# Original Article

# Identifying the attributes of adherence to tuberculosis treatment in Indonesia: A Delphi study

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## Abstract

Adherence to tuberculosis (TB) treatment is essential for achieving successful health outcomes. Establishing a consensus among healthcare professionals regarding the definition and key attributes of adherence to TB treatment is essential. The aim of this study was to explore the perspectives of experts and patients on the attributes of adherence to TB treatment. A total of 20 TB specialists and 10 pulmonary TB patients from various regions in Indonesia participated in a three-round Delphi study designed to categorize and validate these attributes. In the first round, participants were interviewed to gather qualitative insights. In the second and third rounds, experts assessed the level of agreement on identified attributes using a five-point Likert scale. The strength of consensus was measured using the interquartile range (IQR), following the best practices outlined in the Conducting and REporting DElphi Studies (CREDES) guidelines. The experts achieved a substantial consensus, with over 85% agreement on the identified attributes. The findings indicated that adherence to TB treatment encompasses the ability of pulmonary TB patients to follow agreed-upon recommendations, including both medication adherence and lifestyle modifications. These lifestyle changes include improved nutritional care, smoking cessation, abstaining from alcohol, stress management, improved physical activity, better sleep, and rest quality, and preventive behaviors related to TB. In conclusion, the findings enhanced the understanding of adherence to TB treatment by highlighting its multifaceted nature. The consensus emphasized that adherence extends beyond medication-taking behaviors to include essential lifestyle changes, underscoring the comprehensive approach needed to support TB patients effectively.

**Keywords:** Adherence to treatment, attributes, Delphi study, healthcare consensus, tuberculosis

## Introduction

*T*he End Tuberculosis (TB) Strategy outlines the worldwide endeavor to eradicate tuberculosis by aiming to reduce TB-related fatalities by approximately 90% by the year 2030 compared to 2015. Nevertheless, TB, which is one of the leading causes of death globally, continues to be a prominent concern in the contemporary era [1]. The effectiveness of TB treatment cannot be attained unless patients regularly adhere to their treatment [2]. Indonesia is facing a challenge in regard to adherence to TB treatment. Approximately, 24.6% of persons diagnosed with pulmonary TB reported failing to finish the treatment [3]. Furthermore, the challenges are not only related to the medication-taking process but also lifestyle-related circumstances [4]. It was

strengthened by prior research that lifestyle-related factors influence TB treatment outcomes including inadequate nutrition support [5,6], smoking behavior [7,8], alcohol consumption [9], depression [10-12], limited physical exercise [13,14], also sleep and rest quality [15,16].

Nevertheless, a universally accepted definition of adherence to TB treatment remains elusive [17-19]. Prior research has demonstrated that definitions have fluctuated and been customized to evaluate diverse categories of interventions. Typically, adherence is conceptualized as the degree to which patients fulfill their medication regimens in accordance with medical professionals' directives [20]. The World Health Organization (WHO) defines adherence to TB treatment as "the extent to which the patient's history of therapeutic drug-taking coincides with the prescribed treatment" [19]. Similarly, adherence has been defined in certain contexts as the "extent to which the patient's actions align with the agreed-upon recommendations of the prescribers" (**Table 1**) [2,20-25].

Table 1. Diverse definitions of adherence to treatment as examples from existing literature

| No | Definition | References |
|---|---|---|
| 1 | Adherence is "the degree to which a person's behavior, such as taking medication, following a diet, and/ or implementing lifestyle modifications, matches with agreed-upon advice from a health care professional" <br> Adherence to treatment refers to the extent to which patients are able to follow the agreed recommendations for prescribed treatments with healthcare providers <br> Adherence to TB treatment is defined as "the extent to which the patient's history of therapeutic drug-taking coincides with the prescribed treatment" | [2] |
| 2 | Adherence to treatment is defined as "persistence in practice and maintenance of desired health behaviors resulting from active participation and agreement" | [21] |
| 3 | Adherence refers to the patient's capacity and willingness to comply with mutually agreed-upon treatment suggestions | [22] |
| 4 | Adherence to TB treatment entails adopting modifications in one's lifestyle (nutrition intake, stop smoking, preventing the transmission of TB), adhering to recommended medication regimens, promptly seeking assistance in the event of symptom changes, and attending scheduled consultations | [23] |
| 5 | Adherence refers to the degree to which a patient's actions align with the guidance provided by healthcare professionals | [24] |
| 6 | Adherence to treatment emphasized the importance of the changing doctor-patient relationship and the salient influence of the patient's perspective on health beliefs in general and of their illness in particular. This may lead to a negotiated treatment plan to which both patient and doctor can adhere | [25] |
| 7 | Adherence is often an active choice by each patient on how to comply with the assigned therapy | [20] |

However, in regard to TB management, this contemporary definition is limited to the procedural dimensions of drug administration, thereby creating potential uncertainties concerning the understanding of the specific characteristics or attributes associated with this concept [18]. Furthermore, the definition is deficient, as the WHO has also articulated that "adherence encompasses a broad spectrum of health-related behaviors that extend beyond the simple act of following prescribed medications" [19]. By exclusively prioritizing the procedure of the medication-taking process, the importance of developing lifestyle modifications cannot be sufficiently conveyed, despite the notably noteworthy influence of lifestyle changes [26]. Additionally, according to a systematic review by Munro, Lewin [27], the procedure of taking medications is not the only aspect of adherence to TB treatment. Although prescription medications are effective and can improve health, they do not always address the underlying causes of disease, which might be exacerbated by a poor lifestyle. Moreover, the significance of lifestyle changes, particularly, has been recognized as a crucial element in the recommendations for persons diagnosed with TB [23]; nutrition care, smoking cessation, eliminating alcohol consumption, stress management, and physical exercise are the most significant components.

Due to the management of TB care, nurses in Indonesia assume an essential function, frequently acting as the primary healthcare providers who navigate patients through their therapeutic program [28,29]. Nurses are typically the initial professionals to recognize and address barriers to adherence to TB treatment [27,28]. Given the importance for nurses to assess adherence to treatment that covers not only medication-taking behavior but also lifestyle changes, a concept of adherence to TB treatment is necessary to be synthesized. To accomplish

this goal, the study utilized a Delphi method. Using the Delphi method, a concept of adherence to TB treatment will be constructed to further guide health professionals, especially nurses, working with persons with TB in evaluating adherence to TB treatment and designing the proper program for TB patients. Additionally, this study involved TB patients to gain their perspective on adherence to TB treatment. Studies have highlighted the substantial influence of patients and public involvement on the outcomes of the Delphi technique [30-32]. According to Young and Bagley [33], it is advisable to engage in consultations with patients in order to ascertain significant outcomes and guarantee that the terminology employed to describe these outcomes in a constructed measurement instrument holds significance for patients. The aim of this study was to define and validate essential characteristics of adherence to TB treatment in order to guide the formulation of a standardized framework for the assessment of adherence within both clinical and research environments.

## Methods

### Assessing tuberculosis (TB) adherence using Delphi method

Three rounds of the Delphi technique were performed, aiming at classifying, clustering, and verifying the characteristics of adherence to TB treatment in Indonesia. The three-round Delphi was selected due to the multidimensional constructs of the topic. The three rounds allow for further prioritization and validation of complex themes or items. In the first round, experts and patients contribute diverse perspectives to generate a broad pool of attributes and items based on their experience. The second and third rounds of Delphi were then performed to reach experts' consensus regarding previous attributes of the concept. This study followed the recommendations for the Conducting and REporting of DElphi Studies (CREDES) [34]. The process is presented in **Figure 1**.

### Panelists

In the context of the Delphi method, experts are defined as knowledgeable individuals, specialists, and those possessing expertise in a particular domain [35]. The expert panel was constituted from diverse regions across Indonesia. A heterogeneous panel experts, confers greater credibility and acceptance than a homogeneous panel, as it allows for a broader range of perspectives, thereby encompassing all conceivable facets of the issue at hand [36]. The panel of experts comprised clinical nurses as well as academic nurses possessing specialization in TB management. To achieve a more thorough consensus regarding the findings, this research additionally solicited insights from additional health professionals within the domain of TB, specifically, physicians specializing in TB. The criteria for inclusion were as follows: (a) presently employed in the field of TB care, (b) possess over two years of experience in the profession, and (c) have a keen interest in participating in this study. Eventually, a total of twenty experts were selected to serve as panel members, and the sample size was determined based on the guidance provided in the literature [37].

Panelists were initially contacted via electronic mail, followed by subsequent communication through telephone calls. They were provided with comprehensive explanations regarding the process, their obligations as participants, the anticipated duration required to complete the questionnaires, and their commitment to the completion of the study. A consent form and a study information sheet were furnished to them, which they were required to return via email should they consent to participate voluntarily.

Additionally, this study also included ten individuals with pulmonary TB to provide their insights on adherence to treatment. The number was chosen to meet the objective of acquiring thirty manageable respondents, thereby guaranteeing an optimal equilibrium between TB patients and expert contributions. Yet, conducting the patient group discussion was challenging due to the patients' arrival at the TB clinic at different intervals. Consequently, a questionnaire was utilized as the interview guide. The patients were requested to provide information regarding their perception of adherence to TB treatment. This research engaged 30 meticulously chosen participants to guarantee a range of representation and to reach data saturation. The selection procedure aimed to maintain a balance between different expert and patient groups while accounting for logistical and resource limitations to enable thorough data gathering.
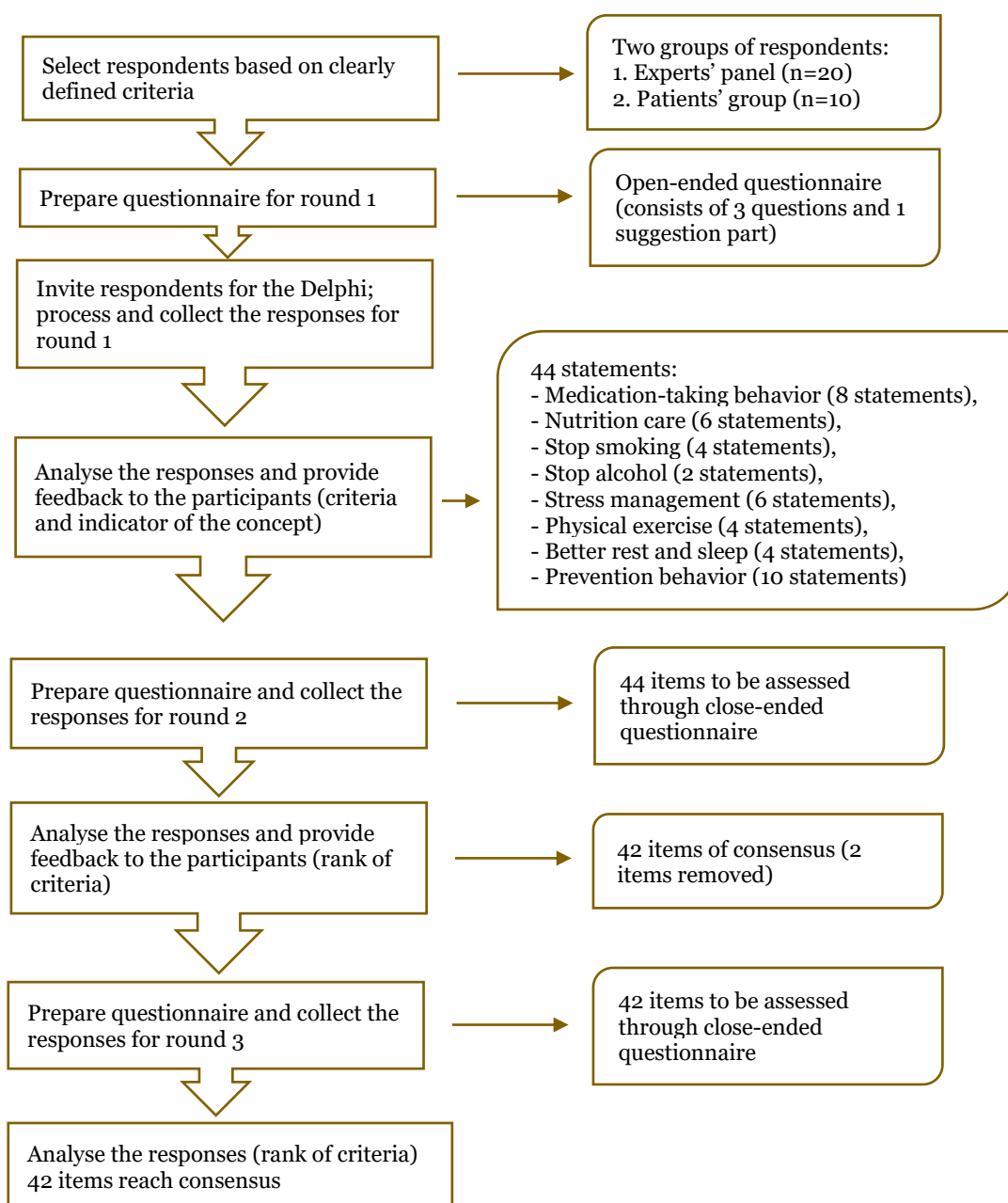
Select respondents based on clearly defined criteria

Two groups of respondents:
1. Experts' panel (n=20)
2. Patients' group (n=10)

Prepare questionnaire for round 1

Open-ended questionnaire (consists of 3 questions and 1 suggestion part)

Invite respondents for the Delphi; process and collect the responses for round 1

Analyse the responses and provide feedback to the participants (criteria and indicator of the concept)

44 statements:
- Medication-taking behavior (8 statements),
- Nutrition care (6 statements),
- Stop smoking (4 statements),
- Stop alcohol (2 statements),
- Stress management (6 statements),
- Physical exercise (4 statements),
- Better rest and sleep (4 statements),
- Prevention behavior (10 statements)

Prepare questionnaire and collect the responses for round 2

44 items to be assessed through close-ended questionnaire

Analyse the responses and provide feedback to the participants (rank of criteria)

42 items of consensus (2 items removed)

Prepare questionnaire and collect the responses for round 3

42 items to be assessed through close-ended questionnaire

Analyse the responses (rank of criteria)
42 items reach consensus

Figure 1. Procedure of the study in identifying the attributes of adherence to tuberculosis treatment using Delphi method.

## Instruments

The Delphi study utilized three instruments: 1) the round one interview guideline; 2) the round two close-ended questionnaire; and 3) the round three close-ended questionnaire (**Underlying Data**). The interview guideline consisted of four open-ended questions asking about the meaning of adherence to treatment for persons with pulmonary TB from the participant's perspective, the characteristics of treatment adherence, what lifestyle changes should be made by TB patients to achieve optimum outcomes, and the participant's suggestions related to the topic. The details of the question can be found in **Table 2**.

Table 2. Instruments for round 1

| No | Instrument round 1 (open-ended questionnaire) |
|---|---|
| 1 | Would you tell us the meaning of adherence to treatment for persons with pulmonary TB from your perspective? |
| 2 | Would you tell us about the characteristics of adherence to treatment among persons with pulmonary TB? |

| No | Instrument round 1 (open-ended questionnaire) |
|---|---|
| 3 | Please tell us what lifestyle changes should be made by persons with pulmonary TB to achieve optimum outcomes |
| 4 | Please provide us with any suggestions related to the topic |

Participants' statements that accurately portrayed the attributes related to adherence to TB treatment were discovered in round one. Subsequently, the statements were consolidated classified claims that appeared to be closely related or overlapping. These statements then become the items for the round two questionnaire. Finally, the final phase was selecting a terminology for each cluster that represents the concept of adherence to TB treatment.

The experts evaluated the items in Delphi round two, considering the relevance of each item within the cluster. The experts then were asked to rate the item on a five-point Likert scale, with 1 representing strong disagreement and 5 representing strong agreement, indicating their level of agreement. A total of retained elements from the second round were re-evaluated in Delphi's third round (**Table 3**).

Table 3. Instruments for round 2 (close-ended questionnaire)

| No | Criteria | Importance (less → most) | | | | | Suggestion |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | |
| | **Medication-taking behavior** | | | | | | |
| 1 | Filling initial prescription | | | | | | |
| 2 | Taking the first dose | | | | | | |
| 3 | Refilling prescriptions on time | | | | | | |
| 4 | Never missing doses | | | | | | |
| 5 | Proper administration of medication regimen | | | | | | |
| 6 | Stopping medication as recommended | | | | | | |
| 7 | Regular following-up sputum microscopy | | | | | | |
| 8 | Regular checking-up | | | | | | |
| | **Nutrition care** | | | | | | |
| 9 | Increasing high-protein food | | | | | | |
| 10 | Increasing high-calories food | | | | | | |
| 11 | Increasing fruits & vegetable | | | | | | |
| 12 | Consuming vitamins and minerals | | | | | | |
| 13 | Increasing weight | | | | | | |
| 14 | Keeping hydrated | | | | | | |
| | **Smoking cessation** | | | | | | |
| 15 | Knowing the importance to stop | | | | | | |
| 16 | Determining to stop the behavior | | | | | | |
| 17 | Staying away from smoking | | | | | | |
| 18 | Stopping smoking inside the house | | | | | | |
| | **Stop alcohol consumption** | | | | | | |
| 19 | Knowing the importance to stop | | | | | | |
| 20 | Determining to stop the behavior | | | | | | |
| | **Stress management** | | | | | | |
| 21 | Eliminating stressor | | | | | | |
| 22 | Developing resilience | | | | | | |
| 23 | Coping mechanism | | | | | | |
| 24 | Improving spiritual aspect | | | | | | |
| 25 | Having hobby | | | | | | |
| 26 | Maintaining interpersonal relationship | | | | | | |
| | **Physical exercise** | | | | | | |
| 27 | Pertaining duration of exercise | | | | | | |
| 28 | Maintaining the exercise | | | | | | |
| 29 | Avoiding sedentary life | | | | | | |
| 30 | Doing light exercise | | | | | | |
| | **Rest and sleep quality** | | | | | | |
| 31 | Maintaining adequate sleep | | | | | | |
| 32 | Avoiding overexertion | | | | | | |
| 33 | Going to bed on time | | | | | | |
| 34 | Having enough rest | | | | | | |
| | **Prevention behavior** | | | | | | |
| 35 | Performing personal hygiene | | | | | | |
| 36 | Performing house cleanliness | | | | | | |
| 37 | Using different cutlery | | | | | | |
| 38 | Not spitting indiscriminately | | | | | | |
| 39 | Reducing the frequency of presence in public | | | | | | |

| No | Criteria | Importance (less → most) | | | | | Suggestion |
|----|----------|---|---|---|---|---|------------|
| | | 1 | 2 | 3 | 4 | 5 | |
| 40 | Wearing a respirator mask in public during an infective phase of the disease | | | | | | |
| 41 | Disposing sputum with a safe method | | | | | | |
| 42 | Covering face when sneezing/coughing/speaking loudly | | | | | | |
| 43 | Informing contact of tuberculosis status | | | | | | |
| 44 | Performing good house ventilation | | | | | | |

In the third round, the expert panel was re-sent the items for the next assessment, considering the relevance of each item by evaluating the inter-rater score within the group through the interquartile range. The level of agreement among the experts was determined by re-evaluating each item using a five-point Likert scale, which ranged from 1 to 5. A rating of 1 denoted a strong disagreement, while a rating of 5 represented a strong agreement (**Table 4**).

Table 4. Instrument for round 3 (close-ended questionnaire)

| No | Criteria | Interquartile range | | | | | Median | Consensus | Your previous response | Your new response |
|----|----------|---|---|---|---|---|--------|-----------|------------------------|-------------------|
| | | 1 | 2 | 3 | 4 | 5 | | | | |
| | **Medication-taking behavior** | | | | | | | | | |
| 1 | Filling initial prescription | | | | | | | | | |
| 2 | Taking the first dose | | | | | | | | | |
| 3 | Refilling prescriptions on time | | | | | | | | | |
| 4 | Never missing doses | | | | | | | | | |
| 5 | Proper administration of medication regimen | | | | | | | | | |
| 6 | Stopping medication as recommended | | | | | | | | | |
| 7 | Regular following-up sputum microscopy | | | | | | | | | |
| 8 | Regular checking-up | | | | | | | | | |
| | **Nutrition care** | | | | | | | | | |
| 9 | Increasing high-protein food | | | | | | | | | |
| 10 | Increasing high-calories food | | | | | | | | | |
| 11 | Increasing fruits & vegetable | | | | | | | | | |
| 12 | Consuming vitamins and minerals | | | | | | | | | |
| 13 | Increasing weight | | | | | | | | | |
| 14 | Keeping hydrated | | | | | | | | | |
| | **Smoking cessation** | | | | | | | | | |
| 15 | Knowing the importance to stop | | | | | | | | | |
| 16 | Determining to stop the behavior | | | | | | | | | |
| 17 | Staying away from smoking | | | | | | | | | |
| 18 | Stopping smoking inside the house | | | | | | | | | |
| | **Stop alcohol consumption** | | | | | | | | | |
| 19 | Knowing the importance to stop | | | | | | | | | |
| 20 | Determining to stop the behavior | | | | | | | | | |
| | **Stress management** | | | | | | | | | |
| 21 | Eliminating stressor | | | | | | | | | |
| 22 | Developing resilience | | | | | | | | | |
| 23 | Coping mechanism | | | | | | | | | |
| 24 | Improving spiritual aspect | | | | | | | | | |
| 25 | Having hobby | | | | | | | | | |
| 26 | Maintaining interpersonal relationship | | | | | | | | | |
| | **Physical exercise** | | | | | | | | | |
| 27 | Pertaining duration of exercise | | | | | | | | | |
| 28 | Maintaining the exercise | | | | | | | | | |
| 29 | Avoiding sedentary life | | | | | | | | | |
| 30 | Doing light exercise | | | | | | | | | |
| | **Rest and sleep quality** | | | | | | | | | |
| 31 | Maintaining adequate sleep | | | | | | | | | |
| 32 | Avoiding overexertion | | | | | | | | | |
| 33 | Going to bed on time | | | | | | | | | |

| No | Criteria | Interquartile range | | | | | Median | Consensus | Your previous response | Your new response |
|----|----------|---|---|---|---|---|--------|-----------|------------------------|-------------------|
| | | 1 | 2 | 3 | 4 | 5 | | | | |
| 34 | Having enough rest | | | | | | | | | |
| | **Prevention behavior** | | | | | | | | | |
| 35 | Performing personal hygiene | | | | | | | | | |
| 36 | Performing house cleanliness | | | | | | | | | |
| 37 | Not spitting indiscriminately | | | | | | | | | |
| 38 | Wearing a respirator mask in public during an infective phase of the disease | | | | | | | | | |
| 39 | Disposing sputum with a safe method | | | | | | | | | |
| 40 | Covering face when sneezing/coughing/speaking loudly | | | | | | | | | |
| 41 | Informing contact of tuberculosis status | | | | | | | | | |
| 42 | Performing good house ventilation | | | | | | | | | |

## Data collection

### Delphi round 1

The first round was conducted with a panel of experts and representatives from patient groups to solicit their perspectives regarding the factors influencing adherence to tuberculosis treatment. The data obtained from this round was meticulously transcribed for its content. A qualitative content analysis was performed to pinpoint statements that exemplify the characteristics of adherence to TB treatment.

### Delphi round 2

The second round was designed to assess the gathered statements that reflect the characteristics of adherence to TB treatment from the prior round. The same panel of experts who participated in the first round of the Delphi method were invited to partake in the second round. The questionnaire for the second round was disseminated electronically via email. The expert panelists were requested to appraise each item utilizing a five-point scale that ranged from strongly disagree to strongly agree. Additionally, they were allowed to offer comments regarding each item. The completed questionnaire was mandated to be returned within a time frame of two weeks using email correspondence.

### Delphi round 3

The third round was conducted to validate the prior assertions made by the experts. The identical panel of experts was invited to re-evaluate the items based on the feedback received from the collective group, employing the questionnaire designed for the third round. The formulation of this questionnaire was informed by the outcomes derived from the second round, which was subjected to statistical analysis utilizing both the median (Mdn) and the interquartile range (IQR). Specifically, the IQR serves as a quantitative indicator of consensus derived from the responses of the experts. The IQR score illustrates the spectrum of expert opinion regarding the significance of the pertinent item from the second round. The experts were subsequently requested to submit the completed questionnaire within a timeframe of two weeks, by transmitting it via electronic mail. The researcher meticulously analyzed the data obtained during this round to ascertain consensus regarding the selection of statements that accurately reflect the characteristics of adherence to tuberculosis treatment.

## Data analysis

The data were subjected to rigorous examination employing content analysis alongside descriptive statistics, which encompassed percentage (%), median (Mdn), interquartile range (IQR), and consensus level agreement. Following each round, panelists were provided with a concise summary of feedback, which encompasses statistical outcomes of the IQR and percentage agreement, alongside qualitative commentary. This process enables participants to reassess their

perspectives in light of prevailing group trends. Items that do not attain consensus despite several rounds may be omitted from the final compilation, thereby ensuring the retention of attributes that are broadly accepted. The criteria established for achieving consensus regarding the selection statement that epitomized the characteristics of medication adherence included a median value equal to or exceeding 3.50, an interquartile range not surpassing 1.50, and a consensus level of agreement exceeding 70% [38]. Through the integration of statistical benchmarks with iterative feedback and enhancements, disagreements are methodically resolved, thereby fostering the convergence of expert opinions throughout the rounds.

# Results

## Identification and validation of Delphi method
Employing the Delphi technique, three rounds were undertaken to identify, categorize, and validate the characteristics pertaining to adherence to TB treatment in Indonesia. In round one, experts contributed insights regarding the factors that relate to adherence to TB treatment, which were subsequently analyzed and organized into eight categories including medication-taking behavior, nutrition care, smoking cessation, stopping alcohol consumption, stress management, physical exercise, better rest and sleep, and prevention behavior. The second round involved the refinement of these characteristics through expert evaluations. In round three, experts confirmed the identified characteristics from round two by evaluating each characteristic from the IQR, Mdn, and percentage consensus.

## Demographic information
A total of 30 participants participated in the first round of Delphi, including 20 experts and 10 individuals with pulmonary TB. Moreover, a similar set of expert panelists was invited to participate in Delphi rounds two and three. Nevertheless, two of the experts were unable to join in round three. The absence of a response can be ascribed to a lack of available time for participation (**Table 5**).

Table 5. Characteristics of the respondents

| Characteristics | Expert panelists | | Tuberculosis patients | |
|---|---|---|---|---|
| | n | % | n | % |
| Gender | | | | |
|     Male | 8 | 40 | 6 | 60 |
|     Female | 12 | 60 | 4 | 40 |
| Location (geographic area) | | | | |
|     Bengkulu | 1 | 5 | - | - |
|     West Java | 8 | 40 | 3 | 30 |
|     Central Java | 2 | 10 | - | - |
|     Yogyakarta | 1 | 5 | - | - |
|     East Java | 1 | 5 | - | - |
|     West Kalimantan | 4 | 20 | 3 | 30 |
|     East Kalimantan | 2 | 10 | 4 | 40 |
|     East Nusa Tenggara | 1 | 5 | - | - |
| Education | | | | |
|     Elementary school | - | - | 2 | 20 |
|     Junior high school | - | - | 2 | 20 |
|     Senior high school | - | - | 6 | 60 |
|     Undergraduate | 8 | 40 | - | - |
|     Master | 10 | 50 | - | - |
|     Doctorate | 2 | 10 | - | - |
| Workplace | | | | |
|     Hospital | 2 | 10 | - | - |
|     Public health center | 12 | 60 | - | - |
|     University | 6 | 30 | - | - |
|     Others | - | - | 10 | 100 |
| Current occupation | | | | |
|     Clinical nurses | 4 | 20 | - | - |
|     Academic nurses | 10 | 50 | - | - |
|     Physician | 6 | 30 | - | - |
|     Tuberculosis patients | - | - | 10 | 100 |

The group of 30 participants involved in the study was composed of two distinct categories: expert panelists and TB patients. Among the 20 expert panelists, the majority of experts were classified as female (60%), whereas the majority of TB patients were males (60%). In terms of geographical representation, the panelists were distributed across various regions, with the majority originating from West Java (40%), while the TB patients predominantly came from East Kalimantan (40%). Regarding academic qualifications, a significant proportion of experts held a master's degree (50%), whereas the majority of TB patients had achieved completion of senior high school (60%). The professional environments varied considerably, with 60% engaged in public health centers. The roles of expert panelists included academic nurses (50%), clinical nurses (20%), and physicians (30%).

## Delphi rounds

After the initial round of Delphi, 44 statements were identified (**Table 6**) that reflected the characteristics of adherence to treatment among individuals with pulmonary TB. Numerous statements emerged from the initial round, which highlighted the significance of complying with tuberculosis treatment:

*"Adherence to Pulmonary TB Treatment is a condition where the Pulmonary TB program is implemented in accordance with guidelines, technical instructions, and standard operational procedures, by all components, including the government, the private sector, the community, and the patients themselves." (Expert 6)*

*"Adherence with TB means following all recommended treatment therapy and is proven by taking all the medication given according to the recommended time. Adherence is also shown by coming to have his TB condition checked at the specified time and not refusing examination/support measures." (Expert 8)*

*"Adherence to the TB treatment program is obeying or complying with every therapy program/ procedure for TB sufferers, which is not only complying with drug therapy but also following recommendations and being willing to change behavior that can worsen the patient's condition." (Expert 15)*

Subsequently, the classified statements that appeared to be closely related or overlapped were combined. Finalizing the selection of a nomenclature for each cluster that accurately represents adherence to TB treatment characteristics, which are medication-taking behavior (eight statements), nutrition care (six statements), smoking cessation (four statements), stop alcohol consumption (two statements), stress management (six statements), physical exercise (four statements), better rest and sleep (four statements), and prevention behavior (10 statements). The eight domains were established based on comprehensive expert consensus to holistically capture the multifaceted behaviors required for adherence to TB treatment. These domains represented critical areas influencing the success of treatment outcomes for persons with pulmonary TB. Each domain was developed through a systematic exploration of key themes identified as essential in TB management practices (**Table 6**).

Table 6. Delphi round 1 result

| No | Dimension/statement |
|---|---|
| 1 | **Medication-taking behavior** |
| 1.1 | Filling initial prescription |
| 1.2 | Taking the first dose |
| 1.3 | Refilling prescriptions on time |
| 1.4 | Never missing doses |
| 1.5 | Proper administration of medication regimen |
| 1.6 | Regular following-up sputum microscopy |
| 1.7 | Regular checking-up |
| 1.8 | Stopping medication as recommended |
| 2 | **Nutrition care** |
| 2.1 | Increasing high-protein food |
| 2.2 | Increasing high-calories food |

| No | Dimension/statement |
|---|---|
| 2.3 | Increasing fruits & vegetable |
| 2.4 | Consuming vitamins and minerals |
| 2.5 | Increasing weight |
| 2.6 | Keeping hydrated |
| 3 | **Stop smoking** |
| 3.1 | Knowing the importance to stop |
| 3.2 | Determining to stop the behavior |
| 3.3 | Staying away from smoking |
| 3.4 | Stopping smoking inside the house |
| 4 | **Stop alcohol consumption** |
| 4.1 | Knowing the importance to stop |
| 4.2 | Determining to stop the behavior |
| 5 | **Stress management** |
| 5.1 | Eliminating stressor |
| 5.2 | Developing resilience |
| 5.3 | Coping mechanism |
| 5.4 | Improving spiritual aspect |
| 5.5 | Having hobby |
| 5.6 | Maintaining interpersonal relationship |
| 6 | **Physical exercise** |
| 6.1 | Pertaining duration of exercise |
| 6.2 | Maintaining the exercise |
| 6.3 | Avoiding sedentary life |
| 6.4 | Doing light exercise |
| 7 | **Better rest & sleep** |
| 7.1 | Maintaining adequate sleep |
| 7.2 | Avoiding overexertion |
| 7.3 | Going to bed on time |
| 7.4 | Having enough rest |
| 8 | **Prevention behavior** |
| 8.1 | Performing personal hygiene |
| 8.2 | Performing house cleanliness |
| 8.3 | Using different cutlery |
| 8.4 | Not spitting indiscriminately |
| 8.5 | Reducing the frequency of presence in public |
| 8.6 | Wearing a respirator mask in public during an infective phase of the disease |
| 8.7 | Disposing sputum with a safe method |
| 8.8 | Covering face when sneezing/coughing/speaking loudly |
| 8.9 | Informing contact of tuberculosis status |
| 8.10 | Performing good house ventilation |

The objective of the second round of Delphi was to confirm the characteristics of adherence to TB treatment. A response rate of 100% was achieved in this round, as a total of 20 questionnaires were returned. In the second Delphi round, 42 items were agreed upon as attributes of adherence to treatment for individuals with pulmonary TB. Eight domains of adherence to TB treatment were confirmed, including medication-taking behavior (eight attributes), nutrition care (six attributes), stop smoking (four attributes), stop alcohol (two attributes), stress management (six attributes), physical exercise (four attributes), sleep and rest quality (four attributes), and prevention behavior (10 attributes). The items "reducing frequency of presence in public" and "using different cutlery" may not have achieved consensus because they are perceived as less directly related to treatment adherence. Additionally, their practicality is questionable, as avoiding public spaces may not be feasible for individuals with daily responsibilities, and using separate cutlery may be seen as unnecessary or culturally sensitive. Furthermore, these behaviors lack strong scientific evidence linking them to improved TB treatment outcomes, making them less compelling as core attributes of adherence. The details of Delphi round two are presented in **Table 7**.

Table 7. Delphi round 2 result

| Dimension | Median | IQR | Consensus (%) |
|---|---|---|---|
| **Medication-taking behavior** | | | |
| Filling initial prescription | 5 | 1 | 86.67 |
| Taking the first dose | 5 | 0 | 95.56 |
| Refilling prescriptions on time | 5 | 1 | 91.11 |
| Never missing doses | 5 | 0 | 98.89 |

| Dimension | Median | IQR | Consensus (%) |
|---|---|---|---|
| Proper administration of medication regimen | 5 | 0 | 96.67 |
| Stopping medication as recommended | 5 | 0 | 92.22 |
| Regular following-up sputum microscopy | 5 | 0 | 95.56 |
| Regular checking-up | 5 | 0 | 96.67 |
| **Nutrition care** | | | |
| Increasing high-protein food | 5 | 1 | 91.11 |
| Increasing high-calories food | 5 | 1 | 91.11 |
| Increasing fruits & vegetable | 5 | 1 | 91.11 |
| Consuming vitamins and minerals | 5 | 0.25 | 94.44 |
| Increasing weight | 4 | 1 | 84.44 |
| Keeping hydrated | 5 | 1 | 92.22 |
| **Stop smoking** | | | |
| Knowing the importance to stop | 5 | 0 | 98.89 |
| Determining to stop the behavior | 5 | 0 | 95.56 |
| Staying away from smoking | 5 | 0 | 96.67 |
| Stopping smoking inside the house | 5 | 0 | 95.56 |
| **Stop alcohol consumption** | | | |
| Knowing the importance to stop | 5 | 1 | 93.33 |
| Determining to stop the behavior | 5 | 0.25 | 94.44 |
| **Stress management** | | | |
| Eliminating stressor | 5 | 1 | 91.11 |
| Developing resilience | 5 | 1 | 91.11 |
| Coping mechanism | 5 | 1 | 91.11 |
| Improving spiritual aspect | 5 | 1 | 91.11 |
| Having hobby | 4 | 1 | 86.67 |
| Maintaining interpersonal relationship | 5 | 1 | 91.11 |
| **Physical exercise** | | | |
| Pertaining duration of exercise | 4.5 | 1 | 87.78 |
| Maintaining the exercise | 5 | 1 | 88.89 |
| Avoiding sedentary life | 5 | 1 | 87.78 |
| Doing light exercise | 4 | 1 | 86.67 |
| **Better rest and sleep** | | | |
| Maintaining adequate sleep | 5 | 1 | 87.78 |
| Avoiding overexertion | 5 | 1 | 88.89 |
| Going to bed on time | 4 | 1 | 87.78 |
| Having enough rest | 5 | 1 | 93.33 |
| **Prevention behavior** | | | |
| Performing personal hygiene | 5 | 0 | 95.56 |
| Performing house cleanliness | 5 | 0 | 95.56 |
| Using different cutlery | 4.5 | 2 | 82.22 |
| Not spitting indiscriminately | 5 | 0 | 97.78 |
| Reducing the frequency of presence in public | 4 | 2 | 72.22 |
| Wearing a respirator mask in public during an infective phase of the disease | 5 | 0 | 95.56 |
| Disposing sputum with a safe method | 5 | 0 | 96.67 |
| Covering face when sneezing/coughing/speaking loudly | 5 | 0 | 95.56 |
| Informing contact of tuberculosis status | 5 | 1 | 92.22 |
| Performing good house ventilation | 5 | 0 | 96.67 |

IQR: interquartile range

In round three, a total of 20 specialists were invited to participate in this round. A response rate of 90% was achieved, as a total of 18 questionnaires were returned. In the third round, 42 items were agreed upon as attributes of adherence to treatment for individuals with pulmonary TB. In conclusion, eight domains of adherence to TB treatment were reconfirmed, including medication-taking behavior (eight attributes), nutrition care (six attributes), smoking cessation (four attributes), abstaining from alcohol (two attributes), stress management (six attributes), physical exercise (four attributes), sleep and rest quality (four attributes), and prevention behavior (eight attributes) (**Table 8**).

Table 8. Delphi round 3 result

| Dimension | Median | IQR | Consensus (%) |
|---|---|---|---|
| **Medication-taking behavior** | | | |
| Filling initial prescription | 5 | 0 | 98.89 |
| Taking the first dose | 5 | 0 | 97.78 |
| Refilling prescriptions on time | 5 | 0 | 96.67 |
| Never missing doses | 5 | 0 | 98.89 |

| Dimension | Median | IQR | Consensus (%) |
|---|---|---|---|
| Proper administration of medication regimen | 5 | 0 | 97.78 |
| Stopping medication as recommended | 5 | 0 | 97.78 |
| Regular following-up sputum microscopy | 5 | 0 | 97.78 |
| Regular checking-up | 5 | 0 | 95.56 |
| **Nutrition care** | | | |
| Increasing high-protein food | 5 | 0.75 | 94.44 |
| Increasing high-calories food | 5 | 1 | 91.11 |
| Increasing fruits & vegetable | 5 | 1 | 93.33 |
| Consuming vitamins and minerals | 5 | 0 | 96.67 |
| Increasing weight | 4 | 1 | 86.67 |
| Keeping hydrated | 5 | 0 | 95.56 |
| **Stop smoking** | | | |
| Knowing the importance to stop | 5 | 0 | 98.89 |
| Determining to stop the behavior | 5 | 0 | 97.78 |
| Staying away from smoking | 5 | 0 | 97.78 |
| Stopping smoking inside the house | 5 | 0 | 97.78 |
| **Stop alcohol consumption** | | | |
| Knowing the importance to stop | 5 | 0 | 92.22 |
| Determining to stop the behavior | 5 | 0 | 93.33 |
| **Stress management** | | | |
| Eliminating stressor | 5 | 0 | 95.56 |
| Developing resilience | 5 | 1 | 91.11 |
| Coping mechanism | 5 | 0.75 | 94.44 |
| Improving spiritual aspect | 5 | 0.75 | 94.44 |
| Having hobby | 4.5 | 1 | 90.00 |
| Maintaining interpersonal relationship | 5 | 1 | 93.33 |
| **Physical exercise** | | | |
| Pertaining duration of exercise | 4 | 1 | 87.78 |
| Maintaining the exercise | 5 | 1 | 91.11 |
| Avoiding sedentary life | 5 | 1 | 92.22 |
| Doing light exercise | 4 | 1 | 88.89 |
| **Better rest and sleep** | | | |
| Maintaining adequate sleep | 5 | 1 | 92.22 |
| Avoiding overexertion | 4 | 1 | 87.78 |
| Going to bed on time | 4.5 | 1 | 88.89 |
| Having enough rest | 5 | 1 | 93.33 |
| **Prevention behavior** | | | |
| Performing personal hygiene | 5 | 0 | 96.67 |
| Performing house cleanliness | 5 | 0 | 97.78 |
| Not spitting indiscriminately | 5 | 0 | 97.78 |
| Wearing a respirator mask in public during an infective phase of the disease | 5 | 0 | 97.78 |
| Disposing sputum with a safe method | 5 | 0 | 97.78 |
| Covering face when sneezing/coughing/speaking loudly | 5 | 0 | 95.56 |
| Informing contact of tuberculosis status | 5 | 0 | 95.56 |
| Performing good house ventilation | 5 | 0 | 98.89 |

IQR: interquartile range

## Themes

### *Medication-taking behavior*
Theme 1 sought to map experts' consensus on the relevant behaviors of the medication-taking process. It had eight statements, consisting of: 1) filling the initial prescription; 2) taking the first dose; 3) refilling the prescription on time; 4) never missing doses; 5) proper administration of medication regimen; 6) stopping medication as recommended; 7) regular following-up sputum microscopy; and 8) regular checking-up. The consensus value varies between 95.56 and 98.89, which shows good agreement among experts on this theme (**Figure 2**).

### *Nutrition care*
Theme 2 evaluated experts' perspectives on the related behaviors of nutrition care for persons with pulmonary TB. This theme involved six statements, consisting of: 1) increasing high-protein food; 2) increasing high-calorie food; 3) increasing fruits & vegetables; 4) consuming vitamins and minerals; 5) increasing weight; and 6) keeping hydrated. The consensus number ranges from 91.11 to 96.67, indicating excellent agreement among experts on this topic.
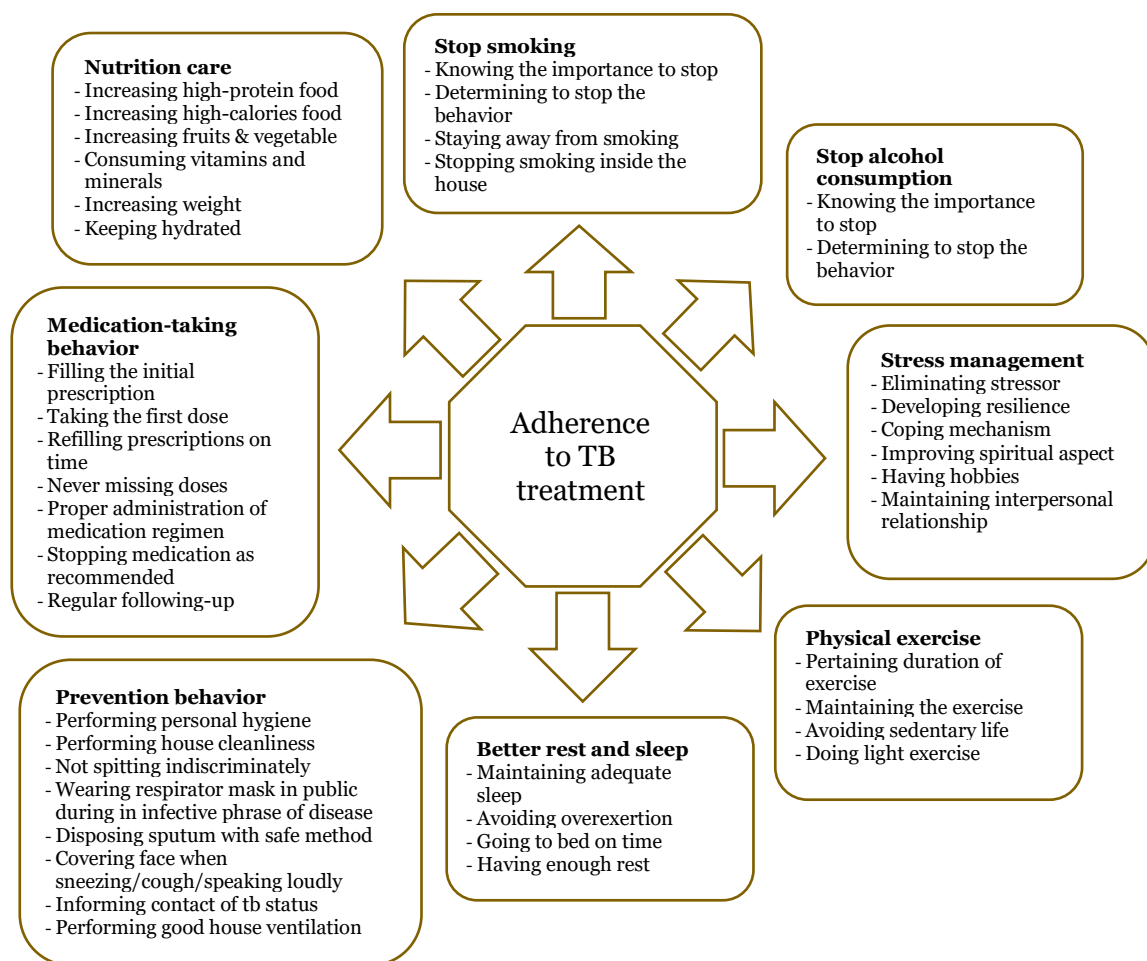
Figure 2. Proposed attributes of adherence to tuberculosis (TB) treatment.

### Stop smoking
Theme 3 sought expert consensus on related behavior of stop smoking. The theme consisted of four statements, consists of: 1) knowing the importance of stopping; 2) determining to stop the behavior; 3) staying away from smoking; and 4) stopping smoking inside the house. The consensus value varies between 97.78 and 98.89, which displayed good agreement among experts for this theme.

### Stop alcohol consumption
Theme 4 highlighted related behavior regarding stopping alcohol consumption. The theme consists of two statements, consists of: 1) knowing the importance of stopping; and 2) determining to stop the behavior. The consensus rating ranges between 92.22 to 93.33, indicating widespread agreement among experts on this topic.

### Stress management
This theme was characterized by six statements related to behavior that could be performed by those diagnosed with pulmonary TB. The theme consists of: 1) eliminating stressors; 2) developing resilience; 3) coping mechanisms; 4) improving spiritual aspect; 5) having hobbies; and 6) maintaining interpersonal relationships. The consensus number is between 90.00 and 95.56, indicating excellent agreement among experts on this topic.

### Physical exercise
In theme 6, related behavior in regard to physical exercise was enlisted. There are four statements in this domain consisting of: 1) pertaining duration of exercise; 2) maintaining the exercise; 3) avoiding a sedentary life; and 4) doing light exercise. The consensus number ranges from 87.78 to 92.22, indicating strong agreement among experts on this topic.

*Sleep and rest quality*

Theme 7 asked experts to evaluate related behavior regarding sleep and rest quality. Four statements in this domain are: 1) maintaining adequate sleep; 2) avoiding overexertion; 3) going to bed on time; and 4) having enough rest. The consensus value varies between 87.78 and 93.33, which shows good agreement among experts on this theme.

*Prevention behavior*

Theme 8 solicited expert opinions on what activities persons diagnosed with pulmonary tuberculosis should engage in to prevent the disease from spreading. There were 10 statements within this domain, which are: 1) performing personal hygiene; 2) performing house cleanliness; 3) not spitting indiscriminately; 4) wearing a respirator mask in public during in infective phase of the disease; 5) disposing of sputum with a safe method; 6) covering face when sneezing/coughing/speaking loudly; 7) informing contact of TB status; and 8) performing good house ventilation. The consensus rating ranges from 95.56 to 98.89, indicating excellent agreement among experts. Furthermore, in round two, the experts agreed that the words "using different cutlery" and "reducing the frequency of presence in public" should be deleted due to their lack of relevance to the concept.

## Discussion

The purpose of this Delphi study was to reach a consensus on the definition and related attributes of adherence to TB treatment in Indonesia. The perspectives of the participants of the study were utilized to pinpoint key ideas regarding how characteristics of treatment adherence to TB could be clarified and to reach a consensus regarding their significance. The participants' geographic locations and educational backgrounds ranged widely. The participants' dedication to finding relevant attributes within adherence to TB treatment and reaching a consensus on the significance of these aspects is demonstrated by the high response rate across all three rounds. Most participants had more than five years of experience, which attested to their knowledge and capacity to add to the body of knowledge produced by this study.

After three rounds of the Delphi study, 42 attributes deemed significant in assessing adherence to tuberculosis treatment had been agreed upon. Following the organization of these 42 attributes into 8 domains, participants' agreement on the domains and conceptual groups was attained. In the second round of the Delphi, two statements were necessitated to be removed due to the absence of consensus among the experts. Concerning the utilization of different cutlery, most experts asserted that such practices bear no correlation to the transmission of TB. With respect to the imposition of frequency of presence in public, the prevailing view among experts posits that if individuals diagnosed with TB curtail their social interactions and community engagements, it may significantly adversely affect their psychological well-being; thus, it is deemed inadvisable to impose limitations on the frequency of presence in public of these patients.

The study's consensus extended beyond awareness of available TB treatments or treatment adherence motivation. The experts' panelists agreed that due to the context of adherence to TB treatment, not only medication-taking behavior but also the point of lifestyle change is also noted as an essential part of adherence to TB treatment. Furthermore, the study validated the significance of combining lifestyle-related factors like quitting smoking with medication-taking behavior domains to maximize the results of TB treatment. Therefore, it can be summarized that adherence to TB treatment refers to the extent to which persons with TB can follow the agreed recommendations for prescribed TB treatments, which consists of medication-taking behavior and lifestyle changes including nutrition care, stop smoking, stop alcohol consumption, stress management, physical exercise, rest and sleep, and prevention behavior.

The result of the study is strengthened by other studies regarding adherence to TB treatment. In a systematic study conducted by Munro *et al.* [27], it was found that adherence to TB treatment is not solely determined by the act of taking drugs. While prescription drugs can be useful in improving health, they may not always target the root causes of a condition, which might be worsened by an unhealthy lifestyle [39]. Furthermore, adherence to treatment signifies the joint endeavours of the patient and healthcare professionals, especially nurses, to improve the patient's health by integrating the medical knowledge of the healthcare professionals with the patient's

lifestyle modifications, principles, and treatment preferences [40]. Lisum and Waluyo [23] discovered that persons diagnosed with TB are recommended to follow a regular treatment schedule, consume a well-balanced diet including vital nutrients, and adopt positive lifestyle changes to reduce the likelihood of getting more serious illnesses. Hence, it is crucial to incorporate both drug adherence and lifestyle modifications into the therapy recommendation.

The theme of medication-taking behavior achieved an impressive consensus, reflecting the critical role of adherence in TB treatment. Experts emphasized the entire continuum of the medication process, from filling prescriptions and taking the first dose to maintaining regular follow-ups and completing the course as prescribed [20]. The high consensus underscores the recognition of these behaviors as foundational to treatment success, reducing drug resistance, and ensuring patient recovery. Notably, behaviors like refilling prescriptions on time and proper administration were seen as indispensable for treatment continuity and efficacy.

Consensus values for nutrition care reveal widespread agreement on the importance of addressing nutritional needs in TB management. The presence of malnutrition compromises the immune response, thereby heightening vulnerability to TB and diminishing the organism's capacity to effectively respond to therapeutic interventions [41]. Nutritional care behaviors such as increasing protein, caloric intake, fruits, and hydration align with the heightened metabolic demands in TB patients. Furthermore, the focus on maintaining weight and consuming vitamins and minerals underscores the essential role of nutrition in enhancing immune function and recovery. This domain highlights the holistic approach needed for managing TB, complementing pharmacological interventions with dietary support [1].

The high consensus within this field underscored the pressing necessity to mitigate smoking as a pivotal risk factor in the advancement and dissemination of TB. Previous studies have found that smoking is a separate risk factor for TB [42,43]. Previous research has similarly highlighted the importance of lifestyle modifications for individuals afflicted with pulmonary TB. Chaves *et al.* [44] posits that behaviors such as abstaining from alcohol consumption and discontinuing smoking significantly influence the attainment of positive treatment outcomes.

Experts reached a consensus on the behaviors associated with the cessation of alcohol consumption. The consumption of alcohol is widely recognized as a significant risk factor for inadequate adherence to treatment and the progression of TB [45-47]. Emphasizing the necessity of comprehending its significance and committing to behavioral modifications illustrates the essential role of awareness and self-agency in altering established habits. This particular domain highlights the critical incorporation of substance use counseling into TB management programs.

Stress management attained a robust consensus among experts, underscoring its critical role in the provision of TB care. The delineated behaviors, which encompass the eradication of stressors, the formulation of coping strategies, and the cultivation of resilience, underscore the psychological burden that TB exerts on affected individuals. A recent investigation conducted by Rouf *et al.* [48] has elucidated that depression significantly undermines the efficacy of TB treatment, resulting in adverse clinical outcomes. Therefore, it is crucial to regularly evaluate TB patients for depression and anxiety and promptly send them to a psychiatrist. This practice can enhance both the result and the quality of life for these individuals [49,50]

The theme of physical exercise has underscored the necessity for light, sustainable activities to enhance health outcomes among patients afflicted with TB. Although the level of consensus was somewhat lower compared to other areas, it nevertheless underscores the significance of eschewing a sedentary lifestyle and preserving physical functionality. Recommendations regarding the duration and type of exercise are in concordance with the imperative for patient-specific regimens that take into consideration TB-related fatigue and physical constraints [51]. Alsharani *et al.* [41] have identified several influential factors that contribute to the cessation of TB treatment among individuals, including a deficiency in physical activity.

Experts also underscored the significance of sleep and rest quality in TB care. Behaviors like maintaining adequate sleep, avoiding overexertion, and establishing consistent sleep routines are essential for recovery and immune function [52]. The slightly lower consensus in this domain may reflect variations in individual sleep needs, but it highlights the necessity of integrating rest into patient education and support. Various research has elucidated the connection between sleep

deprivation and TB, highlighting the correlation between insufficient sleep and compromised immune function [53,54].

Prevention behaviors achieved high consensus, underlining their central role in TB control. Activities like maintaining personal and household hygiene, safe sputum disposal, and wearing masks during the infectious phase are vital for reducing disease transmission. The decision to exclude "using different cutlery" and "reducing public presence frequency" reflects expert agreement on focusing on more impactful measures. Prevention of pulmonary TB transmission behavior is also one of the keys to the decreased incidence of pulmonary TB [55]. Unhealthy behavior in patients with pulmonary TB can be caused by a lack of information about TB in the community so they lack responsibility for the TB transmission [56].

The study's findings broaden the understanding of how to conceptualize adherence to TB treatment in regard to persons with pulmonary TB in Indonesia. First, it classifies adherence to TB treatment into constructs that characterize the behaviors necessary for individuals with pulmonary TB to follow, which are closely related to taking medication and making lifestyle changes. Analyzing these concepts makes it possible to quantify and conceptualize the behaviors that people with pulmonary tuberculosis take. Second, in developing and conceptualizing what adherence to TB treatment is, this Delphi study has considered both the opinions of the experts and a patient-centered perspective. This means that it looks at indicators and results that are related to the patient undergoing TB treatment as well as the theoretical ideas raised by the panel of experts. Third, the study integrates the viewpoints of TB treatment recipients and providers. This was a purposeful choice made to guarantee that the public, TB care professionals, and TB patients could all understand the terminology used to characterize adherence to TB treatment.

The results of this study enhance the understanding of adherence to TB treatment. Undoubtedly, it is crucial to have a thorough description of this concept to create all-encompassing strategies for TB care that encourage adherence and enhance treatment results by incorporating approaches to improve medication adherence and lifestyle changes. Following the findings of the studies, nurses take a critical position in this issue. Specifically, nurses in Indonesia function as the primary interface between the healthcare system and individuals receiving treatment for TB. They assume a crucial role in educating patients, administering medications, monitoring adverse effects, and providing psychosocial support [57]. Their intimate interactions with patients afford them a direct understanding of the various obstacles and enablers of treatment adherence [58]. Thus, the findings of the study yield invaluable insights concerning adherence to TB treatment for the improvement of TB management in Indonesia.

This Delphi study engaged a diverse panel of specialists possessing extensive educational qualifications in TB, encompassing nursing practitioners from both clinical and educational settings, as well as physicians intimately involved in TB management, to evaluate the determinants of adherence to TB treatment. By cultivating a consensus among experts with varied areas of specialization, the study yielded comprehensive insights pertinent to multiple health disciplines involved in managing TB. With an agreement exceeding 90%, the experts acknowledged the imperative to expand the definition of adherence to encompass not only medication intake but also necessary lifestyle modifications. Although the emphasis on Indonesia—currently positioned as the second highest globally in TB incidence—may impose limitations on the generalizability of findings due to discrepancies in patient demographics and healthcare system characteristics, the results continue to hold substantial relevance for evaluating adherence to TB treatment and devising targeted interventions to enhance health outcomes.

## Conclusion

The study identified the key attributes of adherence to TB treatment in Indonesia, which highlighted the varied challenges associated with promoting adherence among individuals with pulmonary TB. These findings suggested that it is crucial to strike a balance between the process of taking medicine and making lifestyle adjustments to achieve the best possible outcomes in TB treatment. Moreover, this study emphasized crucial areas of consensus, such as preventative behavior, which experts consider to be of great significance. This study offers guidance to nurses and other healthcare professionals who are responsible for TB management, by highlighting the complex nature of adherence to TB treatment, the importance of a comprehensive approach to

assessing adherence, and specific areas of agreement that can be applied in clinical practice to improve the outcomes of TB treatment among individuals with pulmonary TB, therefore, the effectiveness and efficiency of TB management can be achieved.

### Ethics approval

The study received approval from the Health Research Ethics Committee of the Immanuel Institute of Health, Bandung, Indonesia (No.039/KEPK/IKI/V/2024). Data was gathered after acquiring consent from each of the participants. Participants had the option to decline the questionnaires or opt out of the Delphi process if they did not wish to participate or lacked sufficient time. They were free to resign from the study at any point without facing any consequences.

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### Competing interests

The authors declare that there is no conflict of interest.

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### Underlying data

Derived data supporting the findings of this study are available from https://doi.org/10.6084/m9.figshare.28082615.v1.

### Declaration of artificial intelligence use

This study used artificial intelligence (AI) tools and methodologies for manuscript writing support: an AI-based language model, Quillbot, was employed for language refinement (improving grammar, sentence structure, and readability of the manuscript). We confirm that all AI-assisted processes were critically reviewed by the authors to ensure the integrity and reliability of the results. The final decisions and interpretations presented in this article were solely made by the authors.

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## References

1. World Health Organization. Global tuberculosis report 2021. 2021. Available from https://iris.who.int/handle/10665/346387. Accessed: 13 July 2024.

2. Burkhart PV, Sabaté E. Adherence to long-term therapies: Evidence for action. J Nurs Scholarsh 2003;35(3):207.

3. Kementerian Kesehatan Republik Indonesia. Petunjuk teknis: Pendampingan pasien TBC resistan obat oleh komunitas. 2020. Available from https://www.tbindonesia.or.id/wp-content/uploads/2021/06/TBRO_Buku-Juknis-Pendampingan-Pasien-RO-Final.pdf. Accessed: 15 July 2024.

4. Kementerian Kesehatan Republik Indonesia. Strategi nasional penanggulangan tuberkulosis di Indonesia 2020-2024. 2020. Available from https://www.tbindonesia.or.id/wp-content/uploads/2021/06/NSP-TB-2020-2024-Ind_Final_-BAHASA.pdf. Accessed: 16 July 2024.

5. Sagala ABM, Rekawati E, Nursasi A. The effect of nutritional management in the nutritional status of patients with pulmonary tuberculosis: A systematic review literature. Indones J Glob Health Res 2024;6(3):1161-1172.

6. Yuniar I, Lestari SD. Hubungan status gizi dan pendapatan terhadap kejadian tuberkulosis paru. J Perawat Indones 2017;1(1):18-25.

7.    Affandi VIP. Rokok dan kejadian konversi sputum pasien tuberkulosis. JIKSH 2019;10(2):226-232.

8.    Nisa T, Sari V. Effect of smoking on tuberculosis treatment failure: Meta-analysis. J Epidemiol Public Health 2022;7(2):251-262.

9.    Makalew LA. Faktor risiko alkoholisme terhadap penderita TB paru BTA positif di Puskesmas Kawangkoan Kabupaten Minahasa. JIK 2010;5(1):1-8.

10.   Abdurahman S, Yadeta TA, Ayana DA, *et al*. Magnitude of depression and associated factors among patients on tuberculosis treatment at public health facilities in Harari Regional State, Eastern Ethiopia: Multi-center cross-sectional study. Neuropsychiatr Dis Treat 2022;18:1405-1419.

11.   Basuki R, Rihadini, Budhiarti E. Pengaruh depresi terhadap kepatuhan minum OAT pada penderita TB. J Unimus 2014;3(2):1-8.

12.   Pratiwi NRB. Depression among tuberculosis patients and its association with medication adherence of anti-tuberculosis drugs: Literature review. MPPKI 2024;7(7):1730-1737.

13.   Afidah RL. Attitude, smoking behavior, and physical activities toward diabetes mellitus–pulmonary tuberculosis. JPK 2019;7(2):156-162.

14.   Mulyanto H. Relationship five behavioral indicators and healthy living with tuberculosis multidrug-resistant. JBE 2014;2(3):355-367.

15.   Erlina N, Marisa NDE, Syaripudin NA. The correlation between anxiety and sleep quality in tuberculosis patients in the work area of public health center Sitopeng Area Cirebon City. JKM 2020;7(2):1-5.

16.   Nurlaela S, Rahardjo S, Jayanti RD. Analysis of the quality of life of tuberculosis patients based on the SF-36 form (case study in Banyumas Regency). Indian J Tuberc 2024;71 Suppl 2:S225-S228.

17.   Sazali MF, Rahim SSSA, Mohammad AH, *et al*. Improving tuberculosis medication adherence: The potential of integrating digital technology and health belief model. Tuberc Respir Dis (Seoul) 2023;86(2):82-93.

18.   Valencia S, León M, Losada I, *et al*. How do we measure adherence to anti-tuberculosis treatment? Expert Rev Anti Infect Ther 2016;15(2):157-165.

19.   World Health Organization. Adherence to long term therapies. 2003. Available from https://iris.who.int/handle/10665/346387. Accessed: 13 July 2024.

20.   Vernon A, Fielding K, Savic R, *et al*. The importance of adherence in tuberculosis treatment clinical trials and its relevance in explanatory and pragmatic trials. PLoS Med 2019;16(12):e1002884.

21.   Cohen SM. Concept analysis of adherence in the context of cardiovascular risk reduction. Nurs Forum 2009;44(1):25-36.

22.   Cramer JA, Roy A, Burrell A, *et al*. Medication compliance and persistence: Terminology and definitions. Value Health 2008;11(1):44-47.

23.   Lisum K, Waluyo A, Nursasi A. Treatment adherence among tuberculosis patients: A concept analysis. Open Access Maced J Med Sci 2021;9(T5):20-28.

24.   Lyu C, Zhang L. Concept analysis of adherence. Front Nurs 2019;6(2):81-86.

25.   Vermeire E, Hearnshaw H, Van Royen P, *et al*. Patient adherence to treatment: Three decades of research. A comprehensive review. J Clin Pharm Ther 2001;26(5):331-342.

26.   Louwagie G, Kanaan M, Morojele NK, *et al*. Effect of a brief motivational interview and text message intervention targeting tobacco smoking, alcohol use and medication adherence to improve tuberculosis treatment outcomes in adult patients with tuberculosis: A multicentre, randomised controlled trial of the ProLife programme in South Africa. BMJ Open 2022;12(2):e056496.

27.   Munro SA, Lewin SA, Smith HJ, *et al*. Patient adherence to tuberculosis treatment: A systematic review of qualitative research. PLoS Med 2007;4(7):e238.

28.   Herawati H, Santi NF, Puspitarini Z. The role of community nurse regarding case detection of tuberculosis in public health center in Banjarbaru Municipality South Borneo. Indones Nurs J Educ Clin 2018;1(2):142.

29.   Erawati M, Andriany M. Determinants of latent tuberculosis infection among nurses at public health centers in Indonesia. Belitung Nurs J 2022;8(1):28-34.

30.   Williamson PR, Blazeby JM, Brookes ST, *et al*. Controversy and debate series on core outcome sets. Paper 4: Debate on paper 1 from the perspective of COMET [Core Outcome Measures in Effectiveness Trials]. J Clin Epidemiol 2020;125:222-224.

31.   Mikdashi J. The meaningful role of patients, and other stakeholders in clinical practice guideline development. Rheum. Dis. Clin. N. Am. 2022;48(3):691-703

32. Nasa P, Jain R, Juneja D. Delphi methodology in healthcare research: How to decide its appropriateness. World J Methodol 2021;11(4):116-129.

33. Young B, Bagley H. Including patients in core outcome set development: Issues to consider based on three workshops with around 100 international delegates. Res Involv and Engagem 2016;2:25.

34. Jünger S, Payne SA, Brine J, et al. Guidance on Conducting and REporting DElphi Studies (CREDES) in palliative care: Recommendations based on a methodological systematic review. Palliat Med 2017;31(8):684-706.

35. Trevelyan EG, Robinson N. Delphi methodology in health research: How to do it? Eur J Integr Med 2015;7(4):423-428.

36. Ismail G, Taliep N. The Delphi method. In: Liamputtong P, editor. Handbook of social sciences and global public health. Cham: Springer; 2023.

37. de Villiers MR, de Villiers PJ, Kent AP. The Delphi technique in health sciences education research. Med Teach 2005;27(7):639-643.

38. Keeney S, Hasson F, McKenna H. The Delphi technique in nursing and health research. Oxford: John Wiley & Sons; 2011.

39. Hartley M. Lifestyle modification as first line of treatment for chronic disease. J Diabetes Metab Disord Control 2014;1(2):35-39.

40. Jimmy B, Jose J. Patient medication adherence: Measures in daily practice. Oman Med J 2011;26(3):155-159.

41. Alsharani F, Zafar M, Omar EO, et al. Lifestyle risk factors associated with tuberculosis patients in Asir Region of Saudi Arabia. Int J Prev Med 2021;12:89.

42. Soh AZ, Chee CBE, Wang YT, et al. Alcohol drinking and cigarette smoking in relation to risk of active tuberculosis: Prospective cohort study. BMJ Open Respir Res 2017;4(1):e000247.

43. Bates MN, Khalakdina A, Pai M, et al. Risk of tuberculosis from exposure to tobacco smoke: A systematic review and meta-analysis. Arch Intern Med 2007;167(4):335-342.

44. Chaves Torres NM, Quijano Rodríguez JJ, Porras Andrade PS, et al. Factors predictive of the success of tuberculosis treatment: A systematic review with meta-analysis. PLoS One 2019;14(12):e0226507.

45. Silva DR, Muñoz-Torrico M, Duarte R, et al. Risk factors for tuberculosis: Diabetes, smoking, alcohol use, and the use of other drugs. J Bras Pneumol 2018;44(2):145-152.

46. Lönnroth K, Castro KG, Chakaya JM, et al. Tuberculosis control and elimination 2010-50: Cure, care, and social development. Lancet 2010;375(9728):1814-1829.

47. Barr T, Helms C, Grant K, et al. Opposing effects of alcohol on the immune system. Prog Neuropsychopharmacology Biol Psychiatry 2016;65:242-251.

48. Rouf A, Masoodi MA, Dar MM, et al. Depression among tuberculosis patients and its association with treatment outcomes in District Srinagar. J Clin Tuberc Other Mycobact Dis 2021;25:100281.

49. Febi AR, Manu MK, Mohapatra AK, et al. Psychological stress and health-related quality of life among tuberculosis patients: A prospective cohort study. ERJ Open Res 2021;7(3):00251-2021.

50. Mohammedhussein M, Dule A, Tessema W, et al. Perceived stress and its psychosocial and clinical correlates among patients with pulmonary tuberculosis: A cross-sectional study. Indian J Psychiatry 2023;65(1):103-106.

51. Ruta V, Alexescu T, Tarmure S, et al. Physical exercise – the friend or the enemy of the patient with pulmonary tuberculosis? J Mind Med Sci 2019;6(1):11-8.

52. Besedovsky L, Lange T, Haack M. The sleep-immune crosstalk in health and disease. Physiol Rev 2019;99(3):1325-1380.

53. Leung C, Chang K. Impact of lifestyle on tuberculosis. Respirology 2008;13 Suppl 3:S65-S72.

54. Yoshida N, Yoshiyama T, Asai E, et al. Exercise training for the improvement of exercise performance of patients with pulmonary tuberculosis sequelae. Intern Med 2006;45(6):399-403.

55. Putra KWR, Wiliyanarti PF, Annisa F. Analysis of prevention behaviors of pulmonary tuberculosis transmission questionnaire (PBPTTQ). NHJK 2020;9(1):16-22.

56. Dewi C, Barclay L, Passey M, et al. Improving knowledge and behaviours related to the cause, transmission and prevention of tuberculosis and early case detection: A descriptive study of community led tuberculosis program in Flores, Indonesia. BMC Public Health 2016;16:740.

57. Bosch-Capblanch X, Abba K, Prictor M, et al. Contracts between patients and healthcare practitioners for improving patients' adherence to treatment, prevention and health promotion activities. Cochrane Database of Syst Rev 2007;2007(2):CD004808.

58. Verloo H, Chiolero A, Kiszio B, et al. Nurse interventions to improve medication adherence among discharged older adults: A systematic review. Age Ageing 2017;46(5):747-754.