Migration among individuals with leprosy: a population-based study in Central Brazil

Migração entre pessoas com hanseníase: estudo de base populacional no Centro-Oeste do Brasil

La migración entre personas con lepra: un estudio basado en la población en el centro de Brasil

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Abstract

This study investigates social and clinical factors associated with migration among individuals affected by leprosy. A cross-sectional study was conducted among those newly diagnosed with leprosy (2006-2008), in 79 endemic municipalities in the state of Tocantins, Brazil (N = 1,074). In total, 76.2% were born in a municipality different from their current residence. In the five years before diagnosis 16.7% migrated, and 3.6% migrated after leprosy diagnosis. Findings reflect aspects associated with historical rural-urban population movement in Brazil. Indicators of poverty were prominent among before-diagnosis migrants but not after-diagnosis migrants. Migration after diagnosis was associated with prior migration. The association of multibacillary leprosy with migration indicates healthcare access may be an obstacle to early diagnosis among before-diagnosis migrants, which may also be related to the high mobility of this group.

Internal Migration; Leprosy; Poverty

Resumo

Este estudo investiga fatores sociais e clínicos associados à migração entre pessoas afetadas pela hanseníase. Estudo transversal entre recém-diagnosticados com hanseníase (2006-2008), em 79 municípios endêmicos do Estado de Tocantins, Brasil (N = 1.074). No total, 76,2% nasceram em município diferente de sua residência atual. Nos cinco anos antes do diagnóstico, 16,7% migraram, e 3,6% migraram após o diagnóstico da hanseníase. Resultados refletem aspectos associados com o movimento histórico da população rural-urbana no Brasil. Indicadores de pobreza foram proeminentes antes do diagnóstico de migrantes. A migração após o diagnóstico foi associada com migração anterior. A associação da forma multibacilar com migração indica que o acesso à saúde pode ser um obstáculo para o diagnóstico precoce de migrantes, o que pode também estar relacionado com a elevada mobilidade desse grupo.

Migração Interna; Hanseníase; Pobreza

Background

Leprosy remains a public health problem in endemic pockets among several countries throughout the world, including Brazil. Migration has been identified as one of the social determinants that can influence health and risk for neglected tropical diseases (NTDs) [1,2], and is considered a possible factor in leprosy susceptibility and distribution in Brazil [3,4]. Other neglected diseases have also been associated with population movement, including leishmaniasis [5,6] schistosomiasis [7,8,9], and Chagas disease [10]. Migration can increase the risk of NTD transmission and susceptibility, as non-immune migrants move into areas of NTD endemicity, and infected migrants may return to non-endemic areas through circular migration or permanent movement [5,7].

There are many reasons for migration: employment opportunities and access to better infrastructure, such as healthcare and education, can attract migrants from other areas [11,12]; while the socioeconomic environment, including poor job opportunities and low wages [12,13,14,15] influence the decision to migrate from the place of origin. This is especially reflected in rural to urban population movement. In Brazil, migration has historically been stimulated by strong disparities between poor rural areas in the northeast of the country and large urban centers, a pattern typical of migration flow throughout Latin America [16]. Recently, there has been a shift in migration dynamics toward rural in-migration [17] resulting from opportunities in civil development projects and agricultural expansion. National policies and regional economic disparities and conditions can influence the direction and duration of migration [5], and temporary or circular patterns [18,19,20].

A complex relationship exists where low socioeconomic status and poor education influence job skills and employment options, creating urgency for movement, particularly to urban areas creating uncontrolled growth around city perimeters. Poverty and biological vulnerability converge in crowded and substandard housing in areas lacking basic sanitary conditions, access to clean water and other utilities, factors that are also associated with leprosy transmission [4,21,22]. These crowded living conditions that include close proximity to individuals with leprosy, particularly multibacillary leprosy, increase the risk of infection in comparison to other social contacts [22,23,24]. In Brazil, household contact monitoring is part of the national leprosy surveillance strategy, as is monitoring leprosy among children as an indicator of ongoing active transmission [25].

Understanding leprosy transmission dynamics is important for insight into how population movement complicates disease control [5,7]. As World Health Organization (WHO) strategies increasingly move toward greater control and elimination of NTDs, a focused examination of factors associated with migration in those affected by the disease is necessary to better integrate interventions aimed at disease control and elimination. This study has the goal of supporting the Brazil Ministry of Health Leprosy Control Programs in providing services for migrating populations. The study was designed with the objective of identifying demographic, socioeconomic, health-service related and clinical factors associated with migration before and after diagnosis with leprosy in an affected population.

Methods

Study design

This cross-sectional study was designed as operational research to provide evidence for improvement to the national and state leprosy control programs. All municipalities included are located in a major endemic cluster identified by the Brazilian Ministry of Health as high-risk areas for leprosy [26].

Study area and population

Tocantins, the newest Brazilian state located in the north region, is a leprosy hyperendemic area with the highest incidence in Brazil – 88.54/100,000 inhabitants in 2009 (Health Informatics Department. http://tabnet.datasus.gov.br/cgi/deftohtm.exe?idb2011/d0206.def, accessed on 10/Apr/2011). With one of the fastest growing agriculture-based economies, Tocantins attracts labor migration with more than one third of the population coming from a different state and more than one half born in different municipalities [27,28].

The target population included all new leprosy cases diagnosed between 2006 and 2008, who were living in endemic municipalities. Individuals living outside of the cluster, those with mental illness or other characteristics that hindered interviews were excluded. Relapsed leprosy cases and those who died after diagnosis were also not included.

Data collection

Municipality Health Secretariats were informed by the Tocantins State Health Department about the study and field visits were coordinated for

data collection. The study population was identified through the database of the National Information System for Notifiable Diseases (SINAN). Patients were invited through Community Health Agents to participate in the study and to be interviewed at the local health care center. Home visits accompanied by local Community Health Agents were performed when individuals did not present at the health care center.

Data collection was conducted between September and December 2009. Clinical data were collected from patients' charts. All other variables, including information on migration, were investigated by interview using structured questionnaires. Data collection forms were composed of six groups of variables, and information on migration itself: (1) Socio-demographics (sex, age, marital status, education, employment); (2) Housing/Economic variables (household density, household income, area of residence, utility access; (3) Disease-related variables (clinical form of the disease, operational classification, grade of disability at diagnosis); (4) Health services variables (visits by community health worker, access to health services); (5) Migration variables (length of time at residence, migration before and after diagnosis); and (6) Attitudes and reported practices regarding leprosy and its cure. For detailed information on migration, study participants were asked for the municipality and state of their birth, where they had lived during the five years prior to diagnosis, and whether they had moved after diagnosis.

Data analysis

Bivariate analysis using Fisher's exact test was conducted whereby socio-demographic, economic, clinical, health service-related and attitudes/practices variables were compared between migrants with leprosy and non-migrant residents with leprosy (Table 1). These variables were investigated for their association with three different (migration) outcome variables: (1) migration after birth, defined as municipality of birth different from current municipality of residence; (2) migration during five years prior to leprosy diagnosis; and (3) migration after diagnosis. Migration after birth provided a baseline for any lifetime migration, while migration before diagnosis was limited to the average five year latency period for leprosy onset, which is also the current standard in the Brazilian Census survey and reduces recall bias in the survey. As migrant multi-stage migration was also considered, we allowed for non-exclusivity between the three migration outcomes being investigated in the bivariate analysis.

Odds ratios and their respective 95% confidence intervals (95%CI) were calculated. Theoretically meaningful confounders (age, income, gender and education) were investigated in the bivariate analysis by determining their association ($p < 0.05$) with the three migration variables. Only age was a potential confounder. Income was not associated with the three migration outcomes and education was no longer significant among birth migrants after controlling for age. As internal migration is equally distributed between males and females in Brazil [29], and the sample is also equally distributed between males and females, gender was not believed to present confounding. Additionally, only one of the migration outcomes in the bivariate analysis was significantly associated with gender.

A separate multivariate logistic regression analysis was conducted for each variable found to be significant in bivariate analysis with a p-value < 0.05 controlling for age. Adjusted odds ratios for the association of migration before diagnosis and after diagnosis migration outcomes compared to non-migrant residents were calculated.

Data were entered twice, using Epi Info software version 3.5.1 (Centers for Disease Control and Prevention, Atlanta, USA) and cross-checked for entry-related errors. Shapiro-Wilk test and histograms were used to assess normality. Data analysis was conducted using Stata version 11 (Stata Corp., College Station, USA).

Ethics

The study was approved by the Ethics Research Committee of the Federal University of Ceará (Fortaleza, Brazil) and by the Ethics Research Committee of Lutheran University of Palmas (Palmas, Brazil). Permission to perform the study was also obtained by the Tocantins State Health Secretariat, the State Leprosy Control Program and the municipalities involved. Informed written consent was obtained from study participants after explaining the objectives of the study. To avoid any harm, strict confidentiality was kept, and the diagnosis was not revealed to others, including family members. Interviews were conducted in private. In the case of minors, consent was obtained from a guardian.

Results

The sample was selected from 2,160 individuals diagnosed with leprosy between 2006 and 2008. A total of 1,074 individuals from 79 municipalities were included in the analysis. One municipality did not diagnose any cases of leprosy

Table 1

Bivariate analysis of factors associated with migration before and after leprosy diagnosis *.

	After birth migration				Migration before diagnosis				After diagnosis migration			
	Total ** [n = 1,050]	Positive n (%)	OR (95%CI)	p-value	Total [n = 1,071]	Positive n (%)	OR (95% CI)	p-value	Total ** [n = 1,062]	Positive n (%)	OR (95%CI)	p-value
Socio-demographic variables												
Sex												
Male	545	413 (75.8)	0.95 (0.71-1.28)	0.77	553	102 (18.4)	1.30 (0.93-1.82)	0.12	548	28 (5.1)	2.71 (1.26-6.32)	0.007 ***
Female	505	387 (76.6)	Reference		518	77 (14.9)	Reference		541	10 (2.0)	Reference	
Age groups (years)												
0-14	82	40 (48.8)	Reference		79	8 (10.1)	Reference		80	2 (2.5)	Reference	
15-29	236	135 (57.2)	1.4 (0.82-2.4)	0.20	239	52 (21.8)	2.46 (1.09-6.30)	0.20	237	10 (4.2)	1.72 (0.35-16.44)	0.74
30-44	261	194 (74.3)	3.04 (1.76-5.42)	< 0.0001 ***	269	64 (23.8)	2.77 (1.24 – 7.00)	0.01 ***	267	12 (4.5)	1.84 (0.40-17.21)	0.54
45-59	254	224 (88.2)	7.84 (4.23-14.54)	< 0.0001 ***	257	30 (11.7)	1.17 (0.50-3.10)	0.84	254	12 (4.7)	1.93 (0.42-18.13)	0.53
≥ 60	217	207 (95.4)	21.74 (9.62-51.95)	< 0.0001 *	227	25 (11.0)	1.10 (0.45-2.95)	1.00	224	2 (1.0)	0.35 (0.03-4.94)	0.28
Education												
Illiterate/ Never attended school	231	210 (90.9)	3.86 (2.38-6.53)	< 0.0001 ***	240	37 (15.4)	0.88 (0.58-1.32)	0.56	236	5 (2.1)	0.52 (0.16-1.36)	0.23
Attended school any time	815	588 (72.2)	Reference		827	142 (17.2)	Reference		822	33 (4.0)	Reference	
Work status												
Employed	453	346 (76.4)	Reference		458	79 (17.3)	Reference		455	17 (3.7)	Reference	
Unemployed	155	122 (78.7)	1.14 (0.72-1.84)	0.58	162	28 (17.3)	1.00 (0.60-1.64)	1.00	161	10 (6.2)	1.71 (0.68-4.04)	0.19
Part-time	55	43 (78.2)	1.11 (0.55-2.40)	0.87	55	15 (27.3)	1.80 (0.88-3.52)	0.09	54	4 (7.4)	2.06 (0.48-6.65)	0.26
Retired/ Pensioner	170	160 (94.1)	4.95 (2.50-10.88)	< 0.0001 ***	178	22 (12.4)	0.67 (0.39-1.14)	0.08	174	1 (0.6)	0.15 (0.0-0.97)	0.03 ***
Student/ Housewife/ Others	217	129 (59.5)	0.45 (0.32-0.65)	< 0.0001 *	218	35 (16.1)	0.92 (0.58-1.44)	0.74	218	6 (2.8)	0.73 (0.23-1.97)	0.65

(continues)

Table 1 (continued)

	After birth migration				Migration before diagnosis				After diagnosis migration			
	Total ** [n = 1,050]	Positive n (%)	OR (95%CI)	p-value	Total [n = 1,071]	Positive n (%)	OR (95% CI)	p-value	Total ** [n = 1,062]	Positive n (%)	OR (95%CI)	p-value
Socio-demographic variables												
Farm worker (any time in life)												
Yes	413	351 (85.0)	2.38 (1.71-3.33)	< 0.0001	427	74 (17.3)	1.09 (0.77-1.53)	0.68	423	13 (3.1)	0.80 (0.37-1.66)	0.61
No	629	443 (70.4)	Reference	***	636	103 (16.2)	Reference		632	24 (3.8)	Reference	
Housing- and economic-related variables												
Household monthly income #												
≥ R$ 465,00	736	566 (76.9)	Reference	0.42	298	52 (17.4)	1.06 (0.73-1.53)	0.78	299	12 (4.0)	1.14 (0.52-2.40)	0.72
< R$ 465,00 (≈ US$ 270)	289	215 (74.4)	0.87 (0.63-1.21)		750	124 (16.5)	Reference		741	26 (3.5)	Reference	
Residence area												
Rural/ Settlement	252	194 (77.0)	1.06 (0.75-1.51)	0.80	256	53 (20.7)	1.43 (0.98-2.06)	0.06	256	12 (4.7)	1.47 (0.67-3.08)	0.33
Urban	797	605 (75.9)	Reference		814	126 (15.5)	Reference		805	26 (3.2)	Reference	
Electricity												
No	64	42 (65.6)	0.57 (0.33-1.03)	0.049 ***	64	18 (28.1)	2.05 (1.09-3.72)	0.02 ***	65	3 (4.6)	1.33 (0.25-4.40)	0.42
Yes	985	757 (76.9)	Reference		1006	161 (16.0)	Reference		996	35 (3.5)	Reference	
Public waste collection												
No	291	221 (76.0)	0.98 (0.71-1.37)	0.93	297	64 (21.6)	1.57 (1.11-2.23)	0.01 *	295	14 (4.8)	1.54 (0.73-3.15)	0.20
Yes	758	578 (76.2)	Reference		773	115 (14.9)	Reference		766	24 (3.1)	Reference	
Public sewer system												
No	120	86 (71.7)	0.76 (0.49-1.20)	0.21	123	27 (21.0)	1.47 (0.89-2.37)	0.12	122	4 (3.3)	0.90 (0.23-2.60)	1.00
Yes	929	714 (76.9)	Reference		947	152 (16.1)	Reference		939	34 (3.6)	Reference	
Public water supply												
No	194	150 (77.3)	1.08 (0.74-1.60)	0.71	197	43 (21.8)	1.52 (1.01-2.25)	0.44	196	9 (4.6)	1.39 (0.57-3.08)	0.40
Yes	856	650 (75.9)	Reference		874	136 (15.6)	Reference		866	29 (3.4)	Reference	

(continues)

Table 1 (continued)

	After birth migration				Migration before diagnosis				After diagnosis migration			
	Total ** [n = 1,050]	Positive n (%)	OR (95%CI)	p-value	Total [n = 1,071]	Positive n (%)	OR (95% CI)	p-value	Total ** [n = 1,062]	Positive n (%)	OR (95%CI)	p-value
Housing- and economic-related variables												
Brick/Adobe house construction												
No	192	147 (76.6)	1.03 (0.70-1.52)	0.93	197	44 (22.34)	1.57 (1.05-2.33)	0.03 ***	194	6 (3.1)	0.83 (0.28-2.06)	0.83
Yes	858	653 (76.1)	Reference		874	135 (15.5)	Reference		868	32 (3.7)	Reference	
Number of rooms/ household												
1-2	67	50 (74.6)	0.91 (0.50-1.71)	0.77	67	11 (16.4)	0.97 (0.45-1.93)	1.00	66	1 (1.5)	0.40 (0.0-2.44)	0.51
> 2	980	749 (76.4)	Reference		1,001	168 (16.8)	Reference		993	37 (3.7)	Reference	
Living alone												
1 person	56	52 (92.9)	4.28 (1.55 – 16.44)	0.002*	58	10 (17.2)	1.04 (0.46 – 2.13)	0.86	58	(6.9)	2.11 (0.52-6.23)	0.15
> 1 person	993	747 (75.2)	Reference		1,012	169 (16.7)	Reference		1,003	34 (3.4)	Reference	
Disease-related variables at diagnosis												
Clinical form												
Tuberculoid	182	133 (73.1)	1.04 (0.68-1.61)	0.92	185	29 (15.7)	1.00 (0.58-1.68)	1.0	185	10 (5.4)	1.81 (0.66-4.93)	0.24
Borderline	247	194 (78.5)	1.41 (0.94-2.12)	0.10	255	45(17.7)	1.15 (0.72-1.82)	0.58	255	9 (3.5)	1.16 (0.41-3.22)	0.82
Lepromatous	92	79 (85.9)	2.33 (1.21-4.80)	0.01 ***	94	19 (20.2)	1.36 (0.71-2.51)	0.35	94	2 (2.1)	0.69 (0.07-3.31)	1.00
Indeterminate	324	234 (72.2)	Reference		331	52 (15.7)	Reference		326	10 (3.1)	Reference	
Operational classification												
Multibacillary	416	335 (80.5)	1.54 (1.12-2.11)	0.006 ***	426	79 (18.5)	1.37 (0.96-1.95)	0.07	424	12 (2.8)	0.74 (0.33-1.58)	0.48
Paucibacillary	572	417 (72.9)	Reference		583	83 (14.2)	Reference		579	22 (3.8)	Reference	
Disability grade at diagnosis												
Disability grade II	29	26 (89.7)	2.98 (0.90-15.56)	0.08	30	5 (16.7)	1.20 (0.35-3.28)	0.79	30	0 (0.0)	-	1.00
Disability grade 0 or I	703	523 (74.4)	Reference		719	103 (14.3)	Reference		717	22 (3.1)	Reference	

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Table 1 (continued)

	After birth migration				Migration before diagnosis				After diagnosis migration			
	Total ** [n = 1,050]	Positive n (%)	OR (95%CI)	p-value	Total [n = 1,071]	Positive n (%)	OR (95% CI)	p-value	Total ** [n = 1,062]	Positive n (%)	OR (95%CI)	p-value
Housing- and economic-related variables												
Time from symptom onset and sought diagnosis (months)												
> 6	271	214 (79.0)	1.24 (0.87-1.78)	0.24	276	51 (18.5)	1.16 (0.78-1.69)	0.45	274	11 (4.0)	1.07 (0.47-2.30)	0.85
≤ 6	661	497 (75.2)	Reference		671	110 (16.4)	Reference		667	25 (3.8)	Reference	
Health service-related variables												
Regular home community health worker visit (≤ 1 months)												
No	338	267 (79.0)	1.26 (0.91-1.75)	0.16	345	59 (17.1)	1.04 (0.73-1.48)	0.86	343	15 (4.4)	1.38 (0.66-2.80)	0.38
Yes	712	533 (74.9)	Reference		726	120 (16.5)	Reference		719	23 (3.2)	Reference	
Time to reach the health care centre (minutes)												
> 30	181	137 (75.7)	0.98 (0.66-1.46)	0.92	407	64 (15.7)	0.87 (0.61-1.23)	0.45	189	8 (4.2)	1.21 (0.47-2.77)	0.67
≤ 30	850	647 (76.1)	Reference		647	114 (17.6)	Reference		856	30 (3.5)	Reference	
Difficulty reaching health care center												
Yes	201	158 (78.6)	1.19 (0.81-1.77)	0.41	209	37 (17.7)	1.07 (0.70-1.61)	0.76	207	11 (5.3)	1.70 (0.74-3.60)	0.15
No	835	631 (75.6)	Reference		848	142 (16.8)	Reference		841	27 (3.2)	Reference	
Migration												
Migrant after diagnosis												
Yes	-	-	-	-	38	22 (57.9)	7.87 (3.83-16.38)	< 0.0001 ***	-	-	-	-
No	-	-	-		1,022	152 (14.9)	Reference		-	-	-	
Migrant 5-years prior to diagnosis												
Yes	-	-	-	-	-	-	-	-	174	22 (12.6)	7.87 (3.83-16.38)	< 0.0001 ***
No	-	-	-		-	-	-		886	16 (1.8)	Reference	

(continues)

Table 1 (continued)

	After birth migration				Migration before diagnosis				After diagnosis migration			
	Total ** [n = 1,050]	Positive n (%)	OR (95%CI)	p-value	Total [n = 1,071]	Positive n (%)	OR (95% CI)	p-value	Total ** [n = 1,062]	Positive n (%)	OR (95%CI)	p-value
Health service-related variables												
Time at residence (years)												
0-5	470	349 (74.3)	0.79 (0.56-1.11)	0.18	476	146 (30.7)	25.22 (11.06-70.63)	< 0.0001 ***	469	33 (7.0)	8.70 (2.69-44.64)	< 0.0001 ***
6-10	237	183 (77.2)	0.93 (0.61-1.41)	0.76	245	27 (11.0)	7.06 (2.79-21.2)	< 0.0001 ***	243	2 (0.8)	0.95 (0.8-8.40)	1.00
≥ 11	340	267 (78.5)	Reference		348	6 (1.7)	Reference		348	3 (0.9)	Reference	
Practices and attitudes												
Sought other health service prior to diagnosis												
Yes	-	-	-	-	181	36 (19.9)	1.29 (0.83-1.96)	0.23	179	10 (5.6)	1.80 (0.76-3.90)	0.12
No	-	-	-		886	143 (16.1)	Reference		879	28 (3.2)	Reference	
Hide leprosy diagnosis due of fear of prejudice												
Yes	-	-	-	-	-	-	-	-	1,039	38 (3.7)	-	1.00
No	-	-	-		-	-	-		20	0 (0.0)	Reference	
Different behavior from others after diagnosis												
Yes	-	-	-	-	-	-	-	-	157	3 (1.9)	0.48 (0.09-1.55)	0.35
No	-	-	-		-	-	-		898	35 (3.9)	Reference	

* After birth migration, migration in the five years before leprosy diagnosis and migration after diagnosis;

** Data not available for all individuals;

*** Significant at 95% ($p < 0.05$);

At the time of the survey US$ 1 was equivalent to R$ 1.72, and R$ 465.00 – the official minimum wage as set by the Federal Government.

during the study period, and three municipalities had few cases (n = 12) which were not included due to non-consent or because they could not be located. Of those who were not interviewed, 11 were not confirmed leprosy cases, were unable to attend due to illness/hospitalization, inebriation or incarceration (n = 15), could not be located at the given address (n = 35), were not known at the healthcare center (n = 23), lived in a remote area (n = 23), moved after diagnosis (n = 269), or were otherwise not at home/working/traveling (n = 469). Despite multiple attempts, some did not attend the scheduled interviews (n = 210) and 31 refused to participate. These individuals were excluded from the study.

Of the total 1,074 individuals, 555 (51.7%) were males and 519 (48.3%) females, ranging in age from 5 to 98 years of age (mean = 41.8 year; standard deviation: 19.01). There were 82 children under 15 (7.6%). Nearly half of the individu-

als (514; 47.9%) were working at least part time/in temporary employment, 162 (15.1%) were unemployed, 178 (16.6%) retired and 230 (21.4%) engaged otherwise, most notably as students 127 (11.8%) or housewives 78 (7.3%). About one in five (n = 240, 22.4%) was illiterate and 190 (17.8%) completed a high school education or more. The mean monthly household income was R$ 757 (≈ US$ 440), and nearly one-third (n = 299, 28.5%) were living on less than the minimum monthly wage.

Overall, 426 (42.1%) were classified with multibacillary leprosy at the time of diagnosis, the majority having Grade 0 disability at diagnosis (n = 566, 75.4%), followed by Grade I (n = 155, 20.6%) and Grade II (n = 30, 4.0%). The clinical form of diagnosis was primarily indeterminate (n = 332, 38.3%), followed by borderline (n = 255, 29.5%), tuberculoid (n = 185, 21.4%) and lepromatous leprosy (n = 94, 10.9%).

In terms of migration, 800 (76.2%) individuals interviewed migrated at some point in time after birth; 179 (16.7%) were migrants in the five years prior to diagnosis; and 38 (3.6%) migrated after diagnosis. Children also were among those migrating, and comprised 4.5% of those migrating before diagnosis (n = 8) and 8.5% after diagnosis (n = 19). In total, nearly one fifth (n = 199, 18.6%) of those interviewed lived in a different municipality or state five years prior and/or after diagnosis. Migration in the endemic cluster in Tocantins (43.9%, n = 76) and migration residence in other states (45.1%, n = 78) comprised the majority of population movement before diagnosis. Only 17.3% of migrants resided in non-endemic municipalities in Tocantins during the five years prior to diagnosis. After diagnosis, 73.7% moved within Tocantins, 57.9% to endemic areas of the state. 26% of those who migrated after diagnosis moved to other states.

Factors associated with migration in the five years before diagnosis

In bivariate analysis age (30-44), poverty, and residence of 10 years or less were associated with migration before diagnosis with leprosy (Table 1).

Logistic regression, controlling for age, identified poverty and clinical variables associated with migration before diagnosis with leprosy. The migrants were more likely to lack access to electricity, public water, and waste management, all indicators of poverty in Brazil. Migrants were also significantly less likely to live in a brick home compared to non-migrant residents, with significantly less time living in their current place of residence (10 years or less). Migrants before diagnosis were also more likely to have multibacillary form of leprosy compared to non-migrant residents with leprosy (Table 2).

Factors associated with migration after diagnosis

After diagnosis, residence in the current household of five years or less and before diagnosis migration was associated with migration (Table 1).

Migration after diagnosis was associated with key demographic factors after adjusting for age (Table 3). Males were more likely to migrate than females. Also, residence at current household of five years or less and before diagnosis migration was significantly associated with migration.

Table 2

Adjusted odds ratios (OR) of factors significantly associated with before diagnosis migration compared to non-migrant residents with leprosy, controlling for age.

	Before diagnosis migration	
	Adjusted OR (95%CI)	p-value
Socio-demographic variables		
No public water	1.65 (1.12-2.43)	0.012 *
No trash service	1.70 (1.2-2.41)	0.003 *
Living in a non-brick home	1.57 (1.01-2.32)	0.022 *
Diagnosis multibacillary	1.55 (1.09-2.19)	0.014 *
Migration variables		
Years at current residence 0-5 years	23.38 (10.1-54.09)	< 0.0001 *
Years at current residence 6-10 years	6.77 (2.73-16.75)	< 0.0001 *

* Significant at 95% (p < 0.05)

Table 3

Adjusted odds ratios (OR) of factors significantly associated with after diagnosis migration compared to non-migrant residents with leprosy, controlling for age.

	After diagnosis migration	
	Adjusted OR (95% CI)	p-value
Socio-demographic variables		
Male sex	2.87 (1.38-5.99)	0.005 *
Migration variables		
Before diagnosis migration	7.74 (3.89-15.37)	< 0.0001 *
Years at current residence 0-5 years	8.69 (2.57-29.32)	< 0.0001 *

* Significant at 95% (p < 0.05).

Discussion

Migration can complicate disease control when infected and susceptible people move between endemic and non-endemic areas. Environmental and social factors can influence migration, while health outcomes can be affected by the conditions at locations where movements take place.

In this study, many socio-demographic, clinical, health service and migration variables were investigated. After adjusting for age, a confounding factor for leprosy and migration, key demographics, poverty, factors associated with migration, and multibacillary form of leprosy remained significant for those who migrated before leprosy diagnosis, while only factors related to migration remained associated after diagnosis. Contrary to our expectations, migrant accounts of health service access and stigma did not appear to be associated with migration, although advanced disease expression indicated a delay in diagnosis.

A culture of migration was observed among those affected by leprosy in Tocantins, with more than three-quarters having migrated at some stage in their lives and nearly one-fifth within the last five years. We also found that after diagnosis migration was significantly associated with prior migration, consistent with findings in other studies [30]. Migration can additionally place resident populations at risk, and in Brazil migration has been considered as a possible explanation for diseases, such as leishmaniasis, schistosomiasis and Chagas disease, that have moved into previously non-endemic areas [5,7,8,9,10]. We found that much of the migration in the five years prior to diagnosis was within the endemic cluster in Tocantins and also other states, primarily neighboring Maranhão and Pará. From Maranhão, migration was largely from Imperatriz, while in Pará State, Conceição do Araguaia and São Geraldo were principal sites of prior residence. These three municipalities are located in hyperendemic areas for leprosy [26]. Considerably fewer migrants resided in municipalities in Tocantins outside of the endemic cluster during the five years prior to diagnosis. The majority of after diagnosis migrants moved to other endemic areas in Tocantins. Presence of leprosy among children who migrated highlights active transmission in these regions.

Key demographics

Migration is most often associated with the movement of young adults, typically males between the ages of 20 and 35, who migrate for employment [14,19,30,31]. We found that migration of leprosy-affected individuals was significantly associated with being male after diagnosis, and overall, migrants were slightly older than the younger age-set typical of migration globally. This age pattern is consistent with population movement in Brazil [17]. Migration increased with age and dropped only slightly among those aged 60 or older. Migration of the older age groups may be the result of historical population movements in the Northeast region from rural areas to urban centers due to industrialization [32] and periods of severe drought [33]. This trend has continued into recent decades and may be a factor hindering disease control [8,34]. This historic population movement has contributed to poor sanitation and overcrowding in areas of uncontrolled urbanization in Brazil.

Nearly half of those with leprosy were employed regardless of whether they were migrants or non-migrant residents. This indicates that stigma as a result of leprosy does not appear to be a significant factor for securing employment. In a previous study, stigma was also found to be an insignificant factor in changing residence [35] and was a minor issue in therapy interruption [36].

Poverty

NTDs are known to be associated with low socioeconomic status, often resulting in poor health [2]. While migration typically provides an opportunity to lift individuals out of poverty over time [20], the initial decision to migrate is often a strategy to mitigate poverty, and migration also supplements income at critical moments [16,18,20,30]. Unfortunately, these decisions can have further repercussions, negatively affecting health as result of poor housing, sanitation and other socio-environmental conditions [2] closely associated with poverty.

While low household income was not specifically associated with migration among leprosy-affected individuals in Tocantins, indirect indicators of poverty were associated with migration in this study. This was particularly relevant for those who migrated prior to diagnosis compared to non-migrant residents with leprosy. Absence of trash collection and access to public water, or not living in a house made of brick were all associated with those who migrated in the five years before diagnosis. Previous studies have found that non-migrants typically have a higher socioeconomic status than migrants [37,38]. Thus, migrants and non-migrant residents with leprosy might be exposed to low socioeconomic levels and poor living standards differentially.

Migration after diagnosis had no association with indicators of poverty. Socioeconomic factors influence the initial decision to migrate, and these variables may change once migration has taken place [30]. Although our study only considered socioeconomic variables and utility access after leprosy diagnosis, access to better amenities, such as electricity, has been associated with a reduction in further migration [19].

Migration, leprosy and healthcare access

In Brazil, the most prominent form of leprosy is borderline (41.5%), followed by lepromatous (23.2%), tuberculoid (19.6%) and indeterminate (15.6%) leprosy [39]. A quarter of leprosy cases in Brazil in 2010 were classified as multibacillary [40], which includes midborderline, borderline lepromatous, and lepromatous forms of leprosy. In Tocantins, before diagnosis migration was associated with the more severe multibacillary classification. Multibacillary has a high risk of transmission [23,41], while paucibacillary forms have a low transmission risk among those in close contact with individuals with leprosy [42]. The odds of multibacillary among before diagnosis migrants were 1.5 times higher than non-migrant residents with leprosy. Access to early diagnosis may in fact be a consideration for this group.

While poor access to health services has been found to be a motivating factor for migration [11], our findings show minimal after diagnosis migration. This is perhaps a response to the need to maintain treatment at the place of diagnosis, within primary health care. Another study of the same population found that lifestyle changes (home ownership, family, better living/neighborhood conditions) were the primary reasons for changing residences, with less than 5% moving for the purpose of seeking diagnosis or treatment [35]. The decentralization of health services for leprosy diagnosis and treatment to community health centers throughout Brazil has likely played an important role in this regard.

There was no significant difference in the time from symptom onset to diagnosis among migrants in Tocantins compared to non-migrants. While there is some speculation that migrants are less likely to use health facilities [43], other research has shown that availability of health services even among the displaced, has contributed to improved health [44]. Health services were sought by up to a fifth of those that migrated prior to diagnosis and by a quarter of those who migrated after diagnosis, yet migrants did not have significantly more difficulty in accessing health centers or community health workers than non-migrants. Despite this positive information, the prevalence of advanced multibacillary leprosy among those who migrated in the five years prior to diagnosis suggests a delay in diagnosis or poor knowledge of symptoms associated with leprosy. Given the progressive evolution of multibacillary leprosy, lack of access to health care and poor attention to infection could occur over multiple movements.

Limitations

Like many other cross-sectional studies, our study is subject to several limitations. First, the cross-sectional design made causal and temporal relationships difficult to establish. Migration may cause certain behaviors/characteristics, and also be caused by these same variables. For this reason, we focused on associations rather than causes in the analysis and discussion of data.

Despite being a population-based study in a hyperendemic area, we only included in-migrants to municipalities. Anyone moving outside of the cluster during the defined study period was excluded, which limited additional knowledge in regards to after diagnosis migration.

This study was performed in 79 municipalities with a broad geographical range. While this increases the representativeness of our findings, approximately 50% of the population could not be reached. Many individuals were not encountered even after multiple home visits or did not attend scheduled interviews. Some individuals moved to another city outside the cluster. Incomplete patients' charts and subsequent missing data hampered analysis in some cases. Non-participation bias may have played a role. We aimed at reducing bias by rigorously planning field visits and integrating local primary health care professionals and the State and Municipal Leprosy Control Programs during field work for the present study.

A final limitation is that socioeconomic data were collected after migration. Other researchers have noted the difficulty in differentiating between migrant and non-migrant households because socioeconomic factors may influence the decision to migrate, and these same variables may change once migration has taken place [31]. In addition, current economic conditions do not account for latency in leprosy, which can manifest up to decades after exposure.

Conclusions

This is the first major systematic study exploring migration in leprosy-affected individuals. In this population in a highly endemic area, factors associated with poverty were associated with migration.

Attention to reaching possibly infected and highly mobile populations in Brazil should be a focus to prevent further transmission of the disease and development of disabilities among those infected. This is particularly important in endemic states, with high in- and between- municipality migration, such as Tocantins. Attention to low-income rural areas should take into account difficulties with transportation. Ease of healthcare access provides the opportunity to reduce disability and increase leprosy control.

Newly emerging trends of circular migration provide an opportunity to investigate these patterns and their relationship to disease transmission and migration flow between community of origin and destination and should be considered for future studies.

Resumen

Este estudio investiga los factores sociales y clínicos asociados con la migración entre las personas afectadas por lepra. Un estudio transversal se llevó a cabo entre las personas recién diagnosticadas con lepra (2006-2008), en 79 municipios endémicos en el estado de Tocantins, Brasil (N = 1,074). En total, el 76,2% nacieron en otro municipio diferente a su residencia actual. En los cinco años antes del diagnóstico el 16,7% emigró, y el 3,6% migró después del diagnóstico de lepra. Los resultados reflejan aspectos relacionados con el movimiento histórico de la población rural-urbana en Brasil. Los indicadores de pobreza fueron sobresalientes entre el grupo de migrantes antes del diagnóstico. La migración tras el diagnóstico se asoció a una migración anterior. La asociación de lepra multibacilar con migración indica que el acceso a la atención médica puede ser un obstáculo para el diagnóstico temprano en el grupo de migrantes antes de la migración.

Migración Interna; Lepra; Pobreza

Contributors

C. Murto contributed with analysis and interpretation of data; drafting the article; revision of the article for important intellectual content; and final approval of the version to be published. L. Ariza contributed to the conception and design, acquisition of data; analysis and interpretation of data; revision of the article for important intellectual content; and final approval of the version to be published. C. H. Alencar contributed to the conception and design, acquisition of data; revision of the article for important intellectual content; and final approval of the version to be published. O. A. Chichava contributed to conception and design, acquisition of data; revision of the article for important intellectual content; and final approval of the version to be published. A. R. Oliveira contributed to conception and design, data entry; revision of the article for important intellectual content; and final approval of the version to be published. C. Kaplan contributed to the conception, data analysis, and writing of the paper. L. F. M. Silva contributed to conception and design; revision of the article for important intellectual content; and final approval of the version to be published. J. Heukelbach contributed to conception and design, acquisition of data; revision of the article for important intellectual content; and final approval of the version to be published.

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