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Research Article

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Adults and elderly patients with pulmonary tuberculosis in Surabaya: a comparative cross-sectional study

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Abstract

Age-related physiological and immunological changes may influence pulmonary tuberculosis (TB) manifestations. This study compared clinical characteristics, comorbidities, radiological findings, and laboratory profiles between adult and elderly patients with pulmonary TB in Surabaya, Indonesia. An analytical comparative cross-sectional study was conducted at three DOTS network facilities from July to September 2026, involving 50 patients (25 adults and 25 elderly) recruited through consecutive sampling. Clinical, radiological, and laboratory characteristics were compared, and binary logistic regression was used to identify factors independently associated with elderly group membership. Malnutrition was more prevalent among elderly patients (64.0% vs 16.0%; OR 9.33; p = 0.001). Elderly patients reported less frequent cough (24.0% vs 84.0%; OR 0.06; p < 0.001), but more frequent night-time fever (68.0% vs 20.0%; OR 8.50; p = 0.001) and weight loss (60.0% vs 24.0%; OR 4.75; p = 0.021). Radiological distribution, random blood glucose, and GeneXpert MTB/RIF results showed no statistically significant differences. Multivariable analysis identified malnutrition as the only independently associated factor (adjusted OR 7.606; 95% CI 1.410–41.029; p = 0.018). These findings suggest greater nutritional vulnerability and less cough-dominant presentations among elderly patients with pulmonary TB. Age-sensitive clinical assessment and nutritional evaluation are recommended, although the small sample and cross-sectional design limit generalizability and causal interpretation.

INTRODUCTION

Tuberculosis (TB) remains a major public health problem worldwide. According to the World Health Organization's Global Tuberculosis Report 2024, eight countries accounted for more than two-thirds of the estimated global incident TB cases in 2023, with Indonesia contributing approximately 10% [1]. Indonesia had an estimated 1.09 million incident TB cases in 2023 [2]. These national estimates cover all forms of TB across all age groups, rather than pulmonary TB specifically among adults and elderly patients. At the local policy level, Surabaya adopted a Regional Action Plan for TB Control for 2024–2029 through Mayor Regulation No. 118 of 2024 [3]. This

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national burden and local policy context provide a rationale for examining age-related differences in pulmonary TB presentation in Surabaya.

Age-related immune decline, reduced physiological reserves, malnutrition, and multiple comorbidities may alter the presentation of TB in older adults [4–6]. Previous studies have shown that older patients may present with fewer typical symptoms and more nonspecific complaints, which may contribute to delayed diagnosis [7–9]. Compared with younger adults, older patients have also been reported to have higher rates of weight loss, malnutrition, hypertension, coronary heart disease, and anemia, as well as more frequent bilateral, lower-zone, and diffuse lung lesions [10]. However, findings from other healthcare settings may not be directly applicable to TB patients in Surabaya.

Although previous studies have reported age-related differences in the clinical presentation and comorbidities of patients with tuberculosis (TB), evidence comparing these profiles in Surabaya remains limited. Local data are also scarce regarding age-group differences in radiological findings and laboratory profiles. These domains may vary across settings because of differences in patient characteristics, diagnostic pathways, and access to investigations. Therefore, this study compares clinical characteristics, comorbidities, radiological findings among patients with available chest radiographs, and laboratory profiles between adult and elderly patients with TB in Surabaya. The main research question was whether these measured characteristics differed between the two age groups. The study was exploratory, with no prespecified primary domain or directional hypothesis.

Beyond providing facility-based data from Surabaya, this study adds a comparison of rapid molecular test results between adult and elderly patients with TB, including rifampicin susceptibility status (rifampicin-sensitive, indeterminate, or resistant). This laboratory dimension complements comparisons of clinical characteristics, comorbidities, and radiological findings and may help describe the profile of TB detected in these local care settings.

METHODS

Study Design

This study used an analytical observational design with a comparative cross-sectional approach. Clinical characteristics, comorbidities and risk factors, radiological findings, and laboratory findings were assessed within a single observation period and compared between adults and elderly with active pulmonary tuberculosis (TB). Age group was treated as the comparison variable.

Setting and Period

The study was conducted at three facilities in the TB directly observed treatment, short-course (DOTS) network in Surabaya, Indonesia, comprising two primary health centers and one hospital. Data collection was conducted from July to September 2026.

Population, Sample, and Sampling

The target population comprised adult and elderly patients with TB in Surabaya. The accessible population consisted of patients aged 18 years or older who had active pulmonaray TB and received care at the participating DOTS-network facilities during the study period. The sampling unit and unit of analysis were the individual patient.

Patients were eligible if they were at least 18 years old; had active pulmonary TB diagnosed using clinical assessment and supporting investigations accepted by the national TB program; were at the beginning of treatment, defined as no more than one

month after treatment initiation; and provided written informed consent. Patients were excluded if they were pregnant, younger than 18 years, unable to provide the required information without an accompanying person who could assist, in an emergency condition that precluded data collection, had incomplete medical records for the main study variables, or declined participation. Radiological findings were analyzed only for participants with available chest radiographs.

Active pulmonary TB was classified according to the Indonesian Ministry of Health's 2020 *National Clinical Practice Guideline for Tuberculosis Management*. Bacteriologically confirmed TB was defined as a positive result from direct microscopy, a TB molecular rapid test (GeneXpert MTB/RIF), or culture. Clinically diagnosed TB was defined as active TB diagnosed by a physician in a patient who did not meet the bacteriological confirmation criteria and for whom TB treatment was initiated. Based on the available GeneXpert MTB/RIF results, participants with MTB detected were classified as bacteriologically confirmed; those with MTB not detected were classified as clinically diagnosed only when this classification was documented in the medical record.

Sample size was calculated using a two-proportion formula, based on weight-loss proportions of 54.4% in adults and 97.2% in elderly patients reported by Sakthivadivel et al. With a two-sided α of 0.05, 80% power, and a 10% allowance for incomplete data, the minimum required sample was 17 participants per group. The recruitment target was set at 25 per group. Consecutive sampling was used until 50 participants were enrolled (25 adults and 25 elderly patients).

Variables, Instruments, and Measurements

The primary comparison variable was age group. Age was recorded in completed years and categorized as adult (18-59 years) or elderly (60 years or older). Other demographic and treatment-related variables included sex (male or female), occupation, and TB treatment history (new case, relapse, or reactivation). Risk factors and comorbidities included smoking, alcohol consumption, malnutrition, diabetes mellitus, hypertension, and a history of human immunodeficiency virus (HIV) infection. Clinical variables included cough, night-time fever, weight loss, hemoptysis, dyspnea, and anemia.

Radiological assessment classified TB lesions by laterality (unilateral or bilateral) and extent. Reported radiological patterns included infiltrates, fibrosis, consolidation, bronchiectasis, and a miliary pattern. Laboratory variables included random blood glucose in mg/dL, HIV test results, and molecular rapid test results for TB. Random blood glucose was recorded as a continuous value. For descriptive tabulation, values were categorized using a study-defined threshold as <200 mg/dL or ≥200 mg/dL; these categories were not intended to define normal glucose status or diagnose dysglycemia. HIV test results were recorded as positive or negative. Molecular rapid test results were classified as rifampicin-sensitive, rifampicin-indeterminate, rifampicin-resistant, or negative.

Data were recorded using a structured case report form and a medical-record extraction sheet. These were data capture tools rather than psychometric instruments; therefore, item scoring, scale interpretation, construct validity, internal consistency, and Cronbach's alpha were not applicable. Measurement quality was supported by predefined operational categories and the use of routine clinical, radiological, and laboratory results recorded in the patients' source documents.

Intervention or Procedure

No intervention, experimental exposure, or

comparator treatment was assigned because this was an observational study. Eligible patients were enrolled at the beginning of TB treatment or within one month after treatment initiation. Participants underwent a structured interview, and relevant information was abstracted from their medical records and available routine examination results. Chest radiographs were available only for participants whose treating physician requested imaging or who underwent imaging through the government TB program; therefore, not all participants had radiographs. Radiographs were interpreted and verified by a radiologist as part of routine care. The study procedures did not alter the diagnostic or therapeutic care provided by the participating facilities.

Data Collection

Demographic characteristics, symptoms, risk factors, and comorbidities were obtained through patient interviews and review of medical records. Radiological findings, random blood glucose, HIV test results, and molecular rapid test results were transcribed from available routine clinical reports.

The structured forms and operational definitions were used to standardize data capture. Before analysis, the dataset was checked for duplicate identifiers, completeness, and coding consistency; the final dataset contained 50 unique participant numbers and no duplicated records.

Data Analysis

Data analysis was performed using IBM SPSS Statistics software. Categorical data were presented as frequencies and percentages (n, %), whereas continuous data were presented as mean ± standard deviation (mean ± SD) and median (minimum–maximum range). The normality of continuous data was assessed using the Shapiro–Wilk and Kolmogorov–Smirnov tests. The study objective was to compare adults and elderly patients with tuberculosis across four domains: clinical characteristics, comorbidities and risk factors, radiological findings, and laboratory profiles. However, no single primary endpoint was prespecified; therefore, comparisons of individual variables across these domains were considered exploratory and hypothesis-generating.

Comparisons of continuous variables between adult and elderly patients were performed using the independent-samples t-test for normally distributed data and the Mann–Whitney U test for non-normally distributed data. Categorical variables were compared using Pearson's chi-square test or Fisher's exact test when the expected cell-frequency assumptions were not met. Odds ratios (ORs) with 95% confidence intervals (95% CIs) were calculated for categorical comparisons. Thoracic radiological profiles were analyzed as an exploratory complete-case subanalysis among participants with available chest radiographs. Multivariable binary logistic regression using the Enter method was performed as an exploratory analysis to examine which measured characteristics were associated with elderly group membership. No adjustment for multiple comparisons was applied; thus, p-values are nominal and should be interpreted cautiously alongside the effect estimates and their 95% CIs. All tests were two-tailed, with statistical significance set at $p < 0.05$.

Ethical Considerations

The study protocol received ethical approval from the Surabaya City Health Office (approval no. 500.6.18/12609/436.7.2/2026). Written informed consent was obtained from all participants before data collection.

RESULTS

Study Population

The study included 50 patients with tuberculosis, comprising 25 adults and 25 elderly patients. Chest radiographs were available for 27 patients (13 adults and 14 elderly patients). Continuous variables were non-normally distributed; therefore, Mann-Whitney U results were used for group comparisons.

Participant Characteristics

Occupational distribution and employment status differed between adults and elderly patients. Sex distribution and previous tuberculosis treatment did not differ significantly between groups (Table 1).

Comorbidities and Clinical Presentation

Malnutrition was more common among elderly patients. Elderly patients reported cough less frequently, but night-time fever and weight loss more frequently than adults. The remaining comorbidities and clinical manifestations did not differ significantly between groups (Table 2).

Radiological Findings

Chest radiographs were available for 27 of the 50 participants (13/25 adults and 14/25 elderly patients). Radiological comparisons were based on these available radiographs (adults, n = 13; elderly patients, n = 14).

Upper-zone involvement was observed in 9/13 adults (69.2%) and 4/14 elderly patients (28.6%). Lower-zone involvement was observed in 2/13 adults (15.4%) and 8/14 elderly patients (57.1%), while middle-zone involvement was observed in 2/13 adults (15.4%) and 2/14 elderly patients (14.3%). The overall distribution of lung-zone involvement was not statistically different between the groups ($\chi^2 = 5.737$, $p = 0.057$; Table 3). These findings are descriptive and should be interpreted cautiously because the radiological analysis was based on a small subset of participants.

Laboratory and Molecular Findings

Random blood glucose and GeneXpert MTB/RIF results did not differ significantly between groups. All patients had non-reactive HIV rapid-test results (Table 4).

Multivariable Logistic Regression

In the exploratory multivariable logistic regression analysis, malnutrition was associated with elderly group membership (adjusted OR = 7.61, 95% CI 1.41–41.03; $p = 0.018$). Cough, night-time fever, and weight loss were not statistically significant in the adjusted model (Table 5). Nagelkerke R^2 was 0.606; this pseudo-R^2 should not be interpreted as the proportion of variance explained. The wide confidence interval for malnutrition indicates substantial uncertainty in the magnitude of this association.

Table 1.
Demographic characteristics and previous tuberculosis treatment

Characteristic	Adults (n = 25)	Elderly (n = 25)	Test statistic	p value
Age, mean +/- SD, years	44.72 +/- 12.67	65.32 +/- 5.32	-	-
Age, median (range), years	48.0 (18-57)	64.0 (60-76)	U = 0.0	<0.001
Male sex, n (%)	15 (60.0)	14 (56.0)	Continuity correction = 0.000	1.000
Female sex, n (%)	10 (40.0)	11 (44.0)		
Occupation, overall			chi-square = 10.525	0.033
Private employee, n (%)	9 (36.0)	2 (8.0)		
Homemaker, n (%)	5 (20.0)	8 (32.0)		
Self-employed, n (%)	5 (20.0)	4 (16.0)		
Student, n (%)	2 (8.0)	0 (0.0)		
Not working, n (%)	4 (16.0)	11 (44.0)		
Productively employed, n (%)	14 (56.0)	6 (24.0)	Fisher exact	0.042
Not working or domestic role, n (%)	11 (44.0)	19 (76.0)		
New tuberculosis case, n (%)	19 (76.0)	24 (96.0)	Fisher exact	0.098
Relapse, n (%)	6 (24.0)	1 (4.0)		

SD, standard deviation; U, Mann-Whitney U statistic.

Table 2.
Comorbidities, risk factors, and clinical manifestations

Variable	Adults (n = 25)	Elderly (n = 25)	OR (95% CI)	p value
Smoking history	11 (44.0)	6 (24.0)	0.40 (0.12-1.35)	0.232
Alcohol consumption	10 (40.0)	3 (12.0)	0.20 (0.05-0.87)	0.051
Malnutrition	4 (16.0)	16 (64.0)	9.33 (2.43-35.84)	0.001
Diabetes mellitus	2 (8.0)	2 (8.0)	1.00 (0.13-7.72)	1.000
Hypertension	3 (12.0)	4 (16.0)	1.40 (0.28-7.00)	1.000
HIV coinfection	0 (0.0)	0 (0.0)	-	-
>=1 comorbidity	24 (96.0)	23 (92.0)	0.48 (0.04-5.65)	1.000
Total comorbidities, median (range)	1.0 (0-2)	1.0 (0-3)	-	0.896
Cough	21 (84.0)	6 (24.0)	0.06 (0.01-0.25)	<0.001
Night-time fever	5 (20.0)	17 (68.0)	8.50 (2.34-30.91)	0.001
Weight loss	6 (24.0)	15 (60.0)	4.75 (1.41-16.05)	0.021
Hemoptysis	1 (4.0)	1 (4.0)	1.00 (0.06-16.93)	1.000
Dyspnea	3 (12.0)	6 (24.0)	2.32 (0.51-10.54)	0.464
Clinical anemia	2 (8.0)	0 (0.0)	-	0.490

Values are n (%) unless otherwise stated. ORs compare elderly patients with adults. Categorical variables were analyzed using Fisher's exact test, and total scores were analyzed using the Mann-Whitney U test. CI, confidence interval; HIV, human immunodeficiency virus; OR, odds ratio.

Table 3.
Chest radiograph availability and radiological findings

Finding	Adults	Elderly	Test statistic	p value
Radiograph available	13 (52.0)	14 (56.0)	Fisher exact	1.000
Radiograph unavailable	12 (48.0)	11 (44.0)		
Unilateral lesion, n	9	7	Fisher exact	0.248
Bilateral lesion, n	4	7		
Lung zone, overall			chi-square = 5.737	0.057
Upper zone, n	9	4		
Middle zone, n	2	2		
Lower zone, n	2	8		
Cavitation, n (%)	4 (30.8)	3 (21.4)	Fisher exact	0.678
Consolidation, n (%)	0 (0.0)	2 (14.3)	Fisher exact	0.481
Infiltrate, n (%)	10 (76.9)	13 (92.9)	Fisher exact	0.326
Fibrosis, n (%)	1 (7.7)	1 (7.1)	Fisher exact	1.000

Percentages for radiograph availability are based on the full age-group denominators (n = 25 per group). Radiological findings and comparisons are based on participants with available chest radiographs (adults, n = 13; elderly patients, n = 14; total n = 27).

Table 4.
Laboratory and GeneXpert MTB RIF results

Parameter	Adults (n = 25)	Elderly (n = 25)	Test statistic	p value
Random blood glucose, mean +/- SD, mg/dL	102.12 +/- 30.57	105.76 +/- 38.28	-	-
Random blood glucose, median (range), mg/dL	96.0 (78-202)	92.0 (78-210)	U = 297.5	0.770
Glucose <200 mg/dL, n (%)	23 (92.0)	22 (88.0)	Fisher exact	1.000
Glucose >=200 mg/dL, n (%)	2 (8.0)	3 (12.0)		
HIV non-reactive, n (%)	25 (100.0)	25 (100.0)	-	-
Rifampicin sensitive, n (%)	22 (88.0)	23 (92.0)	chi-square = 3.022	0.388
Rifampicin indeterminate, n (%)	2 (8.0)	0 (0.0)		
Rifampicin resistant, n (%)	0 (0.0)	1 (4.0)		
MTB not detected, n (%)	1 (4.0)	1 (4.0)		

HIV, human immunodeficiency virus; MTB, Mycobacterium tuberculosis; SD, standard deviation; U, Mann-Whitney U statistic.

Table 5.
Binary logistic regression for elderly group membership

Variable	B	SE	Wald	p value	Adjusted OR (95% CI)
Cough	-1.981	1.101	3.236	0.072	0.138 (0.016-1.194)
Night-time fever	0.966	1.125	0.737	0.391	2.628 (0.290-23.832)
Weight loss	1.412	0.864	2.670	0.102	4.105 (0.755-22.327)
Malnutrition	2.029	0.860	5.567	0.018	7.606 (1.410-41.029)
Constant	-0.667	1.219	0.300	0.584	0.513

Outcome coding: 0 = adult and 1 = elderly. B, regression coefficient; CI, confidence interval; OR, odds ratio; SE, standard error.

DISCUSSION

In this sample of 50 patients with pulmonary tuberculosis, malnutrition was more common among elderly patients than adults (16/25 [64.0%] vs 4/25 [16.0%]; OR 9.33, 95% CI 2.43–35.84). Elderly patients reported cough less frequently (6/25 [24.0%] vs 21/25 [84.0%]) and night-time fever and weight loss more frequently than adults. Lower-zone involvement was observed in 8/14 elderly patients and 2/13 adults, but the overall lung-zone distribution was not statistically different between groups (p = 0.057). Occupation and employment status also differed between the age groups, whereas no statistically significant differences were detected in the measured laboratory and microbiological characteristics. In the adjusted exploratory model, malnutrition was associated with elderly group membership (adjusted OR 7.61, 95% CI 1.41–41.03; p = 0.018); the wide confidence interval indicates uncertainty in the magnitude of this association. These cross-sectional findings describe differences within this sample and do not establish that age caused the observed manifestations.

The association with malnutrition was substantial after adjustment (adjusted OR 7.606, 95% CI 1.410–41.029). The wide confidence interval, however, indicates considerable uncertainty about the exact magnitude, which is expected in a sample of 50 participants. The direction of the association is consistent with comparative studies reporting a greater nutritional burden among elderly patients with tuberculosis and with evidence that poor nutritional status is clinically important in elderly pulmonary tuberculosis [10–13]. A plausible interpretation is that tuberculosis-related anorexia and catabolism occur on top of age-related reductions in physiological reserve and immune function [14–16]. Because nutritional status and tuberculosis can influence one another, the cross-sectional

design cannot determine whether malnutrition preceded active disease, resulted from it, or reflected both processes. The present study therefore extends previous evidence by demonstrating the same pattern in a Surabaya sample, but it does not establish a causal pathway.

The symptom profile further suggests that pulmonary tuberculosis may be expressed differently in elderly patients. Less frequent cough alongside more frequent night-time fever and weight loss is partially consistent with literature describing less typical respiratory presentations and prominent constitutional symptoms in elderly populations [10,17,18]. The higher frequency of night-time fever nevertheless contrasts with reports of attenuated febrile responses in some elderly cohorts [18,19]. This difference should not be explained by presumed advanced disease because disease severity was not measured. Variation in age thresholds, care setting, symptom definitions, and ascertainment may contribute to the heterogeneous findings across studies, but those explanations remain untested here. Substantively, the results indicate that the absence of prominent cough should not lower clinical suspicion when constitutional symptoms and nutritional decline are present in an elderly patient. In this sample, cough was reported less frequently by elderly patients than by adults (24.0% vs 84.0%), whereas night-time fever and weight loss were reported more frequently by elderly patients. This pattern suggests a less cough-dominant symptom profile among the elderly participants in this study. However, diagnostic sensitivity, missed diagnoses, and clinical outcomes were not assessed, and the small sample does not support a clinical recommendation based on cough status alone.

In the exploratory adjusted model, malnutrition was the only variable that remained statistically associated with elderly group membership (adjusted OR = 7.61, 95% CI 1.41–41.03; p = 0.018). Cough, night-time fever, and weight loss were not statistically significant after adjustment; given the small sample and wide confidence intervals, these results do not establish that these symptoms lack clinical relevance. Weight loss and malnutrition may reflect overlapping nutritional processes, but this possibility remains speculative because collinearity was not assessed. The model describes adjusted associations with age-group membership among patients with pulmonary tuberculosis; it does not identify predictors of tuberculosis or establish malnutrition as the sole relevant characteristic of elderly patients.

The radiological findings point in a potentially important but inconclusive direction. Upper-zone involvement was observed more frequently among adults, whereas lower-zone involvement was observed more frequently among elderly patients. However, the lung-zone analysis was based on only 27 observations, and the overall distribution was not statistically different between the age groups (p = 0.057). Given the limited number of observations, this finding should be interpreted descriptively and does not support a clinical rule regarding basal involvement. The direction is consistent with studies that have described more frequent lower-field or atypical radiographic involvement in elderly patients [10,17,18,20], although other work has found no distinct age-related radiographic pattern. Age-related changes in lung mechanics and airway clearance offer a biologically plausible explanation [21,22]. Any role of aspiration or impaired swallowing is provisional because these factors were not measured. Accordingly, this study cannot claim an age-specific radiological predilection; it supports the narrower clinical point that basal involvement should not be used to discount tuberculosis in elderly patients.

Differences in occupation and current employment are best interpreted as age-structured social characteristics rather than

causal determinants of tuberculosis. The greater proportion of economically active adults and non-working or domestic-role elderly participants is consistent with the expected transition from working age to retirement and with demographic patterns reported in comparative tuberculosis studies [10–12]. The available data do not establish workplace transmission, financial barriers, treatment adherence, or reactivation of latent infection. Those mechanisms would require direct measures of exposure, socioeconomic position, care-seeking, adherence, and molecular epidemiology. The contribution of the present finding is therefore descriptive: social context differed between the two age groups and may need to be considered when organizing patient support.

No statistically significant age-group differences were detected for several demographic, comorbidity, laboratory, and microbiological variables. For uncommon comorbidities, the small number of cases and imprecise estimates limit the ability to exclude potentially meaningful differences. The absence of HIV-positive participants reduces heterogeneity within this sample but also limits application of the findings to populations with HIV–tuberculosis coinfection. All 50 participants had non-reactive HIV test results; therefore, this sample did not include patients with TB–HIV coinfection. The study could not assess whether clinical, nutritional, radiological, or laboratory profiles differ by HIV status. Accordingly, the findings should be applied cautiously to TB populations that include people living with HIV. Although no statistically significant age-group difference was detected in GeneXpert MTB/RIF results, this finding does not establish equivalence between the groups or rule out age-related differences in a larger sample.

The regression findings are exploratory. The model included four predictors and 25 elderly participants, yielding 6.25 events per predictor; therefore, overfitting and sparse-data effects may have influenced the estimates. The wide confidence intervals reflect this uncertainty, and quasi-separation cannot be excluded. The model was not externally validated and should not be interpreted as a predictive model.

CONCLUSION

In this sample of 50 patients with pulmonary tuberculosis recruited from three DOTS-network facilities in Surabaya, malnutrition, cough, night-time fever, and weight loss differed between adults and elderly patients. In an exploratory adjusted analysis, malnutrition was associated with elderly group membership (adjusted OR 7.61, 95% CI 1.41–41.03), although the wide confidence interval indicates uncertainty in the magnitude of this association. Lower-zone involvement was observed more frequently among elderly patients, but incomplete radiological data and the lack of a statistically significant difference in the overall zone distribution preclude a definitive age-specific conclusion. No statistically significant differences were detected in the measured laboratory and microbiological variables. Given the small sample and incomplete radiological data, these findings should be interpreted cautiously and do not establish causal relationships or equivalence between age groups.

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