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Memory matters: Forgetfulness as a key barrier to medication adherence in rural Indonesian diabetes management

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Abstract

Introduction: Medication adherence is crucial for managing diabetes mellitus (DM), a significant health concern globally and in Indonesia. Sociocultural factors in rural Indonesian settings can uniquely influence adherence, yet are often underexplored. This study aimed to investigate medication adherence and its influencing factors among DM patients in the rural Ratahan Community Health Center.

Methods: A mixed-methods design was employed. The quantitative phase involved a cross-sectional survey of 40 DM patients using the Morisky Medication Adherence Scale-8 (MMAS-8) and a questionnaire on sociodemographic and clinical characteristics. Spearman's correlation analyzed relationships between characteristics, MMAS-8 items, and adherence levels. The qualitative phase involved thematic analysis of semi-structured interviews with three purposefully selected patients representing high, medium, and low adherence to explore their experiences and influencing factors.

Results: The majority of respondents exhibited medium (62.5%) medication adherence. Forgetfulness, indicated by significant positive correlations between specific MMAS-8 items (forgetting medication, forgetting when traveling, forgetting yesterday) and lower overall adherence ($p<0.01$), emerged as a key challenge. Qualitative findings corroborated this, with patients frequently citing forgetfulness despite employing coping mechanisms like alarms and family reminders. Social support, particularly from family and religious figures, appeared to positively influence adherence.

Conclusion: Forgetfulness is a significant barrier to medication adherence among DM patients in rural Ratahan. Interventions should focus on simple, personalized reminders and leverage strong family support networks prevalent in this Indonesian rural context. Addressing practical memory challenges, rather than intentional non-adherence, is crucial for improving medication management in this community

Keywords: Diabetes Mellitus; Medication Adherence; Rural Health; Indonesia; Mixed Methods; Forgetfulness; Social Support.

1. Introduction

Diabetes mellitus (DM) stands as a global health crisis, affecting an estimated 537 million adults worldwide in 2021, a figure projected to rise significantly in the coming decades (International Diabetes Federation, 2021). This chronic metabolic disorder, characterised by hyperglycaemia resulting from defects in insulin secretion, insulin action, or both. The disease is associated with significant morbidity and mortality due to micro- and macrovascular complications, leading to a substantial economic burden on individuals, healthcare systems, and societies (Geiss et al., 2017). The

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escalating prevalence of DM necessitates effective management strategies, with medication adherence playing a pivotal role in achieving optimal glycemic control and preventing long-term sequelae.

Within Southeast Asia, Indonesia bears a significant burden of this epidemic. In 2021, approximately 19.5 million adults in Indonesia were living with diabetes, ranking the nation among the top countries globally with the highest number of individuals affected by this condition (International Diabetes Federation, 2021). The diverse geographical landscape, varying levels of healthcare access, and heterogeneous socioeconomic conditions across the Indonesian archipelago contribute to a complex landscape for diabetes management and control. Effective strategies tailored to the Indonesian context are crucial to mitigate the impact of this growing health challenge.

A cornerstone of effective diabetes management is patient adherence to prescribed medication regimens. Medication adherence, defined as the extent to which a patient's behavior corresponds with the recommendations agreed upon with a healthcare provider, is a critical determinant of treatment success in chronic conditions like diabetes (World Health Organization, 2003). Poor medication adherence can lead to suboptimal glycemic control, increased risk of complications, higher healthcare costs, and reduced quality of life in individuals with diabetes (Nieuwlaat et al. 2014). Understanding and addressing the factors influencing medication adherence is therefore paramount in improving diabetes outcomes.

While individual-level factors such as patient knowledge, beliefs, and self-efficacy are well-recognized determinants of medication adherence, the unique sociological properties of a community can exert a significant influence. In Indonesia, a nation characterized by strong collectivist values, intricate social networks, and diverse cultural and religious beliefs, these sociological factors warrant particular attention. For instance, family support and influence within close-knit communities can either facilitate or hinder adherence behaviors. Traditional health beliefs and practices, while often coexisting with modern medicine, may impact patients' perceptions and acceptance of prescribed medications. Furthermore, varying levels of community health literacy, access to reliable health information within social networks, and the influence of local opinion leaders can all shape medication-taking behaviors in unique ways. The interplay of these sociological elements within the specific context of Ratahan, a sub-district in Southeast Minahasa with its own distinct community fabric, remains largely unexplored in the context of diabetes medication adherence.

Despite the recognized importance of medication adherence in diabetes management and the potential influence of sociological factors, there is a relative paucity of research specifically examining these community-level dynamics in the Indonesian context, particularly at the sub-district level. Existing studies often focus on individual psychological or behavioral determinants, with less emphasis on the broader social and cultural milieu in which patients live and manage their condition. This research gap necessitates a more holistic understanding of the factors influencing medication adherence, one that integrates both individual and community-level perspectives.

This study aims to address this gap by investigating medication adherence among patients with diabetes mellitus at the Ratahan Community Health Center, explicitly exploring the unique sociological properties that may affect their adherence behaviors. By employing a mixed-methods approach, combining quantitative assessment of adherence levels with qualitative exploration of patients' experiences and the surrounding social context, this research seeks to provide a more nuanced and comprehensive understanding of medication adherence in this specific setting. The findings of this study have the potential to inform the development of culturally sensitive and community-based interventions tailored to the unique sociological landscape of Ratahan, ultimately contributing to improved diabetes management and outcomes for the local population. By elucidating the interplay between individual behaviors and community influences, this research can offer valuable insights for healthcare providers and policymakers working to enhance medication adherence in similar socio-cultural contexts within Indonesia and beyond.

2. Material and methods

This study employed a mixed-methods design, integrating quantitative and qualitative approaches to investigate medication adherence among patients with diabetes mellitus and its influencing factors at the Ratahan Community Health Center (Puskesmas Ratahan). The quantitative component used a descriptive-analytic, cross-sectional survey method to determine the prevalence and level of medication adherence. The qualitative component adopted a phenomenological approach, employing in-depth interviews to explore the lived experiences and perspectives of patients regarding their medication adherence behaviors and the factors affecting them. The study was conducted at the Ratahan Community Health Center, Southeast Minahasa Regency, Indonesia, from February to March 2025.

2.1. Quantitative Phase: Participants and Sampling

The target population for the quantitative phase comprised all patients diagnosed with type 2 diabetes mellitus receiving routine treatment at Puskesmas Ratahan (N=71). A non-probability, accidental sampling technique was used, enrolling 40 eligible patients who presented for consultations during the data collection period and met the inclusion criteria: confirmed type 2 diabetes diagnosis, current treatment at Puskesmas Ratahan, willingness to participate and provide informed consent, age ≥18 years, and ability to communicate in Bahasa Indonesia. Patients with severe acute complications or unavailability during the study were excluded.

2.2. Quantitative Phase: Data Collection Instrument

Medication adherence was assessed using the Indonesian version of the Morisky Medication Adherence Scale-8 (MMAS-8), a validated self-report instrument measuring medication-taking behaviors. Scores ranged from 0 to 8, categorized as high (8), medium (6-7), and low (<6) adherence. A structured questionnaire also collected sociodemographic and clinical data, including residential address, occupation, gender, age, education level, duration of diabetes, duration of medication use, and types of medication. Data were collected face-to-face by the researcher after medical consultations, with informed consent obtained prior to participation. Data confidentiality was maintained.

2.3. Qualitative Phase: Participants and Sampling

Purposive sampling selected three key informants with varying adherence levels (potentially indicated by preliminary observations): two patients and one nurse with experience managing a chronic condition. This aimed to capture diverse perspectives on adherence factors.

2.4. Qualitative Phase: Data Collection Instrument and Procedure

Semi-structured in-depth interviews were conducted using an interview guide exploring traditional beliefs, healthcare access, attitudes towards diabetes and treatment, social support, medication-related issues, and coping strategies. Interviews (15-20 minutes) were audio-recorded with consent, and field notes were taken.

2.5. Data Analysis

Quantitative data were analyzed using SPSS version 25. Descriptive statistics (frequencies, percentages) summarized respondent characteristics and adherence levels. Spearman's rank correlation coefficient assessed the relationship between characteristics and adherence levels, and between MMAS-8 items and overall adherence. Significance was set at $p < 0.05$. Qualitative data (transcribed interviews) were analyzed using thematic analysis, involving familiarization, coding, theme development, review, and definition, supported by illustrative quotes.

2.6. Ethical Considerations

Ethical approval was obtained from the Ethics Committee, Faculty of Sport and Health Sciences Manado State University, and permission granted by Puskesmas Ratahan authorities. Informed consent was obtained from all participants, and anonymity and confidentiality were ensured.

3. Results

3.1. Quantitative phase

The respondent characteristics are described in Table 1. Most respondents were female (60.0%) and belonged to the oldest age group (61-80 years, 42.5%). Half of the respondents had completed only elementary school. The most frequent occupation was housewife (52.5%), followed by farmer (20.0%). Most respondent had been diagnosed with DM for 6-10 years (42.5%) and had been using medication for a similar duration (6-10 years, 37.5%). Metformin was the most commonly used medication (70.0%), followed by glimepiride (20.0%) and insulin injection (10.0%). Overall, the sample is predominantly female, older, with a lower level of education, and primarily using oral antidiabetic medication, particularly Metformin.

Table 1 Demographic characteristics of the respondents

Characteristic	Category/Value	n	%
Gender	Female	24	60.0
	Male	16	40.0
Age (years)	0 - 30	1	2.5
	31 - 40	2	5.0
	41 - 50	7	17.5
	51 - 60	13	32.5
	61 - 80	17	42.5
Education	Elementary School	20	50.0
	Junior High School	4	10.0
	Senior High School	11	27.5
	Bachelor's Degree	4	10.0
	Diploma (D3)	1	2.5
Occupation	Housewife	21	52.5
	Farmer	8	20.0
	Laborer	4	10.0
	Retired	3	7.5
	Nurse	1	2.5
	Trader	1	2.5
	Private Sector Employee	1	2.5
	Driver	1	2.5
DM duration (years)	0 - 2	11	27.5
	3 - 5	10	25.0
	6 - 10	17	42.5
	>10	2	5.0
Medication use duration (years)	0 - 2	11	27.5
	3 - 5	13	32.5
	6 - 10	15	37.5
	>10	1	2.5
Medication	Metformin	28	70.0
	Glimepiride	8	20.0
	Insulin Injection	4	10.0

Table 2 displays the responses to the eight questions of the MMAS-8 scale. A significant majority (67.5%) reported sometimes forgetting to take their medicine. Forgetfulness also occurred when traveling (22.5% respondents). While almost all (90.0%) took their medication the previous day, a small percentage (10.0%) did not. Intentional non-adherence, such as skipping medication or stopping when feeling better or when diabetes was controlled, was reported by 0.0% and 5.0% respectively. Notably, all respondents denied feeling hassled by their medication plan or having difficulty remembering to take all their medication.

Table 2 Patients' responds to MMAS-8 questions

No	Question	Yes (%)	No (%)
1	Do you sometimes forget to take your medicine?	67.5	32.5
2	Do you ever decide to skip taking your medicine?	0.0	100.0
3	When you feel better, do you sometimes stop taking your medicine?	0.0	100.0
4	When you travel or go away from home, do you sometimes forget to bring your medicine?	22.5	77.5
5	Did you take all your medicine yesterday?	90.0	10.0
6	When you feel that your diabetes is under control, do you sometimes stop taking your medicine?	95.0	5.0
7	Have you ever felt hassled about sticking to your medication plan?	100.0	0.0
8	Do you have difficulty remembering to take all your medicine?	100.0	0.0

The majority of the participants (62.5%) exhibited a medium level of adherence to their diabetes medication. A notable portion (30.0%) demonstrated high adherence. Conversely, a smaller percentage of the respondents (7.5%) were classified as having low medication adherence (Table 3).

Table 3 Adherence level

No	Adherence Level	Frequency	%
1	Low	3	7.50
2	Medium	25	62.50
3	High	12	30.00
	Total	40	100.00

There is no correlation between adherence level with any of the demographic characteristics (sex, age, education, job, diabetes duration, medication duration, and drugs being used). When adherence level was correlated with individual MMAS-8 question, significant positive correlations ($p < 0.01$) were observed for forgetting to take medicine ($r = 0.886$), forgetting to bring medicine when traveling ($r = 0.416$), and forgetting to take medicine yesterday ($r = 0.507$). This indicates that respondents who reported these instances of forgetfulness tended to have lower overall adherence. In contrast, stopping medication when feeling healthy did not show a significant correlation with overall adherence ($r = 0.268$, $p = 0.095$), suggesting that there was no intention to deliberately miss the medication.

Table 4 Correlation between adherence level and MMAS-8 item

No.	MMAS-8 Item Question	r	p-value
1	Do you sometimes forget to take your medicine?	0.886**	<0.001
2	When you travel, do you forget to bring your medicine?	0.416**	0.008
3	Did you forget to take your medicine yesterday?	0.507**	0.001
4	When you feel healthy, do you sometimes stop taking your medicine?	0.268	0.095

3.2. Qualitative phase

The qualitative phase of this study involved in-depth interviews with three key informants, purposefully selected to represent varying levels of medication adherence: high, medium, and low. This strategy aimed to capture a diverse range of perspectives on the factors influencing medication adherence among patients with diabetes mellitus at the Ratahan Community Health Center. The first informant (I-1) was a 37-year-old female nurse at the health center, who had been undergoing treatment for 5 years and reported high medication adherence. The second informant (I-2) was a 62-year-old male farmer, treated for 6 years, with medium adherence. The third informant (I-3) was a 68-year-old male farmer,

treated for 7 years, exhibiting low medication adherence. All three informants resided within the catchment area of the Puskesmas Ratahan and had been managing their diabetes for a considerable period. They willingly shared their experiences regarding their diabetes management journey during face-to-face interviews conducted at the health center, lasting approximately 15 to 20 minutes each. A semi-structured interview guide was utilized, encompassing topics such as the influence of traditional culture and beliefs, accessibility of healthcare services, environmental factors, perceptions of symptoms, and challenges encountered in adhering to their prescribed medication.

3.2.1. Traditional Culture: An Initial Influence, Not a Barrier

Traditional cultural beliefs and practices surrounding health and illness remain prevalent in the community where this study was conducted. Several informants acknowledged having initially explored traditional remedies before transitioning to and adhering to medical treatment for their diabetes. However, this prior engagement with traditional medicine did not appear to negatively impact their current adherence to prescribed medications. Instead, traditional practices were often viewed as an initial step in seeking relief before fully embracing and trusting conventional medical treatment. This suggests that culture, in this context, acted more as a preliminary exploratory phase rather than an ongoing barrier to medication adherence.

"Ibu nda pernah mencoba hal-hal laeng dalam pengobatan, selain minum obat dari resep dokter." (I-1) ("I have never tried anything else for my treatment, other than taking the medication prescribed by the doctor.")

"Om biasa kalo di acara biasa minum aer abis teru akang nasi bungkus, menurut om gula darah setelah minum itu turun, walau nda se-efektif suntik insulin." (I-2) ("Usually, when there are events, I drink the water left after cooking rice in banana leaf wrappers; I think it lowers my blood sugar, although not as effectively as insulin injections.")

"Sebelum minum obat yang sekarang, om pernah coba minum rebusan air kayu bajaka yang dari kalimantan, tapi memang nda se-efektif minum obat yang sekarang." (I-3) ("Before taking my current medication, I tried drinking boiled water from Bajakah wood from Kalimantan, but it wasn't as effective as my current medication.")

3.2.2. Ease of Access to Healthcare Services

Accessibility to healthcare facilities is a crucial factor in ensuring continuity of treatment. In this study, the informants did not report significant geographical barriers. The proximity of the Puskesmas to their residences and the availability of personal transportation facilitated their regular health check-ups and medication pick-ups. Consequently, geographical limitations did not appear to be a hindrance to medication adherence for the interviewed informants.

"Puskesmas kan dekat, jadi nda sulit kalo mo ambe obat." (I-1) ("The community health center is close, so it's not difficult to get medication.")

"Jarak ke puskesmas kan nda talalu jao, jadi nd susah kalo mo ba kontrol atau pun mo ambe obat" (I-2) ("The distance to the community health center isn't too far, so it's not difficult to go for check-ups or to get medication.")

"Skarang kan so ada motor jdi so nda sulit mo ka puskesmas, nda sama dengan dulu" (I-3) ("Now that we have a motorbike, it's not difficult to go to the community health center, unlike before.")

3.2.3. Active and Non-Resigned Attitude Towards Illness

Attitude towards one's illness significantly influences adherence to treatment. All three informants in this study demonstrated a proactive and non-resigned attitude towards their diabetes. They expressed enthusiasm for their treatment, consistently taking their medication, and following the advice of healthcare professionals. Their unwillingness to accept their condition passively served as motivation to continue treatment and actively manage their health.

"Klo ibu sama skali nda pasrah, semangat minum obat, semangat ba kontrol." (I-1) ("I am not resigned at all; I am enthusiastic about taking my medication and going for check-ups.")

"Kalu om nda pasrah, tetap badengar pa dokter mo suruh minum apa." (I-2) ("I am not resigned; I always listen to what the doctor tells me to take.")

"Kalo pasrah nda mungkin kita mo minum ini obat." (I-3) ("If I were resigned, I wouldn't be taking this medication.")

3.2.4. Influence of Religion and Spirituality in Enhancing Adherence

Spirituality and religious support had a positive impact on the informants' motivation to adhere to their treatment. Encouragement from religious figures, such as pastors, provided a source of strength and belief that recovery was possible through continued medical treatment. The informants believed that faith and medical efforts should go hand in hand, reinforcing their motivation to consistently take their medication and attend regular check-ups.

"Dorongan dari ibu/bpk pendeta pas lalu dirawat di rs bekeng qt jadi semangat untuk sembuh" (I-1) ("The encouragement from the pastor when I was hospitalized gave me the spirit to continue my treatment.")

"Bapak pendeta selalu bilang, semangat percaya kalo Tuhan mo se bae" (I-2) ("The pastor always tells me to be enthusiastic and believe that God will heal me.")

"Ibu pdt jaga kase semangat kalo Tuhan pasti mo kase bae lewat pengobatan yg selama ini torang bekeng." (I-3) ("The pastor always encourages me, saying that God will surely heal me through the treatment I have been undergoing.")

3.2.5. Awareness of the Need for Medication Despite Lack of Symptoms

Several informants demonstrated an understanding that diabetes often presents without noticeable symptoms, yet they consistently adhered to their medication regimen. Awareness of the importance of preventing complications and prior experiences with high blood sugar levels were key motivators for continuing treatment, even in the absence of immediate discomfort or symptoms. This reflects a good level of understanding regarding their chronic condition.

"Kalo kita kan so tau-tau walaupun nda daparasa dpe gejala mar namanya so diabetes, tetap musti minum obat." (I-1) ("We already know that even if we don't feel any symptoms, since it's diabetes, we still have to take the medication.")

"Karna dari awal dapatau kalo om diabetes itu om pe kadar gula darah sampe 500 lebe jadi dari situ om tetap minum obat biar nda barasa saki." (I-2) ("Because from the beginning when I found out I had diabetes, my blood sugar level was over 500, so from then on, I kept taking my medication even if I didn't feel sick.")

"Kalo kita biar nda dapa rasa saki, tetap minum obat, supaya katu aman." (I-3) ("Even if I don't feel sick, I still take my medication, so that I feel safe.")

3.2.6. Interest in Traditional Medicine (Initial Phase)

Some informants had initially experimented with traditional medicine. However, upon experiencing its ineffectiveness or discomfort, they chose to return to medical treatment. Despite a sense of curiosity and interest in natural alternatives, the informants recognized that medical treatment yielded more desirable outcomes in lowering their blood sugar levels. This suggests that while traditional medicine holds cultural appeal, effectiveness remains the primary determinant in adhering to medical treatment.

"Dulu pernah coba noh pake daong salam, mar cuman satu kali abis itu so nda." (I-1) ("I once tried using bay leaves, but only once, and then I stopped.")

"Pernah lagi om coba minum rebusan goro kayu tolor dorang bilang disini, mar depe rasa rupa oli tua, so banyak katu ja coba mar tetap nda sama deng minum obat dari dokter." (I-2) ("I also once tried drinking the boiled sap from a very large tree they call 'goro kayu tolor' here, but it tasted like old oil. I've tried many traditional remedies, but they are never as effective as the medication from the doctor.")

"Dulu dorang pernah bilang coba rubus tunas pisang yang belum kaluar dari tanah, mar sama jo nda ada de pe pengaruh." (I-3) ("People used to tell me to boil the shoots of bananas that haven't emerged from the ground yet, but it had no effect at all.")

3.2.7. Forgetfulness in Medication Intake

Forgetfulness emerged as a significant challenge in medication adherence for the informants. Several acknowledged frequently forgetting to take their medication, particularly when busy with events like celebrations or when traveling for work. This issue was perceived to be exacerbated by age-related memory decline. However, the informants also demonstrated proactive strategies to mitigate this problem, such as setting reminders on their mobile phones, especially on medication refill dates. Furthermore, family support played a crucial role in maintaining adherence, with family members routinely inquiring whether medication had been taken. These self-initiated reminders and external

monitoring from their immediate environment helped patients maintain medication regularity despite occasional forgetfulness.

"Kalo lupa katu lengkali noh, cuman kita ja bekeng alaram di hp dang tiap tanggal brapa ba ambe obat, supaya nda jga lupa." (I-1) ("I sometimes forget, but I usually set an alarm on my phone for every date I need to get my medication, so I don't forget.")

"Lengkali katu memang jaga lupa, apalagi pas ada acara kong so sibuk-sibuk, lengkali 2 sampe 3 hari nd ja minum tu obat. Mar katu ada orang rumah yang jaga kase inga supaya nda mo lupa." (I-2) ("I often forget, especially when there are events and I'm busy; sometimes I don't take my medication for 2 to 3 days. But thankfully, there are family members at home who remind me so I don't forget.")

"Kalo lupa katu wajar tamba leh so umur toh, lengkali kalo mo kaluar mo karja kong ba cepat-cepat jaga ta lupa bawa itu obat, mar kalo di rumah tetap orang rumah mo tanya kalo so minum obat atau belum jadi ada orang kase inga." (I-3) ("Forgetting is natural, especially at my age. Sometimes when I go out to work and I'm in a hurry, I forget to bring my medication. But at home, my family always asks if I've taken my medication or not, so there's someone to remind me.")

4. Discussions

This mixed-methods study provides novel insights into medication adherence among diabetes mellitus patients in the rural setting of Puskesmas Ratahan, Indonesia. By integrating quantitative assessment of adherence levels with qualitative exploration of patient experiences, this research offers a more comprehensive understanding than studies relying solely on one methodological approach. Our findings highlight a predominantly medium level of medication adherence within this population, with forgetfulness consistently emerging as a significant barrier, a finding supported by both quantitative and qualitative data streams.

The quantitative results, particularly the strong positive correlations between forgetfulness-related MMAS-8 items and lower overall adherence, statistically underscore the impact of memory and routine on medication-taking behavior in this rural context. This is further corroborated by the qualitative interviews, where informants frequently cited instances of forgetting medication, especially when daily routines were disrupted by social events or travel, and often compounded by age-related memory challenges. The strategies they employed to counter forgetfulness, such as utilizing phone alarms and relying on family reminders, emphasize the practical, often low-tech, approaches adopted within this community.

This convergence of quantitative and qualitative findings strengthens the reliability and validity of our conclusion regarding the primacy of forgetfulness as a challenge to medication adherence in this population. This aligns with a substantial body of literature across various settings that identifies unintentional non-adherence, including forgetfulness, as a major contributor to suboptimal medication management in chronic conditions (Haynes et al., 1996; Nieuwlaat et al., 2014). However, our study adds a specific contextual lens by examining this phenomenon within a rural Indonesian community.

Previous research in Indonesia has explored medication adherence in diabetes, often focusing on factors such as patient knowledge, socioeconomic status, and access to healthcare (e.g., Setiawan et al., 2018; Trisnawati & Setyarini, 2017). While these studies provide valuable insights, they often employ a singular quantitative approach and may not fully capture the nuances of daily life and the specific challenges faced in rural settings. Our mixed-methods design allows for a richer understanding of how the practicalities of rural life, including potentially less structured daily schedules compared to urban settings, and reliance on memory in the absence of sophisticated reminder systems, contribute to forgetfulness.

The qualitative data further illuminates the role of social context, a key aspect often less explored in quantitative studies. The strong emphasis on family support in reminding patients, a recurring theme in our interviews, underscores the importance of leveraging existing social networks within this collectivist rural culture to improve adherence. Family support has been shown to play an important role in improving patient adherence to treatment. Research by Tahulending et al. (2023) showed that the family's role in motivating patients, helping to obtain medication, and providing emotional encouragement can shape patient adherence during medical treatment. These findings are in line with our study results which show that patients who receive regular support from their families tend to have higher adherence rates. These findings are in line with research highlighting the significant relationship between family support and medication adherence in diabetic patients (Pakaya et al., 2024). The role of religious encouragement also suggests the potential for faith-based community interventions to promote medication adherence in this setting.

Interestingly, the lack of significant intentional non-adherence (e.g., stopping medication when feeling better) suggests that the primary issue is not a rejection of medical treatment but rather a difficulty in consistently integrating medication intake into daily routines. This distinction is crucial for designing targeted interventions. Rather than focusing on changing negative beliefs about medication, interventions should prioritize strategies to improve memory and establish reliable routines, potentially tailored to the specific daily schedules and social structures of this rural community.

The homogeneity of our sample, while a limitation for generalizability, provides a focused understanding of the specific challenges within this rural health center's catchment area. The predominance of older adults with lower levels of formal education may contribute to the prominence of forgetfulness as a barrier, highlighting the need for simplified medication regimens and memory aids tailored to this demographic. The widespread use of Metformin as the primary medication reflects standard first-line treatment for type 2 diabetes but also suggests that adherence strategies need to be applicable to commonly prescribed oral therapies in this setting.

To enhance medication adherence for diabetes patients in Ratahan, healthcare providers should emphasize simple, personalized reminders and actively involve family members in the process. Patients are encouraged to utilize personal reminder systems and seek family support, integrating medication into daily routines. Community health workers and existing programs can further reinforce adherence, while promoting health literacy remains crucial. Prioritizing low-cost, culturally relevant strategies that leverage strong social networks is key to improving medication management in this rural Indonesian setting, particularly addressing the prevalent issue of forgetfulness

5. Conclusion

In conclusion, this mixed-methods research uniquely contributes to the understanding of medication adherence in a rural Indonesian diabetes population. The consistent finding of forgetfulness as a primary barrier, elucidated through both quantitative and qualitative data, underscores the need for context-specific interventions that address memory and routine. Leveraging the strong social support networks and considering the influence of religious beliefs within this rural Indonesian culture may be key to developing effective strategies to improve medication adherence and ultimately enhance diabetes management outcomes in this community.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declared no conflict of interest.

Statement of ethical approval

Ethical approval was obtained from the Ethics Committee Faculty of Sport and Health Sciences, Manado State University

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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