Hospital Morbidity among Guarani Indians in Southeastern and Southern Brazil*

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Abstract

Studies on hospital morbidity among Brazilian indigenous peoples are relatively recent, show limited coverage, and lack data sources capable of generating specific indicators according to ethnic group. The current study describes hospital morbidity in the indigenous population living in 83 Guarani villages in Southern and Southeastern Brazil (N=6,483), based on primary data obtained from a hospital admissions surveillance system implemented in 2007-2008, specifically for a case-control study on acute respiratory infections (ARI) in Guarani children. During the study period there were 666 hospitalizations in a total of 497 individuals, the majority under 5 years of age (71.9%). Respiratory illnesses were the main causes of hospitalization (64.6%), especially in children (<5 years: 77.6%; <1 year: 83.4%) and exceeded the proportions of hospital admissions from these causes in other indigenous groups. The overall hospitalization rate (per 100 person-years) was 8.8, or 71.4 under 1 year and 21.0 from 1 to 4 years of age. The ARI hospitalization rate (5.3) was 6.5 and 2.0 times higher than for diarrhea and other causes, respectively, while in children under 5 years of age (ARI=23.7) these differences were 7.4 and 5.4 times, respectively. The standardized Guarani hospitalization rate exceeded the standardized rates for the South and Southeast of Brazil by 40% and 210%, respectively. Hospitalization for primary care sensitive conditions and the high ARI rates indicate the need for studies to understand the epidemiology of ARI and investments to upgrade primary health care for the Guarani.

Key words: Hospitalization. Morbidity. Indians. Respiratory Infection. Pneumonia. Brazil.

INTRODUCTION

Studies on hospital morbidity represent important tools for understanding the epidemiological profile of population groups, since they contribute to the evaluation of the severity of diseases, surveillance and control of diseases, analysis of access to and utilization of health services, and health planning[1-3]. More recently, analysis of the avoidable causes of hospitalization have backed the discussion on access and quality in primary health care[3].

Studies on hospital morbidity in indigenous peoples in Brazil are relatively recent and have limited coverage[4-6]. However, the few available studies have shown morbidity and mortality patterns among indigenous peoples that are consistent with those observed among the country's most vulnerable social segments, generally with low schooling, inadequate housing and sanitation, and difficulties in access to health services [4-9].

The analysis of hospital morbidity among indigenous peoples in Brazil entails additional difficulties besides those already documented[1,2,10-12]. It is not possible to retrieve information on ethnicity from the Hospital Information System of the Unified National Health System (SIH/SUS). Meanwhile, the Information System on Health Care for Indigenous Peoples (SIASI), managed by the National Health Foundation (FUNASA) under the Ministry of Health, presents limitations as to coverage and data quality[13]. It thus becomes obvious that studies on hospital morbidity in indigenous peoples lack adequate sources for description, and that adapted data collection strategies are necessary to determine the profile of indigenous hospitalizations in each specific case[4-6].

This article describes hospital morbidity in the Guarani population living in 83 villages, based on primary data obtained from an indigenous hospital admissions surveillance system implemented specifically for a case-control study on etiological factors in acute respiratory infections (ARI) in Guarani children hospitalized in Southern and Southeastern Brazil. Based on these indicators, the leading causes of hospitalization were identified, as well as the segments of the Guarani population most vulnerable to hospitalization.

STUDY POPULATION AND METHODS

A primary descriptive hospital morbidity study was conducted in the Guarani indigenous population served by FUNASA and living in 83 villages and camps in Southern and Southeastern Brazil, distributed by State as follows: Rio Grande do Sul (32), Santa Catarina (16), Paraná (4), São Paulo (27), and Rio de Janeiro (5). This distribution represents the series of Guarani villages located on the coastal area extending from Rio de Janeiro to Rio Grande do Sul[14], plus the 9 Guarani villages in the interior of Rio Grande do Sul State. In general, Guarani families are large and live in a situation of vulnerability marked by precarious environmental, socioeconomic, and housing conditions. A hospital admissions surveillance system among the Guarani people was implemented, coordinated by one of the researchers and led by a team of nurses from FUNASA appropriately trained during two workshops held in Rio de Janeiro, with a pilot field test in between. A routine surveillance system was established, aimed at monthly reporting of hospitalizations for all causes and ages. Systematic visits were made to the nurses in charge of reporting, the villages, and the hospitals serving the Guarani, in order to check the data and review patient charts. This process produced a primary databank of hospitalizations for the Guarani population in the study area.

The data from the current study's description are from this hospital admissions surveillance system, implemented in the 83 villages from May 1, 2007, to June 30, 2008. "Hospitalization" was defined as in-hospital patient care ≥ 24 hours. Causes of hospital morbidity were defined as the diagnostic hypotheses recorded locally by

the FUNASA health teams. The causes were classified by one of the authors (Cardoso) according to the ICD-10[15]. When there was more than one diagnosis, classification of the principal cause was defined in light of the primary reason for hospitalization and ICD-10 guidelines. Patient transfers between associated hospital units for a single disease episode were computed as a single hospitalization, as were re-hospitalizations of the same individual for the same event.

The population denominator needed to calculate the overall and sex, age, and cause-specific rates was based on the total Guarani population living in the study area in mid-period, according to information provided by the local FUNASA health teams. Hospitalizations were considered numerators for the rates and denominators for the global and age, sex, and cause-specific proportions (ICD Chapters and Special Tabulation List for Morbidity - ICD 10). The rates were also calculated, considering as the numerator the individuals that underwent at least one hospitalization during the period. Given the seasonality of some illnesses, rates were calculated initially by eliminating the hospitalizations that occurred in the first two or last two months (which were repeated during the 14-month study period). We finally elected to calculate the rates for the entire 14-month period, subsequently transformed into annual rates, since this was the approach that considered all the hospitalizations and that produced rates equivalent to the lowest rates, obtained by excluding the repeated months, in which the highest incidence of hospitalization was observed[16].

The Guarani hospital morbidity indicators were produced by comparison of the proportions of hospitalizations and by rate ratios between the age, sex, and cause brackets. The indicators were also compared to those for the regions of Brazil (after rates standardization by the direct method, using the 2006 Brazilian population as the reference) and those produced in other studies focusing on indigenous and non-indigenous Brazilian populations.

ETHICAL APPROVAL

The research project was approved by the District Indigenous Health Council for the Southern Coast, the Institutional Review Board of the National School of Public Health (ENSP/FIOCRUZ, Review no. 130/05), and the National Research Ethics Commission (CONEP, Review no. 154/2006). The indigenous leaders of the villages were contacted in order to explain the research project to them and obtain properly signed Free and Informed Consent Forms. The project was also authorized by the National Foundation for Indian Affairs (Authorization no. 23/CGEP/07).

RESULTS

Among the villages that were invited to participate, 98.8% entered the study (there was only one refusal, on the coast of São Paulo). In December 2007 there were 6,483 indigenous people living in the 83 villages, and during the study period there were 780 hospitalizations of 608 Guarani individuals. After excluding 5 hospitalizations (0.6%) due to lack of information on sex, age, and cause and 109 in-hospital deliveries (14%), 666 hospitalizations of 497 individuals remained for analysis. The overall hospitalization rate in 14 months was 12.0/100 persons, and after the above-mentioned exclusions it was 10.3/100 persons (or 8.8/100 person-years).

Of the hospitalized persons, 96 (19.3%) underwent more than one hospitalization during the period, and no differences were observed between the sexes in the proportions of re-hospitalizations (M: 25.5%, F: 25.3%; p=0.96). The number of hospitalizations per person varied by 1 to 8 times, and the re-hospitalization rate was inversely related to age (Table 1). A high proportion of hospitalizations occurred in children under 5 years of age (71.9%), with nearly half of these under 1 year of age (46.8%). Diseases of the respiratory system (Chapter X) were the main causes of multiple hospitalizations in a single individual. Among the respiratory causes, the proportion of pneumonia cases

increased progressively in the subsequent hospitalizations (data not shown).

Ill-defined causes (Chapter XVIII) accounted for 4.2% of all hospitalizations, with a predominance of females (M: 1.9% and F: 6.3%; p=0.004) and individuals over 10 years of age (≤ 10 years: 1.7% and >10 years: 13.3%; p=0.000), and 1.3% of hospitalizations under 5 years of age. After excluding Chapter XVIII, the hospitalizations were ordered by decreasing frequency according to age bracket and causes (Table 2). Overall and under 5 years of age, there was a progressive reduction in the number of hospitalizations with increasing age. Diseases of the respiratory tract were the most important causes of hospitalization, accounting for 64.6% of all hospitalizations and 77.6% under 5 years of age.

Hospitalizations were more frequent in females (M: 9.4%, F: 11.2%; p=0.02). The proportion of hospitalizations due to respiratory diseases was inversely related to age, appearing as the leading cause of hospitalization up to 9 years of age and over 50 years in both sexes. Endocrine, nutritional, and metabolic causes (Chapter IV) were important under 1 year of age. External causes (Chapter XIX) appeared between 1 and 4 years and increased with age, becoming the leading cause of hospitalization in males starting at 10 years. Among females, causes related to pregnancy, childbirth, and the puerperium (Chapter XV) assumed greater importance starting at 15 years. Among males over 20 years of age, mental and behavioral disorders (Chapter V) became more frequent and were the third leading cause in the over-50-year group. The latter age bracket also included diseases of the circulatory system (Chapter IX), while diseases of the digestive system were an important cause among women (Chapter XI) (data not shown).

In the analysis according to the Special Tabulation List for Morbidity[15] for children under 5 years (Table 2), pneumonia accounted for 56.7% of hospitalizations, followed by unspecified acute lower respiratory infections (15.2%) and gastroenteritis (10.4%). Pneumonia accounted for at least half of the hospitalizations in all the age groups under 5 years. Among the respiratory causes of hospitalization under 5 years of age, pneumonias reached proportions of 70% or more; when unspecified acute lower respiratory infections were added, the total reached 90% in practically all the age groups (data not shown).

The Guarani show a higher standardized

Table 1 - Absolute number and proportions of hospitalizations by age groups, according to order of hospitalizations, Guarani Indians, Southeastern and Southern Brazil, 2007-2008.

AGE BRACKET	HOSPITALIZATIONS IN ORDER								TOTAL	
	1st	2nd	3rd	4th	5th	6th	7th	8th		
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	% cum.
< 1 year	151 (30,4)	41 (42,7)	20 (50,0)	9 (47,4)	3 (37,5)	–	–	–	224 (33,6)	33,6
1 year	81 (16,3)	28 (29,2)	13 (32,5)	6 (31,6)	4 (50,0)	4 (100,0)	1 (100,0)	1 (100,0)	138 (20,7)	54,3
2 years	44 (8,9)	6 (6,3)	4 (10,0)	3 (15,8)	1 (12,5)	–	–	–	58 (8,7)	63,0
3 years	35 (7,0)	4 (4,2)	1 (2,5)	–	–	–	–	–	40 (6,0)	69,0
4 years	18 (3,6)	1 (1,0)	–	–	–	–	–	–	19 (2,9)	71,9
5-9 years	40 (8,0)	3 (3,1)	–	–	–	–	–	–	43 (6,5)	78,4
10-14 years	20 (4,0)	1 (1,0)	–	–	–	–	–	–	21 (3,2)	81,6
15-19 years	15 (3,0)	3 (3,1)	–	–	–	–	–	–	18 (2,7)	84,3
20-49 years	54 (10,9)	4 (4,2)	2 (5,0)	1 (5,3)	–	–	–	–	61 (9,2)	93,5
50 + years	39 (7,8)	5 (5,2)	–	–	–	–	–	–	44 (6,6)	100,0
TOTAL	497 (100,0)	96 (100,0)	40 (100,0)	19 (100,0)	8 (100,0)	4 (100,0)	1 (100,0)	1 (100,0)	666 (100,0)	–

hospitalization rates than all the regions of Brazil (Table 3). The overall annual hospitalization rate was 8.8/100 persons (Table 4). The age-specific rates were 71.4/100 child-years under 1 year and 21.0/100 child-years from 1 to 4 years of age, dropping off drastically beginning at that age until reaching 50 years, when they increase again. The sex-specific hospitalization rates were significantly higher among females for all hospitalizations (rate ratio: 1.2; 95%CI: 1.01-1.40) and for the 1 to 4-year group (rate ratio: 1.3; 95%CI: 1.02-1.73) and 15 to 19-year group (rate ratio: 4.4; 96%CI: 1.46-13.55).

The specific hospitalization rates for ARI exceeded those due to diarrhea and other causes (Table 4). The rate ratios for specific causes were higher in children under 5 years of age. The ARI rates were higher in girls from 1 to 4 years of age (rate ratio: 1.5; 95%CI: 1.08-2.03) and slightly higher in boys under 1 year (rate ratio: 1.1; 95%CI: 0.82-1.52), although without statistical significance. As for rates due to other causes, there was a significantly higher rate among females in the 15 to 19-year group (rate ratio:

Table 2 - Principal causes of hospitalization (ICD 10) according to age groups, Guarani Indians, Southeastern and Southern Brazil, 2007-2008.

CLASSIFICATION CRITERIA	AGE GROUPS	CAUSES OF HOSPITALIZATION											Proportion of hospitalizations by age bracket		
		1st cause			2nd cause			3rd cause			Other causes				
		Chap./ Category	n	%	Chap./ Category	n	%	Chap./ Category	n	%	n	%	n	%	% cum.
ICD10 CHAPTERS	Overall	X-Respiratory	412	64,6	I-Infectious	72	11,3	XIX-External	36	6,0	118	18,5	638	100,0	-
	< 5 years	X-Respiratory	367	77,6	I-Infectious	52	11,0	XII-Skin	**21**	**4,4**	**33**	**7,0**	**473**	**74,1**	**74,1**
	< 1 year	X-Respiratory	186	83,0	I-Infectious	18	8,0	IV-Endocrine/ nutritional	4	1,8	15	6,7	223	47,1	47,1
	12-23 month	X-Respiratory	99	72,3	I-Infectious	22	16,1	XII-Skin	5	3,6	11	8,0	137	29,0	76,1
	24-35 months	X-Respiratory	43	76,8	I-Infectious	9	16,1	IV-Endocrine/ nutritional	2	3,6	2	3,6	56	11,8	87,9
	36-47 months	X-Respiratory	29	74,4	XII-Skin	6	15,4	I-Infectious	1	2,6	3	7,7	39	8,3	96,2
	48-59 months	X-Respiratory	10	55,6	XII-Skin	4	22,2	I-Infectious	2	11,1	2	11,1	18	3,8	100,0
	1-4 years	X-Respiratory	181	71,8	I-Infectious	34	13,5	XII-Skin	17	6,7	20	7,9	252	53,3	-
	5-9 years	X-Respiratory	17	44,7	I-Infectious	6	15,8	XII-Skin	5	13,2	10	26,3	38	6,0	80,5
	10-14 years	XIX-External	7	36,8	I-Infectious	3	15,8	XI-Digestive	2	10,5	7	36,8	19	3,0	83,4
	15-19 years	X-Respiratory	3	25,0	XV-Childirth/ Postpartum	3	25,0	XIX-External	3	25,0	3	25,0	12	1,9	85,3
	20-49 years	XIX-External	13	24,1	X-Respiratory	7	13,0	I-Infectious	6	11,1	28	51,9	54	8,5	93,8
	50 + years	X-Respiratory	17	42,5	I-Infectious	4	10,0	IX-Circulatory	4	10,0	15	37,5	40	6,3	100,0
SPECIAL TABULATION LIST OF MORBIDITY, ICD10	< 5 years	PNM	268	56,7	UALRI	72	15,2	GE	**49**	**10,4**	**84**	**17,8**	**473**	**100,0**	**-**
	< 1 year	*PNM*	131	58,7	*UALRI*	44	*19,7*	*GE*	17	*7,6*	*31*	*13,9*	223	47,1	47,1
	12-23 months	PNM	76	55,5	GE	21	15,3	UALRI	16	11,7	24	17,5	137	29,0	76,1
	24-35 months	PNM	32	57,1	GE	8	14,3	UALRI	7	12,5	9	16,1	56	11,8	87,9
	36-47 months	PNM	20	51,3	BR	5	12,8	I. SKIN	5	12,8	9	23,1	39	8,3	96,2
	48-59 months	PNM	9	50,0	I. SKIN	4	22,2	GE	2	11,1	3	16,7	18	3,8	100,0

Notes: 1. Chapter XVIII excluded; 2. The acronyms correspond to the following categories from the Special List and ICD-10 codes: PNM-pneumonia (169=J12-J18); UALRI unspecified acute lower respiratory infection (179=J22); GE–Gastroenteritis (5=A09); BR–Acute bronchitis and bronchiolitis (170=J20-J21); SKIN I. –Infections of the skin and subcutaneous tissue (198=L00-L08).

5.7; 95%CI: 1.54-20.91) and 20 to 49-year group (rate ratio: 1.9; 95%CI: 1.03-3.64).

Considering individuals hospitalized at least once as the numerator, the annual hospitalization rate under 5 years of age drops to 21.5/100 child-years, with 48.1/100 child-years as the rate under 1 year (Table 4). The age-specific rates are still higher under 5 years of age, but the differences between the sexes in all-cause hospitalization rates only persists in the 15 to 19-year age bracket (rate ratio: 5.7; 95%CI: 1.54-20.91).

Secondary diagnoses were recorded in 22.4% of the hospitalizations. Respiratory causes (bronchospasm, bronchitis, bronchiolitis, and asthma) were the most frequent, while their proportions decreased with age, from 48.3% under 1 year to 6.7% starting at 5 years. Other important secondary diagnoses included iron deficiency anemia (Chapter III: 13.8%) under 1 year; malnutrition and dehydration (Chapter IV: 23.6%) and diarrhea and septicemia (Chapter I: 16.7%) from 1 to 4 years; as well as nonspecific signs and symptoms (Chapter XVIII: 22.2%) and external causes (Chapter XX: 37.8%) in adults (data not shown).

DISCUSSION AND CONCLUSIONS

Given the relative lack of adequate data sources on indigenous peoples' health in Brazil, various methodologies have been employed and great effort is necessary to provide knowledge on this population segment's hospital morbidity profile. Some recent studies[4-6] have used manual searches of hospitalizations in indigenous individuals in the respective referral hospitals, by identifying the ethnic group (which in many Brazilian indigenous groups is combined with the individual's first name)[4]. Some of these studies[4,5] also used Hospital Admission Authorization Forms (AIH).

Among the Guarani, a manual search for hospital admissions through hospital records is basically unfeasible for various reasons: lack of various referral flows, including clearly established referral procedures to higher levels of complexity in the National Health System (SUS) outside the villages; and the broad territorial distribution of the villages included in the study, resulting in a huge number of possible hospital units to be visited in the five States of the South and Southeast. In addition, unlike some other indigenous groups in Brazil, the Guarani do not use their ethnic name added to their first name, which greatly hinders any manual search for names in hospital records.

In addition to the well-known limitations of the Hospital Information System of the Unified National Health System (SIH/SUS) for describing hospital morbidity in the general population, utilization of the database also suffers from serious limitations for analyzing hospital morbidity in specific ethnic groups, since its race/color classifi-

Table 3 - Comparison of standardized hospitalization rates between Guarani Indians from Southeastern and Southern Brazil and the general Brazilian population, according to regions, 2007-2008.

Regions of Brazil	Standardized Rates (per 100 person-years)			Standardized Rate Ratios (Guarani/other)		
	Male	Female	Overall	Male RR	Female RR	Overall RR
Southeast	2,8	3,0	2,9	2,9	3,2	3,1
Northeast	4,5	5,7	5,1	1,8	1,7	1,7
Brazil	4,8	5,5	5,2	1,7	1,7	1,7
Northeast	4,7	6,1	5,4	1,7	1,6	1,6
Central West	5,4	6,4	5,9	1,5	1,5	1,5
South	5,9	6,3	6,1	1,4	1,5	1,4
Guarani South-Southeast	8,1	9,6	8,8	1,0	1,0	1,0

Notes: 1 – Reference population: Brazil, 2006 (DATASUS); 2 – data refer to hospitalizations in Guarani Indians and in the general Brazilian population from May 1, 2007, to June 30, 2008, converted to annual rates; 3 – Childbirth excluded.

cation lacks details on ethnic affiliation and is thus insufficient for distinguishing individuals that belong to a specific ethnic group[4].

Notwithstanding the advantages and limitations of methodologies to describe hospital morbidity, the method used in this study has the advantage of allowing the potential retrieval of all hospital admissions occurring in the study population, clearly identifying the population denominator for producing the hospitalization rates, not duplicating admissions, and minimizing distortions of diagnoses related to financing procedures in the National Health System.

Hospital morbidity is considered an important tool for health services evaluation

Table 4 - All-cause and specific cause-related annual hospitalization rates and rate ratios according to sex and age groups, Guarani Indians, Southeastern and Southern Brazil, 2007-2008.

SEX AND AGE BRACKET	POPULATION	HOSPITALIZATIONS									HOSPITALIZED PERSONS	
		OVERALL RATE (100person-years)		SPECIFIC RATES (100person-years)				RATE RATIOS (95%CI)			OVERALL RATE (100person-years)	
	N (%)	n	Rate	ARI	Diarrhea	Other Causes	ARI/ Diarrhea	95%CI	ARI/ Other causes	95%CI	n	Rate
MALE												
< 5 years	711 (21,0)	242	29,2	21,8	3,1	4,2	7,0	(4,85-10,20)	5,2	(3,52-7,66)	170	20,5
< 1 year	139 (4,1)	120	74,0	61,7	5,5	6,8	11,2	(5,44-23,14)	9,1	(4,69-17,55)	84	51,8
1-4 years	572 (16,9)	122	18,3	12,1	2,5	3,6	4,8	(2,76-8,49)	3,4	(2,06-5,47)	86	12,9
5-9 years	614 (18,2)	17	2,4	1,1	–	1,3	–	–	0,8	(0,32-2,26)	15	2,1
10-14 years	449 (13,3)	8	1,5	–	–	1,5	–	–	–	–	7	1,3
15-19 years	403 (11,9)	4	0,9	0,2	–	0,6	–	–	0,3	(0,04-2,74)	3	0,6
20-49 years	939 (27,8)	23	2,1	0,3	0,4	1,5	0,8	(0,18-3,11)	0,2	(0,06-0,67)	21	1,9
50 + years	262 (7,8)	24	7,9	1,3	0,7	5,9	1,9	(0,37-9,33)	0,2	(0,07-0,67)	21	6,9
TOTAL	3378 (100,0)	318	8,1	5,0	0,8	2,3	6,3	(4,18-9,36)	2,2	(1,66-2,84)	237	6,0
FEMALE												
< 5 years	600 (19,3)	237	33,9	26,0	3,3	4,6	7,9	(4,96-12,52)	5,7	(3,78-8,45)	159	22,7
< 1 years	130 (4,2)	104	68,6	55,4	5,3	7,9	10,4	(4,87-22,42)	7,0	(3,69-13,33)	67	44,2
1-4 years	470 (15,1)	133	24,3	17,9	2,7	3,6	6,6	(3,70-11,86)	5,0	(2,97-8,33)	92	16,8
5-9 years	575 (18,5)	26	3,9	1,3	0,6	1,9	2,2	(0,65-7,21)	0,7	(0,28-1,68)	25	3,7
10-14 years	430 (13,8)	13	2,6	0,2	–	2,4	–	–	0,1	(0,01-0,55)	13	2,6
15-19 years	303 (9,8)	14	4,0	0,6	–	3,4	–	–	0,2	(0,04-0,75)	12	3,4
20-49 years	946 (30,5)	38	3,4	0,4	0,2	2,9	2,0	(0,41-9,68)	0,1	(0,05-0,39)	33	3,0
50 + years	251 (8,1)	20	6,8	2,7	0,3	3,8	9,0	(1,19-67,82)	0,7	(0,28-1,83)	18	6,1
TOTAL	3105 (100,0)	348	9,6	5,7	0,8	3,1	7,1	(4,70-10,81)	1,8	(1,44-2,36)	260	7,2
OVERALL												
< 5 years	1311 (20,2)	479	31,3	23,7	3,2	4,4	7,4	(5,31-10,33)	5,4	(4,07-7,13)	329	21,5
< 1 year	269 (4,1)	224	71,4	58,6	5,4	7,3	10,8	(6,38-18,46)	8,0	(5,04-12,78)	151	48,1
1-4 years	1042 (16,1)	255	21,0	14,7	2,6	3,6	5,7	(3,77-8,48)	4,1	(2,86-5,82)	178	14,6
5-9 years	1189 (18,3)	43	3,1	1,2	0,3	1,6	4,0	(1,33-12,06)	0,7	(0,38-1,47)	40	2,9
10-14 years	879 (13,6)	21	2,0	0,1	–	2,0	–	–	0,1	(0,01-0,32)	20	2,0
15-19 years	706 (10,9)	18	2,2	0,4	–	1,8	–	–	0,2	(0,07-0,75)	15	1,8
20-49 years	1885 (29,1)	61	2,8	0,3	0,3	2,2	1,0	(0,33-3,03)	0,1	(0,06-0,32)	54	2,5
50 + years	513 (7,9)	44	7,4	2,0	0,5	4,8	4,0	(1,11-14,38)	0,4	(0,20-0,85)	39	6,5
TOTAL	6483 (100,0)	666	8,8	5,3	0,8	2,7	6,6	(4,95-9,70)	2,0	(1,64-2,35)	497	6,6

and health planning and programming[1,2], even though it only partially represents a population's morbidity pattern. In Brazil, the hospitalization pattern has changed rapidly, with a reduction in infectious, parasitic, and ill-defined causes and an increase in chronic non-communicable causes and those related to accidents and violence[17,18]. These changes result from social, environmental, demographic, epidemiological, financial, and technological factors and those related to the health services structure[17], and are expressed unequally between the various regions of Brazil, between different social groups[18], and nationally and internationally.

Diseases of the respiratory system were the principal causes of hospitalization among the Guarani, especially in children under 5 years, with more than 77% of admissions. Respiratory diseases exceed the second and third leading causes of hospitalization by 6 and 11 times, and more than 7 and 17 times, respectively, among the overall Guarani population and Guarani children under 5 years of age.

A recent study among the Xavante in the State of Mato Grosso[4] identified the following proportions of hospitalization due to respiratory diseases: 47.7% (overall), 55.1% (<5 years), and 57.5% (<1 years). Among indigenous people in the State of Rondonia, the overall proportion was lower (26.8%), but it was also concentrated in children under 5 years (43.4%)[6]. Also in Rondonia, among the Suruí, 57.0% of hospitalizations in children under 5 years were due to diseases of the respiratory system[5].

Interestingly, nutritional causes (Chapter IV) appear less frequently as the primary cause of hospitalization in Guarani children under 5 years, contrary to the situation among the Xavante[4]. Given the occurrence of malnutrition among the secondary causes of hospitalization in the Guarani, one can conjecture that even if malnutrition is underreported, it is not a direct cause of hospitalization among the Guarani. Rather, it is part of the secondary diagnoses, given the association between malnutrition and the principal causes of hospitalization in the Guarani (ARI and diarrhea).

The analysis according to the ICD-10 Special Tabulation List of Morbidity highlights the importance of pneumonia among the causes of hospitalization in Guarani children under 5 years of age. The sum of the proportions of pneumonia (56.7%), unspecified acute lower respiratory infections (15.2%), and bronchitis and bronchiolitis (4.4%), corresponding to all acute respiratory infections, totals 76.3% of the causes of hospitalization in Guarani children under 5 years. Among Sururí children under 10 years of age, pneumonias accounted for 63.8% of the respiratory causes of hospitalization[5].

The analysis of hospitalization proportions in Brazil according to ICD-10 Chapters (excluding Chapter XV) identifies diseases of the respiratory system as the principal causes of hospitalization in 2005 (17.8%), having shown a downward trend from 1995 to 2005[10]. Although the relevance of respiratory diseases is similar among indigenous and non-indigenous populations, their magnitude among the Guarani is 3.6 times that of the overall Brazilian population.

If one applies to the under-5 Guarani population the estimates obtained for median incidence of community pneumonia (0.29 case/child-year) and the proportion of hospitalizations due to this cause (7-13% of community pneumonias) obtained from a systematic review of studies in developing countries[16], one would expect 381 new cases of pneumonia per year, resulting in 27 to 50 hospitalizations of Guarani under 5 years. The worst-case scenario would be to apply the highest incidence (2.45 cases/child-years) among the 28 studies in the review (Indonesia, 1995), which would lead to an expected 225 to 418 hospitalizations, similar to the number observed among the Guarani (268).

Hospitalizations due to pneumonia in under-5 Guarani were 5.4 to 9.9 times more frequent than the expected number based on the estimated median pneumonia incidence in under-5 children in developing countries. Since the majority of the studies in the review were conducted in urban areas,

where higher ARI rates have been reported[19], and published in the late 1980s and early 90s, the current Guarani hospitalization pattern is comparable to that in children under 5 years of age in developing countries at least 15 years ago.

The standardized overall annual hospitalization rate among the Guarani (8.8/100 persons) was 70% higher than the corresponding rate for Brazil (5.2/100 persons), and was 1.4 and 3.1 times higher than the standardized rates in the South (6.1/100 persons) and Southeast of Brazil (2.9/100 persons), respectively[20], and at least 50% higher than the other regions of the country for both sexes.

The overall annual Guarani hospitalization rate was similar to that among the Xavante[4] (9.5/100 persons), although the latter includes causes related to pregnancy, childbirth, and the puerperium, which if excluded would leave a lower rate for the Xavante (8.3/100 persons) than for the Guarani. The Guarani hospitalization rate for infants (< 1 years) was 3.4 and 23.0 times higher than for children 1 to 4 and 5 to 9 years of age, respectively, in the same ethnic group, and was higher than the corresponding rates for the overall Brazilian population[20] up to 9 years of age. From 10 years upward, the situation is reversed, whereby adults in the overall Brazilian population show a higher hospitalization rate than indigenous adults, while indigenous children are hospitalized more frequently than non-indigenous (although children are more heavily affected among both indigenous and non-indigenous people).

The specific hospitalization rates for ARI were 3 to 11 times higher than those for diarrhea and other causes in children under 5 years, while in the overall Brazilian population the hospitalization rates due to other causes were higher than for ARI in all age brackets, including infants (<1 year)[20]. Females showed higher hospitalization rates than males, both overall and in the 1-4-year and 15-19-year age brackets. Hospitalization rates due to ARI among the Guarani were much higher than for the Suruí[5], in whom hospitalizations due to respiratory diseases varied from 10.6 to 11.9/100 child-years. They were also higher than among non-indigenous children under 5 years (11.5%) in the municipality of Rio Grande, State of Rio Grande do Sul[21].

Utilization of the number of hospitalizations in a given period as the numerator for a rate results in an estimate of the mean number of hospitalizations per person, allowing one to calculate the number of hospitalizations that are expected to occur in the population in that time period. Meanwhile, using the number of persons with at least one hospitalization during the period results in an estimate of the probability that a person will experience at least one hospitalization during the period[1]. Thus, in addition to calculating the rates using the number of events (hospitalizations) as the numerator, we also used the number of persons with one or more hospitalizations as the numerator, which could estimate the individual risk of a Guarani undergoing at least one hospitalization per year. Using this method, the hospitalization rate in children under 5 dropped to 21.5/100 child-years, and the rate in children under 1 year to 48.1/100 child-years.

From 1 to 4 years of age, we observed a higher risk of hospitalization among girls for all causes and for ARI. Three birth cohorts in Southern Brazil[2,22] showed a higher risk of hospitalization among boys under 1 year, which was attributed to the lower median breastfeeding time in male infants. Differences between the sexes in exposure to environmental risk factors[23] could explain differential risks for hospitalization due to ARI in the 1 to 4-year group.

The risk of hospitalization among Guarani infants (< 1 year of age) was 2.5 times that described in three cohorts in Southern Brazil (1982: 19.6%; 1993: 18.1%; 2004: 19.2%)[2,22]. The risk of a Guarani infant having been hospitalized at least once a year (48.1/100) was higher than the risk reported for infants from lower-income families (monthly family income up to one minimum wage in 1982: 26.8%) and those

with a history of low birth weight (<2,000g in 1982: 40.9%). However, it was lower than the risk of hospitalization reported for the < 2,000g birth weight bracket in the cohorts from 1993 (71.6%) and 2004 (73.2%), which was attributed to the increasing prematurity among the newborns in these more recent cohorts.

The principal secondary causes reinforce the relevance of respiratory diseases among the Guarani. The frequency of re-hospitalizations due to pneumonia in children under 2 years, combined with the frequent occurrence of secondary diagnoses of wheezing suggest limitations in the validity of specific diagnoses of pneumonia, and that bronchial hyperreactivity is implicated in the pathogenesis of these repeat hospitalizations[24].

The hospital morbidity profile among the Guarani is characterized by conditions that are sensitive to primary care, including bacterial pneumonia, gastroenteritis, dehydration, iron deficiency anemia, skin and subcutaneous infections, bronchitis, and asthma[3,11]. These conditions can be defined as diseases involving potentially avoidable hospitalization, given the existing health technologies and access to qualified primary care[3,25,26]. No differences would be expected between different social groups in the probability of hospitalization from these causes, as long as all the groups had universal access to high-quality primary health care[25]. Thus, this set of diseases has been used for monitoring and evaluating access to quality primary health care, especially in vulnerable groups.

Acute respiratory infections are among the leading causes of morbidity and mortality in developing countries, accounting for 30 to 50% of outpatient consultations and more than 50% of hospitalizations. There is a similarity in the incidence of ARI between wealthy and poor countries (4-7 cases/child-year), with a higher frequency in children under 5 years and in urban areas. More vulnerable social groups show a worse prognosis, given the severity of events and the preponderance of bacterial pneumonia, which accounts for 19 to 21% of the 10 million deaths per year in children under 5 years of age worldwide, and 11 to 18% in Brazil[19,27,28].

Recent data suggest that indigenous peoples are among the most marginalized population groups in Latin America[9,29], with higher morbidity and mortality rates than among the non-indigenous. Among the main points related to inequalities are access to and utilization of health services[30,31], which in the case of the Guarani is aggravated by social and environmental adversities that routinely characterize indigenous peoples[9,32]. With the implementation of the Subsystem for Indigenous Health Care in Brazil, it was expected that the principal barriers to access by indigenous peoples to the Unified National Health System (SUS) would have been overcome, since there was a massive investment in structuring local health services on Indigenous Lands nationwide, with extensive expansion of primary care coverage. However, the increased health care coverage appears not to have been accompanied by the elimination of technical and health care limitations, caused by deficient support and technical supervision, or by substantial improvements in living conditions among indigenous peoples.

For example, according to a study in a county in the Ribeira Valley in the State of São Paulo to monitor child health indicators in response to work by Community Health Agents[33] (considered essential for providing universal primary care in rural areas), there was a reduction in hospitalizations after training for diagnosis and early treatment of ARI and diarrhea, encouragement for basic immunization, monitoring of child growth, and orientation for introducing specific foods in the diet. Flaws in the work by the Community Health Agents (in the present case, Indigenous Health Agents in the Indigenous Health Subsystem) were attributed to inappropriate training, support, and supervision and multiple duties, resulting in low effectiveness in their work.

Among the various factors implicated in morbidity and mortality from ARI in

developing countries, like crowding, substandard housing, and household pollution, malnutrition, and short breastfeeding, most of which are commonplace among the Guarani, various aspects have been highlighted that influence the course and outcome of ARI: perception of the disease by families; patterns of care and habits during the illness; the decision to seek care outside the home; which kind of care is provided, and how; and compliance with treatment guidelines[19]. The latter two are particularly related to the indiscriminate use of antibiotics, resulting in additional risk of unfavorable evolution given the development of bacterial resistance to antimicrobials in the Americas.

The high hospitalization proportions and rates due to respiratory diseases among the Guarani emphasize the importance of overcoming access barriers to hospital care and suggest that such high figures could result from the increased probability of hospitalization among indigenous peoples in Brazil, considered more vulnerable to health problems, as occurs in populations with worse socioeconomic conditions[26]. This fact is known as the hospitalization bias or Berkson paradox and results in potential distortion in hospital morbidity analyses[21,34].

Based on the comparisons performed in this study, the situation of the Guarani allows raising two general hypotheses. First, that ARI incidence among the Guarani is higher than in other population groups. In this case, etiological factors are purportedly acting in a particular way in this group and leading to higher illness and hospitalization rates than reported in other indigenous and non-indigenous groups. Second, that ARI incidence in the Guarani is similar to that in other population groups. In this case, what differs is the severity or frequency of hospitalization. Local health services are not efficient in handling and treating cases locally. Additionally, the Guarani may be particularly subject to an hospitalization bias, resulting in higher than expected hospitalization rates and proportions.

Considering that primary care sensitive conditions (PCSC) reflect both the epidemiological profile and access and utilization of primary health care services[11,26], the two hypotheses appear to be acting in combination. Thus, studies on the etiology and prognosis of ARI, frequency of diseases in the community, validity of outpatient and hospital diagnoses, technical and scientific quality of the care provided, and access to and utilization of outpatient and hospital services would be useful for better understanding the epidemiology of ARI among the Guarani and orienting intervention strategies.

In the short term, health surveillance and prevention of ARI and wheezing, with a focus on mother and child care, could contribute to better clinical evolution and a reduction in hospitalizations. Care could be strengthened by adequate composition of health teams, with improved work stability and training to conduct effective home visits, early and timely case identification, adequate clinical management, and monitoring of ARI treatment in the villages. These and other actions have been organized in a set of strategies called Integrated Management of Childhood Illnesses (IMCI), widely recommended by the Pan-American Health Organization as the key alternative for controlling ARI and improving the health of children under 5 years[19].

In addition, closer dialogue between local health teams and other referral units in the Unified National Health System, as well as the use of protocols for the management of ARI, could lead to better application of indigenous health resources and a possible reduction in the unnecessary exposure of individuals to the hospital environment[33,35]. It is important to maintain continuous and accurate health records for monitoring and evaluating indigenous health, time trends, and the impact of interventions. In the medium and long term, interventions would be expected that would extend beyond the health sector, such as improvements in living conditions and sanitation, housing, income, and sustainable development, among others, in order to reduce such he-

alth inequalities.

These issues highlight the pressing need for better knowledge of ARI epidemiology among the Guarani and improved quality of training and care among local health teams and professionals working in the referral system outside the villages, including anthropological aspects, in order to act comprehensively and efficiently to control acute respiratory infections among indigenous groups in the South and Southeast of Brazil.

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