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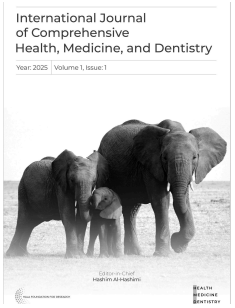

Original Article

Epidemiological Profile of Acute Flaccid Paralysis in the Democratic Republic of Congo from 2021 to 2022

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Abstract

Background and Objectives: The Democratic Republic of Congo (DRC) has not reported any cases of wild poliovirus since 2017 and has since been declared free of wild poliovirus. However, there have been a few cases of poliomyelitis caused by vaccine-derived poliovirus. The objective of this study is to describe the epidemiological characteristics of acute flaccid paralysis (AFP) cases reported in the DRC between 2021 and 2022, in order to suggest adaptations to current control strategies.

Methods: This is an observational, retrospective, descriptive, and cross-sectional study based on secondary surveillance data of AFP in the DRC from 2021 to 2022. An exhaustive sampling was conducted using records from the disease control database, focusing on AFP cases reported in all provinces of the DRC during the 2021-2022 period. Included in the analysis were all database entries confirmed as actual AFP case

Keywords: Poliomyelitis, Acute flaccid Paralysis, Epidemiology, Democratic Republic of Congo

Introduction

The minimum standard recommended by the World Health Organization (WHO) for poliomyelitis surveillance is syndromic surveillance based on acute flaccid paralysis (AFP) cases at the national level, with laboratory confirmation of poliovirus from stool samples (World Health Organization, 2018). Acute flaccid paralysis is defined as the sudden onset of paralysis characterized by a reduction in muscle tone in one or more limbs. This syndrome can result from a variety of etiologies, including Guillain-Barré syndrome, transverse myelitis, and neuropathies. These conditions are associated with neurotropic

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viruses, such as enteroviruses (including poliovirus), Herpesviridae, and parainfluenza virus (Dickson et al., 2020). AFP cases must be identified through active and passive surveillance, as well as detection methods based in healthcare facilities and communities. AFP surveillance is further complemented by environmental surveillance (analysis of wastewater samples for poliovirus detection) under specific conditions (World Health Organization, 2018). The Democratic Republic of Congo (DRC) has not reported any cases of wild poliovirus since 2017, and since then, it has been declared free of wild poliovirus circulation. However, the country has recorded several cases of poliomyelitis caused by vaccine-derived poliovirus. Since May 8, 2017, the country has been experiencing a resurgence of type 2 vaccine-derived poliovirus (cVDPV2) cases. A total of 61 confirmed cases of cVDPV2 have been recorded, with 22 in 2017, 20 in 2018, and 19 in 2019, spread across 23 health zones in 9 provinces: Maniema, Haut Lomami, Mongala, Haut-Katanga, Kasaï, Tshuapa, Sankuru, Ituri, and Tanganyika (Programme élargi de vaccination RDC, 2019). This work takes place in a context where the DRC has been experiencing a worsening epidemiological situation regarding polio since late August 2021, with the confirmation of four new distinct outbreaks. During the first quarter of 2023, 31 cases of cVDPV were recorded (World Health Organization, 2023). The objective of this work was therefore, through the analysis of surveillance data from a database containing information on AFP cases investigated, to describe the epidemiological characteristics of AFP cases reported in the DRC between 2021 and 2022 in order to propose adaptations to the current control strategies.

Methods

This was an observational, retrospective, descriptive, and cross-sectional study based on AFP surveillance data in the DRC from 2021 to 2022. The description of the epidemiological characteristics was carried out according to WHO recommendations regarding the data to be analyzed within the framework of syndromic surveillance based on AFP cases (World Health Organization, 2018).

2.1 Definitions and Final Case Classification Used

Suspected Case: Any case presenting with acute flaccid paralysis (AFP).

AFP Case: Defined as a child under 15 years of age suffering from the recent or sudden onset of flaccid paralysis or muscle weakness due to any cause, or any person of any age suffering from a paralytic illness when poliomyelitis is suspected by a clinician.

Confirmed Case: A suspected case with the isolation of wild poliovirus (WPV) or vaccine-derived poliovirus (VDPV) from stool samples collected from the suspected case or a close contact.

Compatible Case: A suspected case without an adequate sample; no isolation of WPV or VDPV in the suspected case or close contact; and residual paralysis after 60 days of follow-up, which is considered by the national expert review committee as clinically and epidemiologically compatible with poliomyelitis.

Discarded Case: A suspected case that has been adequately investigated (including the collection of adequate stool samples) and resulted in one of the following: no biological evidence of WPV or VDPV infection, inadequate sample collection, or determination of weakness within 60 days of the onset of paralysis, judged not to be compatible with poliomyelitis by the national expert review committee.

2.2 Data Collection Method

The AFP surveillance database from which data for the analysis was collected was available in two formats: Excel and Access. For this work, the Excel file was used. It consisted of a table with 3,440 observations and 98 variables related to the politico-administrative, geographical, and health information of the reported case location, the sociodemographic situation, clinical presentation, vaccination status of the patient, laboratory tests, and the final case classification. Since the data dictionary was not available, the WHO acute flaccid paralysis (AFP) case investigation form used in the DRC served as a reference for understanding the coding and definition of the variables in our database. The AFP case investigation form used in the DRC was a document composed of question blocks with response options and corresponding codes. These questions, covering the various aspects mentioned above related to AFP cases, were presented as closed-ended, binary, numerical, or multiple-choice questions and corresponded to the variables in the database. Confidentiality of the information was ensured by maintaining anonymity.

2.3 Studied Variables

The variables selected to address the study's objectives included sociodemographic data (age, sex, provinces), vaccination status (number of oral polio vaccine [OPV] and inactivated polio vaccine [IPV] doses received during routine immunization), clinical data (signs, symptoms, and case progression), various dates (consultation, notification, onset of paralysis, onset of fever, investigation, stool sample collection, receipt of samples at the laboratory), and diagnostic-related data (quality of stool samples, laboratory results, and final case classification).

2.4 Statistical Analysis

The data analysis was conducted using RStudio software, version 2023.03.0+386. Quantitative variables were described in terms of minimum and maximum values, medians with their interquartile ranges (IQR), or means and standard deviations depending on whether they exhibited a normal distribution on the histogram. Qualitative variables were described in terms of frequencies and percentages. Statistical tests were not applied. The following AFP surveillance performance indicators were calculated and interpreted:

Non-polio AFP Rate (NP-AFP Rate): Number of cases classified as NP-AFP among children under 15 years/Number of children under 15 years × 100,000 per year. WHO epidemic situation target: NP-AFP rate ≥ 3.

Percentage of cases reported to public health authorities within a specified time frame (generally ≤ 7 days) from the onset of paralysis: Number of AFP cases reported within 7 days of paralysis onset/Number of reported AFP cases × 100. WHO target: ≥ 80%.

Percentage of cases investigated within 48 hours of notification: Number of AFP cases investigated within 48 hours of notification/Number of reported AFP cases × 100. WHO target: ≥ 80%.

Percentage of stool samples arriving at a WHO-accredited laboratory within 3 days of collection: Number of samples arriving within 3 days of collection/Number of collected samples × 100. WHO target: ≥ 80%.

Percentage of AFP cases with two stool samples collected at ≥ 24-hour intervals within 14 days of paralysis onset, with samples arriving in good condition at a WHO-accredited laboratory: Number of AFP cases with two stool samples collected at ≥ 24-hour intervals within 14 days of paralysis onset and arriving in good condition/Number of reported AFP cases × 100. WHO target: ≥ 80% (World Health Organization, 2018).

Results

During the study period, 3,424 cases of acute flaccid paralysis (AFP) were reported across all 26 provinces of the Democratic Republic of the Congo (DRC). The ages of the patients ranged from 0 to 69 years, with a median age of 3 years (IQR: 2-5).

3.1 Suspected Cases by Age Group and Sex (Table 1)

The majority of suspected cases were male. Females represented 44.6% of the cases, with a calculated male-to-female sex ratio of 1.3. The age group of 0 to 5 years was the most represented, with 2,515 cases.

Table 1: Frequency of AFP Cases by Age Group and Sex Reported Between 2021 and 2022 in the DRC

	AFP cases (n= 3424)	
	Total	**%**
Sex		
Male	1902	56
Female	1522	44
Age		
< 5	2518	73.5
5-14	844	24.7
>= 15	62	1.8

3.2 Suspected Cases by Notification Source and Contact with Medical Services for AFP Treatment (Table 2)

AFP cases were primarily reported by health workers and community relays. Regarding the places where patients sought treatment, the majority of AFP cases lacked information on this aspect. However, among the limited data available, it was observed that patients mainly consulted conventional health institutions

(primarily health centers and posts, general referral hospitals, clinics, university clinics, etc.). A small proportion of patients (6%) consulted traditional healers. The average treatment duration for both conventional and traditional settings was 4 days (standard deviation: 6).

Table 2: Distribution of AFP Cases Reported between 2021 and 2022 in the DRC by Notification Source

	AFP cases (n = 3424)	
Notification Source	**Number of AFP Cases**	**%**
Health Workers	1988	58.1
Humanitarian NGO	5	0.1
Parents	121	3.5
Community Relays	1293	37.8
Traditional Healers	16	0.5
Not specified	1	0.0

3.3 Suspected Cases by Province

The provinces of Tanganyika, Haut Lomami, Ituri, Equateur, and Sud Kivu reported the highest number of AFP cases, with 343 cases, 299 cases, 207 cases, 205 cases, and 177 cases, respectively. Figure 1 illustrates the distribution of AFP cases across the 26 provinces of the DRC.

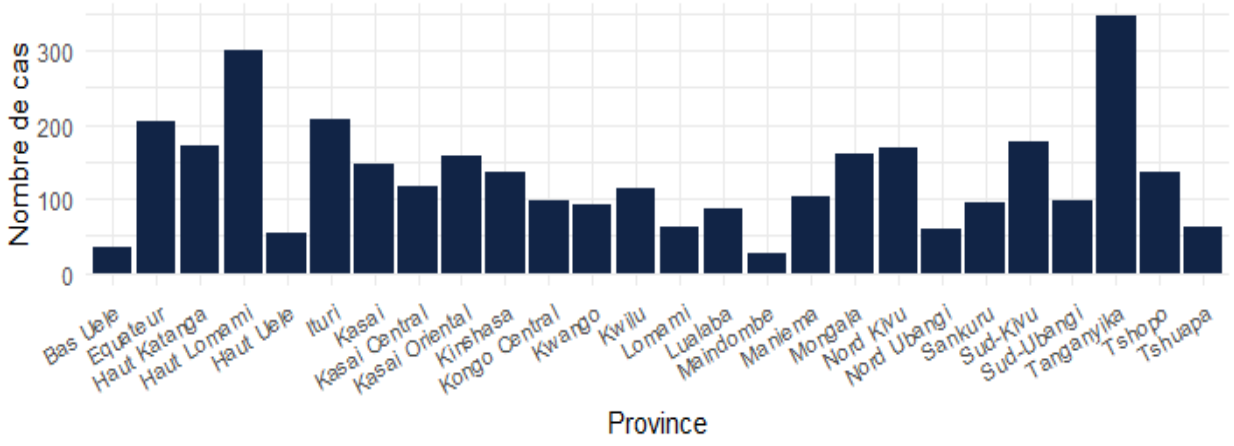

Figure 1. Distribution of Notified AFP Cases by Province in the DRC (2021-2022)

3.4 Clinical Characteristics, Laboratory Results, and Final Classification of Suspected Cases (Table 3)

During the patient history or clinical history, 80% of patients reported a fever at the onset of paralysis. 94% reported progressive paralysis over 3 days. Paralysis was asymmetric in 41% of patients and symmetric in 58%. The lower limbs were the most affected. The hospitalization rate was 23%. Laboratory analysis of stool samples revealed that 80% of samples were negative, 14% contained a

non-polio enterovirus, and 5% were suspected of containing poliovirus. A total of 27 cases of vaccine-derived poliomyelitis were confirmed, with 26 of these being type 2. No wild poliovirus was identified.

Table 3: Clinical and laboratory characteristics of AFP Cases Reported in the DRC Between 2021 and 2022

	AFP (n=3424)		
CLINICAL PRESENTATION			
	Yes	**No**	**Not specified**
	Total (%)	**Total (%)**	**Total (%)**
Fever at Onset	2736 (79.9)	355 (10.4)	333 (9.7)
Progressive Paralysis in 3days	2353 (68.7)	629 (18.4)	442 (12.9)
Asymmetric Paralysis	1415 (41.3)	1993 (58.2)	16 (0.5)
Hospitalization	794 (23.2)	2630 (76.8)	0 (0.0)
LOCALIZATION OF PARALYSIS	**Yes**	**No**	**Not specified**
Right Upper Limb	359 (10.5)	3065 (89.5)	0
Left Upper Limb	388 (11.3)	3036 (88.7)	0
Right Lower Limb	2672 (78)	752 (22)	0
Left Lower Limb	2672 (78)	752 (22)	0
Pain Sensitivity in Paralyzed Limbs	2420 (70.7)	938 (27.4)	70 (2)
Intramuscular Injection Prior to Onset	599 (17.5)	2722 (79.5)	103 (3)
CELL CULTURE RESULTS			
	Total		**%**
Negative	2748		80
Non-Polio Enterovirus	486		14
Polio Suspected	175		5.1
Polio and Non-Polio Enterovirus Suspected	9		0.3
Not Specified	6		0.2
FINAL CLASSIFICATION			
	Total		**%**

Compatible	12	0.4
Rejected	3375	98.6
Confirmed (Circulating VDPV)	27	0.8
Not Specified	10	0.3

SEROTYPE OF cVDPV		
	Total	**%**
Type2	26	96.3
Not Specified	1	(3.7)

3.5 Final Classification of AFP Cases by Province

Among the 27 cases of cVDPV, 17 (63%) were identified in Maniema Province. The provinces of Sud-Ubangi, Mongala, and Nord-Ubangi reported 5, 4, and 1 case(s) respectively.

3.6 Confirmed Polio Cases by Age Group, Sex, and Vaccination Status (Table 4)

All confirmed polio cases were detected in children under the age of 5 years. There were more confirmed cases in boys than in girls. Over 50% of the polio cases were found in unvaccinated children. Nearly 30% of the data regarding the vaccination status of confirmed cases were unspecified.

Table 4: Distribution of Confirmed Polio Cases by Age Group, Sex, and Vaccination Status in the DRC from 2021 to 2022

Confirmed Polio Cases (n= 27)		
Age		
	Total	**%**
< 5	27	100
5 – 14	0	0.0
>= 15	0	0.0
Sex		
	Total	**%**
Male	15	55.6
Female	12	44.4
Routine OPV		
	Total	**%**
0 Dose	14	51.9

1 – 2 Doses	5	18.5
>= 3 Doses	1	3.7
Not Specified	7	25.9
Routine IPV		
	Total	**%**
0 Dose	18	66.7
1 -2 Doses	2	7.4
>= 3 Doses	0	0.0
Non précisé	7	25.9

3.7 Non-Poliomyelitis Acute Flaccid Paralysis (NFAP) Cases by Age Group, Sex, and Vaccination Status

The majority of non-polio acute flaccid paralysis (NFAP) cases were among children under 5 years old. There were more cases in boys than girls. Cases were more frequent among individuals who had received at least 2 doses of either the oral polio vaccine (OPV) or the inactivated polio vaccine (IPV). Approximately 40% of the data regarding vaccination status for NFAP cases were not specified.

3.8 Follow-up Examination at 60 Days for Residual Paralysis

More than 50% of the acute flaccid paralysis (AFP) cases monitored had no residual paralysis at the 60-day follow-up examination. Residual paralysis was present in nearly 35% of the cases. The final diagnosis for non-polio AFP cases was not reported throughout the study period.

3.9 Performance Indicators of AFP Surveillance

Non-Poliomyelitis Acute Flaccid Paralysis Rate (NFAP)

The total population of children under 15 years used here (44,614,746) is derived from World Bank data for 2021 (7). The calculated rate of non-polio AFP was 7.4 per 100,000 children under 15 years.

Percentage of Cases Reported to Public Health Authorities Within a Defined Time Period (Generally ≤ 7 Days) from the Onset of Paralysis: 73.5%.

Percentage of Cases Investigated Within 48 Hours of Notification: 96.1%.

Percentage of Samples Arriving at an WHO-Accredited Laboratory Within 3 Days of Collection: 7.6%.

Percentage of AFP Cases with Collection of Two Stool Samples ≥ 24 Hours Apart and Within 14 Days of Onset of Paralysis, and Arrival of These Samples in Good Condition at a WHO-Accredited Laboratory: 81%.

Discussion

In this study, we described the epidemiological characteristics of acute flaccid paralysis (AFP) cases reported in the Democratic Republic of Congo (DRC) between 2021 and 2022, with the aim of proposing adaptations to current control strategies.

Our results indicate that the majority of AFP cases occurred in children aged 0 to 4 years, with a predominance of males. These findings align with those of several studies, including those by Aboubacar Conté et al. in Guinea (Conté et al., 2021), Tesfaye et al. in Kenya (Tesfaye et al., 2020), and Calles et al. in Spain (Masa-Calles et al., 2018), where children under 5 years old accounted for 74.49%, 63.6%, and 45.7% of AFP cases, respectively. The higher incidence in this age group could be attributed to their increased vulnerability. Males were also the majority in these studies, with a male-to-female sex ratio of 1.4, 1.3, and 1.3, respectively. Although statistical tests were not conducted in this study to determine if the difference in proportions between males and females was significant, Calles et al. (Masa-Calles et al., 2018) reported in their study that no gender discrimination was observed in the AFP population, as the difference in proportions was not statistically significant. However, our findings regarding the age group of children under 5 years contrast with those of Nsambu et al. (2013), where the majority of AFP cases were among individuals aged 15 years or older (47%). The authors, working in the context of a wild poliovirus epidemic, explained this observation by referring to the study by Baldo et al. (2012) in Italy, which demonstrated a decline in the proportion of seropositive individuals to wild poliovirus types 1 and 3 with age. Alleman et al. (2014) also explained the higher proportion of polio cases in the 15 years and older age group by an immunity gap for polio type 1 due to insufficient exposure to type 1 poliovirus, either naturally or through vaccination.

Nearly all patients reported a history of fever at the onset of paralysis and progressive paralysis within three days. Paralysis was asymmetrical in the majority of cases, with a preference for the lower limbs. Most patients were not hospitalized. These findings are consistent with those reported by Tesfaye et al. (2020), Camara et al., and Aboubacar Conté et al. (2021). The authors suggest that these patterns might be related to the case definitions used during AFP investigations. However, the results of Calles et al. (2018) show a much lower proportion of AFP cases with a history of fever at the onset of paralysis (20.2%), as well as a lower proportion of asymmetrical paralysis (8.2%), but with a 100% hospitalization rate in tertiary-level hospitals.

Twenty-seven cases of vaccine-derived poliovirus (VDPV) were confirmed, including 26 cases of serotype 2 and one case of unspecified serotype, predominantly in the Maniema province, with additional cases in the Sud-Ubangi, Mongala, and Nord Ubangi provinces. All confirmed polio cases were detected among children under the age of five, with a higher prevalence in boys compared to girls. More than 50% of polio cases were found in unvaccinated children. These findings align with those reported by Grace R. Macklin, Ajay K. Goel, O. Mach, et al. (2023), where the median age of VDPV2 cases was 1.92 years [95% CI: 0.5, 7.0], with a lower proportion of cases among girls (44.0%) compared to boys (54.9%). The highest number of cases occurred in children under five, and 37.9% of cases were in those who had not received any IPV doses. M.M. Alleman, J. Jorba, Y. Riziki, et al. (2023) noted in their study that during three of the four VDPV2 outbreaks between 2017 and 2018, cases were reported in the provinces of Haut Katanga, Haut Lomami, Maniema, and Tanganyika, a region with a history of VDPV2 outbreaks between 2005 and 2012. Furthermore, ten of the 15 VDPV2 outbreaks in circulation in the DRC between 2019 and 2021 were first detected in provinces outside this southeastern region.

Alleman et al. (2014) emphasized that up until 2021, all VDPVs detected in the DRC were of serotype 2. Their study also highlighted that the DRC-MAN-2, DRC-MAN-3, DRC-MAN-4, and DRC-MAN-5 outbreaks were first identified in the second half of 2021 in Maniema, where mOPV2 had been used more recently in August 2019, and in neighboring provinces in December 2019. They suggested that the 2020 outbreak caused by Sabin-2 could have been due to inappropriate use of mOPV2 or another exposure to Sabin-2 following supplementary vaccination activities. Additionally, the COVID-19 pandemic delayed the transport of AFP case samples and the implementation of response vaccination campaigns to the DRC-KAS-3 outbreak in 2020, which was planned for the provinces of Kinshasa, Maindombe, and Tshopo, contributing to the geographic spread and scale of the 2021 outbreak. According to the report by C. Mbaeyi, M.M. Alleman, D. Ehrhardt, et al. (2019), the 2018 VDPV2 outbreak in the Haut Katanga province was likely linked to the use of mOPV2 in response activities to the outbreak in the Haut Lomami region, with suboptimal coverage.

The 60-day follow-up examination conducted to identify residual paralysis is crucial for the expert committee to finalize case classification and potentially arrive at a definitive or most likely diagnosis. During the study period, this follow-up examination was limited to cases with inadequate laboratory samples, focusing on classification without necessarily achieving a final diagnosis. As a result, the prevalence of non-polio AFP etiologies in the DRC may remain under recognized.

Two key AFP surveillance performance indicators—non-polio AFP (NP-AFP) rate and stool sample adequacy—met the WHO target objectives. The NP-AFP rate serves as an indicator of the sensitivity of the AFP surveillance system in a country. Achieving the target NP-AFP rate suggests that the surveillance system is sufficiently sensitive to detect cases of wild poliovirus (WPV) or circulating vaccine-derived poliovirus (cVDPV) if the virus is circulating. This outcome reflects effective active and passive surveillance during the study period in the DRC. The stool sample adequacy rate is used to assess the timeliness of investigation and the quality of the reverse cold chain mechanism used for poliovirus isolation. Meeting the target stool sample adequacy percentage indicates the ability to detect poliovirus among AFP cases if the virus is circulating. However, two indicators did not meet the expected performance: the percentage of samples arriving at the national laboratory within three days of collection fell short of the target, as did the timeliness of case notification. The low percentage of timely sample shipment may be due to inadequate policies on batch sample transport within the country and the geographic isolation of certain healthcare facilities. The delay in case notification could be attributed to the late reporting by initial points of contact where patients seek treatment for paralysis. This delay may be due to a lack of awareness among healthcare professionals or traditional healers, who are often the first to receive patients, about the importance of immediately reporting acute flaccid paralysis (AFP) cases, resulting in late notifications and making it impossible to collect stool samples promptly.

Despite the short study period considered in this work, which may limit the generalizability of the results, particularly in assessing the performance of AFP surveillance through the calculated indicators, and despite the presence of missing data and some database variables being poorly documented, which made the analysis and interpretation of certain data somewhat challenging, this study successfully described the main characteristics of acute flaccid paralysis (AFP) cases reported in the DRC. It was also observed that, overall, the WHO-set objectives for evaluating the quality of surveillance were met. A study conducted over several years, with annual assessments of performance indicators, would provide a more comprehensive evaluation of the effectiveness and quality of this surveillance system.

Conclusion

The acute flaccid paralysis (AFP) cases reported in the DRC from 2021 to 2022 exhibit a classic profile. The highest prevalence of poliomyelitis cases was observed in the Maniema province. The performance of AFP surveillance indicators was generally good according to WHO standards, reflecting effective surveillance during this period in the DRC. However, there are areas for improvement, particularly regarding the timely submission of stool samples to laboratories, which underscores the need for a coherent sample transport policy. Additionally, the promptness of case notification requires enhancement, highlighting the importance of raising awareness among healthcare professionals and traditional healers about the necessity of immediately reporting AFP cases to public health authorities. The quality of data entry in the database also needs improvement.

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