






# Poliovirus on the rise in Pakistan amidst unprecedented floods and COVID-19 pandemic: An urgent concern

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## Abstract

**Background:** Poliomyelitis is always a great concern in Pakistan and is a public health emergency. COVID-19 and recent floods have increased the challenge.

**Aim:** This article highlights the situation of polio in Pakistan and also recommends several steps to eradicate the disease as early as possible.

**Methodology:** Selected articles were selected from electronic databases such as PubMed, Google Scholar, and Scopus using keywords such as Wild Poliovirus, Vaccine Derived Polio Infection, Acute Flaccid Paralysis, Vaccine, and Pakistan.

**Result:** Polio infection has two types, wild poliovirus and vaccine-derived polio infection. 2019 and 2020 were a challenging time as cases were increased at that time in Pakistan. Acute flaccid paralysis is the most common complication of this disease. The maximum cases of polio are being reported from Khyber Pakhtunkhwa. **Conclusion:** A special public health importance should be given in this province. Regular vaccination and strict surveillance are important. It is also important to spread awareness among the people. Early identification and timely diagnosis are very important. Early diagnosis, proper timely treatment, vaccination, awareness, and community-based research will help Pakistan to eradicate this disease as early as possible.

## KEYWORDS

acute flaccid paralysis, Pakistan, vaccine, vaccine-derived polio infection, wild poliovirus

The picornaviridae “poliovirus” causes poliomyelitis, an infectious illness that affects the nervous system. Poliomyelitis affects the anterior horn cells of the spinal cord.<sup>1</sup> Poliovirus spreads through the fecal-oral route. Most of the patients can remain symptom-free but can still spread the virus to another person. The clinical features of Poliomyelitis range from asymptomatic to paralysis.<sup>2</sup> The initial symptoms of the disease can resemble any nonspecific viral illness.

Some cases never develop into paralysis and are called abortive poliomyelitis, whereas in some cases, flaccid paralysis can occur leading to paralytic poliomyelitis. The most sensitive approach for diagnosing poliovirus infection is virus isolation in culture. Poliovirus is almost certainly isolated from feces samples.<sup>2,3</sup> Using a virus obtained in culture as the starting material, real-time reverse transcription polymerase chain reaction is used to distinguish probable

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wild strains from vaccine-like strains (“intra-typic differentiation/ITD”). Partial genome sequencing is utilized to validate the genotype of the poliovirus and to pinpoint its likely geographic origin. Contaminated samples are first subjected to viral isolations (L20B Cell and RD cell), followed by ITD and VP1 sequencing analysis.<sup>4</sup> The virus can also be isolated from throat swabs, blood, and cerebrospinal fluid (CSF). It is recommended to take two samples, 24 h apart, within 2 weeks of the start of the symptoms.<sup>3</sup> Prevention of polio has been the focus to decrease the spread of this serious illness. Scientists worked for the development of vaccinations that have helped to control the fast spread of the virus. Two types of vaccine are currently available for poliovirus. Inactivated or killed vaccine, also known as Salk, which is administered intramuscularly; and live vaccine, also known as Sabin, which is administered orally. Many different initiatives have been made globally to eradicate polio from the world. Many countries have completed this task, whereas in some countries it is still present. This may be due to several factors including geographical factors of various regions involved, *financial* terrains, and religious or cultural beliefs.<sup>5</sup> The management of a patient with postpolio paralysis uses a multidisciplinary approach, including orthopedic surgery for the correction of the joint, tendon deformities, and contractures; physiotherapy for the rehabilitation of the involved limbs; and ventilation devices to help the paralyzed respiratory muscles.<sup>6</sup> Vaccine-derived poliovirus (VDPV) can replicate in immunocompromised individuals and can cause polio outbreaks in areas with low Sabin oral polio vaccine (OPV) coverage. VDPV has the potential for persistent circulation and can result in paralytic polio in humans. The majority of Sabin vaccine-related poliovirus isolates are physiologically similar to wild poliovirus (WPV), however, Sabin vaccine-related poliovirus differs from WPV genetically and is capable of long-term transmission.<sup>7</sup> There are three types of VDPV, VDPV cases can be characterized based on epidemiologic factors: strains associated with immunocompromise (iVDPV), strains associated with person-to-person or community transmission (cVDPV), and “ambiguous” strains, for which the epidemiology is unknown (aVDPV).

WPV type 2 was declared eradicated in 2015 with the last case detected in India in 1999 while WPV type 3 was last detected in Nigeria in 2012 and was declared eradicated in 2019. This leaves the type 1 serotype as the sole circulating type seen in indigenous countries.<sup>8</sup> Global Polio Eradication Initiative (GPEI) was launched in 1988 when 350,000 cases occurred in 125 countries all over the world. This initiative aimed at global eradication of the poliovirus. Since then, wild poliovirus transmission has been interrupted in most countries leaving only three countries with indigenous WPV cases including Pakistan, Afghanistan, and Nigeria. In the year 2015, only Pakistan and Afghanistan reported transmission by WPV but the number of cases was significantly less than in previous years.<sup>8</sup> According to the report published by the Centers for Disease Control and Prevention (CDC),<sup>9</sup> a significant decrease was seen in the number of cases reported in Pakistan with 20 cases in 2016 to eight cases in 2017, showing a 60% decrease in the incidence of cases. In 2023, Pakistan reported its first case when a 3-year-old boy was affected by this virus.<sup>10</sup> Yet environmental surveillance samples still detected

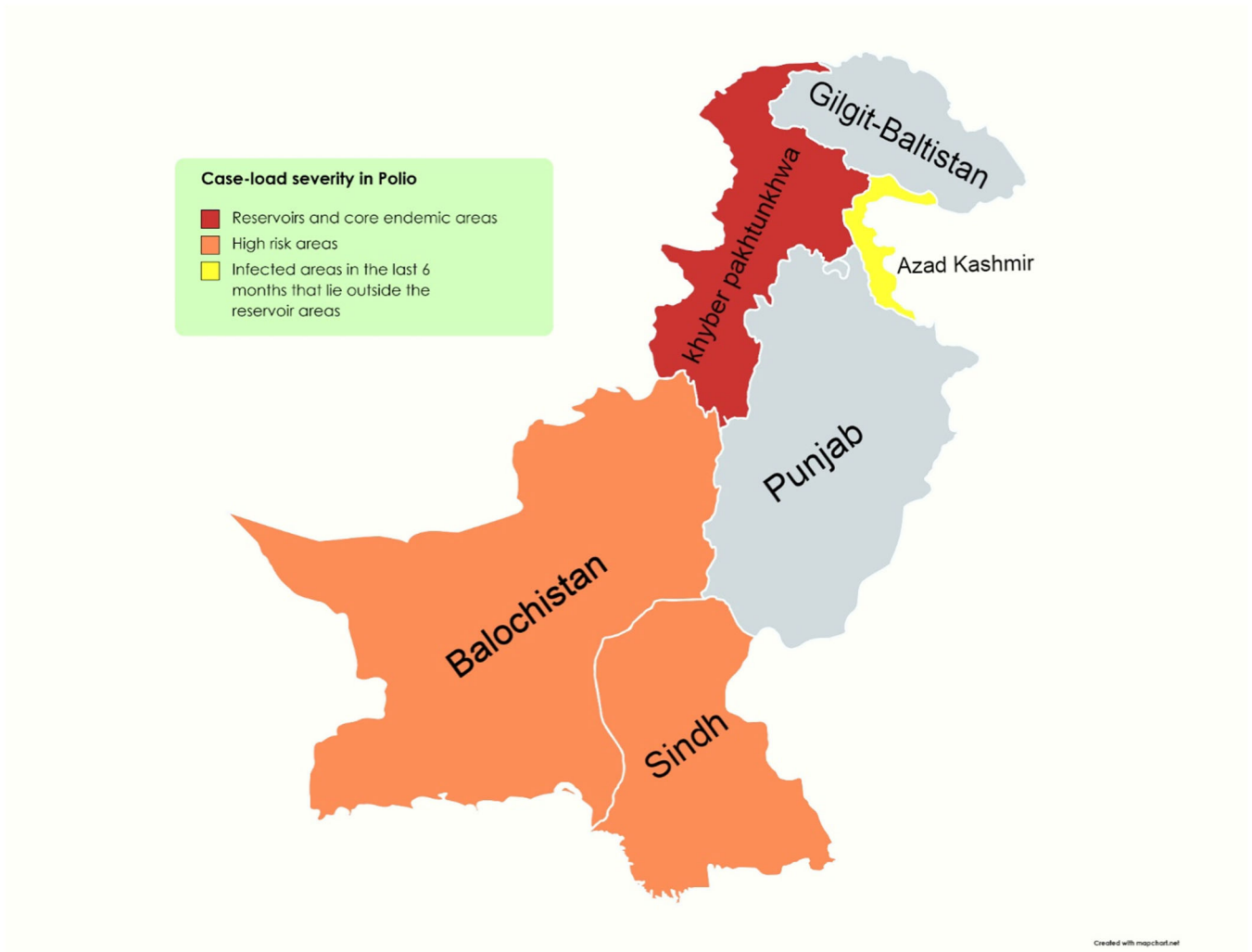
the virus in the samples from all provinces of the country. Moreover, in the same duration, some transmission of circulating vaccine-derived poliovirus 2 (cVDPV2) was identified that came 1 year following the switch to the bivalent oral polio vaccine in 2016. In the year 2020, a significant rise in the VDPV was seen that is attributed largely to the lack of vaccine coverage, seen following the deployment of polio workers for COVID-19 vaccination campaigns.<sup>11</sup> In 2021, only one case of WPV was reported paving the way for the goal of eradication. However, the resurgence of polio was reported after a 15-month hiatus when a wild polio-type case was reported in a child from North Waziristan.<sup>12</sup> In the map (Figure 1), caseloads of polio with respect to the states of Pakistan are shown.

Since then, aggressive re-emergence of polio has been seen with 19 cases reported till September 2022. This comes at a time when the country is facing unprecedented floods affecting one-third of the country and immunization campaigns cannot be conducted in Balochistan province and parts of Sindh province during the transmission season.<sup>13</sup> This gap could translate into an increased number of cases in the coming years. The trend of cases according to the official number of cases reported by the Pakistan Polio Eradication Program is shown in Figures 2 and 3.<sup>14</sup> Acute flaccid paralysis (AFP) is a common complication of polio. Table 1 shows the incidence rate of AFP due to polio and nonpolio in Pakistan from 2015 to 2023.<sup>15</sup>

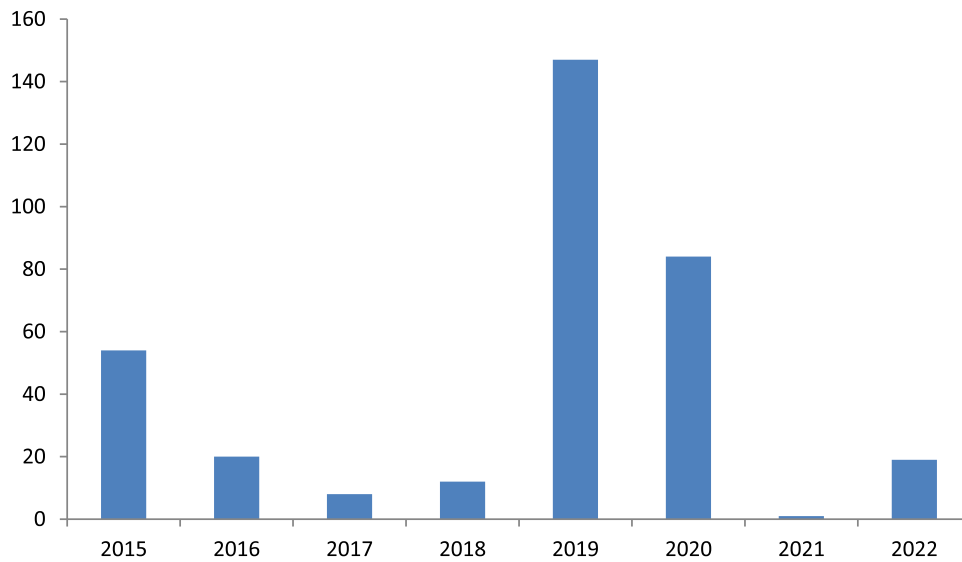
## 1 | COVID 19 TIME: 2020–2022

It is noteworthy that the cases have re-emerged at a time when a wild poliovirus case was reported in Malawi, which was declared polio-free previously.<sup>16</sup> Moreover, VDPV cases detected in the United Kingdom, United States, and Israel are speculated to be exported from Pakistan or Afghanistan where the wild type is still present and oral polio vaccine is in use.<sup>17,18</sup> This situation dictates a need for high vaccine coverage in not only the endemic countries but also in the parts of the world where polio is not endemic. It reiterates the idea that until polio is eradicated, no country is safe.

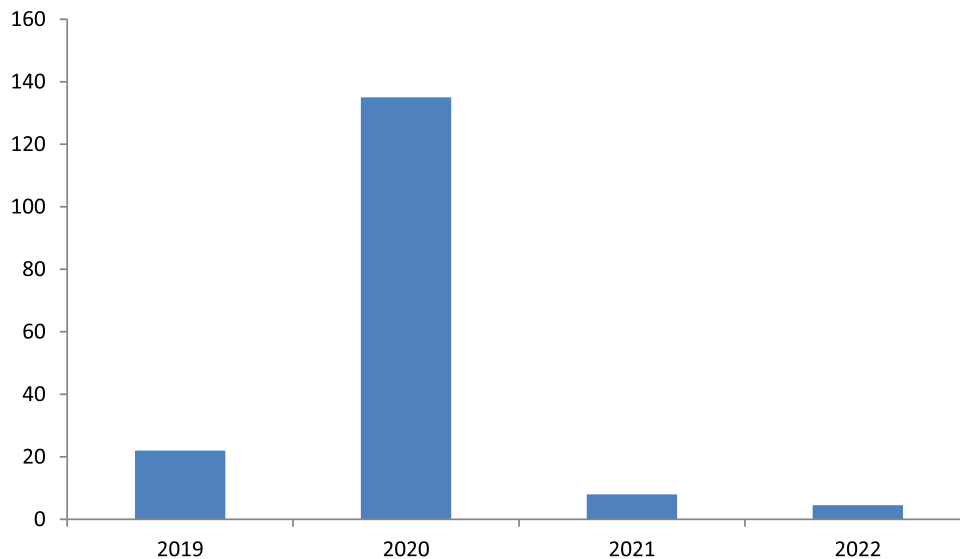
Polio has been eradicated from 99% of the countries.<sup>13</sup> Unfortunately, Pakistan is still listed among Polio-endemic countries.<sup>14</sup> Lack of awareness, low literacy rate, the mindset of conspiracy among the public, and the gap in polio campaigns for vaccination due to security issues of polio workers are the major challenges faced by Pakistan.<sup>19</sup> Low wages and minimum incentives like fewer promotions, temporary posts, and decreased facilities from the state coupled with extreme stress due to uncertain conditions of the high-risk areas where residents used to attack the workers raised dissatisfaction among the workers against polio in Pakistan.<sup>20</sup> The polio vaccination program was turning out to be a huge success against this endemic but the COVID-19 pandemic made the condition worse. The GPEI suffered during the COVID-19 pandemic and has almost crashed. 40 million children remain unvaccinated due to the lockdown and other restrictions implemented by the Government of Pakistan.<sup>21</sup> Most importantly the recent floods in Pakistan due to intense climatic change have increased the chances of the spread of



**FIGURE 1** Case-load severity of polio in states of Pakistan.



**FIGURE 2** Number of wild poliovirus cases reported in Pakistan from year 2015 to 2022.



**FIGURE 3** Number of vaccine-derived poliovirus cases reported in Pakistan from 2019 to 2022.

**TABLE 1** The cases of acute flaccid paralysis (AFP) due to polio and nonpolio.<sup>15</sup>

Year	Country	AFP case	Nonpolio AFP rate	Percentage of adequate stool collection
2015	Pakistan	5807	9.2	87
2016	Pakistan	7843	12.77	87
2017	Pakistan	10,315	16.84	86
2018	Pakistan	12,257	20.01	87
2019	Pakistan	15,192	24.54	87
2020	Pakistan	11,961	18.77	86
2021	Pakistan	13,098	21.37	85
2022	Pakistan	19,010	35.86	85
2023	Pakistan	19,733	32.24	84

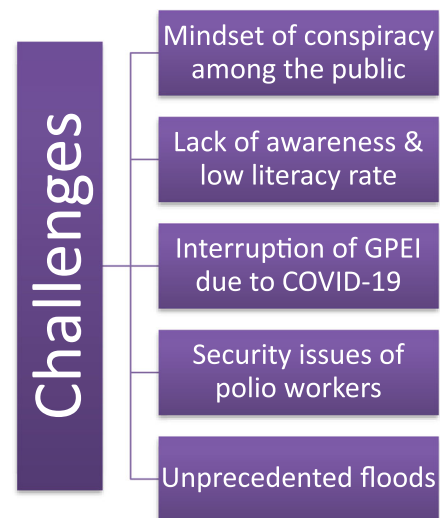
**TABLE 2** Month-wise report of wild poliovirus cases in 2022 and 2023.

Duration	Flood duration	Cases
January–June, 2022	2022 flood: 15 June to October	14
July–December, 2022		6
January–June, 2023	2023 flood: March to July	1

Note: All the cases are being reported from Khyber Pakhtunkhwa. In both the recent floods, Khyber Pakhtunkhwa was highly affected.

Source: Adapted with permission from Mbaeyi et al.<sup>22</sup>

polio. The floods have resulted in impaired sanitary systems and the mixing of waste from sewerage with flowing water. Table 2 has created a relationship between the incidence of Polio and floods in Pakistan.<sup>22</sup> Moreover, the use of disposable diapers present in



**FIGURE 4** Challenges in the eradication of polio in Pakistan.

flowing water predisposes to poliovirus. Stools from children vaccinated with OPV pass into the sewage system and resultantly can contaminate the water reserves. This occurs at a tremendous rate during floods increasing susceptibility to poliovirus infection.<sup>23</sup> The Challenges are mentioned in Figure 4.

A key strategy for eliminating the disease is to introduce the polio vaccine in the highest-risk areas.<sup>21</sup> Routine immunization (RI) ensures that every child receives three doses of OPV.<sup>24</sup> Therefore, support for routine immunization should be increased in health camps. High-risk areas should be provided with staff along with adequate infrastructure to continue RI. Focused improvement in sanitation facilities in slums and high-risk areas along with water facilities is important in eradication. Supplementing with additional health facilities in high-risk areas will hinder the spread of disease.<sup>25</sup> The use of digital technology for keeping the record of vaccinated



**FIGURE 5** Recommendations for making polio-free Pakistan.

and unvaccinated children can work wonders as it will help to monitor every child that missed the vaccine.<sup>26</sup> In January 2023, a nationwide polio campaign has been started.<sup>27</sup> Enhanced security should be ensured for polio workers so that they can feel protected while performing their duties. Control guidelines and standard operating procedures (SOPs) should be devised to minimize the chances of the spread of COVID-19 while vaccinating against polio. To decrease the spread of contaminated water, strategies should be developed to conduct environmental surveillance for the detection of the excretion of poliovirus strains from OPV-immunized individuals.<sup>23</sup> Pakistan is already afflicted with several outbreaks<sup>28,29</sup> this year, and this outbreak can pose a serious threat to public health and safety. We believe, that if the aforementioned measures are taken effectively, Pakistan can be a polio-free country. The recommendations are highlighted in Figure 5.

## 1.1 | Limitations

The AFP cases with respect to WPV and VDPV respectively are not present in any database.

## AUTHOR CONTRIBUTIONS

**Shehroze Tabassum:** Conceptualization; Writing—original draft; Writing—review and editing. **Abubakar Nazir:** Writing—original draft; Writing—review and editing. **Maleeka Zamurad Khan:** Writing—original draft; Writing—review and editing. **Saima Gill:** Writing—original draft; Writing—review and editing. **Aymar Akilimali:** Writing—review and editing. **Dattatreya Mukherjee:** Conceptualization; Writing—review and editing. **Mohammed Dheyaa Marsool Marsool:** Writing—review and editing. **Malik Olatunde Oduoye:** Writing—review and editing. All authors have read and approved the final version of the manuscript.

## CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

## DATA AVAILABILITY STATEMENT

This is a correspondence; no new data were generated. CORRESPONDING AUTHOR or MANUSCRIPT GUARANTOR had full access to all of the data in this study and take complete responsibility for the integrity of the data and the accuracy of the data analysis.

## TRANSPARENCY STATEMENT

The lead author Aymar Akilimali affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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