CLINICAL NUTRITION
DOI: 10.12957/demetra.2025.83296

DEMETRA
Alimentação, Nutrição & Saúde

e-ISSN:2238-913X

Fernanda Borges de Figueiredo[1]
Liliany Fontes Loures[1]
Mário Flávio Cardoso de Lima[1]

[1] Hospital Universitário da Universidade Federal de Juiz de Fora / Empresa Brasileira de Serviços Hospitalares. Juiz de Fora, MG, Brasil.

**Correspondence**
Fernanda Borges de Figueiredo
fernandaborgesde@hotmail.com

**Assistant Editor**
Luciane Pires da Costa

# *Sociodemographic and clinical aspects, nutritional status, social participation and activity limitation and risk awareness of patients with leprosy*

## Aspectos sociodemográficos e clínicos, nutricionais, participação social e limitação de atividade e consciência de risco de pacientes com hanseníase

## Abstract

*Introduction*: Leprosy is a neglected tropical disease, endemic in Brazil, with aspects of vulnerability associated with the disease that are little explored in the literature. *Objective*: Evaluating the sociodemographic, clinical and nutritional profile, social participation and activity limitation, and risk awareness of individuals with leprosy at a multidisciplinary leprosy outpatient clinic in Minas Gerais. *Methods*: Sociodemographic, anthropometric, food consumption, handgrip strength (HGS), food insecurity risk screening questionnaire, screening activity limitation and safety awareness, and social participation scale data from a convenience sampling of individuals followed at the outpatient clinic were analyzed. *Results*: The sample studied included 20 individuals, 60% male, mostly adult, white, married, with a monthly income between 1 and 3 minimum wages, 64.71% with the multibacillary form, 85% with some degree of activity limitation, and 61% with restricted participation. There was a prevalence of 40% of obesity according to the Body Mass Index, with excess fat (45%) in the fat area of the arm, low adequacy of the muscle circumference of the arm (80%) and risk of food insecurity in 40%. A positive correlation was observed between higher HGS and total muscle mass (p=0.028); of the right arm (p=0.008) and left arm (p=0.013). Food consumption showed an altered lipid profile, consumption below the recommended level of retinol (95%), vitamin C (15%), iron (35%) and zinc (20%). *Conclusion*: A profile with sociodemographic vulnerabilities, functional limitations, excess weight and reduced muscle mass, risk for food insecurity and nutritional inadequacies was evidenced.

Keywords: Leprosy. Nutritional status. Muscle strength. Food insecurity. Daily activities.

## Resumo

*Introdução*: A hanseníase é uma doença tropical negligenciada, endêmica no Brasil e que possui aspectos de vulnerabilidade ligados à doença que são pouco explorados na literatura. *Objetivo*: Avaliar o perfil sociodemográfico, clínico e nutricional, a participação social e limitação de atividade e a

consciência de risco de indivíduos com hanseníase de um ambulatório multiprofissional de hanseníase em Minas Gerais. ***Métodos***: Foram analisados dados sociodemográficos, antropométricos, consumo alimentar, força de preensão palmar (FPP), questionário de Triagem para Risco de Insegurança Alimentar, Triagem de Limitação de Atividade e Consciência de Risco e Escala de Participação Social de uma amostra de conveniência de indivíduos acompanhados no ambulatório. ***Resultados***: A amostra analisada incluiu 20 indivíduos, 60% do sexo masculino, maioria adulta, cor branca, casado(a), renda mensal entre 1 e 3 salários mínimos, 64,71% com a forma multibacilar, 85% com algum grau de limitação de atividade e 61% com restrição à participação. Houve prevalência de 40% de obesidade pelo Índice de Massa Corporal, com excesso de gordura (45%) quanto à área gordurosa do braço, baixa adequação da circunferência muscular do braço (80%) e risco de insegurança alimentarem 40%. Observou-se correlação positiva entre FPP maior e massa muscular total (p=0,028); do braço direito (p=0,008) e esquerdo (p=0,013). O consumo alimentar evidenciou perfil lipídico alterado, consumo abaixo do recomendado de retinol (95%), vitamina C (15%), ferro (35%) e zinco (20%). ***Conclusão***: Evidenciou-se um perfil com vulnerabilidades sociodemográficas, limitações funcionais, excesso de peso e redução de massa muscular, risco para insegurança alimentar e inadequações nutricionais.

Palavras-chave: Hanseníase. Estado nutricional. Força Muscular. Insegurança Alimentar. Atividades Cotidianas.

## INTRODUÇÃO

Leprosy is an infectious, transmissible, and chronic disease classified as a neglected tropical disease (NTD) and remains endemic in Brazil.[1,2] In 2022, 174,087 new cases were reported worldwide, with India, Brazil, and Indonesia accounting for approximately 78%. Brazil is the second country with the highest number of cases in the world, behind only India.[2,3] *Mycobacterium leprae* is transmitted mainly through the upper respiratory tract, over prolonged and close contact with untreated infected people. The disease can cause permanent damage and disabilities to the skin, nerves, face, hands, and feet, including loss of motor control.[1-3] In addition to the physical impacts, which can limit daily activities performance, leprosy is a stigmatizing disease, which discrimination has a significant impact on restricting individuals' social participation.[1,3]

The highest prevalence of leprosy cases occurs in areas with high social and economic vulnerability, and low access to health services. It is directly related to food insecurity (FI), lack of access,in quantity and quality, to an adequate, regular and permanent diet, which can affect the nutritional status of individuals, mainly causing malnutrition or undernutrition.[4]

Food shortages can lead to inadequate consumption of macro and micronutrients, which may be related to the disease, although the cause-and-effect mechanism has not yet been fully elucidated. It is known that some nutritional deficiencies are detected in individuals with leprosy, such as vitamins A, C, D, E, magnesium, zinc and selenium.[4] Deficiencies of these nutrients can have implications for the immune system, with changes in oxidative stress, the body's natural barriers, influencing the predisposition to developing diseases and also reducing protection against infectious agents.[5]

Furthermore, treatment of the disease and reactive episodes is carried out through multidrug therapy (MDT), anti-inflammatory drugs and immunosuppressants, respectively. These medications can generate side effects related to nutrition, such as gastrointestinal disorders and anemia. MDT combines the drugs dapsone , rifampin and clofazimine, and the duration of treatment varies from 6 to 12 months, depending on the leprosy operational classification, whether paucibacillary (PB) (up to 5 skin lesions and negative bacilloscopy exam) – 6 months of treatment; or multibacillary (MB) (more than 5 lesions and/or positive bacilloscopy) – 12 months of treatment.[6] Studies focusing on nutritional aspects, body composition, food intake and their relationship with leprosy are limited and little explored in the literature.[4]

Based on this context, the objective of this study is to evaluate the sociodemographic, clinical and nutritional profile, social participation, activity limitation and risk awareness of patients with leprosy at a multidisciplinary leprosy outpatient clinic in Minas Gerais.

## METHODS

### Study design and population

This is a cross-sectional study with convenient sampling composed of monitored patients managed by reactive episodes, undergoing treatment with polychemotherapy, or already discharged from the multidisciplinary leprosy outpatient clinic in the city of Juiz de Fora, Minas Gerais. Individuals of both sexes, over 18 years of age, no pregnant, and who agreed to participate in the research by signing the Informed Consent Form were selected. Individuals who presented body alterations that prevented them from undergoing physical assessment were excluded from the study.

Data collection occurred between October 2023 and January 2024, after analysis and approval by the Ethics Committee on Research with Human Beings of the University Hospital of the Federal University of Juiz de Fora, under opinion no. 6,306,874.

## Sociodemographic assessment

Sociodemographic data was obtained through electronic medical records of service and archived care records of the multidisciplinary leprosy outpatient clinic.

## Assessment of the Screening Activity Limitation and Safety Awareness (SALSA) and of the Social Participation scale

Through the archived care records from the multidisciplinary leprosy outpatient clinic, the applied Screening Activity Limitation and Safety Awareness (SALSA) and social participation scale questionnaires were accessed.

## Anthropometric assessment

The patient's weight and height measurements were assessed using a digital platform scale with a stadiometer attached (Welmy type), which was later used to calculate the Body Mass Index (BMI). Regarding the classification, were used as reference the WHO parameters for adults[7] and the Pan American Health Organization (PAHO) for the elderly.[8]

The arm circumference (AC), waist circumference (WC), and triceps skinfold thickness (TSF) measurements were checked and subsequently classified.[9] The measurements followed the technical recommendations of the International Society for the Advancement of Kinanthropometry.[10] An inflexible metal tape measure was used to determine the circumferences, and an analog clinical adipometer, Innovare-Cescorfbrand, measured the TSF. The AC and TSF measurements were used to calculate the mid-arm muscle circumference (MAMC) and arm fat area (AFA).[11-12] Concerning the WC measurement, were used the cutoff points proposed by Lean et al.[13]

Body composition was assessed using bioelectrical impedance analysis (BIA)with a Tanitabrand (BC-1500) tetrapolar device. Participants were instructed to follow the proposed protocol from the equipment manual (before the test: fasting for at least 4 hours, no alcohol or caffeine in the previous 24 hours, and without any intense physical activity).

## Muscle strength assessment

Muscle strength was assessed using handgrip strength (HGS), measured with a Jamar hydraulic hand dynamometer. During the assessment, the individual remained seated with their feet flat on the floor, arm positioned close to the chest, and elbow bent at 90º without support. The measurement was performed on both limbs, at maximum contraction intensity, with each measurement taken in triplicate. A 1-minute rest interval was provided between measurements, and the highest value obtained was considered the result. The values used to classify probable sarcopenia were based on the criteria proposed by the European Consensuson Sarcopenia.[14]

## Food insecurity risk assessment

To assess the risk of food insecurity (FI) in individuals, the Screening for Food Insecurity (SFI) questionnaire was applied. In order to identify compromised access to food. It is a quick and simple instrument consisting of two questions that inquire about food shortages and their relationship to household finances in recent months. The risk of mild FI is identified when the answer is "yes" to one of the two questions, while moderate or severe FI is indicated when both questions are answered "yes."[15]

## Assessment of food consumption

Food consumption was assessed using a Food Frequency Questionnaire (FFQ) consisting of 99 items. The FFQ estimated food consumption over the previous year, with frequency options ranging from "never" to "10 times," and included daily, weekly, or monthly periods. The average portion size consumed by the individual was also considered.

Food survey data were analyzed using food composition tables, with household measurements converted into weight. This allowed for the quantification of daily intake of macronutrients, as well as dietary fiber, vitamins, and minerals. The adequacy of food consumption was calculated based on the values proposed by the Dietary Reference Intakes (DRI) of the Institute of Medicine,[16] except for the recommendations for mono and polyunsaturated lipids, which followed the guidelines of the Brazilian Society of Cardiology.[17]

## Statistical analysis

Initially, the data were tabulated in an electronic spreadsheet and the normality analysis of the data was performed using the Shapiro–Wilk test. The results were described in absolute and relative frequency, average, median and standard deviation, according to the characteristic of the variable. Pearson correlation was used to assess the correlation between variables; for comparison between variables, the t-test for independent samples was used. In all analyses, the level of significance was considered <0.05 and all data were analyzed using the SPSS 20.0 program (SPSS Inc., Chicago, IL, USA).

## RESULTS

A total of 124 individuals were identified through data from the multidisciplinary leprosy outpatient clinic. Of these, 45 individuals were contacted either in person or by telephone, as their contact information was available through the service. Among those contacted, 23 individuals did not respond or refused to participate, with the primary reason being difficulty accessing the city due to residing in another location. Of the individuals who agreed to participate, one was absent on the day of data collection, and another was excluded because did not meet the criteria for bioimpedance testing.

The final sample consisted of 20 individuals, 7 of whom were undergoing treatment with multidrug therapy (MDT), 1 was being monitored due to a leprosy reaction, and the remaining 12, although discharged from medical treatment, were still participating in the multidisciplinary leprosy outpatient clinic. The sample was heterogeneous but did not exhibit statistically significant differences between groups.

The group comprised 60% males, with average age of 54.35 ± 14.36 years. Additional sample characteristics are presented in Table 1. The individuals had an average gross income of R$2,508.00 (± 1,209.80), based on the minimum wage for the period, which was R$1,320.00. Considering the number of people living in the same household, the average per capita income was R$974.05 (± 490.70).

Table 1. Sociodemographic characteristics, operational classification, SALSA scales, and social participation of individuals followed by the multidisciplinary leprosy outpatient clinic. Juiz de Fora, Minas Gerais, 2024.

| Feature | Total (N) | Percentage (%) |
|---|---|---|
| Age group (years) | | |
| 18 – 59 years old | 14 | 70 |
| >60 years | 6 | 30 |
| Skin Color | | |
| White | 12 | 60 |
| Black | 3 | 15 |
| Brown | 5 | 25 |
| Education | | |
| Incomplete Elementary | 7 | 35 |
| Complete Elementary/Incomplete High School | 1 | 5 |
| Completed Intermediate/Incomplete Higher Education | 3 | 15 |
| Complete Higher Education | 2 | 10 |
| Ignored | 7 | 35 |
| Monthly Income | | |
| < 1 Minimum Wage | 1 | 5 |
| ≥ 1 - < 3 Minimum Wages | 15 | 75 |
| ≥ 3 - < 5 Minimum Wages | 4 | 20 |
| Marital status | | |
| Single | 6 | 30 |
| Married | 7 | 35 |
| Widower | 1 | 5 |
| Other | 6 | 30 |
| Operational classification* | | |
| Paucibacillary | 6 | 35 |
| Multibacillary | 11 | 65 |
| SALSA scale* | | |
| No Limitations | 2 | 15 |
| Slight Limitation | 6 | 46 |
| Moderate Limitation | 5 | 39 |
| Social Participation Scale* | | |
| No Restriction | 5 | 39 |
| Light Restriction | 2 | 15 |
| Moderate Restriction | 3 | 23 |
| Severe Restriction | 2 | 15 |
| Extreme Restriction | 1 | 8 |

*Some individuals did not have data in the system. Calculation performed with available data.

The Body Mass Index (BMI) classification revealed that 15% of individuals were underweight, 35% were eutrophic, 15% were overweight, and 40% were obese.

The average adequacy of arm circumference (AC) was 101.33% (±18.91). The majority of individuals were classified as eutrophic (30%), followed by 25% with mild malnutrition, 25% with obesity, 15% with overweight, and 10% with moderate malnutrition. For mid-upper arm muscle circumference (MAMC), the average adequacy was 84.87% (±14.01), with most individuals classified as having some degree of malnutrition: mild (40%), moderate (25%), or severe (15%).

Regarding adiposity, the classification based on adiposity fat assessment (AFA) showed that the majority of individuals had excess fat (45%). Waist circumference (WC) measurements indicated that 60% of individuals had values above the ideal, with 35% presenting very high values.

All individuals reported that their right arm was the dominant arm, but handgrip strength (HGS) was measured in both arms due to reports of loss of sensitivity or muscle strength in either or both limbs. The highest HGS measurement between the two arms had an average of 32.40 kgf (±11.91), while the lowest measurement averaged 24.40 kgf (±15.62).

Two individuals were unable to generate force in their left arm after three attempts. The risk of sarcopenia, based on HGS classification, was observed in 20% of the individuals. Table 2 provides the results of the other measurements taken.

**Table 2**. Average, standard deviation, median, minimum and maximum values of anthropometric measurements. Juiz de Fora, Minas Gerais, 2024.

| Variables | Average± SD | Median | Minimum | Maximum |
|---|---|---|---|---|
| Weight (kg) | 75.74 ± 19.84 | 70.30 | 43.90 | 122.20 |
| Height (m) | 1.66 ± 0.10 | 1.66 | 1.48 | 1.87 |
| BMI (kg/m²) | 27.57 ± 6.66 | 26.13 | 18.27 | 40.11 |
| AC (cm) | 32.64 ± 5.83 | 29.47 | 21.57 | 43.73 |
| TSF (mm) | 31.85 ± 15.25 | 30.17 | 10.56 | 55.67 |
| MAMC (cm) | 22.19 ± 3.80 | 21.27 | 16.14 | 34.6 |
| AFA (cm²) | 34.82 ± 20.90 | 29.39 | 13.28 | 81.16 |
| WC (cm) | 93.32 ± 16.95 | 90.45 | 67.43 | 124.1 |
| L HGS(kgf) | 25.75 ± 16.42 | 24.00 | 0.00 | 59.00 |
| R HGS(kgf) | 31.05 ± 11.59 | 28.50 | 13:00 | 57.00 |

Acronyms: BMI – Body Mass Index, AC – Arm Circumference, TSF – Triceps Skinfold, MAMC – Arm Muscle Circumference, AFA – Arm Fat Area, WC – Waist Circumference, L HGS – Left Handgrip Strength, R HGS - Right Handgrip Strength.

The body composition results of individuals performed through BIAare shown in Table 3.

**Table 3.** Average, standard deviation, median , minimum and maximum values of body composition according to bioimpedanceresults. Juiz de Fora, Minas Gerais, 2024.

| Classification | Average± SD | Median | Minimum | Maximum |
|---|---|---|---|---|
| Total fat percentage (%) | 26.39 ± 12.08 | 26.70 | 9.00 | 46.70 |
| Fat-free mass (kg) | 51.41 ± 12.91 | 51.35 | 13.90 | 77.30 |
| Muscle mass (kg) | 50.42 ± 8.70 | 50.10 | 37.90 | 73.50 |
| Muscle mass leg E (Kg) | 8.59 ± 1.77 | 8.40 | 6.50 | 12.50 |
| Muscle mass leg D (Kg) | 8.74 ± 1.77 | 8.70 | 6.50 | 12.10 |
| Muscle mass arm E (Kg) | 2.76 ± 0.72 | 2.60 | 1.70 | 4.90 |
| Muscle mass arm D (Kg) | 2.77 ± 0.75 | 2.65 | 1.90 | 4.80 |

Despite the observed difference between the highest and HGS measurements, no significant differences were found in muscle mass between the right and left arms of the individuals. The highest HGS value was used as a standard for correlation with anthropometric measurements. A positive correlation was observed between the highest HGS and total muscle mass ($r = 0.492$; $p = 0.028$), as well as with muscle mass in the right arm ($r = 0.578$; $p = 0.008$) and left arm ($r = 0.543$; $p = 0.013$).

Concerning food insecurity, 40% of individuals were at risk for some level of insecurity, with 15% classified as having mild food insecurity (FI) and 25% as having moderate or severe FI.

In relation to food consumption, the average caloric intake was 2,322.93 kcal (±794.41), with the following distribution: 54.34% (±6.55) from carbohydrates, 17.76% (±2.81) from protein, 28.67% (±5.04) from lipids, and 10.25% (±2.73) from saturated fat. Notably, the average cholesterol consumption was 519.45 mg (±279.87), which is considered high, while the intake of calcium - 726.95 mg (±437.35) - and retinol - 225.68 µg (±188.04) was low. Table 4 provides a detailed overview of macronutrient and micronutrient intake, including the percentage of adequacy in relation to the Dietary Reference Intake (DRI)[16] recommendations.

Most individuals presented adequate macronutrients consumption, although there were variations in lipid intake proportions. When the consumption of other nutrients was classified by age group and age, fiber intake below of the recommended level was identified in 30% of individuals and in 35% regarding iron.

Table 4. Classification of individuals according to food consumption based on *Estimated Average Requirement* (EAR) recommendations. Juiz de Fora, Minas Gerais, 2024.

| Nutrients | (N) | Percentage (%) |
|---|---|---|
| Carbohydrate (%) | | |
| ≤45 | 1 | 5 |
| 45-65* | 19 | 95 |
| Protein (%) | | |
| 10-35* | 20 | 100 |
| Lipid (%) | | |
| <20 | 1 | 5 |
| 20-35 * | 17 | 85 |
| >35 | 2 | 10 |
| Saturated Fat (%) | | |
| ≤10 * | 12 | 60 |
| >10 | 8 | 40 |
| Polyunsaturated Fat (%) | | |
| <12 | 20 | 100 |
| ≥12* | 0 | - |
| Monounsaturated Fat (%) | | |
| <10 | 18 | 90 |
| 10-20* | 2 | 10 |
| Fiber (g) | | |
| <21 | 4 | 20 |
| 21-38* | 10 | 50 |
| >38 | 6 | 30 |
| Iron (mg) | | |
| <6 | 2 | 10 |
| 6-8.1* | 2 | 10 |
| >8.1 | 16 | 80 |
| Retinol (ug)† | | |
| <500 | 19 | 95 |
| >625 | 1 | 5 |
| Vitamin C (mg) | | |
| <60 | 3 | 15 |
| 60-75* | 2 | 10 |
| >75 | 15 | 75 |
| Zinc (mg) | | |
| <6.8 | 4 | 20 |
| 6.8-9.4* | 5 | 25 |
| >9.4 | 11 | 55 |

*Nutrients according to RDI Recommendation (EAR); † Recommendation from 500 to 625 mg/day. Note: The reference values used for Monounsaturated and Polyunsaturated Fat were from the Brazilian Society of Cardiology.[16]

## DISCUSSION

In this study, the sample profile was predominantly composed of white male individuals, earning between 1 and 3 minimum wages, who were married and experienced some degree of limitation in activities and restricted participation. They presented excess weight and adiposity, including in the abdominal region, along with reduced muscle mass and strength in at least one arm. Additionally, the participants exhibited an

altered lipid profile, characterized by increased saturated fat intake and decreased consumption of fiber, retinol, iron, and zinc.

A higher proportion of males observed in the study is consistent with the latest epidemiological report from the Ministry of Health (MH).[3] This report indicates that 55.6% of new cases in the country, between 2013 and 2022, occurred in men. Similarly, in the municipality of Juiz de Fora, between 1995 and 2015, a higher prevalence was noted among men.[18] The average age of participants, 54.35 years, aligns with the age group (30-59 years) exhibiting the highest prevalence of cases nationwide.[3] Matos[18] found that in Juiz de Fora, the peak age range shifted from 30-44 years (1995-2004) to 45-59 years (2005-2015), suggesting a trend toward older age groups. This higher incidence in economically active individuals reflects Brazil's demographic transition, characterized by an increasing elderly population.[19]

A greater proportion of white individuals was identified, consistent with the 41.5%[20] reported in the Southeast Region between 2017 and 2021, as well as with findings from other studies conducted in the municipality.[21,22] This observation aligns with the demographic characteristics of these regions, where both the municipality and the state are predominantly composed of individuals who self-identify as white.[23] Conversely, at the national level, the majority of cases were recorded among individuals identifying as brown 58.3%,[3] also in accordance with IBGE data, in which the majority of Brazilians declared themselves as brown.[23]

The occurrence of the disease is strongly correlated with sociodemographic factors, with education level and income being significant determinants, as highlighted in the systematic review by Pescarini et al.[24] These factors are considered risk markers for the disease. Among the data collected, a higher prevalence of individuals who had not completed elementary school was observed, a finding corroborated by other studies.[3,22,25-28] Additionally, education level has been linked to a greater degree of physical disability,[29] which authors attributed to limited understanding of the disease and its treatment, negatively impacting self-care. Thus, monitoring the education level is a major factor in the care of these patients.

Income analysis revealed that most individuals earned between one and three minimum wages, a result consistent with findings from other studies.[26,27,30] Furthermore, this study identified that 45% of patients were classified as poor according to the criteria established by the Institute of Applied Economic Research(IPEA).[31] Lopes & Rangel[32] analyzed the vulnerability of leprosy patients with irregular treatment adherence, emphasizing that economic factors may pose significant barriers to treatment monitoring and completion.

Regarding operational classification, the majority of cases analyzed were of the multibacillary (MB) form of leprosy, aligning with national data, which reported that 83.6%[3] of cases in 2022 fell into this category. Similar trends have been observed in other studies examining the operational classification of the disease.[25,26,30]

It is observed, through the SALSA scale that the majority of the sample experienced some degree of activity limitation, suggesting an increased risk of functional loss. Similarly, the Social Participation scale revealed that 61% of individuals faced some degree of social restriction. In contrast, Nascimentoet al.[33] reported that 45.3% of their sample exhibited activity limitations and 24% experienced social participation restrictions. Moreover, they identified an association between these variables and the severity of the disease. Silva et al.[34] showed that individuals with neuropathic pain scored higher on the SALSA scale and showed decreased scores on psychological assessment and quality-of-life scales. These findings underscore the importance of managing and preventing disabilities caused by the disease, including reducing stigma and promoting social participation—key components of the global leprosystrategy.[1]

Excess weight was observed in 55% of the sample, aligning with findings from other Brazilian studies reflecting the country's recent nutritionaltransition.[25,27]In contrast, Montenegro et al.[30] in Brazil, and Oktaria

et al.,[35] in Indonesia, observed a higher prevalence of eutrophic individuals, while Anantharam et al.,[36] in Ethiopia, and Khandapani & Mishra,[37] in India, reported a greater prevalence of underweight individuals. These differences can be attributed to variations in sociodemographic and cultural contexts across countries.

Anthropometric assessments indicated reductions in muscle mass, with 80% of participants classified as malnourished based on MAMC. Increased fat levels were noted, with 40% of individuals classified as overweight or obese (AC) and 45% showing excess fat (AFA). Oliveira et al.[26] reported similar findings, with 60% of their sample classified as malnourished. Montenegro et al.[30] found 31.6% with malnutrition values according to the measurement. Anantharam et al.[36] found reduced AC in leprosy patients compared to controls. WC, correlated with abdominal fat and metabolic complications, was high in the majority of participants, consistent with Bruschi et al.,[29] who found elevated WC measurements in 74.3% of their sample.

Using BIA, the average body fat percentage was 26.39%, with many individuals classified as eutrophic but with 30% categorized as obese. Cunha et al.[38] reported 63.2% of leprosy patients with high body fat percentages using skinfold measurements. Similarly, Kim et al.[39] found an average body fat percentage of 32% in elderly Korean leprosy patients using Dual Energy Examination Absorptiometry (DEXA), alongside reduced muscle mass. Their analyses suggested that treated individuals face a higher risk of obesity and sarcopenia compared to healthy individuals.[39]

HGS assessment revealed sarcopenia risk in 20% of the sample. Kim et al.[39] reported a 38.7% prevalence of sarcopenia in 36 leprosy patients. Loss of strength and/or sensitivity was reported in both limbs, with reductions in HGS observed despite preserved muscle mass. Moreira & Alvarez[40] evaluated HGS in individuals treated at a leprosy outpatient clinic and found reduced values in both limbs, with a significant difference when compared to the control group.

Our study observed significant differences between the highest and lowest HGS values in a single individual, indicating notable functional loss even with the preservation of the arms muscle mass. This reduction in muscle strength likely reflects neural involvement in the musculoskeletal system, highlighting the utility of HGS as a parameter for assessing functionality. Positive correlations between HGS and BIA-measured muscle mass further support its use in monitoring lean mass loss and sarcopenia risk throughout treatment.

Food insecurity (FI) was identified in 40% of the sample, with mild FI reported in three individuals and moderate-to-severe FI in five individuals. These findings indicate compromised food quality and reduced food quantity.[15] Teixeira et al.[25] observed FI in 41% of leprosy patients, with 28.3% experiencing mild FI, 8% moderate FI, and 4.7% severe FI. The FI levels in our study are lower than national data, where FI affects 58.7% of households.[41] The relationship between FI and leprosy is well discussed in the literature, and data shows that having experienced food shortages can expose the individual to a greater chance of developing the disease, which highlights the need for public policies aimed at this vulnerability factor.[24]

Despite this FI risk and a low average income in the sample, it was observed that most individuals had macronutrient consumption within the recommended values, especially proteins (100% of individuals), sourced from higher-cost foods. Teixeira et al.[25] reported frequent consumption of protein-rich foods, primarily red meat and beans. In contrast, Oliveira et al.[26] and Montenegro et al.[30] observed low consumption of high-biological-value foods, particularly meat, but moderate-to-high consumption of beans. Wagenaar et al.[42] found that during food shortages, leprosy patients significantly reduced meat and fish consumption compared to controls. Such disparities highlight the influence of sociodemographic and cultural differences.

Regarding lipid intake, 40% of participants exceeded recommendations for saturated fats, while most consumed insufficient levels of polyunsaturated and monounsaturated fats (100% and 90%, respectively).

Bruschi et al.[27] reported excessive intake across the entire lipid profile. Such imbalances may affect inflammatory processes, with omega-3 and omega-6 identified as biomarkers for disease expression, though further investigation is needed.[4]

Concerning micronutrients, this study found low consumption of retinol, vitamin C and zinc in 95%, 15% and 20% of the individuals, respectively. Dwivedi et al.[4] emphasize that this may implicate in free radicals formation and in the body's immune response. Khalid et al.[43] found reduced serum levels of zinc and vitamin C in patients with leprosy, and emphasizes that the cause is multifactorial, linked to metabolic alterations caused by the bacillus, low dietary intake, or even deficiencies prior to the disease. Inadequate iron intake, a micronutrient linked to anemia, was found in 35% of the individuals,[6] which may be exacerbated by dapsone, a common treatment drug. Monitoring these factors is crucial.

Despite the relevant findings in our studies and the importance of a healthy diet in the general context of the disease, and also its relevance in controlling inflammatory processes and oxidative stress, it remains unclear whether micronutrient deficiencies are a cause or consequence of the disease.

Limitations of this study include challenges in patient recruitment and incomplete secondary data, which may affect the results. Dietary assessments may also be subject to recall bias. Nonetheless, the absence of similar studies highlights the clinical relevance of this analysis in guiding treatment and preventing disabilities.

## CONCLUSION

This study outlined the sociodemographic, clinical, nutritional and dietary profile of currently undergoing or previously treated for leprosy. The sample revealed individuals with factors of fragility and vulnerability, such as low educational attainment, limited income, and a risk of food insecurity. Additionally, the majority of participants exhibited activity limitations and restrictions on social participation due to the disease.

In terms of the nutritional profile, a higher prevalence of overweight and adiposity was observed, contrasting with reductions in muscle mass and strength. Dietary analysis revealed inadequacies in the intake of certain nutrients that may either influence or be influenced by the disease. These findings highlight the critical need for targeted nutritional interventions.

To address these challenges, continuous monitoring of body composition, muscle strength, dietary intake, sociodemographic factors, and daily living activities is essential. Such measures can help prevent and mitigate disabilities associated with leprosy and improve overall patient outcomes.

Leprosy remains a neglected disease. It is hoped that this study will inspire further research to raise awareness and advocate for more effective public health policies, particularly those focusing on nutrition, which has been shown to play a significant role in managing the disease.

## REFERENCES

1. World Health Organization(WHO). Ending the neglect to attain the Sustainable Development Goals: a road map for neglected tropical diseases 2021–2030 [Internet]. Geneva: WHO; 2021[Citado19 fev 2024] 30 p. Disponível em: https://www.who.int/publications/i/item/9789290228509

2. World Health Organization(WHO). Global leprosy (Hansen disease) update, 2022: new paradigm – control to elimination. Weekly epidemiological record [Internet]. Geneva: WHO; 2023 [Citado19 jan 2024].409-430 p. Disponível em: https://iris.who.int/bitstream/handle/10665/372812/WER9837-eng-fre.pdf?sequence=1

3. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde e Ambiente. Boletim Epidemiológico, Hanseníase. 2024 [Internet]. Número Especial. Brasília, DF; Jan. 2024 [Citado 04 mar 2024]. Disponível em: https://www.gov.br/saude/pt-br/centrais-de-conteudo/publicacoes/boletins/epidemiologicos/especiais/2024/be_hansen-2024_19jan_final.pdf

4. Dwivedi VD, Banerjee A, Das I, Saha A, Dutta M., Bhardwaj B, et al. Diet and nutrition: An important risk factor in leprosy. Microbial pathogenesis. 2019;137(1):103714. https://doi.org/10.1371/journal.pntd.0003766

5. Klowak M, Boggild AK. A review of nutrition in neuropathic pain of leprosy. Therapeutic Advances in Infectious Disease. 2022;9(1):1-19. https://doi.org/10.1177/20499361221102663

6. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. Protocolo Clínico e Diretrizes Terapêuticas da Hanseníase [Internet]. Brasília: MS; 2022. [Citado18 jan 2024]. 1 ed. p. 152. Disponível em: https://www.gov.br/saude/pt-br/assuntos/saude-de-a-a-z/h/hanseniase/publicacoes/protocolo-clinico-e-diretrizes-terapeuticas-da-hanseniase-2022

7. World Health Organization (WHO). Physical status: the use and interpretation of anthropometry. Technical Report Series, Geneva: WHO. 1995. 452 p.

8. Organización Panamericana de la Salud (OPAS). Encuesta Multicéntrica Salud Bienestar y Envejecimiento (SABE) en América Latina y el Caribe: informe preliminar. 36ª Reunión del Comité Asesor de Investigaciones en Salud. Kingston. Washington, DC: OPAS. 2001. 19 p.

9. Blackburn GL, Thornton PA. Nutritional Assessment of the Hospitalized Patient. Med Clin North Am. 1979;63(5):1103-15. https://doi.org/10.1016/S0025-7125(16)31663-7

10. Stewart A, Marfell-Jones M, Olds T, Ridder H. International Society for the Advancement of Kinanthropometry.Padrões Internacionais para Avaliação Antropométrica. 1. ed. Guardalupe, Spain: ISAK; 2011. 115 p.

11. Gurney JM, Jelliffe DB. Arm anthropometry in nutritional assessment: nomogram for rapid calculation of muscle circumference and cross-sectional muscle and fat areas. Am J ClinNutr. 1973;26(9):912-5. https://doi.org/10.1093/ajcn/26.9.912

12. Frisancho AR. Anthropometric standards for the assessment of growth and nutritional status. Ann Arbor, MI: The University of Michigan Press; 1990. 189 p.

13. Lean MEJ, Han TS, Morrison CE. Waist circumference as a measure for indicating need for weight management. Bmj. 1995;311(6998):158-161. https://doi.org/10.1136/bmj.311.6998.158

14. Cruz-Jentoft AJ, Bahat G, Bauer J, Boirie Y, Bruyère O, Cederholm T, et al. Sarcopenia: revised European consensus on definition and diagnosis. Age and ageing. 2018;48(1):16-31. https://doi.org/10.1093/ageing/afy169

15. Brasil.Ministério da saúde. Secretaria de Atenção Primária à Saúde. Insegurança Alimentar na Atenção Primária à Saúde Manual de Identificação dos Domicílios e Organização da Rede [Internet].1 ed. Brasília: MS; 2022. [Citado 04 mar 2024]. 20 p. Disponível em: http://189.28.128.100/dab/docs/portaldab/publicacoes/instrutivo_inseguranca_alimentar_aps.pdf

16. Padovani RM, Amaya-Farfán J, Colugnati FAB, Domene SMA. Dietary reference intakes: aplicabilidade das tabelas em estudos nutricionais. Revista de Nutrição. 2006.19(1):741-760. https://doi.org/10.1590/S1415-52732006000600010

17. Izar COM, Lottenberg AM, Giraldez VZR, Santos Filho RD, Machado RM, Bertolami A, Assad MHV, et al. Sociedade Brasileira de Cardiologia. Posicionamento sobre o Consumo de Gorduras e Saúde Cardiovascular – 2021. Arquivos Brasileiros de Cardiologia. 2021;116(1):160-212. http://dx.doi.org/10.36660/abc.20201340.

18. Matos AMF. Epidemiologia da Hanseníase e sua distribuição espacial por determinantes sociais em Juiz de Fora 1995-2015 [dissertation on the Internet]. Juiz de Fora: Universidade Federal de Juiz de Fora; 2017. [Citado19 abr 2024].83 p. Disponível em: https://repositorio.ufjf.br/jspui/bitstream/ufjf/6100/1/alinemotafreitasmatos.pdf.

19. Rocha MCN, Nobre ML, Garcia LP. Características epidemiológicas da hanseníase nos idosos e comparação com outros grupos etários, Brasil (2016-2018). Cadernos de Saúde Pública. 2020;36(9):e00048019. https://doi.org/10.1590/0102/311X00048019

20. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. Boletim Epidemiológico, Hanseníase [Internet]. Número Especial. Brasília, DF; Jan. 2023 [Citado18 jan 2024].56 p. Disponível em: https://www.gov.br/saude/pt-br/centrais-de-conteudo/publicacoes/boletins/epidemiologicos/especiais/2023/boletim_hanseniase-2023_internet_completo.pdf

21. Seixas MB, Loures LF, Mármora CHC. Perfil sociodemográfico e clínico dos pacientes em atendimento fisioterapêutico no Hospital Universitário da Universidade Federal de Juiz [Internet]. Hu Revista 2015 [Citado19 fev 2024];41(1 e 2):7-13. Disponível em: https://periodicos.ufjf.br/index.php/hurevista/article/view/14035.

22. Alves ACR, Lemos GS, de Paiva PDR. Perfil socioeconômico dos pacientes atendidos pelo Centro de Referência em Reabilitação da Hanseníase da Zona da Mata Mineira. HU Revista. 2017;43(2):99-104. https://doi.org/10.34019/1982-8047.2017.v43.2640

23. Instituto Brasileiro de Geografia e Estatística (IBGE). Censo Demográfico 2022: População e Domicílio [Citado 08 mar 2024]. Disponível em: https://censo2022.ibge.gov.br/panorama/.

24. Pescarini JM, Strina A, Nery JS, Skalinski LM, Andrade KVF, Penna MLF, et al. Socioeconomic risk markers of leprosy in high-burden countries: A systematic review and meta-analysis. PLoS Neglected Tropical Diseases. 2018;12(7):e0006622. https://doi.org/10.1371/journal.pntd.0006622

25. Teixeira CSS, Medeiros DS, Alencar CH, Ramos Júnior AN, Heukelbach J. Aspectos nutricionais de pessoas acometidas por hanseníase, entre 2001 e 2014, em municípios do semiárido brasileiro. Ciência & Saúde Coletiva. 2019;24(1):2431-2441. https://doi.org/10.1590/1413-81232018247.19642017

26. Oliveira MP, Sousa JR, Araujo RS, Aarão TLS, Quaresma JAS. Protein profile of leprosy patients with plantar ulcers from the Eastern Amazon region. Infectious Diseases of Poverty. 2017;6(1):1-8. https://doi.org/10.1186/s40249-017-0318-y

27. Bruschi KR, Labrêa MGA, Eidt LM. Avaliação do estado nutricional e do consumo alimentar de pacientes com hanseníase do ambulatório de dermatologia sanitária. Hansenologia Internationalis: hanseníase e outras doenças infecciosas. 2011;36(2):53-61. https://doi.org/10.47878/hi.2011.v36.36211

28. Garcia ICO. Avaliação nutricional e caracterização sócio-demográfica de portadores de hanseníase-SP [dissertation on the Internet]. São Paulo: Universidade de São Paulo. 2006. 44 p. https://doi.org/10.11606/D.6.2006.tde-26092022-152139

29. Lages D dos S, Kerr BM, Bueno I de C, Niitsuma ENA, Lana FCF. A baixa escolaridade está associada ao aumento de incapacidades físicas no diagnóstico de hanseníase no Vale do Jequitinhonha. HU Revista. 2019;44(3):303-9. https://doi.org/10.34019/1982-8047.2018.v44.14035

30. Montenegro RMN, Molina MDC, Moreira M, Zandonade E. Avaliação nutricional e alimentar de pacientes portadores de hanseníase tratados em unidades de saúde da grande Vitória, Estado do Espírito Santo. Revista da Sociedade Brasileira de Medicina Tropical. 2011;44(1):228-231. https://doi.org/10.1590/S0037-86822011005000016

31. Instituto de Pesquisa Econômica Aplicada (IPEA). Radar social. Brasília: IPEA. 2005. [Citado 04 mar 2024]. 144 p. Disponível em: https://bvsms.saude.gov.br/bvs/publicacoes/radar_social.pdf

32. Lopes VAS, Rangel EM. Hanseníase e vulnerabilidade social: uma análise do perfil socioeconômico de usuários em tratamento irregular. Saúde em Debate. 2014;38(1):817-829. https://doi.org/10.5935/0103-1104.20140074

33. Nascimento DDS, Ramos Jr AN, Araújo ODD, Macêdo SFD, Silva GVD, Lopes WMPS, et al. Limitação de atividade e restrição à participação social em pessoas com hanseníase: análise transversal da magnitude e fatores associados em município hiperendêmico do Piauí, 2001 a 2014. Epidemiologia e Serviços de Saúde. 2020;29:e2019543. https://doi.org/10.5123/S1679-49742020000300012

34. Silva SR, de Souza SN, Santana MFS, Domingos AM, Martins NDS, de Paula HL, et al. Assessment of neuropathic pain, functional activity limitation and quality of life of people affected by leprosy in an endemic area in Northeast Brazil: a cross-sectional study. Transactions of the Royal Society of Tropical Medicine and Hygiene. 2023;117(6),451-459. https://doi.org/10.1093/trstmh/trac133

35. Oktaria S,Hurif NS, Naim W, Thio HB, Nijsten TEC, Richarduset JH. Dietary diversity and poverty as risk factors for leprosy in Indonesia: A case-control study. PLOS Neglected Tropical Diseases. 2018;12(3):1-15. https://doi.org/10.1371/journal.pntd.0006317

36. Anantharam P, EmersonLE, BilchaKD, FairleyJK, TesfayeAB. Undernutrition, food insecurity, and leprosy in North Gondar Zone, Ethiopia: A case-control study to identify infection risk factors associated with poverty. PLOS Neglected Tropical Diseases. 2021;15(6):e0009456. https://doi.org/10.1371/journal.pntd.0009456

37. Khandapani T, Mishra BK. Health problems and nutritional status of selected leprosy victims of Burla Town, Orissa, India. Curr Res J Soc Sci. 2010 [citado 23 dez 2024]. 2(6):350-7. Disponível em: https://maxwellsci.com/print/crjss/v2-350-357.pdf

38. Cunha EHM,Caciquinho B, Cominotti LL, Oliveira MNS, Avelar AC, Faria ES, et al. Associação entre percentual de gordura corporal e IL-10 plasmática em indivíduos portadores de hanseníase de área endêmica Brasileira. Brazilian Journal of Development. 2021;7(7):72220-72232. https://doi.org/10.34117/bjdv7n7-413

39. Kim W, Park HW, Hwang BK, Bae SO, Kim IK, Chung SG. Comparison of sarcopenic status between elderly leprosy survivors and general population. Archives of Gerontology and Geriatrics. 2014;58(1):134-139. https://doi.org/10.1016/j.archger.2013.07.013

40. Moreira D, Alvarez RRA. Avaliação da força de preensão palmar com o uso do dinamômetro Jamar em pacientes portadores de hanseníase atendidos em nível ambulatorial no Distrito Federal. Hansenologia Internationalis: hanseníase e outras doenças infecciosas. 2002;27(2):61-69. https://doi.org/10.47878/hi.2002.v27.36413

41. Rede Brasileira de Pesquisa em Soberania e Segurança Alimentar e Nutricional (Rede PENSSAN). II VIGISAN: Inquérito Nacional sobre Insegurança Alimentar no Contexto da Pandemia da Covid-19 no Brasil. Brasília: Rede PENSAN; 2022.[ Citado 23 dec 2023] 66p. Disponível em: https://www12.senado.leg.br/noticias/arquivos/2022/10/14/olheestados-diagramacao-v4-r01-1-14-09-2022.pdf

42. Wagenaar I, Muiden LV, Alam K, Bowers R, Hossain MA, Kispotta K, et al. Diet-related risk factors for leprosy: a case-control study. PLoS neglected tropical diseases. 2015;9(5):e0003766. https://doi.org/10.1371/journal.pntd.0003766

43. Khalid HN, Mostafa MI, Attia NS, Bazid HASE. Serum level of Selenium, Zinc, and Vitamin C and their relation to the clinical spectrum of leprosy. The Journal of Infection in Developing Countries. 2022;16(03):491-499. https://doi.org/10.3855/jidc.14832.

## Contributors

Figueiredo FB, Loures LF, and Lima MFC participated in the study design, data collection, analysis, interpretation, and drafting of the study. All authors contributed to the final review and approval of the manuscript for submission.

Conflict of Interest: The authors declare no conflicts of interest.

Received: April 6, 2024
Accepted: September 2, 2024