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ORIGINAL RESEARCH ARTICLE

Personal Hygiene Practices and Pulmonary Tuberculosis in the Service Area of Bangil Public Health Center, Pasuruan Regency: A Case-Control Study

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ABSTRACT

Pulmonary tuberculosis (TB) remains a major public health problem in Indonesia, and personal hygiene practices such as cough etiquette, mask use, and handwashing are routinely promoted in primary health care; however, evidence on their association with pulmonary TB remains inconsistent. This study aimed to examine the association of cough etiquette, handwashing habits, mask use, use of eating utensils, and window-opening practices with pulmonary TB in the service area of Bangil Public Health Center, Pasuruan Regency, East Java, Indonesia. An analytical observational study with a case-control design was conducted in 2025 among 82 participants, comprising 41 pulmonary TB cases registered in the TB control programme and 41 controls without TB from the same service area. Practices were assessed using a structured questionnaire and an observation sheet and classified as good or less-than-ideal. Associations were analyzed using the chi-square test, and crude odds ratios (ORs) with 95% confidence intervals (CIs) were calculated. Less-than-ideal practices were common in both groups, particularly for cough etiquette (63.4% of cases and 70.7% of controls). No statistically significant association was found between pulmonary TB and cough etiquette (OR = 0.72; 95% CI 0.28–1.81), handwashing (OR = 0.74; 95% CI 0.30–1.79), mask use (OR = 0.68; 95% CI 0.28–1.61), use of eating utensils (OR = 0.82; 95% CI 0.34–1.97), or window-opening practices (OR = 0.74; 95% CI 0.31–1.78); all p-values exceeded 0.05. The selected practices did not distinguish pulmonary TB cases from controls in this population. Because practices were measured after diagnosis and the sample was small, these findings should be interpreted cautiously, and TB control should combine hygiene promotion with active case finding, contact investigation, and improvement of household ventilation.

Introduction

Tuberculosis (TB) remains one of the leading infectious causes of morbidity and mortality worldwide. In 2023, an estimated 10.8 million people developed TB and 1.25 million died of the disease, and Indonesia accounted for about 10% of the global burden, the second largest share after India [1]. Within Indonesia, TB cases are reported from nearly all provinces, with a high concentration on the densely populated island of Java, and East Java is among the provinces with the largest number of cases [2]. These figures indicate that transmission is still ongoing and that prevention needs to be strengthened at the community and primary health-care levels.

Pulmonary TB is caused by *Mycobacterium tuberculosis* and is transmitted mainly through the air when a person with infectious pulmonary TB coughs, sneezes, or speaks. The probability of

transmission depends on the infectiousness of the source case, the susceptibility of the exposed person, the intensity and duration of exposure, and indoor conditions, particularly poor ventilation, crowding, and prolonged close contact [3], [4]. Consequently, TB is a multifactorial disease: individual characteristics such as age, nutritional status, and comorbidities, together with household conditions such as occupancy density, ventilation, humidity, natural lighting, and contact with an active case, have all been associated with TB in Indonesia [5], [6], [7].

At the behavioral level, cough etiquette, mask use, hand hygiene, and opening windows to improve air circulation are routinely promoted in TB prevention activities at primary health-care facilities [3], [8], [9], [10]. These practices act through different pathways. Cough etiquette and mask use mainly reduce the release of infectious droplets from people who are already ill (source control), and modelling studies suggest that mask use combined with case detection can reduce TB transmission [11]. Opening windows dilutes airborne particles in the home, and habitual window opening has been associated with TB in East Java [12], [4]. Hand hygiene and the use of personal eating utensils, in contrast, are general household hygiene practices, and their relevance to an airborne disease is less direct [3].

Evidence on the association between these practices and pulmonary TB remains inconsistent. Some Indonesian studies have reported associations between personal hygiene or preventive behavior and TB, whereas others have found that household environmental conditions and contact history are more consistently associated with the disease [13], [14], [15], [16]. Furthermore, previous studies have usually assessed personal hygiene as a single composite construct or examined individual behaviors separately [17], [18], which makes it difficult to determine which practices differ between people with and without TB. In the service area of Bangil Public Health Center, no study has yet examined these practices together within one population.

Therefore, this study aimed to examine the association of five selected practices, namely cough etiquette, handwashing habits, mask use, use of eating utensils, and window-opening practices, with pulmonary TB in the service area of Bangil Public Health Center, Pasuruan Regency, East Java, Indonesia. Recognizing their different pathways, cough etiquette, mask use, and handwashing were treated as personal preventive behaviors, window opening as a household ventilation-related practice, and the use of eating utensils as a household hygiene practice.

Materials and Methods

Study Design and Setting: This analytical observational study used a case-control design and was conducted in 2025 in the service area of Bangil Public Health Center (*Puskesmas*), Pasuruan Regency, East Java, Indonesia. The area was selected because pulmonary TB remains a priority problem according to the surveillance data of the health center.

Cases and Controls: Cases were residents of the service area who had been diagnosed with pulmonary TB according to the national TB guidelines (bacteriological confirmation or clinical diagnosis) and were registered in the TB control programme of Bangil Public Health Center. Controls were residents of the same service area who had no history of a pulmonary TB diagnosis, as verified through health-center records and interview. Drawing cases and controls from the same geographical source population was intended to improve comparability and reduce selection bias.

Sample Size and Sampling: The study included 82 participants, comprising 41 cases and 41 controls (case-to-control ratio 1:1). Eligible cases were recruited consecutively from the TB register during the study period until 41 cases were obtained, and controls who met the eligibility criteria were recruited from the same service area until an equal number was reached.

Variables and Measurement: The dependent variable was pulmonary TB status (case or control). The independent variables were cough etiquette (covering the mouth and nose when coughing or sneezing), handwashing habits (washing hands with soap and running water at critical times), mask

use (wearing a mask when interacting with other people or when having respiratory symptoms), use of eating utensils (using personal utensils and not sharing them with other household members), and window-opening practices (opening house windows daily to allow air circulation). Each variable was measured with 10 questionnaire items answered yes or no and scored 1 or 0, giving a total score of 0–10. Scores of 6–10 were classified as good and scores of 0–5 as less-than-ideal; the less-than-ideal category was treated as the exposure and the good category as the reference.

Research Instrument: Data were collected using a structured questionnaire and an observation sheet developed from the TB prevention guidance of the Ministry of Health of the Republic of Indonesia and the World Health Organization [3]. The observation sheet was used to complement the self-reported practices. Item validity was tested using Pearson's item–total correlation, and items were considered valid when the calculated correlation coefficient exceeded the r-table value (0.361). Reliability was assessed using Cronbach's alpha, with a coefficient of ≥ 0.60 considered acceptable.

Data Collection: Data were collected after research permission and ethical approval had been obtained. Participants received an explanation of the study objectives, procedures, voluntary participation, and confidentiality, and provided written informed consent. The same interview and observation procedures were applied to cases and controls. Completed forms were checked for completeness and consistency before coding and data entry.

Statistical Analysis: Univariate analysis described the distribution of each practice in the case and control groups as frequencies and percentages. Bivariate analysis used a 2 × 2 table for each practice; associations were tested with Pearson's chi-square test (Fisher's exact test when an expected cell count was below 5), and the crude odds ratio (OR) with its 95% confidence interval (CI) was calculated. Statistical significance was set at a two-sided $p < 0.05$. An OR above 1 indicated higher odds of less-than-ideal practice among cases than among controls, and an OR below 1 indicated lower odds; the direction of the OR was interpreted together with its CI and p-value rather than on its own. Multivariable analysis was not performed because none of the practices was associated with TB in the bivariate analysis and data on major confounders were not collected.

Ethical Considerations: This study received ethical approval from the Health Research Ethics Committee of Poltekkes Kemenkes Surabaya (No. EA/4184/KEPK-Poltekkes_Sby/V/2025). All participants provided written informed consent, participation was voluntary, participants could withdraw without consequences, and their identities were kept confidential.

Results

A total of 82 participants were analyzed, consisting of 41 cases and 41 controls. Table 1 presents the distribution of each practice in the two groups together with the crude odds ratios. Less-than-ideal practices were common in both groups. The largest proportion of less-than-ideal practice was found for cough etiquette (63.4% of cases and 70.7% of controls), followed by the use of eating utensils (56.1% and 61.0%) and window-opening practices (51.2% and 58.5%). Mask use was less-than-ideal in 46.3% of cases and 56.1% of controls, and handwashing in 36.6% and 43.9%, respectively. For every practice, the proportion of less-than-ideal practice was slightly lower among cases than among controls.

Table 1. Distribution of Personal Hygiene and Household Practices among Pulmonary TB Cases and Controls and Crude Odds Ratios, Bangil Public Health Center Service Area, 2025

Practice	Cases (n = 41)		Controls (n = 41)		OR	95% CI	p-value
	Less-than-ideal, n (%)	Good, n (%)	Less-than-ideal, n (%)	Good, n (%)			
Cough etiquette	26 (63.4)	15 (36.6)	29 (70.7)	12 (29.3)	0.72	0.28–1.81	0.481
Handwashing habits	15 (36.6)	26 (63.4)	18 (43.9)	23 (56.1)	0.74	0.30–1.79	0.499
Mask use	19 (46.3)	22 (53.7)	23 (56.1)	18 (43.9)	0.68	0.28–1.61	0.377
Use of eating utensils	23 (56.1)	18 (43.9)	25 (61.0)	16 (39.0)	0.82	0.34–1.97	0.654
Window-opening practices	21 (51.2)	20 (48.8)	24 (58.5)	17 (41.5)	0.74	0.31–1.78	0.506

Row percentages within each group. OR, crude odds ratio for less-than-ideal versus good practice (reference); CI, confidence interval (Woolf method); p-values from Pearson's chi-square test (all expected cell counts ≥ 5).

Because less-than-ideal practice was slightly less common among cases, all crude ORs in Table 1 were below 1, ranging from 0.68 for mask use to 0.82 for the use of eating utensils. However, every 95% CI included 1 and all p-values exceeded 0.05 (range 0.377–0.654), indicating that none of the five practices was significantly associated with pulmonary TB. The wide CIs show that the data are compatible both with no association and with moderate associations in either direction.

Discussion

This study found no statistically significant association between pulmonary TB and any of the five practices examined. All ORs were below 1, but because their confidence intervals were wide and included 1, they should not be interpreted as evidence that less-than-ideal practices protect against TB, nor as proof that these practices have no effect. Rather, the results indicate that, in this population, cases and controls could not be distinguished by their reported hygiene and household practices.

The most likely explanation for the direction of the estimates is the timing of measurement. Practices were assessed after cases had been diagnosed and enrolled in treatment, during which patients usually receive counselling on cough etiquette, mask use, and household hygiene. Health education has been shown to improve mask use among TB patients [19], and family knowledge is associated with efforts to prevent transmission within the household [20]. Cases may therefore have adopted better practices after diagnosis, so that the practices measured at the time of the study may not reflect their behavior before infection. Such reverse causation would systematically lower the ORs and could mask an underlying association. Social desirability bias may have acted in the same direction, as patients who had recently received counselling may have been more likely to report recommended behaviors.

The biological pathways of the practices also help to explain the findings. Cough etiquette and mask use primarily reduce the emission of infectious droplets from people who already have TB [3], [11]; for a person without TB, these behaviors do little to reduce his or her own risk of infection. Their protective effect is therefore expected mainly at the household or community level rather than in a comparison of individuals' own practices. Hand hygiene and the use of personal eating utensils are not established routes of transmission for an airborne disease and were included as markers of general household hygiene. Window opening is a proxy for ventilation, but it does not capture ventilation area, airflow, humidity, or lighting, which have been more consistently associated with TB [21], [6].

These findings differ from those of studies in Magetan and Surabaya, in which habitual window opening was associated with TB [12], [4], and from a study in Jember that associated personal hygiene and environmental sanitation with TB [13]. Differences in population characteristics, exposure contrast, measurement instruments, and the timing of measurement may account for these discrepancies. In the present study, most participants in both groups reported similar practices, which limited the contrast available to detect an association. At the same time, reviews and meta-analyses have consistently linked

TB with household crowding, poor ventilation, humidity, and inadequate lighting [6], [5], with household contact with an active case [7], and with socioeconomic and housing conditions at the population level [22]. Because these factors were not measured, the present study cannot determine whether they explain the absence of an association, and they should be regarded only as possible contributors.

From a programme perspective, the findings do not imply that hygiene practices are unimportant. Cough etiquette, mask use, and hand hygiene remain recommended components of TB infection prevention and control, particularly for people with active TB and their households [3]. However, hygiene promotion alone is unlikely to be sufficient. Primary health-care programmes should integrate it with active case finding, investigation of household contacts, TB preventive treatment, and improvement of household ventilation and occupancy density [1], [16], [7].

This study has several limitations. First, the case-control design cannot establish temporal sequence, and practices were measured after diagnosis, creating a risk of reverse causation. Second, practices were largely self-reported and may be affected by recall and social desirability bias. Third, the sample was small, and the formal assumptions used to determine the sample size were not documented, so the study had limited power to detect moderate associations. Fourth, dichotomizing the scores may have reduced the ability to detect differences. Finally, important determinants of TB, including household contact history, nutritional status, smoking, diabetes mellitus, occupancy density, measured ventilation, and socioeconomic status, were not collected, so confounding could not be assessed.

Conclusions

In the service area of Bangil Public Health Center, cough etiquette, handwashing habits, mask use, use of eating utensils, and window-opening practices did not differ meaningfully between people with pulmonary TB and those without the disease, and none of these practices was associated with pulmonary TB. Less-than-ideal practices were nevertheless common in both groups, so hygiene promotion remains relevant, but it should be delivered as part of a comprehensive TB control strategy that also includes active case finding, household contact investigation, and improvement of the home environment.

Future studies should use larger samples with a documented sample size calculation and measure practices in a way that reflects behavior before diagnosis, for example through prospective designs or by recruiting newly diagnosed cases before counselling. They should also include household contact history, nutritional status, comorbidities, smoking, socioeconomic status, and objectively measured housing conditions such as ventilation, humidity, lighting, and occupancy density, and apply multivariable analysis to estimate the independent contribution of each practice.

Declarations

Author Contributions: Conceptualization, A.D.K., S., P.A.I., and M.; methodology, A.D.K. and S.; data collection, A.D.K.; formal analysis, A.D.K.; writing—original draft preparation, A.D.K.; writing—review and editing, S., P.A.I., and M.; supervision, S., P.A.I., and M. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement: Written informed consent was obtained from all participants before data collection.

Data Availability Statement: The data presented in this study are available on reasonable request from the corresponding author.

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Declaration of Generative AI and AI-Assisted Technologies: During the preparation of this manuscript, AI-assisted tools were used only to improve language, grammar, and readability and to support copyediting. These tools were not used to generate data, perform analyses, or interpret the results. The authors reviewed and edited all content as needed and take full responsibility for the content of the publication.

Conflicts of Interest: The authors declare no conflict of interest.

References

[1] World Health Organization, *Global Tuberculosis Report 2024*. Geneva, Switzerland: WHO, 2024. [Publisher]

[2] Kementerian Kesehatan RI, *Profil Kesehatan Indonesia 2024*. Jakarta: Kementerian Kesehatan RI, 2025. [Publisher]

[3] World Health Organization, *WHO Consolidated Guidelines on Tuberculosis. Module 1: Prevention – Infection Prevention and Control*. Geneva, Switzerland: WHO, 2022. [Publisher]

[4] F. K. Putri, N. D. C. Putri, and L. Y. Hendrati, "Hubungan antara indikator rumah sehat dan status gizi dengan kejadian tuberkulosis paru pada balita di Kecamatan Sawahan, Surabaya," *J. Kesehat. Lingkung. Indones.*, vol. 24, no. 1, pp. 109–115, 2025. [Crossref], [Publisher]

[5] S. S. Deliananda and R. Azizah, "Faktor risiko kejadian tuberkulosis paru di Indonesia tahun 2014–2021: literature review," *Media Publ. Promosi Kesehat. Indones.*, vol. 5, no. 9, pp. 1054–1062, 2022. [Crossref], [Publisher]

[6] Y. T. Kencana, "Studi meta-analisis tentang hubungan ventilasi, kelembaban, pencahayaan dan kepadatan hunian dengan kejadian TB paru di Indonesia (2015–2020)," *Visikes*, vol. 23, no. 1, pp. 104–117, 2024. [Crossref]

[7] J. F. Faiz and E. N. Hadi, "Risk factors for latent tuberculosis infection (LTBI) among household contacts of TB patients: a systematic review," *J. Ilmu Kesehat. Masy.*, vol. 15, no. 3, pp. 288–302, 2024. [Crossref]

[8] H. Hapipah, I. Istianah, Z. Arifin, and I. Hadi, "Edukasi etika batuk yang benar sebagai upaya pencegahan penyakit TB paru di Dusun Aik Nyet Lombok Barat," *J. Abdimas Kesehat. Perintis*, vol. 2, no. 2, pp. 17–21, 2021.

[9] A. Safitri, "Pencegahan TBC dengan cara cuci tangan dan etika batuk," *J. Pengabdi. Masy. Glob.*, vol. 5, no. 1, pp. 149–152, 2026.

[10] L. N. B. Sembiring and S. Baminggen, "Pengetahuan pasien TB paru dalam penggunaan masker di Puskesmas Sentani," *J. Nurs. Health*, vol. 7, no. 3, pp. 305–316, 2022.

[11] D. Aldila, B. L. Fardian, C. W. Chukwu, M. H. N. Aziz, and P. Z. Kamalia, "Improving tuberculosis control: assessing the value of medical masks and case detection—a multi-country study with cost-effectiveness analysis," *R. Soc. Open Sci.*, vol. 11, no. 6, Art. no. 231715, 2024. [Crossref], [Publisher]

[12] W. S. Budi, M. Raharjo, and N. Nurjazuli, "Hubungan perilaku masyarakat dengan kejadian tuberkulosis di Kecamatan Panekan Kabupaten Magetan," *J. Kesehat. Lingkung. Indones.*, vol. 23, no. 3, pp. 267–272, 2024. [Crossref], [Publisher]

[13] F. A. Muhammad *et al.*, "Analysis of environmental sanitation factors and personal hygiene on the incidence of tuberculosis in Jember Regency," *Gema Lingkung. Kesehat.*, vol. 22, no. 2, pp. 78–84, 2024.

[14] M. Sabir and Sarifuddin, "Analisis faktor risiko tingginya kasus tuberkulosis paru di Indonesia: literatur review," *J. Kolaboratif Sains*, vol. 6, no. 6, pp. 453–468, 2023. [Crossref]

[15] P. N. Ina Kii, I. A. T. Hinga, and Y. R. Riwu, "Faktor yang berhubungan dengan kejadian penyakit tuberkulosis paru pada wilayah kerja Puskesmas Oebobo tahun 2024," *An-Nadaa: J. Kesehat. Masy.*, vol. 12, no. 1, p. 53, 2025. [Crossref]

[16] S. N. Pelle, S. Landi, Y. R. Riwu, and M. M. D. Wahyuni, "Faktor risiko kejadian tuberkulosis paru di Pulau Sabu tahun 2024," *Prepotif: J. Kesehat. Masy.*, vol. 9, no. 2, pp. 6312–6318, 2025. [Crossref], [Publisher]

[17] E. Nopita, L. Suryani, and H. E. Siringoringo, "Analisis kejadian tuberkulosis (TB) paru," *J. Kesehat. Saelmakers Perdana*, vol. 6, no. 1, 2023. [Crossref]

[18] C. Sudarsa, L. Karaudja, M. Syahrir, and D. W. Balebu, "Prevention of pulmonary TB transmission behavior by household contacts in the working area of the Kampung Baru Health Center," *Bul. Kesehat. Mhs.*, vol. 1, 2023. [Publisher]

[19] H. M. Krisdianto, D. Retnaningsih, and E. Supriyanti, "Pengaruh pemberian edukasi tuberkulosis terhadap praktik pemakaian masker pada pasien TBC," *J. Nurs.*, vol. 1, no. 2, pp. 52–61, 2025. [Crossref]

[20] S. Sugion, F. Ningsih, and R. Ovany, "Hubungan tingkat pengetahuan keluarga dengan upaya pencegahan penularan tuberculosis paru di wilayah kerja UPT Puskesmas Pahandut," *J. Surya Med.*, vol. 8, no. 3, pp. 228–234, 2022. [Publisher]

[21] N. Narwati, F. Y. Ferdiansyah, K. Khambali, I. Thohari, and E. Sari, "Physical condition of homes for pulmonary tuberculosis patients in the Tanjunganom Health Center area, Nganjuk District 2024," *J. Kesehat. Terpadu*, vol. 15, no. 1, pp. 30–40, 2024. [Crossref]

[22] A. M. Liyew, A. C. A. Clements, T. Y. Akalu, B. Gilmour, and K. A. Alene, "Ecological-level factors associated with tuberculosis incidence and mortality: a systematic review and meta-analysis," *PLOS Glob. Public Health*, vol. 4, no. 10, Art. no. e0003425, 2024. [Crossref], [Publisher]



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