Association between social determinants of health and drug-resistant tuberculosis in patients with HIV/TB coinfection in Risaralda (2016-2021)

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Abstract

Co-infection of HIV and drug-resistant tuberculosis is a severe chronic infectious disease caused by *Mycobacterium tuberculosis* in people living with HIV. The department of Risaralda reported 3.03% of 344 cases at the national level, ranking in twelfth place. Identifying the social determinants of health associated with this co-infection in Risaralda will allow for more effective interventions and efficient allocation of resources.

Objective: To establish the association between social determinants of health and the presence of HIV and drug-resistant tuberculosis co-infection in Risaralda between the years 2016 and 2021.

Materials and Methods: sA cross-sectional analytical study was conducted using data from the Public Health Information System (SISAP) of the department of Risaralda, during the period 2016-2021, on patients with HIV/TB co-infection and drug-resistant tuberculosis. A total of 684 records were analyzed through univariate and bivariate analysis to determine the distribution of variables, using the Chi-Square test to explore the association between drug-resistant tuberculosis and independent variables. Vari-

ables with a p-value <0.05 were considered statistically significant. The data were recorded in Excel and analyzed in SPSS version 23.

Results: IMost patients were adult men from urban areas. Pulmonary tuberculosis cases were predominant, and drug resistance was significantly associated with the admission condition. Additionally, municipalities with higher levels of poverty and unmet basic needs had elevated rates of co-infection and drug resistance. No significant associations were found with other social determinants such as gender or comorbidities.

Conclusions: The condition of admission is a key determinant of TB resistance in co-infected patients. Structural determinants such as poverty did not show statistical significance, but their influence on the survival of the co-infected population was evident, highlighting the need to address socioeconomic determinants to improve clinical outcomes in these vulnerable populations.

Keywords: Human Immunodeficiency Virus, Tuberculosis, Social determinants of health, Coinfection

Resumen

Introducción: en personas con VIH se puede presentar coinfección con la tuberculosis (TB) farmacorresistente, enfermedad infecciosa crónica grave, causada por ***Mycobacterium tuberculosis***.El departamento de Risaralda reportó el 3,03% de 344 casos a nivel nacional, ubicándose en el doceavo lugar, por ende, identificar los determinantes sociales en salud asociados a esta coinfección permitirá diseñar intervenciones más efectivas y asignar recursos de manera eficiente.

Objetivo: establecer la asociación entre los determinantes sociales de la salud y la presencia de coinfección VIH y tuberculosis farmacorresistente en Risaralda entre los años 2016 y 2021.

Materiales y métodos: se realizó un estudio transversal analítico utilizando datos del Sistema de Información de Salud Pública (SISAP) del departamento de Risaralda, durante el período 2016-2021, en pacientes con coinfección VIH/TB farmacorresistente. Se analizaron 684 registros mediante un análisis univariado y bivariado para determinar la distribución de las variables, utilizando la prueba de Chi Cuadrado para explorar la asociación entre la tuberculosis farmacorresistente y variables independientes. Se consideraron estadísticamente significativas aquellas variables con un valor de p <0.05. Los datos fueron registrados en Excel y se analizaron en SPSS

versión 23.

Resultados:la mayoría de los pacientes eran hombres adultos provenientes de áreas urbanas. Los casos de tuberculosis (TB) pulmonar fueron predominantes, y la farmacorresistencia se asoció significativamente con la condición de ingreso. Asimismo, los municipios con mayores índices de pobreza y necesidades básicas insatisfechas (NBI) presentaron tasas elevadas de coinfección y farmacorresistencia.

Conclusiones: la condición de ingreso es un determinante clave en la resistencia a la TB en pacientes coinfectados. Aunque los determinantes estructurales, como la pobreza, no mostraron significancia estadística directa, se evidenció su influencia en la supervivencia de la población coinfectada. Estos hallazgos resaltan la necesidad de abordar los determinantes socioeconómicos para mejorar los resultados clínicos en poblaciones vulnerables.

Palabras clave: Virus de la Inmunodeficiencia Humana (VIH), Tuberculosis armacorresistente (TB), determinantes sociales de la salud, coinfección**.**

Introduction

Co-infection with the Human Immunodeficiency Virus (HIV) and tuberculosis (TB) represents a major global public health issue. This situation is particularly critical in regions with high prevalence of both diseases, where co-infection worsens patient prognosis (1–5). In 2016, the department of Risaralda accounted for 7% of the cases reported in Colombia (6).

Drug-resistant TB in co-infected patients has become a significant challenge due to its longer, more expensive, and less effective treatment compared to drug-sensitive TB (7). Moreover, this form of TB contributes to higher mortality rates, highlighting the need for comprehensive interventions that address both clinical aspects and the social determinants of health (8).

In 2016, according to the National Institute of Health (INS), 1,939 cases of TB/HIV co-infection were reported in Colombia, 135 of which were in Risaralda, accounting for 7% of the total cases nationwide. This placed the department as the fourth highest in number of co-infections that year (6). In 2021, 1,654 TB/HIV co-infection cases were reported in Colombia, representing 11.5% of the national total. In Risaralda, 85 cases were recorded, corresponding to 18.8% of the national co-infected population, exceeding the national average and positioning the department as the second highest

in TB/HIV co-infection prevalence (6,9).

In the case of HIV and TB co-infection, the social determinants of health play a significant role, as they contribute to a comprehensive analysis of the health status of this population (10). These include factors such as socioeconomic status, education, access to healthcare services, and living conditions, all of which are crucial in the epidemiology of TB and its resistance to treatment. Studies have shown that poor living conditions—such as overcrowding and lack of access to medical care—are associated with a higher risk of developing TB and drug-resistant TB (11). In particular, the presence of unmet basic needs (UBN) has been linked to an increase in TB incidence, suggesting that interventions must go beyond medical treatment and take into account the social context of patients (12).

In the department of Risaralda, where a high percentage of patients with unmet basic needs (UBN) has been reported, it is essential to investigate how these social determinants influence the emergence of drug-resistant TB in HIV/TB co-infected patients. Existing literature indicates that a significant percentage of individuals with HIV/TB co-infection are unaware of their status, which further complicates the situation and highlights the need for targeted interventions that address both detection and treatment (13).

People living in socially vulnerable situations with UBN may have lower health coverage and, therefore, less opportunity for interventions addressing social determinants that could help reduce the high prevalence rates of co-infection (14). The lack of information on the relationship between social determinants and drug-resistant TB in this region limits the ability to design effective health policies tailored to the population's needs.

Research has highlighted that HIV and TB co-infection represents a significant public health challenge, especially in regions with a high prevalence of both diseases. Social determinants such as poverty, lack of education, and unmet basic needs (UBN) have been closely linked to increased TB incidence and resistance to treatment (11,12). A study in Manizales revealed that 12.8% of TB patients were also co-infected with HIV, underscoring the need to address these social factors to improve health outcomes (15). Drug-resistant TB has been identified as a growing concern, with 1.3% of patients showing resistance to rifampicin in the context of co-infection (16,17). It is estimated that 49% of individuals with co-infection are unaware of their status, further complicating the management of these diseases (12,18).

Research into the association between social determinants of health and drug-resistant TB in HIV/TB co-infected patients in Risaralda is crucial to addressing a public health issue that affects vulnerable populations, given the prevalence of co-infection and treatment resistance in the region (19). Identifying the social and economic factors that influence the emergence of drug-resistant TB will allow for the design of more effective interventions tailored to the specific needs of the population, which is essential for improving patient care and treatment outcomes (7). Therefore, the objective of this study was to establish the association between social determinants of health and the presence of drug-resistant TB in patients with HIV/TB co-infection from Risaralda between 2016 and 2021.

Methodology

Study design: : Analytical cross-sectional study.

Study population: 684 patients reported with HIV/TB co-infection in the department of Risaralda during the period 2016–2021.

Data collection: The information sources used were the records from SISAP Risaralda. The following variables were included: drug-resistant tuberculosis, age, sex, ethnicity, type of health insurance, place of residence, population group, type of tuberculosis, comorbidities, and antiretroviral treatment. Social determinants such as the Multidimensional Poverty Index and unmet basic needs (UBN) by municipality were also analyzed. Duplicate cases were excluded, retaining only those with the most complete data.

Statistical Analysis: Univariate analysis was performed to determine the distribution of the variables and calculate measures of central tendency and dispersion for quantitative variables, as well as absolute and relative frequencies for qualitative variables. In the bivariate analysis, the association between the dependent variable (drug-resistant tuberculosis) and independent variables was evaluated using the Chi-square test, with results considered statistically significant for p-values < 0.05. For multivariate analysis, a logistic regression model was constructed for statistically significant variables ($p < 0.05$), including potential confounders such as sex and age. Data entry and coding were conducted using IBM SPSS Statistics software, version 29.

Ethical Considerations: This research was classified as minimal risk according to Resolution 8430 of 1993 by the Ministry of Health and Social Protection. Data obtained from SISAP records between 2016 and 2021 were anonymized following Law 1581 of 2012, protecting individuals' pri-

vacy through the use of an alphanumeric code. The study was approved by the ethics committee of Fundación Universitaria del Área Andina.

Results

1. Univariate Analysis

Intermediate Determinants: A total of 684 individuals were included in the SISAP database from the Risaralda department. Of the total patients, 80.56% (551) were male. By life course, adulthood (ages 27 to 59 years) was the predominant population, accounting for 72.37% (495). The mean age was 40.31 years (SD ±14 years) with a median age of 37 years. Additionally, the variable "population group" indicates that 14% (97) were homeless, while 85% (578) were classified as "others."

The majority of tuberculosis cases were pulmonary, representing 72.2% (494). Among extrapulmonary TB cases, the majority were classified as "others" at 69.3% (474), followed by meningeal TB at 10.1% (69). Of the total patients, 89.6% (613) had no comorbidities.

Regarding admission condition, 85.5% (585) of the patients diagnosed with HIV-TB co-infection were classified as "new" cases. 54.1% (370) of the population had a prior diagnosis of HIV and were tested for tuberculosis, while 45.5% (311) underwent the tuberculosis test without a prior HIV diagnosis. Additionally, 6.4% (44) were diagnosed with drug-resistant TB.

In terms of treatment, 52.2% of the patients received ART (antiretroviral therapy). 37.1% (254) completed tuberculosis treatment, and 1.9% (13) experienced treatment failure. Finally, 39.5% (270) of the patients died.

Table 1. Intermediate determinants of the health of the study population (n=684)

Variable		n	%
Gender	Female	133	19,44
	Male	551	80,56
Life course	Childhood - 6 to 11 years	2	0,29
	Adolescence - 12 to 17 years	8	1,17
	Youth - 18 to 26 years	103	15,06
	Adulthood - 27 to 59 years	495	72,37
	Old age - 60 years and older	76	11,11
Ethnicity	Indigenous	14	2,05
	Afro-colombian	10	1,46
	Other ethnic groups	660	96,49
Insurance	With insurance	634	92,69
	Without insurance	50	7,31
Population Group	Homeless	97	14
	Migrant	8	1
	Other	578	85
	Prison population	1	0,15
Type of tuberculosis	Extrapulmonary	190	27,8
	Pulmonary	494	72,2
TB Resistance	Drug resistant	44	6,4
	Sensitive	640	93,6
Extrapulmonary tuberculosis	Other	474	69,3
	Meningeal	69	10,1
	Nodal	51	7,5
	Pleural	38	5,6
	Miliary	20	2,9
	Intestinal	15	2,2
	Peritoneal	10	1,5
	Osteoarticular	3	0,4
	Pericardial	3	0,4
	Cutaneous	1	0,2
Entry condition	New	585	85,5
	Others previously treated	17	2,5
	Re- admission	82	12,0
Test was carried out	No	3	0,4
	Yes	311	45,5
	Previous HIV +	370	54,1
Confirmatory test	Positive	315	46,1
	Previous HIV +	369	54,0

Receive antiretroviral treatment	No	274	40,1
	Yes	357	52,2
	No data	53	7.8
Receive Trimethoprim	No	231	33,8
	Yes	401	58,6
	No data	52	7,6
Number of Comorbidities	0	613	89,6
	1	51	7,5
	2	20	2,6
Discharge condition upon completion of TB treatment	Deceased from TB	270	39,5
	Failure	13	1,9
	No data	147	21,5
		254	37,1

*Elaboración propia

Structural Determinants: It was found that, by geographic area, the majority of the population resides in urban areas, accounting for 88.89% (608). The municipality of Pereira concentrates most of the population with 63.30% (433), followed by Dosquebradas with 19.01% (130) and Santa Rosa de Cabal with 5.70% (39).

The municipalities with the highest rate of Unmet Basic Needs (UBN) were Pueblo Rico (55.47), Mistrató (41.17), and Marsella (17.29). On the other hand, the municipalities with the highest Multidimensional Poverty Index were Pueblo Rico (27.2) and Guática (22.7).

Table 2. Structural Determinants of Health in the Study Population (n=684)

Variable		n	%
Geographic area	Populated center	2	0.29
	Rural	74	10.82
	Urban	608	88.89
Municipality of residence	Pereira	433	63.30
	Dosquebradas	130	19.01
	Santa rosa de cabal	39	5.70
	La Virginia	34	4.97
	Mistrató	10	1.46
	Pueblo rico	8	1.17
	Marsella	7	1.02
	Belén de Umbría	6	0.88
	Santuario	6	0.88
	Guática	4	0.58
	La Celia	3	0.44
	Quinchía	3	0.44
	Balboa	1	0.15

*Own elaboration.

Regarding the socioeconomic aspect, it is evident that patients from the municipality of Pueblo Rico have the highest Unsatisfied Basic Needs (UBN) index (55.47), with the most affected components being access to services (37.99), followed by overcrowding (33.37). This is due to the fact that most patients reside in rural areas. In this particular case, overcrowding could increase the risk of HIV-TB coinfection. This correlates with the municipality's high rates of HIV-TB coinfection (49.1 per 100,000 inhabitants) and drug resistance (6.1 per 100,000 inhabitants). In terms of the Multidimensional Poverty Index, Pueblo Rico also ranks first (27.2), which highlights the concerning living conditions of the population in this municipality.

Tables No. 3 and 4 present all structural health determinants disaggregated by municipality.

Table 3. Structural Determinants of Health in the Study Population: Socioeconomic Section (n=684)

Municipality	Population	TB/HIV coinfection records	NBI index by municipality	Houseing	Services	Overcrowding non-attendance		Non-attendance	Economic dependance	Sum of multidimensional poverty by municipality
Apía	12.276	0	0	0	0	0		0	0	0
Balboa	6.348	1	9,97	1,21	0,32	2,43		1,59	6,05	17,5
Belén de Umbría	24.660	6	13,02	0,77	0,58	3,79	1,63	8,68		19
Dosquebradas	220.771	130	4,35	0,3	0,25	0,72	0,96	2,4		12,8
Guática	12.108	4	10,96	0,82	0,16	3,29	0,81	6,86		22,7
La Celia	7.448	3	12,14	1,17	0,83	2,83	1,72	7,38		17,3
La Virginia	27.916	34	6,59	0,18	0,07	0,96	2,06	3,71		18,7
Marsella	16.782	7	17,29	7,48	6,51	3,06	2,23	7,96		17,3
Mistrató	17.110	10	41,17	1,87	10,67	19,73	13,18	21,61		18
Pereira	472.406	433	5,88	0,78	0,22	1,32	1,45	2,74		13,1
Pueblo Rico	16.309	8	55,47	2,32	37,99	33,37	15,39	21,72		27,2
Quinchía	27.235	3	16,42	1,74	0,46	5,78	1,32	10,02		20,2
Santa Rosa de Cabal	78.636	39	7,71	0,47	0,65	1,81	1,1	4,46		17,3
Santuario	12.506	6	10,34	0,37	0,14	3,14	1,08	7,13		22,2

*Source: own elaboration

Table 4. Records of TB/HIV Coinfection and Drug Resistance

Municipality	Population	TB/HIV coinfection records	TB/HIV coinfection rate per 100,000 inhabitants	Drug-resistant TB/HIV Registries	Rate of drug-resistant TB/HIV coinfection per 100,000 inhabitants
Apía	12.276	0	0,0	0	0,0
Balboa	6.348	1	15,8	0	0,0
Belén de Umbría	24.660	6	24,3	0	0,0
Dosquebradas	220.771	130	58,9	5	2,3
Guática	12.108	4	33,0	0	0,0
La Celia	7.448	3	40,3	0	0,0
La Virginia	27.916	34	121,8	3	10,7
Marsella	16.782	7	41,7	0	0,0
Mistrató	17.110	10	58,4	0	0,0
Pereira	472.406	433	91,7	24	5,1
Pueblo Rico	16.309	8	49,1	1	6,1
Quinchía	27.235	3	11,0	0	0,0
Santa Rosa de Cabal	78.636	39	49,6	11	14,0
Santuario	12.506	6	48,0	0	0,0
Risaralda	952.511	684	71,8	44	4,6

*Source: own elaboration

2. Bivariate analysis

Intermediate Determinants of Health: In the bivariate analysis, the condition at entry was the only variable significantly associated with TB resistance ($p < 0.001$). Other factors such as sex, age, and comorbidities did not show a significant association with TB resistance. Multidimensional poverty showed a trend toward increasing the likelihood of TB resistance, although it was not statistically significant at the 5% level ($p = 0.093$). The results are presented in Table 5.

Table 5. Bivariate Analysis of the Social Determinants of Health

Variable	Category	Sensitive	Drug-resistant	Total	Chi-Square (χ^2)	P Value (Pr)
Male	514	37	551			
Life course	Childhood	2	0	2	16.262	0.804
	Adolescence	7	1	8		
	Youth	1	0	1		
	Adulthood	458	34	492		
	Old age	73	3	76		
Ethnicity	Indigenous	12	2	14	21.272	0.345
	Black/Afro-colombian	10	0	10		
	Other ethnicities	618	42	660		
Insurance	No	49	1	50	17.610	0.184
	Yes	591	43	634		
Population group	Homeless	83	14	97	12,416	0.006
	Migrant	8	0	8		
	Others	549	30	579		
Type of tuberculosis	Extrapulmonary	179	11	190	0,181	0,671
	Pulmonary	461	33	494		
Entry condition	New	561	24	585	36,684	0.000
	Others previously treated	14	3	17		
	Re-admission	65	17	82		
Test was carried out	No	3	0	3	3,68	0,297
	Yes	308	15	323		
	Previous HIV +	328	29	357		
Confirmatory test	Positive	300	15	315	2,708	0,100
	Previous HIV +	340	29	369		
Receives antiretroviral treatment	No	252	22	274	12,192	0.334
	No data	51	2	53		
	Yes	337	20	357		
Receives Trimethoprim	No	214	14	228	0,933	0,627
	No data	50	2	52		
	Yes	376	25	401		
Adherencia al tratamiento	No	341	20	361	1,0119	0,314
	Si	299	24	323		
Comorbidities	No	572	41	613	0,6413	0,423
	Yes	68	3	71		

Discharge condition	Deceased from TB	244	26	270	8,0248	0,046
	Failure	13	0	13		
	Indetermined	140	7	147		
	Treatment completed	243	11	254		
Geographic Area	Populated center	2	0	2	0.1507	0.927
	Rural	69	5	74		
	Urban	569	39	608		
Municipality of residence	Balboa	1	0	1	36,292	0.000
	Belén de Umbría	6	0	6		
	Dosquebradas	125	5	130		
	Guática	4	0	4		
	La Celia	3	0	3		
	La Virginia	31	3	34		
	Marsella	7	0	7		
	Mistrató	10	0	10		
	Pereira	409	24	433		
	Pueblo rico	7	1	8		
	Quinchía	3	0	3		
	Santa rosa de cabal	28	11	39		
	Santuario	6	0	6		
Unmet Basic Needs				684	362.924	0.000
Multidimensional Poverty				684	267.816	0.008

*Own elaboration

The data showed no significant difference in the distribution of drug-sensitive and drug-resistant cases across different ethnic groups (Indigenous, Black/Afro-Colombian, other ethnicities) (χ^2=21.272, p=0.345). The majority of cases were concentrated in the 'other ethnicities' category, reflecting the ethnic composition of the study population.

A comparison between insured and uninsured individuals showed that among the uninsured, there were 49 drug-sensitive cases and 1 drug-resistant case; among the insured, there were 591 drug-sensitive cases and 43 drug-resistant cases. No significant differences were found between the two groups (χ^2=17.610, p=0.184), indicating that insurance status is not a key factor in drug resistance within this population.

There are significant differences in drug resistance according to the population group (χ^2=12.416, p=0.006). People experiencing homelessness

show a higher proportion of drug-resistant cases (14 out of 97), highlighting the vulnerability of this population group.

There are also significant differences in drug resistance according to the condition at admission (χ^2=36.684, p=0.000). Reentry cases present a higher proportion of drug resistance.

The use of antiretroviral therapy does not show a significant difference in drug resistance (χ^2=12.192, p=0.334). Most individuals receiving antiretroviral therapy also receive tuberculosis treatment, which is essential for managing coinfections. There are significant differences in patient discharge conditions (χ^2=8.0248, p=0.046). Patients who completed treatment had fewer cases of drug resistance, highlighting the importance of completing treatment to prevent resistance.

Treatment adherence does not show significant differences in terms of drug resistance (χ^2=1.0119, p=0.314). However, adherence is crucial for treatment success and the prevention of resistance. There are no significant differences in drug resistance between those with and without comorbidities (χ^2=0.6413, p=0.423). Most cases had no comorbidities, which may reflect an underestimation of these conditions.

Structural health determinants: There are significant differences in the distribution of tuberculosis cases across different cities of residence (χ^2=36.292, p=0.000). Cities such as Pereira and Dosquebradas report a higher number of cases, whereas other cities show lower prevalence rates. No significant differences in drug resistance were found between types of tuberculosis (extrapulmonary versus pulmonary tuberculosis) (χ^2=0.181, p=0.671).

The presence of unsatisfied basic needs shows a significant difference in drug resistance (χ^2=362.924, p=0.000). A significant difference is also observed in drug resistance in relation to multidimensional poverty (χ^2=267.816, p=0.008).

3. Multivariate Analysis The logistic regression model indicated that the condition of admission was the only variable significantly associated with TB drug resistance ($p < 0.001$). The detailed results of the model are presented below:

Tabla 6. Modelo de regresión logística

Variable	Coefficient	Standard Error	z-value	p-value	OR	CI 95%
Constant	-3.3672	0.6057	-5.5592	<0.001	0.0345	(0.0105, 0.1130)
Age	0.0048	0.0117	0.4106	0.681	1.0048	(0.9820, 1.0282)
Gender	0.1066	0.4393	0.2427	0.808	1.1125	(0.4703, 2.6314)
Entry condition	0.9374	0.1733	5.4094	<0.001	2.5534	(1.8180, 3.5861)
Years of Onset of symptoms	0.1422	0.1061	1.3405	0.180	1.1528	(0.9364, 1.4193)
Comorbidities	-0.4323	0.4668	-0.9260	0.354	0.6490	(0.2599, 1.6204)
Unmet basic needs (UBN)	-0.0260	0.0299	-0.8702	0.384	0.9743	(0.9188, 1.0332)
Multidimensional poverty	0.1179	0.0701	1.6821	0.093	1.1251	(0.9807, 1.2908)

*Own elaboration

Most patients complete their treatment in an average of 139 days, with a standard deviation of 119 days (results not shown), where TB resistance shows an increasing trend over time, although it is not statistically significant. Mortality tends to decrease over time, but again, this trend is not significant. Age remains a determining factor in mortality, with a higher probability of death in older patients. Multidimensional poverty has a significant influence on mortality, reducing the likelihood of survival.

Areas with higher levels of multidimensional poverty show a greater proportion of drug-resistant TB cases. This underscores the need for public health policies that address poverty and improve living conditions in order to reduce TB resistance.

Discussion

In many countries, there is a high burden of drug-resistant tuberculosis, which can be attributed to social determinants such as poverty, lack of education, cultural factors, overcrowding, malnutrition, the quality of care for the sick, and the lack of social security.

This research focused on the relationship between social determinants of health and drug-resistant tuberculosis in patients coinfected with HIV/TB in Risaralda during the period 2016-2021. In the multivariate analysis, it was identified that the intermediate determinant, the patient's admission condition, is the most significant factor in tuberculosis resistance, with a

positive and statistically significant coefficient (OR = 2.4560, p < 0.001). This suggests that patients readmitted for TB infection have a higher likelihood of developing drug resistance.

These findings are consistent with studies such as the one conducted in the department of Boyacá (20), which identified key determinants in TB resistance (20), as well as the research (21) that found a relationship between admission conditions such as previous treatment failure, relapse, and non-adherence with the development of multidrug-resistant tuberculosis (MDR-TB) (aOR=64.22: (95% CI; 12.786-322.507) p=0.001) and (aOR=37.44: (95% CI; 3.895-359.836, p=0.002), respectively.

On the other hand, in our analysis, no significant influence was observed between having comorbidities and developing drug-resistant TB (χ^2=0.6413, p=0.423), suggesting that the impact of coinfection may vary depending on the context and specific characteristics of the studied population. In contrast, a study on multidrug-resistant tuberculosis (MDR/RR-TB) in Colombia between 2013 and 2018 (22) revealed that young men and Afro-descendants were the most affected, and that comorbidities such as malnutrition and diabetes increased the risk of developing drug-resistant tuberculosis. During that period, 80,601 cases of TB were reported, of which 597 (0.74%) were MDR, concentrated in the departments of Antioquia and Valle del Cauca. Although no significant relationship was found with these comorbidities in our study, the results from study (22) suggest that these differences may be influenced by the sociodemographic characteristics and geographic distribution of the studied population.

Additionally, some studies have found that coinfection with HIV is an important risk factor for the development of multidrug-resistant TB (21,23,24). This suggests that the TB/HIV coinfection increases the likelihood of drug resistance.

Regarding treatment adherence, although HIV coinfection has been identified in other studies (25) as a significant risk factor, our analysis found no significant differences in adherence related to drug resistance (χ^2=1.0119, p=0.314).

On the other hand, a study conducted in Cali (26) found that the lack of adherence to TB treatment and antiretroviral therapy increased mortality, highlighting age as a critical factor in patients coinfected with HIV/TB, with an OR of 0.9678 for each additional year. Most of the deaths (93.33%) occurred in newly diagnosed cases. This aligns with the results obtained in

another study (27) and our findings, where age was also identified as a determining factor in patient mortality.

Regarding UBN (unsatisfied basic needs) and multidimensional poverty, no statistically significant association with TB resistance was observed. However, a trendency was identified (OR = 1.1251, p = 0.093), warranting further analysis. This result contrasts with the findings of a study in Ethiopia (28) where they identified that socioeconomic factors are key determinants in treatment adherence and disease progression in vulnerable populations.

Similarly, a study (29) highlights that poverty and lack of access to healthcare services are factors that significantly contribute to drug resistance in tuberculosis patients. This suggests that, as in Risaralda, interventions should focus on reducing poverty and improving living conditions to mitigate the impact of drug-resistant tuberculosis.

Regarding limitations, this study presents those inherent to cross-sectional studies, which do not allow for causality to be established. Additionally, the use of secondary sources may have excluded relevant variables. The results underscore the need for public policies that reduce poverty, improve treatment, and promote adherence, highlighting the importance of social determinants in controlling drug-resistant tuberculosis in people with HIV.

Conclusions

The study has identified the condition of admission as a key intermediate determinant in drug resistance to TB in HIV/TB coinfected patients in Risaralda, suggesting that patients who experience readmission for TB have a higher likelihood of developing drug resistance. This highlights the need to implement more specific and personalized care strategies for these individuals in order to improve their clinical outcomes.

Regarding structural determinants: multidimensional poverty and unmet basic needs, although not statistically significant, did show a trend that warrants further in-depth analysis. The results highlight the importance of considering social determinants of health and the socioeconomic context when planning interventions to control TB, especially in HIV/TB coinfected patients. The condition of admission is identified as the key factor for TB resistance, suggesting that more attention may need to be given to certain patients.

These structural factors are intrinsically linked to mortality in patients with TB and HIV, showing that higher levels of poverty are associated with lower survival rates in coinfected individuals. This underscores the impor-

tance of addressing the socioeconomic determinants affecting these vulnerable populations to reduce their influence on TB resistance.

Finally, this study emphasizes the need for a comprehensive approach that considers both structural and intermediate determinants in the planning of public health policies. These policies should focus on improving healthcare services, promoting adherence to antiretroviral treatments, and addressing the social and economic inequalities that affect these populations in order to improve their health outcomes.

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