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# The Dynamic of Smoking Behavior through the Course of Tuberculosis Illness: A Hospital-Based Study in Medan, Indonesia

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**ABSTRACT**

**Introduction:** Smoking is associated with the prognosis of tuberculosis (TB). The diagnosis of TB in patients who smoke or recently quit smoking can be a pivotal moment that motivates them to continue quitting smoking. However, there is a paucity of information on changes in smoking status among TB patients through the course of the disease. This study presented self-report smoking status during the pre-symptomatic, post-symptomatic, intensive treatment, and continuation treatment phases among TB patients receiving treatment.
**Methods**: This was a cross-sectional study conducted at four hospitals in Medan, Indonesia, from December 2019 to February 2020. For at least one month, healthcare workers invited TB patients who had received treatment at the hospitals' TB-Directly Observed Treatment Shortcourse (DOTS) clinics to participate in this study. Trained enumerators collected the data through face-to-face interviews, in which the patients self-reported information on their smoking status at various phases.
**Results:** Of 285 patients who met the inclusion criteria, 277 gave their consent (97% participation), of whom 146 never smoked in their lifetime. Among 131 ever smokers, 88 (67%) had quit smoking before or during the pre-diagnosis phase, 65 (51.6%) of whom remained quitters throughout the course of the disease. Thirty-eight patients continued to smoke after symptom onset, and more than half of them had stopped smoking by the continuation phase of treatment.
**Conclusion:** Smoking cessation was relatively common after the appearance of TB symptoms and after diagnosis. However, some patients subsequently relapsed, while others were unable to quit smoking. Social desirability could have influenced the responses and should be considered in interpreting the study findings.

## INTRODUCTION

The majority (87%) of the 10.6 million new tuberculosis (TB) cases globally are found in low- and middle-income countries (LMICs), of which the Southeast Asia Region accounted for the largest number of cases, 46% in 2022.[1] Indonesia has the second highest TB burden disease with a TB incidence rate of 385 per 100,000 population and a 37% increasing number of TB deaths, where the disease is the fourth most common cause of death.[2,3] Tobacco use is estimated to cause more than eight million deaths worldwide and is in the top five causes of death in Indonesia.[3–5] As a country with a high prevalence of tobacco use, particularly among Indonesian men, where the prevalence is reported to be the highest in the world at 71%, the western provinces, which encompass North Sumatra, exhibit a slightly higher prevalence of smoking.[6–8] The World Health Organization (WHO) reported that more than 20% of global TB incidence may be attributable to smoking, and it is projected to cause an additional 18 million TB cases and 40 million deaths by 2050.[9,10]

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Smoking is associated with TB infection and TB-related mortality.[11–14] It is also significantly associated with TB treatment failure, default, and relapse after successful TB treatment.[15–18] Since tobacco smoking is addictive and individual smoking behavior is quite persistent, individuals who smoked in the past are several times more likely to smoke today relative to the previous non-smokers.[19] Nonetheless, there is a dearth of information about changes in smoking behaviors of patients of pulmonary tuberculosis (PTB) in LMICs before and after TB diagnosis. Such information can contribute to integrating tobacco control into TB prevention, diagnosis, and treatment programs.

This study presented self-reported smoking status during the pre-symptomatic, post-symptomatic, intensive treatment, and continuation treatment phases of TB among TB patients receiving treatment at tertiary hospitals in Indonesia.

## METHODS

This was a hospital-based cross-sectional study among adult pulmonary TB patients aged 18 years old or older who had received TB treatment for at least one month at four general hospitals in Medan, North Sumatra, Indonesia.

Based on a previous study, the prevalence of current smokers among TB patients in this study was estimated to be 77.6% (p = 0.776).[20] With a precision level of 5% (d = 0.05), 95% confidence level, and 10% non-response rate, the minimum sample size was 294 patients using the sample size calculation formula for estimating proportion in a single population.

A total of 318 pulmonary TB patients who had received at least one month of TB treatment and came to the four study hospitals from December 2019 to February 2020 for follow-up visits were identified from the study hospitals. The study hospitals had the largest public TB-Directly Observed Treatment Shortcourse (DOTS) clinics in Medan. Of the 318 patients originally identified, 33 patients (10.4%) did not meet the inclusion criteria or had insufficient information regarding medical status. Among 285 patients who met the inclusion criteria and had sufficient medical status information, eight refused to participate, and 277 gave their informed consent and were interviewed (response rate = 277/285 = 97.2%).

This study used a structured interview questionnaire to obtain information on the patients' characteristics, such as socioeconomic and demographic factors, including ethnicity, religion, marital status, education, income, health insurance scheme, living residence, and TB symptoms. The Global Adult Tobacco Survey Questionnaire (GATS) was used as a self-reported smoking behavior measurement tool.[21] The smoking behavior measurement questions included, 1) Lifetime history of tobacco use ("*Have you ever smoked at least 100 cigarettes or kretek in your lifetime*?"); 2) Smoking behavior after TB symptoms started to develop ("*After symptoms appeared* [*cough/cough with sputum/hemoptysis*] *for <4 weeks before TB diagnosis, have you smoked any cigarette or kretek, even a puff?*"); 3) Smoking behavior after the diagnosis ("*Since you started the TB treatment, have you smoked any cigarette or kretek, even a puff?*"); and 4) Smoking behavior during the "Continuation Phase" of treatment and after the end of the "Intensive Phase" of treatment (i.e., the first two months) ("*After two months of intensive TB treatment, have you smoked any cigarette or kretek, even a puff?*").

If the participant reported no lifetime history of tobacco use, they were considered "Never smokers." Among participants who reported a lifetime history of tobacco use during each phase, as pre-symptomatic, the participant would be considered as being in one of the following categories, 1) *Recent quitters*, those who indicated that they had quit after the start of the current phase; 2) Long-term quitters, those who quit smoking in the previous phase and continued to be former smokers; 3) *Relapse*, those who were former smokers during the previous phase, had smoked at least once after the start of the current phase; 4) *Remained smokers (hardcore)*, those who smoked at least once during the previous phase and smoked at least once since the beginning of the current phase; 5) *Incomplete information* to determine the status, thus the participant could not be categorized; 6) *Error/contradicting answers*, thus the participant could not be categorized; 7) *Refused to answer*; 8) Participants were *still in Intensive Phase*, thus smoking status during the Continuation Phase was not available.

The study questionnaire was drafted in English, translated to Indonesian, and then back-translated to English. Investigators identified discrepancies between the original and back-translation versions and re-assessed the Indonesian version to resolve translation inaccuracies. Two public health and epidemiology experts reviewed the questionnaire in the local context. Then the study instrument was pilot-tested in Indonesian in ten patients who met the same eligible criteria at the hospitals' TB-DOTS clinic and used the feedback from the pilot-test participants to modify the study instrument further. The patients included in the pilot test were not included as participants in the survey.

Seven trained enumerators were recruited from a local health science institute. The study instrument included a structured questionnaire pilot-tested before the data collection period. Healthcare providers at the TB-DOTS clinics were asked to invite the patients to

participate and introduce the patients to the trained enumerators. Patients were interviewed once in the TB-DOTS clinics by face-to-face interviews, which took approximately 45 minutes to complete in a private area using the paper-based version of the study instrument, and all participants consented to a confidential interview.

Two research team members independently performed double data entry of the paper and pencil questionnaire using Epidata software. Discrepancies in the entered data were discussed and resolved among research team members. The principal investigator subsequently cleaned the entered data before analysis. The characteristics of the study participants were summarized using descriptive statistics, i.e., frequencies, percentages, mean, and standard deviation. All statistical analyses were performed using R (version 3.5.2).[22]

### Ethical Approval

This study had received ethical approval from the Human Research Ethics Committee, Faculty of Medicine, Prince of Songkla University, Thailand (REC. 62-322-18-1), and Faculty of Medicine, Universitas Sumatera Utara, Medan, Indonesia.

## RESULTS

Table 1 presents the baseline characteristics of the study participants. The participants were predominantly males aged 35-39 years old (mean age 41.7 years old). Nearly half of the participants had no income and were jobless. Nearly all participants had no prior history of TB and coughed with either sputum or blood, although the latter was uncommon. Of the 131 individuals who had ever smoked, 99 (75.5%) reported no adverse effects after TB-related therapy. However, 32 out of the 38 smokers at diagnosis reported mostly having itchy or rash and dark or brown urination.

Concerning smoking behavior, 131 of the 277 participants (47.3%) reported a lifetime history of smoking (Figure 1). Among the 131 ever-smokers, 88 participants (67.2%) reported smoking cessation after developing TB symptoms, and 65 participants (49.6%), i.e., three-quarters of all quitters, did not relapse through the entire diagnosis and treatment process. Eight quitters relapsed during the intensive phase of treatment (three of whom were able to quit smoking again), and nine patients relapsed either during the intensive phase or the continuation phase of treatment.

On the other hand, among the 131 ever smokers, there were 38 participants (29.0%) who continued to smoke after developing symptoms, 15 of whom quit smoking during the intensive phase of treatment, and 19 of whom were "hardcore" smokers who continued to smoke. Of the "hardcore" smokers, 14 persons were found to remain smokers during the continuation phase of treatment.

**Table 1.** Characteristics of the study participants (n = 277 patients)

| Variable | N | n |
|---|---|---|
| **Male** | 277 | 164 (59.2%) |
| **Age (years old) [mean ± SD]** | | 41.7 ± 14.1 |
| **Age groups (years old)** | 277 | |
| 15-19 | | 11 (4.0%) |
| 20-24 | | 30 (10.8%) |
| 25-29 | | 27 (9.7%) |
| 30-34 | | 25 (9.0%) |
| 35-39 | | 37 (13.4%) |
| 40-44 | | 27 (9.7%) |
| 45-49 | | 31 (11.2%) |
| 50-54 | | 32 (11.5%) |
| 55-59 | | 23 (8.3%) |
| 60-64 | | 22 (7.9%) |
| 65+ | | 12 (4.5%) |
| **Ethnicity** | 276 | |
| Batak | | 104 (37.7%) |
| Javanese | | 85 (30.8%) |
| Others | | 87 (31.5%) |
| **Religion** | 276 | |
| Islam | | 169 (61.2%) |
| Christian | | 105 (38.1%) |
| Others | | 2 (0.7%) |
| **Marital status** | 277 | |
| Never married | | 70 (25.3%) |
| Married | | 186 (67.1%) |
| Divorced/widowed | | 21 (7.6%) |
| **Education level** | 277 | |
| Primary school or less | | 72 (26.0%) |
| Senior high school | | 160 (57.8%) |
| Completed high school or higher | | 45 (16.2%) |
| **Occupation** | 276 | |
| Unemployed | | 114 (41.3%) |
| Private employee | | 106 (38.4%) |
| Government employee | | 9 (3.3%) |
| Labor worker | | 11 (4.0%) |
| Others | | 36 (13.0%) |
| **Current income[&]** | 239 | |
| No income | | 116 (48.5%) |
| Below regional average | | 31 (13.0%) |
| Upper regional average | | 92 (38.5%) |
| **Owns health insurance (Yes)** | 277 | 191 (67.0%) |
| Healthcare BPJS* | | 167 (87.4%) |
| Social Security BPJS | | 6 (3.1%) |
| Others | | 18 (9.5%) |
| **Living residence** | 277 | |
| Within Medan | | 231 (83.4%) |
| **No prior diagnosis of TB** | 162 | 147 (90.7%) |
| **TB symptoms experience** | 275 | |
| No symptoms | | 9 (3.3%) |
| Cough only | | 80 (29.1%) |
| Cough with sputum | | 135 (49.1%) |
| Cough up blood | | 51 (18.5%) |
| **TB treatment side effect experience**** | 131 | |
| No side effect | | 99 (75.5%) |
| Dark or brown urine | | 12 (9.2%) |
| Itchiness or a rash | | 12 (9.2%) |
| Nausea, vomiting, or no appetite | | 8 (6.1%) |

*[&]1,811,875 Rupiah/person-month, *BPJS is Social Security Administrator for Health in Indonesia, **Questions limited to those who have ever smoked*

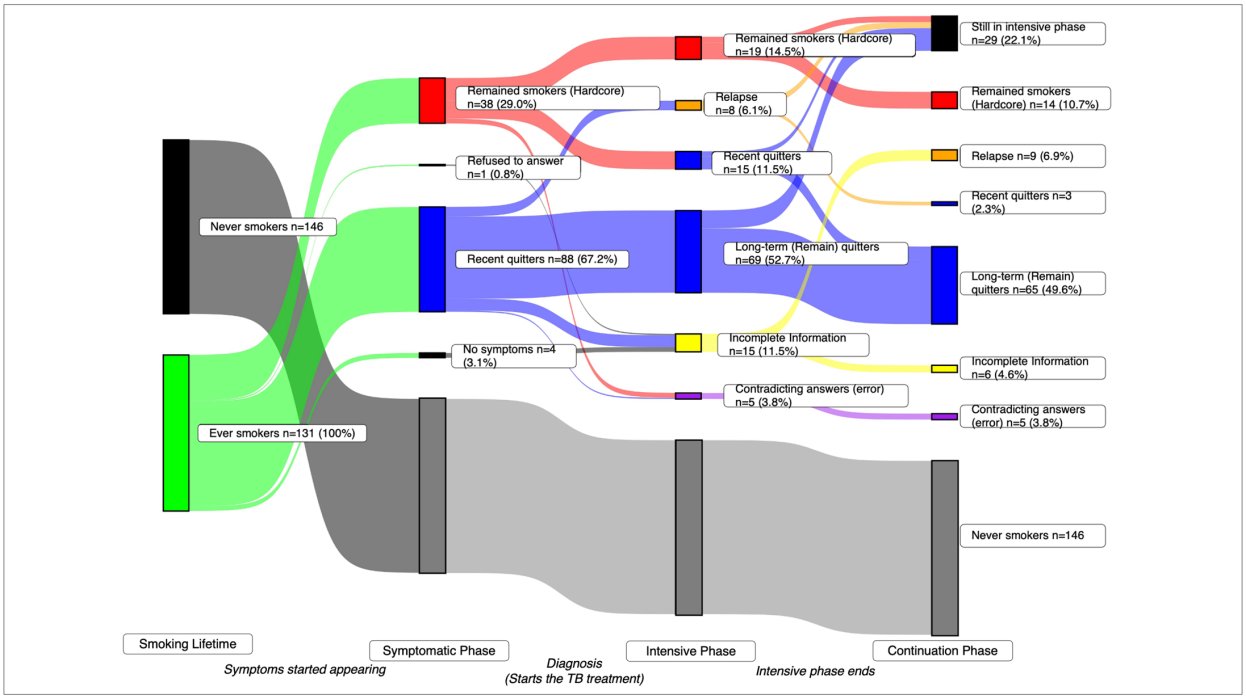


**Figure 1**. Sankey diagram of smoking status among study participants before diagnosis, on the day of TB diagnosis and started the treatment (intensive phase), and on the day of the interview (continuation phase) (n = 277)

## DISCUSSION

The majority of TB patients quit smoking after experiencing TB symptoms and did not relapse throughout the treatment. One-fifth of the patients who quit smoking relapsed either during the intensive phase or the continuation phase of treatment. TB patients who never stopped smoking ("hardcore smokers") accounted for just over 10% of all ever-smokers.

A study found that TB patients who quit and remained quitters were likely to report high levels of perceived disease severity, which might have influenced the low incidence of relapse.[23] TB patients who quit smoking may also believe that smoking can make the TB treatment less effective.[24] Recently-diagnosed TB patients may also experience severe anxieties, including fear of death, unfavorable prognosis, stigmatization, and social effects conditions.[25–27] TB diagnosis can function as a "teachable moment" for TB patients who were current smokers or recent quitters to quit or to remain quitters and may provide an opportunity to provide or refer the patient to cessation counseling.[28,29]

Nicotine dependence likely contributed to some smokers becoming "hardcore" as well as relapses.[30] However, several other factors could also have influenced the outcomes, including lack of perceived harm of smoking, or the perception that tobacco use at low doses is relatively safe.[24,31,32] Smoking is a cultural and social activity among Indonesian men, and cigarettes are commonly given out at events, including weddings, funerals, religious ceremonies, and community meetings. The pressure to accept the offer might have made it difficult for current smokers to stop despite illness. However, some patients may also opt to smoke at home when alone.[33] Hence, understanding the tobacco use knowledge, attitudes, and behaviors among TB patients is of significance in the provision of behavioral therapy for smoking cessation.[23,34]

Several issues should be considered concerning the measurement of smoking status in this study. The wording in this study created overlaps in smoking behaviors between the intensive and continuing phases, which made the status among some participants unclear. The use of cigarettes at any dose was considered to be an indication of being "hardcore" or "relapsed". Thus, these groups of smokers might have included patients who smoked just a few puffs in the entire 2-month period of the intensive phase to conform to social pressures, as well as patients who continued to smoke more than one per pack per day during the intensive phase. The measurement method in this study did not allow to distinguish those who attempted smoking cessation but failed from those who never attempted smoking cessation during a given period. This study also did not collect data on when and why participants decided to quit and their perceived reasons for success or relapse, which could have yielded important data for tobacco control program planning.

The strength of this study was the very high response rate (97.2%), which implied a low likelihood of selection bias due to non-response. However, several limitations should be considered in interpreting the study

findings. Firstly, important details about timing and reasoning for smoking cessation and relapse were not measured. Secondly, all of the information was self-reported. Thus, social desirability could have influenced the under-reporting of smoking behaviors. Future studies should consider more detailed questions, a longitudinal study design, or the use of biomarkers to allow for more detailed and objective measurements of changes in smoking behaviors. Lastly, the participants in this study were from four urban hospitals in Medan. Although the smoking rate in Medan surpassed that of North Sumatra, at the provincial level, it remained below the national average for smoking prevalence.[8,35] Thus, the findings may not be generalizable to TB patients in other areas of Indonesia.

## CONCLUSION

This study described self-reported smoking behaviors among TB patients at various points in time according to their recollection. Even though imprecise, the data suggested that most TB patients who were smokers before the development of TB symptoms gave up smoking after the symptoms appeared and remained quitters throughout the treatment process. However, some patients relapsed, while others were unable to quit smoking. It is crucial to comprehend the tobacco habits of TB patients to tailor smoking cessation interventions through behavioral therapy. This understanding is also vital in developing successful educational programs aimed at preventing TB, avoiding treatment failure, recurrence post-treatment success, and mitigating other adverse outcomes. Issues concerning the measurement of smoking status and generalizability should be considered in interpreting the study findings.

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**Conflict of Interest**
The authors declared there is no conflict of interest.

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**Authors' Contributions**
Study idea and design, proposal development, and data collection: NS, WW, and VC. Examined the data and drafted the first paper draft: NS and WW. Data analysis: NS and WW. Reviewed the manuscript: WW and VC. All authors contributed and approved the final version of the manuscript.

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