) remains the most prevalent form of anemia worldwide despite significant global health improvements.[1,2] IDA is among the most commonly acquired anemias as a result of insufficient intake of iron that is required for the body or rapid depletion of iron stores.[3–5]

IDA accounts for 50% of anemias on a global scale.[4,6] WHO estimates that globally, 30.7% of all women (15–49 years), 35.5% of pregnant women, 30.5% of non-pregnant women (15–49 years), and 39.8% of children aged 6–59 months are anemic.[7] 42% of children worldwide are affected by IDA.[8]

The etiology of IDA varies according to gender, age, and socioeconomic status.[1,4,9] IDA develops because of reasons such as inadequate iron intake, inadequate iron absorption, and increased need for iron or iron loss.[9] The etiology and risk factors of IDA include frequent consumption of snacks, increased fast food intake,

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vegetarianism, level of development, parasitic diseases, medications used, blood donation, etc.[6,10–12] It was reported in previous studies that its incidence increases in low-income societies.[13] It is usually caused by nutritional deficiencies and is a public health problem in many countries, regardless of the level of development.[1,2,4] IDA is more common in women and occurs as a result of menstrual bleeding and pregnancy in premenopausal women, and as a result of gastrointestinal (GI) bleeding and malabsorption in postmenopausal women and adult men.[14,15]

In anemia, the signs and symptoms vary depending on the age of the individual, comorbidities, and the severity and duration of anemia. In some cases, the disease may not show any symptoms despite the presence of anemia.[3] The most common symptoms of IDA include fatigue, weakness, chest pain, dizziness, headache, activity intolerance, and dyspnea.[9] Also, pale and cold skin, thinning hair, irregular heartbeat, palpitations, syncope, loss of libido, nausea, tinnitus and weight loss, pica, ice eating (pagophagia) and restless leg syndrome might be detected.[3,5,9] Difficulty swallowing (dysphagia), changes in tongue papillae (atrophic glossitis), pain in the tongue, spoon nails (koilonychia), and blue sclera might be observed rarely in individuals who have severe IDA.[16,17] The most common symptom in IDA individuals is fatigue.[18] Fatigue affects the quality of life and daily life activities of individuals negatively.[19]

The primary treatment for IDA is to determine the underlying cause and reduce IDA. Then, to increase erythrocyte and haemoglobin (HGB) values and to replenish iron stores.[3,5] IDA is treated in two ways. The first way is oral iron therapy and the second way is parenteral iron therapy.[5,10,20] Constipation, indigestion, nausea, vomiting, diarrhea, dark stools, or blackening of the teeth are side effects of oral iron therapy.[5,9,21]

IDA is a common and preventable condition typically treated with oral iron supplements. However, despite its accessibility, treatment adherence remains suboptimal, with nearly half of patients discontinuing due to side effects, forgetfulness, or treatment fatigue.[20,22] These barriers highlight that pharmacological treatment alone is insufficient for successful management. Sustainable improvement in adherence requires educational and behavioral interventions that help patients understand the importance of consistent treatment, manage side effects, and develop effective self-care behaviors.[23,24] Existing educational programs for individuals with IDA have primarily emphasized disease knowledge and biochemical outcomes, with limited focus on behavioral outcomes such as treatment adherence and fatigue—key determinants of patient experience and quality of life.[23,24] To achieve sustainable management of IDA, patient education should not only increase awareness but also empower individuals to manage side effects and maintain consistent treatment over time.[23,24]

Within the framework of the Quadruple Aim, which highlights patient experience, population health, cost-effectiveness, and healthcare provider well-being, nurse-led educational interventions represent a practical and multidisciplinary approach to improving adherence in chronic conditions. Nurses are uniquely positioned to deliver personalized, continuous education that supports patient engagement and long-term treatment success.[25]

Although several studies conducted in Türkiye have examined fatigue, nutrition, and medication types in IDA,[26,27] research evaluating the combined effect of nurse-led education on treatment adherence and fatigue remains limited.The primary objective of this study was to evaluate the effect of nurse-led education on treatment adherence among individuals with IDA. The secondary objective was to assess its impact on fatigue levels. This study aims to fill a critical gap in the literature by investigating how structured, nurse-led education can enhance both adherence and quality-of-life outcomes within a chronic care framework.

Materials and Methods

Design

The study was conducted in a tertiary care center in Turkey using a parallel randomized control group pre-test and post-test intervention design. This study was registered at ClinicalTrials.gov (Identifier: NCT05909891). The study was conducted with a randomised controlled experimental design and complied with the Consolidated Standards of Reporting Trials (CONSORT) Checklist (Figure 1).

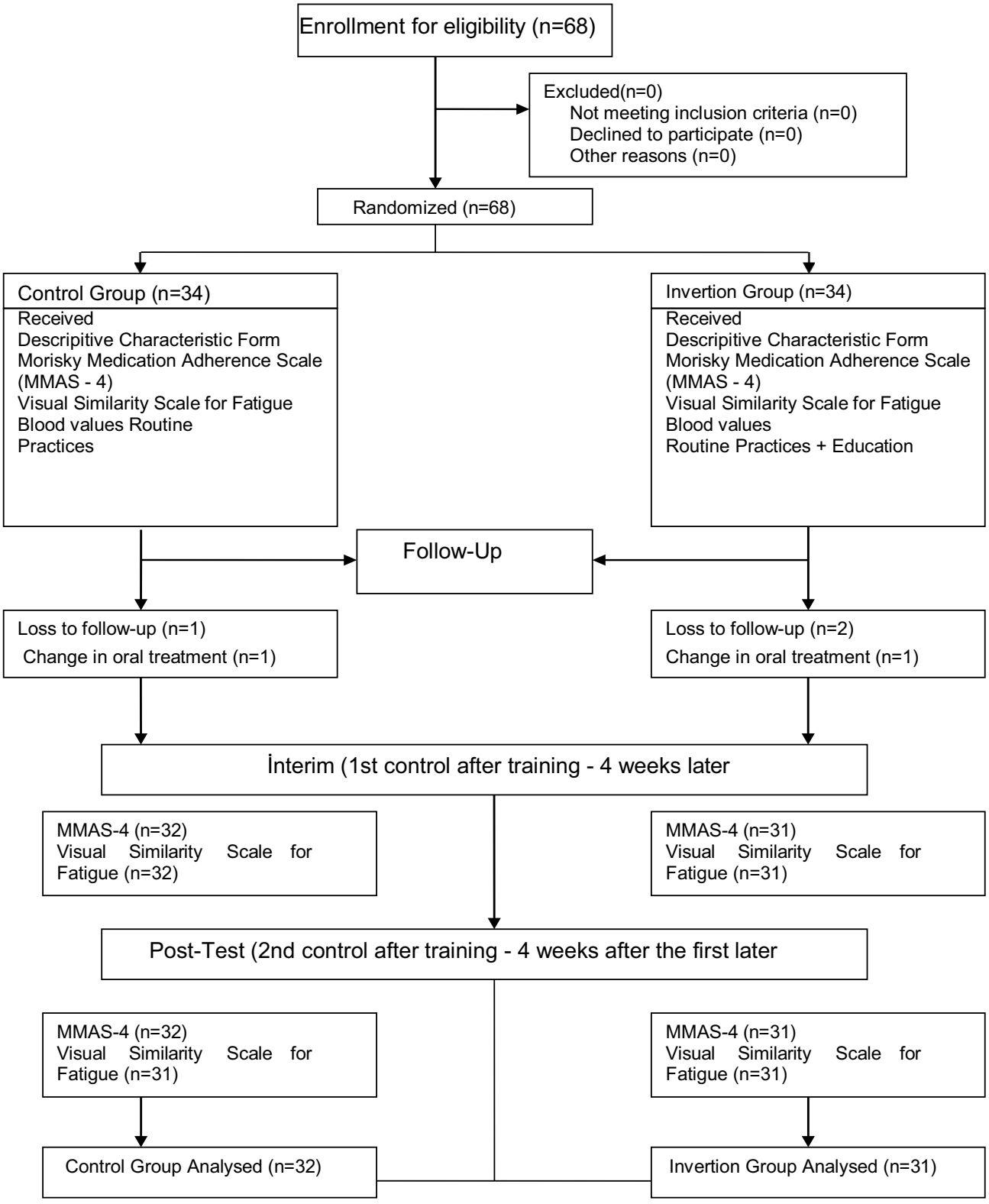


Figure 1 CONSORT flowchart. The MMAS-4 Scale, content, name, and trademarks are protected by US copyright and trademark laws. Permission for use of the scale and its coding was obtained through a license agreement from MMAR, LLC, https://www.moriskyscale.com.

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The Hypothesis of the Study

H1: Training given to individuals who have iron deficiency anemia positively affects compliance with treatment and fatigue symptoms.

Study Setting and Sampling

The study was conducted with iron deficiency anemia patients who applied to State Hospital Internal Medicine, Hematology Clinics and were hospitalized in the Internal Medicine Wardbetween December 2023 and June 2024. In determining the sample size, a priori power analysis was made in the G Power 3.1.9.7 Softwareby using the pre-test and post-test mean scores of the Morisky Scale motivation sub-dimension of the intervention group based on the study conducted by Hatır (2020).[28] It was found that the required sample size was 20 for the intervention group and 20 for the control group with an effect size of 0.81, a confidence interval of 0.95, and a margin of error of 0.05. Considering the patients who might leave the study for various reasons after starting, the intervention group was randomly formed from 34 people and the control group from 34 people.[28] The data were collected from 34 people for the intervention group and 34 people for the control group. However, the study was completed with 31 people in the intervention group and 32 people in the control group (5 of the participants in the study were inpatients and the other participants were outpatients). 3 participants, 1 from the control group and 2 from the intervention group, could not be reached at the interim test because they did not return for follow-up. 2 participants, 1from the control group and 1 from the intervention group, were switched from oral iron therapy to parenteral iron therapy by their physician due to serious adverse drug reactions and withdrew from the study.The study included an Intervention Group (31) and a Control Group (32) randomly, and the study was conducted with 63 patients. Random number table used. According to the table, 1 control and 2 intervention groups were created (Figure 1).

Inclusion and Exclusion Criteria

Inclusion Criteria

- İndividuals who were oriented to person, place, and time,
- Had no problems in communicating,
- Voluntarily accepted to participate in the study,
- Were diagnosed with Iron Deficiency Anemia,
- Were between the ages of 18–65,
- Were able to read and write,
- Had received oral iron medication for at least 1 month,
- Had a low Morisky scale score.

Exclusion Criteria

- İndividuals who were under the age of 18,
- İndividuals who were aged 65 and over because of physiological changes,
- Foreign nationals,
- Those with malignant diseases,
- Pregnant individuals.

Additionally, individuals diagnosed with cancer, pregnant women, and individuals over the age of 65 were excluded from the study because physiological changes were observed.

Outcome Measures

To collect the data for the study, the Descriptive Characteristics Form, which was developed by the researcher and included personal characteristics, the Morisky Medication Adherence Scale, and the Visual Similarity Scale for Fatigue were used. Patient selection was made according to the planned randomization after examining the study inclusion and exclusion criteria.

Descriptive Characteristics Form

The Descriptive Characteristics Form was prepared by the researcher as a result of a literature review to obtain dataon the general characteristics of patients with iron deficiency anemia. It included questions about the patients' gender, age, marital status, family type, training level, income level, place of residence, smoking and alcohol use, how long they had iron anemia, whether they received training on this disease, nutritional status, comorbidity status, and medication use for the disease.[5,10,26] The first and current results of parameters such as hemoglobin and ferritin from the patients' blood tests in the laboratory system were also included.

Morisky Medication Adherence Scale (MMAS-4)

The scale was developed by Morisky et al in 1986 to assess adherence to antihypertensive medication treatment.[29–31] The validity and reliability study of the Morisky Medication Adherence Scale, which has been used in many studies for chronic diseases, was conducted by Yılmaz et al (2012) to measure adherence to antipsychotic treatment in our country.[32] The scale has a four-question design that can separately assess motivation and knowledge levels to assess adherence to long-term medication treatment in chronic diseases. Questions are answered using a "Yes/No" format, with "Yes" being scored as "0" and "No" as "1." The highest total score possible from the scale is "4," with higher scores indicating higher adherence to treatment. Scores from the scale indicate adherence to treatment as follows: 0–1 = Low level, 2–3 = Moderate level, 4 = High level. The Cronbach's alpha value of the scale developed by Morisky et al in 1986 was calculated as 0.61.[29–31] While the Cronbach's alpha value of the scale was 0.52 by Yılmaz,[32] the Cronbach's alpha value was found to be 0.937 in our study.

Visual Similarity Scale for Fatigue

The scale, whose validity and reliability for the Turkish language were conducted by Yurtsever and Bedük (2003), was developed by Lee et al (1990) and consists of 18 items in the fatigue (items 1, 2, 3, 4, 5, 11, 12, 13, 14, 15, 16, 17, and 18) and energy level subscales (items 6, 7, 8, 9, and 10). Each item on the scale has 10 cm long lines, with a positive statement at one end and a negative statement at the other, and is scored from "0" to "10".[33,34] Items on the fatigue subscale are rated from most positive to most negative, while items on the energy subscale are the opposite. An increase in the fatigue subscale score indicates an increase in fatigue severity, while an increase in the energy subscale score indicates an increase in energy. High scores on fatigue questions and low scores on energy questions indicate higher levels of fatigue. In the validity and reliability study of the scale, the Cronbach alpha value was found to be 0.90 for fatigue and 0.74 for the energy sub-dimension.[33] In this study, the Cronbach alpha value was found to be 0.925 for the fatigue sub-dimension and 0.968 for the energy sub-dimension.

Data Collection

Morisky Medication Adherence Scale (MMAS-4) and Visual Similarity Scale for Fatigue were applied to the individuals in the Intervention Group. The same forms were applied to the patients in the Control Group as well. The data collection forms were collected by the researcher in the training room and patient room after the purpose of the study was explained to the patients in detail and their permissions were obtained through one-on-one interviews. The individuals in the Control Group underwent routine monitoring of the hospital. The patients in the Intervention Group were first examined and underwent routine monitoring of the hospital. The interim was administered 4 weeks after the pre-test and the post-test was administered 8 weeks later (Figure 1).

Ethical Consideration

The study was approved by the Atatürk University Faculty of Medicine Ethics Committee (26.01.2023/B.30.2. ATA.0.01.00/116). Permissions were obtained from the institution where the study would be conducted. Approvals for the use of the scales were obtained with e-mails from the authors of the scales. Verbal and written consents were obtained from each patient who met the inclusion criteria and agreed to participate in the study voluntarily. Written permissions were obtained by giving the patients an "Informed Consent Form" stating that participation in the study would be voluntary, that they could withdraw from the study at any time, and that their personal information would not be disclosed. It was conducted in accordance with the Declaration of Helsinki.

Interventions

Randomisation

Simple randomization was used. A computer-generated (https://www.random.org/integers/) random number sequence was used to randomly assign participants to each group. Before the interventions, an education booklet based on the opinions of 10 experts was prepared. Patients who met the inclusion criteria were divided into groups. The Descriptive Characteristics Form, Morisky Medication Adherence Scale (MMAS-4), and Visual Similarity Scale for Fatigue were administered to individuals in the Intervention Group. The same forms were administered to patients in the Control Group. Patients in the intervention and control groups used oral iron medications prescribed by their physicians. Education was provided to the intervention group, while routine follow-up was applied to the control group.

Training Booklet

An educational booklet was developed based on a literature review of IDA.[5,9,11] The 41-page booklet was evaluated for content and readability using the DISCERN Measurement Tool and expert opinions. The booklet includes information on the disease's definition, diagnosis, signs and symptoms, treatment, and nursing care. It addresses potential problems that patients may experience during oral and parenteral iron therapy and offers recommendations for managing these problems. Common side effects of oral iron therapy, such as nausea, vomiting, constipation, indigestion, dark stools, and tooth discoloration, as well as potential complications of parenteral therapy and adherence to treatment, are also discussed. The booklet also provides information on iron-rich foods and foods that enhance iron absorption, and provides sample tables demonstrating how to take oral iron medications with meals and other medications. Written and visual educational materials were included to support patient understanding.

Educational sessions based on the booklet were conducted individually by the researcher, a registered nurse with experience in patient education. Education was provided to patients who agreed to participate in the study in a room specifically designated by the researcher for outpatients and a hospital room for inpatients. Each education session lasted approximately 35–40 minutes. Following the education, patients received a copy of the education booklet. Patient compliance and fatigue levels were assessed at the first routine follow-up visit, 4 weeks after the education, and at the second routine visit, 8 weeks after the education.

The control group received standard care throughout the study and received the educational booklet only after the study was completed. The control group received standard care, which included very brief information about when to take medications, when to attend follow-up appointments, and possible side effects. However, the control group received the same detailed education as the intervention group.

DISCERN Measurement Tool

The DISCERN measurement tool, which was prepared to evaluate the information quality of the prepared training materials, was created by Charnock et al (1990) as a valid and reliable scale and composed of 2 different sections.[35] The first section includes the "Evaluation of Appropriateness of Written Materials" form and consists of 4 items associated with content status, 5 items associated with literacy status, 5 items associated with picture-graphic status, 8 items associated with writing and planning status, 3 items associated with learning and motivation status, and 2 items associated with cultural appropriateness status, totaling six sections and 27 questions. Item appropriateness is evaluated by giving "1" points for "Yes" and "0" points for "No", and a total evaluation is made between "1" and "27" points. The high score obtained indicates that the readability of the training material is high. The second section is used to evaluate the reliability and information quality levels of the training material with 15 items in a 5-point Likert style. The 15 points given for the evaluation indicate that the quality of the booklet is low, while the 75 points indicate that the quality is high. The Turkish validity and reliability of this measurement tool was conducted by Gökdoğan in 2003.[36]

The training booklet that was prepared for the patients was evaluated by experts using the DISCERN Measurement Tool. The average score of the readability level of the training material was found to be 21.30±1.95, and the average score of reliability and information quality was determined to be 63.90±6.35. Kendall's W Coefficient of Concordance Test was used in the evaluation of the expert opinions, which takes a value between "0–1" and shows that the agreement between the evaluators increases as the value approaches "1". Also, Kendall's W-Coefficient of Concordance being

$p<0.05$ is interpreted as an agreement between the evaluators. In the present study, it was found that Kendall's W-Coefficient was 0.596 for readability level and 0.471 for reliability and information quality. As a result of the analysis, it was found that there were no differences between the expert opinions.

Analysis

The data of the study were analyzed using the SPSS (Statistical Package for the Social Sciences) for Windows version 22. Descriptive statistics, including numbers, percentages, minimum and maximum values, means, and standard deviations, were used in the data analysis. The conformity of the data to normal distribution was evaluated using "Kurtosis" and "Skewness" coefficients (±2). Data analysis was conducted with the support of an expert statistician who was independent of the study. To ensure blinding, the dataset was coded as "X" for the Intervention Group and "Y" for the Control Group.

Statistical tests were used in the analysis of the data (*t*-test was used for normally distributed measurements, Variance Analysis, and LSD test for advanced analysis. All statistical tests were two-tailed, and a significance level of $p < 0.05$ was considered statistically significant. The Mann Whitney U and Friedman Analysis (Wilcoxon Test was used for advanced analysis) were used for measurements that were not normally distributed. Cronbach's a coefficient was used for internal validity.[37]

In determining the sample size, an a priori power analysis was conducted using G Power 3.1.9.7 software, based on the pre-test and post-test mean scores of the Morisky Scale motivation sub-dimension in the intervention group, according to the study by Hatır (2020).[28] It was found that the required sample size was 20 participants for the intervention group and 20 for the control group, assuming an effect size of 0.81, a power of 0.80, a significance level of 0.05 (two-tailed), and a 95% confidence interval. This confirmed that the sample size was sufficient to detect medium-to-large effects under the specified assumptions.

Results

A total of 63 participants were included in the study: 31 in the Intervention Group and 32 in the Control Group (Figure 1). Five participants (three from the intervention and two from the control group) discontinued participation before the final assessment.

Participants in the Intervention and Control Groups, respectively, were 93.5% (100%) female, 51.6% (62.5%) married, 93.5% (96.9%) nuclear family, 77.4% (96.9%) university graduates or above, 67.7% (81.3%) with income equal to expenses, and 96.8% (93.8%) living in the city center (Table 1).

Table 1 Descriptive Characteristics of Participants (N:63)

	Intervention		Control		Test and Significance
	n	%	n	%	
Gender					
Male	2	6.5	–	–	x^2=2.132
Female	29	93.5	32	100	p=0.238
Marital status					
Married	16	51.6	20	62.5	x^2=0.762
Single	15	48.4	12	37.5	p=0.383
Family type					
Nuclear family	29	93.5	31	96.9	x^2=0.384
Extended family	2	6.5	1	3.1	p=0.613
Educational status					
Primary school	2	6.5	1	3.1	x^2=6.210
Middle school	2	6.5	–	–	p=0.102
High school	3	9.7	–	–	
University and above	24	77.4	31	96.9	

(*Continued*)

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Table 1 (Continued).

	Intervention		Control		Test and Significance
	n	%	n	%	
Income level					
Income is less than expenses	2	6.5	1	3.1	x^2=1.542
Income equals expense	21	67.7	26	81.3	p=0.463
Income is more than expense	8	25.8	5	15.6	
Place of residence					
Village	–	–	1	3.1	x^2=0.984
District	1	3.2	1	3.1	p=0.611
Town center	30	96.8	30	93.8	

Of the participants in the Intervention and Control Groups, respectively, 63%, 74.2% had menstrual bleeding lasting 1–7 days; 66.7%, 77.4% did not have irregular menstrual periods; 66.7%, 77.4% did not have excessive menstrual bleeding. 71%, 84.4% of the participants were non-smokers, respectively; 77.8%, 80% of smokers consumed less than 1 pack a day; 93.5%, 96.9% did not drink alcohol; 80.6%, 81.3% had received previous treatment; 92%, 88.5% had received treatment in pill form; 77.4%, 65.6% had a treatment duration of 1–3 months; 16.1%, 46.9% had received education about the disease; All participants received training from specialists (12.9% from physicians and 3.2% from nurses), and 92.9% received training from specialists (31.3% from physicians, 15.6% from nurses, and 3.1% from pharmacists). In the Intervention Group, 54.8% of participants had no family history of IDA, while 53.1% of participants in the Control Group had a family history of IDA (Table 2).

Table 2 Some Characteristics of the Participants and Their Status of Receiving Iron Deficiency Anemia Treatment and Training (N:63)

		Intervention		Control		Test and Significance
		n	%	n	%	
Presence of IDA in the family	Yes	14	45.2	17	53.1	x^2 = 0.400
	No	17	54.8	15	46.9	p = 0.527
Menstrual duration	1-7 days	17	63.0	23	74.2	x^2 = 0.850
	8-13 days	10	37.0	8	25.8	p = 0.356
Menstrual irregularity	Yes	9	33.3	7	22.6	x^2 = 0.835
	No	18	66.7	24	77.4	p = 0.361
Menstrual bleeding	Yes	9	33.3	7	22.6	x^2 = 0.835
	No	18	66.7	24	77.4	p = 0.361
Smoking status	Yes	9	29.0	5	15.6	x^2 = 1.638
	No	22	71.0	27	84.4	p = 0.201
The amount of	Less than 1 pack per day	7	77.8	4	80.0	x^2 = 1.646
cigarettes smoked daily	1 pack	2	22.2	1	20.0	p = 1.000
Alcohol use	Yes	2	6.5	1	3.1	x^2 = 0.613
	No	29	93.5	31	96.9	p = 0.488
Previously IDA treatment receiving status	Yes	25	80.6	26	81.3	x^2 = 0.004
	No	6	19.4	6	18.8	p = 0.951
Previous IDA	Pill	23	92.0	23	88.5	x^2 = 0.981
treatment method	Syrup	-	-	1	3.8	p = 0.612
	Intravenous access	2	8.0	2	7.7	

(*Continued*)

Table 2 (Continued).

		Intervention		Control		Test and Significance
		n	%	n	%	
IDA treatment duration	1-3 months	24	77.4	21	65.6	x^2 = 1.073
	3-6 months	7	22.6	11	34.4	p = 0.225
IDA training	Yes	5	16.1	15	46.9	x^2 = 6.870
receiving status	No	26	83.9	17	53.1	p= **0.009***
How IDA training was received	Expert Person	6	100	13	92.9	x^2 = 4.704
	Brochure	-	-	1	7.1	p = 1.000
Person providing IDA training						
Physician	No	27	87.1	22	68.8	x^2 = 3.067
	Yes	4	12.9	10	31.3	p = 0.080
Nurse	No	30	96.8	27	84.4	x^2 = 2.809
	Yes	1	3.2	5	15.6	p = 0.196
Pharmacist	No	31	100	31	96.9	x^2 = 0.984
	Yes	-	-	1	3.1	p = 1.000
Similar Patient	No	31	100	31	96.9	x^2 = 0.984
	Yes	-	-	1	3.1	p = 1.000
*p<0.001						

The mean age of the participants in the Intervention and Control Groups was found to be (32.48±10.34, 29.53±5.92, respectively), mean diagnosis time (31.45±36.01 months, 40.22±47.45 months, respectively), mean HGB (9.52±1.42, 9.91±1.18, respectively), mean hematocrit (HCT) (30.92±4.67, 31.99±3.90, respectively), mean ferritin (5.63±2.15, 6.02 ±2.84, respectively) (Table 3).

During treatment, participants in the Intervention and Control Groups, respectively, experienced 35.5%, 34.4% abdominal pain; 29%, 40.6% indigestion; 9.7%, 6.3% diarrhea; 61.3%, 46.9% constipation; 3.2%, 6.3% tooth discoloration; 83.9%, 68.8% stool discoloration; 35.5%, 25% nausea, and 3.2%, 9.4% skin discoloration; 51.6%, 62.5% did not know the long-term benefits of the medication; 80.6%, 93.8% forgot to get their medication prescribed; 67.7%, 81.3% did not take their medication yesterday; 93.5%, 90.6% forgot to take their medication while traveling; 74.2%, 84.4% felt

Table 3 Age, Diagnosis Time, and Blood Values of the Participants (N:63)

	Intervention			Control			Significance	MD	SED	%95 CI for the Difference	Effect Size
	n	Mean	SD	n	Mean	SD					
Age	31	32.48	10.34	32	29.53	5.92	U= 455.00 p = 0.571	2.95	2.13	−1.33–7.24	0.35
Diagnosis period (months)	31	31.45	36.01	32	40.22	47.45	t = −0.824 p = 0.413	−8.76	10.63	−30.03–12.50	−0.20
HGB	31	9.52	1.42	32	9.91	1.18	t = −1.187 p = 0.240	−0.38	0.32	−1.04–0.26	−0.29
HCT	31	30.92	4.67	32	31.99	3.90	t = −0.990 p = 0.326	−1.07	1.08	−3.23–1.09	0.24
Ferritin	31	5.63	2.15	32	6.02	2.84	t = −0.615 p = 0.541	−0.38	0.63	−1.65–0.87	−0.15

Note: *p<0.001.
Abbreviations: SD, Standard Devation; MD, Mean Difference;SED, Standard Error Difference; CI, Confidence Interval.

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uncomfortable using daily medication, and 41.9% (usually), 31.3% (sometimes) forgot to take their medication (Supplementary Table 1).

When the pre-test treatment adherence mean scores of the Intervention and Control groups were compared respectively (0.58±0.76, 0.56±0.67), it was found that the difference between the groups was not statistically significant (p>0.05). The difference between the pre-test mean scores of the Intervention and Control groups (Fatigue 69.86±18.66, Energy 22.72±8.03; Fatigue 74.30±20.95, Energy 23.66±9.44) was found to be statistically significant (p>0.05). At the interim assessment, the difference in mean treatment adherence scores between the Intervention (3.35±0.71) and Control (0.59±0.87) groups was found to be statistically significant (p<0.05). At the interim assessment, the difference in mean fatigue and energy scores between the Intervention (Fatigue 54.51±13.93, Energy 29.44±5.94) and Control (Fatigue 82.71±22.09, Energy 20.43±10.24) groups was statistically significant (p<0.05). At the post-tests, the difference in mean fatigue and energy scores between the Intervention (Fatigue 82.71±22.09, Energy 20.43±10.24) groups was found to be statistically significant (p<0.05). The difference between the mean treatment adherence scores in the (3.65±0.84) and Control (0.38±0.83) groups was found to be statistically significant (p<0.05). In the post-tests, the difference in the mean fatigue and energy scores between the Intervention (Fatigue 34.38±10.15, Energy 37.56±5.67) and Control (Fatigue 85.32±22.45, Energy 20.45±11.02) groups was found to be statistically significant (p<0.05) (Table 4). Confidence intervals for treatment adherence were pre-test (−0.34–0.37), interim (0.20–3.16), and post-test (2.84–3.69); and for Fatigue were pre-test (−14.44–5.56), interim (−37.51- −18.89), and post-test (−59.73- −42.12); For energy, pre-test (−5.35–3.48), interim (4.78–13.22), post-test (12.69–21.53) were found.

Table 4 Comparison of Adherence and Fatigue Scores Across Time Points (N:63)

	Intervention			Control			Test and Significance	MD	SED	%95 CI for the Difference	Effect Size
	n	Mean	SD	n	Mean	SD					
Pre-test											
MMAS-4	31	0.58	0.76	32	0.56	0.67	t = 0.100, p = 0.920	0.01	0.18	−0.34–0.37	0.02
Fatigue	31	69.86	18.66	32	74.30	20.95	t = −0.887, p = 0.379	−4.43	5.00	−14.44–5.56	−0.22
Energy	31	22.72	8.03	32	23.66	9.44	t = −0.424, p = 0.673	0.93	2.21	−5.35–3.48	−0.10
Interim Test											
MMAS-4	31	3.35	0.71	32	0.59	0.87	t = 13.735, p = **0.000***	2.76	0.20	2.35–3.16	3.46
Fatigue	31	54.51	13.93	32	82.71	22.09	t = −6.081, p = **0.000***	−28.20	4.63	−37.51 - −18.89	−1.52
Energy	31	29.44	5.94	32	20.43	10.24	t = 4.288, p = **0.000***	9.00	2.10	4.78–13.22	1.07
Post-test											
MMAS-4	31	3.65	0.84	32	0.38	0.83	t = 15.529, p = **0.000***	3.27	0.21	2.84–3.69	3.91
Fatigue	31	34.38	10.15	32	85.32	22.45	t = −11.661, p = **0.000***	−50.93	4.36	−59.73 - −42.12	−2.90
Energy	31	37.56	5.67	32	20.45	11.02	t = 7.785, p = **0.000***	17.11	2.19	12.69–21.53	1.94

Note: *p<0.001. The MMAS-4 Scale, content, name, and trademarks are protected by US copyright and trademark laws. Permission for use of the scale and its coding is required. A license agreement is available from MMAR, LLC., https://www.moriskyscale.com.
Abbrevations: SD, Standard Devation; MD, Mean Difference;SED, Standard Error Difference; CI, Confidence Interval.

Partial Eta-Squared/Effect Size could not be calculated because the pre-test, interim, and post-test MMAS scores of the intervention and control groups were non-parametric tests (η2=-). Although the Eta-Squared/Effect Size on the Visual Similarity Scale for Fatigue Sub-Dimension Scores of the intervention and control groups were calculated as η2=0.749 in the pre-test, interim, and post-test, the Eta-Squared/Effect Size of the fatigue sub-dimension of the intervention group was η2=0.278. Also, the Eta-Squared/Effect Size of the energy sub-dimension of the intervention group could not be calculated (η2=-) but the Eta-Squared/Effect Size of the energy sub-dimension of the control group was calculated as η2=0.126.

Discussion

The present study examined the effect of education provided to individuals with IDA on treatment adherence and fatigue. The findings revealed that education significantly improved treatment adherence, increased energy levels, and reduced fatigue symptoms among participants in the Intervention Group compared to the Control Group. These results support the study hypothesis that education positively affects adherence and fatigue outcomes in individuals with IDA (Table 4).

As in our country and other countries, IDA is a significant public health problem. However, many studies in this area have been conducted on children, adolescents, and women.[10,14,38,39] The participants in the current study were similar to those in the literature. 93.5% of the participants in the Intervention Group were female, 6.5% were male, and all participants in the Control Group were female (Table 1). A previous study reported that 89.7% of patients were female and 10.3% were male.[26] A study investigating the global prevalence of anemia reported a higher prevalence of anemia in women across almost all regions. The most common type of anemia is IDA, and its prevalence is higher in women.[2] Consistent with previous literature, more than 90% of the participants in this study were female, reflecting the higher prevalence of anemia among women worldwide.[2,5]

Adherence to treatment is crucial in IDA treatment, and our study found that adherence increased. However, one of the most important factors affecting patient adherence is the side effects of the medications.[20,22] In this study, individuals were asked about side effects that affected medication adherence and found that constipation and stool discoloration were the most common symptoms (Supplementary Table 1). Studies by Gereklioğlu et al (2016) and Coint et al (2025) found that medication-related gastrointestinal side effects decreased adherence. In our study, although approximately 50% were aware of the long-term benefits of medication use, approximately 80% forgot to fill their prescriptions, negatively impacting medication adherence. Additionally, many patients reported discomfort with their daily medication regimens and frequently forgot to take their medications. These factors also negatively impact medication adherence and the symptoms of fatigue associated with the disease.[40,41]

In our study, it was determined that the education provided to the intervention group significantly increased treatment adherence (Table 4). Furthermore, fatigue levels decreased and energy levels increased in the intervention group compared to the control group at interim and post-tests. Nurses should provide patient education to improve adherence to long-term medication regimens.[25,42]

In our study, the education provided to the intervention group was found to significantly increase treatment adherence (Table 4). Furthermore, according to the interim and posttest results, fatigue levels decreased and energy levels increased in the intervention group compared to the control group. These findings emphasize the importance of nurses educating patients to improve adherence to long-term medication regimens. Similarly, Abu Baker et al (2021) reported that education provided to students with IDA improved their disease knowledge, attitudes toward treatment, and practice.[38] Ganjoo et al (2022), in their study of women of reproductive age, found that health programs delivered through multiple interpersonal communication channels increased medication use.[43] Sontakke et al (2022), in their study of women with IDA during the prenatal period, showed that reminders delivered via mobile phone increased adherence to iron supplementation and resulted in greater increases in HGB levels.[23] Similarly, in our study, the primary factors that increased adherence to treatment were education and the educational booklet used as a reminder material. Other studies in the literature also indicate that printed materials partially improve patient health outcomes, while the education provided significantly increases treatment adherence.[44–49] Elsharkawy et al (2022) conducted a study with pregnant women, reporting that health messages and reminders sent via WhatsApp increased treatment adherence.[50] These results demonstrate that nursing interventions supported by various communication tools and educational methods are effective in improving treatment adherence.

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In the study conducted by Ekici and Kaskır (2017), patients' fatigue severity decreased and their energy levels increased with education.[51] In our study, education increased individuals' compliance with treatment, reduced fatigue symptoms, and increased energy levels.

It was also found in the present study that the Intervention Group's compliance with treatment and energy levels were low in the pre-test, and their fatigue levels were high. The Intervention Group's compliance with treatment and energy levels increased and their fatigue levels decreased in the interim and post-test after the training. This result reveals that the hypothesis Training given to individuals who have iron deficiency anemia positively affects compliance with treatment and fatigue symptom was accepted.

Perspectives for Clinical and Assistive Practice

The findings of this study emphasize the importance of structured, nurse-led educational interventions in enhancing treatment adherence and reducing fatigue among individuals with iron deficiency anemia.[25] Integrating patient education into routine clinical care may strengthen patient engagement and self-management, particularly in populations with recurrent or long-term treatment needs. Training programs that address medication timing, dietary habits affecting iron absorption, and management of side effects can significantly improve compliance. Providing supportive materials such as educational booklets and individualized counseling may further empower patients to maintain adherence.[52] In line with the Quadruple Aim framework, implementing such educational strategies can improve patient experience, optimize clinical outcomes, and contribute to more cost-effective and sustainable healthcare delivery.[53]

Limitations

This study has several limitations. The sample consisted primarily of women from a single region, which may limit the generalizability of the findings to larger or male populations. The study focused on treatment adherence and fatigue levels rather than biochemical measurements. The eight-week follow-up period is also a limitation. The self-reported nature of the scales is also a limitation.

Conclusion

Nurse-provided education effectively increased treatment adherence and reduced fatigue in individuals with IDA. Integrating structured educational programs into clinical practice may contribute to more comprehensive and sustainable management of IDA, consistent with the goals of holistic care in modern healthcare systems.

Data Sharing Statement

All data analyzed in this study are available from the corresponding author on reasonable request.

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Disclosure

The authors declare that they have no conflict of interest.

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