



Trends and distribution of acute flaccid paralysis cases and their outcomes among children below 15 years, Uganda, 2016–2023

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Summary

Background: Uganda, in line with the global efforts to eradicate polio by 2026 identifies, investigates, and reports acute flaccid paralysis (AFP) cases among children <15 years for timely detection of polio. We analyzed secondary data from 2016–2023 to describe the demographic and clinical characteristics of AFP cases; determine trends and spatiotemporal distribution, and assess physical and laboratory outcomes of AFP cases in children under 15 in Uganda.

Methods: We conducted a retrospective study of secondary data archived in the EPI laboratory at UVRI of all AFP case samples tested in the country from January 2016 to December 2023. Our outcome variables included demographic characteristics, clinical characteristics, non-polio AFP (NPAFP) rates, physical and laboratory outcomes of AFP cases. Descriptive information was interpreted using frequencies, proportions and rates. We compared NPAFP rates across study years using trend analysis in STATA.

Results: A total of 6,409 AFP cases were cumulatively reported in the 8-years period. Of these, 5,837 (97%) were true AFP cases and 5,687 (89%) were detected early. The majority (59%) were children <5 years and most (58%) were males with a median age of 3 years (IQR: 1-7 years). Clinically, the majority (90%) of case-patients were identified from the community (not hospitalized); (91%) had fever at onset of paralysis, (86%) had paralysis progress in 3 days, (80%) had asymmetrical paralysis. and (57%) had only one limb of their bodies paralyzed. Of 5,744 case-patients, 4,960 (77%) had received 3+ doses of oral polio vaccine and 158 (3%) had not received any dose. In each year of the study period, 99.9% of all the districts in the country had achieved an NPAFP rate of $\geq 1.0/100,000$ children <15 years. Of the 6,405 samples tested, 154 (2%) were suspected to have poliovirus and 8 (0.1%) had non-polio enterovirus (NPENT) plus poliovirus suspected. Of the 823 case-patients followed-up after 60 days, 250 (30%) still had residual paralysis present, 5(0.6%) were lost to follow-up and 9 (1%) had died before follow-up.

Conclusion: The AFP surveillance system in the country is active and well distributed as evidenced by 99.9% of all districts each year of the 8-years study period reporting at least one AFP case. However, the targeted NPAFP rate of $\geq 3/100,000$ children <15 years was poorly achieved in some districts throughout the study period. This calls for a need to continuously support both the passive and active surveillance systems in these districts



Introduction

Acute Flaccid Paralysis (AFP) is defined as the sudden onset of weakness/floppiness or paralysis in any part of the body of a child below 15 years of age (1). The primary purpose of AFP surveillance is to increase the chances of early detection of any variant of poliomyelitis in populations of children below 15 years. It is also one of the strategies in the efforts to globally eradicate polio worldwide by 2026 (2). Poliomyelitis is a viral infection caused by Polio virus (PV) of genus Enterovirus (3). Acute flaccid paralysis and muscle weakness from polio infection manifests when the virus attacks the central nervous system, preferentially infecting and destroying motor neurons (3).

One of the indicators used in AFP surveillance is the non-polio AFP (NPAFP) rate. It is an indicator of surveillance sensitivity. NPAFP rate represents the number of non-polio AFP cases that are detected annually per 100,000 population aged <15 years (10). Where polio is present or where polio is a threat, this target, the objective is to detect at least two cases of non-polio AFP each year for every 100,000 children <15 years in all at-risk and outbreak countries, and to detect at least three cases of non-polio AFP each year for every 100,000 children under 15 years in endemic countries and outbreak-affected areas, where Uganda belongs (10). For every AFP case identified and investigated after 14 days from onset of paralysis (late case), a mandatory 60 days follow up has to be conducted by a trained medical/clinical officer (10).

Uganda conducts both passive and active surveillance for AFP among children <15 years as a notifiable condition. From this, hundreds of AFP cases are identified, investigated and reported through the country's surveillance system annually. We described the AFP case-patients by person, place, and time characteristics; and their physical and laboratory outcomes following the 60 days follow up.

Methods

Study setting, design, and data source: We conducted a retrospective study using AFP surveillance data generated at the Uganda Virus Research Institute (UVRI) from the entire country, January 1, 2016 to December 30, 2023. As per the integrated disease surveillance and response, a true AFP case was defined as any child under 15 years of age with a sudden onset of flaccid/floppy paralysis on any limb identified within the 60 days from onset of paralysis, or a person of any age in whom polio is suspected by a clinician. An early AFP case on the other hand was defined as one identified within 14 days from onset of paralysis. A late AFP case was one detected after 14 days from onset of paralysis. A silent district was one that had not reported any single AFP case in a calendar year contributing a Non-Polio Acute Flaccid Paralysis (NPAFP) of 0/100,000 children <15years.

Study variables, data abstraction, and analysis: We abstracted data about the demographic variables including age, sex; clinical variables including hospitalization status of the case-person, fever at onset of paralysis, progression of paralysis within 3 days after onset of paralysis, and nature of the paralysis, number of doses received from either the routine or SIAs if vaccinated. We categorized the paralysees into four



types based on the limbs affected that is monoplegia, hemiplegia, diplegia and quadriplegia.

The dataset was entered into EpiInfo and STATA software for analysis. We summarized the demographic and clinical characteristics, laboratory and physical outcomes of the AFP case-patients using frequencies and percentages. To demonstrate the trends and temporal-spatial distribution of AFP case-patients over the study period, we calculated the annual NPAFP rates for each year. We calculated the annual NPAFP rate as number of reported NPAFP cases <15 years in a year divided by the total number of children <15 years of age in that year multiplied by 100,000. We utilized projected under 15 years population estimates for each year from Uganda Bureau of Statistics (UBOS) as denominators. Comparison of NPAFP rates across years within the study period was done using trend analysis in STATA. Choropleth maps were drawn to show temporal-spatial distribution of NPAFP rates in districts using QGIS software.

Ethics approval: Our study utilized routinely aggregated surveillance data with no personal identifiers compiled and archived at the Uganda Virus Research Institute. The Uganda Public Health Fellowship Program is part of the National Rapid Response Team and has been granted permission to access and analyze surveillance data in the DHIS2 and other data such as survey and field investigation data to inform decision-making in the control and prevention of outbreaks and public health programming. Additionally, the Ministry of Health has also granted the program permission to disseminate the information through scientific publications. We stored the abstracted dataset in a password-protected computer and only shared it with the investigation team.

Results

Demographic and clinical characteristics of Acute Flaccid Paralysis case-patients among children <15 years, Uganda, 2016–2023

A total of 6,409 AFP cases were cumulatively reported in the 8-years period. Of these, 5,837 (97%) were true AFP cases and 5,687 (89%) were detected early. Median age of case-patients was 3 years (IQR: 1-7 years); the majority (59%) were children <5 years and males (58%).

In terms of clinical history, the majority (90%) of case-patients were identified from the community (not hospitalized). Of the 6409 case-patients, 5816 (91%) had reported fever at onset of paralysis, 5,476 (86%) reported that paralysis had progressed in 3 days and 5,097 (80%) had asymmetrical paralysis. The majority (57%) of case-patients had only one limb of their bodies paralyzed (monoplegia). Of the 4,548 case-patients, 533 (12%) had received an injection before onset of paralysis. Of the 5,744 case-patients who had revealed their OPV vaccination history, 4960 (77%) had received 3+ doses and 158 (3%) had not received any dose (Table 1).

Table 1: Demographic and clinical characteristics of Acute Flaccid Paralysis case-patients among children below 15 years, Uganda, 2016–2023



Demographic and clinical characteristics of AFP cases N=6409	Mean proportion	
	N	(%)
True AFP	5,837	97
Early cases	5,687	89
Late cases	722	11
Demographic characteristics		
Age (years)*		
<5 years	3,801	59
≥ 5 years	2,608	41
Sex		
Female	2,706	42
Male	3,703	58
Clinical characteristics		
Hospitalization status		
Yes	431	10
No	3,913	90
Clinical history		
Fever at onset of paralysis	5,816	91
Paralysis progressed in 3 days	5,476	86
Paralysis Asymmetrical	5,097	80
Type of paralysis		
Monoplegia	3,682	57
Right Hemiplegia	525	8
Left Hemiplegia	662	10
Upper Diplegia	218	3
Lower Diplegia	1,157	18
Quadriplegia	165	3
Any Injection given before paralysis (n=4,548)		
Yes	533	12
No	4,015	88
Vaccination status (n=5,744)		
Zero dose	158	3
1–2 doses	626	10
3+ doses	4,960	77

*Median age 3 years (IQR: 1-7 years)

Trends and temporal-spatial distribution of Acute Flaccid Paralysis case-patients among children <15 years, Uganda, 2016–2023

The national annual NPAFP rate was $\geq 3.0/100,000$ children <15 years in 5 out of the 8 study years with an average of $3.4/100,000$ children <15 years in the 8-years study period. There was a noted decrease in the NPAFP rate from $3.6/100,000$ children <15 years in 2016 to $2.7/100,000$ children <15 years with no statistically significant trend ($p=0.8$), (Figure 1).



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Greater than 50% of all districts each year except in 2020, throughout the study period had achieved the global NPAFP rate target (≥ 3.0) for an endemic and outbreak prone country. In each year of the study period, 99.9% of all the districts in the country had achieved an NPAFP rate of $\geq 1.0/100,000$ children <15 years (Table 2 and Figure 2).

Table 2: Non-polio Acute Flaccid Paralysis rate per 100,000 children below 15 years performance at districts level, Uganda, 2016–2023

Year	<15 years population ^β	Number of True AFP cases	Number of True AFP Districts*	National Annual NPAFP Rate	Districts with NPAFP ≥ 3.0		Districts with NPAFP <1.0		Silent District (s)	
					N	(%)	N	(%)	N	(%)
			N=5837	n/100,000						
2016	19,030,648	679	112	3.6	69	(62)	8	(0.07)	1	(0.01)
2017	19,647,524	621	116	3.2	66	(57)	2	(0.02)	1	(0.01)
2018	20,281,924	701	116	3.5	79	(68)	2	(0.02)	0	(0)
2019	20,931,456	573	128	2.7	119	(93)	8	(0.06)	0	(0)
2020	21,594,820	456	135	2.1	51	(38)	23	(0.2)	2	(0.01)
2021	22,272,224	1,208	135	5.4	119	(88)	1	(0.01)	0	(0)
2022	22,962,368	955	135	4.2	101	(75)	3	(0.02)	0	(0)
2023	23,664,160	644	135	2.7	107	(79)	4	(0.03)	0	(0)

* Number of districts: These kept changing as new districts were created

^β Population estimates from Uganda Bureau of Statistics (UBOS)

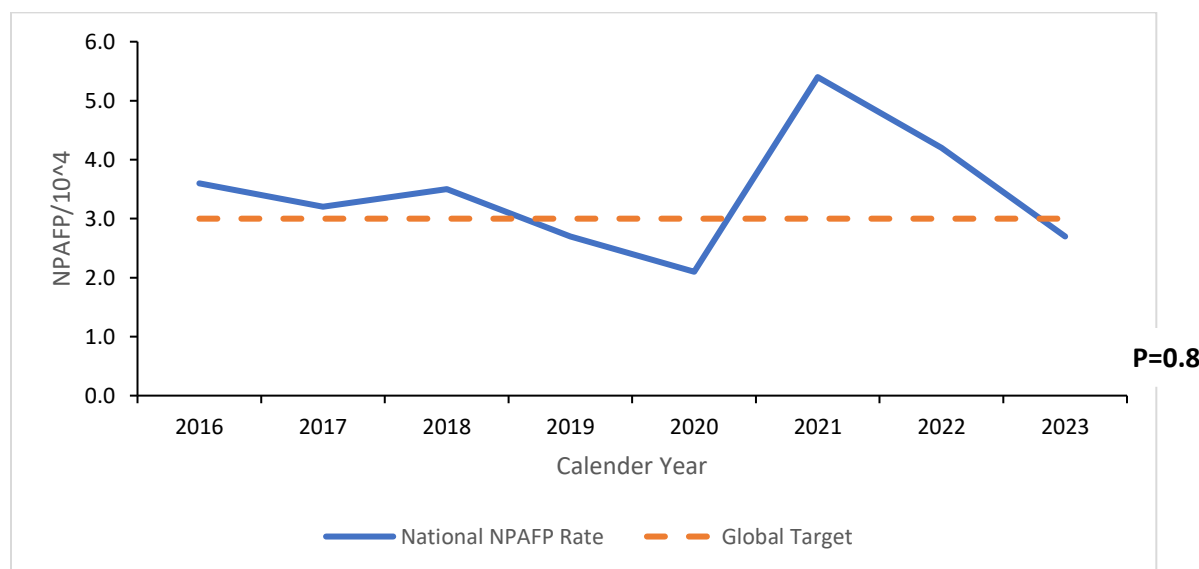


Figure 1: Trends of Non-polio Acute Flaccid Paralysis rates per 100,000 children below 15 years by the districts of Uganda, 2016–2023



Laboratory and physical outcomes of Acute Flaccid Paralysis case-patients among children <15 years, Uganda, 2016–2023

Of the 6,405 samples tested, 154 (2%) were suspected to have poliovirus and 8 (0.1%) had Non-polio enterovirus (NPENT) plus poliovirus suspected. The majority (86.2%) of the samples tested negative.

Of the 823 case-patients followed-up, 250 (30%) still had residual paralysis present, 5(0.6%) were lost to follow-up and 9 (1%) had died before follow-up. The majority (67.9%) had made complete recovery with no residual paralysis present.

Discussion

In our study, the majority of case-patients were children <5 years of age and males by sex. Clinically, greater than three quarters of all case-patients had reported fever at onset of paralysis, had paralysis progress in 3 days, had asymmetrical paralysis and had received more than 3 doses of OPV. For each year of the study period except in 2020, greater than half of all the districts had attained an NPAFP rate greater than the recommended global NPAFP rate (≥ 3.0) for an endemic and outbreak prone country. There was no significant trend in the national annual NPAFP rate throughout the 8-years study period. The majority of stool samples from case-patients tested negative and only 2% were suspected for polio. Less than half of the followed-up case-patients 60 days later had residual paralysis and less than 2% had either died or were lost to follow up.

The majority (59.3%) of cases in the 8-years period were children <5 years of age and most (57.8%) were males by sex. These findings are consistent with those reported in a large dataset study in East and South Africa, also in Ghana, Nigeria and Bangladesh (12, 13, 14, 15). Infants and children <5 years who are not yet toilet-trained and also play in dirty environments are more at risk for contracting polio. This is because polio is most often spread from poor hygiene practices. This includes poor handwashing practices and ingestion of food or water that is contaminated by faeces (17). Therefore, a surveillance system such as this that captures a majority of AFP cases among this age group has more chances of early detection, reporting and investigation of a polio infection.

The majority (91%) of the cases had reported fever at onset of paralysis, (86%) reported that paralysis had progressed in 3 days, (80%) had asymmetrical paralysis and of the 5,744 case-patients who had revealed their OPV vaccination history, 4960 (77%) had received 3+ doses. Similar documentation was noted in studies conducted in Zambia and Ethiopia (21, 22). This signifies that our case-patients were actual AFPs cases and that there was good clinical history capture of the cases by the surveillance team. This good documentation is also important for follow up of contacts of such cases and for final classification by the National Polio Expert Committee (NPEC) (20).

The majority (90%) of case-patients were identified from the community (not hospitalized). Similar findings were reported in a study in Zambia (18). This underpins the importance of community-based surveillance (CBS) including the utilization of community health structures like village health teams (VHTs) and community extension workers (CHEWs) to support AFP surveillance. The World Health Organization guides that CBS is a key method to access hard-to-reach areas and communities that are not



reached by the regular AFP surveillance system. Community-based surveillance is particularly useful in settings or areas at high risk of undetected poliovirus transmission or at risk of new outbreaks following importation or vaccine-derived poliovirus (VDPV) emergence (20).

The national annual NPAFP rate was $\geq 3.0/100,000$ children <15 years in 5 out of the 8 study years with an average of $3.4/100,000$ children <15 years in the 8-years study period. Other studies had similar findings with average annual NPAFP rates being above the WHO recommendation including in Zambia, Ethiopia, Ghana, Uganda and Bangladesh (21,22,13, 23,18). Overall, the country achieved the required NPAFP rate of $\geq 3.0/100,000$ children <15 years in the 8 years period which signifies a sensitive surveillance system in an endemic and outbreak prone country. The drop in the rate noted in 2019 and 2020 is largely attributable to disruption in surveillance and health services caused by the COVID-19 pandemic (21).

Greater than 50% of all districts each year except in 2020, throughout the study period had achieved the global NPAFP rate target (≥ 3.0) for an endemic and outbreak prone country. In each year of the study period, 99.9% of all the districts in the country had achieved an NPAFP rate of $\geq 1.0/100,000$ children <15 years. Another study in Uganda had similar findings though the researchers used the ambitious national target of $\geq 4.0/100,000$ children <15 years (21). In October 2006, Uganda was declared polio free after 10 years of not reporting any indigenous cases of polio (22). But since then there have been pockets of outbreaks of polio in different parts of country, most being imported from the neighboring countries and from environmental surveillance. For this reason, the country is still considered endemic and outbreak prone and is recommended by WHO to have an NPAFP rate of ≥ 3.0 per 100,000 population of children <15 years per annum (20). Despite some districts not achieving the required NPAFP rate (≥ 3.0), these findings are indicative of a sensitive AFP surveillance system in the country.

Of the 6,405 samples tested, 154 (2%) were suspected to have poliovirus and 8 (0.1%) had NPENT plus poliovirus suspected. Poliovirus is the most sought cause of paralysis among children <15 years of age but there are other etiologies too. Poliovirus is of genus enterovirus, the spinal type presents with asymmetric paralysis that most often involves the legs and the bulbar polio leads to weakness of muscles innervated by cranial nerves (3). Several studies have as well implicated non-polio enteroviruses (NPENT) in AFP including enterovirus 71 (EV-A71), enterovirus-D68 (EV-D68), Japanese encephalitis and West Nile virus (6, 7, 8, 9). This implies that these enteroviruses are circulating among the Ugandan communities and causing paralysis. Therefore, it is important to have definitive laboratory tests to pinpoint the specific enteroviruses for easy management

Of the 823 case-patients followed-up, 250 (30%) still had residual paralysis present, 5(0.6%) were lost to follow-up and 9 (1%) had died before follow-up. Many studies have shown similar findings (10, 11, 13). According to WHO, a case that has inadequate stool specimens (late case) and has residual paralysis after 60 days of onset of paralysis or the patient is lost to follow up or dies within 60 days of symptom is classified as compatible with polio. Presence of such cases that are compatible for polio implies



possibility of presence of actual polio virus variants and surveillance should keep the vigilance and investigate all AFP cases diligently.

Study limitations: Some variables had missing data elements for example, of the 6409 case-patients reported, 29% had not answered the question on having had an injection before onset of paralysis. Also, there could have been misclassification bias during entry of the primary data which is hard to adjust in secondary data. However, standard operating procedures were used in entry of this data which could have reduced presence of such bias.

Conclusion: The AFP surveillance system in the country is active and well distributed as evidenced by a large proportion of AFP being detected early and nearly all districts each year of the 8-years study period reporting at least one AFP case. The majority of case-patients identified were true AFP cases; most were detected from the community, had received >3 doses of OPV and had only one limb of their bodies paralyzed. A few case-patients were compatible for Polio. However, the presences of such case-patients underpin the importance of a continued surveillance for AFP to improve the chances of early detection of actual polio cases.

For districts that consistently failed to achieve the required NPAFP rates, we recommend the following as measures to improve identification, investigation and reporting of AFP cases; i) Intensify active case search for AFP in both health facilities and communities. This can be done by utilizing existing surveillance structures in the health facilities and communities such as health facility/health sub-district surveillance focal persons, village health team members; ii) Absorb and integrate private health facilities including physiotherapy and massage centers as well as other informal points of health care such as traditional healers, bone setter in surveillance for AFP. Many AFP cases seek for care; iii) Intensify community mobilization and sensitization for AFP surveillance. Findings from our study highlight that the majority of AFP were not hospitalized. This means that these cases were detected in the community. It is therefore important to have the community members involved in active identification and reporting of any AFP in their communities.

There was a lot of missing data on some important variables, for example, of the 6409 case-persons reported, only 4,548 of them answered the question on having had an injection before onset of paralysis. To mitigate such, it is important for surveillance officers to use standard case investigation forms and make sure that they are filled completely.

Conflict of interests: The authors declare no conflict of.

Authors' contributions: EOO conceptualized the study idea, obtained data, analyzed it, and wrote the manuscript. IM, FN, SO, BSN, MB, PE, ET, AK, HT, RM, BK, and ARA participated in editing and reviewing the bulletin article to ensure scientific integrity and intellectual content. All the authors contributed to the final draft of the bulletin.

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