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Age-stratified tuberculosis treatment outcomes in Zimbabwe: are we paying attention to the most vulnerable?

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Setting: A high tuberculosis (TB) incidence, resource-limited urban setting in Zimbabwe.

Objectives: To compare treatment outcomes among people initiated on first-line anti-tuberculosis treatment in relation to age and other explanatory factors.

Design: This was a retrospective record review of routine programme data.

Results: Of 2209 patients included in the study, 133 (6%) were children (aged <10 years), 132 (6%) adolescents (10–19 years), 1782 (81%) adults (20–59 years) and 162 (7%) were aged ⩾60 years, defined as elderly. The highest proportion of smear-negative pulmonary TB cases was among the elderly (40%). Unfavourable outcomes, mainly deaths, increased proportionately with age, and were highest among the elderly (adjusted relative risk 3.8, 95%CI 1.3–10.7). Having previous TB, being human immunodeficiency virus positive and not on antiretroviral treatment or cotrimoxazole preventive therapy were associated with an increased risk of unfavourable outcomes.

Conclusion: The elderly had the worst outcomes among all the age groups. This may be related to immunosuppressant comorbidities or other age-related diseases misclassified as TB, as a significant proportion were smear-negative. Older persons need better adapted TB management and more sensitive diagnostic tools, such as Xpert® MTB/RIF.

TUBERCULOSIS (TB) remains a global public health problem, with 10.4 million estimated incident cases in 2015.[1] The African region had the highest incidence (275 per 100 000 population), close to twice the global rate. TB was one of the top 10 causes of death due to an infectious disease, with 1.8 million deaths worldwide in 2015.[1]

Zimbabwe is among the 30 countries with the highest TB burden, with a human immunodeficiency virus (HIV) driven epidemic. In 2014, the treatment success rate was 81%, just below the global target of ⩾85%.[1] Reported treatment outcomes were not routinely disaggregated by age, nor was there any differentiation in treatment interventions adjusted for specific age groups.

Traditionally, national TB programmes (NTPs) categorise those aged <15 years as children, and adults as being aged ⩾15 years.[1,2] The indiscriminate grouping of young adolescents (age 10–14 years) as children and older adolescents (age 15–19 years) as adults ignores the World Health Organization (WHO) definition of adolescents as being aged between 10 and 19 years.[3] Mortality among adolescents with HIV infection, however, has tripled since 2000, and adolescents report poorer retention on antiretroviral therapy (ART) in similar high TB-HIV endemic settings.[4–8] Given the intertwined nature of these two epidemics in Zimbabwe, where seven in 10 TB patients have HIV, it remained to be assessed if poorer retention in HIV care was similar among adolescents receiving TB treatment. Although TB is among the 10 main causes of death among children worldwide,[9] childhood TB remains neglected in resource-limited settings

TB treatment among the elderly (defined as persons aged ⩾60 years in this study), has been found to be complicated by the treatment of comorbidities such as diabetes mellitus (DM), leading to increased adverse drug effects, mortality, high rates of recurrent TB and drug resistance.[10–12] This population, which also has high rates of HIV co-infection in Zimbabwe, may have distinctly different TB treatment outcomes from other age groups.

Published studies on age-stratified TB treatment outcomes in high TB-HIV prevalent settings are scarce, particularly in southern Africa. Notably, one recent study from Botswana looked only at loss to follow-up among adolescents on TB treatment compared to other age groups.[4] Age-disaggregated comparisons of treatment outcomes are important in informing age-specific interventions. Given this background, we set out to 1) compare age-stratified demographic and clinical characteristics, 2) compare TB treatment outcomes and 3) describe factors associated with unfavourable outcomes among people initiated on first-line anti-tuberculosis treatment in 2014 in Bulawayo, Zimbabwe.

STUDY POPULATION, DESIGN AND METHODS

Study design

This was a retrospective cohort study using routinely collected NTP data.

Setting

General setting

Zimbabwe is one of the countries hardest hit by HIV, with a prevalence of approximately 15% among 15–49 year olds.[13] The country has a high incidence of TB, estimated at 242 per 100 000 population.[1]

Specific setting

The study was conducted in Bulawayo, the second largest city in Zimbabwe, with a population of 655 000

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(5% of the national population)[14] and the highest TB notification rate in the country in 2015. TB treatment services are integrated with other general health services at all 19 public health clinics, 16 of which offer HIV treatment.[15] In line with national treatment guidelines, all TB patients diagnosed at public hospitals and private facilities are referred to the nearest city clinic for registration and treatment. At each clinic, there is a dedicated nurse responsible for 1) providing facility-based directly observed treatment and patient support during the intensive phase of treatment, 2) issuing weekly drug resupplies during the continuation phase of treatment, and 3) updating TB patient records/registers. Complicated cases are referred to a doctor who has a scheduled weekly visit to each clinic; alternatively, the patient is referred for admission to the Thorngrove Hospital infectious diseases unit in Bulawayo.[15]

Tuberculosis diagnosis and management under the National TB Programme

Direct smear microscopy was the primary diagnostic test for drug-susceptible TB, with Xpert® MTB/RIF (Cepheid, Sunnyvale, CA, USA) prioritised for high-risk groups, namely people living with HIV, children and those with presumed drug-resistant TB (DR-TB), defined as contacts of confirmed DR-TB patients, those with recurrent TB, treatment failure, health workers, and clients from congregate settings and high DR-TB prevalent countries.[16,17]

All individuals with presumed pulmonary TB (PTB) underwent sputum examination by direct smear microscopy (DSM) for acid-fast bacilli or Xpert, if eligible. Those with positive DSM smears or Xpert results were diagnosed as bacteriologically confirmed PTB, while those negative for both tests but symptomatic were initiated on broad spectrum antibiotics and referred for chest radiography. If the latter was suggestive of TB, and the client was non-responsive to antibiotics, a diagnosis of smear-negative PTB was recorded. Extra-pulmonary TB (EPTB) was diagnosed on clinical grounds, with supporting diagnostic tests such as lymph node aspiration or abdominal ultrasonography.[16]

Diagnosed TB patients were notified and registered in a health facility and district TB register. All new and previously treated TB cases were classified according to standard WHO case definitions.[18] The standardised 6-month anti-tuberculosis regimen for new cases consisted of a 2-month initial phase of rifampicin (R, RMP), isoniazid (H, INH), pyrazinamide (Z, PZA) and ethambutol (E, EMB), followed by 4 months of RH (2RHZE/4RH); the continuation phase was extended to 8–12 months for disseminated extra-pulmonary disease. New TB patients were defined as those who had never received anti-tuberculosis treatment in the past or who had previously taken anti-tuberculosis drugs for <30 days. Previously treated TB, defined as a history of ⩾1 month of anti-tuberculosis drugs, was treated with an initial 2 months of RHZE and streptomycin (S), followed by an additional month of RHZE and a 5-month continuation phase of RHE (2RHZES/1RHZE/5RHE).[16] Patients were monitored throughout their treatment and evaluated at the end for assignment of an outcome based on standardised WHO definitions.[16–18]

TB patients with unknown HIV status were routinely offered HIV counselling and testing and, if HIV-positive, were offered cotrimoxazole preventive therapy (CPT) and ART within 2–8 weeks, irrespective of CD4 cell count and site of TB disease.[16]

Study population

The study included all patients registered and initiated on first-line treatment during the period 1 January–31 December 2014.

Data variables, sources of data and data collection

Anonymised data were abstracted from health facility and district registers into a structured proforma and entered into a data file using EpiData Entry v.3.1 (EpiData Association, Odense, Denmark). The variables collected included TB registration number, age, sex, disease classification (PTB, EPTB), type of treatment (new, previously treated), bacteriological status at treatment initiation, HIV serological status, ART uptake status, CPT uptake status and treatment outcomes.

Data analysis and statistics

Data cleaning and analysis were performed using STATA 13 software (Stata Corp, College Station, TX, USA). Comparisons between age group and other categorical variables were done using the χ^2 test, or Fisher's exact test when the assumptions were violated. The primary outcome was an unfavourable outcome as defined by the WHO (treatment failure, died, lost to follow-up and not evaluated) at the end of anti-tuberculosis treatment.[2] Crude and adjusted relative risks and their 95% confidence intervals (CIs) were determined through log binomial regression to compare differences in unfavourable outcomes by age group and determine other unfavourable outcome-related factors. Potential confounding variables adjusted for in multivariate regression included sex, HIV status, type of TB, TB category and uptake of ART and CPT. Only variables with a P value < 0.25 were included in the multivariate regression model. Significance levels were set at 5%.

Ethics approval

Permission to carry out the study was obtained from the Ministry of Health and Child Care, Harare, Zimbabwe, and the Bulawayo City Health Department. Local ethics approval was obtained from the Medical Research Council (Harare, Zimbabwe). The study fulfilled the exemption criteria set by the Ethics Review Board (ERB) of Médecins Sans Frontières (MSF), Geneva, Switzerland, for a posteriori analyses of routinely collected data, and thus did not require MSF ERB review. The study was also approved by the Ethics Advisory Group of the International Union Against Tuberculosis and Lung Disease, Paris, France. As this was a record review, informed patient consent was not required.

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Conflicts of interest: none declared.

TABLE 1 Demographic and clinical characteristics of patients initiated on first-line TB treatment in Bulawayo, Zimbabwe, stratified by age category, 2014

Characteristics (*N* = 2209)	Children <10 years *n* (%)	Adolescents 10–19 years *n* (%)	Adults 20–59 years *n* (%)	Elderly ⩾60 years *n* (%)	*P* value
Total	133 (6)	132 (6)	1782 (81)	162 (7)	
Sex					
Male	62 (47)	58 (44)	1031 (58)	88 (54)	<0.01
Female	68 (51)	74 (56)	750 (42)	74 (47)	
Not recorded	3 (2)	—	1 (<1)	—	
Age, years*					
Median [IQR]	2 [1–4]	17 [15–19]	35 [29–42]	67 [63–75]	
TB category					
New	128 (96)	111 (84)	1550 (87)	140 (86)	0.01
Previous TB	5 (4)	21 (16)	231 (13)	21 (13)	
Not recorded	—	—	1 (<1)	1 (<1)	
Type of TB					
PTB-positive†	5 (4)	61 (46)	720 (40)	49 (30)	<0.01
PTB-negative‡	13 (10)	38 (29)	529 (30)	64 (40)	
PTB-NP§	101 (76)	—	8 (<1)	—	
EPTB	14 (10)	33 (25)	524 (29)	49 (30)	
Not recorded	—	—	1 (<1)	—	
HIV status					
HIV positive	44 (33)	58 (44)	1429 (80)	69 (43)	<0.01
HIV negative	87 (65)	74 (56)	344 (19)	92 (57)	
Unknown	2 (2)	—	9 (<1)	1 (<1)	
ART status					
Yes	41 (93)	54 (93)	1287 (90)	63 (91)	
No	3 (7)	4 (7)	140 (10)	6 (9)	
Not recorded	—	—	2 (<1)	—	
CPT status					
Yes	43 (98)	57 (98)	1405 (98)	66 (96)	
No	1 (2)	1 (2)	22 (2)	3 (4)	
Not recorded	—	—	2 (<1)	—	

*Four study participants with ages missing were excluded from all analyses.
†Positive for PTB on smear or Xpert.
‡Negative for PTB on smear or Xpert.
§Smear/Xpert for PTB not performed.
TB = tuberculosis; IQR = interquartile range; PTB = pulmonary TB; NP = not performed; EPTB = extra-pulmonary TB; HIV = human immunodeficiency virus; ART = antiretroviral therapy; CPT = cotrimoxazole preventive therapy.

RESULTS

Demographic and clinical characteristics

In 2014, there were 2213 registered TB patients on first-line treatment in Bulawayo. Four patients with unrecorded ages were excluded from the study. Table 1 shows the demographic and clinical characteristics of the 2209 patients included in the study. The median age was 35 years. The majority, 1782 (81%), were adults (age 20–59 years), while the other age groups were equally distributed, with 6–7% each. Notably, children were skewed to those aged <5 years, with a median age of 2 years. There were more females than males among children and adolescents, while the inverse was observed with increasing age.

Only 4% of children had previously treated TB, with the other age groups each accounting for >10%. Distribution by type of TB was comparable among adolescents, adults and the elderly, although the proportion of bacteriologically confirmed PTB patients was higher among adolescents (46%), while there were significantly more smear-negative PTB patients among the elderly (*n* = 64, 40%). Less than 1% had unknown HIV status. Among those with known HIV status, adults had the highest rate of TB-HIV co-infection (80%). ART and CPT uptake were ⩾90% in all age groups.

Treatment outcomes

Treatment success for all forms decreased with increasing age. It was highest among children (92%) and lowest among the elderly (70%, $P < 0.01$). Death was the most frequent unfavourable outcome; the death rate was 4% for children and much higher, 25%, among the elderly ($P < 0.01$) (Table 2A). This finding was sustained among new TB cases (Table 2B). There was, however, no difference in treatment outcome among previously treated cases when stratified by age group. Among patients with smear-negative PTB, those aged ⩾60 years were four times more likely to be HIV-negative than those aged <60 years (95 [16.4%] vs. 29 [45.3%], odds ratio 4.0, 95%CI 2.85–5.6). Narrowing the analysis to deaths among smear-negative PTB cases, there were more HIV-negative deaths in those aged ⩾60 years compared to those aged <60 years (12/107 [11%] vs. 8/16 [50%], $P < 0.001$).

TABLE 2A Comparison of treatment outcomes stratified by age among all types of TB patients initiated on first-line treatment in Bulawayo, Zimbabwe, 2014

Treatment outcome N = 2209	Children <10 years n (%)	Adolescents 10–19 years n (%)	Adults 20–59 years n (%)	Elderly ⩾60 years n (%)	P value
Total	133	132	1782	162	
Treatment success	123 (92)	117 (89)	1438 (81)	113 (70)	<0.01
Treatment failure	—	1 (1)	17 (<1)	1 (<1)	0.9
Lost to follow-up	2 (2)	2 (2)	39 (2)	3 (2)	1.0
Died	6 (4)	11 (8)	267 (15)	41 (25)	<0.01
Not evaluated	2 (2)	1 (<1)	21 (1)	4 (2)	0.4

TABLE 2B Comparison of treatment outcomes stratified by age among new TB patients initiated on first-line treatment in Bulawayo, Zimbabwe, 2014

Treatment outcome N = 1929	Children <10 years n (%)	Adolescents 10–19 years n (%)	Adults 20–59 years n (%)	Elderly ⩾60 years n (%)	P value
Total	128	111	1550		
Treatment success	119 (93)	101 (91)	1272 (82)	140	
Treatment failure	—	—	13 (<1)	95 (68)	<0.01
Lost to follow-up	2 (2)	1 (<1)	29 (2)	1 (<1)	0.9
Died	5 (4)	8 (7)	219 (14)	3 (2)	0.9
Not evaluated	2 (2)	1 (<1)	17 (1)	39 (28)	<0.01

TB = tuberculosis.

Factors associated with unfavourable outcomes

The factors associated with having an unfavourable treatment outcome are shown in Table 3. The elderly had a 3.8 times higher risk of an unfavourable outcome than children. Those with recurrent TB or EPTB had respectively a 30% and 40% higher risk of an unfavourable outcome compared to new TB and bacteriologically confirmed PTB cases. Having an unknown HIV status, or being HIV-positive but not on ART, were associated with respectively a 3.3 and 4.5 times higher risk of an unfavourable outcome.

DISCUSSION

This retrospective record review is the first in Zimbabwe to explicitly compare TB treatment outcomes among different age groups, which we examined due to the suboptimal treatment outcomes in our setting and the need to determine the relative contribution of different age groups to unfavourable outcomes to inform more targeted corrective interventions.[1] We observed age-related differences in unfavourable TB treatment outcomes that increased with older age. Death constituted the greatest proportion of unfavourable outcomes, and this increased with increasing age to as high as one in four among the elderly. As expected, being HIV-positive and not receiving ART or CPT were associated with unfavourable outcomes.[19]

This city-wide study conducted in Bulawayo, the second largest city in Zimbabwe with the highest TB notification rate in the country, may reflect similar urban settings in the southern region of the country. The study adhered to the STrengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines on the conduct of observational studies, and portrayed typical routine programme settings; it can therefore be used to inform decision making.[20] An obvious limitation inherent to such observational studies is the possibility of data documentation errors that could not be validated. We also lacked data on other comorbidities that may have affected treatment outcomes, particularly for the elderly cohort. Furthermore, children aged <5 years represented three quarters of the children in this cohort, thus limiting the generalisability of the findings to older children (aged 5–10 years); this may nevertheless reflect better diagnostic coverage or heightened risk of active TB among younger children.

Although HIV prevalence in the elderly was half that in the adult population, the elderly group had the greatest proportion of smear-negative PTB. This suggests that possible pre-existing comorbidities, such as age-related diminishing immunity and an increased magnitude of chronic illnesses such as DM, could have exaggerated the risk for unfavourable outcomes in this group, as reported elsewhere.[21] Furthermore, the poorer outcomes may be driven by HIV, which affected nearly half of those aged ⩾60 years.[19]

In our study, adolescents had fewer adverse outcomes than the older age groups, in contradiction with a recent study from Botswana, where adverse outcomes in adolescents were more frequent than in older populations.[4] This is surprising, given that HIV prevalence in our adolescent cohort was higher than that observed in Botswana. Notably, adverse outcomes in our adolescents were driven largely by death, whereas in the Botswana study they were due to loss to follow-up; this may indicate better patient tracing in our setting. Our observation in this group also contradicts the literature from the region, which shows poor adherence and retention in ART care among adolescents relative to older age groups, which we had hypothesised as also applying to our cohort.[6–8]

The majority of the unfavourable outcomes observed in our study were due to death. While the vast majority of those who died were HIV-positive, nine in 10 were on life-saving ART and CPT. This could indicate possible late health care seeking with advanced TB-HIV disease, associated with atypical clinical presentations such as EPTB.[22] This was observed in at least one in four patients presenting with EPTB among the adolescent and older age groups. Given the high HIV testing rates observed in this cohort,

TABLE 3 Factors associated with unfavourable treatment outcomes among TB patients initiated on first-line treatment in Bulawayo, Zimbabwe, 2014 (four study participants with ages missing were excluded from all analyses)

Factors	*N*	Unfavourable outcome *n* (%)	Crude RR (95%CI)	aRR (95%CI)	*P* value
Age category (years)					
Children (<10)	133	10 (8)	Reference	Reference	
Adolescents (10–19)	132	15 (11)	1.5 (0.7–3.2)	1.8 (0.6–5.4)	
Adults (20–59)	1782	344 (19)	2.6 (1.4–4.7)	2.4 (0.9–6.8)	
Elderly (⩾60)	162	49 (30)	4.0 (2.1–7.6)	3.8 (1.3–10.7)	0.01
Sex					
Female	966	170 (18)	Reference	Reference	
Male	1239	249 (20)	1.1 (0.9–1.2)	1.0 (0.9–1.2)	
History of TB					
New cases	1929	343 (18)	Reference	Reference	
Previous TB	278	77 (28)	1.6 (1.3–1.9)	1.3 (1.1–1.6)	<0.01
Type of TB					
PTB-positive*	835	128 (15)	Reference	Reference	
PTB-negative†	644	148 (23)	1.5 (1.2–1.9)	1.2 (1.0–1.5)	
PTB-NP‡	109	9 (8)	0.5 (0.3–1.0)	1.4 (0.5–4.2)	
EPTB	620	135 (22)	1.4 (1.1–1.8)	1.4 (1.1–1.7)	<0.01
HIV status					
HIV-negative	597	69 (12)	Reference	Reference	
HIV-positive, no ART	153	96 (62)	5.3 (4.1–6.9)	4.5 (3.4–5.8)	<0.01
HIV-positive, on ART	1445	251 (17)	1.5 (1.2–1.9)	1.4 (1.0–1.7)	0.02
Unknown HIV status	12	4 (33)	2.9 (1.3–6.6)	3.3 (1.5–7.5)	<0.01
On CPT					
Yes	1571	334 (21)	Reference	Reference	
No	27	13 (48)	2.3 (1.5–3.4)	2.1 (1.4–3.1)	<0.01

*Positive for PTB on smear or Xpert.
†Negative for PTB on smear or Xpert.
‡Smear/Xpert for PTB not performed.
TB = tuberculosis; RR = relative risk; CI = confidence interval; aRR = adjusted RR; PTB = pulmonary TB; NP = not performed; EPTB = extra-pulmonary TB; HIV = human immunodeficiency virus; ART = antiretroviral therapy; CPT = cotrimoxazole preventive therapy.

the higher rate of unfavourable outcomes observed among the few TB patients with unknown HIV status may reflect a subpopulation that declined HIV testing and that was likely to be HIV-positive. Innovative provider-initiated counselling and testing strategies may be needed for this subpopulation.

This study has some important implications. First, there is a need for more focused attention on the more vulnerable older population, which presents with worse treatment outcomes than other age groups. While reasons for this were not investigated, a first step may be to systematically screen for potential comorbidities, such as DM, which are more common in aging populations.[12,23] A pilot project on bi-directional screening of TB and DM has only recently begun in the public setting, and will inform the burden of TB-DM co-morbidity in Zimbabwe. Furthermore, diagnostic errors involving older patients are common for conditions such as chronic obstructive pulmonary disease.[24] Misdiagnosis of diseases such as TB cannot be ruled out in this cohort, and this highlights the need for more accurate screening prior to TB treatment. Second, despite the high ART uptake among those who were HIV-positive, the observed unfavourable outcomes could indicate a need for earlier community HIV testing and treatment to prevent late presentation with severe disease. Furthermore, the high rates of unfavourable outcomes among those who were HIV-positive and not on ART or CPT underscores the benefit of CPT and ART as part of integrated TB-HIV care.

In conclusion, there are age-related differences in the unfavourable TB treatment outcomes, with the elderly being the worst affected. Our findings underscore the need to investigate to what extent underlying treatable comorbidities, such as DM, and misdiagnosis may be contributing to adverse outcomes among older persons in our setting. This is crucial to inform better adapted public health approaches in the management of TB in this subpopulation.

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Contexte : Une zone urbaine aux ressources limitées avec une incidence élevée de tuberculose (TB) au Zimbabwe.
Objectifs : Comparer les résultats du traitement parmi des patients mis sous traitement antituberculeux de première ligne, en relation avec leur âge et d'autres facteurs explicatifs.
Schéma : Une revue rétrospective de dossiers de données de routine du programme.
Résultats : Sur les 2209 patients inclus dans l'étude, 133 (6%) ont été des enfants (âgés de <10 ans), 132 (6%) des adolescents (10–19 ans), 1782 (81%) des adultes (20–59 ans) et 162 (7%) ≥60 ans, définies comme âgées. Le taux le plus élevé de cas de TB pulmonaire à frottis négatif a concerné les personnes âgées (40%). Les résultats défavorables, en particulier le décès, ont augmenté proportionnellement à l'âge et ont donc été les plus élevés parmi les personnes âgées (risque relatif ajusté 3,8 ; IC95% 1,3–10,7). Avoir des antécédents de TB, être positif pour le virus de l'immunodéficience humaine et ne pas être sous traitement antirétroviral ni sous traitement préventif par cotrimoxazole ont été associés avec un risque accru de résultat défavorable.
Conclusion : Les personnes âgées ont eu de plus mauvais résultats que tous les autres groupes d'âge. Ceci peut être lié aux comorbidités immunosuppressives ou à d'autres pathologies liées à l'âge, classées à tort comme TB, puisqu'une proportion significative a eu un frottis négatif. Les personnes plus âgées ont besoin d'une prise en charge de la TB mieux adaptée et d'outils diagnostiques plus sensibles, comme l'Xpert® MTB/RIF.

Marco de referencia: Un entorno urbano con alta incidencia de tuberculosis (TB) y recursos limitados en Zimbabwe.
Objetivos: Comparar los desenlaces terapéuticos de las personas que habían iniciado el tratamiento antituberculoso de primera línea, según la edad y otras variables explicativas.
Métod: Un estudio retrospectivo con análisis de los datos corrientes del registro del programa.
Resultados: De los 2209 pacientes incluidos en el estudio, 133 eran niños (6%, <10 años de edad), 132 adolescentes (10–19 años, 6%), 1782 adultos (20–59 años, 81%) y 162 eran personas de ≥60 años (7%), definidas como ancianas. La más alta proporción de casos de TB pulmonar con baciloscopia negativa se observó en el grupo de ancianos (40%). Los desenlaces desfavorables, en la mayoría de los casos por muerte, aumentaron de manera proporcional con la edad y fueron más frecuentes en los ancianos (riesgo relativo ajustado 3,8; IC95% 1,3–10,7). Los factores asociados con un mayor riesgo de alcanzar desenlaces desfavorables fueron el antecedente de TB, la positividad frente al virus de la inmunodeficiencia humana y el hecho de no recibir tratamiento antirretrovírico ni tratamiento preventivo con cotrimoxazol.
Conclusión: Los pacientes ancianos presentaron los desenlaces más desfavorables en comparación con los demás grupos etarios. Esto se podría explicar por las enfermedades concomitantes que provocan inmunodepresión u otras enfermedades asociadas con la edad, designadas de manera errada como TB, pues en una proporción considerable la baciloscopia fue negativa en este grupo. Las personas ancianas necesitan un tratamiento antituberculoso mejor adaptado e instrumentos diagnósticos más sensibles, como la prueba Xpert® MTB/RIF.

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