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Original Research Article

Medication Adherence, Depressive Symptoms and Outpatient Healthcare Utilization among Adults with Chronic Diseases: A Hospital-Based Cross-Sectional Study from Eastern India

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Abstract

Introduction: Medication non-adherence is a major challenge in the management of chronic diseases and may be influenced by treatment burden, psychological factors and healthcare-system characteristics. Evidence examining these determinants simultaneously among adults with chronic diseases in the Indian outpatient setting remains limited.

Aim: To assess medication adherence among adults with chronic diseases and determine its association with depressive symptoms, treatment burden, outpatient healthcare utilization and selected sociodemographic and disease-related factors.

Materials and Methods: A hospital-based analytical cross-sectional study was conducted among 610 adults with physician-diagnosed chronic diseases attending the General Outpatient Department of Medical College, Kolkata. Participants had been prescribed at least one medication for continuous use for ≥3 months. Sociodemographic characteristics, disease duration, medication burden and healthcare-utilization characteristics were recorded. Depressive symptoms were assessed using the Patient Health Questionnaire-9 (PHQ-9), while functional disability was assessed using WHODAS. Medication adherence was categorized as low or good according to the adherence measure used in the study. Continuous variables were compared using Welch's independent-samples t-test and Spearman's correlation, while categorical associations were assessed using the chi-square test. Multivariable binary logistic regression was performed to identify independent factors associated with poor medication adherence, with adjusted odds ratios (aORs) and 95% confidence intervals (CIs).

Results: Of 610 participants, 217 (35.57%) had low medication adherence and 393 (64.43%) had good adherence. The mean age was 43.51±12.74 years, mean disease duration was 7.32±6.41 years, and mean daily tablet burden was 5.93±2.75 tablets. Participants with low adherence had significantly longer disease duration than those with good adherence (8.19±5.84 vs. 6.84±6.66 years; p=0.010) and consumed more tablets per day (6.47±3.38 vs. 5.64±2.27; p=0.001). Adherence was significantly associated with employment, location, literacy and monthly outpatient attendance. In multivariable analysis, longer disease duration (aOR=1.050, 95% CI: 1.018–1.082; p=0.002), greater daily tablet burden (aOR=1.113, 95% CI: 1.038–1.193; p=0.003) and higher PHQ-9 score (aOR=1.087, 95% CI: 1.030–1.148; p=0.002) were independently associated with greater odds of poor adherence. Greater monthly OPD attendance was associated with lower odds of poor adherence (aOR=0.403, 95% CI: 0.212–0.768; p=0.006). Location also remained independently associated with adherence (aOR=0.608, 95% CI: 0.412–0.896; p=0.012).

Conclusion: Approximately one-third of adults with chronic diseases demonstrated low medication adherence. Disease chronicity, higher medication burden and depressive symptoms were independently associated with poor adherence, whereas greater outpatient attendance was associated with lower odds of poor adherence. Periodic adherence assessment, treatment simplification, screening for depressive symptoms and strengthening continuity of outpatient care may help improve medication adherence.

Keywords: Medication Adherence; Chronic Disease; Depressive Symptoms; Healthcare Utilization; Outpatient Care.

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Introduction

Medication adherence is a major determinant of the effectiveness of pharmacological treatment in chronic diseases. Despite the availability of effective therapies, non-adherence remains a persistent challenge and can compromise disease control, increase healthcare utilization and contribute to avoidable morbidity. A systematic review of interventions for chronic medical conditions reported that approximately 20–50% of patients do not adhere adequately to prescribed medical therapy. [1] The problem is also evident at the population level; a systematic review and meta-analysis involving 519,971 patients reported a pooled prevalence of primary medication non-adherence of 17% (95% CI: 15–20%), with substantial variation according to disease and patient characteristics. Younger age, polypharmacy, practitioner-related factors and higher patient co-payment were among the factors associated with non-adherence. [2]

Medication adherence is a complex and multifactorial behaviour and cannot be explained solely by forgetfulness, motivation or patient-related factors. An overview of systematic reviews identified patient-related, socioeconomic, disease-related, therapy-related and healthcare-system factors as important determinants of adherence. [3] Among the psychological determinants, depression has consistently been associated with poorer medication-taking behaviour. A meta-analysis of 31 studies involving 18,245 patients with chronic diseases demonstrated that individuals with depression had approximately 1.76-fold higher odds of being medication non-adherent compared with those without depression. [4] Depression may therefore represent an important and potentially modifiable determinant of adherence among patients requiring long-term pharmacological treatment.

Depression itself constitutes a substantial public-health concern in India. A systematic review and meta-analysis of 17 Indian studies estimated an aggregate point prevalence of depression of 23.0% in primary-care settings. [5] Evidence from specific chronic disease populations also supports the relationship between depression and medication adherence. In a study of 100 Indian patients with chronic myeloid leukemia receiving imatinib, depression was significantly associated with adherence and remained an independent predictor in multivariable analysis, with an odds ratio of 10.37. [6] These findings suggest that identifying depressive symptoms among patients with chronic diseases may be relevant to understanding and addressing medication non-adherence.

However, adherence is not exclusively a psychological or behavioural phenomenon. Healthcare-system and physician-related barriers are recurrent determinants of non-adherence, indicating that responsibility for adherence should not be placed exclusively on patients. [7] Healthcare accessibility encompasses more than the frequency of hospital visits and may be influenced by geographical distance, transportation, waiting time, appointment availability, treatment-related expenditure, medicine availability, continuity of care and communication with healthcare professionals. A systematic review identified barriers to healthcare access at multiple stages, including availability, accessibility, acceptability and contact with health services. [8]

These issues are particularly relevant in India, where chronic disease management occurs within heterogeneous public and private healthcare systems. A systematic review of healthcare utilization among patients with non-communicable diseases in India identified financial constraints, geographical barriers, inadequate awareness, medicine stock-outs, transportation difficulties and health-system inefficiencies as important barriers to appropriate healthcare utilization. [9] Although affordability frequently favoured government healthcare services, faster access was an important reason for preference for private healthcare. [9] In Kolkata, a recent mixed-methods study among the urban poor identified several barriers to chronic disease management, including healthcare-facility location, logistical difficulties, perceived quality of care, outpatient timings, inadequate availability of medicines and diagnostic facilities, loss of employment associated with repeated healthcare visits, inadequate information and communication, and dysfunctional referral systems. [10]

The quality and continuity of outpatient care may further influence medication-taking behaviour. An Indian mixed-methods study reported that only 55% of patients recalled receiving verbal follow-up and medication instructions, while deficiencies in documentation, communication, referral practices and continuity of care were identified as barriers to effective outpatient management. [11] Local evidence also demonstrates considerable medication non-adherence. In a diabetic clinic at a medical college in Kolkata, the reported compliance rate with antidiabetic medication was 57.7%; non-compliance was associated with increasing age, male sex, illiteracy, lower per-capita income, longer disease duration and treatment-related factors. Forgetfulness and financial constraints were the most commonly reported reasons for non-compliance. [12]

Despite increasing evidence linking depression and healthcare accessibility with medication adherence, these determinants have frequently been investigated independently. Emerging evidence suggests that healthcare utilization and health-system factors may influence medication-adherence trajectories over time. [13] However, limited evidence has examined whether psychological factors such as depression and outpatient healthcare utilization/accessibility independently contribute to poor medication adherence when considered simultaneously, particularly among adults attending tertiary-care outpatient services in India.

Therefore, the present study aims to determine the association of depression and outpatient department (OPD) service utilisation/accessibility with medication adherence among adults with chronic diseases.

The study additionally seeks to estimate the prevalence of medication non-adherence and depression, characterize patterns of OPD utilization and accessibility, and identify demographic, socioeconomic, disease-related and treatment-related factors associated with poor adherence. By evaluating psychological and healthcare-system determinants together while accounting for relevant patient and treatment characteristics, this study intends to provide a more comprehensive understanding of barriers to medication adherence among adults with chronic diseases attending outpatient services.

Materials and Methods

Study Design and Setting: It is a hospital-based analytical cross-sectional study conducted in the General Outpatient Department (OPD) of Medical College, Kolkata for 2 months. The study population comprised adult patients attending outpatient services for chronic diseases who have been prescribed at least one medication for continuous use for a minimum duration of 3 months.

Eligibility Criteria: Patients was eligible if they are aged ≥18 years, have a physician-diagnosed chronic disease requiring long-term pharmacological treatment, have been prescribed at least one regular medication for ≥3 months, attend the participating OPD during the study period, are able to understand the study questions in English, Bengali or Hindi using approved translated versions where applicable, and provide written informed consent.

Patients was excluded if they are unable to provide informed consent; have severe cognitive impairment or acute delirium that interferes with reliable questionnaire completion; are critically ill or require immediate emergency management; are currently hospitalized; have an acute psychiatric emergency requiring immediate specialist intervention; are unable to complete the interview because of severe communication difficulties without an appropriate communication aid; or have already participated in the study during an earlier OPD visit.

Sample Size and Sampling Technique: The expected prevalence of poor medication adherence is considered as 42.3%, based on the study by Mukherjee et al. [12] Using P=42.3%, Q=57.7% and an allowable error of 4.23% (10% relative allowable error), the sample size was calculated using the formula:

$$n = 4PQ/L^2$$

The calculated sample size is 546 participants. After allowing for 10% incomplete or non-response data, the final target sample size is 610 participants.

All eligible patients attending the participating OPD during the study period were screened consecutively and invited to participate until the required sample size is achieved.

Study Variables and Outcome Assessment: The primary outcome was medication adherence, preferably assessed using the General Medication Adherence Scale (GMAS).

The principal exposure variables were depressive symptoms and outpatient healthcare utilisation/accessibility**.** Depressive symptoms were assessed using the Patient Health Questionnaire-9 (PHQ-9)**.**

Healthcare utilization during the preceding 6 months was assessed using the number of OPD visits, emergency department visits, hospital admissions, healthcare facilities and doctors consulted for the same chronic condition, completion of prescribed investigations, and whether prescribed medicines were obtained as advised.

Study Procedure: After explaining the study objectives, procedures, confidentiality, voluntary nature of participation and right to withdraw, written informed consent was obtained. Demographic and clinical information were collected. Participants were interviewed using the medication-adherence instrument, PHQ-9, OPD utilization/accessibility questionnaire and treatment-burden assessment, where applicable.

Statistical Analysis: Data were analysed using SPSS version 22.0. Continuous variables were assessed for distribution and summarized as mean ± standard deviation (SD) or median with appropriate measures of dispersion, while categorical variables were expressed as frequencies and percentages. Participants were categorized into low- and good-adherence groups according to the predefined

medication-adherence classification. Differences in continuous variables between the two adherence groups were assessed using Welch's independent-samples t-test, which was used because it does not assume equal variances between groups. Spearman's rank correlation was used to evaluate the relationship between continuous variables and medication-adherence status and to assess associations of PHQ-9 and WHODAS scores with selected demographic, disease-related and healthcare-utilization variables. Associations between categorical variables and medication adherence were examined using Pearson's chi-square test, with Fisher's exact test applied where expected cell frequencies were small. Disease-specific associations were examined as exploratory analyses. A multivariable binary logistic regression model was subsequently constructed to identify factors independently associated with poor medication adherence. Adjusted odds ratios (aORs) with corresponding 95% confidence intervals (CIs) and p-values were reported. A two-sided p-value <0.05 was considered statistically significant.

Ethical Considerations: The study protocol was reviewed and approved by the Institutional Ethics Committee of Medical College and Hospital, Kolkata. Written informed consent were obtained from all participants before enrolment. Confidentiality was maintained through anonymization of study data, secure storage of records and restricted database access.

Results

A total of 610 participants were included in the analysis. The mean age of the study population was 43.51±12.74 years and the mean duration of disease was 7.32±6.41 years. 101(16.56%) of the participants were female. 415 (68.03%) participants were from rural area.

Participants had a mean of 1.12±0.35 monthly OPD visits, while the mean waiting time in the queue was 174.62±119.18 minutes. The mean number of hospital admissions attributable to the disease was 0.70±1.42. The mean monthly expenditure on medicines was ₹1708.44±2619.12 and the mean number of tablets consumed per day was 5.93±2.75.

Overall, 217 (35.57%) participants had low medication adherence, whereas 393 (64.43%) had good medication adherence.

The mean WHODAS score for the depression-related assessment was 16.13±9.69, while the mean PHQ-9 score was 9.28±5.78. Based on conventional PHQ-9 severity categories, 117 (19.18%) participants had minimal depressive symptoms, 216 (35.41%) had mild symptoms, 186 (30.49%) had moderate symptoms, 40 (6.56%) had moderately severe symptoms and 51 (8.36%) had severe depressive symptoms.

Table 1: Frequency distribution of socio-demographic variables of the population

Variable/category	**n (%)**
Medication adherence	
Low adherence	217 (35.57)
Good adherence	393 (64.43)
Literacy scale	
Illiterate	132 (21.64)
Primary School Education	115 (18.85)
Middle School Education	198 (32.46)
High School Education	93 (15.25)
Graduate	14 (2.30)
Doctorate/ Post- doctorate	58 (9.51)
Employment	
Unemployed	158 (25.90)
Elementary **occupation** (unskilled workers)	195 (31.97)
Plant and machine operators and assemblers	129 (21.15)
Craft and related trade workers	26 (4.26)
Skilled agricultural and fishery workers	26 (4.26)
Skilled workers and shop and market sales workers	31 (5.08)
Clerks	15 (2.46)
Technicians and associate professionals	30 (4.92)
Monthly OPD visits	
0	4 (0.66)
1	528 (86.56)
2	78 (12.79)
Depressive symptoms (PHQ-9)	
Minimal (0–4)	117 (19.18)

Mild (5–9)	216 (35.41)
Moderate (10–14)	186 (30.49)
Moderately severe (15–19)	40 (6.56)
Severe (20–27)	51 (8.36)
Functional Disability (WHODAS)	
No difficulty(0-9)	161 (26.39)
Mild difficulty(10-19)	245 (40.16)
Moderate difficulty(20-29)	128 (20.98)
Severe difficulty(30-39)	76 (12.46)
Extreme difficulty(40-48)	0 (0.00)

The PHQ-9 distribution indicated that 45.90% of participants had at least moderate depressive symptoms (PHQ-9 ≥10). The WHODAS depression-related score showed a mean of 16.13±9.69, with most participants falling within the 10–19 descriptive score range, indicating mild difficulty.

Table 2: Association of Outpatient services, depression and functional disability with medication adherence

Variable	Low adherence (n=217), Mean±SD	Good adherence (n=393), Mean±SD	Welch's t	p-value	Spearman's ρ	p-value
Age (years)	43.09±11.95	43.74±13.16	−0.623	0.534	0.042	0.296
Duration of disease (years)	8.19±5.84	6.84±6.66	2.590	**0.010**	−0.163	**<0.001**
Monthly OPD visits	1.09±0.35	1.14±0.34	−1.542	0.124	0.060	0.139
Waiting time (minutes)	164.86±121.44	180.01±117.72	−1.491	0.137	0.076	0.060
Hospital admissions	0.81±1.34	0.64±1.46	1.388	0.166	−0.076	0.061
Medicine expenditure (₹)	1728.80±2972.33	1697.20±2405.98	0.134	0.893	0.042	0.304
Tablets/day	6.47±3.38	5.64±2.27	3.211	**0.001**	−0.076	0.060
WHODAS score	16.77±9.05	15.78±10.01	1.249	0.212	−0.039	0.341
PHQ-9 score	9.86±5.97	8.96±5.67	1.817	0.070	−0.062	0.126

Welch's t-test demonstrated that participants with low medication adherence had a significantly longer duration of disease than those with good adherence (8.19±5.84 vs. 6.84±6.66 years, p=0.010). They also consumed a significantly greater number of tablets per day (6.47±3.38 vs. 5.64±2.27, p=0.001). Age, monthly OPD visits, waiting time, number of hospital admissions, medicine expenditure, WHODAS score and PHQ-9 score did not demonstrate statistically significant correlations with medication adherence.

Table 3: Association of sociodemographic characteristics with medication adherence

Variable	χ^2	df	p-value
Gender	3.679	1	0.055
Employment	36.135	7	**<0.001**
Location	4.075	1	**0.044**
Literacy scale	14.231	5	**0.014**
Monthly OPD visits	8.041	2	**0.018**

Medication adherence was significantly associated with employment category, location, literacy scale and monthly OPD attendance. Employment demonstrated the strongest association among the socio-demographic variables (χ^2=36.135, p<0.001). Location (χ^2=4.075, p=0.044), literacy scale (χ^2=14.231, p=0.014) and monthly OPD visits (χ^2=8.041, p=0.018) were also significantly associated with adherence. Gender showed a borderline association with medication adherence (χ^2=3.679, p=0.055).

Table 4: Association of disease conditions with medication adherence

Disease condition	Low adherence, n (%)	Good adherence, n (%)	χ^2	p-value
Hypertension	152 (70.05)	209 (53.18)	15.771	**<0.001**
COPD	43 (19.82)	130 (33.08)	11.461	**<0.001**
Type 2 diabetes mellitus	19 (8.76)	85 (21.63)	15.483	**<0.001**
Hypothyroidism	14 (6.45)	15 (3.82)	1.601	0.206
Ischaemic heart disease	0 (0.00)	34 (8.65)	18.272	**<0.001**
Chronic kidney disease	5 (2.30)	4 (1.02)	0.829	0.362
Rheumatoid arthritis	9 (4.15)	0 (0.00)	13.813	**<0.001**
Osteoarthritis	9 (4.15)	5 (1.27)	3.952	**0.047**
Interstitial lung disease	4 (1.84)	13 (3.31)	0.632	0.427

Disease-specific analysis revealed significant associations between medication adherence and hypertension, COPD, type 2 diabetes mellitus, ischaemic heart disease, rheumatoid arthritis and osteoarthritis. Hypertension was more frequent among participants with low adherence, whereas COPD, type 2 diabetes mellitus and ischaemic heart disease were more frequently represented among participants with good adherence. No statistically significant association was observed for hypothyroidism, chronic kidney disease or interstitial lung disease.

Table 5: Association of depression and functional disability with disease-related and outpatient-service characteristics

Variable	PHQ-9 score: Spearman's ρ	p-value	WHODAS score: Spearman's ρ	p-value
Age (years)	0.163	<0.001	0.193	<0.001
Duration of disease (years)	0.186	<0.001	0.209	<0.001
Monthly OPD visits	0.137	<0.001	0.067	0.100
Waiting time (minutes)	0.065	0.108	0.075	0.063
Hospital admissions	−0.037	0.358	−0.010	0.813
Medicine expenditure (₹)	0.259	<0.001	0.299	<0.001
Tablets/day	0.143	<0.001	0.061	0.134

Spearman's correlation analysis showed that PHQ-9 scores were positively correlated with age (ρ=0.163, p<0.001), duration of disease (ρ=0.186, p<0.001), monthly OPD visits (ρ=0.137, p<0.001), medicine expenditure (ρ=0.259, p<0.001), and daily tablet burden (ρ=0.143, p<0.001).

No significant correlation was observed with waiting time (ρ=0.065, p=0.108) or hospital admissions (ρ=−0.037, p=0.358). WHODAS scores demonstrated significant positive correlations with age (ρ=0.193, p<0.001), disease duration (ρ=0.209, p<0.001), and medicine expenditure (ρ=0.299, p<0.001), whereas correlations with monthly OPD visits (ρ=0.067, p=0.100), waiting time (ρ=0.075, p=0.063), hospital admissions (ρ=−0.010, p=0.813), and tablets/day (ρ=0.061, p=0.134) were not statistically significant.

Overall, increasing age, longer disease duration and greater medication-related expenditure appeared to be associated with both greater depressive symptom burden and functional disability, while healthcare waiting time and hospitalisation frequency showed no significant relationship with either outcome.

Table 6: Multivariable binary logistic regression for factors associated with poor medication adherence

Predictor	Adjusted OR	95% CI	p-value
Age (per year)	0.995	0.979–1.011	0.509
Duration of disease (per year)	**1.050**	**1.018–1.082**	**0.002**
Monthly OPD visits	**0.403**	**0.212–0.768**	**0.006**
Waiting time (per minute)	0.998	0.997–1.000	0.054
Hospital admissions	1.025	0.905–1.161	0.699
Medicine expenditure (per ₹1)	1.000	1.000–1.000	0.266
Tablets/day	**1.113**	**1.038–1.193**	**0.003**
WHODAS score (per point)	0.975	0.946–1.005	0.106
PHQ-9 score (per point)	**1.087**	**1.030–1.148**	**0.002**
Gender	1.660	0.982–2.803	0.058
Location	**0.608**	**0.412–0.896**	**0.012**

Multivariable binary logistic regression identified several independent factors associated with poor medication adherence. Longer duration of disease was independently associated with greater odds of poor adherence, with the odds increasing by approximately 5% for each additional year of disease duration (adjusted OR [aOR]=1.050, 95% CI: 1.018–1.082; p=0.002). In contrast, a greater number of monthly OPD visits was associated with lower odds of poor adherence (aOR=0.403, 95% CI: 0.212–0.768; p=0.006). Increasing daily tablet burden was independently associated with poor adherence, with each additional tablet per day increasing the odds by approximately 11% (aOR=1.113, 95% CI: 1.038–1.193; p=0.003). Depression also emerged as an independent factor: each one-point increase in PHQ-9 score was associated with an approximately 9% increase in the odds of poor medication adherence (aOR=1.087, 95% CI: 1.030–1.148; p=0.002). Location was also independently associated with adherence (code 2 versus code 1: aOR=0.608, 95% CI: 0.412–0.896; p=0.012). Age, hospital admissions, medicine expenditure, WHODAS score and gender did not demonstrate statistically significant independent associations with poor

adherence, although the association with gender was borderline (p=0.058). Waiting time also approached but did not reach statistical significance (p=0.054).

Discussion

Medication adherence is a multidimensional determinant of outcomes in chronic disease and is influenced by patient-related, disease-related, treatment-related and healthcare-system factors. [1,3,7] In the present study of 610 patients with chronic diseases, 35.57% demonstrated low medication adherence, while 64.43% had good adherence. Low adherence was significantly associated with longer disease duration, greater daily tablet burden, and several socioeconomic and healthcare-utilisation characteristics, including employment, literacy, geographical location and monthly OPD attendance. These findings reinforce the concept that adherence is a complex behavioural and healthcare-delivery outcome rather than simply a consequence of patient motivation. [3,7] The use of the General Medication Adherence Scale (GMAS) is particularly relevant because it is a multidimensional instrument developed to assess medication-taking behaviour in patients with chronic illnesses and has demonstrated validity across different populations and cultural settings. [21,22] However, GMAS should not be considered an independent predictor in causal modelling when the adherence classification is derived from the same or closely related adherence constructs.

One of the principal findings was the association between longer disease duration and poorer medication adherence. Patients with low adherence had a significantly longer duration of disease, and disease duration showed a significant inverse correlation with adherence. In the multivariable model, each additional year of disease duration increased the odds of poor adherence by approximately 5% (aOR 1.050, 95% CI 1.018–1.082; p=0.002). Chronic diseases frequently require prolonged or lifelong treatment, and adherence may decline over time because of treatment fatigue, perceived reduction in treatment benefit, adverse effects and increasing treatment burden. Chen et al. highlighted that medication adherence is dynamic and may change throughout the course of chronic disease, while qualitative evidence indicates that patients continuously balance perceived treatment benefits against inconvenience and treatment burden. [13,14] Thus, patients with longstanding disease may require repeated adherence assessment rather than assuming that adherence established early in treatment will persist.

The significant association between daily tablet burden and poor adherence provides further evidence for the role of treatment complexity. Patients with low adherence consumed significantly more tablets per day, and in multivariable analysis each additional tablet was associated with approximately 11% higher odds of poor adherence (aOR 1.113, 95% CI 1.038–1.193; p=0.003). Increasing regimen complexity creates greater opportunities for missed doses, confusion and intentional discontinuation, particularly among patients with multimorbidity. Kardas et al. identified treatment and regimen-related factors among important determinants of adherence, while Kvarnström et al. found that patients commonly perceive medication burden and practical inconvenience as barriers to sustained adherence. [7,14] The ADAGIO study similarly demonstrated the importance of treatment- and patient-related determinants of adherence. [6] These findings support practical interventions such as regimen simplification, once-daily formulations where clinically appropriate, medication reconciliation and synchronisation of refills.

Healthcare utilisation also showed an important relationship with adherence. Monthly OPD attendance was significantly associated with adherence in categorical analysis, and in multivariable regression, greater OPD attendance was associated with substantially lower odds of poor adherence (aOR 0.403, 95% CI 0.212–0.768; p=0.006). This may indicate that regular contact with healthcare professionals provides opportunities for reinforcement of treatment instructions, monitoring and adherence counselling. However, frequent healthcare contact may alternatively reflect greater disease burden or poorer disease control and should therefore not automatically be interpreted as evidence of better adherence. Healthcare utilisation is influenced by accessibility, affordability, continuity of care and communication. [13,18] Evidence from India has demonstrated substantial socioeconomic and health-system variation in healthcare utilisation among patients with non-communicable diseases, while studies from Kolkata have highlighted accessibility, affordability and continuity-of-care barriers in chronic disease management. [10,18,19]

The significant associations of adherence with employment, literacy and geographical location further support the influence of social and contextual determinants. Literacy may affect understanding of prescriptions and medication instructions, whereas employment can influence financial resources, time availability and the practical feasibility of maintaining treatment schedules. Geographic location may influence transportation, healthcare accessibility and continuity of treatment. Banerjee et al., in a mixed-method study from rural West Bengal, similarly demonstrated that adherence among patients with non-communicable diseases was shaped by

interacting individual, social and healthcare-system factors. [15] These findings are particularly relevant in the Indian setting, where adherence interventions need to address socioeconomic and accessibility barriers alongside patient education.

The relationship between depression and medication adherence requires particular consideration. Although PHQ-9 score was not statistically significant in the initial unadjusted comparison, depression became an independent predictor of poor adherence after multivariable adjustment. Each one-point increase in PHQ-9 score was associated with an approximately 9% increase in the odds of poor adherence (aOR 1.087, 95% CI 1.030–1.148; p=0.002). This finding is consistent with the meta-analysis by Grenard et al., which demonstrated an association between depression and poorer medication adherence across chronic diseases. [4] The relatively high burden of depressive symptoms in the present population is also consistent with evidence demonstrating substantial depression prevalence in Indian primary-care settings. [5] The emergence of depression as significant only after adjustment suggests that its relationship with adherence may be partly masked by disease duration, treatment burden, healthcare utilisation and other covariates. Depression may impair motivation, concentration and treatment organisation, while chronic treatment demands may simultaneously contribute to psychological distress, making the relationship potentially bidirectional.

The analysis of depression and functional disability against disease and healthcare characteristics provided additional insight. PHQ-9 scores were significantly positively correlated with age, disease duration, monthly OPD visits, medicine expenditure and daily tablet burden, whereas WHODAS scores were significantly correlated with age, disease duration and medicine expenditure. The strongest observed relationship for both psychological and functional outcomes was with medicine expenditure, suggesting that expenditure may partly represent overall disease and treatment burden. Previous literature has identified economic barriers as important determinants of chronic disease management and adherence, particularly in vulnerable populations. [8,10,15,18,23] Increasing age and longer disease duration may similarly reflect cumulative physical, psychological and functional consequences of chronic illness. [13,14] Conversely, waiting time and hospital admissions were not significantly associated with either PHQ-9 or WHODAS scores, suggesting that cumulative disease and treatment burden may be more relevant to these outcomes than isolated healthcare encounters.

Despite the presence of functional limitations, WHODAS score was not significantly associated with medication adherence. Functional disability could theoretically impair medication-taking through difficulties with mobility, cognition or self-care, but disability may simultaneously increase dependence on caregivers and healthcare professionals, thereby improving medication supervision. The absence of a significant association may therefore reflect opposing pathways and should not be interpreted as evidence that functional disability has no influence on adherence.

Disease-specific analysis demonstrated significant associations between adherence and hypertension, COPD, type 2 diabetes mellitus, ischaemic heart disease, rheumatoid arthritis and osteoarthritis. These findings should be interpreted cautiously because disease frequencies differed considerably and some individual disease groups were small. Nevertheless, the association observed for diabetes is consistent with Indian evidence demonstrating that adherence to antidiabetic therapy is influenced by patient-, treatment- and healthcare-related factors. [12,20] Differences between disease groups may also reflect variation in symptom burden, perceived treatment benefit, medication complexity, treatment duration and consequences of non-adherence.

The findings have important clinical implications. Evidence from the Cochrane review by Haynes et al. indicates that improving medication adherence generally requires active interventions rather than simply advising patients to take their medicines regularly. [1] A systematic review of interventions in India similarly identified educational, behavioural, reminder-based, counselling and healthcare-system approaches, although effectiveness varies between settings.[16] Patients with longstanding disease should therefore undergo periodic adherence reassessment, while those with high pill burden may benefit from regimen simplification. Depression screening should also be incorporated into chronic disease care, particularly because depressive symptoms demonstrated an independent association with poor adherence in the adjusted model.

Effective patient–provider communication represents another potentially modifiable component. Studies of chronic disease care in India have identified challenges in clinical communication and handover, highlighting the importance of clear, coordinated and patient-centred communication. [11,17]

Medication reconciliation, understandable written and verbal instructions, discussion of adverse effects, simplified dosing schedules and caregiver involvement where appropriate may help address both intentional and unintentional non-adherence.

Finally, medication non-adherence has consequences extending beyond individual disease control, including treatment failure, increased healthcare utilisation and avoidable economic burden. [23] Therefore, adherence interventions may offer both clinical and economic benefits. A multidimensional approach addressing disease chronicity, treatment complexity, depressive symptoms, socioeconomic circumstances, healthcare accessibility and communication is likely to be more effective than treating non-adherence solely as an individual behavioural problem.

The cross-sectional design limits determination of temporal or causal relationships. The hospital-based setting may limit generalisability, while self-reported adherence may be affected by recall and social-desirability bias. The heterogeneous chronic-disease population and small numbers within some disease categories may also obscure disease-specific associations. Nevertheless, the study provides a comprehensive assessment of medication adherence alongside psychological, functional, treatment and healthcare-related factors in a chronic-disease population.

Overall, the study demonstrates that poor medication adherence is strongly related to disease chronicity and treatment burden, while depressive symptoms emerge as an important independent predictor after adjustment. These findings support periodic adherence assessment, treatment simplification, psychological screening, improved patient–provider communication and attention to socioeconomic and healthcare-access barriers as integral components of chronic disease management.

Conclusion

In this hospital-based population of adults with chronic diseases, medication non-adherence was not simply a consequence of individual patient behaviour but reflected the combined influence of disease chronicity, treatment burden, psychological distress and healthcare utilization. Longer disease duration, greater daily tablet burden and increasing depressive symptom severity were independently associated with higher odds of poor medication adherence, whereas more frequent outpatient attendance was associated with lower odds of poor adherence. These findings highlight the importance of moving beyond a purely patient-centred view of non-adherence towards a multidimensional approach that incorporates treatment simplification, periodic adherence assessment, screening and management of depressive symptoms, effective patient–provider communication and accessible continuity of outpatient care. Although the cross-sectional design precludes causal inference, the findings suggest that identifying patients with prolonged disease duration, complex medication regimens and depressive symptoms may help clinicians recognize those at greater risk of poor adherence and prioritize them for targeted adherence-support interventions.

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