Articles info

Introduction: Identifying epilepsy in local indigenous populations and describing its epidemiological, etiological, electroencephalographic, and therapeutic aspects can assist public health policies planning toward epilepsy in indigenous communities.

Methods: This descriptive, cross-sectional study investigated epilepsy among indigenous people residing in Jaguapirú Village, Dourados, Mato Grosso do Sul, Brazil. Participants had their clinical histories reviewed and physical examination performed, as well as one or more electroencephalograms (EEG) registered. Other laboratory tests and neuroimaging data available were analyzed and patients with nonepileptic paroxysmal events were additionally identified.

Results: Out of 2,994 respondents, 49 had a confirmed diagnosis of epilepsy (2.37%) and 22 had self-limited epileptic syndromes, a rate that exceeds the global prevalence but is close to other data reported in the Brazilian population. Focal epilepsy, predominantly from temporal lobe origin, was the most prevalent epileptic syndrome (71.4%). Febrile seizures occurred in only 0.4% of respondents, much lower rate than reported in the general population, which can be attributed to the cross-sectional study design. The etiology of epilepsy was undetermined in 82.6% of cases, with the remaining cases attributed to head trauma, hypoxic-ischemic encephalopathy, and brain malformations. A history of delayed neuropsychomotor development was significantly associated with epilepsy. Monotherapy with first-generation antiseizure medications was greatly effective in most epilepsy cases (87.7%). Electroencephalogram helped to define focal epilepsies and diagnose seizures of nonepileptic origin; the latter mostly included cases of psychogenic seizures and, less frequently, syncope.

Conclusion: Diagnosing epilepsy, its clinical presentation, and therapeutic response profile in traditional communities is essential for the establishment of public health policies in developing countries and may help community involvement for successful treatment.

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The social effects of epilepsy differ according to the severity of the social stigma, and they can also vary among communities. According to the Brazilian National Health Foundation (FUNASA), traditional indigenous health systems, for example, are based on a holistic approach, which prioritizes the harmony among individuals, families, communities, and the universe that surrounds them. Healing practices are the product of a particular relationship with the spiritual world and beings in the environment in which the indigenous communities live, reflecting the internal logic of each community [7].

In Brazil, there are approximately 817,000 indigenous people currently living in the inner territories; the state of Mato Grosso do Sul (MS) accounts for 9% of this population [8]. In a 2011 study of the prevalence of epilepsy in the Bakairi ethnic group of Mato Grosso state (MT), nine patients with epilepsy were identified, indicating a prevalence of 12.4 per 1,000 inhabitants [9].

The present study aimed to characterize the epilepsy and the nature of paroxysmal events of nonepileptic origin in the indigenous population of Jaguapirú village in the municipality of Dourados (MS) (Fig. 1).

Identifying epilepsy and its epidemiological, etiological, electroencephalographic, and therapeutic aspects in this population may help the planning of public policies specially addressed to prevent and control this disease in those ethnic communities.

2. Methodology

This study was carried out between November 2012 and November 2017 and was approved by the Research Ethics Committee Involving Human Beings of the Federal University of Grande Dourados and by the Brazilian National Research Ethics Commission (CONEP; references 6810 and 64479, respectively), as well as the appropriate regulatory agencies and indigenous authorities. All participants or their legal representatives signed-up a free and informed consent form translated into the Guarani-Kaiwá language.

A preliminary cross-sectional survey was carried out by the author among indigenous patients from different villages and ethnic groups at the health centers located in the village as well as at the University Hospital outpatient care center, where a screening and monitoring questionnaire was applied. Indigenous residents of Jaguapirú village (Dourados–MS, Brazil) were visited and interviewed by the researcher and his team at home who used a validated questionnaire to collect their sociodemographic and epidemiological data [9]. Participants were also screened for the probable diagnosis of epilepsy by a previously trained team of medical scholars, doctors, and indigenous health agents who provided linguistic assistance to non-Portuguese-speaking individuals [10].

Indigenous people, for whom the investigation of clinical history revealed at least one positive result suggestive of epilepsy, underwent the following approach: an interview recorded on professional equipment (Rebel T4i; Canon®, Tokyo, Japan); assessment of clinical and family history; physical exam; EEG and neuroimaging investigations.

Patients were referred for cranial computed tomography and EEG; BrainNet BNT36; EMSA, Rio de Janeiro, Brazil), which were performed according to the guidelines of the 10–20 International System described by Nuwer et al. [11] When necessary, magnetic resonance imaging (MRI) and complementary exams were also performed.

Sleep deprivation and intermittent photostimulation were proposed when the first EEG was insufficient for electroclinical diagnosis (idiopathic generalized epilepsy). According to patient collaboration and age limitations, hyperventilation of no longer than 3 minutes was proposed for all applicable participants. Tracings had a minimal duration of 20 minutes. Two to four exams were performed for each patient at intervals of 30–90 days.

Patients undergoing drug treatment were categorized into the following groups according to their therapeutic response: remissive, when no seizures occurred during the study period; responsive, when a reduction in the number of seizures and/or morbidity was noted; and unresponsive, when no change in the patient’s condition occurred. The guidelines of the International League Against Epilepsy were followed to categorize seizures and epileptic syndromes [12–15]. Patients with inactive or in remission epilepsy were not treated with medication, they remained on clinical follow-up during the study.

The results are expressed in absolute frequencies and percentages with exact binomial confidence intervals for proportions. The 95% confidence intervals were calculated using R statistical software, version 3.6.1 (https://www.r-project.org/).

3. Results

In total, 2,994 indigenous people (1,557 [52.0%] women; mean age, 21.3 years old; age range, 0–98 years) were interviewed. Epileptic syndromes were found in 71 (2.37%) individuals; a history of an isolated seizure was detected in 9 (0.3%) individuals, a history of febrile seizures was found in 13 (0.4%), and clinical epilepsy was diagnosed in 49 (1.6%) (Fig. 2).

Regarding the ethnicities of the 49 patients diagnosed with epilepsy, we observed that 20 patients belonged to the Guaraní ethnic group (40.83%; mean age, 20.6 years), 12 to the Kaiowá ethnic group (24.48%; mean age, 29 years), and 17 patients were from the Terena ethnic group (34.69%; mean age, 31.33 years).

The results of the electroclinical evaluation, shown in Table 1, are in accord with the International Classification of Epileptic Syndromes published by the International League Against Epilepsy-ILAE [13] in 1989 and officially in use by the time that the subjects in this study were classified. Patients with special epileptic syndromes (i.e., isolated seizures and febrile seizures; n = 22) were not considered for analysis.

Of the 49 patients diagnosed with clinical epilepsy, nine (18.36%) had characteristics of inactive epilepsy, with a mean duration of 15.2 years (median, 22.5 years) with no seizures or the use of antiepileptic medications.
Patients with active epilepsy were medicated with drugs (such as phenobarbital, phenytoin, carbamazepine, valproic acid and clonazepam) provided by the National Health Service.

The classification of epileptic syndromes based upon age of onset, seizure types, ictal semiology, etiology, neurological and neuropsychological findings, as well as EEG and neuroimaging data, applied to 49 patients (exclusion of isolated and febrile seizures out of 71 cases cited in Fig. 1) is shown in Table 2.

Of the three patients with probable symptomatic focal epilepsy and an undefined epileptogenic focus, two had simple focal seizures with bilateral tonic-clonic evolution and one had focal disperceptive seizures associated with behavioral arrest and bilateral tonic-clonic evolution. We failed to characterize a symptomatic zone considering anamnesis, normal EEGs and neuroimaging in all those three patients, with normal physical-neurological examination and no structural damage defined.

While we sought to identify possible triggering factors or define the relationship between epileptic seizures and the sleep-wake cycle, no specific or a relatively high prevalence factor was found in the population (Table 3).

When we evaluated to which the extent possible variables were related to epilepsy (Table 4), we observed aberrant neuropsychomotor development in 34.69% of the patients.

In total, 231 EEGs were performed over the five-year period of the study, and patients with epilepsy had two to four EEG exams during this period. The EEG was normal in 22 patients and abnormal in 27. Changes in background activity were found in 23 of these patients, eight cases of diffuse abnormalities and ten cases of asymmetries. We further identified focal epileptiform paroxysms in 17 patients, multifocal epileptiform discharges in three, bursts of focal slow waves in two, and generalized epileptiform paroxysms in one.

Electroencephalogram analysis revealed focal or asymmetrical disorganizations in activity: specifically, epileptiform paroxysms or bursts of slow focal waves were found in 24 of the 49 patients (48.97%); 23 of these patients had epilepsy with focal syndromes.
Among them, three had a multifocal syndrome and one a generalized epilepsy (juvenile myoclonic epilepsy). Electroencephalogram contributed to the diagnostic confirmation in only one of the three cases of generalized epilepsy since it was normal in two patients. Among 82 (2.73%) patients diagnosed with paroxysmal events of nonepileptic origin, we found 30 (36.58%) of psychogenic seizures, 22 (26.82%) cases of syncope, 7 (8.53%) of headache, 6 (7.31%) breath holding spells, 5 (6.09%) vertigo, 2 (2.43%) parasthesias, and 10 (12.19%) indeterminate events.

4. Discussion

The Indian reserve in Dourados city was demarked within Brazilian territory by 1917 comprising Jaguapiru and Bororó Villages to accommodate indigenous families from various communities belonging to Kaiowá ethnic group, occupants of that area and the surrounding rivers from a long time, as well as Guaranís ethnic group, who came latter to help in the extraction of mate herb, and finally the Terena ethnic group, who came down later to work in the telegraphic web implantation [16]. To a less extent, the reserve also sheltered people from Paraguay and local Brazilians engaged in interracial marriages [16]. A population of more than twelve thousand people live in that area of 3,475 acres.

Of the 49 patients diagnosed with epilepsy in the present study, 20 were of Guarani ethnicity, 17 of Terena, and 12 of Kaiowá. Although the Terena ethnic group comprised the majority of our sample cohort, it ranked second in terms of the number of individuals with epilepsy. This outcome could be ascribed to this group’s relatively good financial and educational prosperity and access to health services.

We observed a predominance of focal epilepsies (71.4%) using an electroclinical characterization of seizures to classify those syndromes in the present study. The low frequency of generalized epilepsies could be attributable to the limitations of our screening questionnaires and the cross-sectional study design. Our findings agree with those reported by previous epidemiological studies [18,19]. One retrospective investigation that employed rigorous criteria in the classification the epileptic syndromes, including a sample cohort, it ranked second in terms of the number of individuals with epilepsy. This outcome could be ascribed to this group’s relatively good financial and educational prosperity and access to health services.

| Table 2 | Stratified classification of syndromes of 49 epileptic patients. |
|---------|---------------------------------------------------------------|
| **Type of Epileptic Syndrome** | **N** | **%** |
| Idiopathic infant | 1 | 2.04 |
| Idiopathic focal | 1 | 2.04 |
| Symptomatic Frontal | 5 | 10.20 |
| Symptomatic Temporal | 9 | 18.36 |
| Symptomatic Parietal | 2 | 4.08 |
| Symptomatic Multifocal | 3 | 6.12 |
| Symptomatic PV Not localized | 3 | 6.12 |
| Symptomatic PV Frontal | 1 | 2.04 |
| Symptomatic PV Temporal | 10 | 20.40 |
| Idiopathic generalized epilepsy | 2 | 4.08 |
| Juvenile myoclonic epilepsy | 1 | 2.04 |
| Undetermined | 11 | 22.44 |

*Probably symptomatic.

| Table 3 | Triggering factors undetermined. |
|---------|---------------------------------|
| **Factors** | **Ethnicity** | **Guarani (n = 20)** | **Kaioá (n = 12)** | **Terena (n = 17)** | **p-value** |
| | | **N** | **%** | **N** | **%** | **N** | **%** | **N** | **%** |
| Hyperthermia | | | | | | | | | |
| Yes | 1 | 5.00 | 1 | 8.33 | 1 | 5.88 | 1.00 |
| No | 19 | 95.00 | 11 | 91.67 | 16 | 94.12 |
| Emotional factor | | | | | | | | | |
| Yes | 3 | 15.00 | 1 | 8.33 | 1 | 5.88 | 0.837 |
| No | 17 | 85.00 | 11 | 91.67 | 16 | 94.12 |
| Sleep | | | | | | | | | |
| Yes | 1 | 5.00 | 0 | 0.00 | 1 | 5.88 | 1.00 |
| No | 19 | 95.00 | 12 | 100.00 | 16 | 94.12 |
| Pregnancy | | | | | | | | | |
| Sim | 0 | 0.00 | 0 | 0.00 | 2 | 11.76 | 0.172 |
| No | 20 | 100.00 | 12 | 100.00 | 15 | 88.24 |
| Alcohol intake | | | | | | | | | |
| Yes | 3 | 15.00 | 1 | 8.33 | 0 | 0.00 | 0.344 |
| No | 17 | 85.00 | 11 | 91.67 | 17 | 100.00 |
| Sleep deprivation | | | | | | | | | |
| Yes | 5 | 25.00 | 1 | 8.33 | 1 | 5.88 | 0.301 |
| No | 15 | 75.00 | 11 | 91.67 | 16 | 94.12 |
| Hyperventilation | | | | | | | | | |
| No | 20 | 100.00 | 12 | 100.00 | 17 | 100.00 | - |
| Menstruation | | | | | | | | | |
| Yes | 2 | 10.00 | 0 | 0.00 | 0 | 0.00 | 0.333 |
| No | 18 | 90.00 | 12 | 100.00 | 17 | 100.00 |
follow-up of 10 years, also found a greater number of patients with focal epilepsies (69.3%) as compared to the generalized ones [19].

Two to four EEGs were performed on all the individuals, even at primary and secondary care levels. To avoid categorizing patients with no obvious focal features and bilateral manifestations in the group of generalized epilepsies, we included them in the groups of seizures and epilepsies of unknown origin [17,20], which could also fit in group III (indeterminate syndromes) of the 1989 ILE classification [13]. As for syndromes with no obvious idiopathic or symptomatic features, we categorized as probably symptomatic [14].

Electroencephalogram examinations of the indigenous population in the village of Jaguapirú helped to classify 24 (48.97%) of the 49 patients in the study as having epilepsy; among them, 23 had focal epilepsy, and one had juvenile myoclonic epilepsy. Electroencephalogram was more effective in defining patients with focal temporal epilepsy since 12 (63.15%) had paroxysmal findings. These results are compatible with the literature, indicating that interictal EEG helps to identify and define the laterality of temporal lobe epilepsy in 70–90% of cases [28,29].

Despite reports that 5–11% of patients with epilepsy have juvenile myoclonic epilepsy [30], we found only one case of that syndrome: a 14-year-old patient who reported that his seizures had begun at the age of 12 years. This finding is consistent with previous reports suggesting that seizures begin between 6 and 22 years of age [30,31]. This patient was put on monotherapy with 1,000 mg/day of valproic acid. Almost complete remission of tonic-clonic and myoclonic seizures was achieved. A curious fact about this case is that his monozygotic twin brother had no complaints of epilepsy, and three completely normal EEGs.

Considering the criteria of Fisher et al., [17] nine of the 49 patients with epilepsy (18.36%) in our study were found to have characteristics of inactive epilepsy with an average of 15.2 years without epileptic seizures or use of antiseizure medications. This apparently high rate of remission cannot be explained by a single factor. We could first point out the cross-sectional nature of this study which does not permit more accurate data on an evolutionary perspective of a disease in a populational sample. Also, remission rates are certainly different considering distinct epileptic syndromes and the analysis of this aspect in our group with a wide age-range variation (0–98 years of age) could not be adequately addressed. However, high rates of remission in populational studies have also been reported by others such as in the study of a large rural population in Ecuador in which a 44% rate of inactivity was found [22]. The authors consider this pattern of remission as a possible influence of early onset treatment which could prevent the evolution of the condition into a chronic disease. In this regard, since our indigenous population is closely monitored at home by a health service, with easy access to neurological evaluation, a more precocious treatment initiation could also be provided and eventually influence that remission rate.

We could not identify the etiology of epilepsy in 41 (83.67%) patients because of limited access to imaging and genetic research resources. Genetic evaluation was requested for all patients with epilepsy of unknown origin or having a possible associated genetic factor. That investigation was requested to the Brazilian National Public Health Service including the appointment with a geneticist. Unfortunately, up until now we have not had any feedback about those requests. The apparent greater genetic predisposition to Epilepsy from Terena group is intriguing and we intend to keep on studying this aspect in that population. Neuroimaging tests were requested for all patients, but only 11 patients were submitted to those exams (seven computed tomography and five MRI scans; one patient had both).

The etiologies of different subtypes of epilepsy vary according to the patient’s age and geographic location. Congenital and genetic developmental malformations are associated with epilepsy in childhood, adolescence, and young adulthood. Epilepsy attributable to cerebrovascular diseases is more common among older adults. Head trauma, sporadic central nervous system infections, and tumors can occur at any age, although tumors are more likely to be found in people older than 40 years of age [18].

An epidemiological study of epileptic seizures carried out in Ecuador, South America, could not identify the causes of epilepsy in at least 73% of patients submitted to a screening questionnaire [21]. In the village of Jaguapirú, the etiology could be confirmed in eight patients (16.32%): three had a history of traumatic brain injury, two had brain malformations, two, a history of hypoxic-ischemic brain injury, and one had a cerebral vascular malformation.

In a study analyzing the triggering factors in 405 patients with epilepsy, found the lack of medication to be a precipitating factor in 40.5% of cases [23]. Of the 49 indigenous people diagnosed with epilepsy in the present sample, lack of medication was deemed an insignificant factor. This finding was likely the result of the primary care work performed by indigenous health agents. The contribution of sleep deprivation and emotional factors to epilepsy in our population was similar to that reported in the literature [23].

Congenital and developmental malformations are reportedly associated with epilepsy in children, adolescents, and young adults, as well as with the presence of perinatal injuries in patients with epilepsy [18]. We observed abnormal neurophysiologic development in 34.69% of the indigenous people diagnosed with epilepsy. In nonepileptic populations, the prevalence of abnormal neurophysiologic development is approximately 10% [24].

The decision to start antiepileptic treatment can be based on three criteria: risk of the recurrence of seizures; consequences of the continuation of seizures for the patient; and efficacy plus adverse effects of the drug chosen for treatment [25].

In agreement with the findings from international and Brazilian studies on antiepileptic treatment, we observed inactive epilepsy as above cited in nine of the 49 patients [26,27]. By categorizing these patients as in “seizure remission” and grouping them along with active patients with epilepsy with seizures controlled or remitting, we found 43 individuals (87%) with improved seizure morbidity and frequency.

The diagnosis of nonepileptic seizures (PNES) was guided by clinical history, normal EEGs, family reports, and assistance. Those patients have been closely followed up by the first author from the neurological point of view as well as by psychiatrists who assist that indigenous village on a regular basis. None of them showed worsening or refractoriness to treatment focused on psychological and/or psychiatric approaches. On the contrary, their treatment responses reinforced our impression of PNES.

In the present study, we were only able to confirm the diagnosis of febrile seizures in 13 cases from a subpopulation of 2,997 individuals (0.4%), which is a much lower prevalence than that reported in the literature. This finding could be attributable to several factors, including the cross-sectional study design, but it is unlikely to be due to the quality of medical evaluation, especially considering that all our study participants had two to four EEGs each with anamnesis and physical examination updated in those occasions. A possible information omission by indigenous parents should be also considered since ictal events during a febrile illness might be accepted as normal manifestations during childhood by those traditional communities.

The inclusion of only 52 percent of the total population was due to the exclusion of possible patients, such as those with non-indigenous miscegenation (non-indigenous father or mother), the ones who were not found in the household after 3 visit attempts on alternate days, and those who did not accept to participate in the research or were not willing to sign the term of consent.

The patients are still being monitored by the author, respecting the COVID-19 distancing guidelines.
5. Conclusion

It was found 1.6% of patients with epilepsy in the studied population during the research period, higher than the global prevalence in the overall population (0.5–1%) but similar to that reported in the Brazilian population. Focal epilepsy accounted for the majority of the identified epileptic syndromes (71.4%), with a predominance of epilepsy of temporal lobe origin. The frequency of febrile seizures was 0.4%, which was much lower than that in the general population. We attribute this finding to the cross-sectional nature of the study. The etiology of epilepsy was undetermined in 82.6% of the cases in this study. However, the identified causes included head trauma, hypoxic-ischemic encephalopathy, and brain malformations. Delayed neuropsychomotor development was related to the presence of epilepsy. An excellent therapeutic response was observed with first-generation antiseizure medication monotherapy in most cases (87.7%).

Electroencephalogram contributed to the definition of focal epilepsies and helped to diagnose patients with seizures of nonepileptic origin. The latter mostly comprised psychogenic seizures and, to a lesser extent, syncope. Vertigo predominated among adults older than 60 years of age. Psychogenic seizures were frequent among younger patients (the diagnosis of nonepileptic seizures was guided by clinical history, normal EEGs, family reports, and assistance from a psychologist and psychiatrist). Epilepsy was more prevalent in the Guarani ethnic group, although these patients comprised less than 30% of the sample. The lower socioeconomic status of this ethnic group in relation to the others could account for this disproportionate prevalence. While not statistically confirmed, we also noted an association between home birth and epilepsy. All patients with epilepsy are still undergoing clinical follow-up with the author.

Declaration of interests

The authors declare no financial conflicts of interest. We confirm that we have read the Journal’s position on issues involved in ethical publication and affirm that this report is consistent with those guidelines.

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