

Pill Burden and Treatment Adherence among Individuals with Multiple Long-Term Conditions in Rural Haryana

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ABSTRACT

Background: Non-communicable diseases (NCDs) such as diabetes and hypertension are rising rapidly in India, especially in rural areas where limited resources and multiple comorbidities increase the treatment burden. Polypharmacy and high pill burden may reduce adherence and worsen outcomes.

Objectives: To evaluate the level of pill burden and treatment adherence among adults with multiple long-term conditions in rural Haryana and to identify associated sociodemographic and clinical factors.

Methods: A community-based cross-sectional study was conducted among 85 participants aged 45–60 years residing in two villages under the Primary Health Centre, Garhi Harsaru, Gurugram. Eligible participants had two or more chronic conditions and were selected using simple random sampling. Data were collected through interviews using a pre-tested schedule. Pill burden was measured by the total number of pills taken daily, and treatment adherence was assessed using the pill-count method. Data were analysed with descriptive statistics and Chi-square tests at a 95% confidence level.

Results: Hypertension (90.6%) and diabetes (85.9%) were the most prevalent chronic conditions. The mean pill-burden score was 11.3 ± 2.6 , and the mean adherence score was 18.7 ± 3.1 . Family type and family history of diabetes, hypertension, and asthma showed significant associations with pill burden ($p < 0.05$). Educational status was borderline significant for adherence.

Conclusion: High pill burden negatively influences adherence among rural patients with multimorbidity. Strengthening patient education, simplifying medication regimens, engaging ASHA workers, and using digital reminder tools can substantially improve adherence and clinical outcomes in resource-limited settings.

Keywords: Pill burden, treatment adherence, multimorbidity, rural India, chronic disease management

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INTRODUCTION

Globally, noncommunicable diseases (NCDs), particularly diabetes mellitus and cardiovascular diseases, have been identified as the primary cause of death. [1] Major NCDs are responsible for 47% of the worldwide illness burden and about 60% of all deaths in terms of morbidity, mortality, and disability. [2] Low- and middle-income nations like China and India account for the majority of fatalities. [3] In India, NCDs are responsible for 53% of all fatalities. Patients' poor control status is the main cause of the rising burden of morbidity and mortality from NCDs. [4] Long term condition defined as "health issues that need to be managed continuously for years or decades"[5] fail to acknowledge the financial, social, and personal costs that an individual, their families, and the larger community bear. Multi-long term conditions, described as "multi-morbidity," which is the co-occurrence of two or more chronic illnesses in a single person.[6] Pill burden is a term used to describe the burden of taking multiple medications, including the number of pills, the frequency of administration, and the complexity of the regimen[7]. Rural patients face additional challenges with high pill burden and polypharmacy, which reduce treatment adherence. Studies in rural India report adherence rates as low as 46.6% among elderly patients with chronic illnesses, with cost, forgetfulness, and lack of caregivers as major barriers. Similarly, rural women with hypertension experience low awareness, poor access, out-of-pocket

payments, and pill burden, all contributing to non-adherence. Yet, the specific impact of pill burden on adherence among rural patients with multiple chronic conditions remains underexplored [38,39].

Non-communicable diseases (NCDs) are a leading cause of morbidity and mortality in India. Poor medication adherence, driven by factors such as pill burden, multimorbidity, low education, and limited healthcare access, affects nearly half of patients with NCDs, leading to suboptimal disease control, complications, and increased healthcare costs. Evidence from interventions in India suggests that patient education, support from community health workers and pharmacists,

simplified treatment regimens, regular follow-up, and technology-based solutions can significantly improve adherence. Addressing these barriers is critical for enhancing clinical outcomes, reducing the economic burden of NCDs, and strengthening the effectiveness of national healthcare strategies[42,43].

Adherence to therapy—the extent to which patients follow prescribed treatments—is a critical determinant of effective chronic disease management worldwide, including conditions like diabetes, hypertension, and cardiovascular diseases. Globally, poor adherence contributes to disease progression, complications, hospitalizations, and escalating healthcare costs, while good adherence improves clinical outcomes, reduces complications, and enhances quality of life. Barriers vary across regions and populations, including complex treatment regimens, limited awareness, socioeconomic constraints, and gaps in healthcare support. Strategies such as patient education, simplified regimens, digital health tools, and continuous professional support have shown promise in improving adherence. Strengthening adherence is essential not only for individual patient health but also for the sustainability and efficiency of healthcare systems globally[40,41]

Treatment adherence involves consistently following prescribed medications, lifestyle changes, and medical advice to manage conditions like heart disease. In rural India, limited healthcare facilities, poor transport, and financial constraints hinder access and affordability, leading many to prioritize basic needs over treatment. [8,9] In rural areas, managing multiple chronic conditions is complex and resource-intensive. Limited finances further hinder access to consistent care, leaving individuals struggling with both health challenges and economic hardship. [21]

Multimorbidity as Public Health Concern, with rising longevity and NCDs, multimorbidity—having two or more chronic conditions—is a growing public health issue, especially in LMICs like India. It leads to poorer health, higher mortality, and increased costs. Yet, healthcare systems still focus on single diseases, resulting in poor outcomes. The COVID-19 pandemic underscored the need for integrated care, but data on multimorbidity in LMICs remains limited. [25] Medication Regimens A 2017 study in Egypt

assessed medication-related care among 63 elderly residents in two institutions. It found high rates of chronic illness, poor patient education, low adherence, and limited awareness of medications. The study recommends better health insurance access and involving clinical pharmacists and gerontological nurses to improve drug management. [29]

Despite increasing awareness of multimorbidity and the complexities of managing multiple chronic conditions, limited evidence exists on how pill burden influences treatment adherence, particularly in rural India. Most existing studies focus on single diseases or urban, hospital-based populations, overlooking the challenges faced by rural patients where access, affordability, and medication continuity remain major barriers. Understanding the impact of pill burden on adherence in such settings is crucial for developing simplified treatment strategies that enhance adherence and reduce the burden of chronic diseases in resource-limited areas like rural Gurugram.

METHODOLOGY

Study Design: A community-based cross-sectional design was chosen to capture real-world patterns of pill burden and treatment adherence. Focusing on long-term, multiple conditions is essential, as patients with multimorbidity face complex regimens and higher risk of non-adherence, directly impacting disease control and quality of life.

Study Setting and Participants: The study was conducted in two villages, Chandu and Sadhrana, under the Primary Health Centre (PHC), Garhi Harsaru, serving a population of approximately 45,729 (Census 2011). Participants were aged 45–60 years with two or more chronic conditions and taking at least one prescribed medication. Eligible individuals were selected using simple random sampling from the PHC registry to ensure a representative and unbiased sample.

Sampling and Sample Size: A simple random sampling technique was used to select the two study villages. The final sample size was 85,

calculated using the formula for estimating a proportion:

$$n = Z^2 \cdot p \cdot (1-p) / d^2$$

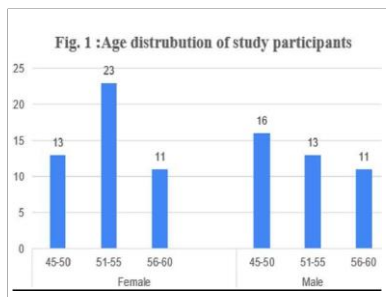
where n is the required sample size, Z is the Z statistic corresponding to the desired confidence level (e.g., 1.96 for 95% confidence), P is the estimated prevalence, and d is the desired precision or margin of error. Selecting appropriate parameters—including confidence level, precision, variability, and anticipated loss—is crucial for accurate sample size estimation (Naing et al., 2022). rate.

Data Analysis: Data were entered into Microsoft Excel, verified for accuracy, and analyzed using SPSS version 26. Pill burden was calculated as the total number of pills taken daily, categorized as 2 pills for patients with two chronic conditions and more than 2 pills for those with multiple (>2) conditions. Treatment adherence was assessed using the pill count method. Descriptive statistics summarized the study variables. Associations between categorical variables were analyzed using Chi-square tests, with statistical significance set at a 95% confidence interval (CI).

Ethical Considerations: Ethical approval was obtained from the Institutional Ethical Committee of SGT University, Gurugram (Approval No.: IEC/FMHS/MD/MS/MPH/2023-8). All participants provided informed consent prior to their inclusion in the study. The study was conducted in accordance with the principles of Good Clinical Practice (GCP).

RESULT

There was a total of 85 eligible participants between the ages of 45–60 years selected using simple random sampling from the field practice area under the Department of Community Medicine, SGT University, in the rural area of Gurugram district. Data was collected by interviewing the participants using a pre-designed and pre-tested study proforma.



Among the 85 participants, hypertension was the most prevalent long-term condition, affecting over 90% of the sample, followed closely by diabetes (approximately 86%). Arthritis was reported by nearly one-fifth of participants, whereas cardiac disease was relatively uncommon (around 3%). Other conditions such as thyroid disorders and asthma were present in 10–13% of participants, while depression and tuberculosis were rare. Overall, a majority of participants reported having at least one chronic condition, highlighting the high burden of multimorbidity in this population.

Table 1: Sociodemographic and Clinical Distribution of Participants (n = 85)

Variables	Categories	Number (%)
Age (years) Mean ± SD 52.9 ± 4.1	45–50	27 (31.8%)
	51–55	36 (42.4%)
	56–60	22 (25.9%)
Sex	Female	45 (52.9%)
	Male	40 (47.1%)
Educational Status	Illiterate	29 (34.1%)
	8th pass	24 (28.2%)
	10th pass	12 (14.1%)
	12th pass	4 (4.7%)
	Graduate	0 (0%)
Earning Status	Yes	48 (56.5%)
	No	37 (43.5%)
Number of Kids Median [IQR] 2 [2–3]	1	4 (4.7%)
	2	38 (44.7%)
	3	35 (41.2%)
	4	7 (8.2%)
	5	1 (1.2%)
Type of Family	Joint	36 (42.4%)
	Nuclear	49 (57.6%)

The prevalence of chronic conditions among participants varied considerably. Diabetes and hypertension were highly prevalent, affecting the majority of individuals, whereas arthritis, thyroid disorders, and asthma were reported by a smaller subset. Cardiac disease,

tuberculosis, and depression were relatively uncommon in this population. Overall, the findings indicate that metabolic and cardiovascular conditions were the most prominent health concerns among the participants.

Table 2: Showing long terms and other long-term conditions in the participants and participant’s family.

		Number (%) in Participants	Number (%) in Participant’s Family
Long term conditions	Diabetes	73(85.9)	37 (43.52)
	Hypertension	77(90.6)	17 (20.0)
	Arthritis	16(18.8)	24 (28.2)
	Cardiac disease	3(3.5)	3 (3.5)
Others	Tuberculosis	1(1.2)	24 (28.2)
	Thyroid	11(12.9)	22 (25.9)
	Asthma	9(10.6)	36 (42.4)
	Depression	2(2.4)	1 (1.2)

Among the study participants, diabetes (43.5%) and asthma (42.4%) were the most commonly reported long-term conditions. Arthritis (28.2%), tuberculosis (28.2%), and thyroid disorders (25.9%) were also relatively frequent. Hypertension was present in one-fifth (20%) of the participants, while cardiac disease was less common (3.5%). Only a small proportion (1.2%) of participants reported depression.

Table 3: Showing the pill burden among participants

Statement	1 (Strongly Agree)	2 (Agree)	3 (Disagree)	4 (Strongly Disagree)
The number of tablets I must take has an influence on how sick I feel.	23 (27.1%)	55 (64.7%)	7 (8.2%)	0 (0%)
I need help at home in order to prepare the intake of tablets for	11 (14.9%)	28 (32.9%)	36 (42.4%)	10 (11.8%)

the day/week.				
How much time do you need per day on average to prepare your tablets?	38 (44.7%)	25 (29.4%)	22 (25.9%)	0 (0%)
The appearance of the tablets is important for me to correctly assign my drugs.	41 (48.2%)	20 (23.5%)	22 (25.9%)	2 (2.4%)
The correct use of drugs is harder for me when their appearance changes.	48 (56.5%)	19 (22.4%)	17 (20.0%)	1 (1.2%)
I am concerned about accidentally forgetting pills or taking the wrong tablets/dose	58 (68.2%)	18 (21.2%)	9 (10.6%)	0 (0%)

Participants reported several challenges in managing their health and treatment regimens. A significant proportion experienced difficulties in handling multiple medications and remembering the timing and method of administration. Financial aspects, including paying for prescriptions and over-the-counter medications, were also a notable concern for some participants. Collecting prescription medications and monitoring chronic conditions, such as blood pressure or blood sugar, required considerable effort for the majority. Arranging appointments and consulting multiple health professionals were additional challenges, reflecting the complexity of navigating healthcare services for individuals with long-term conditions.

Table 4: Showing the treatment adherence among participants

Statement	0(Not Difficult)	1(A Little Difficult)	2(Quite Difficult)	3(Very Difficult)	4(Extremely Difficult)
Taking lots of medications	3 (3.5%)	18 (21.2%)	35 (41.2%)	28 (32.9%)	1 (1.2%)
Remembering how and when to take medication	2 (2.4%)	27 (31.8%)	20 (23.5%)	35 (41.2%)	1 (1.2%)
Paying for prescriptions, over-the-counter equipment	5 (5.9%)	53 (62.3%)	22 (25.9%)	4 (4.7%)	1 (1.2%)
Collecting	0 (0%)	10 (11.8%)	14 (16.5%)	59 (69.4%)	2 (2.4%)
Monitoring your medical conditions (e.g., checking blood pressure, blood sugar, or symptoms)	0 (0%)	0 (0%)	9 (10.6%)	70 (82.4%)	6 (7.1%)
Arranging appointments with health professionals	0 (0%)	0 (0%)	3 (3.5%)	64 (75.3%)	18 (21.2%)
Seeing lots of different health professionals	0 (0%)	0 (0%)	4 (4.7%)	41 (48.2%)	40 (47.1%)

The study population had a mean age of 52.9 ± 4.1 years, with most participants falling between 51 and 55 years. Females slightly outnumbered males. Educational attainment was generally low, with over 60% having completed up to the 8th grade and none being graduates. More than half of the participants reported earning an income. The median number of children per participant was 2, with the majority having two or three children. A larger proportion of participants lived in nuclear families compared to joint families, reflecting contemporary household structures in the study setting.

Table 5: Pill Burden/ Treatment Adherence Scores Among Participants

Variable	Mean ± SD	Median [IQR]
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Pill burden score	11.3 ± 2.6	11 [9–13]
Treatment adherence score	18.7 ± 3.1	18 [16–20]

Participants generally demonstrated a moderate level of adherence to their prescribed treatment regimens. While most maintained consistent adherence, variability in scores indicates that a subset of participants faced challenges in following their medication schedules, highlighting the need for targeted support to improve compliance.

Among the socio-demographic and clinical factors examined, family type and a family history of chronic conditions, including diabetes, hypertension, and asthma, were significantly associated with the outcome of interest. Other factors, such as gender, educational level, earning status, number of children, and the presence of diabetes or hypertension in the participant, did not show a statistically significant association. These findings suggest that familial and household characteristics may play an important role in influencing the studied outcome.

Table 7: Association of Factors with Pill Burden (n = 85)

Factors	χ^2 Value	P-Value	Significance (P < 0.05)
Gender	0.161	0.688	NS
Education	3.014	0.083	NS
Earning	1.961	0.161	NS
Number of Kids	6.109	0.191	NS
Family Type	6.869	0.009	Significant
Diabetes	2.123	0.145	NS
Hypertension	2.009	0.156	NS
Family History – Diabetes	5.363	0.021	Significant
Family History – Hypertension	5.152	0.023	Significant
Family History – Asthma	6.869	0.009	Significant

Table 8: Association of Factors with Treatment Adherence (n = 85)

Factor	χ^2 Value	P-Value	Significance (P < 0.05)
Educational Status	3.609	0.057	Borderline

			Significant
Earning Status	1.5109	0.219	NS
Number of Kids	3.8014	0.434	NS
Type of Family	0.6626	0.416	NS
Presence of Long-Term Conditions	0.0010	0.970	NS

Analysis of socio-demographic and health-related factors revealed that most variables, including earning status, number of children, family type, and the presence of long-term conditions, were not significantly associated with the outcome. Educational status showed a borderline significant relationship, suggesting a potential but not definitive influence. Overall, these findings indicate that the studied outcome appears largely independent of the examined demographic and health characteristics.

DISCUSSION

This study highlights that treatment adherence among individuals with multiple long-term conditions is shaped by a combination of socio-demographic, behavioral, and systemic factors. Females, particularly older homemakers, demonstrated lower adherence levels, reflecting patterns reported in earlier studies that attribute this to limited literacy, dependency on family members, and lower health awareness. Educational status emerged as a critical determinant, as low-literate participants often required assistance in managing their medications and struggled with understanding complex regimens. Similar associations between health literacy and adherence have been observed in previous research conducted in rural populations, reinforcing the need for patient education interventions.

Among the participants, diabetes and asthma were the most commonly reported chronic conditions, followed by arthritis, tuberculosis, and thyroid disorders. Hypertension was observed in a smaller proportion of participants, while cardiac disease and depression were rare. These findings highlight that metabolic and respiratory conditions were the predominant health concerns in the study population.

The study population exhibited a moderate level of pill burden, with most participants taking a number of medications consistent with the observed central tendency. The distribution of pill burden scores suggested that while some participants managed relatively few medications, a notable proportion had higher daily medication requirements, reflecting the complexity of their treatment regimens.

The findings also showed that high pill burden, forgetfulness, and confusion due to medication changes were major barriers to adherence, consistent with evidence linking regimen complexity and memory-related challenges to poor compliance in chronic disease management. Economic and logistical constraints, including cost of medicines, transportation, and irregular follow-up, further contributed to missed doses. The issue of fragmented care—where patients sought treatment from multiple providers—was found to disrupt continuity, as reported in several studies emphasizing the lack of coordinated healthcare in rural India.

Overall, the study indicates that females with lower literacy are particularly vulnerable, and adherence is influenced by both personal and health system-related factors. Strengthening patient literacy through community-based education, using pictorial or simplified instructions, and engaging family members or community health workers could improve medication management. At the system level, integrating reminder systems, ensuring continuity of care, and improving access to affordable primary healthcare can help reduce non-adherence.

The study acknowledges certain limitations, including its small sample size, short duration, lack of follow-up, recall bias in self-reported data, and area-specific nature, which may restrict the generalizability of results. Future studies with larger, diverse samples and longitudinal designs are recommended to validate these findings and develop tailored strategies to improve adherence among patients with multiple chronic conditions.

CONCLUSION

This study highlights that pill burden significantly affects treatment adherence among patients with multiple long-term conditions, leading to confusion, missed doses, reliance on caregivers, and increased time

spent managing medications. A substantial proportion of participants reported feeling sicker due to the number of tablets (91.8%), concerns about forgetting or taking the wrong dose (89.4%), confusion from changes in medication appearance (78.9%), and spending 10–15 minutes daily preparing their tablets (74.1%). Many relied on pill appearance for identification (71.7%) and required assistance at home to manage medications (47.8%). Broader challenges included difficulty in monitoring health, collecting prescribed medications (88.3%), coordinating care among multiple providers, managing appointments, and financial constraints (31.8%).

These findings underscore the critical role of ASHA workers and community health support in guiding medication management, while digital reminder systems can further improve adherence. Policy frameworks should prioritize patient education, simplified regimens, structured follow-up, and coordinated care. Future intervention-based studies should focus on evaluating these strategies in rural settings to strengthen evidence-based programs, reduce pill burden, and improve health outcomes in this vulnerable population.

Overall, the study underscores the urgent need for patient-centered interventions to reduce pill burden, improve medication management, and address financial and systemic barriers. Enhancing patient education, streamlining care coordination, and offering tailored support can significantly improve adherence and health outcomes in this vulnerable population.

RECOMMENDATIONS

To improve treatment adherence and reduce pill burden among patients with multiple long-term conditions, continuous health education should be prioritized through tailored programs, simple educational materials, one-on-one counseling, peer support groups, and digital tools like SMS reminders. Regular workshops—both online and offline—can reinforce knowledge and encourage behavior change, while efforts should be continuously monitored and updated. Frontline health workers such as ASHAs and ANMs play a crucial role: ASHAs can provide door-to-door guidance and support for medication management,

while ANMs can reinforce adherence during health check-ups. Community leaders can further promote adherence by spreading awareness at local events, fostering a culture of accountability and health ownership. Digital reminder systems and mobile health tools can reduce missed doses and simplify pill tracking. Simplifying medication regimens through combination therapies or adjusted dosing schedules, coupled with targeted patient and caregiver education, can further enhance adherence. Structured follow-up, coordinated care across multiple providers, and policy measures supporting medication access and adherence tools are especially important in rural and low-income settings. Future intervention-based studies should evaluate these strategies in real-world rural contexts to strengthen evidence-based programs and optimize health outcomes.

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