



## A Retrospective Study on the Topographical and Etiological Aspects of Acute Flaccid Paralysis in Children in Kenitra Province, Morocco

Samira Jayche<sup>1</sup>, Amr Loutfi<sup>1</sup>, Sanae Sendaoui<sup>2</sup>, Fatima Z. Talbi<sup>3\*</sup>, Mohamed Lahmam<sup>4</sup>, Ahmed Idrissi<sup>5</sup>, Ahmed O.T. Ahami<sup>1</sup>

<sup>1</sup>Unit of Neuroscience and Nutrition, Biology and Health Laboratory, Department of Biology, Faculty of Sciences, Ibn Tofail University, Morocco

<sup>2</sup>Ministry of Health in Agadir, Morocco

<sup>3</sup>Laboratory of Biochemistry, Neurosciences, Natural Resources and Environment, Faculty of Sciences and Technologies, Hassan First University of Settat, P.O. Box 577, 26000 Settat, Morocco

<sup>4</sup>Ministry of Health in Kenitra, Morocco

<sup>5</sup>National School of Public Health, Rabat, Morocco

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### ABSTRACT

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The poliovirus was declared extinct in 1988. In Morocco, the most recent case of wild poliovirus (WPV) was reported in 1989. From 1994 to 2018, Kenitra's polio topographical and etiological epidemiology were described using WHO-recommended polio surveillance criteria. This retrospective descriptive study was conducted following WHO guidelines to examine the topographic and etiological factors that contribute to acute flaccid paralysis (AFP) in Kénitra, Morocco. Patients were recruited from several communities in the Kenitra province throughout a 25-year period, from January 1, 1994, to December 31, 2018. From 1994 to 2018, 76 cases of AFP were reported. The children ranged in age from 3 months to 14 years old; 52% were under the age of 5, and 58.67% were boys. At the time of paralysis onset, 57.33% of children had a fever, and 16% had asymmetric paralysis. The most common diagnosis was Guillain-Barré syndrome (59%), and 72% of sick children received more than three doses of the polio vaccine. Good coverage was obtained due to the national immunization program, as evidenced by the vaccination status. All cases were classified as non-polio AFP. There were no reports of poliovirus, and the vaccination status suggests that there was enough coverage due to the national immunization program. Morocco is vulnerable to the reintroduction of wild viruses due to its geographical location and constant intake of immigrants. This necessitates ongoing vaccination and surveillance efforts until the disease is declared eradicated.

**Keywords:** Children, Epidemiology, Etiology, Flaccid paralysis, Kenitra, Morocco, Topography.

### Introduction

Morocco is one of the eastern Mediterranean countries with varying levels of polio transmission risk. Afghanistan and Pakistan are endemic; the rest of the eastern Mediterranean region is classified as extremely high-risk (Syria, Yemen, and Somalia) or high-risk (Iraq, Sudan, and Libya), and the others are classified as low-risk.<sup>1</sup> The province of Kenitra is located in northwest Morocco and is part of the Rabat Salé Kenitra area (RSK). It accounts for 17% (or 3,253 km<sup>2</sup>) of this region and has a 140 km ocean boundary (Figure 1). Because of its geographical location, the province of Kenitra acts as a transit hub for many sub-Saharan migrants. The bulk of these migrants is from locations where infectious diseases such as malaria and polio are endemic, both of which are being certified in Morocco.<sup>2</sup> As a result, Morocco should meet the requirements of the WHO's Commission for Poliomyelitis Eradication Certification. For a long time, polio was the leading cause of physical disability in Morocco. There were 289 recorded incidences of polio between 1980 and 1989.<sup>2</sup>

\*Corresponding author. E mail: [fatimazahra.talbi@uhp.ac.ma](mailto:fatimazahra.talbi@uhp.ac.ma)  
Tel: +212671543020

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The risk of wild poliovirus re-entering the country, however, must be considered in addition to ensuring that all children are immunized. Strict surveillance and immunization are required to keep Morocco disease-free. Between 1986 and 1987, an increase in vaccination coverage by the oral polio vaccine (third dosage) from 45 to 85% allowed the wild poliovirus to be eradicated from the Moroccan population. The last two cases of polio were reported in 1989.<sup>2</sup>

In 1991, the Acute Flaccid Paralysis (AFP) surveillance system was developed, and in 1995, the National Institute of Hygiene (NIH) launched the polio eradication effort by constructing an accredited laboratory. Morocco, along with other countries in the Eastern Mediterranean Region (EMRO), committed to the WHO's polio eradication certification process in 2001. This is due to the success of the established approach, which permits all required performance metrics to be met (Figure 2).

The performance criteria for the surveillance system and the follow-up of patients with AFP are two of the most essential standards. Regardless, eradication is an "all or nothing" endeavor. Because the virus is so contagious, failure to eradicate polio from its last strongholds could result in a resurgence of the disease, with as many as 200,000 new cases every year in the next ten years.<sup>3</sup> For the time being, the AFP National Monitoring Program is the gold standard for polio detection. Morocco, on the other hand, should be able to detect and record all AFP (2/100,000) possible incidences, as well as examine them (stool samples and inspection) within 60 days (despite announcing zero polio cases). Since 1994, the NIH has been a reference laboratory and has been accredited since 2001. It is responsible for investigating all AFP cases reported in Morocco, seeking polioviruses or other non-polio enteroviruses responsible for AFP in children under the age of 15. When non-samples of AFP cases were collected within 14 days after the onset of paralysis, NIH tested the entourage of the respective cases.<sup>4</sup> The data

and results are sent to the DELM, which is subsequently forwarded to the WHO.

The present study was conducted to describe the epidemiological profile of children with AFP between 1994 and 2018 (25 years of surveillance), to present the frequency of non-polio enteroviruses and the most affected environments/regions, and to identify the clinical aspects of detected cases and their evolution. Also, the geographical and etiological aspects of AFP in children under the age of 15 in the Kenitra province were investigated.

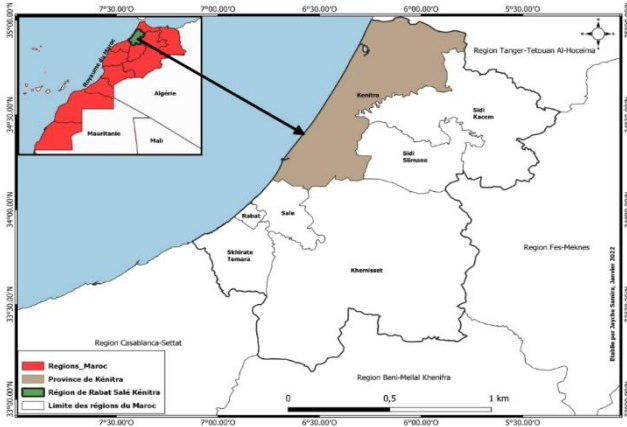


Figure 1: Geographical location of Kénitra Province (2022).

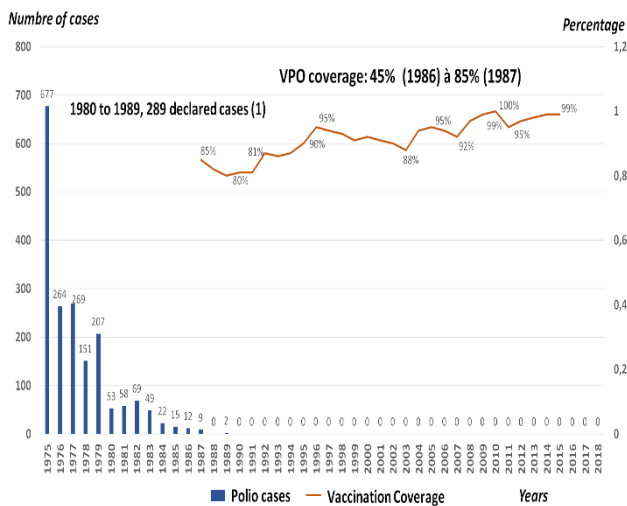


Figure 2: Reported polio cases (1975-2018) and OPV vaccination coverage (since 1986).

Materials and Methods

Study design

This study is a retrospective and descriptive analysis of AFP active surveillance in Kenitra province for a period of 25 years (1994 - 2018). It focused on 76 AFP cases in all. Data collection included children under the age of 15 in Kenitra province who had symptoms of AFP and PFA, regardless of the location of the paralysis or the cause. The study excluded all reported PFA cases outside the study period.

AFP surveillance

All AFP cases that met the WHO definition were subjected to standardized treatment by being classified as polio cases. This is required even if the patient has Guillain-Barre (GB) syndrome or another non-polio AFP.<sup>2</sup>

Case definition

A child under the age of 15 who has recently or suddenly developed floppy paralysis or muscle weakness due to any cause, or any individual

of any age with paralytic illness if poliomyelitis is suspected by a clinician, is considered an AFP case.<sup>5</sup>

Declaration of ethics and protection of personal data

Patients were not asked to provide informed consent because all the data for this retrospective study were obtained through AFP case investigation forms as part of mandatory disease reporting. However, an authorization request was submitted to the National Committee for the Protection of Personal Data (CNPDP). Individually identifiable information was kept strictly confidential. Only anonymized and summarized data were provided as part of the statistical analysis, and the study data were kept in a safe place.

Ethics approval and consent to participate

Patients were not asked to express informed consent for this retrospective study because all the data utilized were previously acquired through PFA case survey forms as part of the mandatory illness reporting process. A request for permission, however, was made to the National Committee for the Protection of Personal Data (CNPDP).

Data analysis

Data was collected using AFP case investigation forms at the provincial epidemiology unit. This study is a descriptive quantitative analysis of the population under consideration. The study focused on socio-demographic, clinical, and other data, which are presented as percentages and averages. The level of significance was fixed at 0.05. Using the appropriate statistical tests, bivariate analysis and measures of disease relationship were established. It included all AFP cases reported to the Kenitra province during the study period and matched the inclusion criteria.

Results and Discussion

Over 25 years (1994-2018), 76 AFP cases were reported. The annual number of AFP cases recorded ranged from zero in 1999/2000 to nine in 2015. The target of six cases per year (1 case per 100,000 people under the age of 15) was met in 2002, 2004, and 2007, but only four instances were achieved in the other years. Figure 3 depicts the proportions of AFP cases reported (annual number and prevalence). The gender distribution revealed a male predominance, with boys accounting for 59% of patients compared to 41% of girls, for a sex ratio (M/F) of 1.43. Acute flaccid paralysis has struck 51% of infants aged less than five years, 28% of children aged 6-10 years, and only 21% of children aged 11-15 years. The rural population exceeded 77%, while the urban population accounted for only about 23% (Table 1). Kenitra has the highest number of declared AFP cases, followed by Ben Mansour with 10, while Sidi Boubker El Haj has the lowest number, with only one notified AFP case in the last 25 years (Figure 4).

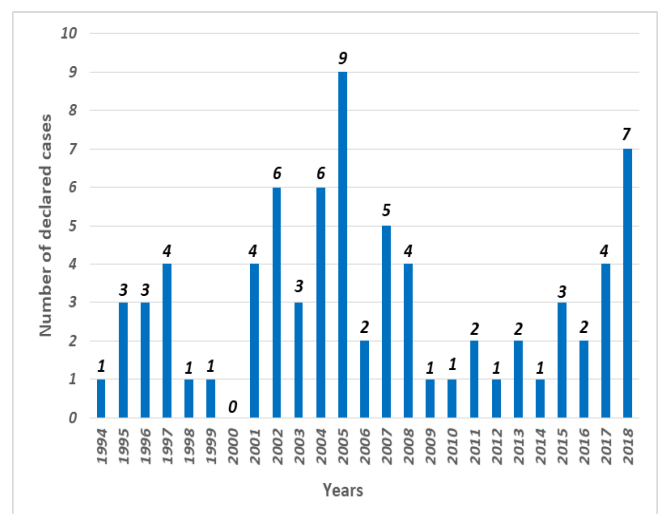


Figure 3: Yearly distribution of acute flaccid paralysis (AFP) cases in Kenitra, Morocco from 1994 to 2018.

The Salk vaccine (IPV) was first developed in 1953 and was first administered in the United States in 1955. A few years later, the Sabin vaccine (OPV) was produced in 1956.<sup>6</sup> On the other hand, the present objective of polio eradication is to eliminate not only the disease but also the virus. The eradication program in Morocco began in 1988 under the auspices of WHO. The eradication deadline was set for the year 2000 and was then postponed to 2005 and then to 2010. However, the epidemiological situation once again prevented this objective from being met. Finally, the program's strategic plan (2010-2012) was developed to end the circulation of wild polioviruses by the end of 2012. However, it failed to meet the new deadline. Although the global target has not yet been met, polio is more strictly delimited than ever, with the number of cases recorded becoming lower than ever.<sup>7</sup> There were 350,000 cases in 125 endemic countries by 1988, and just three cases were declared in the three endemic countries of Pakistan, Afghanistan, and Nigeria in 2017.<sup>8</sup>

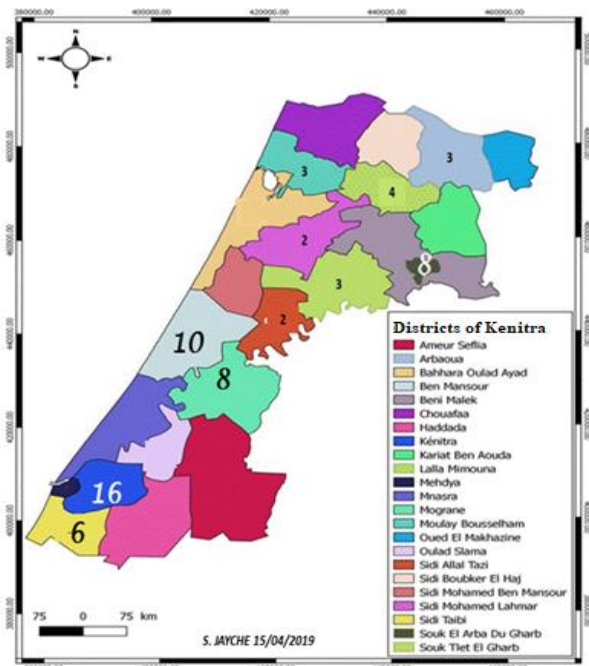
Surveillance of AFP cases appears to be the most effective method of limiting the spread of wild poliovirus (WPV).<sup>9</sup> To this end, it must be specified how to maintain the continuity of detection, investigation, and monitoring, as well as how to preserve and secure the information and resulting data. From 1994 to 2018, 144 incidences of AFP were supposed to be recorded in the Moroccan province of Kenitra (6 incidents per year), however, only 76 were reported. The 76 cases were spread at random: nine cases in 2005, seven in 2018, none in 2000, six cases (the threshold per year) in 2002, 2004, and 2007, and no more than four declarations in the other years. Throughout the study period, the number of AFP-reported cases was significantly lower than expected. Similar findings have been reported at the national level (2006-2011),<sup>10</sup> as well as among Morocco's neighbours in the EMRO region, the AFRO region (World Health Organization regional office for Africa), including Algeria and Mauritania, and the EURO region (World Health Organization regional office for Europe), including Spain, which has already declared itself polio-free. This is most likely due to a relaxation of oversight and the lack of private sector participation in the notification.<sup>11-14</sup>

The results of this study revealed that the most common age for AFP cases was less than 5 years (51%),<sup>11,12,14,16,17,19</sup> with male predominance (59%),<sup>10, 11,16,17,19</sup> and the patients came from rural areas (77%).<sup>10,20</sup> Poliovirus is transmitted faecally and orally through contaminated water, with children under the age of five being the most vulnerable due to a weakened immune system (incomplete vaccination doses) and a lack of hygiene knowledge. Each of Kenitra's municipalities has reported AFP incidents.<sup>23</sup> The geographical distribution of these towns demonstrates a significant reported disparity. Kenitra came first with 15 cases (19%), followed by Ben Mansour with 10 cases (13%), and Sidi Boubker El Haj, Mahdia, and Sidi Ayache in last place with only one case each (3%). Reporting differences between zones have also been noticed at the national level in Morocco and Yemen.<sup>10,15</sup> This disparity could be explained by information dilution or loss from upstream to downstream, particularly in terms of case definition, or by the population density of these towns. The clinical features of the observed AFP cases vary, but a prevalence of acute and flaccid paralysis (87%), which is asymmetric in about 16% of cases, followed by fever (57%) at the outset of the disease was observed (Table 2). Lower limb muscles (90%) were the most impacted, particularly on the right side. However, the respiratory muscles (24%) and loss of senses (13%) were also affected in the most severe cases. The location of the paralysis is not specified for a child.

According to the data analysis, muscle attack is age-dependent. Respiratory muscle paralysis is more common in children under the age of five ( $p = 0.0049 < 0.05$ ), whereas upper limb paralysis is more common in children beyond the age of five ( $p = 0.0046 < 0.05$ ). The hospitalization time is the time between the start of paralysis and the hospital's admission for treatment. It ranges from zero to 84 days in this study (Table 3). Fifty-nine percent (59%) of children were admitted to the hospital within seven days, 11% were admitted beyond seven days, and 27% had no record time. The analysis revealed that the place of residence (urban or rural) has no significant impact on the delay in hospitalization ( $p = 0.530$ ), as did gender ( $p = 0.08$ ) and age ( $p = 0.9$ ). However, the location of the paralysis (upper limbs) is significant ( $p = 0.01 < 0.05$ ). Children's paralysis has a wide range of clinical symptoms.

They can start with just a fever (58%) or with acute (92%) and/or flaccid paralysis (90%), and asymmetric paralysis is unusual (a sign of probable poliovirus infection).<sup>11-13,16,18,21,20</sup>

In general, the muscles of the lower limbs are the most affected (90%).<sup>11,12,22,23</sup> Paralysis of the respiratory muscles (23%) in the most severe cases, and a large number of deaths with a substantial difference, was detected.<sup>12,24</sup> In one out of every 200 polio cases, paralysis of the respiratory muscles might result in death for 5 to 10% of patients.<sup>3</sup> Children's vaccination information was mostly available on their vaccination cards (52.63%), health records (19.74%), health center registers (8%), and from their parents (3%). In 10.53% of cases, no information was provided, and 3% did not have vaccination cards. In addition, it appeared that 72% of vaccinated children received more than three doses of the polio vaccine, while 24% of cases had no information recorded (Figure 5). The analysis of these data revealed that place of residence (urban or rural area) and sex (male or female) do not affect vaccination status ( $p = 0.09$ ). Although just 3% of cases lacked a vaccination card or a health card, vaccination data were not adequately captured in 24% of the forms examined. In 76 percent of the cases, more than three doses of the vaccination were administered.<sup>25,26</sup>



**Figure 4:** Number of acute flaccid paralysis (AFP) observed in Kenitra, Morocco province between 1994 and 2018.

**Table 1:** Descriptive epidemiology of 76 acute flaccid paralysis cases reported in Kenitra, Morocco between January 1994 and December 2018

Characteristics	Frequency	Percentage
<i>sex</i>		
Male	45	59%
female	31	41%
<i>Age groups</i>		
0 – 5 years	39	51%
6—10 years	21	28%
11—15 years	16	21%
<i>Environment</i>		
Urban	59	77%
Rural	17	23%

Furthermore, as part of the vaccine program, vaccination records are well protected at the provincial level. These data support and sustain the high level of poliovirus vaccine coverage in children under the age of one year. Although only 3% of cases did not have the vaccination card or the health card, vaccination data were not adequately captured in 24% of the forms examined. In 76% of the cases, more than three doses of the vaccine were administered.<sup>25,26</sup> Furthermore, as part of the vaccine program, vaccination records are well protected at the provincial level. These results support the high level of poliovirus vaccine coverage in children under the age of one year.

In terms of patient development and follow-up, three evolutionary modes have been identified: favourable evolution, which was observed in 38 patients (50%) with total recovery; evolution with sequelae, which was reported in 32 patients (42.11%); unfavourable evolution (death), which refers to the number of patients who died, accounting for 7 children (6.58%); and no information, which was discovered with no information needed to determine the health state of the hospitalized children, three of whom were unable to be followed up on. Analyzing the deaths based on the location of the paralysis revealed that neither the place of residence (urban, rural, or commune), nor the age or gender influenced the death. However, the location of paralysis appears to influence the severity of cases, leading to death. Children who had respiratory muscle paralysis ( $p = 0.01$ ) died. The different etiologies of AFP were recorded in the present study, as shown in Table 4.

**Table 2:** Distribution of acute flaccid paralysis (AFP) cases according to their clinical symptoms.

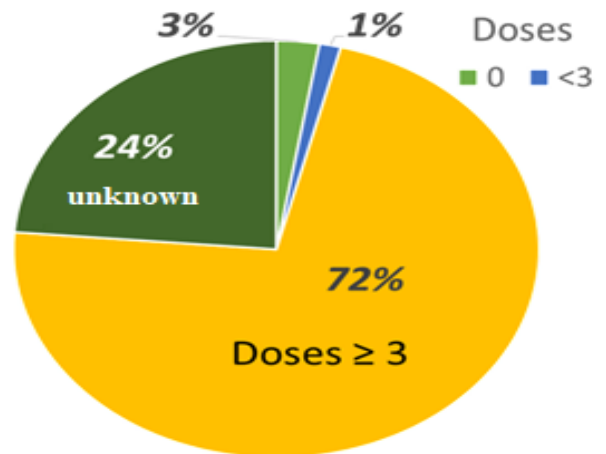
Clinical presentation	Number	Percentage
Acute Paralysis	70	92,11
Flaccid Paralysis	69	90,79
Fever at the beginning of paralysis	43	56,58
Asymetric paralysis	12	15,79
Site of paralysis	Number	Percentage
Lower left muscles	66	86,84
Lower right muscles	67	88,16
Higher left muscles	40	52,63
Higher right muscle	41	53,95
Respiratory muscles	18	23,68
Neck muscles	8	10,53
Face muscles	1	1,32
Loss of sense	10	13,16

**Table 3:** The delay to hospitalization and the onset of paralysis

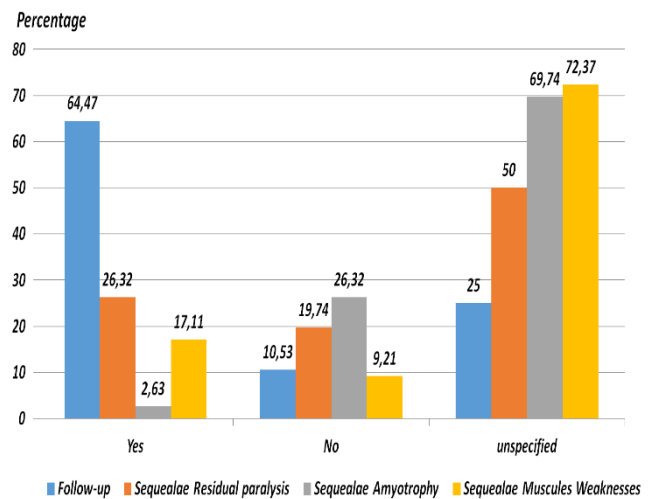
Delay	Number	Percentage
Less than 7 days	45	59,21
More than 7 days	9	11,84
Not specified	21	27,63

**Table 4:** The different etiologies of acute flaccid paralysis (AFP) cases in Kenitra, Morocco

Diagnosis	Number of patients	Percentage
Guillain-Barre (GB)	22	44,90
Myelitis	6	12,24
Polyradiculoneuritis	12	24,49
Others	9	18,37



**Figure 5:** Distribution of acute flaccid paralysis (AFP) cases by vaccination status in Kenitra, Morocco from 1994 to 2018.



**Figure 6:** Follow-up patients and observed sequelae in Kenitra, Morocco from 1994 to 2018.

Guillain-Barre syndrome is predominant. In 64.47% of cases, the final diagnosis was provided, whereas information was missing in 35.53%. The syndrome occurred in roughly 45% of cases, with the remaining 18% divided among meningoencephalitis, spinal cord ischemia, brain tumour, spinal cord trauma, and sickle cell anaemia. Approximately 41% of the children evaluated had residual paralysis, 20% had limb muscular weakness, 1/5 of which was in the left lower limb, and 60% required walking help (Figure 6). Two of the patients who were not followed up on (eight children) died; three cases were lost to follow-up, and one patient's father refused to be followed up on. In 64.47%, the final clinical diagnosis was obtained, while information was absent in 35.53%. Guillain-Barré syndrome (GBS / polyradiculoneuritis) was observed in 44.90% of the cases. Myelitis (12.24%) and polyradiculoneuropathy (24.49%) were also found. These results are consistent with those obtained in Egypt,<sup>27</sup> Afghanistan,<sup>28</sup> Spain,<sup>12,13</sup> Turkey,<sup>17</sup> Jordan,<sup>26</sup> and Iran.<sup>16</sup> The patient should be re-examined. It is necessary to offer the final diagnosis 60 days after the start of paralysis to search for any paralytic sequelae and decide if the diagnosis should be retained.<sup>2</sup> During the study period, residual paralysis (26.32%), muscle weakness (17.11%), 10.53% not followed, and 25% of the files with missing information over the study period were observed.<sup>13,29</sup> The most important difference between polio and other causes of AFP is the course; paralytic sequelae are common in polio, whereas other symptoms tend to heal in 60 days.

To the best of our knowledge, this retrospective study remains the first of its kind ever, describing the epidemiological, etiological, and topographic profiles of patients with AFP admitted to the El Idrissi

Paediatric Hospital, Kenitra, between 1994 and 2018. The information was gathered by going through the patient files. Furthermore, a considerable number of factors (final diagnosis, vaccination status, etc.) were not documented in the files, complicating data analysis. The flaws were mostly related to indications like the number of cases to report each year and the percentage of non-polio enterovirus isolates discovered in the tested samples. The data were collected by going through the patient files. However, there were a large number of variables (final diagnosis, vaccination status, etc.) that were not recorded in the files, which made data analysis complicated. The setbacks were mostly related to indications like the number of cases to report each year and the percentage of non-polio enterovirus isolates discovered in the tested samples.

## Conclusion

This study examined the epidemiology, topography, and etiology of children with AFP in Kenitra, Morocco. Although there have been no reported cases of poliovirus, the number of reported cases is still lower than predicted. The vaccination status indicated that there is good coverage, that GB syndrome is the most common cause recorded, and that their developments were generally favourable. Although weekly and monthly reports confirm the absence of wild poliovirus circulation in Morocco, AFP surveillance and vaccination coverage must be strengthened and maintained until polio eradication certification is obtained.

## Conflict of Interest

The authors declare no conflict of interest.

## Authors' Declaration

The authors hereby declare that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by them.

## Acknowledgments

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