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Original Research

The impact of an educational intervention on medication adherence self-efficacy in patients with type 2 diabetes in hail, Saudi Arabia

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Abstract

Introduction: Medication adherence self-efficacy is vital for improving therapeutic outcomes in patients with Type 2 Diabetes Mellitus (T2DM). Limited data exist on medication adherence self-efficacy among T2DM patients and its relationship with sociodemographic factors. This study examined the effect of an educational intervention on medication adherence self-efficacy using the Self-Efficacy for Appropriate Medication Use Scale (SEAMS). **Methods:** This controlled before-and-after study was conducted at five public hospitals in Hail City, Saudi Arabia. Data were collected pre-intervention (February–May) and post-intervention (August–October). The intervention group received an educational program structured around the American Association of Diabetes Educators 7 Self-Care Behaviors™ (AADE7) framework over six months (12 sessions, every two weeks), delivered via workshops, online modules, and printed materials. A multidisciplinary team guided participants through healthy eating, physical activity, monitoring, problem-solving, medication adherence, reducing risks, and healthy coping. A total of 377 patients completed the study. **Results:** Baseline findings showed that only 17.8% of patients felt "very confident" in taking medications correctly. Over 72% reported feeling only "somewhat confident" about taking medications on busy workdays, and more than half were somewhat confident when managing medications without reminders. Post-intervention, confidence levels improved significantly, with the proportion feeling "very confident" about taking multiple medications daily rising from 17.8% to 47.7%. Patients also reported enhanced confidence in managing medications during busy days and without reminders. Additionally, patients with shorter duration of diabetes(<5 years) demonstrated better adherence. **Conclusion:** The educational intervention significantly increased medication adherence self-efficacy among T2DM patients. These findings highlight the importance of structured, behavior-focused education in improving patients' confidence and adherence to medication regimens.

Keywords: Medication adherence, Type 2 Diabetes, patient education, self-efficacy

INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) is a major global healthcare challenge, particularly in low- and middle-income countries, driven by factors such as urbanization, poor dietary habits, physical inactivity, and socioeconomic barriers[1-3]. In regions like Saudi Arabia, environmental factors and obesity further contribute to the escalating burden of T2DM[4]. Although medical advances have improved diagnosis and treatment options, most patients still experience suboptimal outcomes due to inadequate adherence to recommended regimens. Without robust strategies to address these behavioral and environmental influences, the global impact of T2DM will continue to intensify[5,6].

Self-efficacy is conceptualized as a cognitive mechanism through which individuals, influenced by environmental and social stimuli, acquire new behaviors that subsequently enhance their ability to navigate future circumstances[7]. Adherence is operationally defined as "the extent to which an individual's actions concerning pharmacological treatments, dietary practices, or necessary lifestyle modifications align with prescribed medical guidance"[8].

It has been demonstrated that enhanced adherence to medication among individuals diagnosed with T2DM may result in improved therapeutic outcomes[9,10]. Nonetheless, diminished adherence was observed in individuals lacking literacy skills as well as in those exceeding the age of 40 years[9]. Furthermore, while adherence rates fluctuate based on geographical location and specific disease categories, the overall adherence to medication among patients with T2DM is not within the acceptable range[11,12]. It is estimated that approximately 40–50% of individuals with T2DM exhibit non-adherence to their prescribed medication regimens[11,13].

As such, non-adherence to antidiabetic regimens remains a significant barrier to achieving optimal outcomes in patients with diabetes[14]. The preceding investigation indicated that suboptimal adherence was correlated with adverse cardiorenal outcomes within this cohort, as well as detrimental health consequences and escalated healthcare costs[11,15]. In light of these trends, it is imperative for healthcare practitioners to exercise heightened vigilance and to implement suitable interventions aimed at enhancing adherence among patients with T2DM who are afflicted by chronic health conditions.

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Previous investigations have elucidated a multitude of fundamental factors contributing to adherence medication behaviors, encompassing social, motivational, and economic dimensions, with medication adherence self-efficacy posited as a pivotal determinant in this context[16,17]. Elevated levels of self-efficacy have been demonstrated to correlate significantly with enhanced adherence to medication and effective self-management strategies[18], including patients with type 2 diabetes mellitus[1]. Accordingly, increased self-efficacy has been empirically validated as an effective strategy to incentivize patients toward medication adherence[19,17], as well as to promote engagement in physical activity[20], blood glucose testing[21], and healthy coping mechanisms.

Effective education, support, and follow-ups will enable patients to identify several side effects of medications, hence preventing complications[22]. In addition to these, patient education has a crucial role in ensuring the administration of medications, optimal dose, willingness to adhere to medication, and adequate literacy skills[11,15].

Patients diagnosed with type 2 diabetes should be offered tailored patient education based on their individual needs and treatment plans, which may improve adherence[23]. Patient education, when utilized effectively, may maximize health outcomes, yield better treatment satisfaction, and positively affect the quality of life of adult patients with type 2 diabetes[24].

The current investigation sought to examine the effect of an educational intervention on medication adherence self-efficacy among adult patients with type 2 diabetes attending public hospitals in Hail City, Saudi Arabia. Given the scarcity of evidence regarding medication adherence in this setting and the limited availability of validated Arabic-language scales, the study adapted the Self-Efficacy for Appropriate Medication Use Scale (SEAMS) for Arabic-speaking T2DM patients. SEAMS is specifically designed to assess patients' confidence in their ability to follow prescribed medication regimens, thus providing deeper insights into their medication adherence self-efficacy[25,26].

This research employed a pre-post intervention design, measuring medication adherence self-efficacy before and after the delivery of the educational intervention. By examining changes in SEAMS scores over time, the study aimed to determine whether a tailored educational approach could significantly enhance patients' confidence in managing their medications. Such findings would be of substantial clinical importance, informing future interventions aimed at improving medication adherence among T2DM patients in Saudi Arabia.

METHODS

Study design and patients

This controlled before-and-after study was conducted at five public hospitals in Hail, Saudi Arabia: King Khalid Hospital, King Salman Specialized Hospital, General Hail Hospital, Mogag Hospital, and Al-Shenan Hospital. Adult patients with T2DM attending the endocrine outpatient clinics at these hospitals formed the target population. A convenience sampling method was employed to recruit participants proportionally from each hospital based on patient load. This approach ensured that the study population represented the broader T2DM patient base across all five hospitals in Hail City.

Inclusion criteria required participants to be at least 18 years old, diagnosed with T2DM for at least one year, taking T2DM medications, and able to speak, read, and write Arabic. Exclusion criteria comprised individuals diagnosed with type 1 diabetes or other specific forms of diabetes, those in a diabetic coma, patients with severe comorbidities, individuals with a history of severe diabetes-related complications such as neuropathy or retinopathy, and those unable or unwilling to provide informed consent.

The sample size was calculated based on statistical guidelines for scale validation studies, where a minimum sample size of 130 was required (10 times the 13 indicators included in the Self-Efficacy for Appropriate Medication Use Scale, SEAMS)[23]. However, to enhance precision and representativeness given the total T2DM patient population of approximately 20,000 across the five hospitals (as reported by the Hail Health Cluster), a more rigorous calculation was performed. Using a 95% confidence level and a 5% margin of error, the final sample size was determined to be 377 participants.

This sample size ensured the statistical validity and reliability of the findings, providing a representative subset of the larger diabetic population in the region. Data collection occurred during the pre-education intervention phase (February–May) and the post-education intervention phase (August–October).

Data Collection

During the process of data acquisition, pertinent information about the study was disseminated and consent forms were duly executed by the participants. Before the distribution of the questionnaires to the subjects, each individual was provided with information about the study by the investigator, encompassing both formal and oral explanations regarding the objectives and methodology of the research. Upon the participants' confirmation of their willingness to partake, the consent form was presented to them, and an official signature was procured. Support was provided if participants encountered challenges in comprehending the scale items or in providing their responses autonomously. The study, overall, obtained 377 responses from adult patients through the purposive sampling technique taking place during the pre-education intervention phase from February to May, and the post-education intervention phase from August to October. The subjects of this study comprised patients aged between 18 and 65 years diagnosed with type 2 diabetes.

Ethics Approval and Consent to Participate

This study was conducted by the Declaration of Helsinki. The distribution of the SEMAS questionnaire was ethically approved by the Hail Health Cluster, ensuring that all participants provided written informed consent before their involvement. The study was performed according to the Human Research Ethics

Committee of Universiti Sains Malaysia, (JEPeM) started as Jawatankuasa Etika Penyelidikan Manusia (JEPeM). Permissions were received from the five hospitals at Hail City. In addition, written consent after a detailed explanation about the research was obtained from each patient. All methods, thus, were performed following the relevant guidelines and regulations. The patients chose to participate in this study and were informed that they might withdraw from the data-gathering process at any moment without explanation or penalty. Participants were also allowed to clarify any points they did not understand or to ask the researcher questions.

Instrumentation

Medication adherence was assessed using SEAMS. The instrument was constructed by Risser et al.[23] involving a cohort of 436 individuals diagnosed with coronary heart disease alongside various comorbidities, thereby serving as a metric for assessing self-efficacy in the appropriate utilization of medications among patients suffering from chronic illnesses. The SEAMS was created by a collaborative team of experts specializing in medication adherence and health literacy. Comprehensive analyses regarding reliability and validity were executed independently for participants exhibiting low literacy levels and those with higher literacy levels. The concluding 13-item scale demonstrated satisfactory internal consistency reliability, with a Cronbach's alpha coefficient of 0.89. A two-factor model emerged, elucidating 52.3% of the variance within the scale: self-efficacy for taking medications under difficult circumstances (factor 1) and self-efficacy for continuing to take medications when circumstances surrounding medication-taking are uncertain (factor 2).

For this study, participants expressed their confidence in managing medication across 13 distinct scenarios (1 = not confident, 2 = somewhat confident, and 3 = very confident). The overall score of the scale is derived from the cumulative total of the scores from each item, with possible scores ranging from 13 to 39 points. Elevated scores signify enhanced levels of self-efficacy regarding appropriate medication management. The total variance of the 13-item Arabic-SEAMS was elucidated by two underlying factors, as corroborated by the conducted factor analysis[21]. The mean score of the 13-item Arabic-translated SEAMS was determined to be 32.37 ± 5.31, with the scale demonstrating a satisfactory level of internal consistency (Cronbach's alpha = 0.886) and reliability (Intraclass correlation coefficient = 0.98).

The Educational Intervention

This educational intervention aimed to improve self-management and health outcomes for 377 patients with Type 2 diabetes in Hail City through the AADE7 Self-Care Behaviors framework. Conducted over 12 weeks, the program featured both an intervention group (189 patients) and a control group (188 patients). It focused on seven key areas: healthy eating, physical activity, blood glucose monitoring, problem-solving, medication adherence, healthy coping, and reducing risks.

Patients attended weekly sessions that incorporated workshops, hands-on training, group activities, online modules, and the distribution of printed educational materials. These sessions covered meal planning, exercise routines, proper use of glucometers, strategies for managing blood glucose fluctuations, and coping techniques to prevent diabetes-related stress and complications. Healthcare professionals facilitated the sessions, ensuring that the content was tailored to the patients' needs.

Patient feedback on each session was collected through a feedback form accessible by a QR code or a short link provided at the end of every session. Program effectiveness was evaluated by comparing SEAMS scores before and after the 12-week intervention period.

Statistical analysis

Data were imported from an Excel spreadsheet into IBM SPSS Statistics for Windows®, version 27.0 (IBM Corp., Armonk, NY, USA). Categorical variables, such as age, gender, education level, and diabetes duration, were summarized using frequencies and percentages, while continuous variables were expressed as means and standard deviations. The McNemar-Bowker test was used to assess changes in the self-efficacy of medication adherence before and after the educational intervention for categorical variables. The overall self-efficacy for medication adherence was also calculated. The Kolmogorov-Smirnov test was applied to evaluate the normality of the differences between pre- and post-intervention data. As the p-value was non-significant ($p = 0.2$), indicating normal distribution, a paired t-test was conducted to assess changes in medication adherence for continuous variables before and after the educational intervention. Statistical significance was set at $p < 0.05$.

RESULTS

Demographic Characteristics

The study inclusion criteria were met by 377 patients, and all of these patients completed the survey (Table 1). The majority of participants were male (171/309, 54.6%), with 26.5% (n=100) being 41-50 years of age and 41.4% (n=156) being highly educated. Of the included subjects, 43.2% (n=163) have had diabetes for more than five years.

Baseline Medication Adherence Self-Efficacy

At baseline, most respondents reported feeling "somewhat confident" in taking their medications correctly under various challenging conditions. For instance, 72.4% felt somewhat confident doing so on busy workdays, 63.9% when away from home, 61.3% when taking multiple medications daily, and 60.2% when taking a set of medications more than once a day (Table 2). More than half of the participants felt somewhat confident about taking medications correctly without reminders (59.8%), even if the schedules were inconvenient (56%), during a chaotic daily schedule (56.2%), or after a refill, even if some medications looked different (53.3%).

Conversely, only 17.8% and 12.7% felt very confident that they could take their medications daily correctly, even when

unsure how to take them, or after a refill when the pills looked different, respectively. About 58.9% were somewhat confident in adhering to their medication regimen while feeling unwell (e.g., having a cold or the flu), and 53.1% felt somewhat confident if the medications caused side effects. Additionally, 75% were either somewhat or very confident in taking medications correctly when unsure of usage.

However, approximately 36% of patients were not confident in managing their medications correctly if they caused side effects, highlighting potential challenges in this area. Around half (50%) reported feeling somewhat confident if their doctor changed their medications. These lower confidence levels, particularly in scenarios involving uncertainty of use, appropriate timing, and medication changes, suggest that targeted interventions or educational support may be needed to enhance patients' confidence and, consequently, improve medication adherence.

Table 1. Participants' Characteristics Data

Variable	Classification	Frequency	%
Gender	Female	206	54.6
	Male	171	45.4
Age (in years)	18-30	82	21.8
	31-40	96	25.5
	41-50	100	26.5
	51-60	99	26.3
Educational level	Illiterate	46	12.2
	Primary	49	13
	Secondary	110	29.2
	Bachelor	156	41.4
	Postgraduate	16	4.2
Diabetes duration	One year	35	9.3
	Two years	83	22
	Three years	96	25.5
	from 5 years	163	43.2

Table 2. Baseline Responses to the Self-Efficacy for Appropriate Medication Use Scale (SEAMS)

How confident are you that you can take your medicines correctly?

	Statement	Not confident	Somewhat confident	Very confident
		N (%)	N (%)	N (%)
1	How confident are you in correctly taking multiple medications daily?	79(21.0)	231(61.3)	67 (17.8)
2	How confident are you in taking medications correctly on busy workdays?	69(18.3)	273(72.4)	35(9.3)
3	How confident are you in taking medications correctly when away from home?	90(23.9)	241(63.9)	46(12.2)
4	How confident are you in taking medications correctly without reminders?	109(29.0)	225(59.8)	42(11.2)
5	How confident are you in taking a set of medications more than once a day?	109(28.9)	227(60.2)	41(10.9)
6	How confident are you in taking medications correctly if the schedules are inconvenient?	127(33.7)	211(56.0)	39(10.3)
7	How confident are you in taking medications correctly during a chaotic daily schedule?	123(32.6)	212(56.2)	42(11.1)
8	How confident are you in taking medications correctly after a refill, even if some look different?	128(34.0)	201 (53.3)	48(12.7)
9	How confident are you in taking medications correctly when unsure of usage?	134(35.5)	198(52.5)	45(11.9)
10	How confident are you in taking medications correctly when unsure of the appropriate time?	135(35.8)	196(52.0)	46(12.2)
11	How confident are you in taking medications correctly if the doctor changes them?	133(35.3)	195(51.7)	49(13.0)
12	How confident are you in taking medications correctly if they cause side effects?	138(36.6)	200(53.1)	39(10.3)
13	How confident are you in taking medications correctly when feeling unwell, like having a cold or the flu?	91(24.1)	222(58.9)	64(17.0)

Note: higher scores indicate better health literacy

Assessment of adherence by using SEAMS score

Table 3 presents the lowest recorded SEAMS score was 13, while the highest was noted to be 39; the average SEAMS score was determined to be 24. As delineated in the methodology section and corroborated by the validation of the SEAMS instrument, scores below 13 signified non-adherence, scores ranging from 14 to 38 indicated an intermediate level of adherence, and a score of 39 denoted high adherence. The majority of patients exhibited a moderate to medium level of adherence. Consequently, we opted not to employ univariate logistic regression.

Sociodemographic factors correlated with the SEAMS score

The Mann–Whitney U and Kruskal–Wallis tests were used to assess the relationships between gender, age, educational level, diabetes duration, and medication adherence. Only diabetes duration was significantly associated with the medication adherence score ($p < 0.05$). Notably, participants with a diabetes duration of less than 5 years demonstrated a markedly higher mean rank score than those with a duration of 5 years or more (200.37 vs. 174.08, p-value = 0.02), indicating stronger self-efficacy for medication adherence in the earlier stages of diabetes (Table 4).

3.5 Changes in Medication Adherence Self-efficacy Before and After Educational Intervention

Table 5 presents the changes in Medication adherence self-efficacy among diabetes mellitus patients after an educational intervention. Across all areas of medication management, significant improvements were observed. The proportion of patients who were "very confident" in taking multiple medications daily increased notably from 17.8% to 47.7% ($\chi^2 = 107.41$, $P < 0.001$). Likewise, confidence in adhering to medication schedules during busy workdays grew from 9.3% to 44.6% ($\chi^2 = 111.93$, $P < 0.001$). Confidence in managing medications in other circumstances, such as while away from home or without reminders, also rose significantly, from 12.2% to 41.1% and from 11.4% to 33.2%, respectively (both $P < 0.001$).

In more complex scenarios, such as taking medications more than once a day or dealing with inconvenient schedules, patients' confidence also improved after the intervention. The percentage of patients who were "very confident" in managing multiple daily doses increased from 10.9% to 28.1% ($\chi^2 = 36.27$, $P < 0.001$), while confidence in managing inconvenient schedules rose from 10.3% to 25.7% ($\chi^2 = 28.51$, $P < 0.001$). Notably, handling chaotic daily routines saw a similar gain, with "very confident" responses increasing from 11.1% to 24.9% ($\chi^2 = 22.12$, $P < 0.001$). Confidence in handling medication refills when pills looked different also improved, rising from 12.7% to 19.9% ($\chi^2 = 8.29$, $P = 0.040$), and there were significant increases in confidence when patients were unsure of the correct usage or timing (both $P < 0.05$).

Additionally, patients displayed greater confidence in challenging situations, such as when doctors changed their prescriptions or when medications caused side effects. The proportion of "very confident" patients rose from 13.0% to 21.2% and from 10.3% to 19.9%, respectively ($P < 0.001$). Furthermore, confidence in adhering to medication schedules while feeling unwell (e.g., during a cold or flu) increased from 17.0% to 21.0% ($\chi^2 = 14.39$, $P = 0.002$). Overall, these findings highlight the significant positive impact of the educational intervention on enhancing patients' confidence in managing their medications, with all improvements strongly supported by statistical evidence.

Table 3. Assessment of adherence by using SEAMS score

Domain	Score interpretation	Frequency (%)	
SEAMS score	39: High	1	-0.05
	14–38: medium	377	-0.95
	13: low	0	-0.5

Table 4. Sociodemographic factors correlated with the SEAMS score (n=377)

		N	Mean Rank [&]	Test value	P value
Gender [a]	Female	206	190.42	17321.5	0.781
	Male	171	187.3		
Age [b]	18-30	82	194.43	0.393	0.942
	31-40	96	189.07		
	41-50	100	189.16		
	51-60	99	184.27		
Educational level [b]	Illiterate	46	175.62	0.971	0.808
	Primary	49	191.76		
	Secondary	110	194.07		
	Bachelor and above	172	188.55		
Diabetes duration [a]	< 5 years	214	200.37	5.416	**0.020**[*]
	≥ 5 years	163	174.08		

Note: Bold and star sign (*) Indicates significant result; &: high core indicates higher self-efficacy for medication adherence; a: Mann–Whitney U test was employed; b: Kruskal–Wallis test was employed

Table 5. Changes in Medication adherence self-efficacy Before and After Educational Intervention (n = 377 patients)

SEAMS	Confidence level	Pre-intervention, n(%)		Post-intervention, n(%)		χ^2	*P-value* [a]
How confident are you in correctly taking multiple medications daily?	Not confident	79	-21	6	-1.6	107.41	**<0.001***
	Somewhat confident	231	-61.3	191	-50.7		
	Very confident	67	-17.8	180	-47.7		
How confident are you in taking medications correctly on busy workdays?	Not confident	69	-18.3	8	-2.1	111.93	**<0.001***
	Somewhat confident	273	-72.4	201	-53.3		
	Very confident	35	-9.3	168	-44.6		
How confident are you in taking medications correctly when away from home?	Not confident	90	-23.9	16	-4.2	91.13	**<0.001***
	Somewhat confident	241	-63.9	206	-54.6		
	Very confident	46	-12.2	155	-41.1		
How confident are you in taking medications correctly without reminders?	Not confident	109	-28.9	42	-11.1	58.05	**<0.001***
	Somewhat confident	225	-59.7	210	-55.7		
	Very confident	43	-11.4	125	-33.2		
How confident are you in taking a set of medications more than once a day?	Not confident	109	-28.9	64	-17	36.27	**<0.001***
	Somewhat confident	227	-60.2	207	-54.9		
	Very confident	41	-10.9	106	-28.1		
How confident are you in taking medications correctly if the schedules are inconvenient?	Not confident	127	-33.7	82	-21.8	28.51	**<0.001***
	Somewhat confident	211	-56	198	-52.5		
	Very confident	39	-10.3	97	-25.7		
How confident are you in taking medications correctly during a chaotic daily schedule?	Not confident	123	-32.6	99	-26.3	22.12	**<0.001***
	Somewhat confident	212	-56.2	184	-48.8		
	Very confident	42	-11.1	94	-24.9		
How confident are you in taking medications correctly after a refill, even if some look different?	Not confident	128	-34	116	-30.8	8.29	**0.040***
	Somewhat confident	201	-53.3	186	-49.3		
	Very confident	48	-12.7	75	-19.9		
How confident are you in taking medications correctly when unsure of usage?	Not confident	134	-35.5	122	-32.4	15.62	**0.001***
	Somewhat confident	198	-52.5	167	-44.3		
	Very confident	45	-11.9	88	-23.3		
How confident are you in taking medications correctly when unsure of the appropriate time?	Not confident	135	-35.8	134	-35.5	10.57	**0.014***
	Somewhat confident	196	-52	167	-44.3		
	Very confident	46	-12.2	76	-20.2		
How confident are you in taking medications correctly if the doctor changes them?	Not confident	133	-35.3	137	-36.3	11.46	**0.009***
	Somewhat confident	195	-51.7	160	-42.4		
	Very confident	49	-13	80	-21.2		
How confident are you in taking medications correctly if they cause side effects?	Not confident	138	-36.6	141	-37.4	18.3	**<0.001***
	Somewhat confident	200	-53.1	161	-42.7		
	Very confident	39	-10.3	75	-19.9		
How confident are you in taking medications correctly when feeling unwell, like having a cold or the flu?	Not confident	91	-24.1	123	-32.6	14.39	**0.002***
	Somewhat confident	222	-58.9	175	-46.4		
	Very confident	64	-17	79	-21		

Note: a McNemar-Bowker test was used. A p-value < 0.05 indicates a significant change in confidence after the intervention. Asterisk (*) and bold text denote statistically significant changes.

Abbreviation: SEAMS, Self-Efficacy for Appropriate Medication Use Scale.

Effect of the Educational Intervention on Medication adherence self-efficacy

The findings from Table 6 show a statistically significant improvement in self-efficacy for medication adherence after the educational intervention. The mean self-efficacy score increased from 23.71 (SD = 5.38) before the intervention to 26.82 (SD = 6.50) after the intervention, with a mean difference of 3.11 (95% CI: 2.14, 4.08). This change was confirmed by a paired t-test, which yielded a t-value of 6.29 and a P-value of < 0.001, indicating that the improvement is statistically significant. Cohen's d value of 9.59 suggests a large effect size, demonstrating that the educational intervention had a strong impact on enhancing participants' self-efficacy in adhering to their medication.

Table 6. Change in Self-Efficacy for Medication Adherence Before and After Educational Intervention Using SEAMS

SEAMS	Mean	SD	N	Mean Difference (Post-Pre)	95%CI	t-value	P-value [a]
Post-intervention	26.82	6.5	377	3.11	(2.14,4.08)	6.29	**< 0.001***
Pre-intervention	23.71	5.38	377				

Note: [a] A paired t-test was used to compare pre-and post-intervention self-efficacy scores. An asterisk (*) indicates a statistically significant result (P < 0.05). Cohen's d = 9.59, indicating a large effect size.
Abbreviations: SD, standard deviation; SEAMS, Self-Efficacy for Appropriate Medication Use Scale; CI, confidence interval

DISCUSSION

There are a limited number of studies evaluating medication adherence among patients with T2DM in Saudi Arabia. This study was conducted to assess and measure adherence among adult patients attending endocrine outpatient clinics in five hospitals in Hail City, Saudi Arabia. While several relevant international studies were identified, few local studies were found[9,16,1,24]. Thus, this study contributes significantly to understanding medication adherence in T2DM patients in Saudi Arabia and serves as a valuable resource for future research.

The Self-Efficacy for Appropriate Medication Use Scale (SEAMS) has gained recognition for its role in assessing perceived medication adherence across diverse cultural contexts[7]. Its effectiveness and adaptability have been demonstrated in various settings, including a successful translation and cultural adaptation in Greece, which showed high acceptance among patients with end-stage kidney disease[7]. Similarly, Wu et al.[22] validated SEAMS for use in 309 hospitalized elderly patients with type 2 diabetes in China, confirming its reliability and validity. In Saudi Arabia, Alhazzani et al.[21] translated SEAMS into Arabic and tested it on 22 adults with chronic diseases, finding acceptable internal consistency (Cronbach's alpha = 0.886). The Arabic version of SEAMS is expected to help identify inadequate self-efficacy in medication adherence among Arabic-speaking patients, though further research is needed to validate its use in more diverse populations.

The study found that T2DM patients in Saudi Arabia exhibited moderate medication adherence, with an average SEAMS score of 24, indicating medium compliance. This aligns with findings from Sendekie et al.[24], who reported low adherence levels in their study. Similarly, Jannoo & Khan[25] observed moderate adherence among 497 T2DM patients in Malaysia. Improved adherence has been linked to better therapeutic outcomes[11,12], while low adherence is associated with adverse health consequences and increased healthcare costs[9,10]. Educating patients about medication side effects, particularly when limited to one to four key points, has been shown to enhance adherence[18].

The duration of diabetes also influenced adherence, with patients diagnosed for less than five years showing significantly better adherence. This is consistent with Jannoo & Khan[25], who found that longer diabetes duration correlated with lower adherence. Krzemińsk et al.[26] further highlighted that patients with diabetes for up to 20 years adhered more closely to treatment than those with diabetes for over 35 years.

Educational interventions were found to significantly improve participants' self-efficacy in medication adherence. Structured, home-based educational programs have been effective in promoting adherence, patient satisfaction, and quality of life[20]. However, adherence decreased among individuals with limited literacy, particularly when managing medication side effects. Comprehensive education on drug nomenclature, dosage, administration, side effects, and communication with healthcare providers is essential for optimal medication use[27].

A limitation of this study is its focus on a few hospitals in Hail City, limiting the generalizability of the findings. Additionally, the pre-post study design without a randomized control group makes it difficult to attribute changes in adherence solely to the educational intervention, as external factors like improved healthcare services or familiarity with the survey instrument may have influenced results.

Confounding variables such as age, gender, and clinical factors like HbA1c levels and comorbidities (e.g., hypertension, cardiovascular disease) can significantly impact adherence and self-efficacy. Future studies should incorporate these factors and employ more robust designs, such as randomized controlled trials, to better understand the determinants of medication adherence in T2DM patients. Including patients with various comorbidities will also help account for additional confounding factors influencing adherence behaviors.

CONCLUSIONS

The study's findings revealed that patients adhered to medicine at a moderate rate. Patients obtained the greatest mean score

for correctly taking drugs during busy workdays. It was also discovered that medication adherence was related to diabetes duration; patients with a shorter duration of diabetes were more likely to adhere to treatment. Adults with type 2 diabetes should receive enough counseling from their primary care physicians. In addition, adherence constitutes a multifaceted and evolving phenomenon that necessitates continuous oversight, education, and subsequent engagement utilizing a personalized methodology. It was shown that intervention education with the SEAMS increased patient medication adherence self-efficacy. The use of SEAMS for patient teaching of the effectiveness of medication adherence in the long term, from the beginning of the treatment of type 2 diabetes to the end, can be suggested.

AUTHORS CONTRIBUTION

- Abdullah Mohammad Alshammari: Conceptualization, Data Curation, Methodology, Writing – Original Draft Preparation, Study Coordination
- Dr. Mohamed Hassan Elnaem: Formal Analysis, Writing – Review & Editing, Supervision
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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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