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DETERMINANTS OF MEDICATION ADHERENCE AMONG CHRONIC DISEASE PATIENTS IN YOGYAKARTA: STRUCTURAL EQUATION MODELING (PLS-SEM) APPROACH

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ABSTRACT

Chronic diseases are a major global health challenge and remain a leading cause of morbidity and mortality in Indonesia. Sustained adherence to long-term pharmacological therapy is essential but is often suboptimal. This study aimed to analyze the determinants of medication adherence among patients with chronic diseases at RSUD Kota Yogyakarta using structural equation modeling-partial least squares (SEM-PLS). A cross-sectional survey was conducted between January and February 2025 with 120 purposively selected outpatients. Medication adherence was assessed using the Adherence to Refills and Medications Scale (ARMS) and additional questionnaires measuring therapeutic regimens, patient perceptions, socioeconomic factors, and healthcare system attributes. Data were analyzed using SmartPLS 4. The results showed that 74.2% of patients had low adherence and 25.8% had moderate adherence, with none achieving high adherence. SEM-PLS analysis indicated that therapy complexity (β=0.262, $p<0.01$), patient perception (β=0.381, $p<0.01$), socioeconomic status (β=0.265, $p<0.01$), and healthcare system support (β=0.199, $p<0.01$) were significant predictors, explaining 66% of adherence variance (R^2=0.660). In conclusion, medication adherence among patients with chronic diseases in Yogyakarta was low and was strongly influenced by regimen burden, perception, socioeconomic status, and healthcare support. Targeted interventions addressing these factors are essential for improving adherence and long-term health outcomes.

Keywords: chronic disease, therapy adherence, ARMS, SEM-PLS, Yogyakarta

INTRODUCTION

Chronic diseases have emerged as a critical global health issue, with increasing prevalence and associated mortality rates. According to *World Health Organization* (WHO) estimates in 2014, approximately 70,000 deaths worldwide were attributed to chronic conditions, primarily driven by unhealthy lifestyle choices. Epidemiological projections suggest a substantial increase in the number of individuals affected by chronic diseases, with Indonesia anticipated to experience a significant shift, and chronic illnesses were projected to become the leading cause of death by 2018 (Febriawati et al., 2022). Among the most prevalent

contributors to global mortality are diabetes mellitus, hypertension, malignancies, pulmonary disorders and cardiovascular diseases.

A persistent challenge in managing chronic diseases is patient non-adherence to prescribed therapies. Poor adherence not only exacerbates disease progression but also undermines treatment efficacy and compromises patients' quality of life. Empirical evidence indicates that factors such as familial support positively influence adherence, whereas limited health literacy is often associated with nonadherence (Made et al., 2020). Non-adherence may be intentional, stemming from financial constraints or mistrust, or unintentional, such as forgetfulness or incorrect dosing (Alkandahri and Putri, 2021). The consequences are clinically significant and include adverse drug reactions, increased healthcare expenditures, and irreversible organ damage (Rizky et al., 2024).

Given the multifactorial nature of adherence, rigorous investigations are warranted to elucidate its underlying determinants. *Structural equation Modelling* (SEM), particularly the *Partial Least Squares* (PLS) technique, offers a robust analytical framework for examining causal relationships among observed and latent variables (Pradana, 2023). PLS is particularly advantageous in contexts involving small sample sizes and non-normally distributed data (Pradana, 2023). RSUD Kota Yogyakarta, a Class B hospital committed to patient-centered care and safety, provides an appropriate setting for this study, which aims to analyze the factors influencing medication adherence in chronic disease patients using the SEM-PLS approach.

However, most previous studies on medication adherence in Indonesia have been descriptive and focused on single determinants without examining their simultaneous interactions using advanced modeling. Furthermore, there is a lack of empirical evidence from Yogyakarta, where the prevalence of chronic diseases is high, but local adherence determinants remain underexplored. Therefore, this study applies SEM-PLS to comprehensively analyze the factors influencing medication adherence among patients with chronic diseases in Yogyakarta, providing both scientific contributions and practical recommendations for local healthcare programs.

RESEARCH METHODS

Equipment and Materials

The principal instruments employed in this study comprised two structured questionnaires and SmartPLS software (version 4). Patient adherence was evaluated using the *Adherence Refill Medications Scale* (ARMS), a validated and reliable tool (validity coefficient $r = 0.361 > 0.05$; reliability $p = 0.814 > 0.6$), with formal permission from Dr. Sunil Kripalani, M.D., M.Sc., SFHM, FACP of Emory University. To assess the factors influencing adherence, namely perception, socioeconomic status, therapy/medication, and healthcare system, a supplementary questionnaire was developed based on established instruments from prior research. Demographic and clinical characteristics were recorded using a standardized respondent-identification form. SmartPLS was selected for data analysis because of its methodological flexibility, capacity to accommodate small sample sizes and non-normally distributed data, and compatibility with various measurement scales (Harahap, 2020).

Research Procedure

1. Research Design and Participants
   This study adopted a cross-sectional design with an observational analytic approach to investigate the determinants of medication adherence among patients with chronic diseases at RSUD Kota Yogyakarta. The research was conducted from September 2024 to March 2025 at RSUD Kota Yogyakarta, located on Ki Ageng Pemanahan Street, Umbulharjo, Yogyakarta.
2. Sampling Size Calculation
   The study population will include outpatients with chronic diseases attending RSUD Kota Yogyakarta between January and February 2025. Participants were recruited through purposive sampling methods. As the total population size was unknown, the sample size

was calculated using the proportion estimation formula proposed by Lemeshow et al.,(1990), yielding a minimum requirement of 100 respondents with a 10% margin of error. The inclusion criteria encompassed patients aged ≥ 17 years, diagnosed with at least one chronic condition, currently undergoing pharmacological therapy, and willing to participate. Patients with communication impairment were excluded. The independent variables (X) comprised therapy/medication (X1), perception (X2), socioeconomic status (X3), and healthcare system (X4), and the dependent variable (Y) was medication adherence.

Data Analysis

The research process was structured into three sequential phases: (1) Preparation, involving topic selection, proposal development, and administrative approvals; (2) Data Collection, which included pilot testing of questionnaire validity and reliability on 30–40 respondents, followed by full-scale data collection; and (3) Data Management and Analysis, encompassing data processing, interpretation, and reporting.

Data analysis was conducted using SmartPLS version 4. The analytical framework included the evaluation of the measurement model (outer model), assessment of convergent validity, discriminant validity, and reliability, and the structural model (inner model), which examined the R^2 values, effect sizes, and path significance. The model fit was further assessed using the *Goodness of Fit* (GOF) index to ensure the robustness and explanatory power of the proposed model.

RESULTS AND DISCUSSION

The present study was conducted between January and February 2025 and targeted outpatients diagnosed with chronic diseases at the Regional General Hospital (RSUD) Kota Yogyakarta. Data were collected using a structured questionnaire, which was accompanied by verbal clarification and guidance from the researcher to ensure that the respondents accurately comprehended each item. Following data collection and subsequent analytical procedures, 120 participants who met the predefined inclusion criteria were enrolled in this study.

Therapeutic adherence is a multifaceted construct shaped by both intrinsic patient-related attributes and extrinsic elements of the healthcare system. Similar findings were reported by Schäfer (2024), who demonstrated that emotional attitudes, behavioral control, and treatment satisfaction explained about 65% of adherence variation. Barriers to adherence may be categorized into intentional factors, such as financial constraints, individual beliefs regarding treatment effectiveness, and anticipated adverse effects, and unintentional factors, including noncompliance with dosing schedules and the complexity of therapeutic regimens. Additionally, variables such as patient engagement in clinical decision-making, cognitive impairment, and psychiatric comorbidities have been identified as important predictors of adherence (Farisi, 2020).

1. **Level of Medication adherence**

The findings of this study indicated that the majority of respondents indicatet that 89 patients (74.2%) were classified within the low medication adherence category, while 31 patients (25.7%) demonstrated moderate adherence. None of the respondents met the criteria for high adherence.

Table I. Level of Medication adherence

Level of Medication adherence	Frequency (n)	Percentage (%)
High	0	0
Moderate	31	25,8
Low	89	74,2

The observation that a substantial proportion of respondents (74.2%) exhibited low levels of medication adherence aligns with prior empirical evidence reported by Riani

and Putri (2023), who similarly identified a notable prevalence of suboptimal adherence in comparable populations.

2. Relationship of Demographic Characteristics with Medication adherence Level

Further analysis of demographic characteristics in relation to adherence levels revealed discernible patterns in the data. Among patients aged over 65 years, 70% exhibited low adherence and 30% moderate adherence. The predominance of individuals aged over 65 years within the moderate (30%) and low (70%) adherence categories supports existing literature suggesting that cognitive decline among the elderly is significantly associated with reduced medication adherence (Komariyah et al., 2024). In contrast, no statistically significant differences in adherence were observed across the gender groups (Mansyur and Suminar, 2022).

Educational background also appeared to be influential, with 65.78% of patients whose highest level of education was senior high school falling into the low adherence group. Education influenced adherence: 65.78% of high-school graduates showed low adherence, supporting evidence that higher education improves treatment understanding.(Khuzaima, 2021).

Seventy-five percent of married participants had low adherence, possibly because many lacked active spousal support despite their marital status, consistent with evidence linking partner support to better adherence (Isnaini et al., 2023; Pratita (2012), whose study on partner support and *Health Locus of Control* (HLOC) revealed a highly significant association between spousal involvement and adherence to treatment. The cumulative benefits of positive interpersonal interactions have been shown to foster healthier behaviors and lifestyle choices, underscoring the critical role of partner support in sustaining therapeutic adherence (Maulini et al., 2023).

A total of 74.66% of patients with low medication adherence had either recently initiated pharmacological therapy or had been diagnosed with a chronic illness for ≤ 5 years, suggesting that early stage treatment may influence adherence patterns, although this finding contrasts with previous research indicating no significant correlation between treatment duration and adherence (Isnaini et al., 2023). Medication-related behavior also contributed to nonadherence, with 69.44% of patients with low adherence consuming up to three types of drugs and 78.26% taking medication twice daily. Polypharmacy and dosing frequency are known barriers (Ningrum, 2020), and these figures should be interpreted in the context of the respondents' advanced age, which may have required individualized regimen adjustments and could have mitigated the expected impact of these factors.

3. Validity and Reability Testing (*Outer Model*)

Assessment of convergent validity, indicators X2.8, X3.4, X4.6, and X4.9 yielded loading factor values below the acceptable threshold of 0.7 and were therefore excluded from further analysis. The remaining indicators demonstrated satisfactory convergent validity, with loading factors exceeding 0.7.

Table II. Average Variance Extracted

	Average variance extracted (AVE)
X1	0.727
X2	0.702
X3	0.675
X4	0.694
Y	0.567

All constructs demonstrated adequate convergent validity, as evidenced by *Average Variance Extracted* (AVE) values exceeding the recommended minimum threshold of 0.50 (see **Table II**). Discriminant validity was evaluated using both the

Fornell-Larcker criterion and the *Heterotrait-Monotrait* (HTMT) ratio. The square root of the AVE for each construct surpassed its correlations with other constructs, fulfilling the Fornell-Larcker requirement. Furthermore, all HTMT values remained below the critical value of 0.85, confirming satisfactory discriminant validity across the measurement model. Reliability testing further affirmed internal consistency, with all constructs achieving *Cronbach's Alpha* and *Composite Reliability* values above 0.7.

Table III. *Cronbach's Alpha*

	Cronbach's alpha
X1	0.906
X2	0.929
X3	0.881
X4	0.963
Y	0.930

Table IV. *Composite Reliability*

	Composite reliability (rho_c)
X1	0.930
X2	0.943
X3	0.912
X4	0.967
Y	0.940

The *Outer Model* was evaluated using SmartPLS 4.0 to assess the measurement quality of the latent constructs, focusing on both validity and reliability parameters. Validity pertains to the extent to which indicators accurately capture the underlying theoretical constructs (Sarstedt et al., 2021), whereas reliability reflects the consistency of measurements across items (Sekaran and Bougie, 2016). Indicators X2.8, X3.4, X4.6, and X4.9 were excluded from the model due to their *Loading Factor* and *Cross Loading* values falling below the recommended threshold of 0.7, suggesting insufficient construct representation. Such deficiencies may stem from weak item performance, reliability concerns, construct heterogeneity, conceptual overlap, elevated *cross-loadings*, flawed model specifications, or systematic measurement errors (Sarstedt et al., 2021). Following the refinement process, all retained indicators satisfied the criteria for convergent and discriminant validity. Moreover, the *Cronbach's Alpha* and *Composite Reliability* scores exceeded 0.7 across all variables, confirming robust internal consistency and adherence to established reliability standards.

4. *Goodness of Fit* (GOF) Analysis

Table V. SRMR and NFI

	Saturated model	Estimated model
SRMR	0.072	0.072
NFI	0.708	0.708

Model fit was evaluated using the *Standardized Root Mean Square Residual* (SRMR) and *Normed Fit Index* (NFI). The SRMR value was 0.072 (<0.08). Additionally, the NFI value of 0.708, approached the value of 1.

The *Goodness of Fit* (GOF) assessment in *Partial Least Squares Structural Equation Modelling* (PLS-SEM) serves to evaluate both the congruence between the

structural model and empirical data, as well as the model's predictive power. The SRMR value of 0.072, which falls below the recommended threshold of 0.08, demonstrates that the model exhibits a satisfactory fit and effectively replicates the observed data correlations. Additionally, the NFI value of 0.708, which approaches the ideal value of 1, suggests that the proposed model outperforms the baseline model in terms of its explanatory power. Collectively, these indices affirm that the structural model is well aligned with the data and possesses a robust predictive capability.

5. Structural Model Analysis (*Inner Model*)

Table VI. Value of *R-square*

	R-square
Level of Medication adherence (Y)	0.660

The coefficient of determination (R^2) for the dependent variable (medication adherence) was 0.660. The results of the structural model analysis demonstrated that all four independent variables: therapy or medication, patient perception, socioeconomic status, and the healthcare service system, exerted statistically significant effects on medication adherence ($p < 0.05$ for each factor). Specifically:

a. **Therapy/medication variable:** *original sample* = 0.262; T = 3,443.
b. **Patient perception:** *original sample* = 0.381; T = 5.677.
c. **Socioeconomic factors:** *original sample* = 0,265; T = 4.300.
d. **Healthcare service system:** *original sample* = 0.199; T = 3.207.

Collectively, the predictor variables within the structural model accounted for 66.0% of the variance in medication adherence (R^2 = 0.660).

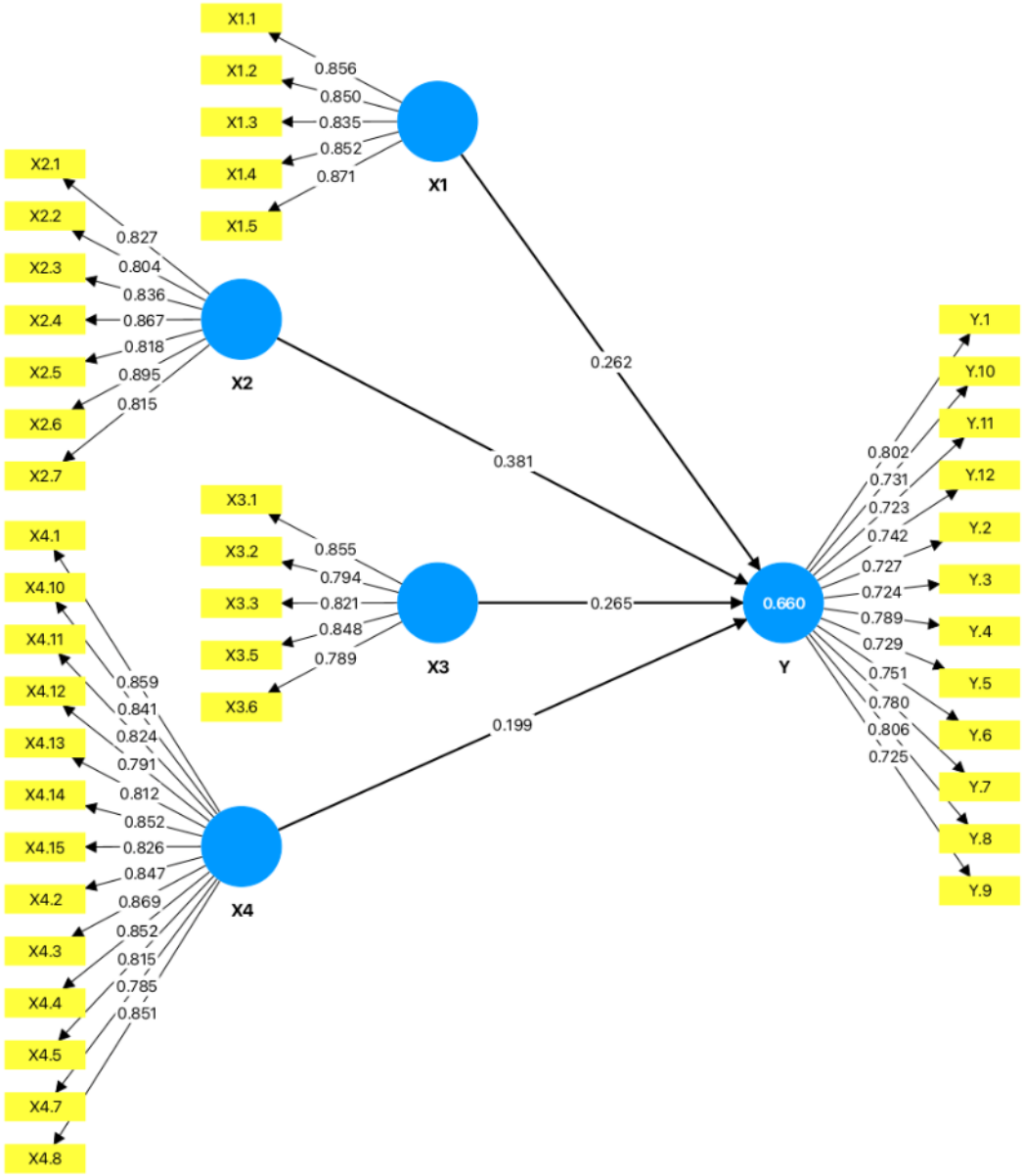

Figure 1. Final *Inner Model* After Modification

Figure 1 illustrates the modified output of the final Inner Model, depicting the causal pathways linking therapy/medication (X1), perception (X2), socioeconomic factors (X3), and the healthcare system (X4) to medication adherence (Y). All path coefficients were statistically significant ($p < 0.05$), suggesting robust associations among the constructs. The model yielded an R^2 value of 0.660, indicating that approximately 66% of the variance in adherence behavior was accounted for by the specified predictors.

Following the confirmation of the measurement model's validity and reliability, the structural model (*Inner Model*) was evaluated using the *bootstrapping* technique. The final model, shown in Figure 1, illustrates the causal pathways linking therapy/medication, patient perception, socioeconomic conditions, and healthcare service quality to medication adherence. The model accounted for 66% of the variance in adherence ($R^2 = 0.660$), indicating that the remaining 34% was attributable to external factors not encompassed within the current framework. This underscores the multifactorial nature of adherence, which is shaped by both individual and systemic determinants rather than a singular influence.

Therapy complexity (number of drugs, frequency, duration, and side effects) significantly affected adherence (β=0.262, p<0.01), confirming regimen burden as a key determinant (Farisi, 2020). Patient perception (illness severity, treatment efficacy, anxiety) strongly predicted adherence (β=0.381, p<0.01), consistent with the Health Belief Model. (Rosenstock et al., 1988; Rahmadi et al., 2024). This aligns with the Health Belief Model and is consistent with the findings of te Paske et al. (2023), who found that trust in healthcare providers and medication beliefs significantly shape adherence behavior.

Socioeconomic variables also contributed meaningfully to adherence outcomes (*original sample* = 0.265; T = 4.300), with financial constraints, limited healthcare access, and inadequate social support frequently associated with suboptimal adherence, corroborating prior research (Farisi, 2020). Additionally, the healthcare service system played a significant role (β=0.199, p<0.01), with effective communication, personalized counselling, and responsive provider–patient interactions being particularly influential. The role of healthcare system support in our study aligns with evidence that trust in physicians strongly predicts adherence, as demonstrated by (Wu et al., 2022). A similar SEM study among hypertensive patients in China found that health literacy and social support significantly influenced adherence, both directly and indirectly (Guo et al., 2023).

Collectively, the findings presented in Figure 1 affirm the complex interplay of medical, psychological, and social factors in shaping adherence behavior. They suggest that interventions should extend beyond regimen simplification to encompass strategies that enhance patient understanding, mitigate socioeconomic barriers, and improve healthcare delivery systems, which is consistent with integrative models of chronic disease management.

Despite offering valuable insights, this study is subject to several methodological limitations that warrant consideration. First, the potential influence of unexamined variables on medication adherence suggests that the current model may not fully capture the complexity of adherence behaviors. Second, inconsistencies in the design of the questionnaire items, particularly the divergence between the socioeconomic instrument and those used for other constructs, such as therapy/medication, perception, and healthcare service systems, may have introduced measurement bias and affected the comparability of the results. Third, the absence of *sworn* or *certified translations* for certain questionnaire items led to semantic ambiguities, which likely contributed to the invalidation of several indicators regarding convergent and discriminant validity. These limitations highlight the need for methodological refinement and instrument standardization in future research to enhance the robustness and generalizability of the findings.

The findings of this study have important practical implications. Hospitals and primary care facilities should strengthen patient education programs that simplify medical information and emphasize the importance of consistent medication use. Strengthening patient education and structured counseling are crucial. A quality improvement project in Portugal also showed that systematic interventions in primary care effectively improved adherence (Oliveira et al., 2024). Pharmacists also play a critical role in structured counseling sessions, ensuring that patients understand dosage schedules and potential side effects. In addition, integrating family and community support, such as caregiver involvement or peer groups, may reduce forgetfulness and motivational barriers in long-term therapy. Furthermore, hospital management could incorporate adherence monitoring into routine follow-up, particularly by aligning with national initiatives such as *Prolanis*, to provide a sustainable framework for chronic care.

This study had several limitations that should be acknowledged. Adherence measurement relied on self-reported questionnaires (ARMS), which may be influenced by recall bias or the tendency of respondents to provide socially desirable answers. In addition, some potentially relevant variables, such as health literacy, cultural beliefs, and psychological factors, were not included in the model. Future studies should incorporate objective adherence measures and expand the range of explanatory variables to enhance the robustness of the findings.

CONCLUSION

The findings of this study indicate that the majority of patients with chronic diseases at RSUD Kota Yogyakarta exhibited low levels of medication adherence, with 74.2% (89 patients) categorized as having low adherence and 25.8% (31 patients) demonstrating moderate adherence. Notably, no respondents were classified within the high adherence category. Statistical analysis further confirmed that four key variables, namely therapy/medication complexity, patient perception, socioeconomic conditions, and the healthcare service system, exerted a significant and positive influence on adherence behavior, as evidenced by p-values below the 0.05 threshold for each factor. These results underscore the multifaceted nature of adherence, suggesting that effective interventions must address both individual and systemic determinants to improve therapeutic results.

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