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Predictive factors of disability in patients with leprosy

ABSTRACT

OBJECTIVE: To analyze predictive factors in the progression of the disability grade in patients with leprosy.

METHODS: A retrospective cohort study followed up 595 patients with disability registered at a healthcare unit in the city of Belo Horizonte (Southeastern Brazil) from 1993 to 2003. Patients' sociodemographic and clinical information was collected from the respective medical records. Comparisons were made between the disability grade upon admission and at the end of treatment using a marginal homogeneity test. To determine factors associated with progression in the disability grade, univariate analysis (linear trend chi-square test) was employed, as well as multivariate analysis by means of the algorithm Chi-square Automatic Interaction Detector.

RESULTS: Among the cases in which the disability grade was recorded upon admission and upon discharge, 43.2% of the patients who had grade 1 in the first assessment progressed to grade 0. Among those who began with grade 2, 21.3% progressed to grade 0 and 20% progressed to grade 1. In the univariate analysis, the variables that proved to be statistically associated with progression in the disability grade were: neuritis, time elapsed until the occurrence of neuritis, number of damaged nerves, type of physiotherapy treatment and higher dose of prednisone. In the multivariate analysis, the main factor associated with the progression of disability was the disability grade upon admission.

CONCLUSIONS: The results showed the importance of an early diagnosis of neuropathy as well as the efficient association of pharmacological and non-pharmacological treatment, through disability prevention techniques and adequate doses of steroid.

DESCRIPTORS: Leprosy, complications. Leprosy, prevention & control. Statistics on Sequelae and Disability. Risk Factors. Clinical Evolution.

INTRODUCTION

Publications on the number of people who present disabilities due to leprosy are scarce. Estimates suggest that approximately two to three million individuals have some degree of physical damage as a result of the disease.^{15,18,19} Moreover, studies show that around 20% of patients with leprosy or treated for leprosy may present physical disabilities and psychosocial restrictions, and they often need some kind of intervention in rehabilitation and/or continuity of medical care.⁶ In Brazil, approximately 23% of patients with leprosy present some kind of disability after discharge.^a

Nowadays, the prevention of physical deficiencies and disabilities resulting from the disease is performed by means of early diagnosis and treatment, and also through the monitoring and adequate management of episodes of neuropathy

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and leprosy reactions. These reactions are manifestations of the patient's immune system in the presence of the bacillus, and they cause the exacerbation and emergence of new skin lesions, systemic inflammatory processes that may or may not be associated with neuropathy.^{5,7,8,19}

Monitoring by means of systematic neurological examination enables early diagnosis and intervention in neural impairment, which reduces the patient's chances of developing disabilities.^{1a} The nerve can be recovered with the use of steroid in doses that are adequate to the patient's weight and to the intensity of the neural damage, together with immobilization procedures of the damaged segment and specific therapeutic exercises.^b Early diagnosis and the adequate treatment of reactions and neuritis are fundamental to avoid or reduce complications (deformities and disabilities), lowering rehabilitation costs and having a positive impact on the individuals' functionality and quality of life.

The present study aimed to analyze predictive factors in the progression of the disability grade in patients with leprosy.

METHODS

The study was based on data from a retrospective cohort composed of 595 patients registered at a healthcare unit in the city of Belo Horizonte (state of Minas Gerais, Brazil) between 1993 and 2003. These patients' diagnosis of leprosy was made by a dermatologist of the unit, according to the criteria of the National Program for Leprosy Control.^c Patients were treated with polychemotherapy, attended physiotherapy sessions with neurological assessments at the onset, during and at the end of treatment, and were discharged in a state of pharmacological cure. Neurological assessments and evaluations of the disability grade were performed by a physiotherapist, using the national protocol for simplified neurological assessment and the disability grading system.^{11,c}

Sociodemographic and clinical information was collected from the medical records: sex, age, region of origin, profession, clinical form, occurrence of neuropathy, reactions, physiotherapeutic monitoring, bacteriological index upon admission, number of damaged nerves at the beginning of treatment, medical prescription for the use and initial dosage of prednisone, time elapsed since the onset of treatment with polychemotherapy, disability grade at the beginning and end of treatment.

The association between the predictive factors and progression of the disability grade was performed by

means of the marginal homogeneity test, comparing the disability grade upon admission and upon discharge (termination of drug therapy). When a positive dynamics was verified in the progression of the disability grade, univariate analysis was carried out through the linear trend chi-square test. The response variable was defined as progression in the disability grade, which is a result of the comparison of the disability grade upon admission and upon discharge, coded in three categories (the patient's health condition "improved", "remained constant", "deteriorated").

Then, multivariate analysis by means of the decision tree was performed, using the algorithm Chi-square Automatic Interaction Detector (CHAID). This analysis employs classification rules based on a decision tree, allowing to identify homogeneous groups of patients from the systematic comparison of their characteristics in order to establish the relationship between explanatory variables and one single response variable. To achieve this, adjustments through successive divisions into the set of data were made, aiming to make the subsets become more and more homogeneous in relation to the response variable. The division process was repeated until none of the selected variables showed significant influence on the division or when the size of the subset was very small.³

In the analysis using CHAID, all the sociodemographic and clinical variables were initially included in the regression tree. To exclude variables from the model, that is, as the criterion to stop the tree's growth, the *p* value of the linear trend chi-square statistics was adopted, with Bonferroni adjustment (*p*<0,05).

The cross-validation procedure was applied to generate sub-samples of the analyzed data. To each sub-sample, a different tree was produced. In this way, the model can be validated if all sub-samples converge to similar trees. Ten sub-samples were used to validate the results by means of the cross-validation procedure. Final model adjustment was evaluated through risk estimation, considering the difference between the expected value and the value observed by the model.³

For the statistical analyses, SPSS 12.0 was used.

The study was approved by the Ethics Committee of Universidade Federal de Minas Gerais.

RESULTS

Of the 595 studied patients, 317 were males (53.3%) and 278 were females (46.7%). Mean age was 42±16.5 years. Concerning occupation, 89 (21.8%) worked in the

^a Ministério da Saúde. Manual de prevenção de incapacidades. Brasília; 2001.

^b Ministério da Saúde. Secretaria de Políticas de Saúde. Departamento de Atenção Básica Guia para controle da hanseníase. Brasília; 2002. (Cadernos de Atenção Básica, 10).

^c Ministério da Saúde. Secretaria de Políticas de Saúde. Departamento de Gestão de Políticas Estratégicas. Relatório de atividades da área técnica de dermatologia sanitária. Brasília; 1999.

Table 1. Sample characteristics. Belo Horizonte, Southeast Brazil, 1993-2003.

Variable	n	%
Clinical Form (n=574)		
Dimorphous	478	81.8
Virchowian	99	17.0
Other forms	7	1.2
Duration of treatment ^a (n=525)		
Less than 24 months	184	35.0
24 months or more	341	65.0
Reactional state (n=521)		
No	422	81.0
Yes	99	19.0
Type of reactional state (n=99)		
Type I	34	34.3
Type II	47	47.5
Types I and II	18	18.2
Neuritis (n=529)		
No	248	46.9
Yes	281	53.1
Higher dose of prednisone used (n=529)		
Did not take it	248	46.9
20 to 30 mg	100	18.9
40 to 50mg	120	22.7
60 mg or more	61	11.5
Bacteriological index (n=436)		
Negative (= 0)	321	73.6
Positive (> 0)	115	26.4
Ulnar nerve damaged (n=473)		
No	309	65.3
Yes	164	34.7
Tibial nerve damaged (n=473)		
No	265	56.0
Yes	208	44.0
Disability grade in 1st assessment (n=584)		
0	369	63.2
1	110	18.8
2	105	18.0
Disability grade upon discharge (n=466)		
0	350	75.1
1	68	14.6
2	48	10.3
Physiotherapy treatment (n=520)		
Instructions	345	66.3
Exercises and instructions	76	14.6
Occurrence of immobilization	34	6.5
Others	65	12.5

^a The variable duration of treatment was categorized by the median.

service and commerce sectors, 81 (19.9%) worked in the industrial goods and services sector, 71 (17.4%) were housewives, 46 (11.3%) were students, 34 (8.3%) were retired and 87 (21.3%) were classified as "others".

Table 1 presents the patients' clinical characteristics. It can be seen that 53% of the sample had neuritis, 19% had leprosy reactions and 26% presented a positive bacteriological index. Neuropathies were diagnosed according to alterations to the neurological examination, based on pain and neural thickening, sensitive and/or motor deficit. As for the treatment received, 14.6% of the sample received physiotherapeutic monitoring with exercises and instructions; 66.3% needed instructions only; 12.5% were advised to use insoles, ankle-foot orthosis with dorsiflexion assist and/or functional orthoses for the hands; and 6.5%, immobilizations.

The maximum period of time elapsed until the occurrence of neuritis was 24 months; a little less than half of the cases (48%) occurred up to the 12th month of treatment.

Among the cohort's patients, 456 (76.6%) had records about the disability grade upon admission and upon discharge (termination of drug therapy). The other patients had no records of the disability grade upon admission and/or discharge.

It was observed that 43.2% of the patients who had grade 1 in the first assessment progressed to grade 0 (Table 2). Among those who began with grade 2, 21.3% progressed to grade 0 and 20% progressed to grade 1 ($p < 0.001$), which showed a positive dynamics in the disability grading.

The sociodemographic variables (occupation, sex, age and region of origin) did not associate with the progression of the disability grade.

Univariate analysis through the linear trend chi-square test ($g.l.=1$) showed that the variables that proved to be associated with the improvement in the progression of the disability grade were: occurrence of neuritis

Table 2. Comparison between the disability grade in the 1st assessment (admission) and upon discharge (n=456). Belo Horizonte, Southeast Brazil, 1993-2003.

Admission	Disability grade			p ^a
	0	1	2	
0	288	4	1	<0.001
%	98.3	1.4	0.3	
1	38	49	1	
%	43.2	55.7	1.1	
2	16	15	44	
%	21.3	20.0	58.7	

^a marginal homogeneity test

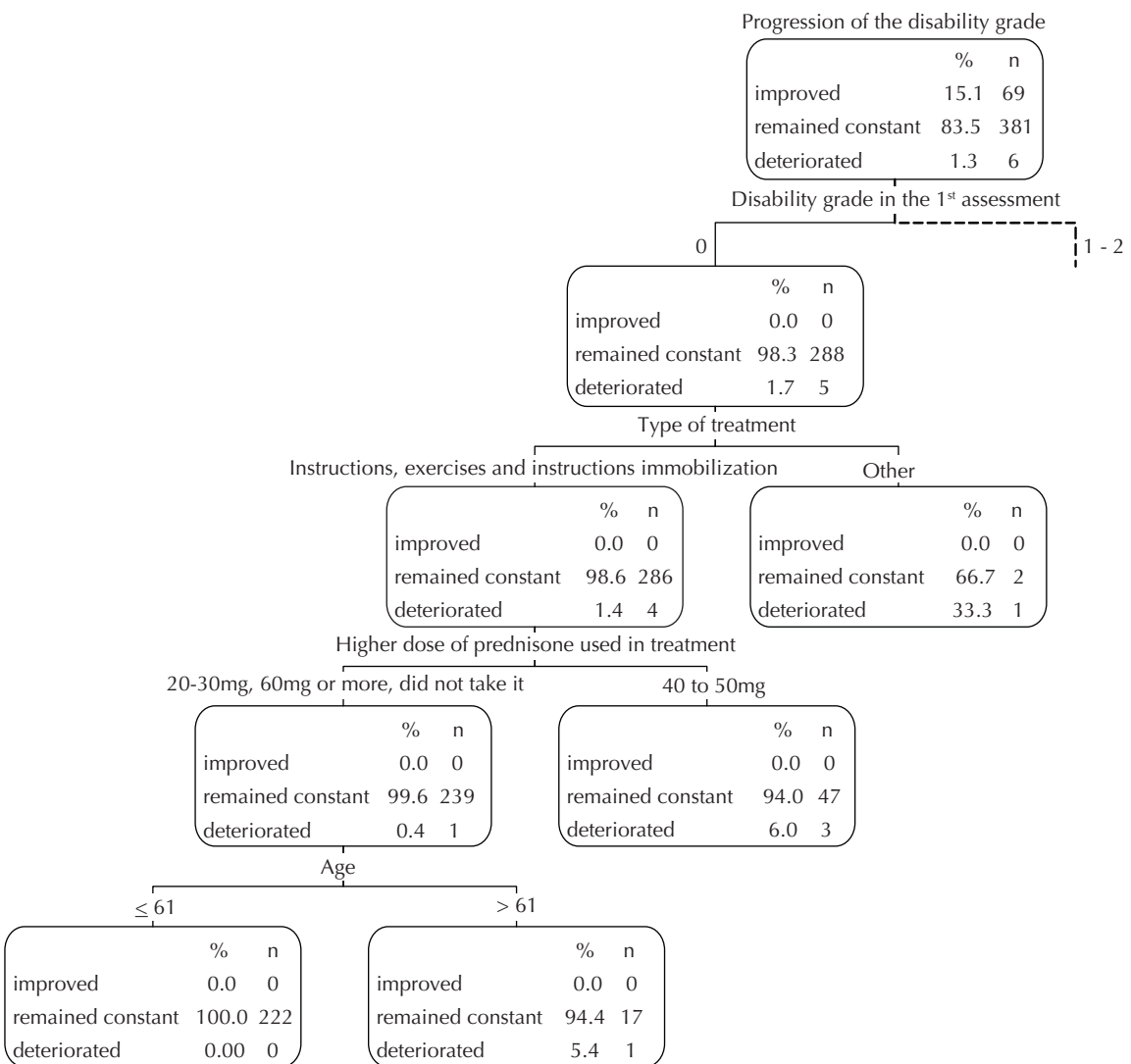
($p=0.028$), time elapsed until the occurrence of neuritis below 15 months ($p=0.006$), more than three damaged nerves ($p=0.001$), exercises and instructions as the type of physiotherapy treatment ($p<0.001$) and dose of prednisone over 60 mg ($p<0.001$).

The analysis of the decision tree by means of the algorithm CHAID is represented in Figures 1 and 2. The factors associated with the progression of the disability grade were: disability grade upon admission, type of physiotherapy treatment, age, higher dose of prednisone, number of damaged nerves and type of reactional state.

Disability grade upon admission was the main predictive factor of disability progression. Among the patients who

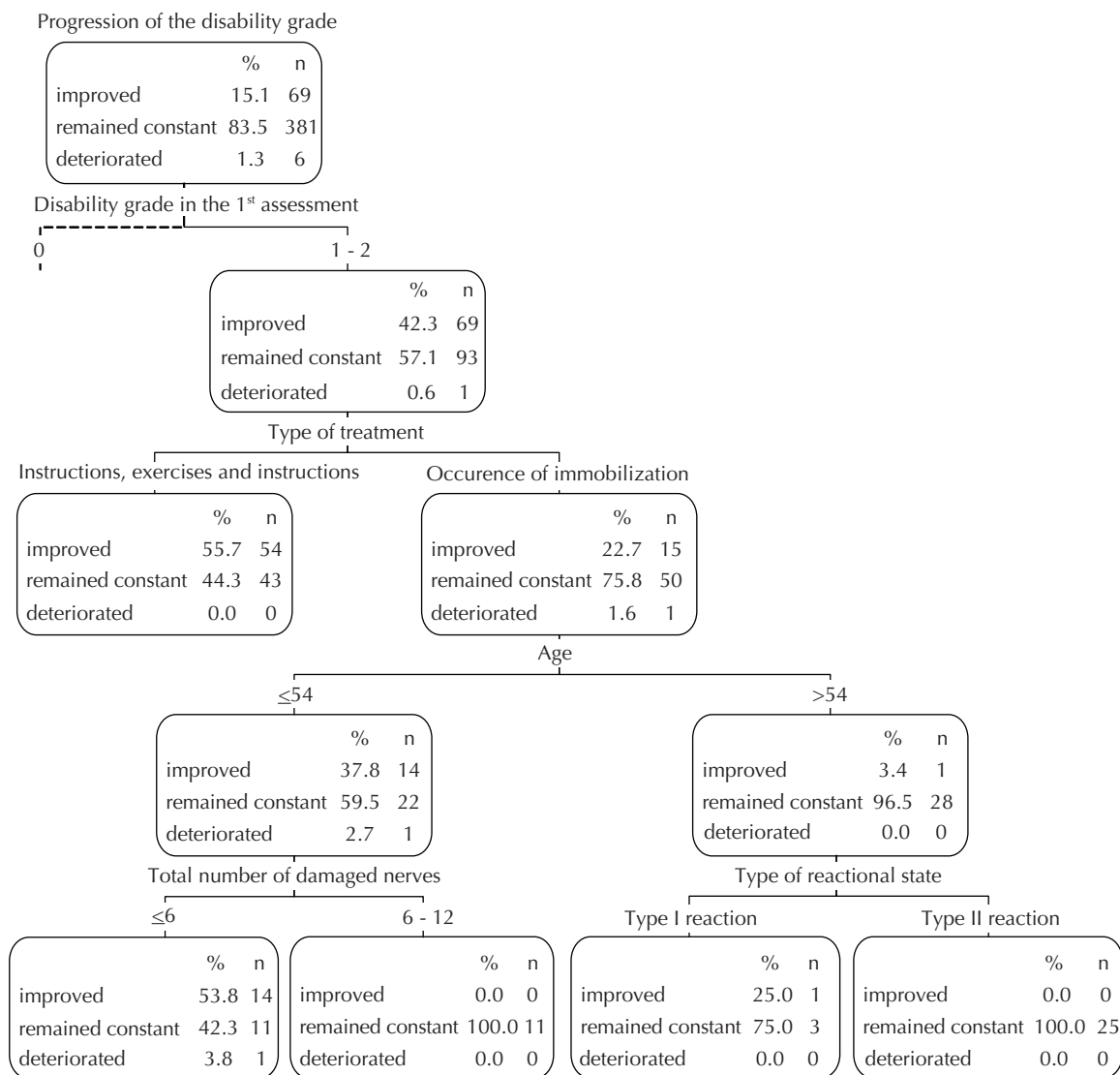
had grade 0 of disability upon admission and received “other physiotherapy treatments”, 67% maintained the same disability grade and the state of 33% deteriorated. For those who had grade 0 of disability upon admission and received as physiotherapy treatment “exercises, instructions or immobilizations”, took “20 to 30 mg of prednisone”, “60 mg or more” or “did not take prednisone”, the influence of age could be observed. Thus, all patients with age below 61 years (100%) remained constant in their disability grade. Among those with ages above 61 years, there was deterioration in one case, which represents a percentage of approximately 6%.

Observing the patients who started the study with grade 1 or 2 and who used as physiotherapy treatment “exercises and instructions” or “just exercises” (cases on the



CHAID: Chi-square Automatic Interaction Detector

Figure 1. Decision sub-tree, CHAID algorithm, for the progression of the disability grade (left side).Belo Horizonte, Southeast Brazil, 1993-2003.



CHAID: Chi-square Automatic Interaction Detector

Figure 2. Decision sub-tree, CHAID algorithm, for the progression of the disability grade (right side). Belo Horizonte, Southeast Brazil, 1993-2003.

right side of the tree, Figure 2), there was improvement in almost 56% of the cases, of which none deteriorated. Patients in whom “immobilization” or “others” were employed as form of physiotherapy treatment, who were younger than 54 years and who had less than six damaged nerves at the beginning of treatment improved their state in more than half of the cases (54%). However, among those who had these same characteristics and more than six damaged nerves, none improved their state – the disability grade they had at the beginning of treatment remained the same.

For patients with grades 1 and 2 who needed “immobilization” or “others” as treatment and were older than 54 years, the type of reactional state was an important factor: 25% of those who had type I reaction improved

their state and in 100% of the cases, patients who had type II reactions remained constant.

As for the physiotherapy treatment, of the 163 patients who started treatment classified as grade 1 or 2, 69 obtained an improvement in the disability grading and only one deteriorated. Of these 69, 54 needed exercises and instructions and 15 needed immobilization, of whom 14 were younger than 54 years and had less than six damaged nerves.

The model generated by the decision tree presented good adjustment. Its risk estimation was just 0.13 (standard error=0.02) and it proved to be a stable model, considering that the risk estimated by cross-validation was very close to the final model (risk-0.17; SE=0.02).

DISCUSSION

Neuropathies occurred in more than half of the sample. Despite the high risk of deformities in the comparison between the disability grade upon admission and upon discharge, an important improvement was perceived, with predominance of progression to grade 0 of disability. The majority of patients improved their state or remained in the same disability grade they were in when the diagnosis was made. The results of the present study showed that only 10% remained in grade 2 of disability after treatment, with the consequent improvement in the epidemiological indicator, which moved from high to medium. These findings are different from those of Deepak (2003),⁶ who found high prevalence of grade 2 disabilities in world-wide data. He also found that this prevalence can vary from 17% to 50% after discharge.

The reduction in the prevalence of grades 1 and 2 of disability found in the present study may be related to the frequency of neurological assessments, which were performed every four months or in an even shorter interval of time. Frequent assessments contribute to the early diagnosis of neural damage, as well as to monitor the evolution of this neurological presentation, subsidizing both the pharmacological treatment, with the use of prednisone, and the physiotherapy treatment. Another important factor was the prescription of prednisone in adequate dosages, according to the results of the neurological assessment that was employed to aid the management of these drugs. The clinical rigor used in patients' grading was also important, with a longer follow-up. These factors increased the chances of diagnosing neuritis in the period of the highest incidence of the presentation, which is up to the 12th month. Besides, frequent neurological examinations are important, due to the high occurrence of silent neuritis, which should be constantly investigated.^{4,16,17}

Research has shown the efficiency of the treatment with polychemotherapy, as the deformities rate decrease among new cases. This treatment protocol has enabled early diagnosis and systematized follow-up^{2,18,20} associated with neural monitoring and interventions aiming at adequate diagnosis and treatment (pharmacological and non-pharmacological) of episodes of neuropathy, associated or not with reactional states.^{8,19} These measures have produced good results, such as the one found in the present study: in only 1.3% of the cases there was a deterioration of the neurological presentation.

Selvaraj et al (1998),¹² in an assessment carried out in India with 1,262 leprosy patients, showed that the individual who is older than 45 years, has more than three thickened nerves and plantar anesthesia had an almost 20 times higher probability of developing new disabilities during and after treatment. According to these authors, the local health team was afraid and there

were no protocols to the utilization of the steroid. The authors argued that this aspect is relevant to the bad progression of the deformities.

There are evidences of associations between age, sex, clinical form, number of damaged nerves at the beginning of treatment, bacteriological index and adopted treatment in the determination of the probability of occurrence of disabilities.^{9,10,12,13,14} In the present study, among all the statistically significant variables, it was possible to verify the importance of the use of prednisone, as well as the type of adopted physiotherapy treatment, contributing to the patients' good evolution. The results showed other variables that predicted a good progression of the disability grade, such as: presence of neuritis, utilization of a dosage of prednisone above 60 mg, more than three damaged nerves upon admission and less than 15 months to the occurrence of neuritis. We expected that the set of variables mentioned above would predict a deterioration of the disability grade; however, they predicted the improvement. This confirms that the diagnosis was made in an early stage of the process and the treatment was instituted in an efficient way, as, generally speaking, the progression was satisfactory to the major part of the sample.

It seems to be a consensus that the absence of an early diagnosis of neuropathies, the fear and the non-adoption of protocols in the use of prednisone are frequent findings that determine, many times, deficiencies and disabilities.^{5,7,12,13,19} In the present study, there was a 15% improvement in the disability grade since admission, possibly due to adequate pharmacological interventions (steroid) and appropriate non-pharmacological actions (disability prevention techniques) carried out by the health team.

According to some studies,^{10,13} neural damages occur mainly before the diagnosis and the incidence of new damages after the diagnosis is low. A research study conducted in India showed the incidence of new disabilities after treatment with polychemotherapy: 0.681/1000 people/year during treatment with polychemotherapy.¹³ Similar results were found in the present study, with a very low percentage of deterioration.

Investigations that analyze the disability prevention techniques adopted in the follow-up of the leprosy patient are scarce. In the majority of them, the techniques are described and recommended, without any evaluation of their efficacy and of their potential to predict the progression of the neurological presentation.² We verified the importance of the association between pharmacological and non-pharmacological treatments for a successful prevention of deformities and consequent disabilities of the leprosy patient. The results confirmed the importance of an early diagnosis both of the disease and of the neuropathies that occur during treatment. Furthermore, the results showed that

the disability prevention techniques have a clinical impact and predict the good progression of the neurological presentation.

The analysis with the CHAID algorithm enabled the development of a decision rule directed at the individual and not at a group of participants, with direct application to the clinical practice of professionals who deal with leprosy. The selected predicting variables represent clinical parameters frequently observed in the daily routine of an outpatient clinic, enabling the individualized application of the results. Disability grading upon admission was the main variable that predicted the progression of the disability grade. Therefore, it was important in the prevention of neural damages, strengthening the need of an early diagnosis. The evolution of the patient's clinical presentation depends on how he was admitted for treatment. Thus, the improvement, deterioration or maintenance of the patient's clinical presentation after the pharmacological and physiotherapy interventions are associated with or reflect the patient's initial presentation. This aspect is important in rehabilitation, because the focus of the treatment is not on curing the disease; rather, it is

on developing the patients' functional capacity to the maximum extent and avoiding that new dysfunctions occur. Other variables also determine the progression of the disability grade: physiotherapy interventions, age and the type of reactional state give an outstanding contribution, influencing on the progression of the disability grade.

The present study presents limitations due to the fact that it was conducted with secondary data. It was not possible to collect data on co-morbidities, patients' body weight and number of neurological assessments performed on the patient.

In short, non-pharmacological interventions contribute to the good evolution of the disability grade in individuals with leprosy. Utilization of the disability prevention techniques as a variable showed the need to carry out these procedures routinely in the services that work with such patients, including frequent neural monitoring, instructions/health education, exercises and orthoses. The association between early diagnosis of neuropathies, use of adequate dosages of steroid and specific techniques for the prevention of disabilities may reduce the prevalence of deformities.

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