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Association between knowledge of anticoagulation, INR control, and warfarin-related adverse events: a cross sectional study

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Abstract

Objective This cross-sectional observational study, conducted from 01/09/2023 to 01/11/2023, involved 200 warfarin-using patients outpatient clinics to assess the knowledge and understanding of warfarin among patients through face-to-face interviews.

Results Almost 70% of participants displayed insufficient knowledge about their warfarin therapy, potentially linked to inadequate counseling or patient comprehension. The participants had an average weekly warfarin dose of 32.9 ± 11.2, and more than half had used warfarin for at least 2 years. Only one third of patients most recent INR level was within the target range. Thirty-seven percent of patients experienced a thromboembolic event, and most of them required hospitalization. One hundred and eight patients (54.0%) experienced bleeding (minor, or major, or both). Eighty-two percent of participants correctly answered Question 8 of the OAK questionnaire regarding warfarin's indication for treating blood clots and 78% of the participants knew what the INR was. Moreover, the research revealed a positive correlation between higher education and adequate knowledge, with university-educated individuals exhibiting superior understanding. Conversely, a prolonged warfarin duration correlated with diminished knowledge, possibly indicating decreased patient vigilance. Furthermore, maintaining INR within the target range showed an association with sufficient knowledge.

Keywords Thrombosis, Anticoagulation, Questionnaire, INR, Education, Bleeding

Introduction

Warfarin is the most frequently recommended oral anticoagulant for the prevention and management of venous thrombosis and thromboembolic incidents [4]. Despite the rise of the other oral anticoagulants, warfarin is still used as an anticoagulant for the prevention and treatment of thromboembolic diseases [25]. To ensure both effectiveness and safety with warfarin therapy, maintaining a high level of control over anticoagulation is crucial. Inadequate control, as indicated by a low proportion of time spent within the therapeutic range (TTR), is linked to a higher risk of strokes and bleeding events [7]. An INR target range of 2.0–3.0 for atrial fibrillation or venous thrombosis and 2.5–3.5 for patients with mechanical heart valves [mechanical aortic valve with a target INR range 2.0 to 3.0, mechanical mitral valve with a target INR range 2.5 to 3.5] [15, 29].

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The prevention of complications in oral anticoagulation heavily relies on patients' understanding. Patients' knowledge is defined by their awareness of the drug name, its indication, dosing regimen, adverse effects or side effects, and specific administration instructions [21].

Several studies revealed a moderate association between patients' knowledge of warfarin therapy and time in therapeutic range [16, 18, 23]. A Chinese study assessed warfarin knowledge using a validated questionnaire revealed correlations between the percentage of INR measurements within the range, and patients' educational levels with warfarin knowledge [9]. A comprehensive education on warfarin equips individuals with a deeper understanding of the medication, including its potential side effects and complications such as bleeding [17].

The 2014 guidelines from the Joint Commission International and National Patient Safety Goal acknowledged that patient education regarding the treatment of oral anticoagulants is a crucial element [6]. Consequently, the level of understanding that patients have about anticoagulation can have a fundamental impact on the management of warfarin therapy [22]. Presently, there are two established questionnaires for evaluating patients' understanding of oral anticoagulation and warfarin therapy. These questionnaires are the Anticoagulation Knowledge Assessment (AKA) test, introduced in 2005 by Briggs et al. [8], and the Oral Anticoagulation Knowledge (OAK) test, introduced in 2006 by Zeolla et al. [31]

Jordan exhibits widespread use of warfarin due to its affordability. Despite its cost-effectiveness, the drug poses numerous serious side effects, and its efficacy may be compromised by various factors, leading to potential complications such as DVT and PE. Compounding this issue is the absence of anticoagulation clinics in Jordan dedicated to patient education [1]. There is a lack of studies addressing the knowledge of patients regarding anticoagulation in this context. This study endeavors to fill this knowledge gap by employing the validated OAK test [31]. The primary aim of this study is to assess patients' anticoagulation knowledge by utilizing the OAK test and data collection sheet. Additionally, we seek to identify potential predictors of adequate knowledge among patients and examine others correlation with the attainment of an adequate understanding of warfarin use to hopefully contribute valuable insights to the field, potentially informing future interventions and educational strategies to enhance patient comprehension of anticoagulation therapy in the context of Jordan.

Methodology

This is a cross-sectional observational study that was conducted over the duration of 2 months starting September 9, 2023. Two hundred patients using warfarin in the outpatient clinics of Al-Hussein New Salt Hospital and Al-Basheer Hospital participated in the study. Information was gathered through face-to-face interviews using the OAK questionnaire [31] and a data collection sheet for the acquisition of sociodemographic and medical data.

To choose the study candidates, the following inclusion and exclusion criteria were considered, Inclusion criteria: any patient 18 year or older and on warfarin for the last 6 months, patient should have at least one INR value. Exclusion criteria: patients who can not communicate verbally, with mental diseases, or have any degree of cognitive impairment, and any patient who does not have INR values.

To obtain the maximum sample size, an estimated proportion of patients that have adequate knowledge in similar studies in the Arab region was used, P = 14%, was used to calculate the sample size [10].

$$n = \frac{\left(z\frac{\alpha}{2}\right)^2 p(1-p)}{d^2}$$

$Z\alpha_{/2} = 1.96$ (Z = score corresponds to 95% confidence level). P = 14%, 1-P = 86%. d = margin of error (0.05). n = required sample size = 185 is the minmum sample size [20].

The Oral Anticoagulation Knowledge (OAK) test was used to evaluate the knowledge regarding warfarin therapy in patients enrolled in the study. A score of 15 or higher reflects a level of knowledge that is considered adequate. Conversely, a score below 15 is interpreted as indicative of inadequate knowledge [22]. A data collection sheet was used to collect sociodemographic and clinical information.

The OAK questionnaire, initially comprising 20 questions, underwent a translation process into Arabic by a linguistic expert. Two proficient Arabic experts thoroughly reviewed the translated version, and subsequently, a linguistic expert conducted a back translation into English. The English version was further evaluated by two additional field experts (Supplementary file: Arabic version of the OAK questionnaire).

A pilot study was conducted involving the recruitment of 10 participants to assess their comprehension of the questionnaire and the data collection sheet questions and to provide feedback on the Arabic version. The participants involved in the pilot study were not incorporated into the final analysis.

Table 1 Socioeconomic and clinical characteristics of the participants, N = 200

Variables	Frequency N	Percentage (%)
Gender		
Males	111	55.5
Females	89	44.5
Age		
20–50	58	29.0
51–65	76	38.0
66–75	48	24.0
76–85	18	9.0
Marital status		
Single	39	19.5
Married	111	55.5
Divorced	7	3.5
Widower	43	21.5
Educational level		
Lower than high school	65	32.5
High school only	73	36.5
University, college	62	31.0
Monthly income		
≤ 300 JOD	121	60.5
> 300 JOD	79	39.5
Smoking history		
Nonsmoker	133	66.5
Smoker	67	33.5
Working status		
Unemployed	106	53.0
Working	50	25.0
Retired	44	22.0
Chronic medical conditions (The participant can choose more than one answer)		
Diabetes mellitus	79	19.3
Hypertension	121	29.5
Cardiovascular diseases	94	22.9
Estrogen therapy	16	3.9
Neurologic diseases	11	2.7
Heart failure	14	3.4
Others	75	18.3
Indication for warfarin anticoagulation (The participant can choose more than one answer)		
Atrial fibrillation	13	4.9
Artificial valves	64	24.3
Cerebrovascular accident	17	6.5
Deep vein thrombosis/pulmonary embolism	116	44.1
Prophylaxis	53	20.2
Received educational orientation on Warfarin		
No	123	61.5
Yes	77	38.5
Duration of warfarin use		
< 1 years	31	15.5
1–2 years	45	22.5
> 2 years	124	62.0

Table 1 (continued)

JOD Jordanian Dinar

Before the initiation of the study, ethical approval was secured from the Institutional Review Board (IRB) at the Jordanian Ministry of Health (MBA/Ethics committee/11927) on August 7, 2023. Adherence to all ethical principles governing medical research involving human subjects was mandatory. The rights and privacy of human subjects were carefully upheld throughout the study, and each participant received a written consent form in the Arabic language. Participants were assured their involvement was entirely voluntary and that any data collected would be used solely for research purposes, and confidentiality would be maintained by the research investigators. All participants signed an informed consent before filling the questionnaire.

Data was gathered through in-person interviews utilizing the OAK questionnaire, along with a data collection sheet encompassing sociodemographic details. The OAK questionnaire was used because it is more concise and tailored to individuals with a seventh-grade level of education and several studies used the OAK questionnaire in the Arabic version. The selection of eligible participants involved a convenient sampling approach to individuals in the outpatient clinics' waiting room (cardiology and internal medicine departments) who were on warfarin. Eligible candidates were verbally briefed on the study's nature, objectives, and voluntary participation. Their medical records were reviewed, including laboratory test results and the INR levels, with the last INR reading taken into consideration. In instances where the last INR reading was unavailable, the average of the INR readings over the preceding 6 months was considered. All INR values from the most recent lab test were obtained and were classified as within range, below range, or above range depending on the indication of warfarin. Bleeding and thrombosis rates were determined from the patient's historical knowledge of an event. The target INR was set at 2–3 for most warfarin indications, except for patients with mechanical heart valves, where it was 2.5–3.5.

The statistical analysis of the data was carried out using SPSS version 26. Continuous data was presented as Mean ± SD, and categorical data as Frequency (%). The Chi-square ($\chi 2$) statistic was utilized to detect association between two categorical variables. Possible predictors of adequate knowledge were assessed using univariate and multivariate logistic regression.

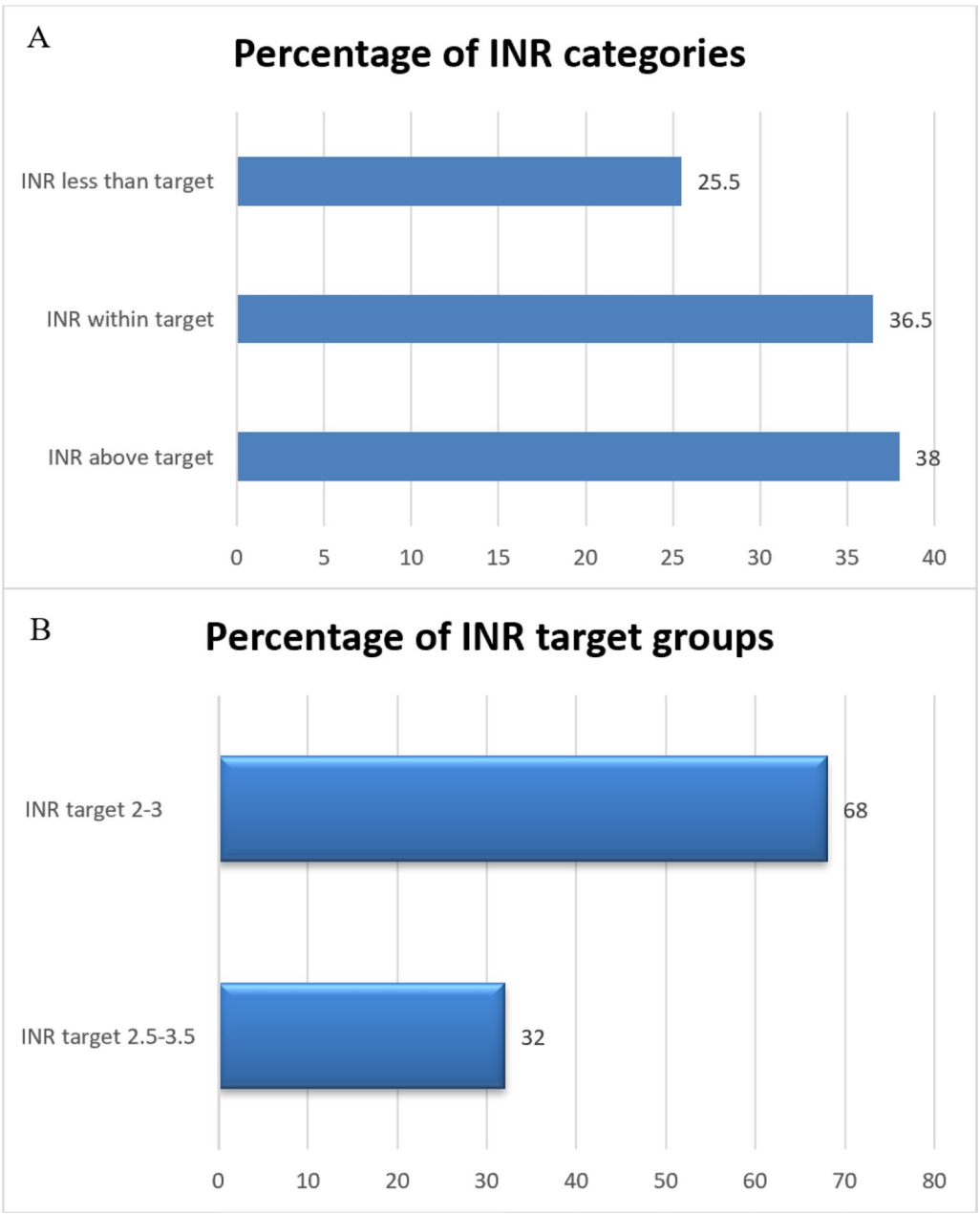

Fig. 1 **A** Percentage of INR categories; **B** Percentage of INR target groups

Results

A total of 200 patients were enrolled in the study from Al Salt and Al-Basheer hospitals. Two hundred and seven patients were approached, 200 agreed to participate in the study with a response rate of 96%. Only one third were 50 years or younger and two thirds were older than 50 years of age. The participants had an average BMI of 27.7 ± 4.4 and an average family member of 4.5 ± 1.6. The general and clinical characteristics of the participants are shown in Table 1.

The participants had an average weekly warfarin dose of 32.9 ± 11.2, and more than half used warfarin for at least 2 years. Only one third of patients had an INR level within the target goal, Fig. 1.

Thirty seven percent of patients experienced a thromboembolic event, most of them required hospitalization. One hundred and eight patients (54.0%) experienced bleeding (minor, or major, or both). The most frequent type of minor bleeding was epistaxis followed by oral

Table 2 Frequency of thromboembolic and bleeding events bleeding events that participants experienced during warfarin therapy

Variable	Frequency N	Percentage (%)
Thromboembolic events during warfarin, N = 200		
No	126	63.0
Yes	74	37.0
Hospitalized during the thromboembolic event, N = 74		
No	4	5.4
Yes	70	94.6
Minor bleeding		
No	95	47.5
Yes	105	52.5
Type of minor bleeding The participant can choose more than one answer (N = 105)		
Epistaxis	68	64.8
Cutaneous bleeding	27	25.7
Cutaneous wound	19	18.1
Oral bleeding	53	50.5
Tooth extraction	20	19.0
Surgical bleeding	10	9.5
Menorrhagia	10	9.5
Major bleeding		
No	163	81.5
Yes	37	18.5
Type of major bleeding The participant can choose more than one answer (N = 37)		
Hemoglobin fall	14	37.8
Required transfusion	33	89.2
Bleeding at critical site	2	5.4

bleeding. Most patients who experienced major bleeding required blood transfusion, Table 2.

A total of 82% of the participants knew why they were using warfarin and 78% knew what the INR was. The frequency of the correct answers for the different OAK attributes are shown in Table 3. Participants were assessed as having adequate knowledge if they achieved a score of 15 or more, and inadequate if they achieved less than 15. Only 30.5% of the participants had adequate (good, score $\geq$ 15) knowledge.

There was no association between the weekely dose and adequate knowledge, the mean weekely dose of those with adequate knowledge was 32.8 ± 10.0 compared to 32.8 ± 11.7 in those with inadequate knowledge, p = 0.965 (using independent samples t test).

Association between different variables and knowledge was assessed in Table 4. Patients with target INR between 2.5 and 3.5, patients with INR values above or lower than target (not within the target), and those who suffered from minor or major bleeding were associated with inadequate knowledge.

In the multivariate logistic regression, the only two predictors of having adequate knowledge were: having university/college education and receiving educational orientation on warfarin, Table 5.

Discussion

Among the entire study population, the male participants outnumbered the females, with the highest age group being individuals aged 50 years and above. This demographic pattern is consistent with findings by Ababneh et al. where the mean participants' age was 56.7 ± 15.1 [1], and Praxedes et al. with a mean age of 55 ± 13, although the latter study had mostly female participants [21].

The prevalence of patients of limited income in our sample is expected since governmental hospitals, where the study was conducted, are usually visited by low-income individuals. Most participants in our study had only a high school degree. Conversely, in Ababneh et al. most participants were illiterate, showcasing variations in educational backgrounds among different study populations. Additionally, warfarin-knowledge scores were significantly associated with adherence scores and

Table 3 Frequency of different attributes of the oral anticoagulation knowledge (OAK) Test, N = 200

No	Item description	Correct answers	Participants with Correct answers N (%)	Participants with Incorrect answers N (%)
1	Missing one dose of Coumadin (warfarin)	b. Can alter the drug's effectiveness	115 (57.5)	85 (42.5)
2	You can distinguish between different strengths of Coumadin (warfarin) tablets by what?	a. Color	151 (75.5)	49 (24.5)
3	A patient on Coumadin (warfarin) therapy should contact the physician or healthcare provider who monitors it when:	d. All the above	105 (52.5)	95 (47.5)
4	Occasionally eating a large amount of leafy greens vegetables while taking Coumadin (warfarin) can:	b. Reduce the effectiveness of the Coumadin (warfarin)	91 (45.5)	109 (54.5)
5	Which of the following vitamins interacts with Coumadin (warfarin)?	d. Vitamin K	86 (43)	114 (57)
6	When is it safe to take a medication that interacts with Coumadin (warfarin)?	b. If your healthcare provide is aware of the interaction and checks your PT/INR ("Protime") regularly	102 (51)	98 (49)
7	The PT/INR ("Protime") test is:	a. A blood test used to monitor your Coumadin (warfarin) therapy	156 (78)	44 (22)
8	Coumadin (warfarin) may be used to:	a. Treat people that already have a blood clot	164 (82)	36 (18)
9	A patient with a PT/INR ("Protime") value below their "goal range":	b. Is at an increase the risk of having a clot	98 (49)	102 (51)
10	Taking a medication containing aspirin or other non-steroidal anti-inflammatory medications such as ibuprofen (Motrin®/Advil®) while on Coumadin (warfarin) will:	b. Increase your risk of bleeding from the Coumadin (warfarin)	98 (49)	102 (51)
11	A person on Coumadin (warfarin) should seek immediate medical attention:	b. If they notice blood in their stool when going to the bathroom	111 (55.5)	89 (44.5)
12	Skipping even one dose of your Coumadin (warfarin) can:	c. Cause your PT/INR("Protime") to be below the "goal range"	103 (51.5)	97 (48.5)
13	Drinking alcohol while taking Coumadin (warfarin):	b. May affect your PT/INR ("Protime")	117 (58.5)	83 (41.5)
14	Once you have been stabilized on the correct dose of Coumadin (warfarin), about how often should your PT/INR("Protime") value be tested?	b. Once a month	98 (49)	102 (51)
15	It is important for a patient on Coumadin (warfarin) to monitor for signs of bleeding:	b. At all times	99 (49.5)	101 (50.5)
16	The best thing to do if you miss a dose of Coumadin (warfarin) is to?	b. Take the next scheduled dose and tell your healthcare provider	118 (59)	82 (41)
17	When it comes to diet, people taking Coumadin (warfarin) should:	c. Be consistent and eat a diet that includes all types of food	107 (53.5)	93 (46.5)
18	Each time you get your PT/INR ("Protime") checked, you should	d. Let your doctor know if you missed any doses of Coumadin (warfarin)	91 (45.5)	109 (54.5)
19	Which of the following over-the-counter products is most likely to interact with Coumadin (Warfarin)?	b. Herbal/dietary supplements	113 (56.5)	87 (43.5)
20	A patient with aPT/INR ("Protime") value above the "goal range":	c. Is at an increased risk of bleeding	119 (59.5)	81 (40.5)

better adherence led to good anticoagulation control [1]. In Rahmani et al. two thirds of patients had college education or a university degree, and results showed that higher level of education predicted passing the OAK test [22].

The prevailing medical condition among our participants was hypertension, followed by cardiovascular diseases and diabetes mellitus, a pattern that was also reported by Ababneh et al. [1].

The primary indication for using warfarin in our study was deep vein thrombosis/pulmonary embolism. In Jordan, Ababneh et al. [1] reported atrial fibrillation as the main indication. While Ahmed et al. [2] in Libya reported that the main indication for warfarin use was mitral valve replacement. These variations are likely to be attributed to the diverse clinical settings and medical institutions, whether primary or tertiary.

Notably, more than half of our participants did not receive educational orientation on warfarin. Two-thirds

Table 4 Association between different variables and adequate knowledge

	Inadequate knowledge N = 139	Adequate knowledge N = 61	P[€]
INR target			0.013
2–3 (N = 136)	87 (64.0%)	49 (36.0%)	
2.5–3.5 (N = 64)	52 (81.3%)	12 (18.8%)	
Status of INR			< 0.001
Lower than target (N = 51)	43 (84.3%)	8 (15.7%)	
Within the target (N = 73)	21 (28.8%)	52 (71.2%)	
Higher than target (N = 76)	75 (98.7%)	1 (1.3%)	
Minor bleeding			< 0.001
No (N = 95)	43 (45.3%)	52 (54.7%)	
Yes (N = 105)	96 (91.4%)	9 (8.6%)	
Major bleeding			< 0.001
No (N = 163)	104 (63.8%)	59 (36.2%)	
Yes (N = 37)	35 (94.6%)	2 (5.4%)	
Duration of warfarin therapy			< 0.001
< 1 year (N = 31)	11 (35.5%)	20 (64.5%)	
1–2 year (N = 45)	23 (51.1%)	22 (48.9%)	
> 2 year (N = 124)	105 (84.7%)	19 (15.3%)	

[€]: Using Chi-square test

of them used warfarin for at least 2 years, but only one-third maintained an INR level within the target goal. Maintaining adequate INR values is crucial but very difficult to achieve in many study populations. This low percentage of optimum INR values was also revealed by Ababneh et al. where only 15% maintained good INR control (TTR > 70%) [1]. Additionally, Anand et al. reported that only 18.2% of participants had an INR within the therapeutic range [3].

Most participants had an INR therapeutic target of 2–3, while one-third aimed for a target of 2.5–3.5. Similar findings were reported by Tahaineh and Ali [26]. During warfarin treatment, 37% of patients experienced a thromboembolic event, with a majority requiring hospitalization. Notably, 54.0% of participants in our study experienced bleeding.

A total of 82% of the participants in our study knew the reason for using warfarin, and 78% were aware of what the INR represented which is higher than that identified by Wang et al. who reported that half of their participants knew that INR was the most important monitoring parameter of warfarin [28].

Additionally, 45.5% of our participants knew that occasionally eating a large number of leafy greens and vegetables while taking warfarin can reduce its effectiveness. In Wang et al. study [28], most participants knew the importance of keeping a consistent diet (68.9%) and 54.0% know what type of diet could affect warfarin therapy. The question that received the highest number of correct answers in our study was question 8, with 82% of participants providing the correct response about warfarin indication to treat blood clots.

Almost 70% of our participants exhibited insufficient knowledge regarding their warfarin therapy. This percentage was comparable to the results reported by several studies [1, 3, 5, 11, 13, 22]. These findings suggest a notably low level of knowledge within the study population. Insufficient knowledge among participants regarding warfarin poses potential risks, given that warfarin is a medication with a narrow therapeutic index and is susceptible to numerous interactions with both drugs and food.

Our research indicates a positive correlation between a higher educational orientation and an elevated level of adequate knowledge. Specifically, individuals with a university education predicted a superior understanding of warfarin compared to those with an elementary education.

This pattern aligns with findings from a Malaysian survey conducted at a Warfarin Clinic, where a significant correlation was identified between patients' educational level and their knowledge of anticoagulation therapy [19]. Moreover, Yabeyu et al. and Wang et al. also reported significant associations between participants' educational levels and their knowledge of warfarin [28, 30]. Patient education should be individualized based on the patient's education, additional risks, duration of warfarin use and any unique individualized situations impacting the management plan.

Another significant predictor of adequate knowledge was receiving educational orientation which emphasizes the importance of education material and patient counseling sessions on a regular basis to improve warfarin knowledge. This is consistent with Ahmed et al. who found that patients' knowledge about anticoagulant therapy has been improved by introducing educational sessions and leaflets for patients taking an oral anticoagulant [2].

Additionally, our study revealed an inverse correlation between the duration of warfarin use and the level of adequate knowledge. This implies that a more extended duration of warfarin use is linked to a diminished level of adequate knowledge. This phenomenon might be attributed to a gradual decrease in patient vigilance over time, potentially stemming from a decreased concern regarding the drug's adverse effects [24]. Similar findings were presented by a study in Nepal that found a significant association between the duration of warfarin therapy and total warfarin score [24]. Knowledge was related to the duration of therapy too as reported by Tang et al. [27] but the finding was in contrast to the result obtained by

Table 5 Possible predictors of adequate knowledge using univariate and multivariate logistic regression

	Univariate logistic regression			Multivariate logistic regression		
	OR	95% CI	P[¥]	OR	95% CI	P[¥]
Gender						
Males[Ω]						
Females	0.814	0.442–1.497	0.508	0.288	0.068–1.223	0.091
Age						
20–50[Ω]						
51–65	0.175	0.082–0.376	**< 0.001**	0.559	0.559–0.134	0.425
66–75	0.152	0.062–0.371	**< 0.001**	0.760	0.760–0.094	0.797
76–85	0.039	0.005–0.311	**0.002**	0.648	0.648–0.033	0.776
Marital status						
Single[Ω]						
Married	0.395	0.187–0.832	**0.015**	0.941	0.211–4.203	0.936
Divorced	0.343	0.059–1.986	0.232	0.092	0.007–1.166	0.066
Widower	0.064	0.017–0.243	**< 0.001**	0.414	0.037–4.613	0.473
Educational level						
Lower than high school[Ω]						
High school only	2.847	0.965–8.406	0.058	1.650	0.388–7.029	0.498
University, college	25.200	8.763–72.471	**< 0.001**	15.571	2.856–84.910	**0.002**
Monthly income						
≤ 300 JOD[Ω]						
> 300 JOD	3.561	1.899–6.675	**< 0.001**	0.364	0.094–1.405	0.142
Smoking history						
Nonsmoker[Ω]						
Smoker	1.965	1.052–3.670	**0.034**	0.691	0.205–2.332	0.552
Working status						
Unemployed[Ω]						
Working	6.323	2.988–13.380	**< 0.001**	1.378	0.306–6.211	0.676
Retired	1.920	0.849–4.342	0.117	0.554	0.088–3.487	0.529
Educational orientation						
No[Ω]						
Yes	38.907	15.730–96.230	**< 0.001**	28.013	8.872–88.447	**< 0.001**

[Ω]: Reference; *JOD* Jordanian Dinar; [¥]: Using logistic regression; Statistical significance $P < 0.05$ (in Bold)

Hasan et al. where no association was found between the duration of therapy and knowledge [12].

Patients who exhibited poor control over their INR targets tend to demonstrate a lower level of adequate knowledge regarding warfarin. This suggests a connection between effective INR management and a comprehensive understanding of warfarin therapy among patients. Our results align with a study conducted in Singapore, which highlighted deficiencies in patients' knowledge about warfarin treatment and its interactions, demonstrating their association with good INR control [28]. However, a randomized controlled study that was conducted with 63 patients who use warfarin at a cardiology and cardiovascular surgery outpatient department in Manisa found that patients' INR control is not affected by warfarin knowledge level [6].

This study showed insufficient knowledge among patients concerning warfarin. Patient education should be individualized based on the patient's education, additional risks, and duration of warfarin use. It is also crucial that feedback from the patients on how to best provide this information be considered. The essential responsibility of educating patients about warfarin is shared among the various components of the healthcare system. Imran F. Khudair's study at Hamad General Hospital in Doha emphasized physicians as the principal educators. Nevertheless, this role may be limited by the challenge of inadequate time for thorough counseling [14].

Limitations

There are certain limitations of the study including recall bias since information was obtained from the patients without any verification from the medical records. In addition, clinical data such as time elapsed between the start of warfarin and thromboembolic events, or bleeding and type of artificial valves were not attainable.

Conclusion

The responsibility of providing comprehensive education falls on the shoulders of physicians, pharmacists, nurses, and every healthcare team member. The high incidence of thromboembolic events during warfarin treatment may be multifaceted and may reflect disparities in different aspects of the anticoagulation therapy that may warrant the establishment and improvements of anticoagulation stewardship.

The collaborative efforts of the members of the healthcare team should address the challenges and opportunities to ensure that patients receive comprehensive and timely education about warfarin therapy.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s13104-025-07167-6.

Supplementary material 1

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Author contributions
N.K. and L.G. and S.A. wrote the main manuscript, N.K. collected the data, L.G. and N.K. conducted the analysis, N.K. and L.G. and S.A. reviewed the manuscript.

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Availability of data and materials
Data is available upon reasonble request from the corresponding author.

Declarations

Ethics approval and consent to participate
Ethical approval was secured from the Institutional Review Board (IRB) at the Jordanian Ministry of Health (MBA/Ethics committee/11927) on 7/8/2023. All participants signed an informed consent before filling the questionnaire. All procedures performed in the study were in accordance with the Helsinki declaration.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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