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Relationship of Medication Adherence, Adverse Drug Reactions and Quality of Life among Patients with type 2 Diabetes and Hypertension

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ABSTRACT

Background: Type 2 Diabetes Mellitus (T2DM) and hypertension frequently coexist, requiring long-term multidrug therapy that may increase medication non-adherence, adverse drug reactions (ADRs), and impaired health-related quality of life (HRQoL). This study assessed medication adherence, ADRs, HRQoL, and their associations among patients with T2DM and hypertension.

Methods: In this prospective observational study, 412 adults receiving pharmacotherapy for ≥3 months were enrolled. Medication adherence, ADRs, and HRQoL were assessed using the MMAS-8, WHO–UMC and Hartwig scales, and MDQoL-17, respectively. Descriptive statistics, correlation analysis, multivariable logistic and linear regression, and one-way ANOVA were performed.

Results: The mean age was 56.8±10.9 years, with 57.3% males. High, medium, and low adherence were observed in 37.4%, 44.2%, and 18.4% of patients, respectively. Polypharmacy independently predicted poor adherence (adjusted OR=2.42, 95% CI: 1.48–3.95; p<0.001). Seventy-eight ADRs occurred in 68 patients (16.5%), predominantly mild (76.0%); polypharmacy, older age, and poor glycaemic control independently predicted ADRs. Mean MDQoL-17 score was 66.9±11.3. HRQoL was significantly higher with high adherence (p<0.001). Adherence was the strongest positive predictor of HRQoL (β=0.51), while higher HbA1c, polypharmacy, and increasing age predicted poorer HRQoL.

Conclusion: Medication adherence strongly influenced HRQoL, whereas polypharmacy increased poor adherence and ADR risk. Integrating adherence assessment, pharmacovigilance, medication review, and rational prescribing may improve outcomes.

Key-words: Polypharmacy; Pharmacovigilance; Patient Safety; Treatment Outcome; Medication Therapy Management

INTRODUCTION

Type 2 diabetes mellitus (T2DM) and hypertension are two of the most prevalent chronic non-communicable diseases globally and leading causes of cardiovascular morbidity, premature mortality, disability and health care expenditure. Such co-existence is becoming increasingly common with the ageing population, urbanization, sedentary lifestyle, obesity and unhealthy eating habits. Hypertension coexists with T2DM in 60-80% of patients and the co-occurrence of these conditions significantly increases the risk of cardiovascular disease, stroke, chronic kidney disease, retinopathy, neuropathy and other vascular complications over either disease alone.[1,2] Thus, effective management requires lifelong lifestyle modification and pharmacotherapy to target glycaemic control, blood pressure regulation and the prevention of cardiovascular complications.[3]

Despite significant improvements in clinical outcomes with pharmacological therapies, the management of patients with concomitant T2DM and hypertension

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remains challenging due to polypharmacy and the complexity of long-term treatment regimens. Hyperglycaemia, hypertension, dyslipidaemia and associated comorbidities are often managed with multiple medications, which increases the risk of medication-related problems such as drug–drug interactions, adverse drug reactions (ADRs), medication errors and poor adherence.[4] These challenges are particularly pronounced in older patients and those with multiple chronic conditions, resulting in increased healthcare utilization and reduced effectiveness of treatment.

Medication adherence is a major factor for successful chronic disease management. World Health Organization defined medication adherence as the degree to which the behaviour of taking medication by a patient matches with the recommendations agreed upon by a healthcare provider.[5] Good adherence is linked to better glycaemic and blood pressure control, lower risk of complications, less hospitalizations and lower healthcare costs, while poor adherence leads to treatment failure, disease progression and increased mortality.[6] Nevertheless, adherence to therapy among patients with T2DM and hypertension remains suboptimal worldwide with reported rates of 40–70% .[7] Factors affecting adherence include socioeconomic constraints, complex medication regimens, poor health literacy, inadequate patient counselling and adverse effects related to treatment, which affect low and middle income countries disproportionately.

ADRs are another major challenge in the long-term management of chronic diseases. Patients with T2DM and hypertension are particularly vulnerable to ADRs due to prolonged exposure to multiple medications, age-related physiological changes, and comorbidities. ADRs associated with common antidiabetic and antihypertensive medications, such as hypoglycaemia, gastrointestinal disturbances, dizziness, hypotension, and electrolyte abnormalities, could reduce treatment satisfaction, undermine adherence, and lead to increased healthcare utilization.[3] Thus, good pharmacovigilance and systematic monitoring of ADRs is needed to improve medication safety and optimize therapeutic outcomes.

Health-related quality of life (HRQoL) has become an important patient-centred measure in the management of chronic diseases, in addition to clinical outcomes. Impaired physical, psychological and social well-being is often found in patients with coexisting T2DM and hypertension due to the disease burden, treatment complexity, complications and drug-related adverse effects.[8] A growing body of evidence indicates a strong correlation between medication adherence, ADRs, and HRQoL. ADRs are frequently a major factor in poor adherence and decreased quality of life, whereas increased adherence is connected to improved clinical outcomes and patient well-being. However, there are relatively few studies, especially from India, which have evaluated these three inter-related outcomes comprehensively in patients with co-existing T2DM and hypertension.[3,9] Hence, the present study was undertaken to assess the medication adherence, ADRs and quality of life and to find out their association among patients with T2DM and hypertension attending a tertiary care teaching hospital.

MATERIALS AND METHODS

Study Design- A prospective observational longitudinal study was conducted in the Departments of Pharmacology and General Medicine at Rama Medical College Hospital & Research Centre, Kanpur, Uttar Pradesh, India, from 01/07/2024 to 31/06/2025. The study evaluated medication adherence, ADRs, and quality of life among patients with T2DM and hypertension. Participants were recruited from the OPD and inpatient wards and followed during routine clinical care without modifying their prescribed treatment.

Inclusion and Exclusion Criteria- Adults (≥18 years) with T2DM and hypertension receiving pharmacotherapy for ≥3 months were included after providing informed consent. Patients with Type 1 or gestational diabetes, secondary hypertension, critical illness, severe psychiatric/cognitive impairment, or those who declined or withdrew consent were excluded.[10,11]

Sample Size Estimation- Sample size was calculated using the single population proportion formula, $n = Z^2p(1-p)/d^2$, with a 95% confidence level, 5% margin of error, and assumed adherence prevalence of 50%. The minimum calculated sample size was 384 participants. Allowing for incomplete responses and loss to follow-up, the final sample size was increased to 412 participants.

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Methodology and Parameters Studied- Participants were enrolled through consecutive sampling and data were collected using interviewer-assisted interviews and medical record reviews. Medication adherence was assessed using the MMAS-8, while ADRs were identified through interviews, clinical examination, prescription and record review, physician documentation, and laboratory investigations. Identified ADRs were documented using the PvPI reporting form, with causality assessed by the WHO-UMC system and severity by the Hartwig and Siegel scale. HRQoL was evaluated using the MDQoL-17. Completed case record forms were checked daily for completeness before data entry.

Study Instruments

Morisky Medication Adherence Scale (MMAS-8)- Medication adherence was assessed using the 8-item Morisky Medication Adherence Scale (MMAS-8), administered in English/Hindi. The questionnaire includes seven Yes/No items and one five-point Likert-scale item assessing medication-taking behaviours. Total scores range from 0–8, with higher scores indicating better adherence: high (8), medium (6 to <8), and low (<6). The MMAS-8 has demonstrated acceptable reliability and validity for assessing adherence in chronic diseases. The lack of prior licensing permission and formal translation/back-translation was acknowledged as a study limitation.[12]

Monitoring of Adverse Drug Reactions- Patients were prospectively monitored for suspected ADRs through active pharmacovigilance, including patient interviews, medical record and laboratory review, prescription assessment, and consultation with treating physicians. Suspected ADRs were documented using the standard PvPI/CDSCO ADR Reporting Form, recording suspected and concomitant medications, clinical features, onset, management, dechallenge/rechallenge where applicable, outcome, and seriousness.[13]

WHO-UMC Causality Assessment- The causal relationship between suspected drugs and ADRs was assessed using the WHO-UMC causality assessment system.[14] ADRs were classified as certain, probable/likely, possible, unlikely, conditional/ unclassified, or unassessable/unclassifiable based on temporal association, dechallenge/ rechallenge, alternative causes, and available clinical evidence, following standardized WHO-UMC guidelines.

Hartwig and Siegel Severity Assessment- ADR severity was assessed using the Hartwig and Siegel severity assessment scale.[15,16] Each ADR was classified from Level 1 (mild) to Level 7 (severe), based on the required medical intervention, hospitalization duration, clinical management, and outcome.

MDQoL-17 Quality of Life Assessment- Health-related HRQoL was assessed using the validated Modified Diabetes Quality of Life Questionnaire (MDQoL-17).[17] It comprises 17 items across seven domains: physical functioning, role limitation, mental health, social functioning, energy/fatigue, dietary satisfaction, and treatment satisfaction. Items were scored according to the validated guidelines and transformed to a 0–100 scale, with higher scores indicating better HRQoL. The questionnaire was administered through interviewer-assisted interviews to minimize missing responses and ensure consistent data collection.

Outcome Measures

Primary outcomes: Medication adherence assessed by MMAS-8, incidence and characteristics (severity and causality) of ADRs, and HRQoL measured by MDQoL-17.

Secondary outcomes: Association between medication adherence and HRQoL, and the effects of selected socio-demographic and clinical variables on adherence, ADRs, and HRQoL.

Statistical Analysis- Data were entered in Microsoft Excel and analyzed using SPSS version 26.0. Continuous variables were presented as mean ± SD and categorical variables as frequencies and percentages. One-way ANOVA assessed differences in quality-of-life scores across adherence categories, while Pearson's correlation evaluated relationships among MMAS-8 scores, HbA1c, medication number, and HRQoL. Multiple linear regression identified independent HRQoL predictors, and multivariable logistic regression assessed predictors of poor adherence and ADR occurrence. Logistic regression results were reported as ORs with 95% CIs. A two-sided $p<0.05$ was considered statistically significant.

Ethical issues- The study was conducted in accordance with the Declaration of Helsinki and received

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Institutional Ethics Committee approval from Rama Medical College Hospital & Research Centre, Kanpur, UP (IEC No. RMCH RC/ESH/Prio-o/2024/3368; dated 04/03/2024). Written informed consent was obtained from all participants. A scanned copy of the approval letter was submitted as supplementary material.

RESULTS

During the study period, a total of 478 patients with T2DM and hypertension were screened. Of these 425 were eligible and enrolled. Thirteen participants were lost to follow-up, leaving a final analytical sample of 412 patients and an overall retention rate of 96.9%. The majority of the study population were males (57.3%). Mean age was 56.8 ± 10.9 years. Most participants were from the rural population (60.2%) (Table 1).

Table 1: Demographic characteristics of study participants (N=412)

Variable	n (%)
Male	236 (57.3)
Female	176 (42.7)
Mean age (years)	56.8 ± 10.9
Rural residence	248 (60.2)
Urban residence	164 (39.8)
Married	348 (84.5)
Literate	336 (81.6)

Mean MMAS-8 score was 6.6 (SD = 1.3). Table 3 shows that 154 (37.4%) participants had high medication adherence, 182 (44.2%) had medium adherence and 76 (18.4%) had low adherence. Multivariable logistic regression analysis revealed that polypharmacy was the strongest predictor of poor medication adherence (β = 0.88, adjusted OR = 2.42, 95% CI: 1.48–3.95, p < 0.001). In addition, advanced age (>65 years) (adjusted OR = 1.86, p=0.017) and low educational status (adjusted OR = 1.74, p=0.032) were independently associated with low adherence (Table 2).

Table 2: Medication adherence by MMAS-8 and predictors for low adherence.

A. Medication adherence according to MMAS-8

Medication adherence category	N	%
High adherence (MMAS-8 = 8)	154	37.4
Medium adherence (MMAS-8 = 6 to <8)	182	44.2
Low adherence (MMAS-8 <6)	76	18.4
Mean MMAS-8 score (Mean ± SD)	6.6 ± 1.3	-

B. Multivariable logistic regression analysis of predictors of low medication adherence

Variable	β coefficient	Adjusted OR (95% CI)	p-value
Age >65 years	0.62	1.86 (1.12–3.08)	0.017
Polypharmacy	0.88	2.42 (1.48–3.95)	<0.001*
Low educational status	0.55	1.74 (1.05–2.89)	0.032

**Statistically significant at p< 0.05.*

A total of 78 ADRs were recorded in 68 patients, giving an overall incidence of ADRs of 16.5%. No serious or life-threatening ADRs were observed during the study period. The most common ADR was hypoglycaemia (23.1%), followed by dizziness (17.9%), gastritis (15.4%), peripheral oedema (12.8%), dry cough (10.3%) and other reactions (20.5%) (Table 3).

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Table 3: Profile of reported adverse drug reactions among study participants (n = 68 ADR cases; total ADRs = 78)

Adverse Drug Reaction	Frequency (n)	Percentage (%)
Hypoglycaemia	18	23.1
Dizziness	14	17.9
Gastritis	12	15.4
Peripheral oedema	10	12.8
Dry cough	8	10.3
Others*	16	20.5
Total	78	100

The main drugs associated with ADRs were metformin, sulfonylureas, insulin, calcium channel blockers, angiotensin-converting enzyme inhibitors and angiotensin receptor blockers (Table 4).

Table 4: Medications implicated in reported adverse drug reactions

Drug/Class	Common ADR(s)	Clinical Outcome
Metformin	Gastritis, gastrointestinal discomfort	Recovered after symptomatic management
Sulfonylureas (Glimepiride/Gliclazide)	Hypoglycaemia	Dose adjustment and recovery
Insulin	Hypoglycaemia	Recovered following glucose administration and dose modification
Amlodipine	Peripheral oedema	Improved after treatment modification
ACE inhibitors (Ramipril/ Enalapril)	Dry cough	Drug substitution required
ARBs (Telmisartan/ Losartan/ Olmesartan)	Dizziness	Conservative management and recovery

According to the Hartwig Severity Assessment Scale, 52 (76.0%) ADRs were mild and 16 (24.0%) were moderate. No severe ADRs were observed (Table 5).

Table 5: Hartwig severity assessment of reported adverse drug reactions (n = 68)

Severity Category	Frequency (n)	Percentage (%)
Mild	52	76
Moderate	16	24
Severe	0	0
Total	68	100

According to WHO–Uppsala Monitoring Centre (WHO-UMC) causality assessment, 38 (48.7%) ADRs were classified as possible, 28 (35.9%) as probable, 6 (7.7%) as certain and 6 (7.7%) as unlikely (Table 6). Polypharmacy was significantly associated with increased odds of ADR occurrence (OR = 2.61, 95% CI: 1.48–4.62; $p < 0.001$). Older age (>65 years) (OR=1.72, p=0.014) and poor glycaemic control (HbA1c>8%) (OR=1.58, p=0.041) were also independently associated with ADR development.

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Table 6: WHO–UMC causality assessment of reported adverse drug reactions (n = 78 ADRs)

WHO–UMC Category	Frequency (n)	Percentage (%)
Certain	6	7.7
Probable	28	35.9
Possible	38	48.7
Unlikely	6	7.7
Total	78	100

Health-related quality of life was measured using MDQoL-17. The overall mean QoL score was 66.9 ± 11.3 which indicates moderate level of perceived quality of life among study participants. The mean score for social functioning domain was highest (71.2 ± 11.6) among the individual domains followed by treatment satisfaction (68.4 ± 12.8), psychological well-being (65.3 ± 10.9) and physical health (62.8 ± 12.4) (Table 7).

Table 7: Quality of life scores in domains measured by Modified Diabetes Quality of Life Questionnaire (MDQoL-17) (n = 412)

MDQoL-17 Domain	Mean ± SD
Physical Health	62.8 ± 12.4
Psychological Well-being	65.3 ± 10.9
Social Functioning	71.2 ± 11.6
Treatment Satisfaction	68.4 ± 12.8
Overall MDQoL-17 Score	66.9 ± 11.3

Table 8 shows the association between medication adherence and quality of life. The quality-of-life scores were significantly higher in the patients with high medication adherence (74.8 ± 8.9) than in those with medium (66.1 ± 9.8) or low adherence (57.4 ± 10.6) (one-way ANOVA, $F = 31.84$, $p < 0.001$). Correlation analysis showed that MMAS-8 scores were moderately positively correlated with quality of life ($r = 0.58$, $p < 0.001$). HbA1c ($r = -0.41$, $p = 0.002$) and the number of prescribed medications ($r = -0.37$, $p < 0.001$) were negatively correlated with quality of life. In a multiple linear regression analysis, medication adherence was the most important positive predictor of quality of life ($\beta = 0.51$, $p < 0.001$), while higher HbA1c levels, polypharmacy and increasing age were significant negative predictors. The regression model accounted for 42% of the variation in quality of life scores ($R2 = 0.42$, Adjusted $R2 = 0.40$; $p < 0.001$).

Table 8: Association of Medication Adherence and Adverse Drug Reactions with Quality of Life (n = 412)

A. Association between medication adherence and quality of life

Medication adherence level	Mean QoL score (Mean ± SD)	Statistical test	p-value
High adherence	74.8 ± 8.9	One-way ANOVA (F = 31.84)	<0.001*
Medium adherence	66.1 ± 9.8		
Low adherence	57.4 ± 10.6		

B. Correlation between clinical variables and quality of life

Variable	Correlation coefficient (r)	p-value
MMAS-8 score	+0.58	<0.001*
HbA1c	−0.41	0.002*
Number of prescribed medications	−0.37	<0.001*

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C. Predictors of quality of life (Multiple linear regression)

Variable	β coefficient	Standard Error	p-value
MMAS-8 score	+0.51	0.08	<0.001*
HbA1c	−0.29	0.07	0.002*
Polypharmacy	−0.24	0.09	0.006*
Age	−0.18	0.08	0.018*

Regression model: R2 = 0.42; Adjusted R2 = 0.40; F = 28.6; p < 0.001
**Significant at 0.05 level.*

DISCUSSION

Medication adherence is an essential component of chronic disease management because sustained adherence is necessary to achieve optimal therapeutic outcomes. In the present study, the mean MMAS-8 score was 6.6 ± 1.3, indicating overall moderate adherence. High adherence was observed in 37.4% of participants, whereas 44.2% and 18.4% exhibited medium and low adherence, respectively. These findings are comparable with those reported by Mishra *et al.,* who also observed predominantly moderate medication adherence among Indian patients with T2DM, and are consistent with the review by Mishra *et al.,* which highlighted moderate adherence as the most frequently reported pattern among patients with coexisting diabetes and hypertension.[3,9] Similar observations have also been reported by Kini & Ho and Moke *et al.,* who emphasized that partial adherence remains common in chronic diseases despite long-term pharmacotherapy.[6,7] The large proportion of patients with medium adherence deserves particular attention because partial adherence frequently remains unrecognized in routine clinical practice while substantially contributing to poor glycaemic control, uncontrolled hypertension, and progression of chronic complications.[17]

Regression analysis demonstrated that polypharmacy was the strongest predictor of poor medication adherence (adjusted OR = 2.42, *p*< 0.001), followed by advanced age and lower educational status. Polypharmacy was highly prevalent in the present study, reflecting the complexity of managing patients with multiple chronic conditions. Similar high rates of polypharmacy among patients with T2DM have been reported by Alwhaibi *et al.*, who observed extensive use of multiple medications in a tertiary-care setting in Saudi Arabia, and by Soni *et al.,* who demonstrated that patients with diabetes and hypertension commonly receive multiple antihypertensive, antidiabetic and adjunctive medications.[4,18] Likewise, Tamene *et al.,* identified polypharmacy as a common finding among patients with T2DM and comorbidities, whereas Chaudhury *et al.,* highlighted its association with increased medication burden, adverse drug reactions, and reduced adherence.[3,19] Collectively, these findings reinforce the need for regular medication review, regimen simplification whenever feasible, and patient counselling to improve long-term adherence.

Medication safety represents another critical component of chronic disease management. A total of 78 ADRs were identified among 68 patients, corresponding to an overall ADR incidence of 16.5%, and no severe ADRs were reported. The incidence observed in the present study is comparable with previous Indian pharmacovigilance studies among patients with diabetes and hypertension. Shinde *et al.,* similarly reported that most ADRs encountered in diabetic hypertensive patients were mild and manageable without permanent discontinuation of therapy.[20] Comparable findings were also reported by Prajapati *et al.,* Mehdi *et al.,* and Nakhate & Badar, all of whom observed predominantly mild-to-moderate ADRs, with hypoglycaemia, dizziness, gastrointestinal disturbances, and peripheral oedema being the most frequently encountered reactions.[21-23] The absence of severe ADRs in the present study may reflect close clinical monitoring and timely intervention in the tertiary-care setting.

Assessment using the Hartwig Severity Scale demonstrated that 76.0% of ADRs were mild and 24.0% were moderate, while no severe reactions were observed. Similarly, WHO–UMC causality assessment categorized most ADRs as possible or probable. These observations are comparable with previous pharmacovigilance studies in which the majority of ADRs among patients receiving multidrug therapy were classified as mild-to-moderate and possible or probable because establishing definite causality is inherently difficult in patients receiving multiple concurrent

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medications.[21-23] These findings further emphasize the importance of continuous ADR monitoring and active pharmacovigilance programmes to improve medication safety.[24]

The present study also demonstrated a high prevalence of polypharmacy, reflecting the complexity of managing patients with multiple chronic diseases. Similar prescribing patterns have been reported from tertiary-care hospitals in India and other countries using WHO prescribing indicators. Desalegn, Chenchula *et al.,* and Verma *et al.,* reported that increasing numbers of prescribed medicines are common in tertiary healthcare settings and are often associated with greater risks of medication-related problems.[25-27] Likewise, Joshi *et al.,* and the national survey by Galappatthy *et al.,* emphasized that regular prescription audits based on WHO/INRUD prescribing indicators are valuable tools for promoting rational drug use, minimizing unnecessary polypharmacy, and improving prescribing quality.[28,29] These observations support the need for routine medication review and evidence-based prescribing practices in patients with T2DM and hypertension.

Health-related quality of life has become an increasingly important patient-centred outcome in chronic disease management. Using the MDQoL-17 questionnaire, the present study found an overall QoL score of 66.9 ± 11.3, indicating moderate quality of life. These findings are consistent with those reported by Mishra *et al.,* who observed moderate quality of life among Indian patients with T2DM and identified medication adherence as a major determinant of patient well-being.[9] Similar levels of HRQoL have also been reported by Sharma *et al.,* all of whom demonstrated that prolonged disease duration, poor glycaemic control, multiple comorbidities, and increasing treatment burden contribute to impaired physical and psychological functioning.[30] In the present study, social functioning demonstrated the highest domain score, whereas physical health showed the lowest score, suggesting that chronic disease burden primarily affects physical functioning while social support may remain relatively preserved.

One of the most important observations of the present study was the strong association between medication adherence and HRQoL. Patients with high adherence had significantly better quality-of-life scores than those with medium or low adherence ($p<0.001$). This finding closely parallels the observations of Mishra *et al.,* who demonstrated that better adherence was independently associated with improved HRQoL among Indian patients with T2DM.[9] Similar associations have also been reported by Sharma *et al.,* indicating that medication adherence not only improves glycaemic and blood pressure control but also positively influences physical, psychological, and social dimensions of quality of life.[30] These findings collectively reinforce the importance of adherence-enhancing interventions as an integral component of comprehensive diabetes and hypertension management.

LIMITATIONS

The study also has some limitations. First, the study was conducted in one tertiary care teaching hospital, which may limit the generalizability of the findings to other healthcare settings and populations. Second, the observational study design can identify associations, but does not establish causal relationships between medication adherence, adverse drug reactions and quality of life. Third, medication adherence was measured by the self-reported MMAS-8 questionnaire and might be influenced by recall and social desirability biases. Fourth, the use of active pharmacovigilance methods for ADRs identification and the relatively short follow-up period of six months may limit the detection of delayed or less frequently occurring ADRs. Finally, longer-term clinical outcomes and changes in medication adherence, ADR occurrence, and quality of life over time were not assessed.

CONCLUSIONS

This study demonstrates that patients with coexisting Type 2 Diabetes Mellitus and hypertension experience moderate medication adherence, predominantly mild adverse drug reactions (ADRs), and moderate health-related quality of life (HRQoL) despite long-term pharmacotherapy. Polypharmacy emerged as the strongest predictor of poor medication adherence, while increasing age and poor glycaemic control were associated with greater ADR occurrence and poorer HRQoL. Medication adherence was the strongest positive determinant of HRQoL, emphasizing its central role in optimizing patient outcomes. Management should therefore extend beyond glycaemic and blood pressure control to include routine adherence assessment, pharmacovigilance, rational prescribing, and periodic

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medication review. Integrating these strategies into multidisciplinary care may reduce medication-related complications, improve adherence, and enhance patient-reported outcomes. Future multicentre prospective studies involving larger populations and longer follow-up are warranted to validate these findings and evaluate the long-term impact of adherence-enhancing and medication-safety interventions on clinical outcomes and HRQoL.

CONTRIBUTION OF AUTHORS

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