

# Determinants of Medication Non-Adherence in 1,750 Indonesian Adults with Chronic Diseases: A Nationwide Cross-Sectional Study

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**Purpose:** Medication adherence is critical for effective chronic disease management, yet non-adherence remains a major challenge. Current evidence on medication adherence in Indonesia is constrained by small sample sizes, narrow geographic scope, and a failure to adequately account for the complex interplay of social, economic, and cultural factors. This study aimed to identify factors associated with medication non-adherence in patients with chronic diseases in Indonesia.

**Methods:** This nationwide cross-sectional study was carried out across 34 provinces in Indonesia during April – November 2024. Participants were patients aged 20–74 years diagnosed with at least one chronic disease. Medication non-adherence was assessed through an online and offline self-reported survey. Data was analyzed using multivariable logistic regression, with Odds Ratio (OR) and 95% Confidence Interval (CI) reported.

**Results:** Among 1,750 participants, 957 (54.7%) were adherent and 793 (45.3%) were non-adherent. Non-adherence was most prevalent in digestive diseases (371/541; 68.6%) and psychiatric disorders (37/52; 71.2%). In multivariable logistic regression, younger age (20–30 years: aOR 4.53, 95% CI 2.90–7.09), residence in Java and Bali (aOR 3.21, 95% CI 1.85–5.56), lower income (<IDR 1,500,000: aOR 2.08, 95% CI 1.48–2.92), absence of health insurance (aOR 1.43, 95% CI 1.06–1.92), self-perceived health status (healthy: aOR 2.48, 95% CI 1.63–3.77), and healthcare-seeking behavior (self-medication: aOR 3.36, 95% CI 2.37–4.77; no treatment: aOR 8.77, 95% CI 4.98–15.44) were significantly associated with non-adherence.

**Conclusion:** Medication non-adherence affected nearly half of Indonesian patients with chronic diseases. Strengthening health insurance coverage, addressing financial and geographic disparities, and implementing targeted education strategies, including gender-sensitive approaches that address financial barriers among women and health perception-related factors among men, are essential to improve medication adherence.

**Keywords:** medication, adherence, chronic disease, Indonesia

## Introduction

Chronic diseases are increasingly prevalent among adults in Indonesia,<sup>1,2</sup> posing substantial challenges for long-term disease management. Data from the Indonesian Basic Health Survey, involving 514,351 respondents, indicate that nearly 10% of the population has at least one chronic condition.<sup>3</sup> Moreover, chronic diseases account for more than 70% of total deaths nationally,<sup>3</sup> reflecting a significant burden on the healthcare system. Many patients with chronic diseases need to take multiple medications, which increases the likelihood of medication-related issues.<sup>4</sup> Despite the fact that medication adherence plays a pivotal role in effective disease management, non-adherence remains a common problem worldwide.<sup>5,6</sup> Non-adherence can result in treatment failure,<sup>7</sup> poor clinical outcomes, increased hospitalization rates,<sup>8</sup> increased treatment, preventable healthcare costs, and readmission costs,<sup>9</sup> and, in severe cases, mortality.<sup>10</sup>

Medication adherence is a multidimensional construct influenced by a complex interplay of patient-related, disease-related, and medication-related factors that may differ across the various phases of the medication-taking process.<sup>11–13</sup> Consequently, generic or “one-size-fits-all” approaches are often ineffective.<sup>14,15</sup> Understanding the determinants of medication non-adherence is critical for informing targeted and context-specific interventions. These insights can support healthcare providers in identifying high-risk patients, enable policymakers to design equitable health policies and resource allocation strategies,<sup>16</sup> and empower patients through tailored education and support programs to improve long-term disease management.

Indonesia operates a national health insurance system, Jaminan Kesehatan Nasional (JKN), launched in 2014 to achieve universal health coverage through the Social Security Agency for Health (Badan Penyelenggara Jaminan Sosial Kesehatan).<sup>17</sup> The scheme integrates public and private healthcare providers and aims to improve access to essential health services and medicines across the country. Despite substantial expansion in coverage, disparities in access, service quality, and financial protection persist, particularly across geographic regions and socioeconomic groups.<sup>17</sup> Although previous studies have explored factors associated with medication adherence in Indonesia, most have been limited by small sample sizes, restricted geographic coverage, or reliance on secondary, outdated, and facility-based data, which may not accurately capture adherence behaviors in the broader community.<sup>18,19</sup> Many investigations have focused on specific groups, such as those with single disease types<sup>20–23</sup> or those with disability,<sup>24</sup> leaving a significant knowledge gap in understanding adherence patterns in the broader and more diverse Indonesian populations. Furthermore, few studies have comprehensively assessed how sociodemographic, behavioral, and health system factors interact to influence adherence across Indonesia’s diverse provinces.

To address these gaps, this study used primary data collected from a large, nationwide cross-sectional survey covering all 34 provinces of Indonesia. By directly engaging patients with chronic diseases from both urban and rural settings, this study provides a more representative and timely understanding of factors associated with medication non-adherence. By examining both individual- and system-level factors, this study aims to provide robust, population-based evidence to guide the development of tailored interventions and inform national strategies for chronic disease management.

## Materials and Methods

This study is reported in accordance with the Consensus-Based Checklist for Reporting of Survey Studies (CROSS),<sup>25</sup> ([Table S1](#), [Supplementary Data](#)).

## Study Design and Settings

A nationwide, cross-sectional design was conducted between April and November 2024 via online and offline surveys distributed across all 34 provinces of Indonesia.

## Participants, Selection, and Eligibility

The study population comprised Indonesian residents aged 20–74 years who had been diagnosed with at least one chronic disease in the past month. The upper age limit of 74 years was selected in accordance with the previous studies,<sup>26,27</sup> considering methodological considerations to minimize heterogeneity related to cognitive decline, functional limitations, or caregiver involvement, which are more prevalent among individuals aged 75 years and above.<sup>27</sup>

The minimum required sample size was determined using Lemeshow’s formula for comparing two proportions of adherence and non-adherence. This method was selected to ensure adequate statistical power for detecting meaningful group differences.<sup>28</sup> Assuming a conservative proportion of 50%, a 95% confidence level, 80% power, and an expected 5% true difference,<sup>29</sup> the estimated minimum sample size was 769 participants per group. Proportional allocation based on provincial population sizes was applied to determine the minimum sample targets for each province to ensure national coverage. However, actual recruitment did not strictly adhere to these proportions; in several provinces, the number of participants exceeded the predetermined minimum due to the use of a convenience sampling approach.

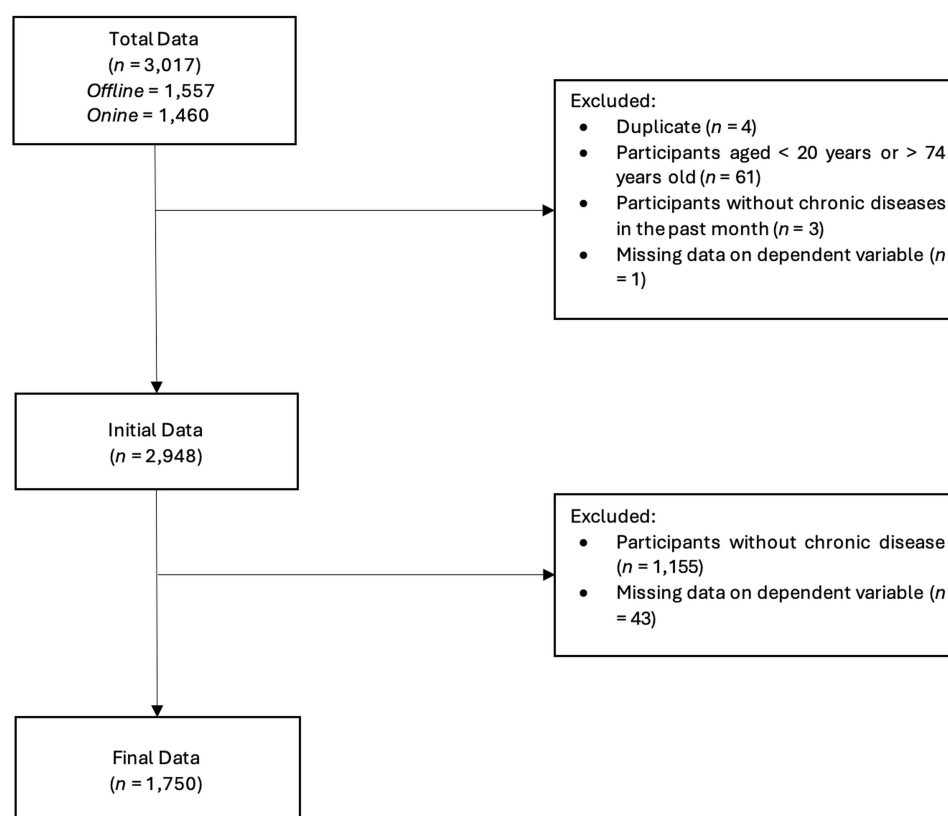
## Sampling and Data Collection

Participants were recruited using convenience sampling to enable nationwide data collection across Indonesia's geographically diverse regions, where probability-based sampling was not feasible due to logistical and resource constraints. To enhance sample diversity and reduce potential selection bias, recruitment was conducted through multiple channels, including trained enumerators, social media platforms, and a paid online survey platform. The paid online survey platform employed targeted recruitment strategies based on geographic location to enhance representation across provinces. Participants recruited through all channels were required to meet the same eligibility criteria, ensuring consistency and comparability across recruitment methods. The survey was accessible nationwide and open to eligible participants during the data collection period.

A total of 3,017 participants initially responded. After excluding duplicate entries, participants without a chronic disease diagnosis in the past month, and cases with missing data on medication adherence, 1,750 eligible participants were included in the final analysis. The participant selection process is presented in Figure 1.

## Covariates

Data on covariates were collected using a structured questionnaire adapted from the Indonesian Family Life Survey (IFLS),<sup>30</sup> by modifying item wording and response formats to suit online administration while maintaining conceptual equivalence. The adapted questionnaire was pilot tested among a small group of participants to assess clarity, relevance, and usability prior to full deployment and has demonstrated high reliability (Cronbach's  $\alpha = 0.85$ ) and strong validity in pilot testing and prior studies.<sup>31</sup> The questionnaire captured information on health-seeking behaviors, such as preferences for formal or informal healthcare settings, self-medication practices, engagement in multiple health-seeking behaviors, or not seeking treatment at all. Formal healthcare settings encompassed government and private hospitals, community health centers, clinics, and private practices operated by licensed physicians and health workers.<sup>32</sup> In contrast, informal settings referred to traditional or complementary medicine providers such as shamans, herbalists, masseurs, and



**Figure 1** Participant selection process.

acupuncturists.<sup>33</sup> Self-medication was defined as the use of one or more drugs for self-treatment without prior consultation or supervision from a healthcare professional.<sup>34</sup>

Additionally, data were obtained on a wide range of covariates. These included sociodemographic factors (age, gender, province of residence, rural or urban setting, employment status, education level, marital status); enabling-related factors (monthly income, health insurance coverage, and accessibility of healthcare facilities); and health-related factors (smoking habits, type of illness, and self-perceived overall health status). Minor adjustments were made to response categories to ensure contextual relevance and clarity for the online survey format.

## Outcome Measurement

Medication adherence was assessed using two self-reported questions. First, participants were asked: “Are you now taking the following treatments to treat [types of chronic diseases] and their complications?”. Those who reported current medication use were subsequently asked: “Do you take your medication regularly?”. Medication non-adherence was defined as a “No” response to the second question, indicating irregular or inconsistent medication use. Conversely, participants who responded “Yes” were categorized as adherent. All variables were self-reported by the participants.<sup>32</sup>

Although brief, this single-item self-report approach has been widely used in large-scale population-based studies and shown to be a valid and practical indicator of general medication-taking behavior, particularly in survey-based epidemiological research where objective adherence measures are not feasible.<sup>4,19,35</sup>

## Patient and Public Involvement

Patients and members of the public were not directly involved in the design, conduct, or reporting of this study. The research utilized data from a nationwide cross-sectional survey conducted across 34 provinces in Indonesia. All participants provided informed consent before taking part in the survey, and their perspectives were captured through self-reported measures on medication use and health-seeking behavior.

Although patients and the public did not contribute to the study design, the findings directly reflect their experiences with chronic disease management and medication adherence in real-world settings. The results will be disseminated to policymakers, healthcare providers, and community health organizations to inform the development of targeted adherence interventions. In future work, patient representatives will be engaged in co-designing educational materials and intervention strategies to improve medication adherence and promote equitable access to healthcare across regions.

## Ethical Approval

Ethical approval for this study was obtained from the Ethics Committee of Universitas Padjadjaran, Indonesia (No. 46/UN6.KEP/EC/2024). This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. All participants provided informed consent before participation after being informed about the study’s objectives, procedures, voluntary nature, and confidentiality assurances. To ensure participant privacy and data security, all responses were collected anonymously without recording personally identifiable information. Data were stored in a secure, password-protected database accessible only to the research team, and all procedures complied with applicable ethical and data protection standards.

## Statistical Analysis

All collected data were securely stored and managed using a centralized database system. Data quality was monitored throughout the collection process to ensure completeness, consistency, and accuracy. Incomplete or inconsistent responses were flagged and reviewed before analysis. Participants with missing data on key variables, including the outcome variable, were excluded from the final analysis. Given the low proportion of missing data, no imputation methods were applied, and complete-case analysis was considered appropriate. The final dataset was coded, cleaned, and anonymized to protect participant confidentiality.

Data analysis was conducted in three main stages. First, descriptive statistics were carried out to summarize participants’ characteristics through frequency distributions and proportions. Second, bivariate analyses were performed using univariate logistic regression to examine the relationships between each independent variable and medication non-

adherence. For each variable, crude odds ratios (cORs) with 95% confidence intervals (CIs) were reported to estimate the strength and direction of unadjusted associations. Variables with  $p$ -values  $< 0.25$  in the bivariate analysis were subsequently included in the multivariate model.

Finally, multivariate logistic regression analysis was conducted to determine the simultaneous effects of independent variables on medication non-adherence. Adjusted odds ratios (aORs) with corresponding 95% confidence intervals (CIs) were reported. To further explore potential gender-specific patterns, subgroup analyses were conducted separately for male and female participants. Subgroup analysis was conducted by gender due to well-established differences in health-seeking behavior, access to healthcare, and socioeconomic factors between men and women, which may differentially influence medication adherence.<sup>36–40</sup> Within each subgroup, both bivariate and multivariate logistic regression models were applied using the same covariates as in the main analysis, including sociodemographic variables, health-related characteristics, and healthcare-seeking behavior. Model fit was assessed using the Hosmer–Lemeshow goodness-of-fit test, and model explanatory power was evaluated using the pseudo- $R^2$  statistics. Statistical significance was defined as  $p < 0.05$ . All analyses were conducted using SPSS version 29.0 (IBM Corp., New York, USA).

## Results

### Participants' Characteristics

A total of 1,750 participants were included in the analysis (Figure 1). The majority were aged 20–30 years (64.5%), female (69.7%), and resided in Java and Bali (47.2%). More than half were employed (51.5%) and had attained university-level education (60.9%). The majority were non-smokers (81.3%), unmarried or divorced (61.7%), and reported a monthly income of less than Indonesian Rupiah (IDR) 1,500,000 (41.7%). In addition, most participants had health insurance (84.4%), lived within 3 km of a healthcare facility (61.5%), and were from urban areas (68.1%).

Among all participants, 957 (54.7%) were adherent while 793 (45.3%) were non-adherent to their prescribed treatment. Non-adherence was significantly more common among younger adults (20–30 years: 75.0% vs 55.7% adherent;  $p < 0.001$ ), females (72.8% vs 67.1%;  $p = 0.010$ ), and residents of Java and Bali (55.1% vs 40.6%;  $p < 0.001$ ). Those who were unemployed, students, or homemakers showed higher non-adherence (54.1% vs 43.9%;  $p < 0.001$ ), as did those with lower monthly income ( $< \text{IDR } 1,500,000$ ; US\$92.2) (51.7% vs 33.4%;  $p < 0.001$ ) and without health insurance (19.8% vs 12.1%;  $p < 0.001$ ). Furthermore, non-smokers (84.7% vs 78.4%;  $p = 0.001$ ) and unmarried or divorced participants (69.6% vs 55.2%;  $p < 0.001$ ) were more likely to be non-adherent. Participants who relied on self-medication (19.5%) or did not seek care (12.4%) were substantially more likely to be non-adherent compared with those who used formal healthcare services (51.8% non-adherent vs 72.9% adherent;  $p < 0.001$ ). No significant associations were found between education level ( $p = 0.362$ ) and place of residence (urban vs rural;  $p = 0.585$ ). The detailed characteristics of participants are presented in Table 1.

### Disease Categories and Adherence Patterns

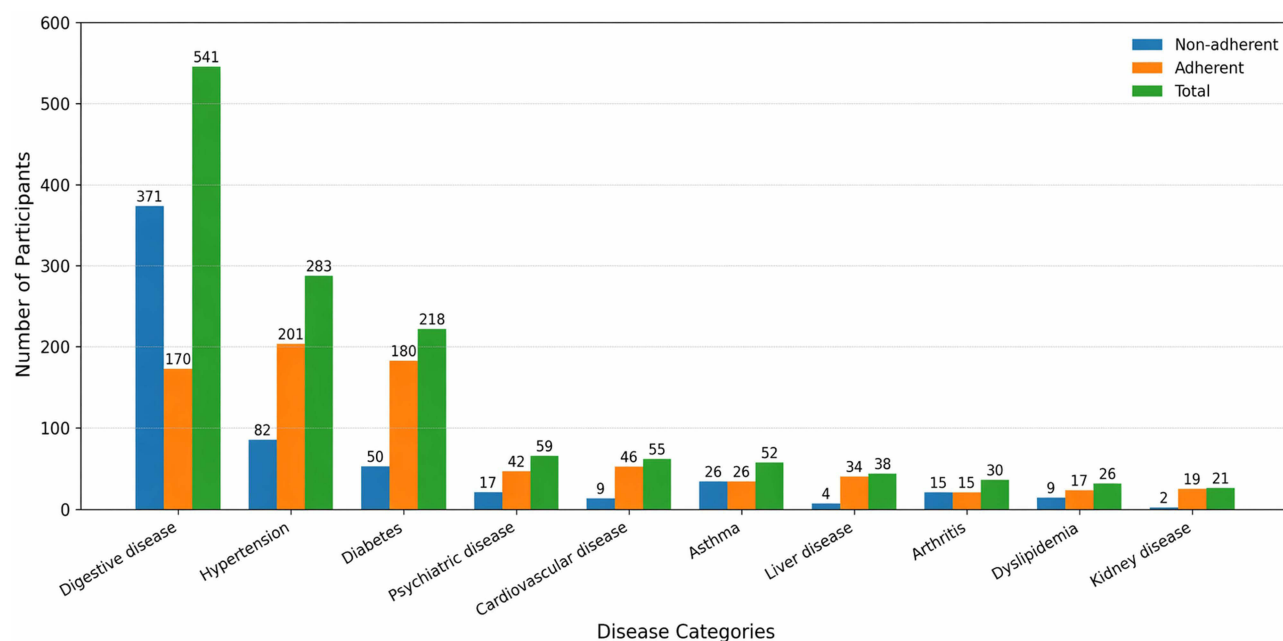
Among the reported chronic conditions, the largest proportions of participants had digestive diseases ( $n = 541$ , 30.9%), hypertension ( $n = 283$ , 16.2%), and diabetes ( $n = 218$ , 12.5%). The prevalence of medication non-adherence was highest among participants with digestive diseases (68.6%) and psychiatric disorders (71.2%), while the lowest non-adherence rate was observed among those with liver disease (10.5%). Among common chronic conditions, non-adherence was reported in 28.9% of participants with hypertension and 17.4% of those with diabetes. Figure 2 illustrates the distribution of adherence and non-adherence across disease groups.

### Factors Associated with Medication Non-Adherence

Multivariable logistic regression analysis identified several factors that were independently associated with medication non-adherence (Table 2). Participants aged 20–30 years (aOR 4.53, 95% CI 2.90–7.09,  $p < 0.001$ ), 31–40 years (aOR 2.98, 95% CI 1.85–4.79,  $p < 0.001$ ), and 41–50 years (aOR 1.95, 95% CI 1.17–3.27,  $p = 0.011$ ) were significantly more likely to be non-adherent compared with those older than 50 years. Participants living in Java and Bali had more than a threefold

**Table 1** Participants' Characteristics (N = 1,750)

| No | Variable                                      | Total<br>N (%) | Adherent<br>(N = 957) | Non-Adherent<br>(N = 793) |
|----|-----------------------------------------------|----------------|-----------------------|---------------------------|
| 1  | Age (years)                                   |                |                       |                           |
|    | 20–30                                         | 1,128 (64.5)   | 533 (55.7)            | 595 (75.0)                |
|    | 31–40                                         | 279 (15.9)     | 181 (18.9)            | 98 (12.4)                 |
|    | 41–50                                         | 171 (9.8)      | 110 (11.5)            | 61 (7.7)                  |
| 2  | 51–74                                         | 172 (9.8)      | 133 (13.9)            | 39 (4.9)                  |
|    | Gender                                        |                |                       |                           |
|    | Female                                        | 1,219 (69.7)   | 642 (67.1)            | 577 (72.8)                |
|    | Male                                          | 531 (30.3)     | 315 (32.9)            | 216 (27.2)                |
| 3  | Province                                      |                |                       |                           |
|    | Java and Bali                                 | 826 (47.2)     | 389 (40.6)            | 437 (55.1)                |
|    | Sumatera                                      | 476 (27.2)     | 266 (27.8)            | 210 (26.5)                |
|    | Kalimantan                                    | 145 (8.3)      | 104 (10.9)            | 41 (5.2)                  |
|    | Nusa Tenggara                                 | 81 (4.6)       | 60 (6.3)              | 21 (2.6)                  |
|    | Sulawesi                                      | 162 (9.3)      | 96 (10.0)             | 66 (8.3)                  |
| 4  | Maluku and Papua                              | 60 (3.4)       | 42 (4.4)              | 18 (2.3)                  |
|    | Working status                                |                |                       |                           |
|    | Employed                                      | 901 (51.5)     | 537 (56.1)            | 364 (45.9)                |
|    | Unemployed/student/homemaker                  | 849 (48.5)     | 420 (43.9)            | 429 (54.1)                |
| 5  | Education                                     |                |                       |                           |
|    | University                                    | 1,066 (60.9)   | 573 (59.9)            | 493 (62.2)                |
|    | High school                                   | 589 (33.7)     | 326 (34.1)            | 263 (33.2)                |
| 6  | Below high school                             | 95 (5.4)       | 58 (6.1)              | 37 (4.7)                  |
|    | Smoking habit                                 |                |                       |                           |
|    | Non-smoker                                    | 1422 (81.3)    | 750 (78.4)            | 672 (84.7)                |
| 7  | Smoker                                        | 328 (18.7)     | 207 (21.6)            | 121 (15.3)                |
|    | Marital status                                |                |                       |                           |
|    | Unmarried/divorced                            | 1,080 (61.7)   | 528 (55.2)            | 552 (69.6)                |
| 8  | Married                                       | 670 (38.3)     | 429 (44.8)            | 241 (30.4)                |
|    | Monthly income                                |                |                       |                           |
|    | < IDR 1,500,000 (<US\$92.2)                   | 730 (41.7)     | 320 (33.4)            | 410 (51.7)                |
|    | IDR 1,500,000–IDR 2,500,000 (US\$92.2–153.7)  | 241 (13.8)     | 138 (14.4)            | 103 (13.0)                |
| 9  | IDR 2,500,000–IDR 3,500,000 (US\$153.7–215.2) | 311 (17.8)     | 212 (22.2)            | 99 (12.5)                 |
|    | > IDR 3,500,000 (>US\$215.2)                  | 468 (26.7)     | 287 (30.0)            | 181 (22.8)                |
|    | Health insurance                              |                |                       |                           |
|    | Yes                                           | 1,477 (84.4)   | 841 (87.9)            | 636 (80.2)                |
| 10 | No                                            | 273 (15.6)     | 116 (12.1)            | 157 (19.8)                |
|    | Access to a healthcare facility               |                |                       |                           |
|    | ≤ 3 kilometres                                | 1,077 (61.5)   | 551 (57.6)            | 526 (66.3)                |
| 11 | > 3 kilometres                                | 673 (38.5)     | 406 (42.4)            | 267 (33.7)                |
|    | Place of residence                            |                |                       |                           |
|    | Urban                                         | 1,191 (68.1)   | 646 (67.5)            | 545 (68.7)                |
| 12 | Rural                                         | 559 (31.9)     | 311 (32.5)            | 248 (31.3)                |
|    | Self-perceived health status                  |                |                       |                           |
|    | Quite healthy                                 | 1,137 (65)     | 609 (63.6)            | 528 (66.6)                |
|    | Healthy                                       | 413 (23.6)     | 197 (20.6)            | 216 (27.2)                |
| 13 | Unhealthy                                     | 200 (11.4)     | 151 (15.8)            | 49 (6.2)                  |
|    | Healthcare-seeking behavior                   |                |                       |                           |
|    | Formal setting                                | 1,109 (63.4)   | 698 (72.9)            | 411 (51.8)                |
|    | Self-medication                               | 212 (12.1)     | 57 (6.0)              | 155 (19.5)                |
|    | Did not seek care                             | 114 (6.5)      | 16 (1.7)              | 98 (12.4)                 |
|    | Multiple sources                              | 315 (18)       | 186 (19.4)            | 129 (16.3)                |



**Figure 2** Prevalence of medication adherence in each disease group.

higher likelihood of non-adherence (aOR 3.21, 95% CI 1.85–5.56,  $p < 0.001$ ) compared with those living in Nusa Tenggara.

Lower monthly income was associated with increased odds of non-adherence: <IDR1,500,000 (aOR 2.08, 95% CI 1.48–2.92,  $p < 0.001$ ) and IDR1,500,000–2,500,000 (aOR 1.76, 95% CI 1.20–2.59,  $p = 0.004$ ) compared with the reference group earning IDR 2,500,000–3,500,000. Participants without health insurance were also more likely to be non-adherent (aOR 1.43, 95% CI 1.06–1.92,  $p = 0.018$ ).

**Table 2** Multivariate Logistic Regression Analysis of Factors Associated with Medication Non-Adherence (N = 1,750)

| No | Variable         | cOR (95% CI)     | p-value | Multivariate <sup>b</sup> |                      |
|----|------------------|------------------|---------|---------------------------|----------------------|
|    |                  |                  |         | aOR (95% CI)              | p-value              |
| 1  | Age (years)      |                  |         |                           |                      |
|    | 20–30            | 3.81 (2.62–5.54) | <0.001  | 4.53 (2.90–7.09)          | < 0.001 <sup>a</sup> |
|    | 31–40            | 1.85 (1.20–2.85) | 0.006   | 2.98 (1.85–4.79)          | < 0.001 <sup>a</sup> |
|    | 41–50            | 1.89 (1.18–3.04) | 0.009   | 1.95 (1.17–3.27)          | 0.011 <sup>a</sup>   |
|    | 51–74            | Ref              |         | Ref                       |                      |
| 2  | Gender           |                  |         |                           |                      |
|    | Male             | 0.76 (0.62–0.94) | 0.01    | 1.19 (0.90–1.57)          | 0.219                |
|    | Female           | Ref              |         | Ref                       |                      |
| 3  | Province         |                  |         |                           |                      |
|    | Sumatera         | 2.26 (1.33–3.83) | 0.003   | 1.66 (0.95–2.91)          | 0.077                |
|    | Java and Bali    | 3.21 (1.92–5.37) | <0.001  | 3.21 (1.85–5.56)          | <0.001 <sup>a</sup>  |
|    | Kalimantan       | 1.13 (0.61–2.08) | 0.704   | 1.02 (0.53–1.95)          | 0.958                |
|    | Nusa Tenggara    | Ref              |         | Ref                       |                      |
|    | Sulawesi         | 1.96 (1.09–3.53) | 0.024   | 1.51 (0.80–2.83)          | 0.201                |
|    | Maluku and Papua | 1.22 (0.58–2.57) | 0.593   | 1.10 (0.50–2.43)          | 0.807                |

(Continued)

**Table 2** (Continued).

| No | Variable                                      | cOR (95% CI)      | p-value | Multivariate <sup>b</sup> |                     |
|----|-----------------------------------------------|-------------------|---------|---------------------------|---------------------|
|    |                                               |                   |         | aOR (95% CI)              | p-value             |
| 4  | Working status                                |                   |         |                           |                     |
|    | Unemployed/student/homemaker                  | 1.51 (1.25–1.82)  | <0.001  | 1.04 (0.81–1.33)          | 0.780               |
| 5  | Employed                                      | Ref               |         | Ref                       |                     |
|    | Education                                     |                   |         |                           |                     |
|    | University                                    | 1.35 (0.88–2.07)  | 0.172   |                           |                     |
|    | High school                                   | 1.26 (0.81–1.97)  | 0.299   |                           |                     |
| 6  | Below high school                             | Ref               |         |                           |                     |
|    | Smoking habit                                 |                   |         |                           |                     |
|    | Non-smoker                                    | 1.53 (1.20–1.96)  | 0.001   | 1.41 (1.03–1.95)          | 0.034 <sup>a</sup>  |
| 7  | Smoker                                        | Ref               |         | Ref                       |                     |
|    | Marital status                                |                   |         |                           |                     |
|    | Unmarried/divorced                            | 1.86 (1.53–2.27)  | <0.001  | 1.11 (0.83–1.47)          | 0.489               |
| 8  | Married                                       | Ref               |         | Ref                       |                     |
|    | Monthly income                                |                   |         |                           |                     |
|    | <IDR 1,500,000 (<US\$92.2)                    | 2.74 (2.07–3.63)  | <0.001  | 2.08 (1.48–2.92)          | <0.001 <sup>a</sup> |
|    | IDR 1,500,000–IDR 2,500,000 (US\$92.2–153.7)  | 1.60 (1.13–2.27)  | 0.009   | 1.76 (1.20–2.59)          | 0.004 <sup>a</sup>  |
|    | IDR 2,500,000–IDR 3,500,000 (US\$153.7–215.2) | Ref               |         | Ref                       |                     |
| 9  | > IDR 3,500,000 (>US\$215.2)                  | 1.35 (1.00–1.83)  | 0.052   | 1.36 (0.97–1.9)           | 0.073               |
|    | Health insurance                              |                   |         |                           |                     |
|    | No                                            | 1.79 (1.38–2.32)  | <0.001  | 1.43 (1.06–1.92)          | 0.018 <sup>a</sup>  |
| 10 | Yes                                           | Ref               |         | Ref                       |                     |
|    | Access to a healthcare facility               |                   |         |                           |                     |
|    | ≤ 3 kilometres                                | 1.45 (1.19–1.76)  | <0.001  | 1.21 (0.97–1.51)          | 0.099               |
| 11 | > 3 kilometres                                | Ref               |         | Ref                       |                     |
|    | Place of residence                            |                   |         |                           |                     |
|    | Rural                                         | Ref               |         |                           |                     |
| 12 | Urban                                         | 1.06 (0.86–1.29)  | 0.585   |                           |                     |
|    | Self-perceived health status                  |                   |         |                           |                     |
|    | Healthy                                       | 3.38 (2.32–4.92)  | <0.001  | 2.48 (1.63–3.77)          | <0.001 <sup>a</sup> |
|    | Quite healthy                                 | 2.67 (1.90–3.76)  | <0.001  | 2.26 (1.55–3.29)          | <0.001 <sup>a</sup> |
| 13 | Unhealthy                                     | Ref               |         | Ref                       |                     |
|    | Healthcare-seeking behavior                   |                   |         |                           |                     |
|    | Formal setting                                | Ref               |         | Ref                       |                     |
|    | Self-medication                               | 4.62 (3.33–6.41)  | <0.001  | 3.36 (2.37–4.77)          | <0.001 <sup>a</sup> |
|    | Did not seek care                             | 10.4 (6.05–17.89) | <0.001  | 8.77 (4.98–15.44)         | <0.001 <sup>a</sup> |
|    | Multiple sources                              | 1.18 (0.91–1.52)  | 0.209   | 1.26 (0.95–1.67)          | 0.102               |

**Notes:** <sup>a</sup>Significant factor ( $P < 0.05$ ). <sup>b</sup>Regression sig. = 0.0000; Pseudo R-Square Test = 0.1592; Hosmer-Lemeshow Test sig. = 0.1141.

**Abbreviations:** aOR, Adjusted Odds Ratios; CI, Confidence Intervals; cOR, Crude Odds Ratios.

Lifestyle and health perceptions were further associated with non-adherence. Non-smokers had higher odds of non-adherence (aOR 1.41, 95% CI 1.03–1.95,  $p=0.034$ ). Participants who perceived themselves as healthy (aOR 2.48, 95% CI 1.63–3.77,  $p<0.001$ ) or quite healthy (aOR 2.26, 95% CI 1.55–3.29,  $p<0.001$ ) were more likely to be non-adherent compared with those reporting poor health.

Compared with participants who sought treatment from formal healthcare providers, those who practiced self-medication (aOR 3.36, 95% CI 2.37–4.77,  $p<0.001$ ) and those who did not seek care (aOR 8.77, 95% CI 4.98–15.44,  $p<0.001$ ) had higher odds of non-adherence. No statistically significant associations were found for gender, marital status, education level, employment status, distance to healthcare facilities, or urban-rural residence after adjustment.

**Table 3** Subgroup Analysis of Factors Associated with Medication Non-Adherence by Gender

| Variable                                      | Male (n = 531)<br>aOR (95% CI) | p-value | Female (n = 1219)<br>aOR (95% CI) | p-value |
|-----------------------------------------------|--------------------------------|---------|-----------------------------------|---------|
| Age (years)                                   |                                |         |                                   |         |
| 20–30                                         | 2.44 (1.15–5.17)               | 0.020   | 6.55 (3.68–11.63)                 | <0.001  |
| 31–40                                         | 1.46 (0.68–3.15)               | 0.332   | 4.45 (2.39–8.27)                  | <0.001  |
| 41–50                                         | 0.90 (0.39–2.06)               | 0.800   | 3.15 (1.60–6.20)                  | 0.001   |
| 51–74                                         | Ref                            |         | Ref                               |         |
| Healthcare-seeking behavior                   |                                |         |                                   |         |
| Self-medication                               | 2.70 (1.38–5.28)               | 0.004   | 3.63 (2.40–5.50)                  | <0.001  |
| Did not seek care                             | 10.17 (3.60–28.75)             | <0.001  | 8.24 (4.16–16.31)                 | <0.001  |
| Multiple sources                              | 1.85 (1.12–3.05)               | 0.017   | 1.09 (0.77–1.54)                  | 0.628   |
| Formal setting                                | Ref                            |         | Ref                               |         |
| Monthly income                                |                                |         |                                   |         |
| < IDR 1,500,000 (<US\$92.2)                   | 1.45 (0.75–2.81)               | 0.273   | 2.35 (1.57–3.53)                  | <0.001  |
| IDR 1,500,000–IDR 2,500,000 (US\$92.2–153.7)  | 2.44 (1.24–4.80)               | 0.010   | 1.49 (0.93–2.40)                  | 0.101   |
| IDR 2,500,000–IDR 3,500,000 (US\$153.7–215.2) | Ref                            |         | Ref                               |         |
| > IDR3,500,000 (>US\$215.2)                   | 1.16 (0.66–2.05)               | 0.603   | 1.48 (0.97–2.26)                  | 0.066   |
| Health insurance (No vs Yes)                  | 1.51 (0.86–2.67)               | 0.155   | 1.42 (1.00–2.02)                  | 0.049   |
| Self-perceived health status                  |                                |         |                                   |         |
| Healthy                                       | 4.08 (1.80–9.26)               | 0.001   | 2.12 (1.29–3.50)                  | 0.003   |
| Quite healthy                                 | 2.92 (1.39–6.13)               | 0.005   | 2.12 (1.36–3.30)                  | 0.001   |
| Unhealthy                                     | Ref                            |         | Ref                               |         |
| Region (Java & Bali)                          | 1.68 (0.60–4.66)               | 0.322   | 3.86 (1.99–7.51)                  | <0.001  |
| Pseudo $R^2$                                  | 0.153                          |         | 0.173                             |         |
| Hosmer–Lemeshow p-value                       | 0.4518                         |         | 0.5876                            |         |

**Abbreviations:** aOR, Adjusted Odds Ratios; CI, Confidence Intervals.

Subgroup analysis revealed distinct gender differences in factors associated with medication non-adherence (Table 3). Among male participants (n = 531), younger age (20–30 years: aOR 2.44; 95% CI 1.15–5.17), self-medication (aOR 2.70; 95% CI 1.38–5.28), and not seeking treatment (aOR 10.17; 95% CI 3.60–28.75) were associated with medication non-adherence. Males who perceived themselves as healthy (aOR 4.08; 95% CI 1.80–9.26) or quite healthy (aOR 2.92; 95% CI 1.39–6.13) were also significantly more likely to be non-adherent compared with those reporting poor health (Table 3).

Among female participants (n = 1,219), non-adherence was significantly associated with younger age (20–30 years: aOR 6.55; 95% CI 3.68–11.63), residence in Java and Bali (aOR 3.86; 95% CI 1.99–7.51), absence of health insurance (aOR 1.42; 95% CI 1.00–2.02), and low monthly income (< IDR 1,500,000; aOR 2.35; 95% CI 1.57–3.53). Consistent with the overall model, health-seeking behavior remained a significant factor: self-medication (aOR 3.63; 95% CI 2.40–5.50) and absence of treatment (aOR 8.24; 95% CI 4.16–16.31) were both significantly associated with non-adherence (Table 3).

Model diagnostics indicated good fit for both male (Hosmer–Lemeshow p = 0.45; pseudo- $R^2$  = 0.15) and female (Hosmer–Lemeshow p = 0.59; pseudo- $R^2$  = 0.17) models.

## Discussion

This nationwide study identified key factors associated with medication non-adherence among adults with chronic diseases in Indonesia. Nearly half of all participants reported not taking their prescribed medications as directed, with the highest prevalence observed in patients with digestive disorders. Younger age, residence in Java and Bali, lower income, absence of health insurance, self-perceived health status, and healthcare-seeking behavior were significantly associated with non-adherence. Gender, education, and place of residence (urban vs rural) were not significant factors.

The prevalence of medication non-adherence observed in this study was higher than that reported in Singapore (38.4%) and the United States (27%),<sup>41,42</sup> but lower than findings from Jordan (68%) and Saudi Arabia (67.9%).<sup>43,44</sup> This pattern reflects broader global disparities, as non-adherence in developing countries is generally higher than in developed settings due to structural and contextual factors.<sup>45</sup> In Indonesia, challenges such as uneven distribution of healthcare workers, infrastructure gaps, shortages of essential medicines, and regional inequities in health resource allocation further exacerbate these issues.<sup>46</sup> Differences in adherence across countries may be explained by variations in health system organization, access to healthcare services, and levels of financial protection across countries. In addition, cultural practices such as self-medication and the use of traditional medicine may further influence adherence behaviors in the Indonesian context.<sup>47</sup>

Participants who engaged in self-medication or did not seek care were at risk of non-adherence. Similar patterns have been documented in Iran, Brazil, and India.<sup>48–50</sup> Cultural reliance on traditional medicine, limited awareness of illness, and financial barriers often contribute to these practices.<sup>21–23,51</sup> The inability to afford treatment, restricted autonomy (especially among women), and the perception that symptoms are mild or transient further discourage continued medication use.<sup>52,53</sup> Although national health insurance initiatives have expanded access to care, inequities persist across provinces.<sup>47</sup> Strengthening primary care, expanding insurance coverage for vulnerable populations, and ensuring equitable distribution of healthcare workers are therefore critical priorities.

We observed that younger participants were more likely to be non-adherent. This finding is consistent with previous studies in Kuwait and the United States,<sup>54,55</sup> where younger patients were less engaged in long-term treatment, less aware of their condition, and more prone to lifestyle-related disruptions in medication routine.<sup>56</sup> In contrast, older participants tend to exhibit better adherence due to stronger family support, higher disease burden, and more frequent interaction with healthcare professionals.<sup>56,57</sup>

We further observed that geographic variation was notable. Participants in Java and Bali, regions with relatively high concentrations of healthcare facilities, had higher rates of non-adherence. Despite better service availability, factors such as overcrowding, periodic drug shortages, and high cost of living, may reduce medication adherence in these densely populated regions.<sup>57</sup> Overstretched healthcare infrastructure can result in long waiting times and limited continuity of care, while financial pressure may prompt patients to prioritize daily needs over medication purchases.<sup>58</sup> Expanding telemedicine and telepharmacy services, coupled with comprehensive insurance coverage, could help mitigate these disparities.<sup>59</sup>

Interestingly, non-smokers demonstrated higher odds of non-adherence, diverging from findings in most previous studies.<sup>60,61</sup> One possible explanation is that non-smokers may perceive themselves as healthier and therefore underestimate the necessity of continuous treatment, consistent with health behavior models that link perceived wellness to reduced motivation for medication adherence.<sup>62</sup> Similarly, individuals who perceive themselves as healthy may underestimate disease severity and the need for sustained medication, leading to lower adherence. This misperception of illness and treatment necessity highlights the importance of targeted educational interventions to improve patients' understanding of chronic disease progression and the benefits of continued medication use, even in the absence of symptoms. This counterintuitive finding also underscores the need for further research to explore the behavioral and psychological mechanisms underlying adherence patterns. This emphasizes the need for tailored education, emphasizing that adherence is essential regardless of lifestyle habits or perceived health status.

Socioeconomic disadvantages, particularly low income and lack of health insurance, were consistent factors associated with medication non-adherence. These findings align with previous evidence from both developed and developing settings showing that financial barriers significantly influence adherence.<sup>63,64</sup> In the United States, for example, over one-tenth of adults have reported taking less medication than prescribed due to cost.<sup>52</sup> While previous study suggest the complex effects of insurance type, copayments, and drug coverage on adherence,<sup>65</sup> the core implication remains that ensuring equitable access to affordable medicines is critical. In this context, expanding health insurance coverage and strengthening financial protection mechanisms, such as reducing out-of-pocket payments and simplifying reimbursement processes, may improve adherence among low-income populations. Therefore, enhancing the implementation of Indonesia's national health insurance program could play a key role in improving access to treatment and achieving more equitable long-term health outcomes. Participants who rated themselves as "healthy" or "quite healthy" were also more likely to be non-adherent. Similar trends have been reported in other chronic disease contexts, where the absence of

symptoms leads to an underestimation of illness severity and diminished motivation to continue treatment.<sup>24,66</sup> These findings emphasize the need for effective communication from healthcare providers, especially physicians and pharmacists, to reinforce the importance of adherence even in the absence of symptoms.<sup>67</sup>

Subgroup analysis highlighted gender-specific factors associated with medication non-adherence, reflecting differences in socioeconomic roles, health beliefs, and access to healthcare. Among men, self-perceived health status and healthcare-seeking behavior were associated with non-adherence, suggesting that perceptions of being healthy may lead to complacency and reduced adherence. In contrast, adherence in women was more affected by socioeconomic factors, particularly low income and lack of health insurance, indicating higher vulnerability to financial barriers in accessing treatment. These patterns are consistent with global findings showing that women often face greater economic and caregiving responsibilities that limit their healthcare access.<sup>2,47</sup> Consequently, gender-sensitive adherence strategies are warranted by targeting younger men with behavioral interventions emphasizing continuous treatment, while improving financial protection and insurance access for women.

The findings of this study have important implications for clinical practice and health policy. For healthcare providers, targeted interventions such as patient education, adherence counseling, and structured follow-up should be prioritized for high-risk groups. At the policy level, strengthening financial protection through expanded health insurance coverage and reducing out-of-pocket costs may improve adherence among low-income populations, while improving access to care and digital health interventions may help address geographic disparities. Furthermore, given the multifactorial nature of medication adherence, interventions should be tailored to individual needs. This requires collaborative efforts from healthcare professionals to address specific barriers to adherence in chronic disease management. Physicians are essential in reinforcing the importance of long-term treatment and simplifying therapeutic regimens, while pharmacists can support adherence through medication counseling, identification of adherence barriers, and implementation of medication therapy management services.<sup>68–70</sup> Evidence suggests that pharmacist-led and multidisciplinary interventions are effective in improving adherence and clinical outcomes in patients with chronic diseases.<sup>71,72</sup> To ensure effectiveness, this role must be supported by improving accessibility to qualified health services, regular training for providers, and appropriate workload and staffing adjustments to enable sustainable chronic disease management in Indonesia. Future research should include qualitative studies to explore the underlying reasons for non-adherence and longitudinal studies to assess changes in adherence before and after targeted interventions across larger and more diverse populations. Such evidence would help refine national strategies for medication adherence and inform scalable interventions tailored to Indonesia's healthcare context.

This study has several strengths. It represents one of the first nationwide investigations to assess medication adherence among adults with chronic diseases in Indonesia, covering all 34 provinces and providing a comprehensive overview of adherence patterns across diverse regions. The use of primary, population-based data enhances the reliability and contextual relevance of the findings. Furthermore, the study followed the CROSS reporting guidelines, ensuring transparency and reproducibility of survey-based methods. The inclusion of a gender-specific subgroup analysis also provides valuable insights into differential factors of non-adherence, which have been underexplored in prior research. Moreover, to enhance regional diversity and increase response rates, the survey was also disseminated through a paid online survey platform. This approach allowed for broader outreach to participants across different provinces, including areas with limited social media engagement. While such platforms may introduce a potential self-selection bias, since individuals who participate in paid surveys might differ from the general population in terms of motivation or digital access, it improved sample representativeness across provinces. The robustness of findings, supported by a large sample size and consistency across recruitment platforms, mitigates this potential bias.

Nevertheless, certain limitations must be acknowledged. Adherence was measured using a single self-reported item, which may not fully capture the complexity, frequency, or underlying reasons for non-adherence and may be subject to recall and social desirability bias. Furthermore, it may oversimplify the multidimensional nature of medication adherence. In particular, self-reported measures are known to overestimate adherence compared with more objective methods, such as pharmacy refill data, pill counts, or electronic monitoring. Furthermore, this measure does not distinguish between intentional and unintentional non-adherence, nor does it capture different phases of adherence, including initiation, implementation, and discontinuation. Therefore, the findings should be interpreted with caution, and future

studies should consider incorporating more comprehensive and objective adherence measures to better capture real-world medication-taking behavior. However, this pragmatic measure remains widely accepted and feasible in large-scale, population-based surveys, particularly in low- and middle-income settings where resource-intensive and more objective methods are not available.<sup>35</sup> Furthermore, while the prevalence of adherence may be overestimated due to the use of a self-reported single-item measure, the observed associations between potential factors and non-adherence are less likely to be substantially affected, as relative measures such as odds ratios are generally more robust to systematic reporting bias. In addition, chronic disease diagnoses were self-reported and not clinically verified, which could introduce misclassification. Second, the cross-sectional design precludes conclusions about causal relationships, as exposures and outcomes were measured simultaneously. Third, convenience and online sampling, including recruitment through a paid survey platform, may have introduced self-selection bias, with possible underrepresentation of older adults, rural residents, and individuals with lower digital literacy. This may limit the generalizability of the findings. However, efforts to recruit participants across all provinces using multiple channels, including geographically targeted strategies, likely enhanced sample diversity and national coverage. Such approaches are commonly employed in large-scale epidemiological studies where probability-based sampling is not feasible, although findings should be interpreted with appropriate caution. Furthermore, the pseudo- $R^2$  values indicate that unmeasured factors may still explain part of the variance in adherence. Lastly, the data were collected during a post-pandemic period, when healthcare-seeking and medication-taking behaviors may have been affected by ongoing changes in service delivery and access.

## Conclusion

Medication non-adherence remains a substantial challenge among Indonesian patients with chronic diseases. While this study identifies key factors associated with non-adherence, the findings should be interpreted in light of the study's limitations, particularly the use of self-reported measures and cross-sectional design. Strengthening health insurance coverage, addressing socioeconomic and geographic disparities, and implementing targeted interventions, including gender-sensitive approaches that address financial barriers among women and health perception-related factors among men, may improve medication adherence. Further longitudinal and intervention studies are needed to better understand causal pathways and evaluate effective strategies to improve medication adherence in diverse populations.

## Abbreviations

aOR, Adjusted Odds Ratio; cOR, Crude Odds Ratio; CI, Confidence Interval; CROSS, Consensus-Based Checklist for Reporting of Survey Studies; IDR, Indonesian Rupiah; IFLS, Indonesian Family Life Survey; SPSS, Statistical Package for Social Sciences.

## Data Sharing Statement

The datasets used in this study are available from the corresponding author upon reasonable request.

## Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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## Disclosure

The authors report no conflicts of interest in this work.

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