Patient Preference and Adherence Dovepress

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Evaluating Strategies for Enhancing Medication Adherence in the Kingdom of Saudi Arabia (KSA): A Cross-Sectional Study

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Purpose: This study aimed to assess medication adherence strategies among users in Saudi Arabia, explore the prevalence and effectiveness of behavioral, technical, and organizational tools, and identify key predictors of adherence related to demographic, health, and medication characteristics.

Patients and Methods: A descriptive cross-sectional study was conducted among 250 Saudi residents aged ≥18 who regularly take prescription/non-prescription medications. The questionnaire was developed through a literature review, validated by academic pharmacists, and refined based on pilot testing feedback. A convenience sampling method, complemented by snowball sampling, was employed to recruit participants. Limitations like sampling bias and self-reported data emphasize the need for broader studies. Quantitative analysis was performed using IBM SPSS.

Results: Participants were predominantly young adults (84%) and females (84%), with 54% reporting being healthy and 46% managing chronic conditions. Behavioral strategies, such as time-based reminders, were the most commonly used (40%), followed by technical tools (33%), including mobile applications. Employment status significantly influenced adherence, with employed individuals (adjusted OR: 3.274, p = 0.028) and those working >8 hours daily (adjusted OR: 9.838, p = 0.049) exhibiting higher adherence. Fieldwork negatively impacted adherence (adjusted OR: 0.052, p = 0.007). While other demographic and health factors showed no significant associations, trends suggested that complex medication regimens increased the likelihood of using adherence strategies.

Conclusion: Behavioral strategies, such as time- and location-based reminders, and technical tools, like apps, effectively improved medication adherence. Healthcare providers should promote simple, cost-effective methods, such as pillboxes and mobile reminders, tailored to patient needs. Addressing adherence barriers for individuals with demanding/unexpected schedules or complex regimens through targeted interventions and awareness campaigns is essential. Future research should explore these strategies' scalability and long-term impact in diverse healthcare settings.

Keywords: health behavior, medication adherence, medication therapy management, patient compliance

Introduction

Medication non-adherence is a global issue,[1] causing nearly 125,000 deaths annually in the United States and costing $290 billion.[1] It also imposes substantial financial burdens globally, with costs reaching €1.25 billion in Europe and AU $7 billion in Australia.[2,3] In the Kingdom of Saudi Arabia (KSA), non-adherence affects up to 50% of chronic illness patients, though the financial impact remains unknown.[1,4,5] Despite regional differences, the implications of non-adherence are universally significant, warranting a deeper exploration of the issue.

Medication non-adherence is inherently multifactorial. According to the World Health Organization (WHO), various factors influence treatment success, with patient-related factors,[6] such as forgetfulness, being the most prevalent.

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Forgetting to take medications often arises from challenges like polypharmacy, poor memory, or difficulty recalling instructions.[7–9] Moreover, aging and hectic lifestyles further exacerbate this issue,[7–10] affecting individuals across age groups and leading to adverse health outcomes.[3,9,11]

In the Kingdom of Saudi Arabia (KSA), cultural and socioeconomic factors shape patients' adherence to medication regimens. The strong emphasis on family involvement in healthcare decision-making can act as both a facilitator and a barrier to adherence,[12] depending on the family's level of understanding and attitudes toward medical treatments.[12] Religious practices, such as fasting during Ramadan, often result in patients altering or skipping medications, thereby compromising treatment efficacy.[13] Additionally, the preference for traditional or herbal remedies in specific communities further complicates adherence to prescribed regimens.[14] On the other hand, the cultural context in the KSA, characterized by family-centric values, can positively influence adherence by encouraging reminders and support from relatives.[12] However, challenges persist with integrating modern adherence strategies, such as mobile health (mHealth) applications, due to varying levels of digital literacy among the population.[15]

Diverse strategies and interventions have been developed to combat medication non-adherence, leading to notable improvements in patient commitment.[16,17] These strategies generally fall into three categories: behavioral, technological, and organizational tools. Behavioral learning theory has been foundational in designing reminder systems, which can be passive (eg, pillboxes or predated medication packs),[15] or active (eg, electronic reminders).[18,19] Active reminders, such as health applications that send audio or video notifications, have demonstrated superior effectiveness in enhancing adherence.[15] These tools include SMS alerts, direct calls from healthcare providers, and electronic medicine boxes that log drug intake and issue reminders.[18] Additionally, automatic pill dispensers with alarms and sorting mechanisms address complex regimens by simplifying medication schedules.[19] Habit-stacking strategies, such as linking medication intake to daily routines,[20,21] further enhance adherence by integrating reminders into everyday life.[22]

While adopting strategies holds promise, their effectiveness across different groups in the KSA still needs to be fully understood. Research highlights significant gaps in understanding the prevalence and impact of adherence strategies in the country. Therefore, this study addresses existing gaps by assessing the prevalence and user perspectives of various medication adherence strategies in the Kingdom of Saudi Arabia (KSA). It further seeks to identify the most effective methods for monitoring medication intake and to examine the relationship between demographic factors, health status, and medication usage patterns with adherence practices.

Materials and Methods

Study Setting, Recruitment and Data Collection

A descriptive, cross-sectional study was conducted between March 2024 and May 2024 among Saudi resident who are ≥18 years of age and taking at least one prescription medication or supplements regularly. A convenience sample, supplemented by snowballing, was selected by distributing the survey via social media platforms such as Facebook, Twitter, WhatsApp, etc. An online survey allowed participants to answer anonymously and at their convenience, potentially increasing engagement and response rates. An information page was created and attached to the first page of the survey to explain the target participants, research purpose, and inclusion criteria. The respondents were asked to read through the information carefully, and before filling out the survey, they had to click on a click-wrap agreement attached at the end of the page to express their agreement to participate.

Sample Size

The data supporting technical, organizational, or behavioral strategies are very limited. However, based on the results obtained from two previously published studies that reported that the prevalence of use or intention to use these strategies was low at 2.6%,[22] and 9%,[23] the sample size was calculated using an online calculator derived from the data of these two studies.[24] To achieve a confidence level of 95% and a margin of error of 5% for a population proportion of 20%, a minimum sample size of 246 users was required.

Study Instrument

The research group developed the questionnaire after a thorough review of the existing literature,[18,25] ensuring that it comprehensively covered relevant topics. Two academic pharmacists with expertise in survey design and pharmacy practice reviewed the initial draft to enhance the instrument's validity. Their feedback was systematically collected, and adjustments were made to improve the clarity, relevance, and alignment of the questions with the study objectives. Following this initial review, the questionnaire underwent a pilot testing phase. It was tested on six individuals who met the study's eligibility criteria but were not part of the target population. This pilot group was instructed to provide detailed feedback on the questionnaire's clarity, comprehensiveness, and usability. Specific aspects, such as the appropriateness of language, length of the survey, and ease of understanding, were closely evaluated. Based on their feedback, several refinements were made, including rewording ambiguous items, restructuring the layout for better readability, and ensuring logical flow across sections.

The questionnaire was divided into five sections, including the participants' background and sociodemographic characteristics. The second section involves the respondents' general health information, asking them to identify any chronic conditions they may have been experiencing. The third section has multiple questions on medication usage, what they use, medication quantity, frequency of usage, etc. The fourth section includes eight questions examining respondents' practices toward remembering medication intake. The final section examines respondents' perceived benefits of the strategies and techniques.

Ethics and Dissemination

Ethical approval has been obtained from the Imam Abdulrahman Bin Faisal University's institutional review board (IRB number is IRB-2024-05-236). In addition, this study was conducted in accordance with the principles of the Declaration of Helsinki.

The survey was distributed via a link on social media. Therefore, respondents were chosen to respond to the questionnaire outside the platform. As a result, the need for specific platform permissions would likely be less required. However, social media platform guidelines regarding how data was collected through their platform were followed, and the collected responses were aligned with the platform's policies. Respondents were informed about how their data would be used and obtained consent with no personal or identifiable data involved.

Data Processing and Analysis

The results were analyzed using descriptive statistics to summarize demographics and responses. Chi-square tests were applied to effectively determine associations between categorical variables (eg, participants and medications' characteristics) and adherence strategies used. Independent samples t-tests were used to compare means for groups regarding medication recall versus medication usage patterns and solutions. Statistical significance was determined at $P \leq 0.05$ for all tests. The binary logistic regression analysis explored the relationship between demographic factors, health status, and medication usage predictors with adherence practices.

Results

Characteristics of the Study Participants (Demographics and Health Status)

Of 371 respondents who viewed and started filling out the questionnaire, 250 completed answering all the required questions, representing a 67% response. Most participants were young adults (n=210: 84%) aged 18 to 39. There were more than five times as many female participants as male ones (female=209: 84% and male=41: 16%). The majority were urban participants (n=214: 86%) and were bachelor (n=130: 52%) or high school degree graduates or less (n=106: 42%), and almost two-thirds of them (n=156: 63%) were unemployed or retired. Table 1 illustrates the respondent characteristics.

Regarding the health-status characteristics of participants, almost an equal number of participants reported the subjective health status as healthy (ie, having nothing or just minor conditions that can be treated with over-The-counter medicines) (n=134: 54%) and unhealthy (ie, having one or multiple chronic conditions) (n=116: 46%). Of those

Table 1 Demographic and Health Status Characteristics of Study Participants (n=250)

Variables	Groups	Numbers	Percentages
Age	18–28 years	162	65
	29–39 years	48	19
	40–50 years	23	9
	≥51 years	17	7
Gender	Female	209	84
	Male	41	16
Residency	Urbana areas.	214	86
	Rural areas.	36	14
Educational status	Illiterate	4	2
	High school degree or less	106	42
	Bachelor's degree	130	52
	Postgraduate's degree	10	4
Employment status	Un-employed or retired	156	63
	Employed	76	30
	Self-employed	18	7
Work nature	Office work.	44	47
	Fieldwork.	17	18
	Mixed of both.	33	35
Working hours/day	< 6 hours	14	7
	6–8 hours	50	20
	> 8 hours	30	12
Health status	Healthy	134	54
	Unhealthy	116	46
Type of diseases	GI problems	37	32
	Skin problems	36	31
	Cardiovascular problems	25	22
	Endocrine problems	24	21
	Bone and joint problems	21	18
	Mental or psychological problems	21	18
	Respiratory problems	18	15
	Pain disorders	9	8

who stated having one/multiple chronic conditions (n=116: 46%), they self-reported several diseases after being given a chance to select multiple options for their multimorbidities. See Table 1 for more information on the participants' health characteristics.

Characteristics of the Medication and Usage

More than half of the participants (n=138: 55%) take one medication daily, while 45% (n=112) have been using more than two medications daily. Participants were asked about the number of times per day they take most of their medication and how much medication they take per time; three-quarters of participants (n=188: 75%) reported taking most of their medication at one time. Regarding how much medication participants are taking per time, data revealed that nearly two-thirds of participants (n=169: 68%) have been taking one medication per time, whereas one-third of the sample (n=81:32%) are taking ≥2 medications per time. Participants were asked if they felt bothered or had trouble recalling their medication intake and, if so, whether they sought a solution. Despite the simplicity of the medication regimen, more than two-thirds (n=166: 66%), including young adults, had difficulty remembering to take their medications on time, and half (n=124: 50%) were bothered by their inability to recall their intake. A chi-square test was used to detect any association between the participants' characteristics and the issues in medication intake or recall and to find a solution for the existing problem. Data revealed that there were no significant differences between age groups (P=0.61), in addition to all other characteristics and having medication recall issues (p>0.05). Therefore, data indicated that different age groups and educational and employment statuses had problems and showed great interest in solving this problem. Two hundred thirteen participants (85%) of regular medication/supplements revealed following one or more of these strategies to track their medication, while a small percentage of participants (15%) did not follow any method.

The independent samples *t*-test was used to compare the means of two independent groups/categorical data (ie, individuals who had problems remembering their medications and looked for a solution and those who did not) to determine whether these differences are significant (p<0.05). Data revealed no statistically significant difference between the two groups who had problems recalling their medications and tried to find a solution and those who did not when compared to the number of medications taken per day (p=0.9) and each time (p=0.3). See Table 2 for more information on the participants' medication characteristics. See Table 2 for more information on the participants' medication characteristics.

Binary logistic regression revealed that employment status significantly impacted adherence, with employed individuals (adjusted OR: 3.274, p = 0.028) and those working over eight hours daily (adjusted OR: 9.838, p = 0.049) more likely to adhere. Conversely, fieldwork reduced adherence (adjusted OR: 0.052, p = 0.007), highlighting challenges in demanding schedules. Other factors, including age, gender, residency, health status, and disease type, showed no

Table 2 Medication Usage Patterns and Associated Characteristics Among Study Participants (n=250)

Variables	Groups	Numbers	Percentages	Having Problems and Finding solution *P-value*
Number of regular medication/day	1	138	55	0.9
	2–3	88	35	
	≥ 4	24	10	
The time(s) most drugs are taken during the day	Only one time.	188	75	0.3
	> One time.	62	25	
The quantity of medication taken each time during the day	1 medication per time.	169	68	0.7
	2 medications per time.	52	21	
	≥3 medications per time.	29	12	

Notes: P-value was calculated using the independent samples *t*-test. Significance determined at P ≤ 0.05 (two-tailed).

significant associations. Though not statistically significant, a trend toward higher adherence was noted among participants taking two to three medications daily (adjusted OR: 7.618). These findings underscore the need for targeted interventions for individuals with complex regimens or challenging work environments. See Table 3 for more information on the results of the binary logistic regression analysis.

Table 3 Binary Logistic Regression Analysis of Predictors Influencing Medication Adherence Practices

		Univariate Unadjusted LR			Adjusted LR		
Variables	**Groups**	**ODDS**	**95% CI**	***p***	**ODDS**	**95% CI**	***p***
Age	18–28 years (Ref.)						
	29–39 years	0.631	[0.310, 1.287]	0.206	1.657	[0.353, 7.782]	0.522
	40–50 years	0.358	[0.116, 1.102]	0.073	0.551	[0.073, 4.162]	0.564
	≥51 years	1.190	[0.430, 3.291]	0.737	5.837	[0.083, 412.12]	0.417
Gender	Female (Ref.)						
	Male	1.327	[0.665, 2.648]	0.422	2.131	[0.361, 12.564]	0.403
Residency	Urbana areas. (Ref.)						
	Rural areas.	1.138	[0.545, 2.379]	0.730	0.818	[0.105, 6.367]	0.848
Employment status	Un-employed or retired (Ref.)						
	Employed	1.348	[0.738, 2.461]	0.331	3.274	[1.138, 9.42]	**0.028**
	Self-employed	3.274	[1.138, 9.42]	**0.028**	3.752	[0.614, 22.93]	0.152
Work nature	Office work. (Ref.)						
	Fieldwork.	0.258	[0.052, 1.279]	0.097	0.052	[0.006, 0.455]	**0.007**
	Mixed of both.	1.425	[0.562, 3.611]	0.456	1.696	[0.453, 6.344]	0.433
Working hours/day	< 6 hours (Ref.)						
	6–8 hours	1.107	[0.290, 3.962]	0.918	3.018	[0.467, 19.513]	0.246
	> 8 hours	1.667	[0.423, 6.562]	0.456	9.838	[1.010, 95.827]	**0.049**
Health status	Healthy (Ref.)						
	Unhealthy	1.002	[0.592, 1.659]	0.995	0.750	[0.157, 3.587]	0.719
Type of diseases	GI problems (Ref.)						
	Skin problems	0.444	[0.109, 1.814]	0.258	0.087	[0.002, 3.127]	0.182
	Cardiovascular problems	0.481	[0.043, 5.401]	0.553	0.125	[0.004, 3.653]	0.227
	Endocrine problems	0.903	[0.289, 2.881]	0.863	0.482	[0.041, 5.698]	0.562
	Bone and joint problems	0.289	[0.073, 1.136]	0.075	0.128	[0.010, 1.696]	0.119
	Mental or psychological problems	0.481	[0.079, 2.948]	0.429	0.365	[0.014, 9.696]	0.547
	Respiratory problems	1.44	[0.236, 8.844]	0.691	0.000	[0.000, 0.000]	0.999
	Pain disorders	0.289	[0.051, 1.646]	0.162	1.148	[0.054, 24.189]	0.929
	Not Applicable	0.856	[0.340, 2.152]	0.741	0.382	[0.058, 2.520]	0.317

(*Continued*)

Table 3 (Continued).

		Univariate Unadjusted LR			Adjusted LR		
Variables	**Groups**	**ODDS**	**95% CI**	***p***	**ODDS**	**95% CI**	***p***
Number of regular medication/days	1 (Ref.)						
	2–3	0.786	[0.442, 1.400]	0.414	7.618	[0.710, 81.716]	0.093
	≥ 4	1.336	[0.553, 3.241]	0.517	57.465	[0.428, 7721.98]	0.105
The time(s) most drugs are taken during the day	Only one time. (Ref.)						
	> One time.	0.756	[0.405, 1.413]	0.381	0.540	[0.083, 3.526]	0.520
The quantity of medication taken each time during the day	1 medication per time. (Ref.)						
	2 medications per time.	1.131	[0.592, 2.163]	0.709	0.591	[0.058, 6.051]	0.657
	≥3 medications per time.	0.749	[0.312, 1.795]	0.516	0.091	[0.003, 3.211]	0.187

Notes: Ref.: Reference group used for comparison in logistic regression analysis. ODDS: Odds Ratio, indicating the likelihood of adherence compared to the reference group. 95% CI: 95% Confidence Interval, representing the range within which the true odds ratio is expected to lie with 95% confidence. p: p-value, indicating the statistical significance of the association. Values ≤ 0.05 are considered statistically significant. Univariate Unadjusted LR: Results from logistic regression without adjusting for other variables. Adjusted LR: Results from logistic regression adjusted for confounding variables. Bold font indicates statistically significant values, with p-values ≤ 0.05.

More than two-thirds of the participants (n=166: 66%) positively endorsed using specific strategies and methods as compensation techniques to support everyday memory. Participants were allowed to pick one or multiple strategies they used to track their medication intake. The most commonly used strategy among participants to track medication intake was the behavioral strategies (n=148: 40%) by either linking medication-taking to specific times (time-based method, eg, mealtime, bedtime, or wake-up time, shower time, etc). (n=126: 59%) or specific places/locations (eg, my office or workplace, my car, etc). (n=47: 22%). Technical strategies (eg, medication reminder applications, mobile diaries, or timers) were among the second most frequently used methods (n=121: 33%), which augments participants' medication taking, followed by receiving social support and using organizational strategies. Participants were found to be using a wide range of equipment to keep their medication, such as pill boxes. Low-technology pill boxes were more often used than mid- and high-technology pill boxes. See Table 4 for more information on the strategies used.

A chi-square test was performed to determine whether the differences between the respondents'/medications' characteristics and strategy(s) participants followed to foster their medication were significant. Data show a statistically significant difference between age categories and the used strategy(s). For example, young adults (≤39) were using the technical (p=0.002) and organizational (p=0.042) strategies significantly more than middle-aged adults and above (>39). However, neither group showed significantly different scores in the use of behavioral strategies. In addition, there was no statistically significant difference between other respondent characteristics and the strategies used (p>0.05) (see Table 5).

Regarding medications' characteristics, data revealed a statistically significant difference between the number of regular medications taken per day and the used strategy(s). For example, participants with more than two medications significantly use the technical (p=0.001) and organizational strategies (p=0.042) compared to the behavioral strategies (p=0.91). There was no statistically significant difference between the time taken and the quantity taken per time categories and the strategies used, except that participants who take more than one medication per time significantly (p=0.047) used organizational strategies to augment their medication adherence (see Table 5).

Users' Perceptions Regarding the Most Used Techniques

When participants were asked about their perceptions of the two commonly used methods (ie, behavioral and technical strategies), more than half of participants (>50%) declared that behavioral strategies were perceived to be more effective, affordable, and convenient/available than technological strategies. However, more than half of users (>50%) expressed their desire to use the technical strategy more in the future to augment their medication adherence (see Table 6).

Table 4 Strategies Used to Enhance Medication Adherence Among Participants (n=250)

Strategies (n=368)	Numbers	Percentages	Specific Followed Way	Numbers	Percentages
Behavioral strategies	148	40	Time-based method: Linking medication-taking to specific times (eg mealtime, bedtime or wake-up time, shower time, etc.)	**126**	**59**
			Place-based method: Linking medication-taking to specific places or locations (eg my office or workplace, my car, etc.)	47	22
			Linking medication-taking to sticky notes or a checklist using a written chart that shows which medications to take and when to take or stick a calendar on the wall or the fridge and make a checkmark when medication is taken.	18	8
			Activity-based method: Linking medication-taking to specific activities (eg household chores, exercise, cooking, etc.)	15	7
			Linking medication-taking to certain actions or physical objects such as turning the medication bottle upside down when it's time to recall, or changing mobile location, etc.	9	4
Technical strategies	121	33	The use of medication reminder applications, mobile diaries or timers.	**121**	**33**
Social support (eg verbal reminders)	64	17	Getting help from people I know to remind me about my medications.	64	17
Organizational strategies (eg pill boxes, etc.)	35	10	Pill boxes with low technology (It is a container divided into different compartments for each time of day).	23	47
			Pill boxes with mid-technology (It t incorporates an alarm, but it is not locked and does not dispense medication).	16	33
			Pill boxes with high technology (it is a locked box that dispenses medication at the appropriate time and sends a notification if a dose is missed).	10	20

Notes: Bold font highlights key categories, values, or strategies that are particularly relevant or significant in the analysis's context.

Table 5 Impact of Participant and Medication Characteristics on Strategy Preferences for Medication Adherence (n=250)

Participants' Characteristics	Behavioral Strategies *P*-value	Technical Strategies *P*-value	Organizational Strategies *P*-value
Age	0.67	**0.001**	**0.042**
Gender	0.70	0.78	0.71
Residency	0.20	0.60	0.88
Educational status	0.47	0.13	0.79
Employment status	0.33	0.51	0.10
Work nature	0.53	0.32	0.55
Working hours/day	0.80	0.46	0.54

(*Continued*)

Table 5 (Continued).

Participants' Characteristics	Behavioral Strategies *P*-value	Technical Strategies *P*-value	Organizational Strategies *P*-value
Medication characteristics			
Number of regular medication/days	0.91	**0.001**	**0.041**
The time(s) most drugs are taken during the day	0.66	0.55	0.78
The quantity of medication taken each time during the day	0.21	0.14	**0.047**

Notes: Statistical significance (P ≤ 0.05) was determined using the chi-square test. Bold font indicates statistically significant values, with p-values ≤ 0.05.

Table 6 Participants' Perceptions of Behavioral and Technological Strategies for Medication Adherence

Statement	Behavioral Strategies Numbers (Percentages)	Technological Strategies Numbers (Percentages)
I consider this method more effective in tracking my medication.	**143 (57)**	107 (43)
I consider this method affordable to use.	**163 (65)**	87 (35)
I consider this method convenient or available to use.	**148 (59)**	102 (41)
I would use this method in the future as a compensation technique to support everyday memory.	106 (42)	**144 (58)**

Notes: Bold font emphasizes key statements, categories, or values that are particularly important or relevant to the analysis's context.

Discussion

This study provides valuable insights into medication adherence patterns and the effectiveness of strategies employed to enhance adherence among a diverse group. The findings highlight the interplay of demographics, health status, and medication characteristics with participants' adherence practices and their preferences to use some strategies over others, shedding light on critical intervention and policy development areas.

Previous research has predominantly reported high rates of medication non-adherence among patients with chronic illnesses in the Kingdom of Saudi Arabia (KSA), with rates reaching up to 50% in some studies.[1,4,5] Similarly, this study observed significant non-adherence rates; however, no substantial differences in adherence-related factors, including demographic characteristics, health status, and medication usage patterns, might influence medication adherence among participants. These results contrast with two previous research studies, in which the researcher noted that only older adults had trouble remembering medication intake.[26,27]

This study provides a unique contribution by quantifying the prevalence and effectiveness of specific adherence strategies used to enhance adherence. Behavioral strategies emerged as the most widely adopted method, with time-based reminders (eg, linking medication intake to meals, bedtime, or wake-up times) being particularly prevalent. These strategies align with established behavioral theories emphasizing habit formation and the integration of new routines into daily activities. Their widespread use among participants suggests that such methods are intuitive and require minimal external tools, making them accessible and culturally adaptable. The preference for behavioral strategies over technical and organizational tools underscores their practicality. However, the potential for integrating behavioral strategies with technological tools still needs to be utilized despite indications that participants are open to adopting these methods in the future. Therefore, these results align with global literature emphasizing behavioral learning theories and offer distinct insights rooted in the KSA context. By integrating this understanding of behavioral influences, healthcare professionals can communicate relevant results and reinforce medication-taking behaviors, ultimately optimizing medicine use and maximizing treatment outcomes.

This study's participants, primarily young adults who are employed or self-employed and work at least six hours daily, often engaged in fieldwork, which could contribute to forgetfulness. Interestingly, the analysis revealed that employment-related factors were key predictors of adherence, with employed individuals, particularly those working over eight hours daily, demonstrating higher adherence rates, likely due to the structure provided by their routines. In contrast, fieldwork was associated with lower adherence, reflecting the challenges of unsettling or irregular schedules. Other factors, such as age, gender, residency, health status, and disease type, did not significantly influence adherence. However, there was a trend toward higher adherence among those managing complex regimens, possibly due to the adoption of compensatory strategies. These findings underscore the importance of tailored interventions to support individuals, especially those with demanding work environments and complex medication routines, in improving adherence. Therefore, although technical strategies, including mobile reminder applications, were less commonly employed, they could show promise among participants with complex medication regimens or extended working hours. This finding reflects the increasing role of digital health tools in addressing adherence challenges, particularly for individuals with demanding schedules. The gradual adoption of these tools and positive perceptions regarding their potential utility indicates an opportunity for healthcare providers and policymakers to promote digital solutions. These tools could be tailored to support individuals balancing high workloads or managing multiple medications, thus addressing specific adherence barriers.[28] The study also identified some predictors of adherence practices. Employment status emerged as a significant factor, with self-employed individuals demonstrating a higher likelihood of adherence. This finding highlights the flexibility associated with self-employment, which may facilitate better integrating adherence strategies into daily routines. Conversely, participants working long hours relied more on supporting tools, emphasizing the importance of tailored interventions for this demographic.

Organizational strategies, such as pillboxes, were the least commonly used. The varying levels of technology embedded in these tools, from simple compartmentalized boxes to advanced models with alarms, reflect a spectrum of needs and preferences. Encouraging such tools, particularly among individuals with lower adherence rates and complex medication regimens, could enhance medication management for those with high medication burdens. These results and recommendations align with two previous studies that suggested using external aids to support lower memory self-efficacy.[29,30] Another study suggested using more than one strategy or technique to lower instances of forgetting.[22,31] Therefore, it may be necessary to incorporate more than one strategy as the number of medications increases, the frequency of dosage, and the difference in the time that the medication is applied, as this may affect everyday memory. The results of this study support previous findings that respondents endorsed using one or more than one compensatory strategy to overcome this issue, as behavioral and technical were used among participants in this study on a large scale, either alone or in combination.

While the study underscores the effectiveness of low-cost and behaviorally anchored strategies, it also reveals gaps in awareness and access to technological and organizational tools. Addressing these gaps requires targeted educational campaigns and the distribution of affordable adherence aids. For instance, promoting labeled pillboxes and mobile applications through community health initiatives could significantly enhance adherence rates, particularly among individuals with high medication burdens or demanding work schedules.

Cultural and regional factors also play a crucial role in shaping adherence behaviors. The findings align with prior research emphasizing the influence of lifestyle and cultural practices on medication-taking routines. Healthcare providers in Saudi Arabia must consider these nuances when designing interventions, ensuring they align with patients' cultural contexts and daily lives. In addition, these strategies must be individualized or tailored to each medication user to boost the realistic integration of new habits into the daily routine. As highlighted by previous research, these strategies have undeniably changed medication-taking behavior and aided medication adherence, resulting in positive health outcomes.[22,32]

Strengths and Limitations

A key strength of this study is its detailed exploration of adherence strategies across various demographic and medication characteristics, offering a nuanced understanding of the factors influencing medication adherence. However, the study's reliance on convenience sampling and self-reported data introduces limitations that affect the generalizability of the

findings. The convenience sampling method, supplemented by snowball sampling, may have introduced biases, particularly selection bias, as participation depended on individuals' willingness and accessibility. Furthermore, online recruitment excluded individuals with limited internet access or low digital literacy, further constraining the study's representativeness. Future studies should consider recruiting participants through diverse healthcare settings to address these limitations and capture a broader and more representative spectrum of individuals. Employing stratified sampling methods based on demographics and adherence challenges could also enhance representation and improve the applicability of findings to the broader population.

Conclusion

This study highlights the importance of promoting behavioral strategies and integrating technological and organizational tools to address medication adherence challenges. Leveraging culturally relevant, low-cost interventions and advancing the adoption of digital health tools can support medication adherence across diverse populations. Tailored interventions and awareness campaigns are critical in mitigating barriers to adherence, ultimately improving patient outcomes and reducing healthcare burdens.

The findings emphasize the need for healthcare policymakers to prioritize access to adherence tools such as pillboxes and reminder applications. Targeted awareness campaigns focusing on habit-stacking techniques and simple organizational tools can further enhance adherence practices. Integrating these strategies into healthcare policies and patient education programs offers a practical approach to tackling medication non-adherence. Future research should explore these interventions' long-term impact and scalability in diverse healthcare contexts, assessing their effectiveness in improving adherence behaviors and overall health outcomes.

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