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Exploring Knowledge, Attitudes, and Practices (KAP) Regarding the Influence of Diet and Exercise on Drug Responses: A Quantitative Study among the Saudi Arabian Population

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ABSTRACT

The interaction between diet, exercise, and drug responses is a key factor in optimizing therapeutic outcomes and minimizing adverse effects. Variations in dietary habits and physical activity significantly impact medication metabolism, efficacy, and safety. Despite the evidence supporting these interactions, public awareness of their implications remains variable, especially in regions with a high prevalence of chronic conditions such as Saudi Arabia. This study aims to assess the knowledge, attitudes, and practices (KAP) of the Saudi Arabian population regarding the influence of diet and exercise on drug responses. The goal is to identify gaps that could be addressed through targeted educational interventions, ultimately enhancing medication outcomes and promoting healthier lifestyle integration. A quantitative, cross-sectional design was employed, involving a stratified random sample of 1,232 adults aged 18 and above from various regions in Saudi Arabia. Data were collected using an online questionnaire designed to evaluate participants' demographic information, knowledge of diet and exercise impacts on drug metabolism, attitudes towards medication management, and relevant health practices. Descriptive and inferential statistical analyses, including multiple regression and factor analysis, were performed using SPSS software to explore associations between demographic variables and KAP outcomes. The study found that 95.1% of participants were aware of the influence of diet on medication, while 80.3% recognized the role of exercise in drug responses. Positive attitudes towards integrating diet and exercise in medication management were prevalent, with 67.4% rating a healthy diet as "Very Important" and 64.2% holding similar views on exercise. However, a significant gap existed between knowledge and practice, as only 14.6% of participants consistently followed a diet plan, and 10.9% engaged in regular exercise while on medication. Regression analysis identified education level, health status, and age as strong predictors of positive attitudes and practices, highlighting the need for more effective communication from healthcare providers. Despite high levels of awareness regarding the impact of diet and exercise on drug responses, the gap between knowledge and practical application remains significant. This study underscores the importance of educational interventions and proactive patient engagement to bridge this gap. Tailored strategies focusing on demographics such as education level and age are recommended to foster better integration of lifestyle factors into medication management.
Keywords: diet, exercise, and drug responses, Knowledge, Attitudes, Practices

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INTRODUCTION

The effect of diet and exercise on drug responses is a fundamental aspect of achieving optimal therapeutic outcomes and reducing adverse effects. Variations in dietary habits and physical activity significantly influence the pharmacokinetics and pharmacodynamics of many medications, impacting their metabolism, effectiveness, and safety profiles. Understanding these interactions is essential for healthcare providers to deliver comprehensive care and for patients to maximize their health outcomes.

Previous research has established that certain foods and nutrients can markedly impact drug metabolism. For instance, grapefruit juice has been shown to inhibit the cytochrome P450 3A4 enzyme, resulting in increased plasma levels of various medications, thereby elevating toxicity risks [9]. Similarly, studies suggest that high-fat diets can alter the absorption of lipid-soluble drugs, potentially compromising their therapeutic effectiveness [12].

The role of exercise in drug metabolism is also well-documented. Regular physical activity can accelerate the body's metabolic processes, leading to quicker drug clearance and potentially shortening the duration of therapeutic effects [3]. Conversely, acute exercise has been found to alter drug distribution by increasing blood flow to muscles, which might require adjustments in medication dosages for drugs with a narrow therapeutic range [15].

Despite the well-established influence of diet and exercise on drug responses, research indicates variable levels of public awareness regarding these interactions. Studies have noted that although individuals often understand the general health benefits of diet and exercise, they might lack specific knowledge on how these factors affect their medication regimens [1]]. This gap in understanding can contribute to suboptimal medication use and an increased likelihood of adverse drug reactions.

Given the high prevalence of chronic conditions like diabetes and cardiovascular diseases in Saudi Arabia [8], exploring the population's awareness and practices regarding diet, exercise, and medication interactions is particularly pertinent. This study aims to assess the knowledge, attitudes, and practices (KAP) of the Saudi Arabian population concerning the influence of diet and exercise on drug responses. The findings will provide insights for healthcare providers and policymakers to design strategies that promote better health outcomes through integrated lifestyle and medication management.

MATERIAL AND METHODS

Study Design

The present study adopted a quantitative, cross-sectional design to investigate the knowledge, attitudes, and practices (KAP) of the Saudi Arabian population concerning the influence of diet and exercise on drug responses. A cross-sectional approach was deemed appropriate as it facilitates the capture of a comprehensive snapshot of the population's current understanding and behaviors at a specific point in time. This design provides a robust foundation for identifying potential gaps that could be addressed through future interventions.

Study Population and Sampling

The target population comprised adults aged 18 years and older residing in Saudi Arabia. To ensure that the sample was both diverse and representative, efforts were made to include participants from various regions, educational backgrounds, and health statuses. A stratified random sampling method was employed to achieve this representation, wherein the population was divided into strata based on key demographic variables, such as age, gender, and region. Random selection was then carried out within each stratum to ensure that the sample adequately reflected the characteristics of the broader population. A power analysis was performed using G*Power software to determine the appropriate sample size for the study. Based on the assumption of a medium effect size, an alpha level of 0.05, and a desired power of 0.80, the minimum required sample size was estimated to be 385 participants. However, to account for the possibility of non-response or incomplete data, a larger sample of 1,500 individuals was targeted. After data cleaning and validation, the final sample consisted of 1,232 respondents, which allowed for a more comprehensive analysis

Data Collection

Data collection was conducted using an online questionnaire, distributed through various channels, including social media platforms, email lists, and healthcare networks. The online format was selected due to its ability to efficiently reach a wide and geographically dispersed audience, as well as its capacity to maintain participant anonymity and minimize response bias.

Questionnaire Development

The development of the questionnaire was informed by a thorough review of existing literature and consultations with experts in pharmacology, nutrition, and public health. The questionnaire was designed to capture data in four main sections:

1. **Demographics:** This section gathered details about participants' age, gender, educational background, region of residence, and health status.
2. **Knowledge:** Participants were asked questions to assess their understanding of how diet and exercise affect drug metabolism, efficacy, and safety. The items included binary (Yes/No) questions and multiple-choice questions to explore specific areas of knowledge.
3. **Attitudes:** A series of Likert scale items were utilized to gauge participants' attitudes towards the importance of diet and exercise in medication management.
4. **Practices:** This section included questions regarding participants' dietary habits, exercise routines, and their interactions with healthcare providers when discussing diet and exercise in the context of medication.

Pilot Testing

Prior to the main data collection, a pilot test was conducted with a sample of 50 participants who closely resembled the target population. The objective of the pilot test was to assess the clarity, reliability, and validity of the questionnaire items. Based on feedback received during this phase, minor revisions were made to the wording and structure of certain questions to enhance their comprehensibility and ease of responses.

Data Collection Procedure

The finalized questionnaire was administered online over a period of three months. Participants were invited to participate voluntarily, with an informed consent process clearly outlined at the beginning of the questionnaire. The consent form detailed the study's purpose, the voluntary nature of participation, and the steps taken to ensure data confidentiality and anonymity. Participants were also informed of their right to withdraw from the study at any time without any negative consequences.

To boost response rates, follow-up reminders were periodically sent via email and social media platforms. Additionally, small incentives, such as entries into a gift card draw, were offered to encourage participation.

Data Analysis

The collected data were analyzed using the Statistical Package for the Social Sciences (SPSS) software, version 26.0. Both descriptive and inferential statistical techniques were employed to address the research questions comprehensively.

Descriptive Statistics

Descriptive statistics, including measures of central tendency (means, standard deviations) and distribution (frequencies, percentages), were used to summarize the demographic characteristics and responses to the KAP questions. These analyses provided a detailed overview of the participants' knowledge, attitudes, and practices, highlighting areas where improvements might be necessary.

Inferential Statistics

Inferential statistical methods were utilized to explore relationships between demographic variables and KAP outcomes. Chi-square tests were conducted to examine associations between categorical variables, such as gender and knowledge of diet-drug interactions. Additionally, independent samples t-tests and ANOVA were applied to compare mean scores on attitude and practice scales across different demographic groups (e.g., education level). To identify predictors of knowledge, attitudes, and practices, multiple regression analyses were performed, accounting for potential confounders such as age, gender, and educational background.

Ethical Considerations

This study was conducted in strict adherence to the ethical principles set forth in the Declaration of Helsinki. Approval for the research was obtained from the Research Ethics Committee (REC) at the University of Hail, with the approval dated 30/09/2024 (Approval No: H-2024-446). All participants provided informed consent electronically before completing the questionnaire, confirming their understanding of the study's purpose and their rights as participants.

To ensure the utmost confidentiality and anonymity, all data were securely stored on a password-protected server, accessible exclusively to the research team. Furthermore, any personal identifiers were removed from the dataset before analysis to safeguard participants' privacy throughout the study.

RESULTS

Demographic Distribution

The study included a diverse sample of 1,232 participants, with the majority being in the younger age groups. Specifically, 62.5% of respondents were aged between 18-25 years, followed by 25.6% who were between 26-35 years. Smaller percentages were found in the older age categories, with 7.9% aged 36-45, 2.8% aged 46-55, and only 1.1% aged 56 and above.

In terms of gender distribution, the sample was predominantly female, comprising 83.5% of the participants, while males made up 16.5% of the sample.

The educational background of the participants varied, with the majority holding a Bachelor's degree (64.1%). Additionally, 19.3% of participants had a Master's degree, 6.2% had a high school diploma, and 4.2% had less than a high school education. Only 6.2% of the participants had attained a Doctorate degree.

Regarding health status, the majority of participants reported their health as "Excellent" (74.5%), followed by "Good" (17.5%). A smaller proportion described their health as "Fair" (6.3%), and only 1.7% reported a "Poor" health status.

Table 1: gender Distribution

Variable	Category	Frequency (n)	Percentage (%)
Age	18-25	770	62.5
	26-35	316	25.6
	36-45	98	7.9
	46-55	35	2.8
	56 and above	13	1.1
Gender	Male	203	16.5
	Female	1029	83.5
Education Level	Less than high school	52	4.2
	High school diploma	77	6.2
	Bachelor's degree	790	64.1
	Master's degree	238	19.3
	Doctorate degree	75	6.2
Health Status	Excellent	918	74.5
	Good	215	17.5
	Fair	78	6.3
	Poor	21	1.7

Knowledge Section

The participants demonstrated a high level of knowledge regarding the influence of diet and exercise on medication. A significant majority (95.1%) were aware that diet can influence how the body responds to medications, while 4.9% were not. Similarly, 80.3% of participants knew that exercise can influence medication responses, with 19.7% unaware of this effect.

Additionally, 92.7% of participants were aware that certain foods can interfere with the effectiveness of medications, while 7.3% were not. A slightly lower, yet substantial, percentage (75.4%) understood that regular exercise can alter the metabolism of medications, with 24.6% lacking this knowledge.

Almost all participants (98.2%) believed in the importance of consulting a healthcare provider about diet and exercise when taking medication, with only 1.8% disagreeing (Table 2).

Table 2: Knowledge Section - Frequency and Percentage

Question	Response	Frequency (n)	Percentage (%)
Aware of Diet Influence on Medication	Yes	1171	95.1
	No	61	4.9
Aware of Exercise Influence on Medication	Yes	989	80.3
	No	243	19.7
Aware of Food Interference with Medications	Yes	1143	92.7
	No	89	7.3
Aware of Exercise Altering Medication Metabolism	Yes	929	75.4
	No	303	24.6
Belief in Consulting Healthcare Provider About Diet and Exercise	Yes	1210	98.2
	No	22	1.8

Attitudes Section

Participants' attitudes towards the importance of diet and exercise while on medication were overwhelmingly positive. The mean score for the importance of maintaining a healthy diet was 4.58 (SD = 0.76), with 67.4% of participants rating it as "Very Important" and 25.1% as "Important." Only a small fraction viewed it as "Neutral" (6.1%), "Not Important" (1.1%), or "Not Important at All" (0.3%).

Similarly, the importance of engaging in regular exercise while on medication had a mean score of 4.54 (SD = 0.74). A majority of participants (64.2%) rated it as "Very Important," 27.4% as "Important," with 6.8% being "Neutral," and only 1.6% rating it as either "Not Important" or "Not Important at All."

When asked whether healthcare providers should educate patients about the impact of diet and exercise on medication, the mean response was 4.76 (SD = 0.52), with 78.5% "Strongly Agreeing" and 19.6% "Agreeing." Only a small number of participants were "Neutral" (1.4%) or disagreed (0.5%).

Participants also reported their adequacy of information regarding the impact of diet and exercise on medication, with mean scores of 4.34 (SD = 0.82) and 4.32 (SD = 0.82), respectively. A majority "Strongly Agreed" or "Agreed" that they had sufficient information, while smaller percentages were neutral or disagreed (Table 3).

Table 3: Attitudes Section - Frequency and Percentage

Question	Response	Frequency (n)	Percentage (%)	Mean	SD
Importance of Maintaining a Healthy Diet While on Medication	Very Important	830	67.4	4.58	0.76
	Important	309	25.1		
	Neutral	75	6.1		
	Not Important	14	1.1		
	Not Important at All	4	0.3		
Importance of Engaging in Regular Exercise While on Medication	Very Important	791	64.2	4.54	0.74
	Important	338	27.4		
	Neutral	84	6.8		
	Not Important	17	1.4		
	Not Important at All	2	0.2		
Healthcare Providers Should Educate About Diet and Exercise Impact	Strongly Agree	968	78.5	4.76	0.52
	Agree	241	19.6		
	Neutral	18	1.4		
	Disagree	5	0.3		
	Strongly Disagree	2	0.2		
Self-Reported Adequacy of Information About Diet Impact	Strongly Agree	630	51.2	4.34	0.82
	Agree	428	34.8		
	Neutral	143	11.6		
	Disagree	26	2.1		
	Strongly Disagree	5	0.3		
Self-Reported Adequacy of Information About Exercise Impact	Strongly Agree	611	49.6	4.32	0.82
	Agree	452	36.7		
	Neutral	142	11.5		
	Disagree	25	2		
	Strongly Disagree	2	0.2		

Practices Section

The survey revealed varied practices regarding diet, exercise, and consultation with healthcare providers when on medication. Following a specific diet plan while on medication had a mean score of 3.29 (SD = 1.03), with 14.6% of participants reporting they "Always" followed a diet plan, 29.7% "Often," and 39.2% "Sometimes." A smaller group reported "Rarely" (12.6%) or "Never" (3.9%) following a diet plan.

Engaging in regular exercise while on medication had a mean score of 2.93 (SD = 1.10). Only 10.9% of participants reported they "Always" exercised regularly, with 27.2% "Often" exercising, and 43.8% doing so "Sometimes." However, 17.8% "Rarely" and 22.3% "Never" exercised regularly while on medication.

Regarding consultations with healthcare providers about dietary changes when prescribed new medication, the mean score was 3.55 (SD = 1.06). Around 20.1% of participants "Always" consulted their

healthcare provider, 31.5% "Often," and 34.4% "Sometimes." Fewer participants reported consulting "Rarely" (11.2%) or "Never" (2.8%).

Consulting healthcare providers about exercise routines had a mean score of 3.06 (SD = 1.12), with 13.4% "Always" consulting, 23.5% "Often," 32.3% "Sometimes," and 20.6% "Rarely" consulting. A significant portion (10.2%) reported they "Never" consulted about exercise routines.

Experiencing side effects from diet and exercise was less common, with only 10.2% reporting side effects from diet and 7.9% from exercise. The vast majority did not experience side effects (89.8% and 92.1%, respectively).

When asked about their likelihood to change diet or exercise habits to improve medication effectiveness, participants responded positively, with mean scores of 4.46 (SD = 0.61) for diet and 4.44 (SD = 0.62) for exercise. A majority indicated they were "Very Likely" or "Likely" to make such changes, with very few being "Neutral" or "Unlikely" (Table 4).

Table 4: Practices Section

Question	Response	Frequency (n)	Percentage (%)	Mean	SD
Following a Specific Diet Plan While on Medication	Always	180	14.6	3.29	1.03
	Often	366	29.7		
	Sometimes	483	39.2		
	Rarely	155	12.6		
	Never	48	3.9		
Engaging in Regular Exercise While on Medication	Always	135	10.9	2.93	1.1
	Often	335	27.2		
	Sometimes	540	43.8		
	Rarely	219	17.8		
	Never	275	22.3		
Consulting Healthcare Provider About Dietary Changes	Always	248	20.1	3.55	1.06
	Often	388	31.5		
	Sometimes	424	34.4		
	Rarely	138	11.2		
	Never	34	2.8		
Consulting Healthcare Provider About Exercise Routines	Always	165	13.4	3.06	1.12
	Often	290	23.5		
	Sometimes	398	32.3		
	Rarely	254	20.6		
	Never	125	10.2		
Experienced Side Effects from Diet	Yes	125	10.2		
	No	1107	89.8		
Experienced Side Effects from Exercise	Yes	98	7.9		
	No	1134	92.1		
Likely to Change Diet to Improve Medication	Very Likely	667	54.2	4.46	0.61
	Likely	463	37.6		
	Neutral	97	7.9		
	Unlikely	5	0.4		
	Very Unlikely	0	0		
Likely to Change Exercise to Improve Medication	Very Likely	655	53.2	4.44	0.62
	Likely	455	37		
	Neutral	113	9.2		
	Unlikely	9	0.7		
	Very Unlikely	0	0		

Females and individuals with a higher education level (Bachelor's degree or above) were more likely to demonstrate high knowledge about diet-drug interactions. Younger participants (18-25 years) also showed a higher likelihood of awareness compared to older participants (Table 5).

Table 5: Logistic Regression Analysis of Knowledge of Diet and Exercise Influence on Medication

Predictor Variables	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Gender (Female vs. Male)	1.78	1.35 – 2.34	< 0.05
Education (Bachelor's degree or higher vs. Less than high school)	2.45	1.78 – 3.29	< 0.01
Age (18-25 years vs. 36+ years)	1.63	1.22 – 2.17	< 0.05

Model Summary: $R^2 = 0.36$, $F(3, 1228) = 45.27$, $p < 0.001$

Education level was the strongest predictor of positive attitudes towards the importance of diet and exercise in medication management, followed by health status and age (Table 6).

Table 6: Multiple Regression Analysis for Predictors of Positive Attitudes towards Diet and Exercise in Medication Management

Predictor Variables	Beta Coefficient (β)	Standard Error (SE)	p-value
Education Level	0.52	0.08	< 0.001
Health Status	0.41	0.1	< 0.01
Age	0.32	0.09	< 0.05

Total Variance Explained: 68%

The three factors identified suggest distinct dimensions within KAP, focusing on knowledge of diet-drug interactions, exercise influence, and engagement with healthcare providers (Table 7).

Table 7: Factor Analysis Results on Knowledge, Attitudes, and Practices (KAP) Related to Diet and Exercise

Factors Identified	Items Loaded on Factor	Variance Explained (%)
Diet-Drug Interaction Awareness	Awareness of specific food interactions with medication	28%
Exercise Influence on Medication	Knowledge of exercise effects on drug metabolism and clearance	22%
Consultation Practices with Healthcare Providers	Frequency of discussing diet and exercise with providers	18%

The interaction effect between education level and gender was significant, indicating that females with higher education were more likely to consult healthcare providers about diet and exercise than their male counterparts with the same education level (Table 8).

Table 8: Interaction Effects between Education and Gender on Consultation with Healthcare Providers

Predictor Interaction	F-statistic	p-value
Education Level * Gender Interaction	$F(1, 1228) = 4.67$	< 0.05

DISCUSSION

The findings of this study provide significant insights into the knowledge, attitudes, and practices (KAP) regarding the influence of diet and exercise on medication responses among the Saudi Arabian population. While the results indicate a generally high level of awareness about the impact of diet and exercise on medication management, there remains a notable gap between this knowledge and the actual practices implemented by individuals.

Knowledge of Diet and Exercise Influence on Medication

Our results revealed that a significant majority of participants were aware of the influence of diet and exercise on drug responses. This finding aligns with Alhur et al.'s [2] study on digital innovations in pharmacy, which highlighted public optimism about health informatics technologies and the crucial role of knowledge in adopting these innovations. Just as awareness was identified as a key factor in the acceptance of digital pharmacy tools, our study shows that awareness of diet and exercise's effects on drug metabolism is essential for medication management.

Similarly, Bailey et al. [9] emphasized that dietary components like grapefruit juice can significantly alter drug metabolism by inhibiting cytochrome P450 enzymes, leading to changes in drug efficacy and increased risk of toxicity. This is consistent with our study's observation that while participants have a high level of awareness about diet's impact on medication, specific knowledge about these mechanisms is sometimes lacking.

Additionally, the study on psychotropic medications by Alhur et al. [3] indicated that younger, well-educated individuals were more knowledgeable about these medications, a pattern also observed in our study's findings on diet-drug interactions. This suggests that demographic factors like age and education significantly influence health-related knowledge, reinforcing the need to target educational efforts towards these groups to enhance their understanding of how lifestyle factors impact medication.

Attitudes Towards Diet, Exercise, and Medication

Participants in our study demonstrated overwhelmingly positive attitudes toward incorporating diet and exercise into their medication management routines. This finding is consistent with the attitudes reported in Alhur et al.'s [4] study on vitamin literacy, where higher education levels were linked to more favorable attitudes toward dietary and nutritional knowledge. Both studies highlight the importance of targeted educational interventions that promote healthy behaviors, particularly in individuals with a solid educational background.

Moreover, Alhur et al.'s [5] research on self-medication patterns in Saudi Arabia revealed a concerning trend where high levels of knowledge did not always translate into safe medication practices. This disconnect between knowledge and practice was also evident in our study, where participants often did not consistently incorporate their knowledge of diet and exercise into their medication routines. Addressing this intention-behavior gap requires tailored strategies that go beyond raising awareness to actively facilitating behavior change.

This gap between knowledge and practice is further supported by the theory of planned behavior [1], which suggests that even when individuals have positive attitudes towards a behavior, translating these intentions into action often requires additional motivational and contextual factors. Similarly, Sheeran [14] noted the discrepancy between intentions and behavior, indicating that knowledge alone may not be sufficient to ensure adherence to recommended health practices.

Practices Related to Diet, Exercise, and Medication

The lower adherence to recommended dietary and exercise practices found in our study mirrors the challenges identified in Alhur's [7] review of emergency medicine informatics, where the integration of knowledge into clinical practice was hindered by barriers like usability and system interoperability. Similarly, our findings suggest that even when individuals are aware of the benefits of diet and exercise, practical obstacles and a lack of guidance from healthcare providers can impede their consistent adoption of these behaviors.

Additionally, Alhur et al.'s [4] study on the prevalence of self-medication with antibiotics demonstrated that self-medication behaviors are strongly influenced by accessibility and a lack of robust health communication. Our study supports these findings by revealing that many participants rarely consult healthcare providers about diet and exercise when managing their medication, underscoring the need for improved patient-provider communication to promote safe and informed health practices. Osterberg and Blaschke [13] have also highlighted the importance of regular consultations in enhancing adherence to medication regimens and lifestyle modifications, emphasizing the critical role of healthcare providers in patient education.

Implications for Healthcare Practice and Policy

The collective evidence from these studies suggests a critical need for tailored educational interventions that not only increase awareness but also facilitate the practical application of knowledge in medication management. Alhur et al.'s [6] findings on digital pharmacy innovations emphasized the value of user-centered designs to enhance public acceptance, which is directly applicable to our recommendations for integrating personalized dietary and exercise counseling into routine care.

Furthermore, insights from Alhur's [7] studies on psychotropic medication awareness and vitamin literacy highlight the importance of demographic-specific strategies. These strategies should consider

factors like age, gender, and education level to design effective educational programs that address the unique needs of different population groups, ensuring that knowledge leads to actionable health behaviors. The findings by Glanz et al. [10] also support the idea that tailored interventions are more effective in driving behavior change, as they cater to individual motivations and barriers.

LIMITATIONS
While this study provides valuable insights, it is important to acknowledge its limitations. The cross-sectional design precludes causal inferences, and the reliance on self-reported data may introduce bias, particularly in the reporting of health behaviors. Additionally, the study's sample may not fully represent the diversity of the Saudi Arabian population, particularly in terms of socioeconomic status and access to healthcare. Future research should aim to address these limitations by employing longitudinal designs and including more diverse populations.

CONCLUSION
In conclusion, this study highlights the strong awareness and positive attitudes toward the role of diet and exercise in medication management among the Saudi Arabian population. However, the observed gaps between knowledge and practice highlight the need for more effective educational interventions and enhanced support from healthcare providers. By addressing these gaps, healthcare systems in Saudi Arabia can improve medication outcomes and promote healthier lifestyles among patients.

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