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The Effect of Patient Education Provided by Clinical Pharmacists in Premenopausal Female Patients with Iron Deficiency Anemia: A Randomized Controlled Trial

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ABSTRACT: According to the World Health Organization, anemia is a prevalent public health issue in developing and industrialized nations, with serious consequences for individual health and broader social and economic development. Iron deficiency anemia (IDA), a prevalent global health issue in Türkiye, adversely affects multiple organs and physiological systems. This study aims to evaluate the effect of pharmacist-led educational interventions on improving patients' knowledge of the causes and consequences of IDA and on enhancing compliance with prescribed treatment regimens. This study was structured as a prospective, parallel, randomized controlled trial. It included all premenopausal women newly diagnosed with iron deficiency anemia (IDA) (hemoglobin levels below 12 g/dL) or those already undergoing iron therapy, who attended outpatient clinics at a research hospital in Istanbul, Türkiye. Participants were randomly allocated in a 1:1 ratio to either the intervention or control group using a computerized simple randomization program. A total of 116 patients were enrolled, with 56 assigned to the intervention group and 60 to the control group. Patients in the intervention group received verbal counseling on iron therapy and a brochure detailing the significance of anemia management, dietary adjustments, treatment recommendations, and strategies for managing side effects. Additionally, these patients were followed up weekly by a clinical pharmacist via telephone. In contrast, patients in the control group received standard medical care from their physicians without any pharmacist intervention. The median age (IQR) of the patients was 40.50 (35.00-46,75) years. The majority of participants in the intervention group (78.3%) exhibited high compliance with iron deficiency anemia (IDA) supplements, compared to the control group (42.9%), with a statistically significant difference ($p < 0.001$). The mean increase in hemoglobin concentration in the intervention group (1.35 g/dL) was greater than that in the control group (0.70 g/dL) ($p < 0.001$). No serious or life-threatening adverse effects were reported in either group. This study demonstrated the importance of the clinical pharmacist's role in the treatment of iron deficiency anemia (IDA) in outpatient clinics; clinical pharmacist interventions and effective physician-pharmacist collaboration have led to improved disease management outcomes.

KEYWORDS: Iron deficiency anemia; premenopausal women; clinical pharmacist; education.

1. INTRODUCTION

Anemia is a major contributor to health loss [1], closely linked to socioeconomic status and education [2], and presents a significant global burden. It can be classified into various types based on red blood cell size, severity, and underlying cause, including iron deficiency anemia (IDA), aplastic anemia, and thalassemia, among others [3]. Among these, IDA is the most prevalent form of anemia [4]. In developing countries, iron deficiency remains the leading cause of anemia and a key driver of morbidity worldwide [1]. This condition is particularly common among women of reproductive age [5]. Globally, anemia affects approximately 40% of children aged 6–59 months, 37% of pregnant women, and 30% of women aged 15–49 years [6]. Recognizing its widespread impact, the World Health Organization (WHO) has prioritized anemia control as a global health objective, aiming to achieve a 50% reduction in anemia prevalence among women of reproductive age by 2025 [12].

WHO defines anemia as a hemoglobin (Hb) concentration of less than 13 g/dL in men, less than 12 g/dL in non-pregnant women, and less than 11 g/dL in women during the second and third trimesters of pregnancy [8].

Since anemia is the most significant indicator of iron deficiency, the terms “iron deficiency” and “iron deficiency anemia” are often used interchangeably [7]. However, iron deficiency can occur without the

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presence of anemia, and tissues may still be adversely affected by this condition [9]. While iron deficiency is considered the most common cause of anemia worldwide, other factors can also contribute, including nutritional deficiencies (such as folate, vitamin B12, and vitamin A), acute and chronic inflammation, parasitic infections, and inherited or acquired disorders that impair hemoglobin synthesis, red blood cell production, or red blood cell survival [8].

The International Pharmaceutical Federation (FIP), a global professional leadership body for pharmacists, pharmaceutical scientists, and educators, conducted an exploratory study in May 2022 focusing on the role of pharmacists in anemia management, particularly iron deficiency anemia (IDA) [10]. The findings of the study emphasized the critical need to strengthen the involvement of practicing pharmacists in the management of IDA [11]. Their active participation was highlighted as essential in improving diagnosis, treatment compliance, patient education, and overall outcomes in anemia care [35]. With their clinical expertise and broad accessibility, pharmacists are uniquely positioned to play a critical role in reducing the burden of iron deficiency anemia (IDA). Their involvement spans multiple facets, including identifying underlying causes, contributing to the development and implementation of treatment strategies, participating in preventive interventions, and promoting self-care practices [35].

While numerous studies in Türkiye have explored the role of clinical pharmacists in improving health outcomes across various disease states, to the best of our knowledge, this will be the first study conducted on patients with iron deficiency anemia. The primary objective of this study is to assess the effect of patient education provided by a clinical pharmacist on patients' knowledge of their condition and the clinical outcomes of anemia treatment. The study specifically examines the pharmacist's counseling on iron therapy, highlighting the importance of anemia management, dietary modifications, treatment recommendations, and side effect management.

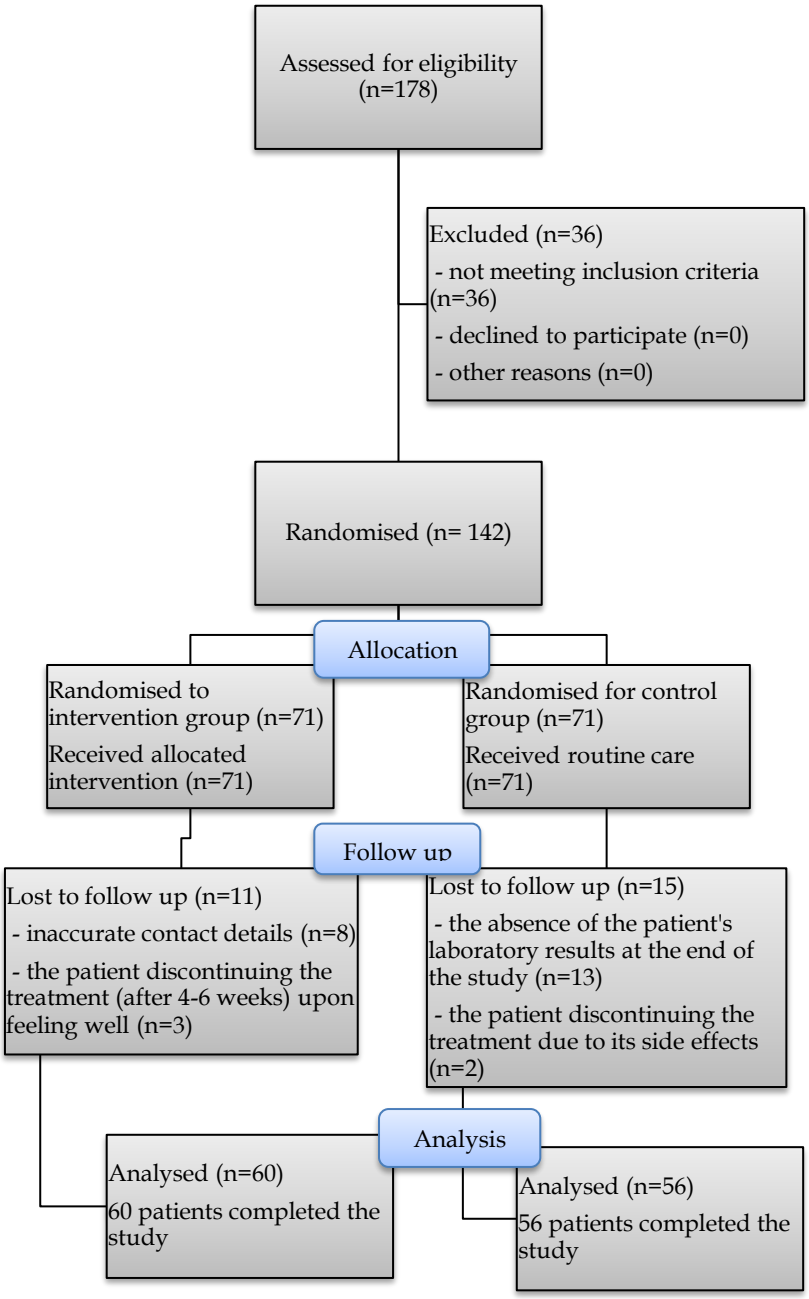


Figure 1. CONSORT (consolidated standards of reporting trials) diagram.

2. RESULTS

142 patients were screened for eligibility, out of which a total of 116 were randomized for the study duration: 60 patients (51.7%) in the intervention group and 56 patients (48.3%) in the control group (Fig. 1). 15 patients dropped out of the control group and 11 patients dropped out of the intervention group, as illustrated in Figure 1. The study population's age ranged from 18 to 53 years. The median age (IQR) of the patients was 40.50 (35.00-46.75) years. Regarding women's related issues, nearly half of the intervention group female patients (30, 50.0%) and half of the control group female patients (26, 46.4%) had normal menstrual cycles ($p = 0.443$). The mean age was 40.00 years in the intervention group and 41.50 years in the control group. At the end of the 15-week duration of the study, the remaining number of patients in the intervention and the control groups were 60 and 56, respectively (Fig. 1). The patients' baseline demographic characteristics are shown in Table 1. As shown in Table 1, there were no statistically significant differences between the socio-demographic characteristics of participants in the control group and those in the intervention group in terms of age, educational level, occupation, and family monthly income ($p > 0.05$).

Table 1. Patients' socio-demographic characteristics at baseline.

Socio-Demographic characteristics	Intervention group (n = 60)	Control group (n = 56)	P value
Age, median (IQR), years	40.00 (34.25-44.75)	41.50 (36.00-47.75)	0.201
Education Level, n (%)*			0.516
High education level (≥12 years)	44 (37.9)	37 (31.9)	
Low education level (<12 years)	16 (13.8)	19 (16.4)	
Employment Status, n (%)			1.000
Employed	18 (30.0)	17 (30.4)	
Unemployed	42 (70.0)	39 (69.6)	
History of Iron Deficiency Anemia Treatment, n (%)			0.071
Yes	56 (93.3)	45 (80.4)	
No	4 (6.7)	11 (19.6)	

* Duration of the compulsory education in Türkiye is 12 years.

Before the intervention, there were no significant differences between the two groups in the median lifestyle score, level of Knowledge score, or Hb levels. After the three-month intervention, as shown in Table 2, no significant difference was found between the two groups in terms of lifestyle characteristics ($p > 0.05$). But there was a significant difference between the intervention and control groups in terms of the median score of knowledge, as shown in Table 3, and Hb levels in Table 6 ($p < 0.001$).

Table 2. A comparison between participants' lifestyles at baseline and after follow-up

Life style characteristics	Intervention group (n = 60)		Control group (n = 56)		P value
	Baseline	Endline	Baseline	Endline	
Weekly Vegetable and Fruit Consumption					0.558
No	1 (1.7)	0 (0.0)	2 (3.6)	2 (3.6)	
Rare	22 (36.7)	12 (20.0)	16 (28.6)	16 (28.6)	
Frequently	37 (61.7)	48 (80.0)	38 (67.9)	38 (67.9)	
Weekly Red Meat, Fish, and Poultry Consumption					0.241
No	0 (0.0)	0 (0.0)	1 (1.8)	1 (1.8)	
Rare	36 (60.0)	22 (36.7)	27 (48.2)	27 (48.2)	
Frequently	24 (40.0)	38 (63.3)	28 (50.0)	28 (50.0)	
Coffee Consumption After Meals					0.094
Yes	35 (58.3)	29 (48.3)	23 (41.1)	22 (39.3)	
No	25 (41.7)	31 (51.7)	33 (58.9)	34 (60.7)	

Daily Tea Consumption					0.445
No	19 (31.7)	45 (75.0)	15 (26.8)	23 (41.1)	
At Every Meal	10 (16.7)	5 (8.3)	15 (26.8)	13 (23.2)	
After Every Meal	14 (23.3)	4 (6.7)	15 (26.8)	11 (19.6)	
Yes > 4 Large Glasses	17 (28.3)	6 (10.0)	11 (19.6)	9 (16.1)	
Being on a Diet					0.445
Yes	24 (40.0)	-	20 (35.7)	-	
No	36 (60.0)	-	36 (64.3)	-	
Intense Exercise					0.648
Yes	8 (13.3)	-	5 (8.9)	-	
No	52 (86.7)	-	51 (91.1)	-	
Smoking Habits					0.022
Yes	33 (55.0)	-	18 (32.1)	-	
No	27 (45.0)	-	38 (67.9)	-	

Table 3. The level of knowledge characteristics and the comparison of participants' knowledge levels at the beginning and end of the study.

Level of Knowledge	**Intervention group (n = 60)**		**Control group (n = 56)**		**P value**	
	Baseline	**Endline**	**Baseline**	**Endline**	**Baseline**	**Endline**
Definition of Anemia					0.764	<0.001
True	23 (38.3)	58 (96.7)	19 (33.9)	24 (42.9)		
False	37 (61.7)	2 (3.3)	37 (66.1)	32 (57.1)		
Definition of Hemoglobin					0.607	<0.001
True	7 (11.7)	56 (93.3)	4 (7.1)	6 (10.7)		
False	53 (88.3)	4 (6.7)	52 (92.9)	50 (89.3)		
Causes of Anemia					1.000	<0.001
True	7 (11.7)	58 (96.7)	7 (12.5)	11 (19.6)		
False	53 (88.3)	2 (3.3)	49 (87.5)	45 (80.4)		
Prevention of Anemia					1.000	<0.001
True	22 (36.7)	59 (98.3)	20 (35.7)	25 (44.6)		
False	38 (63.3)	1(1.7)	36 (64.3)	31 (55.4)		
Common Symptoms of Anemia					0.136	<0.001
True	25 (41.7)	59 (98.3)	15 (26.8)	17 (30.4)		
False	35 (58.3)	1 (1.7)	41 (73.2)	39 (69.6)		
Symptoms of anemia					0.118	<0.001

True	30 (50.0)	59 (98.3)	19 (33.9)	21 (37.5)		
False	30 (50.0)	1 (1.7)	37 (66.1)	35 (62.5)		
Treatment of Anemia					0.105	<0.001
True	1 (1.7)	58 (96.7)	5 (8.9)	12 (21.4)		
False	59 (98.3)	2 (3.3)	51 (91.1)	44 (78.6)		
Iron-Rich Foods					1.000	<0.001
True	14 (23.3)	58 (96.7)	13 (23.2)	15 (26.8)		
False	46 (76.7)	2 (3.3)	43 (76.8)	41 (73.2)		
Foods That Worsen Anemia					0.352	0.109
True	59 (98.3)	60 (100.0)	53 (94.6)	53 (94.6)		
False	1 (1.7)	0 (0.00)	3 (5.4)	3 (5.4)		
Complications of Anemia					0.784	<0.001
True	40 (66.7)	59 (98.2)	35 (62.5)	37 (66.1)		
False	20 (33.3)	1 (1.8)	21 (37.5)	18 (32.1)		
Menstrual Regularity and Duration					0.443	-
Regular, < 5 Days	30 (50.0)	26 (46.4)		-		
Irregular, < 5 Days	5 (8.3)	9 (16.1)		-		
Regular, > 5 Days	20 (33.3)	14 (25.0)		-		
Irregular, > 5 Days	5 (8.3)	7 (12.5)		-		
Anemia as a health condition					0.609	0.483
Yes	59 (98.3)	60 (100.0)	54 (96.4)	55 (98.2)		
No	1 (1.7)	0 (0.00)	2 (3.6)	1 (1.8)		
Seeking medical assistance in case of suspected anemia symptoms					0.441	0.231
Yes	55 (91.7)	60 (0.00)	54 (96.4)	54 (96.4)		
No	5 (8.3)	0 (0.00)	2 (3.6)	2 (3.6)		
The life-threatening risk of severe anemia					0.607	0.427
Yes	53 (88.3)	58 (96.7)	52 (92.9)	5 2(92.9)		
No	7 (11.7)	2 (3.3)	4 (7.1)	4 (7.1)		
The hereditary nature of anemia					0.453	<0.001
Yes	28 (46.7)	56 (93.3)	31 (55.4)	31 (55.4)		
No	32 (53.3)	4 (6.7)	25 (44.6)	25 (44.6)		
Prevention of anemia					0.671	0.231

	Yes	58 (96.7)	60 (100.0)	53 (94.6)	54 (96.4)		
	No	2 (3.3)	0 (0.00)	3 (5.4)	2 (3.6)		
The treatability of certain types of anemia with iron tablets						0.542	0.005
	Yes	49 (81.7)	60 (100.0)	49 (87.5)	49 (87.5)		
	No	11 (18.3)	0 (0.00)	7 (12.5)	7 (12.5)		
Enhancing iron absorption with Vitamin C						0.207	<0.001
	Yes	38 (63.3)	58 (96.7)	28 (50.0)	31 (55.4)		
	No	22 (36.7)	2 (3.3)	28 (50.0)	25 (44.6)		
Treatment of anemia with multivitamins						1.000	0.004
	Yes	47 (78.3)	59 (98.3)	44 (78.6)	45 (80.4)		
	No	13 (21.7)	1 (1.7)	12 (21.4)	11 (19.6)		
Taking iron supplements on an empty stomach						0.822	0.007
	Yes	45 (75.0)	58 (96.7)	40 (71.4)	44 (78.6)		
	No	15 (25.0)	2 (3.3)	16 (28.6)	12 (21.4)		

Table 4 summarizes the common AEs of oral iron in both groups. No severe or life-threatening AEs were reported in either group. None of the patients discontinued the drug due to AEs. There were predominant gastrointestinal AEs, including nausea, flatulence/swelling, constipation, and metallic taste. Although the number of patients who experienced adverse events (AEs) was not statistically different between the two groups, the total number of episodes of nausea, diarrhea, flatulence/bloating, metallic taste, and headache was notably higher in the intervention group.

Table 4. Adverse events during the entire study

Symptoms	**Intervention group n = 60 (%)**	**Control group n = 54 (%)**	**P value**
Nausea	26 (43.3)	25 (44.6)	1.000
Vomiting	1 (1.8)	1 (1.7)	1.000
Diarrhea	9 (15.0)	5 (8.9)	0.473
Flatulence/swelling	27 (45.0)	21 (37.5)	0.528
Constipation	27 (45.0	27 (48.2)	0.872
Metallic taste	20 (33.3)	14 (25.0)	0.435
Heartburn	3 (5.0)	4 (7.1)	0.710
Headache	4 (6.7)	8 (14.3)	0.298
Shortness of breath	2 (3.3)	2 (3.6)	1.000

2.1. Primary endpoint

At follow-up visits, 60.0% of patients in the intervention group and 35.7% of those in the control group achieved their target hemoglobin (Hb) levels. This represents a statistically significant improvement in the intervention group compared to the control group ($p < 0.001$), as shown in Table 6. At week 12, the median hemoglobin (Hb) level in the intervention group was significantly higher than in the control group (12.20 g/dL vs. 11.55 g/dL, respectively).

2.2. Secondary endpoints

Secondary outcomes were to increase other complete blood count (CBC) indices including haematocrit (Hct), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), mean corpuscular volume (MCV) and serum ferritin, are shown in Table 6, and improvement in compliance with IDA supplements as shown in Table 5. There were no significant differences between the intervention and control groups at the end of follow-up in terms of Hct, MCV, MCH, MCHC. and ferritin level. However, serum ferritin levels in the intervention group were significantly higher than those in the control group at the endline, indicating improved iron stores among patients receiving the pharmacist-led intervention. Table 5 presents the mean scores for compliance with iron tablet intake in both groups. In the intervention group, 78.3% of participants demonstrated high compliance, compared to 42.9% in the control group. Conversely, low compliance was observed in 21.7% of the intervention group and 57.1% of the control group. This difference in compliance between the two groups was statistically significant ($p < 0.001$).

Table 5. The compliance of the patients (n = 116) with the oral iron supplementation

Compliance	Intervention group n = 60 (%)	Control group n = 56 (%)	P value
Poor < 70%	13 (21.7)	32 (57.1)	<0.001
High 70–100%	47 (78.3)	24 (42. 9)	
Median	85.00	71.00	

Table 6. Hematological parameters and iron profile parameters within-group at baseline and after follow-up

Laboratory findings mean (SD)	Result	Intervention group	Control group	P value
Hb	Baseline	10.85 (1.16)	11.0 (0.78)	0.015
	Endline	12.20 (1.17)	11.55 (1.18)	<0.001
HCT	Baseline	33.9 (3.1)	34.1 (2.3)	0.721
	Endline	36.1 (3.4)	37.1 (3.0)	0.104
MCV	Baseline	79.1 (9.4)	78.3 (5.9)	0.589
	Endline	81.3 (9.8)	82.2 (6.3)	0.539
MCH	Baseline	25.1 (2.5)	25.1 (2.59)	0.981
	Endline	26.5 (2.8)	26.7 (2.3)	0.731
MCHC	Baseline	31.3 (1.29)	32.2 (1.3)	<0.001
	Endline	32.1 (1.0)	32.2 (0.9)	0.680
Ferritin	Baseline	11.1 (9.0)	8.7 (5.9)	0.256
	Endline	20.9 (17.1)	25.6 (36.3)	0.461

3. DISCUSSION

The International Pharmaceutical Federation (FIP), a global professional leadership organization representing pharmacists, pharmaceutical scientists, and educators, conducted an exploratory study in May 2022 focusing on the role of pharmacists in managing anemia, with a particular emphasis on iron deficiency

anemia (IDA). This study highlighted the critical need to strengthen the participation of practicing pharmacists, especially clinical pharmacists, in the management of IDA [14, 15].

This study was designed to evaluate the effect of patient education provided by clinical pharmacists on premenopausal female patients with iron deficiency anemia. The findings demonstrated that clinical pharmacy services led to a significantly higher percentage of patients in the intervention group achieving their Hb goals compared to those in the control group. Few studies have been conducted to investigate the evaluation of patient education provided by clinical pharmacists for patients with IDA [16, 17]. The results of these studies are consistent with the findings of our study. A prospective, randomized controlled trial was the first to investigate the role of clinical pharmacists in influencing the clinical outcomes of IDA patients in Jordan. In the study conducted by Linda M. Tahaineha and Afaf H. Khasawneh, the mean Hb levels at baseline were 8.5 g/dL for the intervention group and 9.5 g/dL for the control group, respectively. At the end of the intervention, the mean Hb level at follow-up in the intervention group was 11.04 g/dL, compared to 10.6 g/dL in the control group. Our study revealed a higher Hb level compared to the findings of the referenced study. Furthermore, our research emphasized the assessment of compliance with oral therapy and the identification of factors associated with it. In contrast, the study by Linda M. Tahaineh and Afaf H. Khasawneh did not explore the issue of compliance.

The findings of the current study were consistent with those reported in a previous study conducted by Nadia B. Elsharkawy et al. [18] in Saudi Arabia, a single-blind randomized controlled trial who stated that there was a significant difference in Hb levels between the intervention and control groups ($p < 0.001$), emphasizing the effect of education intervention in improving Hb levels among pregnant women. Similarly, a randomized controlled trial with a pre- and post-test design, conducted in Jordan, found that women in the intervention group had higher scores on the post-test lifestyle check, knowledge check, compliance checklist, and hemoglobin levels compared to women in the control group [19].

A facility-based cross-sectional study conducted in Southern Ethiopia found that maternal educational status was significantly associated with compliance with IDA supplementation among pregnant women [24]. In this study, multivariable analysis identified five key predictors: age ≥ 25 years, primary education, and husbands' educational status (primary education or higher) were significantly associated with better compliance with IDA supplementation. Additionally, pregnant mothers with good knowledge about IDA supplementation and those with good knowledge about anemia were also significantly associated with compliance with IDA supplementation [20, 23]. In Japan, a retrospective study was conducted to assess the impact of implementing pharmacy services for 84 outpatients undergoing haemodialysis. In this study, pharmacists provided drug information to physicians, recommended therapeutic plans, evaluated medication use, and educated patients on their medications and necessary lifestyle modifications. The results demonstrated a significant improvement in Hb levels in accordance with hospital guidelines. The study concluded that the introduction of pharmaceutical care services for patients undergoing hemodialysis led to improved healthcare outcomes [21, 22].

We found that the mean knowledge score in the intervention group was significantly higher than that in the control group ($p < 0.001$), Similar findings were reported in studies conducted in Jordan, Saudi Arabia, Ethiopia, and Japan, all of which demonstrated that health educational interventions effectively improved patients' knowledge levels during follow-up after three months [17, 18, 19, 20, 21].

Our study also emphasized the role of lifestyle modifications and the impact of educational interventions in helping anemic premenopausal female patients improve their ability to make informed dietary choices, correctly administer IDA supplements, and eliminate unhealthy habits. A common issue observed was the intake of IDA supplements alongside tea, coffee, or milk, which significantly impairs iron absorption. The findings highlight a pressing need to enhance awareness among anemic women regarding the proper use of dietary supplements during therapy. Educational efforts led by clinical pharmacists are strongly recommended to address this gap and promote better treatment compliance and outcomes.

Sontakke et al. [25] report a randomized controlled open-label trial that concluded mobile phone call reminders, in conjunction with standard iron supplementation therapy, significantly improved compliance with iron supplementation. This improvement in compliance led to a greater rise in Hb levels by the time of delivery in antenatal women with IDA, compared to standard therapy alone. Similarly, a parallel randomized controlled trial in eastern Ethiopia demonstrated that a picture-based nutrition education intervention, combined with frequent follow-ups through household visits, improved women's knowledge about anemia and neural tube defects (NTDs) during pregnancy. This intervention not only raised awareness about better dietary practices but also contributed to a reduction in neonatal and maternal

morbidity and mortality [26]. The findings from these two studies are consistent with our results, where the mean number of iron tablets taken was 85% in the intervention group and 71% in the control group, reflecting improved compliance in the intervention group.

In contrast, a cross-sectional study conducted in Uganda, which was a randomized controlled open-label/non-blinded trial, tested the effectiveness of blister packaging versus loose packaging of Iron-Folic Acid (IFA) pills on compliance with the supplementation regimen. The study found no significant effect of blister packaging on compliance among pregnant women. Hemoglobin changes did not differ significantly between the two groups. However, the findings did indicate that the blister-packaged group experienced a greater increase in Hb levels compared to the loose iron group [27].

The strength of this study lies in the fact that, although numerous studies in Türkiye have investigated the role of clinical pharmacists in improving health outcomes across various disease states, to the best of our knowledge, this is the first study conducted specifically on patients with iron deficiency anemia.

Some limitations should be considered when interpreting the results of this study. First, the study was conducted exclusively in one hospital, which may limit the generalizability of our findings [28]. Additionally, we did not directly observe premenopausal women taking the IDA supplements to assess compliance; instead, we relied solely on self-reporting, which could have introduced response bias. Despite these limitations, the current study identified valuable variables for intervention, providing useful insights for future research and clinical practice.

Our study results have implications for research, policymakers, and practice. Further research should explore the educational needs of health-care providers to enhance their health-promotion care for premenopausal women. For policymakers, the findings of the study provided a basis for them to suggest and implement various strategies and techniques to promote health and preventive behaviors among care providers to combat anemia . Policymakers should motivate pharmacists to enroll in continuing educational programs to improve their education and counseling skills to provide appropriate and effective messages for anemic women.

4. CONCLUSION

This study demonstrated the importance of the clinical pharmacist's role in the treatment of iron deficiency anemia in outpatient clinics. The current study demonstrates that patient education delivered by clinical pharmacists, in conjunction with standard therapy including iron supplementation, significantly improves patient compliance with iron supplementation regimens. As a result, this approach leads to a more significant increase in hemoglobin levels in premenopausal female patients diagnosed with iron deficiency anemia, compared to the outcomes observed with standard therapy alone. clinical pharmacist interventions and effective physician-pharmacist collaboration have led to improved disease management outcomes.

5. MATERIALS AND METHODS

5.1. Design and Participants

This study as a prospective, parallel, randomized controlled 3-month follow-up trial was conducted at a Training and Research Hospital in Istanbul, Türkiye between 18 March 2024 and 18 October 2024. The study protocol was approved by the Clinical Research Ethics Committee (Document Date and Number: 11.03.2024-26445). All premenopausal female patients with recently diagnosed IDA (hemoglobin level < 12 g/dL) and with continued iron treatment and who admitted the outpatient clinics were included in the study. Informed consent was voluntarily completed and signed by each patient before participating in the study.

5.2. Primary and secondary outcomes

The primary outcome of this study was to achieve an increase in Hb levels by at least 2.0 g/dL or to reach non-anemic hemoglobin levels within 4–6 weeks. Non-anemic Hb levels were defined as ≥13.0 g/dL in men and ≥12.0 g/dL in women. Secondary outcomes included improvements in other complete blood count indices—Hct, MCH, MCHC, MCV, and reticulocyte count—as well as enhancements in iron profile parameters, such as increased serum ferritin, and an improvement in the patient's knowledge score and compliance with iron supplementation pills.

5.3. Participant inclusion and exclusion criteria

We recruited premenopausal female patients over the age of 18 years with confirmed IDA, defined by a Hb level of <12 g/dL. The study excluded pediatric patients, pregnant and lactating women, individuals with chronic illnesses that could contribute to anemia—such as cancer or chronic kidney disease—and those requiring parenteral iron supplementation.

5.4. Data Collection and Evaluation

Patients were assigned to the education or control group in a 1:1 ratio using a computer-generated simple randomization program based on their outpatient clinic appointment numbers.

In this study, based on the sample size calculation, a total of 142 patients were planned to be included, with at least 71 patients in each group, to detect a 2 g/dL increase in Hb levels between the two groups with 80% power and an alpha value of 0.05. 142 patients were screened for eligibility, out of which a total of 116 were randomized. Patients in both the intervention and control groups were invited to complete the survey at the time of study enrollment and again at the end of the study, allowing for a before-and-after comparison. During the initial consultation that patients had with the clinical pharmacist researcher, a three-sectioned survey was used to collect data from the patients. The survey was designed as a self-structured questionnaire by the researchers, inspired by examples from the literature [29-36]. It was a knowledge level and attitude assessment questionnaire consisting of three sections. In the first section, patients' socio-demographic and clinical characteristics were recorded. The second section included 7 questions about the patient's lifestyle, including diet history, dieting status, intense exercise, and smoking habits. One of these questions asked whether participants were on a special diet that could cause iron deficiency. They were also asked whether they were involved in an intense exercise program that could be associated with iron deficiency. The third section consisted of a total of 20 questions designed to assess knowledge levels, with 11 questions having four answer choices and 9 questions having two answer choices. A scoring system out of 20 points was applied based on the number of correct answers.

Patients in the education group received verbal counseling regarding iron therapy and were provided with a brochure detailing the significance of anemia management, dietary modifications, treatment recommendations, and strategies for managing side effects. These patients were also informed that they could reach out to the clinical pharmacist with any questions concerning the initiation of new medications or their ongoing treatment.

Patients' socio-demographic information, treatment duration, list of medications included in their treatment regimen, current medications, medical history, routinely measured biochemical laboratory parameters, and other relevant data were recorded using a registration form. Hemoglobin levels of patients in both the education and control groups were measured 15 weeks (equivalent to 3 months and 2 weeks) following the initial visit. At the final follow-up, conducted via telephone, any complaints associated with iron therapy were documented based on patients' self-reports, utilizing a nine-item assessment form. Subsequently, based on the recommendations, the clinical pharmacist referred the patient to a physician if deemed necessary. Patients with missing data were excluded from the study.

In addition, patient compliance was documented by assessing the extent to which individuals adhered to IDA supplementation as recommended by their healthcare providers. Compliance was evaluated through a multi-faceted approach: patients were asked to confirm their compliance with the prescribed treatment regimen, the necessity for prescription refills was assessed to ensure completion of the treatment duration, and possession of the medication was verified during follow-up visits or phone calls. This assessment was based on the total number of prescribed iron therapy tablets and the patients' self-reported intake, as determined using the self-report method. In the self-report method, each patient was contacted weekly by phone, beginning from the initial consultation, and the number of tablets consumed over the week was documented. In both groups, compliance was defined as the intake of 70% or more of the prescribed iron therapy tablets.

Tablet count compliance was calculated as:

Compliance =Number of tablets taken in one month×100/Number of tablets prescribed in one month

Patients in the control group were invited to complete the questionnaire at the beginning and the end of the study (pre- and post-intervention). Patients in the control group continued to receive routine medical care from their physicians without any intervention from the clinical pharmacist. During the follow-up visit, their clinical and laboratory parameters, as outlined previously, were documented. At the end of the study,

patients in the control group were also provided with educational materials, either through verbal communication or in the form of a brochure.

5.5. Statistical analysis

The data were analyzed using the Statistical Package for Social Science (SPSS, version 25 software, Chicago, IL, USA). The Pearson chi-square test was used to compare the percentage of patients achieving primary outcomes between the education and control groups. A paired t-test or its non-parametric counterpart, the Wilcoxon test, was used to compare the means of the initial and final complete blood count indices within each group. To compare changes in the mean complete blood count indices between the education and control groups, the Student's t-test or its non-parametric equivalent, the Mann-Whitney U test, was used. The internal consistency of the administered questionnaire was assessed using Cronbach's alpha coefficient. A p-value of <0.05 was considered statistically significant at a 95% confidence interval.

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