

Epidemiological, Clinical and Therapeutic Aspects of Neuropaediatric Emergencies in Children Aged 1 Month to 15 Years in the Paediatric Emergency Department of CHU-Gabriel Toure

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Abstract

Introduction: Paediatric neurological emergencies are a major public health problem worldwide, in Africa and in Mali. Despite the scale and complexity of paediatric neurological emergencies, there is little data in the literature in Africa and particularly in Mali on these neurological disorders in paediatrics.

Aim: The aim of our study was to examine the epidemiological, clinical and therapeutic aspects of neuropaediatric emergencies in children aged between 1 month and 15 years in the paediatric department of the CHU-Gabriel Touré in 2021.

Patients and Methods: This was a cross-sectional study conducted over a twelve-month period (01 January to 31 January 2021) in children aged 1 month to 15 years hospitalised in the paediatric emergency department for a neurological emergency.

Results: The frequency of hospitalization was 18.35%. The age group 12 to 60 months accounted for 43.7%. The sex ratio was 1.44. Convulsion was the most frequent reason for hospitalisation (49.3%). Delayed psychomotor development was noted in 4%. Around 3% of the children had not been vaccinated. On clinical neurological examination, the signs observed were: Altered consciousness (88.3%), convulsion (61%), and axial hypotonia (29%). Focal convulsions accounted for 59%, and 45.7% were febrile. The main diagnoses were neuromalaria, hyperpyretic convulsion and meningitis (68.3%, 7% and 6.3% respectively). The death rate within the first 24 hours was 48%. The average length of hospitalisation was 5.03 +/-4.5 days, with extremes of 1 and 21 days.

Conclusion: Neuropaediatric emergencies are a major paediatric health problem. They are frequent and contribute substantially to infant and child mortality in our context.

Keywords: Neurological Emergencies, Paediatrics, Bamako

1. Introduction

Neurological disorders, including paediatric neurodevelopmental disorders, have been identified by the World Health Organization (WHO) as one of the greatest threats to global public health

[1]. Throughout the world, in all age groups, they are one of the major causes of morbidity, mortality and long-term disability, as early as the ante-natal period [2-4]. Neurological emergencies are life-threatening because, whatever the cause, the common out-

come for surviving children is pathological phenomena (increased risk of cognitive, physical and psychological disability) as a result of secondary brain damage, and this usually has an impact on their educational and social integration. Their families suffer marked emotional, social and financial strain [5,6].

In general, childhood neurological disorders are much more common in developing countries than in developed countries, and the spectrum of diseases is also different compared to developed countries. This is due to multiple known risk factors such as lack of obstetric and neonatal care, infections, neonatal asphyxia, malnutrition, inadequate immunisation, poverty, war, displacement, lack of qualified personnel, limited access to diagnostic technology and limited resources for obstetric care. In poor countries, lack of resources, ignorance and overpopulation make it very difficult to solve this problem [1,7]. The majority of patients are seen by general practitioners who have little knowledge of neurological diseases. Most developing countries have very few, if any, neuropaediatricians. Yet there is a great need for neurological care in primary care, where the majority of patients struggle with convulsions, epilepsy and neuro-infections [8]. Neurological conditions affect thousands of children every year, accounting for 20-25% of paediatric intensive care admissions [9].

The International Survey of Children Aged 7 to 17 with Acute Neurological Conditions showed the following prevalence rates of intensive care admissions: 18%; 9.8%; 12.7% and 15.8% in North America, Asia, Europe and Africa respectively [7]. Although the vast majority of people affected by neurological disorders live in Africa, existing data in the medical literature is scarce [10]. In sub-Saharan Africa, the burden of neurological disorders remains high and, according to one study in 2017, the prevalence represented 5 to 25% of all admissions in hospital studies over the last 20 years [11]. In Mali, despite the scale and complexity of the phenomenon, the literature review did not document epidemiological data on neurological disorders in paediatrics. The present study was prompted by the lack of epidemiological data reflecting the extent of neurological disorders and disabilities in the paediatric age group, and by the lack of protocols for action in the most frequent neuropaediatric emergencies, including diagnostic and therapeutic guidelines to optimise the initial management of patients in a hospital facility in the event of a neurological pathology that could endanger them.

1.1. Objectives

To study the epidemiological, clinical and therapeutic aspects of neuropaediatric emergencies in children aged between 1 month and 15 years in the paediatric department of the CHU-Gabriel Touré in 2021.

2. Patients and Methods

This was a cross-sectional study conducted over a twelve-month period (01 January to 31 January 2021). It involved all children aged between 1 month and 15 years hospitalised in the paediatric emergency department of the CHU Gabriel Touré for a neurological emergency. Daniel SCHWARTZ's formula enabled us to calculate the size of our sample. Applying the formula gave us a minimum sample size of 136 children aged between 1 month and 15 years. To compensate for the risk of incomplete data, we increased this minimum size by 10% and the required size was 139 children. Data were collected on a survey form after verbal consent from the parent and/or guardian. The variables studied were epidemiological: age, sex, time to consultation, clinical: reason for consultation, signs of examination, paraclinical: TDR, GE, CSF cyto-bacteriological examination, ABO grouping, RH, haemogram, treatment and outcome. For all patients included, the clinical examination was based on neurological assessment, looking for the presence or absence of focal signs, their type and location, the level of consciousness (Glasgow score, Bicêtre scale and blantyre), the presence or absence of a language disorder (dysphasia), the functions of the cranial pairs, motor function, tendon reflexes (asymmetry), sensory function.

Haemodynamic status and the presence or absence of associated pathologies. Microsoft Office Excel was used for data entry and graphical representations (histograms and pie charts). Variable re-coding to facilitate statistical analysis. SPSS version 23 software was used to analyse the data. The data collected were presented in proportion form for the qualitative variables and in mean and standard deviation form for the quantitative variables

- A PEARSON Chi-square test was used to compare means and an alpha risk of 5% was used
- A tabular and graphical presentation of the data was adopted.
- R: software was used for univariate logistic regression. We presented the estimate of the odds ratio (OR) with its 95% confidence interval (CI); The association was considered significant when the p value < 5%. Data confidentiality was respected.

3. Results

3.1. Epidemiological Characteristics

Of the 1,635 patients admitted to the paediatric emergency department of the Gabriel Touré University Hospital during the study period, 300 children aged between 1 month and 15 years were admitted for a neurological emergency, representing a prevalence of 18.35%. These included 177 boys (59%) and 123 girls (41%), with an average age of 60.14 months and extremes of 1 and 180 months. The 12-60 month age group was the most represented (43.7%). Children from reference health centres accounted for 31%. (Table 1 shows the socio-demographic characteristics).

Characteristics		Number (n=1432)	Percentage %
Mean		62,04 ± 49,57	
Âge (months)	1-11	51	17
	12-59	102	34
	60-119	91	30,3
	120-180	56	18,5
Gender	Male	165	55
	Female	135	45
Origin	Bamako	140	46,7
	Outside Bamako	160	53,3
	Medical practice/Clinic	53	17,7
Reference	Cscom	47	15,7
	CSRef	93	31
	Hospital	29	9,7

Table 1: Epidemiological Characteristics

3.2. Clinical Features

Convulsion was the most frequent reason for hospitalisation (49.3%). Children who were admitted for more than 48 hours accounted for 62%. Delayed psychomotor development was ob-

served in 4% of children. Convulsion was the most common neurological history (7.67%). Around 3% of children had not been vaccinated. The admission peak was in October (19%) (Figure 1).

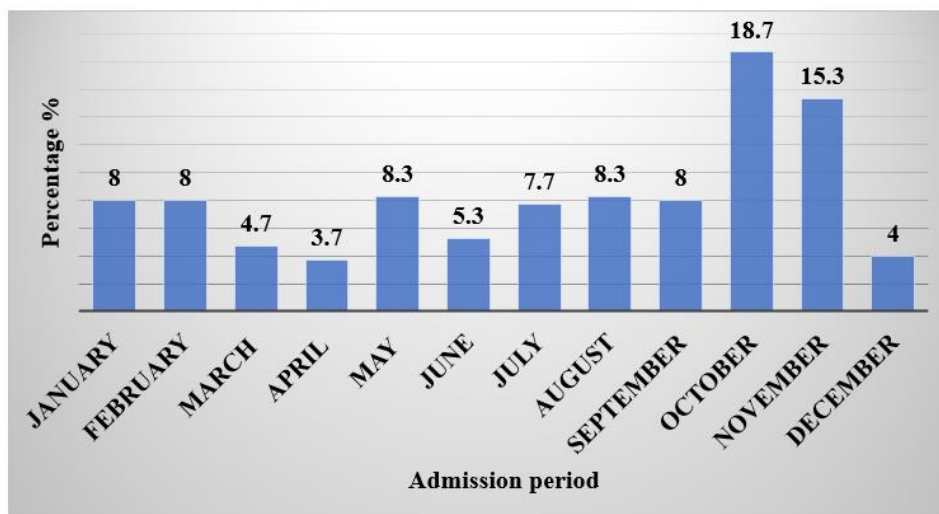


Figure 1: Breakdown of Children by Period of Admission in 2021

On clinical neurological examination, the signs observed in the children were : Altered consciousness with 88.3%, convulsion with 61%, and axial hypotonia with 29%. Focal convulsions accounted for 59% and were febrile in 45.7% (p=0.167). When the

state of consciousness was assessed, 53% of the children were ob-nubilated, with an SGS of 8-12 or a Blantyre of 4, depending on age (Figure 2).

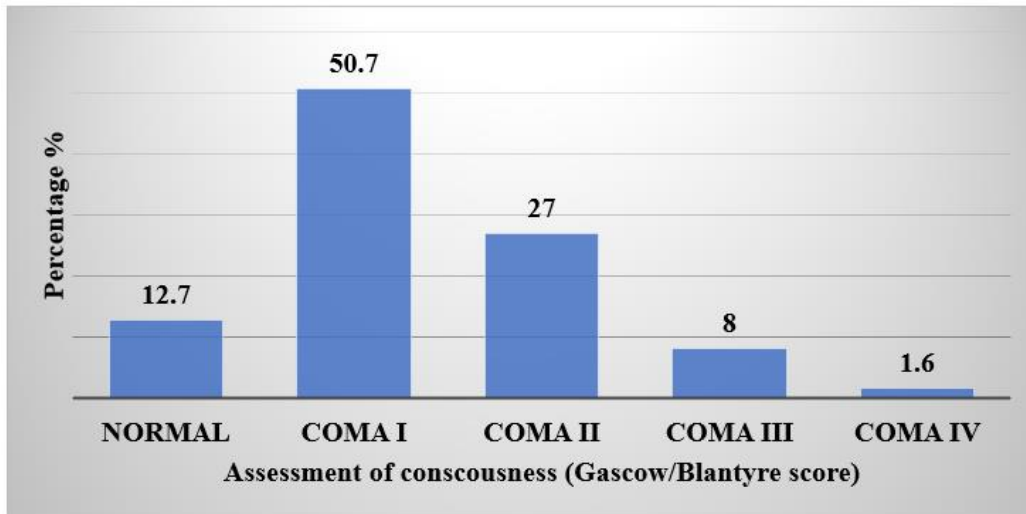


Figure 2: Distribution According to Glasgow/Blantyre Score

CSF was examined in 117 children (39%), and 86.3% of the CSF was clear. Thick film was positive in 42.73%. Cerebral CT scans were performed in 9.3% of patients, and were pathological in 69% of cases. Only 3 patients were able to have an electroencephalo-

gram (give EEG results). The main diagnoses were neuromalaria, hyperpyretic convulsion and meningitis, with 62.7%, 7% and 10% respectively (Table 2).

Diagnosis	Number	Percentage (%)
Neuromalaria	188	62,7
Hyperpyretic convulsions	30	10
Meningitis	17	5,7
Cerebrovascular accident	7	2,3
Tetanus	4	1,3
Encephalitis/meningoencephalitis	4	1,3
Epilepsy	3	1
Other	33	11
Total	300	100
Other: Multifocal infections, sequelae of cerebral atrophy, brain tumour		

Table 2: Breakdown by Diagnosis of Children Aged 1 Month to 15 Years Hospitalised for a Neurological Emergency in the SUP at CHU GT in 2021

In the univariate analysis, children living in rural areas were about 2 times more likely to develop neuromalaria than those living in urban areas, 95% CI: [1.07-3.48]; P = 0.031*; children whose fathers had some education were 0.4 times less likely to develop neuromalaria than those whose fathers had no education, 95% CI: [0.18-0.94]; P: 0.033; children whose mothers had a primary education were about 0.5 times less likely to contract neuromalaria compared to those with no education; CI 95%: [0.26-0.88] ; P: 0.017*.

3.3. Therapeutic Aspects

Antipyretics, antimalarials and anticonvulsants were the treat-

ments most commonly used by patients (90%, 78% and 62.3% respectively). The combination (Ceftriaxone-Gentamicin) was the most commonly used antibiotic therapy, with 38.3% of patients taking it. Diazepam was the anticonvulsant used in 60.7% of children.

3.4. Outcome

The mean length of hospitalisation was 3.70+/- 3.78 days, with extremes of 1 and 21 days. The case fatality rate was 47.3% (Figure 3), with a 58% rate of death within the first 24 hours. Neuromalaria was the most lethal condition (82.5%).

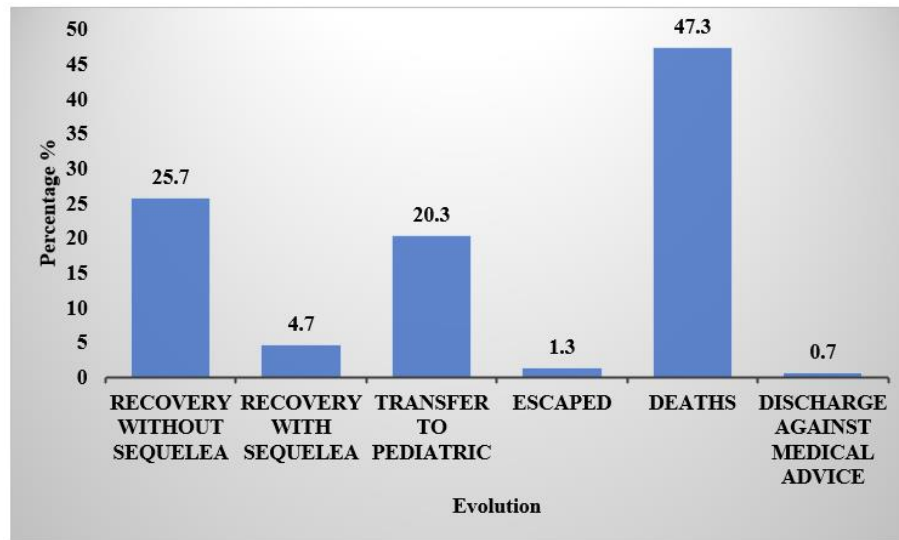


Figure 3: Breakdown by Evolution

4. Discussion

Of all the 1635 children hospitalised in the paediatric emergency department of the Gabriel Touré University Hospital in 2021, the frequency of neurological emergencies was 18.35%. This frequency is higher than that of the studies by Ngoué JE, et al in Cameroon, Ofovwe GE, et al in Nigerian children and Moreau, et al in the USA, with respectively 10.6%, 15.6% and 10.7% [4,12,13]. However, it is lower than that of Abbas et al (2008-2012) in Pakistan, and Mohamed et al (2007-2013) in Sudan, who observed proportions of 19.4% and 62.7% respectively [14,15].

In our context, the high frequency of neurological emergencies in the paediatric emergency department could be explained by the high proportion of infections, particularly malaria, which is endemic in Mali. Another reason for observing differences between studies is variation in sample size, study context, study duration and inclusion conditions. In countries with limited resources, including Mali, child neurology and paediatrics in general are not well established at the primary level of health care; thus, lack of qualified staff, failure to diagnose or delayed diagnosis in children in primary care centres make child neurological disorders a frequent cause of referral to tertiary care hospitals [15,16].

Generally speaking, the age groups varied according to the studies. In our study the mean was 62.04 months with a standard deviation of 49.57 months. This result is somewhat similar to that obtained by Akodu, et al in Nigeria, in whom the 1 to 60 month age group was the most represented (37.6%), with an average age of 52.96 ± 52.62 months, but different from that of Chand, et al in Pakistan, who recorded a predominance of children over 5 years of age (52%), with an average age of 6.04 ± 4.71 years [17,18]. In our context, the predominance of children under 5 years of age (1 to 59 months) is due to the fact that at this age the child is still growing, has vulnerable cerebral structures, is immunologically immature and is more exposed to a variety of common infections.

Convulsion was the cause of the majority of neurological admissions, accounting for with 54%, followed by altered consciousness with 35.7%. This finding was reported by Avoune in Morocco (42.3%), and Albertini, et al at the CHU Timone de Marseille in France [19,20]. In Spain, on the other hand, Garcia-Peñas, et al found epilepsy to be the most frequent reason for admission (41%) [21]. This high frequency of convulsive disorders recorded in the present study could be explained by a greater awareness that convulsion is a medical condition that can be treated, contrary to the traditional belief that it is caused by evil spirit manipulation and witchcraft attacks. In our study, convulsion was the most common neurological antecedent (7.3%). On the other hand, Wammanda, et al in Nigeria and Jiménez-Méndez, et al in Maracaibo, Venezuela found meningitis and congenital hydrocephalus respectively to be the most frequent neurological antecedents [5,22].

According to the parents or carers, the majority of children presenting with neurological emergencies had been vaccinated, i.e. 97.3% according to the national immunisation schedule (EPI). This status testifies to the degree of awareness already acquired by Malian citizens with regard to vaccination. On physical examination, altered consciousness was the most frequent neurological sign in our study with 87.3%, 53.7% of which were post-convulsive with a non-significant p-value ($p=0.09$) and 50.7% had a Glasgow score of between 8-12 or a Blantyre 4 depending on age. In contrast to the studies carried out by Osamura et al in Japan and Avoune in Morocco, seizures were the neurological signs most present on physical examination, at 81.6% and 42.4% respectively [19,23]. In addition, various neurological symptoms and signs were present concomitantly, including convulsions (59.7%), meningeal syndrome (3.7%), motor deficits (3.7%) (paresis/hemiparesis, hemiplegia), axial hypotonia (24.3%), reflex disorders (1.3%), cutaneous hypoesthesia (2.7%) and aphasia/facial paralysis (0.7%).

Motor deficits were most common in stroke and sequelae patients,

and axial hypotonia in patients with neuromalaria. In order to confirm the diagnosis and, if possible, quantify the neurological damage, additional tests were prescribed. All the tests were carried out according to the signs and symptoms present in the children. Thick smear tests and/or RDTs were positive in 73.7% of patients in our series with clinical sign(s) consistent with neuromalaria. Hypoglycaemia was present in 7.7% of hospitalised children.

CSF was examined in 90 patients (30%), 90% of whose fluids were clear and 35.6% confirmed meningitis. Bacteriology was positive in 2.2%, with no viral tests. This result is similar to that of Abbas, et al in Pakistan, who reported CSF in 33% of cases [14]. However, it differs from that of Avoune in Morocco, whose study found CSF in 54.7% of patients, with a lower cellularity than ours (49.3%), and positive bacteriology in 7.8% [19]. Our result could be explained by the difficulty of carrying out viral tests in our context due to the limited resources of our biological laboratories. The electroencephalogram was performed in only 1% of patients and they were all Pathological with either diffuse slow waves or focal wave peaks. Cerebral CT scans were performed in 7% of patients, 52% of whom had current pathologies, 30% had old lesions and 18% were normal. These results differ from those reported by other studies, such as that of Avoune in Morocco, who reported an EEG in 5% of patients, 84.2% of whom had pathological tracings; a cerebral CT scan in 58% of patients, 62% of whom were normal, 33% pathological and 5% with old lesions; and a cerebral or cerebro-medullary MRI scan in 6% of patients, 83.3% pathological and 16.7% with no abnormalities [19]. In Pakistan, Abbas, et al reported that 65% of children had an EEG, 70% had a CT scan and 42% had an MRI [14].

The low rate of complementary examinations such as CT and EEG could be explained by the high cost of these examinations, due to financial constraints, and the insufficient number of these devices in our country. Furthermore, at the Gabriel Touré University Hospital, there is no EEG and cerebral CT scans are only performed on children once a week. The most frequent aetiologies were: neuromalaria (62.7%), followed by hyperpyretic convulsions (10%) and meningitis (5.7%). Several authors have reported results, notably the studies by Atanda, et al in the DRC, Akpan, et al in Nigeria and Wilmschurst et al in Malawi [24-26]. On the other hand, in Spain Garcia-Peñas et al reported other aetiologies such as headache (39%), paroxysmal non-epileptic episodes (20%) and epileptic seizures (15%) [21].

In our context, these results could be explained by the endemicity of malaria in Mali. As young children are not protected against malaria, in the event of infestation by *Plasmodium falciparum*, their clinical condition could rapidly worsen and develop into neuromalaria. Particular emphasis must therefore be placed on preventing this disease. These findings suggest that central nervous system (CNS) infections such as neuromalaria, hyperpyretic convulsions and meningitis account for a significant proportion of paediatric neurology cases in Africa, particularly in the sub-Saharan region.

Given that most of them are severe and have a high potential for full recovery if recognised early and appropriate interventions initiated in a timely manner. They should be given the highest priority in the diagnostic approach. However, when it comes to the types of neuropaediatric emergency most frequently treated, the spectrum differs from country to country. In developed countries, headaches, epileptic seizures, paroxysmal non-epileptic episodes and febrile convulsions predominate, whereas in underdeveloped countries, cerebral malaria, febrile convulsions and bacterial meningitis account for up to 90-95% of all neurological emergencies [3].

The management of a child with neurological disorders is complex and requires a careful balance between cerebral and systemic priorities. In our study, the first-line treatments for neurological emergencies were antipyretics (injectable paracetamol) and anticonvulsants, in particular diazepam, with 79% and 54.7% respectively. The choice of these drugs over others in their class could be explained by their availability in pharmacies, their accessibility, their efficacy, their rapidity of action, their lower cost compared with others, and also the fact that the clinical manifestation of certain infectious diseases includes fever, pain and convulsions. The most commonly used aetiological treatments were antimalarials and antibiotics. Of the children admitted, 72.3% had received anti-malarial drugs, with injectable artesunate the only molecule used. The majority of our patients received antibiotic therapy in 56.3% of cases, the most commonly used being monotherapy with Ceftriaxone (37.3%) followed by dual therapy with the combination of Ceftriaxone and Gentamicin (36.7%). For the management of neuropaediatric emergencies, Avoune in Morocco reports that the most commonly used treatments are antibiotics (40%), antiepileptics (39.4%) and anticonvulsants, with diazepam the most commonly used anticonvulsant (30.6) [19].

The high initial suspicion of bacterial meningitis may explain the high rate of antibiotic use. Inadequate treatment in health facilities and the unaffordable cost of treatment for the majority of the population, as well as a lack of knowledge about neurological pathologies and their seriousness in children, lead to self-medication at home and recourse to traditional medicine. The outcome was marked by a high case-fatality rate of 47.3%, 58% of which occurred within 24 hours of admission. Out of a total of 142 deaths recorded, 85 were related to neuromalaria, 16 to hyperpyretic convulsions, 8 to meningitis, 4 to neuromalaria/meningitis co-infection, 3 to stroke, 1 to tetanus, 1 to encephalitis, and 24 to other causes of neuropaediatric emergencies (multifocal infections, cerebral atrophy in the sequellary phase, brain tumour).

Of the children successfully treated, 25.7% progressed to recovery without sequelae and 4.7% to recovery with sequelae such as hypotonia, hemiplegia and language disorders. Approximately 20.3% of patients were transferred to the general paediatric ward for further management, 1.3% of patients escaped and 0.7% were discharged against medical advice. These results differ from those found in other studies in Africa and elsewhere, notably in southern Nigeria in the paediatric emergency department of the University

Hospital of the State University of Benin, Ofovwe, et al reported an emergency neurological mortality rate of 15.8%, 67.2% of which occurred within 24 hours of admission; in Morocco, in the paediatric emergency department of the mother and child hospital at the Hassan II University Hospital in Fez, Avoune reported a death rate of 9.3%, 77% of which occurred more than 24 hours after admission, with 49.3% of patients discharged home and 41.4% transferred to another department; in Pakistan, Abbas et al found a mortality rate of 18%; in the USA Williams, et al reported a death rate of 12% [7,13,14,19]. The fatal outcome was mainly predicted by the clinical features of the advanced and severe disease at the time of presentation (altered consciousness, cachexia, fever, etc.) rather than by epidemiological risk factors such as distance from hospital or age. Observations showed that preventable infectious diseases were the main causes of emergency neurological morbidity and mortality.

The majority of children died within 24 hours, largely due to the long consultation time. However, the high mortality rate in this study can also be attributed to other factors, including the severity of the neurological illness and the inadequacy of resources for the needs of the paediatric emergency department. In our context, prompt recognition and management of neurological emergencies, as well as effective control of malaria and prevention of meningitis, would reduce the incidence of neurological morbidity, and if these measures are combined with health education of the population on the importance of prompt access to a health facility, mortality from these causes would be significantly reduced. This underlines once again that early diagnosis in the field is essential and must more than ever be based on a meticulous and well-educated medical examination, supported by the judicious use of appropriate discriminating tools in order to reduce the mortality rate.

In our study, the majority of children (81%) spent less than 6 days in hospital. The average length of stay was 3.70 days, with a standard deviation of 3.78 days. In our context, the high number of deaths and the lack of space, most often at the time of peak admission, or patients who after stabilisation are transferred to the general paediatrics department or followed up as outpatients, could explain the short duration of hospitalisation. In addition, hospital paediatric emergency departments were created to improve the management of conditions which, due to their severity, require urgent medical assistance [27].

5. Conclusion

Neuropaediatric emergencies are a major paediatric health problem. They are frequent and contribute substantially to an increase in infant and child mortality in our context.

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