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ORIGINAL RESEARCH

Think Before You Take: Understanding Adult Medication Literacy in Saudi Arabia

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Background: Poor medication literacy may lead to serious health risks. Nevertheless, very little research has examined medication literacy in Saudi Arabia. Thus, this study assessed medication literacy and factors associated with poor medication literacy.

Methods: A descriptive, cross-sectional study was conducted, with eligibility criteria including individuals aged ≥ 18 years, speaking Arabic or English, and residing in Saudi Arabia. Eligible participants completed an online, self-administered survey disseminated through social media platforms over a two-month period. Horvat's Medication Literacy Assessment Questionnaire was employed. The analysis used regression in SPSS version 29 to identify predictors of medication literacy.

Results: A total of 815 participants were included. Most were female (75.7%), aged 18–24 years (50.1%), and held undergraduate degree (47%). The median (IQR) medication literacy score, assessed using Horvat's Medication Literacy Assessment Questionnaire (score range: 0–29), was 22.0 (18–24). Results showed a relatively poor level of medication literacy, with 50% of participants scoring below the average of correct answers. Most problems were found in items related to dosing, requiring understanding information from longer texts and numerical skills. Other issues included refills, drug use in pregnancy, storage and disposal, expiration date, adverse effects, drug interactions, missed doses, label understanding, tablet splitting, and duration of therapy. Multiple linear regression revealed significant predictors. Lower educational levels were associated with reduced scores ($\beta = -1.765$, $p = 0.009$ for high school or below; $\beta = -5.872$, $p = 0.016$ for diploma). Smaller households were associated with higher scores ($\beta = 1.252$, $p = 0.031$ for 1–4 members; $\beta = 1.255$, $p = 0.021$ for 5–8 members). Prescription medications use ($\beta = 2.375$, $p < 0.001$) and less frequent pharmacists consultation ($\beta = 3.602$, $p = 0.001$) were positively associated with higher scores.

Conclusion: Medication literacy among study participants requires improvement, especially in areas involving dosing instructions and numerical understanding. Targeted interventions are necessary for those with inadequate literacy levels.

Keywords: literacy, health, health literacy, medicine, drug, therapy, cross-sectional studies, health surveys, Saudi Arabia

Introduction

Medication or pharmacotherapy literacy is defined as "an individual's capacity to obtain, evaluate, calculate, and comprehend basic information about pharmacotherapy and pharmacy-related services necessary to make appropriate medication-related decisions, regardless of the mode of content delivery. (e.g., written, oral, visual images and symbols)".[1] Patients need to be able to perform numeric tasks to calculate the total number of pills to be taken per day, and they need to recognize and respond to possible side effects to manage their medication regimen. Adequate medication literacy skills are important to understand the expected side effects, the treatment's aim, and specific drug treatment instructions.[1–3]

People with poor medication literacy are less likely to adhere to medication regimens, understand oral or written information, comprehend drug labels or patient information leaflets, or follow advice from healthcare providers regarding possible contradictions, interactions, and side effects.[1–3] Poor medication literacy may result in several potential negative

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consequences, including polypharmacy, prolonged drug use duration, use of excessive or inadequate dosages, wrong-time medications administration, use of incorrect routes of administration, lack of awareness of precautions and warnings, drug interactions, storage in inappropriate conditions or beyond the recommended shelf-life, and medication misuse or abuse.[4] Patients with limited medication literacy may have increased emergency department visits, lengthy hospital stays, and increased costs.[5,6]

A study in Saudi Arabia explored the factors contributing to medication-related problems (MRPs) among patients with diabetes mellitus (DM) and/or cardiovascular diseases (CVDs).[7] The findings revealed that many patients lacked awareness about their medications and how to use them correctly. Some were unable to recall the names or physical characteristics of their medicines, while others only understood their general purpose, such as treating DM or CVDs, without knowing their specific effects. Only a small number of patients could recognize potential side effects. Additionally, treatment inefficacy was observed, as patients often did not adhere to their prescribed medication regimen. Many reported experiencing fluctuations in blood sugar or blood pressure and attempted to manage these changes by adjusting their medication doses or dietary habits without consulting a healthcare professional. Another study which was conducted among 3557 Saudi participants also showed that 39% of study participants did not know how their medications should be monitored, 49% did not know what to do if they missed a dose, and 50% did not know their drug's side effects.[8] Limited medication literacy skills might cause these.

Without targeted interventions, poor medication literacy may continue to contribute to adverse health outcomes.[7,8] It has been shown that a large proportion of medicine-related problems could be preventable with better medication literacy.[9] This is because preventable medicine-related problems are often caused by the suboptimal use of medications, a situation that is linked to a poor understanding of medication instructions and a low level of medication literacy.[9–11] Thus, increasing medication literacy can decrease medicine-related problems, improve adherence to dosage instructions, and empower patients to manage their own medicines.[9–11]

Previous studies have shown that most patients rely on their physicians and pharmacists for drug information.[12,13] However, they are not receiving sufficient oral instructions on how to appropriately manage their medicines.[12,13] This is because physicians and pharmacists may assume that their patients can read, act on, and interpret medication labels and patient information leaflets/printouts. Consequently, they may not provide extensive patient counseling (ie, verbal).[12–14] Different studies have shown that it may be complex and confusing to interpret medication container labels for many patients.[8,12]

Arabic countries generally have high illiteracy levels,[15] but Saudi Arabia stands out, with 87% of its population achieving basic literacy (reading and writing) levels due to its health and education advancement.[16,17] However, a recent study found that 13–30% of the population remains uneducated, with 38% of hospital patients struggling to understand prescription labels.[12] Poor comprehension of written health information can lead to suboptimal medication use, highlighting the importance of monitoring medication literacy.[12,14] Limited literacy skills are often undetected by healthcare providers, as individuals may feel embarrassed or unaware of their inadequacies.[14] Measuring medication literacy levels in Saudi Arabia is crucial for designing effective interventions to address these gaps.

Medication literacy is a component of health literacy; however, it encompasses additional specific skills, such as interpreting medication dosages and measurements.[8,18] Unlike earlier Middle Eastern studies that primarily focused on general health literacy skills,[8,12,18] the present research adopted Horvat's validated 29-items Medication Literacy Questionnaire to provide a comprehensive, quantitative assessment of medication literacy and its predictors.[19] This addition highlights the novelty of our approach in using a validated, medication-specific tool to assess medication literacy —an area that has not been adequately explored in previous regional studies and which is not adequately assessed by general health literacy instruments—thereby building on and advancing the existing Middle Eastern literature.[8,18] In addition, the recognized role of pharmacists in enhancing the safe and appropriate use of medicines identified a need to assess medication literacy levels among adults in Saudi Arabia using a specific instrument focusing on evaluating individuals' understanding of medication information such as dosing information, when to take medication, instructions to follow if a dose is missed, side effects, precautions, and drug interactions, when to omit intake of medication, medication storage instructions, and medication disposal instructions. Thus, the study aimed to assess medication literacy levels among adults in Saudi Arabia and the factors associated with poor medication literacy.

Materials and Methods

Design

Research design

The study used a cross-sectional online survey to collect quantitative data.

Population, Sampling and Data Collection

An online platform was used for the survey (QuestionPro, Austin, Texas, USA). The internet-based survey was distributed over two months by social networking sites, including X® (formerly Twitter), Facebook®, LinkedIn®, and WhatsApp®. Convenience sampling, followed by snowball sampling, was used to select study participants. People aged ≥ 18 years, speaking Arabic or English, and residing in Saudi Arabia were invited to participate in the online survey. The researchers solicited potential participants by sharing posts and sending messages to their friends and professional colleagues through their social media profiles to ask them kindly to distribute the survey link to as many relatives, friends, and colleagues as possible ("snowball principle") for them to take part in the study.

An online information sheet was provided to the respondents, and consent was implied by completing the survey. Individuals were informed that participation in the survey was voluntary and should take about 20 minutes to complete. To stop respondents from taking this survey more than once, the "Prevent Ballot Box Stuffing" function was enabled in QuestionPro. All data were strictly anonymous. All questions in the survey had to be answered, and the study included only responses with a 100% survey completion rate.

Ethical approval was obtained from the Deanship of Scientific Research at Imam Abdulrahman Bin Faisal University (IAU) [IRB-2024-05-764]. This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki.

Survey Development and Description of the Final Version

Horvat's medication literacy assessment questionnaire is a self-administered survey. Researchers at the Faculty of Pharmacy, University of Ljubljana, developed the survey instrument previously used in Slovenia.[19] The original survey questionnaire included a total of 29 questions divided into five categories:

Dosage: when to obtain a refill, tablet splitting, shaking suspensions, duration of therapy, maximum daily dose, maximum single dose, dose adjustment, dosage/administration signature interpretation, adherence to dosage instructions, correct administration site, administration frequency, and actions to take if a dose is missing.

Adverse effects: development of adverse effects, actions to take in the event of an adverse effect occurrence.

Interactions: food interactions, alcohol interactions.

Precautions: precautions symbols on outer packaging, photosensitivity, and pregnancy.

Other information: medication storage, disposal, and expiration date.

The maximum possible score is 29, and the minimum is 0. The questionnaire was selected because it consisted of questions that address basic medication information and assess the safe and proper use of medications from patients' perspectives.[19] The questionnaire has good content validity and can be applied to a wide population.

For this study, the original questionnaire was reviewed and modified by a panel of pharmacists, comprising an academic pharmacist, a hospital pharmacist, and a community pharmacist, to ensure its relevance, appropriateness, and acceptability. The revised survey instrument consisted of 29 questions, with 27 questions directly adapted from Horvat's medication literacy assessment questionnaire and two additional questions developed by the pharmacist panel. In the interactions section, the question that asked about alcohol interactions was replaced by drug-drug interactions. This adjustment was made because alcohol consumption is prohibited by law in Saudi Arabia, as the legal framework is based on Islamic Sharia principles, which strictly forbid any amount of alcohol consumption. Consequently, for both religious and legal reasons, this question was omitted, as any use of alcohol is universally regarded as abuse by the Saudi public. The second modified question asked the participants about the meaning of a symbol that was displayed on a medication container, which was mainly known in Europe. Thus, the symbol was replaced by another one that is used in Saudi Arabia. The modified questionnaire also requests personal information such as gender, age, educational level,

employment status, monthly income, number of people living in the household, province of current residence, and other questions related to medication use and consulting or seeing a healthcare provider about illnesses and medicines.

Validity, Translation, and Reliability of the Questionnaire

Three expert pharmacists representing the academic, hospital, and community pharmacy sectors reviewed the questionnaire to ensure content validity. They assessed its clarity, applicability, comprehensiveness, and cultural relevance. Additionally, the questionnaire was tested with five individuals from the target population who were not part of the main study. Their feedback confirmed that the questions were understandable and appropriate, with no need for major modifications.

For linguistic validation, the questionnaire underwent a parallel blind translation process from English to Arabic.[20] Two independent bilingual researchers conducted separate translations, after which both versions were compared. Any discrepancies were discussed, and necessary adjustments were made before finalizing the translation. To further enhance accuracy, an Arabic-speaking pharmacist reviewed the final version, which was then pretested with five native Arabic speakers from the target audience. This approach was adopted to minimize translator bias and ensure both linguistic precision and conceptual consistency.

The survey's internal consistency was assessed using Cronbach's alpha, which resulted in a coefficient of 0.79, indicating a satisfactory level of reliability.

Sample Size

The sample size for this study was determined using the Raosoft online sample size calculator, with a 95% confidence interval and a 5% margin of error. Based on a population of 23,468,225 individuals aged 18 years and older in Saudi Arabia, and assuming a 50% response rate, the required sample size was calculated to be 385.[21]

Data Management and Analysis

Data were statistically described in terms of median (interquartile range (IQR)) or frequencies (number of correct answers) and percentages when appropriate. Univariate linear regression analysis was used to test for the effect of all the independent variable(s) (participants' characteristics) on medication literacy total score. Associations with a p-value of 0.05 or less were considered significant. Variables in the univariate analysis with a p-value of 0.05 or below were tested for their independent association with medication literacy total score using multiple linear regression analysis. Independent variables that were tested in the multiple linear regression analysis comprised: age, education, number of people living in the participants' household, monthly income, and frequency of consulting or seeing a pharmacist for illnesses and medicines. Associations between the dependent and independent variables were quantified using regression coefficients (beta weights) and reported with 95% confidence intervals (95% CI). All statistical analyses were conducted using two-tailed tests. Data analysis was performed using SPSS software version 29 for Windows (Statistical Package for the Social Sciences, SPSS Inc., Chicago, IL, USA).

Results

Study Participants' Characteristics

A total of 815 participants were included in the study, with the majority being female (75.7%) and Saudi nationals (96%). Half of the participants were aged 18–24 years (50.1%), and most had an undergraduate education (47%). Approximately 54.6% lived in households with 5–8 members, and 34.6% reported a monthly income of less than 5,000 SAR. Most participants reported taking prescription medications (85.9%) and using non-prescription medications (84.3%). Table 1 provides a detailed description of their characteristics.

Results of Horvat's Medication Literacy Assessment Questionnaire

Participants had a median (IQR) total score of 22.0 (18–24), a maximum score of 28, and a minimum score of 3. For the purposes of this study, poor medication literacy was defined as a score below the median value of 22. Results showed a relatively poor level of medication literacy in Saudi Arabia, with 50% of participants scoring below the average of

Table 1 Study Participants' Characteristics (N=815)

Parameter		**N**	**%**
Gender	Male	198	24.3
	Female	617	75.7
Age (years)	18–24	408	50.1
	25–34	188	23.1
	35–44	113	13.9
	45–54	65	8
	≥55	41	5.1
Nationality	Saudi	782	96
	Non-Saudi	33	4
Marital status	Single	433	53.1
	Married	382	46.9
Education	Postgraduate	82	10.1
	Undergraduate	383	47
	Diploma	83	10.2
	High school degree or below	267	32.8
Occupation	Employed as a full-time worker (working ≥ 30 hours a week)	239	29.3
	Employed as a part-time worker (working 1–29 hours a week)	11	1.3
	Self-employed	15	1.8
	Unemployed, looking for work	82	10.1
	Unemployed, not looking for work	67	8.2
	Retired	41	5
	Student (full- or part-time)	360	44.2
Province of current residence	Eastern Province	650	79.8
	Central Province	65	8
	Western Province	55	6.7
	Northern Province	16	2
	Southern Province	29	3.6
Number of people living in your household	1–4	261	32
	5–8	445	54.6
	>8	109	13.4

(*Continued*)

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Table 1 (Continued).

Parameter		N	%
Health status	Very good	418	51.3
	Good	334	41
	Fairly good	56	6.9
	Bad	6	0.7
	Very bad	1	0.1
Monthly income	>10,000 SAR	198	24.3
	5000-10,000 SAR	123	15.1
	<5000 SAR	282	34.6
	None	212	26
Prescription medication use	Yes	700	85.9
	No	115	14.1
Non-prescription medication use	Yes	687	84.3
	No	128	15.7
The need for someone to help you read instructions, pamphlets, or other written material from a doctor or pharmacy	Never	296	36.3
	Rarely	309	37.9
	Sometimes	166	20.4
	Often	31	3.8
	Always	13	1.6
Frequency of consulting or seeing a general practitioner (GP) for illnesses and medicines	Never	71	8.7
	Rarely	258	31.7
	Sometime	313	38.4
	Often	123	15.1
	Always	50	6.1
Frequency of consulting or seeing a pharmacist for illnesses and medicines	Never	148	18.2
	Rarely	309	37.9
	Sometime	253	31
	Often	76	9.3
	Always	29	3.6

correct answers. Participants' performance was categorized into three levels of accuracy based on the proportion of correct responses for each question:

- High accuracy (≥75% correct),
- Moderate accuracy (51–74% correct), and
- Low accuracy (≤50% correct).

These thresholds were used to highlight areas where participants performed well versus those requiring improvement in medication literacy.

a. Areas with low accuracy (≤50% correct answers):

Most problems were seen with questions related to dosing, which require understanding information from longer texts, some level of numerical skills, and medication timing, such as Q10.1 (65% wrong answers) and Q16.2 (64% wrong answers). In question number 1.2 (medication refill understanding), most participants – 54% (437/815) – also did not know when to obtain the next refill if they were given two packages of medication, each containing 28 tablets, and the prescribed regimen for this medication is one tablet twice a day. In addition, almost half of the participants responded incorrectly to questions 12 and 13 related to drug use in pregnancy – 50% (407/815) – and drug interactions between prescribed and non-prescribed medications – 58% (473/815), respectively.

b. Areas with moderate accuracy (51–74% correct answers):

Q9, which asked about the correct storage of medications, also received several wrong answers – 38% (314/815) – with 24% (193/815) of the respondents believing that the medications should be stored in a visible place that is easy to access. Questions Q10.2 and Q10.3 assessed dosage calculation skills—specifically remaining tablets per day and maximum allowable dose—with 193 (24%) and 328 (40%) incorrect responses, respectively.

Questions Q16.3 and Q16.4 evaluated syrup dosing frequency and treatment du-ration, with 303 (37%) and 371 (45%) participants answering incorrectly. Thirty-four percent (283/815) of the respondents answered Q20 incorrectly, which enquired about the expiry date for medications that can be used several times after they are opened, such as syrups or eye drops. Thirty-seven percent (302/815) of participants did not know that adverse effects can occur with all medications, including those obtained without prescription (Q5). Thirty-one percent (275/815) of respondents were unaware of what actions to take in case of a missed dose (Q17). In terms of knowledge regarding tablet splitting (Q11) and duration of antibiotic therapy (Q19), almost a quarter of participants (27%) and (28%) respectively answered incorrectly.

c. Areas with high accuracy (≥75% correct answers):

While participants struggled with numerical and multi-step medication instructions, they demonstrated a better understanding of some basic medication guidelines:

- Correct use of suppositories (Q3): 11% incorrect answers,
- Understanding grapefruit interactions with medications (Q4): 10% incorrect answers,
- External label interpretation – understanding the meaning of "EXTERNAL" (Q2): 22% incorrect answers,
- Recognizing risks like photosensitivity (Q6): 17% incorrect answers,
- Actions to take when experiencing mild adverse effects (Q7): 23% incorrect answers,
- Understanding proper medication disposal and storage (Q14): 23% incorrect answers,
- Understanding and interpreting syrup label instructions, including usage, pre-use actions, storage, and the "SHAKE WELL BEFORE USING" directive (Q18.1–Q18.4): 9%–18% incorrect answers. Table 2 shows the number and valid percentages of right and wrong answers for questions Q1 to Q29.

Table 2 Number and Percentage Frequencies of Right and Wrong Answers for Questions Q1 to Q29

Questions	Right n (%)	Wrong n (%)
Q1.1 Dosage Instructions: Understanding how to take a medication based on the label.	695 (85)	120 (15)
Q1.2 Dosage Instructions: Calculating how long a supply will last based on the label.	378 (46)	437 (54)
Q2 External Label: Understanding the meaning of "EXTERNAL" on medication packaging.	636 (78)	179 (22)
Q3 Suppositories: Knowing the correct way to use medications in suppository form.	724 (89)	91 (11)
Q4 Grapefruit Interaction: Awareness of potential interactions between grapefruit juice and medication.	734 (90)	81 (10)

(*Continued*)

Table 2 (Continued).

Questions	Right n (%)	Wrong n (%)
Q5 Adverse Effects: Understanding that adverse effects can occur with all types of medications.	513 (63)	302 (37)
Q6 Tanning Risk: Awareness of risks like photosensitivity when using certain medications.	672 (83)	143 (17)
Q7 Mild Adverse Effects: Knowing the appropriate actions to take when experiencing mild side effects.	630 (77)	185 (23)
Q8 Symbol Meaning: Interpreting a specific symbol on medication packaging (eg, photosensitivity warning).	701 (86)	114 (14)
Q9 Storage: Knowing the correct way to store medications.	501 (62)	314 (38)
Q10.1 Dosage Timing: Determining the earliest possible time for the next tablet based on dosing interval and initial intake.	282 (35)	533 (65)
Q10.2 Dosage Timing: Calculating the remaining number of tablets that can be taken within the same day based on dosage limits.	622 (76)	193 (24)
Q10.3 Dosage Timing: Calculating the maximum dosage based on instructions for specific scenario.	487 (60)	328 (40)
Q11 Tablets and Capsules: Knowing when and how tablets or capsules can be split or opened.	597 (73)	218 (27)
Q12 Pregnancy Use: Understanding precautions for using medications during pregnancy.	408 (50)	407 (50)
Q13 Drug Interactions: Knowing the risks of combining prescribed and non-prescribed medications.	342 (42)	473 (58)
Q14 Disposal and Expiry: Understanding the proper disposal of expired medications.	627 (77)	188 (23)
Q15 Delayed Effect Medications: Understanding the importance of continuing therapy even without immediate effects.	700 (86)	115 (14)
Q16.1 Syrup Dosage: Identifying the usual single dosage of syrup prescribed for a child.	686 (84)	129 (16)
Q16.2 Syrup Dosage: Calculating the total number of syrup doses that can be administered to a child in a single day.	289 (36)	529 (64)
Q16.3 Syrup Dosage: Calculating the appropriate frequency for a child using syrup.	512 (63)	303 (37)
Q16.4 Syrup Dosage: Calculating the appropriate duration for a child using syrup.	444 (55)	371 (45)
Q17 Missed Dose: Knowing when to take the next dose if a regular dose is missed.	558 (69)	257 (31)
Q18.1 Syrup Label: Understanding specific instructions for using a child's syrup.	735 (90)	80 (10)
Q18.2 Syrup Label: Identifying the required action before administering the syrup to a child.	738 (91)	77 (9)
Q18.3 Syrup Label: Understanding specific instructions for storing a child's syrup.	670 (82)	145 (18)
Q18.4 Syrup Label: Interpreting the meaning and importance of the "SHAKE WELL BEFORE USING" instruction.	702 (86)	113 (14)
Q19 Antibiotic Label: Knowing the duration of antibiotic therapy based on label instructions.	589 (72)	226 (28)
Q20 Post-Opening Expiry: Understanding the expiration guidelines for medications after opening (eg, syrups or eye drops).	532 (65)	283 (35)

Figure 1 illustrates the percentage of correct answers for each item in the medication literacy assessment questionnaire, categorizing them into three levels of accuracy: high (≥75%), moderate (51–74%), and low (≤50%). The questions are ordered by accuracy level to highlight the distribution of participants' performance across various domains of medication literacy. The figure shows that while participants performed well on questions related to basic medication instructions and label interpretation, they struggled with items requiring numerical reasoning or understanding multi-step dosage instructions. This visual grouping helps identify key areas where targeted education or intervention may be most needed.

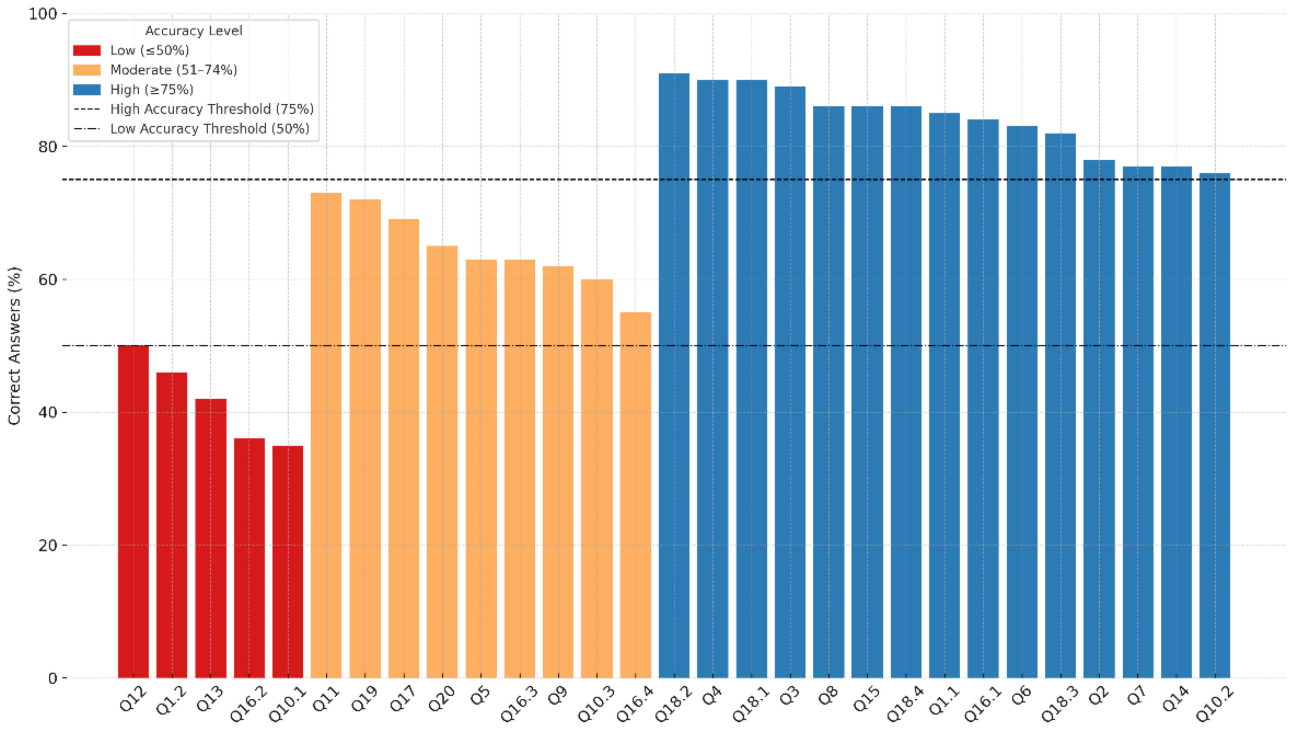

Figure 1 Distribution of correct answers across medication literacy questions, grouped by accuracy level: low (≤50%), moderate (51–74%), and high (≥75%).

Results of Univariate and Multiple Linear Regression Analysis

In order to determine the relationship between participants' characteristics and medication literacy level, univariate and multiple linear regression analyses were conducted.

Univariate analysis revealed significant predictors of lower medication literacy scores, including male gender ($\beta = -1.295$, $p = 0.001$), lower educational levels ($\beta = -2.518$, $p < 0.001$ for high school or below, $\beta = -7.366$, $p = 0.003$ for diploma, $\beta = -1.512$, $p = 0.010$ for undergraduate), a high number of household members ($\beta = 1.738$, $p = 0.002$ for 1–4, $\beta = 1.535$, $p = 0.003$ for 5–8), low monthly income ($\beta = -1.478$, $p = 0.002$ for no income; $\beta = -1.305$, $p = 0.004$ for <5,000 SAR, $\beta = -1.587$, p= 0.004 for 5000–10,000 SAR). Participants who reported taking prescription medications demonstrated significantly higher medication literacy scores ($\beta = 2.977$, $p < 0.001$) than those who did not. Consulting or seeing a pharmacist for illnesses and medicines was associated with increased medication literacy scores, particularly among those who reported never consulting ($\beta = 2.979$, $p = 0.003$) or consulting sometimes ($\beta = 2.292$, $p = 0.016$). The results of univariate regression analysis are shown in Table 3.

The multiple linear regression analysis identified several significant predictors of medication literacy scores while controlling for other variables. The educational level remained a strong predictor, with participants holding a high school degree or below having significantly lower scores ($\beta = -1.765$, $p = 0.009$) compared to those with post-graduate education. Those with a diploma also showed substantially lower scores ($\beta = -5.872$, $p = 0.016$), while undergraduate education approached significance ($\beta = -1.109$, $p = 0.053$).

Household size was positively associated with medication literacy, with participants from households with 1–4 members ($\beta = 1.252$, $p = 0.031$) or 5–8 members ($\beta = 1.255$, $p = 0.021$) showing higher scores compared to households with more than eight members.

Prescription medication use was a significant positive predictor; participants who reported taking prescription medications had higher scores ($\beta = 2.375$, $p < 0.001$) compared to those who did not. Additionally, consulting or seeing a pharmacist for illnesses and medicines showed a significant positive association. Participants who never consulted

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Table 3 Results of Univariate Linear Regression Analysis

Parameter		Univariate Regression		
		Beta (95% CI)	**R Square**	**P Value**
Gender	Male	− 1.295 (−2.07, −0.52)	0.013	0.001
	Female	Reference		
Age	18–24	0.029 (−1.532, 1.589)	0.009	0.971
	25–34	0.938 (−0.704, 2.581)		0.262
	35–44	− 0.512 (−2.249, 1.225)		0.563
	45–54	0.237 (−1.663, 2.137)		0.807
	≥55	Reference		
Nationality	Saudi	− 0.431 (−2.128, 1.267)	0.00	0.618
	Non-Saudi	Reference		
Marital status	Single	−0.639 (−1.308, 0.03)	0.004	0.061
	Married	Reference		
Education	High school degree or below	−2.518 (−3.706, −1.330)	0.032	0.000
	Diploma	−7.366 (−12.172, −2.557)		0.003
	Undergraduate	−1.512 (−2.655, −0.369)		0.010
	Postgraduate	Reference		
Occupation	Employed as a full-time worker	0.417 (−0.378, 1.212)	0.011	0.304
	Employed as a part-time worker	0.193 (−2.725, 3.11)		0.897
	Self-employed	1.781 (−0.731, 4.292)		0.164
	Unemployed, looking for work	0.672 (−0.495, 1.838)		0.259
	Unemployed, not looking for work	−1.189 (−2.457, 0.08)		0.066
	Retired	0.306 (−1.265, 1.877)		0.703
	Students	Reference		
Province of current residence	Eastern province	0.027 (−1.783, 1.837)	0.007	0.977
	Central province	1.436 (−0.693, 3.565)		0.186
	Western province	0.021 (−2.168, 2.209)		0.985
	Northern province	−1.067 (−4.036, 1.903)		0.481
	Southern province	Reference		
Number of people living in your household	1–4	1.738 (0.655, 2.821)	0.013	0.002
	5–8	1.535 (0.52, 2.55)		0.003
	>8	Reference		

(*Continued*)

Table 3 (Continued).

Parameter		Univariate Regression		
		Beta (95% CI)	R Square	P Value
Monthly income	None	−1.478 (−2.414, −0.539)	0.016	0.002
	<5000 SAR	−1.305 (−2.184, 0.425)		0.004
	5000–10000 SAR	−1.587 (−2.676, −0.498)		0.004
	>10,000 SAR	Reference		
Prescription medication use	Yes	2.977 (2.037, 3.916)	0.045	0.000
	No	Reference		
Non-prescription medication use	Yes	0.282 (−0.637, 1.202)	0.000	0.547
	No	Reference		
The need for someone to help you read instructions, pamphlets, or other written material from doctor or pharmacy	Never	0.597 (−2.072, 3.266)	0.032	0.661
	Rarely	−0.667 (−3.334, 1.999)		0.623
	Sometimes	−1.574 (−4.286, 1.139)		0.255
	Often	−1.859 (−4.97, 1.253)		0.241
	Always	Reference		
Frequency of consulting or seeing a general practitioner (GP) for illnesses and medicines	Never	0.701 (−1.066, 2.467)	0.001	0.436
	Rarely	0.487 (−0.992, 1.965)		0.518
	Sometimes	0.378 (−1.079, 1.835)		0.611
	Often	0.501 (−1.104, 2.106)		0.540
	Always	Reference		
Frequency of consulting or seeing a pharmacist for illnesses and medicines	Never	2.979 (1.051, 4.908)	0.015	0.003
	Rarely	1.755 (−0.089, 3.6)		0.062
	Sometimes	2.292 (0.43, 4.153)		0.016
	Often	2.497 (0.424, 4.570)		0.018
	Always	Reference		

Abbreviations: CI, Confidence interval; P-value, Probability value; R2, multiple correlation coefficient, index of goodness fitness in the model.

a pharmacist had higher scores (β = 3.602, p = 0.001) compared to those who consulted frequently, followed by those who consulted sometimes (β = 2.525, p = 0.016) or often (β = 3.067, p = 0.008). See Table 4.

Discussion

Results showed a relatively inadequate level of medication literacy in Saudi Arabia, with 50% of participants scoring below the average of correct answers. In addition, almost half of the participants admitted that they never or rarely consulted a physician or pharmacist about illnesses or medicines. This is a cause for concern because people with limited medication literacy lack the skills and the knowledge to understand the proper way to use medicines; hence, this could be a potential source of treatment failure, medicine-related problems, and health risks. As it may be difficult for the patient to voice the poor medication literacy problem, physicians or pharmacists should discuss this issue with the patient.[22–24]

Table 4 Results of Multiple Linear Regression Analysis

Parameter		Multiple Linear Regression	
		Beta (95% CI)	**P Value**
Gender	Male	−0.849 (−1.698, −0.000)	0.051
	Female	Reference	
Education	High school degree or below	−1.765 (−3.094, −0.437)	0.009
	Diploma	−5.872 (−10.633, −1.110)	0.016
	Undergraduate	−1.109 (−2.280, −0.064)	0.053
	Postgraduate	Reference	
Number of people living in your household	1–4	1.252 (−0.112, 2.393)	0.031
	5–8	1.255 (0.199, 2.311)	0.021
	> 8	Reference	
Monthly income	None	−0.776 (−1.865, 0.314)	0.163
	<5000 SAR	−0.463 (−1.498, 0.573)	0.381
	5000–10,000 SAR	−0.823 (−1.989, 0.343)	0.166
	>10,000 SAR	Reference	
Prescription medication use	Yes	2.375 (1.367,3.383)	0.000
	No	Reference	
Frequency of consulting or seeing a pharmacist for illnesses and medicines	Never	3.602 (1.490, 5.714)	0.001
	Rarely	2.226 (0.181, 4.271)	0.033
	Sometimes	2.525 (0.470, 4.579)	0.016
	Often	3.067 (0.793, 5.341)	0.008
	Always	Reference	

Abbreviations: CI, Confidence interval; P-value, Probability value.

Pharmacists can have a key advisory role in patients' medication literacy: assessing each patient's information needs to ensure the safe and effective use of medicine. Poor medication literacy also needs to be addressed much more than previously in the continuing and basic education of healthcare professionals. An appropriate toolkit is already available.[22] Several studies from different countries have demonstrated the effectiveness of pharmacist-led programs in enhancing medication literacy and improving patient outcomes.

1. Pharmacist-led counseling and patient education: Studies have shown that pharmacist counseling significantly improves patients' understanding of medication use, adherence, and safety. For example, a systematic review by Pouliot and Vaillancourt (2016)[25] highlighted that pharmacists are well-positioned to educate patients on medication use, reduce medication errors, and improve adherence.
2. Medication therapy management (MTM) programs: MTM services, widely implemented in the United States, have been shown to improve medication literacy, optimize therapy outcomes, and reduce adverse drug events.[26]
3. Pharmacist involvement in chronic disease management: Different studies found that pharmacist-led education programs improved medication literacy, adherence, and self-management skills among diabetic patients[27] and hypertensive patients.[28]

4. Health literacy interventions in community pharmacies: A study in Saudi Arabia by Alaqeel and Abanmy (2015)[29] also demonstrated that pharmacist-led counseling improved medication adherence and knowledge among patients with chronic conditions.

The multiple linear regression analysis revealed that participants from smaller (1–4 members) and medium-sized households (5–8 members) had higher medication literacy scores compared to those in larger households (>8 members). This finding aligns with literature suggesting that the social and familial environment can influence health behaviors, including the understanding and managing medications.[30,31] Individuals in smaller household sizes may benefit from more focused communication, easier coordination of healthcare tasks, and greater individual responsibility in handling medication.[30,31] In contrast, individuals in larger households may have more distributed responsibilities related to medication management, potentially reducing individual engagement in learning about medications.[30,31] Additionally, cultural and familial dynamics in larger households may influence how medication-related information is shared and understood. These findings are consistent with previous studies that emphasize the role of social networks, household dynamics, and caregiver burden in shaping health literacy and medication behaviors.[30,31] Further research is needed to explore whether the impact of household size on medication literacy is mediated by factors such as caregiving roles, intergenerational knowledge transfer, and the presence of healthcare professionals within the household.

Additionally, consultation with a pharmacist was significantly associated with medication literacy. Interestingly, those who reported never consulting a pharmacist had higher scores, followed by those who consulted sometimes or often. One possible explanation is that individuals who do not seek pharmacists' advice may rely more on online health resources, educational materials, or personal experiences to enhance their medication knowledge. This aligns with the growing trend of self-directed learning through digital platforms and health-related websites.[23,24] In the digital age, many people increasingly rely on self-directed learning through health-related websites, mobile applications, and social media platforms to obtain medication information.[23,24] This digital self-learning may empower users to interpret dosing instructions, side effects, and precautions independently, especially among younger, more digitally literate populations. As a result, they may feel less need to consult pharmacists, even though the information they acquire may not always be critically appraised or personalized. Additionally, it is possible that those with higher medication literacy feel confident in managing their medications independently, reducing the perceived need to consult pharmacists. However, this does not necessarily indicate optimal medication use, as higher literacy does not always translate into safe or effective medication practices. To further clarify this result, future research could explore the sources of medication information among different groups and assess the quality and accuracy of the knowledge acquired from self-reliant approaches compared to pharmacist consultations.

Moreover, people with a low educational level[2,3,12,32] had a higher prevalence of poor medication literacy levels. This is because individuals with low educational levels may struggle with reading comprehension, numeracy, and access to reliable health information, all of which contribute to poor medication literacy and increase the risk of medication errors and adverse health outcomes. Other studies have shown that people with a low educational level are likely to incorrectly numerate the required medication dosage and understand and read their medication instructions.[12,32] Furthermore, participants who reported taking prescription medications had higher medication literacy scores than those who did not. This may be due to the fact that individuals who take prescription medications are naturally more engaged with their treatment, healthcare providers, and medication instructions. This exposure and the necessity to follow prescription guidelines correctly contribute to their higher medication literacy scores.[19,25]

The percentage of participants with poor medication literacy in the present study is in line with previous Middle Eastern findings,[12,32] which showed that there is inadequate medication literacy in Saudi Arabia (38.5%)[12] and Iran (30.3%).[32] Similarly, studies conducted in Jordan[33] and the United Arab Emirates (UAE)[34] have shown comparable challenges, particularly in understanding dosage instructions and identifying drug interactions. A study in Egypt reported even lower medication literacy levels.[35] In Europe, particularly in Denmark[36] and the Netherlands,[3] where pharmacist-led interventions are more common, medication literacy levels are significantly higher than in Saudi Arabia. Studies from North America further indicate that individuals with chronic conditions tend to have better medication literacy, likely due to frequent healthcare interactions and structured patient education programs.[11,25] Comparisons with a study conducted in China[6] highlight even lower medication literacy rates, primarily due to limited pharmacist counseling and accessibility to

medication information. These global differences emphasize the importance of pharmacist-led interventions and health literacy programs, which have been successfully implemented in Western healthcare systems. To address these gaps, Saudi Arabia can adopt strategies from countries with higher medication literacy levels, such as expanding pharmacist counseling services, incorporating health literacy training into patient education, and integrating digital health tools to improve medication literacy outcomes.

Most problems in the current study were found in items related to dosing, which required an understanding of information from longer texts and some level of numerical skills. However, this finding is inconsistent with a previous study,[12] which showed that medication dosage and timing instructions were less problematic for their study participants. This is possibly because the instructions on the prescription labels that were given to the participants to interpret used simple words and were short.[12] Thus, for many patients, the information was clear. An earlier study suggested that mistakes were more common when instructions had varying numerical information with several components.[5]

Nearly half of the participants could not count how many days of treatment a medication would last if they were given two packages, each containing 28 tablets and taking into account the prescribed regimen of administration: "Take one tablet by mouth twice daily." This may reflect more about a patient's numeracy skills than their reading proficiency. This finding suggests that patients may be unable to correctly calculate the number of days' worth of tablets remaining even though they may be able to read label instructions, suggesting that interpreting words may be an easier literacy task than numeracy.[5] Mistakes were also frequent in response to questions 10 and 16, which had several components and required varying numerical skills to either demonstrate the earliest time to take the next tablet of a medication, the number of pills to be taken, maximum single dose, maximum daily dose, or administration frequency of the medication.

Other problems were also detected in the following items: when to obtain a refill, drug use in pregnancy, correct storage and disposal of medication, medication expiration date, occurrence of adverse effects and what actions to take in case of adverse effects developing, occurrence of drug interactions, actions to take in the event of a missed dose, medication label understanding, tablet splitting and duration of therapy. This is consistent with data from two local studies,[8,12] where many participants had problems understanding information related to duration of treatment,[12] storage instructions,[12] actions to take in case of a missed dose,[8] drug interactions,[8] side effects[8] medication disposal,[8] and drug use in pregnancy.[8]

Several possible factors may explain the low medication literacy levels observed in this study:

1. Gaps in health and medication education — Saudi Arabia's education system lacks structured health literacy programs, which contribute to limited knowledge of medication use, especially among individuals with lower education levels.[8]
2. Limited pharmacist-patient interaction—Many patients consult physicians rather than pharmacists, missing out on essential medication counseling. Overcrowded pharmacies and high patient volumes further restrict pharmacists' ability to provide individualized education.[26,29]
3. High rates of self-medication and misinformation — The widespread use of over-the-counter (OTC) medications and reliance on unverified online sources or family recommendations often lead to misconceptions about medication use.[37]
4. Language and cultural barriers — Many medication leaflets and labels are in English, posing language challenges for Arabic-speaking patients, particularly older adults and those with limited education.[12]

To enhance medication literacy in Saudi Arabia, interventions should focus on integrating medication literacy education into school curricula, expanding pharmacist counseling services and public awareness campaigns, developing accessible Arabic-language medication resources, and simplifying prescription instructions to address numeracy challenges. By addressing these underlying causes, healthcare professionals and policymakers can work toward improving medication literacy and promoting safer medication practices in Saudi Arabia.

Pharmacists may be the ideal healthcare workers to identify people with limited medication literacy who need additional support and tailored care in terms of proper medication use. This is because pharmacists specialize in pharmacotherapy, are easily accessible healthcare providers, have frequent contact with the public, and are ideally positioned to convey health promotion messages.[25,38,39] There are a variety of interventions for people with limited medication literacy, such as educational aids, pictograms, infographics, videos, verbal presentation of information,

written information (tailored to patients' medication literacy levels), and additional consults or extra reviews to explain proper medication use.[2,25] However, to date, these interventions have been used only in daily practice.[2]

In Saudi Arabia, pharmacists are present in nearly all community pharmacies, as national regulations mandate that licensed pharmacists must dispense medications and provide pharmacy services.[40,41] Community pharmacies are highly accessible and distributed across urban and rural areas, positioning pharmacists as a key point of contact for patients. In recent years, the Ministry of Health has introduced initiatives such as the "Wasfaty" e-prescription platform and has begun expanding pharmacists' roles in areas like immunization, medication therapy management (MTM), and chronic disease support.[40,41] Despite this progress, the delivery of patient-centered services—such as individualized counseling, health education, and medication adherence support—remains limited. Challenges include limited private counseling spaces, time constraints, and variable levels of pharmacist training in clinical communication.[40,41] Nevertheless, Saudi Arabia's Vision 2030 health transformation agenda actively supports the enhancement of pharmacists' clinical roles.[40,41] These national efforts provide a practical foundation for implementing targeted interventions to improve medication literacy, particularly within community pharmacy settings.

Ensuring patients understand the proper and safe use of medications is crucial. One effective approach is the "Teach-back" technique, which involves asking patients to repeat instructions to confirm their understanding.[42] However, research suggests[5] that there may be a gap between a patient's ability to correctly demonstrate the required number of pills to be taken daily and their ability to verbalize instructions correctly. This discrepancy highlights the need for a systematic approach to ensure quality care by evaluating whether patients can both articulate and demonstrate specific, accurate medication-taking behaviors.

To improve medication literacy, literacy-sensitive interventions should be incorporated. These include well-designed materials written at a fifth to eighth-grade reading level, the "Ask Me 3" program, and motivational interviews.[25] Rather than overwhelming patients with detailed medical information, pharmacists should focus on practical, day-to-day drug-related information, patients' medication-taking behaviors, and their disease experiences when providing educational materials. Additionally, emphasizing education, action, attitude, and awareness among pharmacists and pharmacy students is equally important in improving the usability of written and verbal information to enhance medication literacy.[25]

Although this study provides important insights using a quantitative approach, it is essential to recognize the value of a more patient-centered, mixed-methods framework in future research. Assessing medication literacy solely through standardized tools may not fully capture individuals' self-perceived information needs, motivations, and behaviors related to medication use. Prior research suggests that sources of information, confidence in self-management, and communication preferences significantly shape medication-related decision-making and adherence.[31,42] Qualitative methods such as interviews or focus groups could provide deeper insights into how people interpret medication instructions, navigate medication-related challenges, and interact with healthcare providers. Future studies should integrate these qualitative components to enrich understanding, triangulate findings, and inform the design of tailored, literacy-sensitive interventions that reflect real-world patient experiences.

Implications for Practice and Policy

Given these findings, targeted interventions are necessary to enhance medication literacy in Saudi Arabia. Expanding the role of pharmacists through structured medication counseling programs in community pharmacies and hospitals could help bridge the literacy gap. Additionally, continuing education programs for pharmacists should focus on health communication techniques, ensuring that patients receive clear and personalized medication guidance.[29] Integrating digital health solutions, including tele-pharmacy services, mobile applications, and digital medication literacy tools, could improve accessibility to medication information, particularly among young adults who frequently engage with digital platforms. A national medication literacy portal with educational videos, pictogram-based medication guides, and interactive patient resources could also enhance public understanding.[35] Medication labels should be standardized and simplified to overcome health communication barriers, integrating pictograms, Arabic-language guides, and large-font instructions to improve readability.[3] Public health campaigns, driven by pharmacists and supported by social media, could further educate the population on safe medication practices, adherence, and the risks of self-medication.[3,11,25] From a policy perspective, certain medications should require mandatory pharmacist counseling and minimum time allocations

for patient-pharmacist interactions should be enforced. Additionally, collaborations between healthcare providers, pharmacists, and regulatory bodies can ensure consistent messaging and better integration of medication literacy programs into the healthcare system.[12,27] By implementing these practice-driven and policy-level interventions, Saudi Arabia could enhance medication literacy, reduce medication errors, and improve overall public health outcomes.

Strengths and Limitations

This study's main strength is that it is the first to assess medication literacy levels among adults in Saudi Arabia using a validated and reliable assessment questionnaire to ensure that the data collected in this study were valid. Certain limitations of the present study should be considered when interpreting the results. This study employed a cross-sectional design, which does not permit the determination of causal relationships between variables. Additionally, differences in characteristics between respondents and non-respondents may limit the generalizability of the findings. For instance, respondents may be more likely to possess computer literacy and show greater interest in the survey topic.

The sample of this research was comprised mainly of Saudi nationals, younger individuals, females, and people living in the Eastern Province of Saudi Arabia. This demographic composition of the study sample contrasts with national demographic data, which indicates a more balanced distribution across age groups, genders, and geographic regions.[21] This skew in representation is likely due to the use of convenience and snowball sampling through online platforms, which tend to reach younger, digitally literate individuals. As such, the findings may not be generalizable to the broader Saudi population, particularly older adults, males, or individuals from underrepresented provinces. While weighting strategies were not applied in the current study, future research should consider using post-stratification weighting to improve representativeness, generalizability, and national applicability of medication literacy data.

A further limitation is that the study sample was skewed toward younger adults (50.1% aged 18–24 years) and females (75.7%), resulting in an underrepresentation of older adults, who are more likely to experience challenges with medication literacy. This demographic imbalance may have influenced the overall findings and limited the applicability of the results to populations with different medication literacy needs. Future studies should consider stratified random sampling or targeted outreach (eg, recruitment through healthcare facilities, pharmacies, and community centers) to ensure a more balanced and representative sample. While resampling was not feasible, the use of sample weighting techniques in future research could help mitigate bias by adjusting for demographic imbalances in the statistical analysis. Although we prioritized presenting the unweighted findings transparently, future studies should explore the application of post-stratification weighting to improve generalizability. Additionally, although the study included data on prescription medication use, it did not specifically differentiate participants based on the presence or type of chronic diseases. This is a notable limitation, as individuals with chronic conditions often exhibit higher medication literacy due to regular healthcare encounters and structured educational interventions. Future studies should explicitly include chronic disease variables to better explore their association with medication literacy.

Another potential limitation is that although our multiple linear regression model accounted for key predictors such as education level, household size, income, prescription medication use, and frequency of pharmacist consultation, some potential confounders may not have been fully addressed because they were not directly measured in our study such as access to health information, cultural and language factors, cognitive ability and numeracy skills, etc. Future research should consider incorporating validated health literacy assessments, numeracy evaluations, and qualitative methods to explore individuals' sources of medication knowledge. Addressing these additional confounders would enhance the robustness of future findings and provide a more comprehensive understanding of the factors influencing medication literacy.

The last limitation is that this study relied solely on a quantitative approach to assess pharmacist consultations and medication literacy. While the statistical analysis provided valuable insights, it did not explore the underlying reasons for participants' behaviors, motivations, or barriers to pharmacist consultations. A qualitative component, such as interviews or focus groups, could provide deeper insight into the factors influencing pharmacist consultations and the challenges faced by individuals with limited medication literacy. Future research should incorporate qualitative methods to gain a more comprehensive understanding of these interactions. Despite these limitations, our study provides valuable foundational insights into medication literacy in Saudi Arabia, highlighting key areas for intervention. Future research

should adopt probabilistic sampling methods and explore qualitative approaches to further understand the barriers and facilitators of medication literacy, particularly among older adults and underserved populations.

Conclusion

Medication literacy needed to be improved among study participants. Some areas require careful attention, such as dosing instructions written in longer text, numerical skills, understanding drug interactions, and other areas that need to be correctly answered. These findings indicate that efforts to improve medication literacy should focus on areas with the highest error rates. Strategies such as pharmacist-led interventions, simplified prescription instructions, visual learning aids, and accessible digital support tools may help patients feel empowered to make safer and more informed medication decisions, ultimately reducing the risk of medication errors and improving health outcomes. Pharmacists can be trained to incorporate medication literacy principles through targeted continuing education programs focused on communication and patient engagement. Additionally, incentivizing pharmacists via recognition systems, continuing education credits, or performance-based rewards may further encourage their active role in improving medication literacy during routine consultations.

Special attention should also be paid to the groups with inadequate medication literacy. This issue needs to be explored in depth using a qualitative approach; for example, assessing how pharmacists identify people with limited medication literacy, what type of intervention pharmacists use to educate their patients, and whether those interventions improve patients' medication-taking behavior. Future research should focus on expanding the sample to include diverse demographic and socioeconomic groups to enhance the representativeness of the results. Additionally, studies should investigate the effectiveness of various educational interventions aimed at improving medication literacy and assess their impact on patient's ability to understand and use medications correctly. Further analyses are also needed to examine the long-term consequences of low medication literacy on health outcomes and treatment adherence.

Disclosure

The authors report no conflicts of interest in this work.

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