PUBLICAÇÃO OFICIAL DO NÚCLEO HOSPITALAR DE EPIDEMIOLOGIA DO HOSPITAL SANTA CRUZ E PROGRAMA DE PÓS GRADUAÇÃO EM PROMOÇÃO DA SAÚDE - DEPARTAMENTO DE BIOLOGIA E FARMÁCIA DA UNISC

ISSN 2238-3360

Revista de Epidemiologia e Controle de Infecção

Original Article

Leprosy in the Vale do Itajaí Santa Catarina, Brazil (2004–2024): epidemiological profile and proposal of an operational indicator for hidden endemic surveillance

Hanseníase no Vale do Itajaí, Santa Catarina, Brasil (2004–2024): perfil epidemiológico e proposta de indicador operacional para vigilância da endemia oculta

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Site doi: https://doi.org/10.17058/reci.v16i.20966

Submitted: 12/10/2025
Accepted: 04/24/2026
Available online: 07/01/2026

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ABSTRACT

Background and Objectives: Leprosy remains endemic in Brazil, the country with the second-highest number of cases worldwide. In low-endemic regions, underreporting and predominantly passive surveillance hinder the identification of the true disease burden. This study aimed to characterize the epidemiological profile of leprosy in the Vale do Itajaí region, Santa Catarina, Brazil, from 2004 to 2024, and to propose an operational indicator — the Active Case Finding Detection Rate among Contacts (ACF-DRC) — to assess early detection capacity by surveillance services. **Methods:** Descriptive ecological study using secondary data from the Notifiable Diseases Information System (SINAN), covering 42 municipalities. Sociodemographic, clinical, and operational variables were analyzed using absolute and relative frequencies. **Results:** A total of 426 cases were recorded, of which 330 (77.5%) were new cases. There was a predominance of males (n=254; 59.6%), White race (n=334; 78.4%), age group 40–49 years (n=106; 24.9%), and incomplete primary education. The multibacillary operational class accounted for 299 (70.2%) cases, and the lepromatous form for 160 (37.6%). Grade 2 physical disability at diagnosis was identified in 25 (6.3%) of those evaluated. Detection through contact examination occurred in only 8 (1.9%) cases. The ACF-DRC calculated for the Médio Vale was 1.11%, classified as poor. **Conclusion:** The findings indicate late diagnosis, predominantly passive surveillance, and a probable hidden endemic. The ACF-DRC is a proposal that may assist surveillance evaluation in low-endemic areas, requiring validation in future studies.

Keywords: *Leprosy. Mycobacterium leprae. Epidemiological Surveillance. Contact Tracing. Health Service Indicators.*

RESUMO

Justificativa e Objetivos: A hanseníase permanece endêmica no Brasil, segundo país com maior número de casos no mundo. Em regiões de baixa endemicidade, a subnotificação e a predominância de vigilância passiva dificultam a identificação da real magnitude da doença. Este estudo objetivou caracterizar o perfil epidemiológico da hanseníase no Vale do Itajaí, Santa Catarina, no período de 2004 a 2024, e propor um indicador operacional, a Taxa de Detecção por Busca Ativa em Contatos (TDBA-C), para avaliar a capacidade de detecção precoce pela vigilância. **Métodos:** Estudo ecológico descritivo com dados secundários do Sistema de Informação de Agravos de Notificação (SINAN), abrangendo 42 municípios. Foram analisadas variáveis sociodemográficas, clínicas e operacionais por meio de frequências absolutas e relativas. **Resultados:** Foram registrados 426 casos, sendo 330 (77,5%) casos novos. Predominaram indivíduos do sexo masculino (n=254; 59,6%), raça branca (n=334; 78,4%), faixa etária de 40 a 49 anos (n=106; 24,9%) e ensino fundamental incompleto. A classe operacional multibacilar correspondeu a 299 (70,2%) casos, e a forma virchowiana a 160 (37,6%). O grau de incapacidade física 2 no diagnóstico foi identificado em 25 (6,3%) dos avaliados. A detecção por exame de contatos ocorreu em apenas 8 (1,9%) casos. A TDBA-C calculada para o Médio Vale foi de 1,11%, classificada como precária. **Conclusão:** Os achados evidenciam diagnóstico tardio, vigilância predominantemente passiva e uma provável endemia oculta. A TDBA-C é proposta como indicador complementar para avaliar a vigilância em áreas de baixa endemicidade, necessitando validação em estudos futuros.

Descritores: *Hanseníase. Mycobacterium leprae. Vigilância Epidemiológica. Busca de Comunicante. Indicadores de Serviços.*

RESUMEN

Justificación y Objetivos: La lepra permanece endémica en Brasil, el segundo país con mayor número de casos a nivel mundial. En regiones de baja endemicidad, la subnotificación y la vigilancia predominantemente pasiva dificultan la identificación de la magnitud real de la enfermedad. Este estudio tuvo como objetivo caracterizar el perfil epidemiológico de la lepra en el Vale do Itajaí, Santa Catarina, en el período de 2004 a 2024, y proponer un indicador operacional — la Tasa de Detección por Búsqueda Activa en Contactos (TDBA-C) — para evaluar la capacidad de detección precoz de la vigilancia. **Métodos:** Estudio ecológico descriptivo con datos secundarios del Sistema de Información de Enfermedad de Notificación Obrigatoria (SINAN), abarcando 42 municipios. Se analizaron variables sociodemográficas, clínicas y operacionales mediante frecuencias absolutas y relativas. **Resultados:** Se registraron 426 casos, siendo 330 (77,5%) casos nuevos. Predominaron individuos del sexo masculino (n=254; 59,6%), raza blanca (n=334; 78,4%), grupo etario de 40 a 49 años (n=106; 24,9%) y escolaridad primaria incompleta. La clase operacional multibacilar correspondió a 299 (70,2%) casos y la forma lepromatosa a 160 (37,6%). El grado de discapacidad física 2 en el diagnóstico fue identificado en 25 (6,3%) de los evaluados. La detección por examen de contactos ocurrió en apenas 8 (1,9%) casos. La TDBA-C calculada para el Médio Vale fue de 1,11%, clasificada como precaria. **Conclusión:** Los hallazgos evidencian diagnóstico tardío, vigilancia predominantemente pasiva y una probable endemia oculta. La TDBA-C constituye un indicador que puede auxiliar en la evaluación de la vigilancia en áreas de baja endemicidad, requiriendo validación en estudios futuros.

Palabras Clave: *Lepra. Mycobacterium leprae. Vigilancia Epidemiológica. Trazado de Contacto. Indicadores de Servicios de Salud.*

INTRODUCTION

Leprosy is a chronic infectious disease caused by *Mycobacterium leprae* and, as more recently described, by *M. lepromatosis*. Transmission occurs predominantly through the upper respiratory tract via aerosols containing bacilli expelled by untreated infected individuals.[1,2] It is primarily a neural disease with tropism for Schwann cells of the peripheral nervous system, which manifests secondarily in the skin and other organs.[2,3] Its long incubation period (on average five years, but can reach more than 50 years) means that the identification of cases in individuals under 15 years of age constitutes a marker of recent transmission and active endemicity in a community.[2,4]

The World Health Organization (WHO) bases the diagnosis of leprosy on cardinal signs: cutaneous areas with altered sensation, thickened peripheral nerves and, if available, positive bacilloscopy (slit-skin smear).[3] According to the Madrid classification (The International Leprosy Congress, 1953) leprosy is classified into four clinical forms: indeterminate, tuberculoid, borderline and lepromatous. This system directly reflects the spectrum of the host's immune response to the pathogen.[2] For operational purposes, the WHO classifies cases as paucibacillary (up to five skin lesions) and multibacillary (more than five lesions), with the latter being primarily responsible for maintaining the chain of transmission.[3]

In 2024, 172,717 new cases of leprosy were recorded globally. Brazil ranks second worldwide in absolute numbers, with 22,129 reported cases, surpassed only by India (100,957 cases).[5] From 2014 to 2023, the country reported 309,091 infections, of which approximately 80% were new cases.[6] The state of Santa Catarina has low endemicity, with a detection rate of 1.95 new cases per 100,000 inhabitants in 2023.[7] However, studies conducted in this same state have shown that the implementation of active case finding using the leprosy suspicion questionnaire (LSQ) increased the annual average of detected cases by 300% in municipalities with low endemicity, revealing the existence of hidden endemicity not reached by passive surveillance.[8]

The assessment of household contacts is one of the main strategies recommended by the WHO and the Ministry of Health for early diagnosis and interruption of the transmission chain.[2,3] Household contacts of multibacillary patients are five to eight times more likely to develop the disease compared to non-contacts.[9] Despite this high risk, only 11.7% of new cases were detected through contact tracing in Brazil in 2023, with referrals serving as the main method of detection (42.8%).[6] This scenario suggests that passive surveillance underestimates the true magnitude of the disease, particularly in regions officially classified as having low endemicity.

The operational indicators currently used by the Ministry of Health (new case detection rate, proportion of cases with grade 2 physical disability/G2PD at diagnosis, proportion of contacts examined, and cure rate) are fundamental tools for monitoring. However, they are limited in their ability to assess early detection within higher-risk populations, such as contacts of multibacillary patients.[10] Although the proportion of contacts examined measures the coverage of the investigation, it does not reflect the effectiveness of active case finding in identifying new cases within this specific group.

Given these gaps, the present study aimed to characterize the epidemiological profile of leprosy in the Vale do Itajaí region from 2004 to 2024, and to propose a complementary operational indicator, here called the Active Case Finding Detection Rate among Contacts (ACF-DRC) to evaluate the sensitivity of surveillance in detecting cases among high-risk contacts.

METHODS

This is a descriptive quantitative ecological study conducted in the Vale do Itajaí region, state of Santa Catarina, southern Brazil. This region encompasses 42 municipalities administratively subdivided into two Health Regions (CIR, Regional Inter-managerial Commission): Alto Vale do Itajaí (28 municipalities) and Médio Vale do Itajaí (14 municipalities), which make up the Health Macroregion called Vale do Itajaí.[11] The estimated population for 2024 is 1,141,142 inhabitants and the average Municipal Human Development Index (MHDI) is 0.739, ranging from 0.669 (Santa Terezinha) to 0.806 (Blumenau).[12] The municipalities of Médio Vale concentrate the largest urban centers in the region, such as Blumenau (366,418 inhabitants), Brusque (140,597) and Gaspar (71,925), while Alto Vale is characterized by predominantly rural and smaller municipalities.

The time frame from 2004 to 2024 was selected because it represents the longest historical series available in the information system used, totaling 21 years of observation. The year 2025 was not included because it contains data not yet consolidated by the Directorate of Epidemiological Surveillance of Santa Catarina (DIVE/SC), which has up to two years to finalize the records.

Secondary data were extracted from the Brazilian Information System for Notifiable Diseases (SINAN), accessed through the TABNET/DATASUS platform (https://tabnet.datasus.gov.br/cgi/tabcgi.exe?sinannet/cnv/hanswbr.def).[13] The search filters used were: State of residence (Santa Catarina), Health Macroregion (4216 — Vale do Itajaí), Health Regions (42004 — Alto Vale do Itajaí; 42006 — Médio Vale do Itajaí) and

notification period (2004–2024). All leprosy records notified and confirmed in the municipalities belonging to the region during the specified period were included.

The variables analyzed were organized into three categories: (a) sociodemographic: sex, self-declared race/color, age group and educational level; (b) clinical: clinical form (Madrid classification: indeterminate, tuberculoid, borderline, and lepromatous), operational class (paucibacillary or multibacillary), bacilloscopy result at the time of diagnosis, number of skin lesions, reactional episodes (types 1, 2, or both), and grade of physical disability (GPD) at diagnosis and discharge (grades 0, 1, and 2, according to the Ministry of Health protocol); and (c) operational: type of entry (new case, transfer, relapse, other), method of detection (referral, self-presentation, community examination, contact examination, other), and number of contacts registered and evaluated. Sociodemographic and clinical variables were extracted from the fields of the SINAN Notification/Investigation Form; the variables for GPD at discharge, reactional episodes, and contacts evaluated were obtained from the case follow-up/evolution fields.

Descriptive analysis was performed using absolute (n) and relative (%) frequencies, organized in tables and figures. New case detection rates per 100,000 inhabitants were calculated using the formula: (number of new cases in the period / sum of estimated annual populations in the period) × 100,000. Population estimates by municipality and by year were obtained from the Brazilian Institute of Geography and Statistics (IBGE).[12] The proportion of GPD 2 at diagnosis was calculated among the cases evaluated upon notification. The proportion of contacts examined was calculated according to the Guidelines for Surveillance, Care and Elimination of Leprosy as a Public Health Problem (2015), and classified as: good (≥90%), fair (75% to 89.9%) or poor (<75%).[14]

To assess the capacity for early detection among contacts of multibacillary cases, the ACF-DRC indicator is proposed, calculated using the formula:

$$ACF - DRC(\%) = \frac{Number\ of\ New\ Cases\ Detected\ by\ Contact\ Tracing}{Total\ Number\ of\ Contacts\ Evaluated}\ x\ 100$$

The numerator corresponds to the number of new cases whose "detection method" variable in SINAN was registered as "contact tracing". The denominator corresponds to the total number of contacts registered and effectively evaluated during the period. For interpretation, based on the available literature on detection rates among examined contacts, three classification ranges are proposed: >2.5% (good performance), 1.5% to 2.5% (fair), and <1.5% (poor).[15] These ranges were defined based on a study conducted in Rio Grande do Norte, which demonstrated a detection rate of 1.9% among examined contacts, compared to a national rate of 0.84%.[15]

The study exclusively used publicly available, anonymized, and freely accessible secondary data, thus dispensing with submission to the Research Ethics Committee, in accordance with Resolution No. 510/2016 of the National Health Council. The data were accessed in compliance with the Access to Information Law (Law No. 12.527/2011) and the anonymization principles provided for in the General Data Protection Law (Law No. 13.709/2018).

RESULTS

A total of 426 cases of leprosy were recorded in 35 of the 42 municipalities of the Vale do Itajaí between 2004 and 2024. Of these, 351 (82.4%) belonged to the Médio Vale and 75 (17.6%) to the Alto Vale. Seven municipalities did not report any cases: Agronômica, Chapadão do Lageado, Dona Emma, Imbuia, José Boiteux, Mirim Doce, and Witmarsum. Below is the distribution of cases by municipality, according to total number, new cases, and selected indicators (Table 1).

Table 1. Distribution of leprosy cases in the municipalities of the Vale do Itajaí and municipal detection rates for the period 2004-2024.

Municipality	Total number of cases (N=426)	Detection rate
Médio Vale Do Itajaí		
Apiúna	7	0.46
Ascurra	5	2.47
Benedito Novo	1	0.43
Blumenau	145	1.73
Botuverá	2	0.98
Brusque	73	2.45
Doutor Pedrinho	4	5.02
Gaspar	42	2.25
Guabiruba	6	1.14
Indaial	26	1.55
Pomerode	17	2.19
Rio dos Cedros	2	0.45
Rodeio	3	1.26
Timbó	18	1.54
Alto Vale Do Itajaí		
Agrolândia	1	0.47
Agronômica	0	0
Atalanta	1	1.44
Aurora	4	1.68
Braço do Trombudo	1	1.32
Chapadão do Lageado	0	0
Dona Emma	0	0
Ibirama	2	0.26
Imbuia	0	0
Ituporanga	11	1.00
José Boiteux	0	0
Laurentino	2	0.73
Lontras	3	0.85
Mirim Doce	0	0
Petrolândia	5	0.96
Pouso Redondo	3	0.29
Presidente Getúlio	1	0
Presidente Nereu	1	2.06
Rio do Campo	2	1.55
Rio do Oeste	1	0.65
Rio do Sul	22	1.30
Salete	4	0.63
Santa Terezinha	2	1.07
Taió	3	0.26

continue

Municipality	Total number of cases (N=426)	Detection rate
Trombudo Central	1	0.68
Vidal Ramos	3	2.24
Vitor Meireles	2	1.84
Witmarsum	0	0

The 10 municipalities with the highest number of cases were: Blumenau (n=145; 34.0%), Brusque (n=73; 17.1%), Gaspar (n=42; 9.9%), Indaial (n=26; 6.1%), Rio do Sul (n=22; 5.2%), Timbó (n=18; 4.2%), Pomerode (n=17; 4.0%), Ituporanga (n=11; 2.6%), Apiúna (n=7; 1.6%) and Guabiruba (n=6; 1.4%). These municipalities accounted for 367 (86.2%) of the total reported cases.

Regarding the sociodemographic profile (Table 2), male patients predominated, accounting for 254 (59.6%) cases. The White race/color was the most frequent (n=334; 78.4%), followed by Brown (n=65; 15.3%) and Black (n=19; 4.5%). The most affected age group was 40 to 49 years (n=106; 24.9%), followed by 30 to 39 years (n=84; 19.7%) and 20 to 29 years (n=74; 17.4%). Twelve (2.8%) cases were recorded in children under 15 years of age. Regarding educational level, the most frequent category was incomplete elementary education (5th to 8th grade) (n=99; 23.2%), followed by incomplete 1st to 4th grade (n=67; 15.7%) and complete elementary education (n=56; 13.1%). Information on educational level was absent or missing in 57 (13.4%) records.

Table 2. Distribution of leprosy cases according to sociodemographic profile in the Vale do Itajaí region from 2004 to 2024.

Variables	Alto Vale N (%)	Médio Vale N (%)
Sex		
Male	46 (61.3)	208 (59.3)
Female	29 (38.7)	143 (40.7)
Race		
White	56 (74.6)	278 (79.2)
Black	5 (6.7)	14 (4.0)
Yellow	0 (0.0)	0 (0.0)
Brown	13 (17.3)	52 (14.8)
Indigenous	0 (0.0)	0 (0.0)
Unknown	1 (1.3)	7 (2.0)
Educational Level		
Illiterate	2 (2.7)	6 (1.7)
Incomplete Elementary School	40 (53.3)	161 (45.8)
Complete Elementary School	12 (16)	44 (12.5)
Incomplete High School	4 (5.3)	21 (6)
Complete High School	5 (6.7)	49 (14)
Incomplete Higher Education	1 (1.3)	2 (0.6)
Complete Higher Education	2 (2.7)	16 (4.6)
Unknown or not applicable	9 (12)	52 (14.8)
Age Range		
Under 14 years old	3 (4)	9 (2.6)
15 to 19 years old	3 (4)	5 (1.4)
20 to 49 years old	38 (50.7)	226 (64.4)
50 to 69 years old	27 (36)	92 (26.2)
Over 70 years old	4 (5.3)	19 (5.4)

Regarding the clinical profile (Table 3), the lepromatous form was the most frequent (n=160; 37.6%), followed by the tuberculoid form (n=93; 21.8%), borderline form (n=69; 16.2%), and indeterminate form (n=42; 9.9%). The operational classification of multibacillary disease corresponded to 299 (70.2%) cases and paucibacillary to 126 (29.6%). Bacilloscopy was positive in 148 (34.7%) cases, negative in 111 (26.1%), unknown in 105 (24.6%), and not performed in 62 (14.6%). Regarding the number of skin lesions, 176 (41.3%) patients presented more than five lesions, 143 (33.6%) from two to five, 58 (13.6%) a single lesion, and 49 (11.5%) did not have this information recorded. As for reactional episodes, 245 (57.5%) patients did not present a reaction, 33 (7.7%) developed a type 1 reaction, 20 (4.7%) a type 2 reaction, and 3 (0.7%) both. This information was unknown for 125 (29.3%) cases.

The GPD at diagnosis was evaluated in 396 (93.0%) patients. Among those evaluated, 247 (62.4%) presented grade 0, 124 (31.3%) grade 1, and 25 (6.3%) grade 2. At discharge, only 279 (65.5%) patients were evaluated for GPD; of these, 200 (71.7%) presented with G0PD, 65 (23.3%) had G1PD, and 14 (5.0%) had G2PD. The total number of records without GPD evaluation at discharge was 147 (34.5%), representing a significant increase compared to the proportion observed at diagnosis (30 records; 7.0%).

Regarding the type of entry (Table 3), 330 (77.5%) were classified as new cases, 35 (8.2%) as transfers from another state, 11 (2.6%) as transfers within the same state, 4 (0.9%) from the same municipality, and 31 (7.3%) as relapses. The proportion of relapses differed between regions: 8 (10.7%) in Alto Vale and 23 (6.6%) in Médio Vale. The main method of detection was referral (n=273; 64.1%), followed by self-presentation (n=57; 13.4%) and missing information (n=76; 17.8%). Detection by contact tracing accounted for only 8 (1.9%) cases, all in Médio Vale, concentrated in two municipalities: Indaial (n=5) and Pomerode (n=3). In Alto Vale, no cases were detected by this method.

Table 3. Distribution of leprosy cases according to clinical and operational profile in the Vale do Itajaí region from 2004 to 2024.

Variables	Alto Vale N (%)	Médio Vale N (%)
Clinical Form (Madrid Classification)		
Indeterminate	6 (8.0)	36 (10.3)
Tuberculoid	11 (14.7)	82 (23.4)
Borderline	17 (22.7)	52 (14.8)
Lepromatous	29 (38.7)	131 (37.3)
No record	12 (16.0)	50 (14.2)
Grade of Physical Disability at diagnosis		
G0PD	36 (48.0)	211 (60.1)
G1PD	22 (29.3)	102 (29.1)
G2PD	8 (10.7)	17 (4.8)
Not evaluated	9 (12.0)	21 (6.0)
Bacilloscopy result at diagnosis		
Positive Bacilloscopy	25 (33.3)	123 (35.0)
Negative Bacilloscopy	11 (14.7)	100 (28.5)
Bacilloscopy not performed	16 (21.3)	46 (13.1)
No data	23 (30.7)	82 (23.4)

continue

Variables	Alto Vale N (%)	Médio Vale N (%)
Operational classification		
Paucibacillary	14 (18.7)	112 (31.9)
Multibacillary	61 (81.3)	238 (67.8)
No data	0 (0.0)	1 (0.3)
Number of lesions		
Less than 5 lesions	26 (34.7)	175 (49.9)
More than 5 lesions	35 (46.7)	141 (40.2)
Missing information	14 (18.7)	35 (10.0)
Leprosy Reaction		
Type 1 Reaction	9 (12.0)	24 (6.8)
Type 2 Reaction	2 (2.7)	18 (5.1)
Type 1 and 2 Reaction	0 (0.0)	3 (0.9)
No reaction	40 (53.3)	205 (58.4)
Missing information	24 (32.0)	101 (28.8)
Type of Entry		
New Case	51 (68.0)	279 (79.5)
Transfer from the same municipality	0 (0.0)	4 (1.1)
Transfer from another municipality	5 (6.7)	6 (1.7)
Transfer from another state	11 (14.7)	24 (6.8)
Relapse	8 (10.7)	23 (6.6)
Other entries	0 (0.0)	14 (4.0)
Unknown	0 (0.0)	1 (0.3)
Method of Detection		
Referral	35 (46.7)	238 (67.8)
Self-presentation	21 (28.0)	36 (10.3)
Collective examination	0 (0.0)	1 (0.3)
Contact examination	0 (0.0)	8 (2.3)
Other methods	1 (1.3)	10 (2.8)
Unknown	18 (24.0)	58 (16.5)

A total of 1,175 contacts were registered during the period, of which 895 (76.2%) were effectively evaluated. The proportion of contacts evaluated differed between regions: 173 (87%) of 199 registered in Alto Vale (fair classification), and 722 (74.0%) of 976 in Médio Vale (poor classification).

The ACF-DRC indicator was calculated for Médio Vale region, in which detection by contact tracing was recorded, resulting in 1.11% (8 new cases / 722 contacts evaluated × 100), which corresponds to a poor classification (<1.5%). This means that for every 90 contacts examined in the region, only one new case of leprosy was identified. In Alto Vale, the ACF-DRC was 0.0%, given that no cases were detected by contact tracing, even though 173 contacts had been evaluated.

Table 4. Distribution of registered and evaluated contacts and evaluation proportion in the Vale do Itajaí region from 2004 to 2024.

Variables	Alto Vale N (%)	Médio Vale N (%)
Contacts		
Registered	199 (100)	976 (100)
Evaluated	173 (87)	722 (74)

DISCUSSION

This study revealed an epidemiological profile of late and predominantly passive surveillance of leprosy in the Vale do Itajaí, a region officially classified as having low endemicity. The high proportion of multibacillary forms (70.2%), the predominance of detection by referral (64.1%) and the presence of G2PD at diagnosis (6.3% of those evaluated) are consistent indicators of underdiagnosis and a probable hidden endemicity.

The sociodemographic profile found showed a predominance of men (59.6%), middle-aged individuals and those with low levels of education. This is consistent with the national panorama, represented by men in 55.4% of cases in 2023, with a higher frequency among those with incomplete primary education (41.3%).[6] Studies conducted in different regions of Brazil indicate that male individuals tend to seek health services less and, when they do, the disease is often in advanced stages.[16] Santos et al. (2024), in a cross-sectional study conducted in Amazonas, observed that men are at a higher risk of late diagnosis compared to women, as do individuals aged 30 to 39 compared to the 15 to 19 age group.[17]

The predominance of cases among White people (78.4%) diverges from the national scenario, where Brown and Black individuals are more affected.[6,18] This finding reflects the demographic composition of Santa Catarina, whose self-declared White population corresponds to 76.3% according to the 2022 Census.[12] Note the conceptual distinction between color (White, Black, Brown) and ethnicity (Black = Black + Brown), as defined by the IBGE.[12]

The detection of 12 cases (2.8%) in children under 15 years of age confirms the existence of active and recent transmission in the region, since this indicator is recognized by the WHO as a sentinel marker of persistent transmission foci.[3,5]

The prevalence of multibacillary leprosy (70.2%), particularly lepromatous (37.6%) and borderline (16.2%) forms, is particularly concerning. In Brazil, the scenario is similar, but the proportion found in the Vale do Itajaí exceeds the national average.[6] Multibacillary patients, especially those with lepromatous and borderline lepromatous forms, are the main maintainers of the transmission chain, given their high bacillary index.[2] This high proportion suggests that diagnosis are occurring at advanced stages of the disease, when clinical manifestations are already evident, rather than through early detection based on neurological signs which, in the natural history of leprosy, can precede prominent skin lesions.[2,3,19]

Among those assessed in the diagnosis, the proportion of G2PD reached 6.3%, a value higher than the WHO target (<5.3% globally in 2024).[5] In Alto Vale, this proportion reached 12.1% of those assessed (8/66), indicating a more pronounced diagnostic delay. These values, when analyzed together with the high frequency of lepromatous and multibacillary forms, reinforce that diagnosis in the region is based on the presence of classic skin lesions, and not on the early identification of neurological signs (sensory alterations, neural thickening), which are frequently the first clinical signs

of the disease.[2,3,19] Recent studies have described that leprosy is the only infectious disease in which laboratory tests (anti-PGL-I serology, qPCR) and neurophysiological tests (electroneuromyography, nerve ultrasound) can identify impairment before the appearance of dermatological lesions, reinforcing the need to incorporate these tools into the diagnostic strategy.[20,21]

The proportion of relapses is noteworthy: 10.7% in Alto Vale and 6.6% in Médio Vale, both higher than the national average of 4.7%.[6] These data may reflect, in addition to factors intrinsic to the patient (such as insufficient treatment time), episodes of reinfection in environments with continuous circulation of the virus.[2] Studies conducted in Minas Gerais identified that 13.3% of household contacts were seropositive for anti-PGL-I and 4.7% showed molecular detection of *M. leprae* via nasal mucosal PCR, even in the absence of skin lesions.[22] Dos Santos et al. (2023), in a national referral center, identified that 35.5% of seropositive contacts presented a positive result in the PCR from slit-skin smear and 23.5% already showed neural impairment in electroneuromyography, in the absence of visible skin lesions, which does not necessarily imply the absence of neurological signs such as sensory loss.[20] These results allow us to infer that even subclinical carriers can maintain silent transmission of the disease.

In the Vale do Itajaí, 64.1% of diagnoses occurred through referral, in contrast to detection by examination of contacts (1.9%). In the Alto Vale, no cases were identified by this latter method, although 173 contacts were evaluated. In Brazil, contact tracing accounted for only 11.7% of diagnoses in 2023, while in the state of Santa Catarina this percentage was 9.8%.[6,7] This predominance of passive detection masks the true magnitude of the disease. Vitiritti et al. (2024) observed that the implementation of active case finding in southern Santa Catarina increased the annual average of detected cases by 300%.[8]

In the Médio Vale, contact tracing coverage reached 74.0%, revealing a poor classification (<75%) according to national guidelines.[14] In Alto Vale, performance was fair (86.9%).[14] Considering that contacts of multibacillary patients have a five to eight times greater risk of developing the disease,[9] and the Médio Vale region concentrated 238 (67.8%) multibacillary cases, it would be expected that a systematic and high-quality active case finding would identify a more significant number of new cases. The detection of only eight cases among 722 contacts evaluated constitutes a scenario of low operational sensitivity. A study conducted in São Paulo with active case finding among contacts identified a detection rate of 10.7 per 1,000 contacts examined, with 64 new multibacillary cases, reinforcing that exposure to undiagnosed multibacillary individuals is the main driver of transmission.[23]

The proposed ACF-DRC indicator aims to specifically measure the ability to detect new cases among effectively evaluated contacts. Unlike the proportion of contacts examined, which assesses coverage, ACF-DRC evaluates the outcome of active case finding in the highest epidemiological risk group. The value of 1.11% found in the Médio Vale region, classified as poor, should not be interpreted as an indicator of low endemicity, but as a reflection of surveillance with low operational sensitivity. Note that this study does not evaluate the effectiveness of the indicator, which would require a comparative design of scenarios with and without its use. This is an initial proposal that needs prospective validation and application in different epidemiological scenarios.

Strategies to improve early detection in the region should include: implementation of systematic active case finding using standardized questionnaires, with proven effectiveness in Santa Catarina;[8] incorporation of complementary diagnostic tools, such as anti-PGL-I serology by rapid lateral flow chromatography test (qualitative), quantitative PCR test (qPCR) for detection of bacillary DNA, peripheral nerve ultrasound and sensory mapping for identification of early neural involvement;[20,21,24] and training of primary care teams to recognize the neurological signs of leprosy that precede dermatological lesions.

This study presents limitations inherent to the ecological design, which prevents inferences of individual causality (ecological fallacy). The use of secondary data from SINAN implies risks of discrepancies between databases, missing information (unfilled fields) and registration inconsistencies. The absence of cross-referencing between variables limits inferences about causal associations between the data. The impact of the COVID-19 pandemic on the primary care network may have underestimated detection rates in the recent period. As the ACF-DRC has not been validated in a comparative study, it constitutes a pilot proposal. The lack of segregation of data by all municipalities individually limits the identification of priority areas within the region. Additionally, the data available in SINAN does not allow distinguishing which evaluated contacts were specifically multibacillary patients, which constitutes an approximation in the construction of the indicator.

The epidemiological profile of leprosy in the Vale do Itajaí from 2004 to 2024 shows a disease with late diagnosis, characterized by a high proportion of multibacillary forms (70.2%), particularly the lepromatous (37.6%) and borderline (16.2%) forms, presence of G2PD in 6.3% of those evaluated at diagnosis, and the occurrence of 12 cases in children under 15 years of age. Surveillance in the region is predominantly passive, with 64.1% of diagnoses made through referrals and only 1.9% through contact tracing.

These data suggest a hidden endemicity in the region, with reported cases likely representing only a fraction of the actual disease burden. The ACF-DRC, an indicator proposed in this study, showed poor performance (1.11% in the Médio Vale and 0.0% in the Alto Vale), reinforcing the weakness of active case finding in the region. Although it is an initial proposal requiring prospective validation, the indicator offers a complementary perspective to existing parameters by focusing on surveillance performance in the highest epidemiological risk group. The incorporation of early diagnosis strategies based on neurological signs, complementary laboratory tools, and systematized active case finding is a priority measure for the effective control of leprosy in areas of low endemicity.

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Vitória Bortolotto Vieira contributed to the bibliographic research, writing the abstract, introduction, methodology, discussion, interpretation and description of results, preparation of tables, conclusions, review and statistics. **Franciani Rodrigues da Rocha** contributed to the writing of the abstract, introduction, methodology, interpretation and description of results, preparation of tables. **Maria Eduarda Oliveira Baschera** contributed to the interpretation and description of results, preparation of tables. **Emanuelle Cristiny Monte dos Santos** contributed to the interpretation and description of results, preparation of tables. **Laura**

Schroeder Medeiros da Silva contributed to the interpretation and description of results, preparation of tables. **Bruno Vitiritti** contributed to the bibliographic research, writing the abstract, introduction, methodology, discussion, interpretation and description of results, preparation of tables, conclusions, review and statistics. **João Luis Beber** contributed to the bibliographic research, writing the abstract, introduction, methodology, discussion, interpretation and description of results, preparation of tables, conclusions, review and statistics.

All authors approved the final version to be published and are responsible for all aspects of the work, including ensuring its accuracy and integrity.

Please cite this article as: Vieira VB, Vitiritti B, Rocha FR, Baschera MEO, Santos ECM, Silva LSM, Beber JL. Leprosy in the Vale do Itajaí Santa Catarina, Brazil (2004–2024): epidemiological profile and proposal of an operational indicator for hidden endemic surveillance. Rev Epidemiol Control Infect [Internet]. 2026 Jul. 1; 16. Available from: https://seer.unisc.br/index.php/epidemiologia/article/view/20966