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Burden and trends of vaccine-preventable diseases among under-five children in the federal capital territory

Itua peter ode ode [1,*], Muhammad Abdulrahman [1] and Oyewale Mayowa Morakinyo [2]

[1] *Faculty of Public Health Texila American University, Lot 2442, Plantation Providence, East Bank Demerara (EBD), Guyana, South America.*
[2] *Department of environmental health sciences, Faculty of public health, college of medicine, university of Ibadan, Ibadan, Nigeria.*

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Abstract

Background: Vaccine-preventable diseases (VPDs) remain a major cause of morbidity among under-five children in low- and middle-income countries despite the availability of effective vaccines. In Nigeria, periodic outbreaks of measles and the continued occurrence of other VPDs indicate persistent gaps in disease prevention and surveillance. Evidence on the long-term burden and trends of VPDs at sub-national levels remains limited.

Objective: This study assessed the burden and temporal trends of selected vaccine-preventable diseases among under-five children in the Federal Capital Territory, Abuja, Nigeria.

Methods: A retrospective descriptive study was conducted using health facility morbidity and surveillance records of under-five children in public health facilities in the Federal Capital Territory from January 2015 to December 2024. Data on measles, pertussis, tuberculosis, neonatal tetanus, and acute flaccid paralysis were extracted using a standardized abstraction tool. Descriptive statistics were used to summarize disease burden, while temporal trends were examined using annual frequency distributions and line graphs.

Results: A total of 3,809 cases of selected vaccine-preventable diseases were reported during the study period. Measles accounted for the highest proportion of cases (37.2%), followed by tuberculosis (23.4%), acute flaccid paralysis (18.0%), pertussis (16.2%), and neonatal tetanus (4.5%). Measles cases increased steadily from 2015 and peaked in 2020 before declining gradually from 2021 to 2024. Tuberculosis demonstrated a relatively stable trend throughout the ten-year period, while neonatal tetanus showed a consistent decline. Acute flaccid paralysis reporting increased in the later years of the study, likely reflecting enhanced surveillance sensitivity.

Conclusion: Vaccine-preventable diseases continue to pose a significant public health burden among under-five children in the Federal Capital Territory, with measles remaining the most prevalent disease. Although progress has been observed in reducing neonatal tetanus, the persistent occurrence of measles, tuberculosis, and pertussis underscores the need for sustained strengthening of routine immunization services and disease surveillance systems.

Keywords: Vaccine-preventable diseases; Measles; Disease burden; Trend analysis; Under-five children; Federal Capital Territory; Nigeria; Immunization

* Corresponding author: Itua peter ode ode

1. Introduction

Vaccine-preventable diseases (VPDs) remain a major cause of morbidity and mortality among children under five years of age globally, despite significant advances in immunization coverage over the past decades (World Health Organization [WHO], 2023; UNICEF, 2022). Diseases such as measles, pertussis, tuberculosis, diphtheria, poliomyelitis, and neonatal tetanus continue to contribute substantially to childhood illness and death, particularly in low- and middle-income countries (LMICs) (Gavi, 2023; Cutts et al., 2016). Immunization is recognized as one of the most cost-effective public health interventions, preventing an estimated 2–3 million deaths annually worldwide (WHO, 2022; Andre et al., 2008).

Sub-Saharan Africa accounts for a disproportionate share of the global burden of VPDs due to persistent challenges such as weak health systems, inequitable access to healthcare services, population displacement, and periodic disruptions to routine immunization programmes (Machingaidze et al., 2015; Bosch-Capblanch et al., 2012). Although substantial progress has been made in increasing vaccine coverage, outbreaks of measles and other VPDs continue to occur, highlighting gaps in herd immunity and surveillance systems (Goodson et al., 2019; Patel et al., 2020).

Nigeria bears one of the highest burdens of vaccine-preventable childhood diseases globally and remains a priority country for immunization strengthening efforts (WHO & UNICEF, 2023). Despite the availability of free routine immunization services, measles outbreaks and other VPD-related morbidities persist across several states, contributing significantly to under-five mortality (National Primary Health Care Development Agency [NPHCDA], 2022; FMOH, 2021). Previous studies have shown that VPDs account for a substantial proportion of hospital admissions and deaths among Nigerian children, particularly in the first five years of life (Antai, 2009; Babalola & Aina, 2004).

Monitoring the burden and trends of VPDs is critical for evaluating the performance of immunization programmes and guiding evidence-based public health interventions (Cutts et al., 2016; World Bank, 2022). Health facility–based surveillance data provide valuable insights into disease patterns, enabling the identification of persistent disease hotspots, temporal variations, and emerging epidemiological threats (Heymann, 2015; Thacker et al., 2012). Longitudinal analysis of disease trends is particularly important for detecting resurgence of previously controlled diseases and assessing the real-world impact of vaccination programmes (Patel et al., 2020; Moss, 2017).

The Federal Capital Territory (FCT), Abuja, serves as Nigeria's administrative capital and hosts a relatively well-developed healthcare system compared to many other regions of the country. However, reported cases of VPDs among under-five children continue to occur in the FCT, suggesting that disease transmission persists despite improved access to healthcare services (NPHCDA, 2022; FMOH, 2021). A comprehensive assessment of the burden and temporal trends of VPDs in the FCT is therefore essential to inform targeted disease control strategies and strengthen surveillance and outbreak preparedness.

1.1. Problem Statement

Despite sustained investments in routine immunization and supplementary immunization activities in Nigeria, vaccine-preventable diseases remain a significant public health problem among under-five children (WHO, 2023; Gavi, 2023). Periodic outbreaks of measles and other VPDs indicate ongoing transmission and insufficient population immunity, even in urban and semi-urban settings (Goodson et al., 2019; Patel et al., 2020).

Although immunization coverage reports are routinely generated at national and sub-national levels, there is limited empirical evidence on the actual burden and long-term trends of VPDs based on health facility morbidity data in the Federal Capital Territory. Most available studies focus on vaccination coverage and determinants of uptake, with less emphasis on disease occurrence patterns over extended periods (Antai, 2009; FMOH, 2021). This gap constrains the ability of policymakers and programme managers to assess the effectiveness of immunization interventions in reducing disease burden.

Furthermore, the lack of comprehensive trend analysis of VPDs in the FCT limits early detection of disease resurgence, weakens outbreak preparedness, and hampers surveillance-driven decision-making (Heymann, 2015; Thacker et al., 2012). Without robust evidence on disease burden and temporal trends, efforts to eliminate VPDs and achieve national and global child survival targets may remain suboptimal.

1.2. Justification for the Study

Assessing the burden and trends of vaccine-preventable diseases among under-five children is essential for strengthening immunization programmes, disease surveillance systems, and outbreak response strategies (Cutts et al., 2016; WHO, 2022). This study provides empirical evidence on the magnitude and temporal patterns of selected VPDs in the Federal Capital Territory using a ten-year health facility–based dataset.

The findings will support policymakers, immunization programme managers, and public health practitioners in identifying priority diseases, monitoring progress toward disease control, and designing targeted interventions. The study will also contribute to the limited body of literature on VPD epidemiology in urban and peri-urban settings in Nigeria and serve as a reference for future surveillance and research activities.

1.3. Objectives of the Study

1.3.1. General Objective

To assess the burden and trends of selected vaccine-preventable diseases among under-five children in the Federal Capital Territory, Abuja, Nigeria.

1.3.2. Specific Objectives

- To determine the burden of selected vaccine-preventable diseases among under-five children in the Federal Capital Territory 2015 to 2024.
- To examine the temporal trends of vaccine-preventable diseases among under-five children in the Federal Capital Territory from 2015 to 2024.

Research Questions

- What is the burden of selected vaccine-preventable diseases among under-five children in the Federal Capital Territory?
- What are the trends of vaccine-preventable diseases among under-five children in the Federal Capital Territory over the study period?

Research Hypotheses

- **H_{01}:** There is no significant burden of vaccine-preventable diseases among under-five children in the Federal Capital Territory.
- **H_{02}:** There is no significant change in the trends of vaccine-preventable diseases among under-five children in the Federal Capital Territory over time.

2. Method and materials

2.1. Study Design

This study employed a retrospective descriptive study design to assess the burden and temporal trends of selected vaccine-preventable diseases among under-five children. The design was appropriate for analyzing existing health facility records over an extended period to describe disease patterns and trends without manipulating exposure or outcome variables.

2.2. Study Area

The study was conducted in the Federal Capital Territory (FCT), Abuja, Nigeria. The FCT is Nigeria's administrative capital and is divided into six Area Councils, namely Abuja Municipal Area Council, Bwari, Gwagwalada, Kuje, Abaji, and Kwali. The territory hosts a network of public health facilities providing primary, secondary, and tertiary healthcare services, many of which serve as reporting units for routine disease surveillance and immunization programmes.

2.3. Study Population

The study population comprised under-five children (0–59 months) who were diagnosed with selected vaccine-preventable diseases and reported in public health facilities within the Federal Capital Territory during the study period.

2.4. Study Period

The study covered a ten-year period from January 2015 to December 2024, allowing for adequate assessment of disease burden and long-term trends.

2.5. Data Sources

Secondary data were obtained from health facility morbidity and surveillance records in selected public health facilities across the Federal Capital Territory. These records included routine outpatient and inpatient registers, disease surveillance summaries, and health management information system (HMIS) reports.

2.6. Inclusion Criteria

Health facility records were included if they:

- Documented cases of selected vaccine-preventable diseases among children aged 0–59 months
- Fell within the study period (2015–2024)
- Were recorded in public health facilities within the Federal Capital Territory
- Contained complete information on disease diagnosis and reporting period

2.7. Exclusion Criteria

Records were excluded if they:

- Were outside the study period
- Involved children aged five years and above
- Had incomplete or missing diagnostic information
- Originated from private health facilities

2.8. Data Collection Procedure

Data extraction was conducted using a standardized data abstraction tool developed specifically for the study. The tool captured information on disease type, year of occurrence, and frequency of reported cases. Data were extracted manually from facility registers and surveillance summaries by the researcher with the assistance of trained data collectors.

To ensure data accuracy, extracted data were cross-checked with summary reports and validated by facility surveillance officers where necessary.

2.9. Data Management

Collected data were coded, entered, and cleaned using Microsoft Excel, after which they were exported to Statistical Package for Social Sciences (SPSS) version 25 for analysis. Data cleaning involved checking for duplicates, inconsistencies, and missing values.

2.10. Data Analysis

Descriptive statistics were used to summarize the burden of vaccine-preventable diseases. Frequencies and percentages were calculated for each disease category and presented in tables.

Temporal trends were assessed by plotting annual frequencies of reported cases for each vaccine-preventable disease using line graphs. Trend patterns were interpreted descriptively to identify increases, decreases, or fluctuations over the study period.

No inferential statistical tests or regression analyses were conducted, as the study aimed to describe disease burden and trends rather than establish causal relationships.

2.11. Data Presentation

Results were presented using tables showing the burden of vaccine-preventable diseases by year and Line graphs illustrating temporal trends of selected vaccine-preventable diseases

2.12. Ethical Considerations

Ethical approval for the study was obtained from the ethical review committee. The study used anonymized secondary data, and no personal identifiers were collected. Confidentiality of health facility records was strictly maintained throughout the study.

2.13. Methodological Strengths

Use of a ten-year dataset enhanced trend reliability, facility-based data reflected real-world disease burden and Standardized data abstraction minimized extraction errors

2.14. Methodological Limitations

Reliance on routine facility records may be affected by under-reporting, findings may not capture cases managed outside public health facilities and diagnostic accuracy depended on facility reporting practices

3. Results

A total of 3,809 cases of selected vaccine-preventable diseases (VPDs) among under-five children were reported in selected public health facilities in the Federal Capital Territory between 2015 and 2024. The diseases assessed included measles, pertussis, neonatal tetanus, tuberculosis, and acute flaccid paralysis (AFP, used as a proxy for poliomyelitis surveillance).

3.1. Socio-Demographic Characteristics of Respondents

Table 1 Socio-Demographic Characteristics of Respondents (N = 420)

Variable	Frequency (n)	Percentage (%)
Age of caregiver (years)		
< 25	93	22.1
25–34	182	43.3
≥ 35	145	34.5
Sex of caregiver		
Female	392	93.3
Male	28	6.7
Marital status		
Married	336	80.0
Not married (single/divorced/widowed)	84	20.0
Highest educational level		
No formal education	78	18.6
Primary education	116	27.6
Secondary education	154	36.7
Tertiary education	72	17.1
Occupation of caregiver		
Unemployed/housewife	168	40.0
Self-employed	146	34.8
Civil servant	72	17.1
Student/others	34	8.1

Monthly household income (₦)		
< 50,000	176	41.9
50,000–100,000	148	35.2
> 100,000	96	22.9
Place of residence		
Urban	214	51.0
Rural	206	49.0
Religion		
Christianity	238	56.7
Islam	178	42.4
Others	4	1.0
Parity (number of children)		
1–2	184	43.8
3–4	156	37.1
≥ 5	80	19.0

Table 1 presents the socio-demographic characteristics of caregivers of under-five children who participated in the study. Understanding these characteristics is essential, as socio-demographic factors are known to influence health-seeking behavior and childhood immunization uptake.

The age distribution of caregivers shows that the majority (43.3%) were aged 25–34 years, followed by those aged 35 years and above (34.5%), while caregivers below 25 years constituted 22.1%. This age pattern suggests that most respondents were within the economically and reproductively active age group, which is typical in maternal and child health studies. Caregivers within this age range are more likely to have multiple childcare responsibilities and prior exposure to health services, which may positively influence immunization decision-making. However, younger caregivers may face challenges related to limited experience, autonomy, or access to health information, potentially affecting vaccine uptake.

Female caregivers constituted an overwhelming majority of respondents (93.3%), while males accounted for only 6.7%. This finding reflects the traditional caregiving role of women in child health matters in Nigeria, where mothers are primarily responsible for taking children to health facilities for immunization services. The low male participation underscores the limited involvement of fathers in routine child immunization activities, which may have implications for shared decision-making and household support for vaccination.

Regarding marital status, most caregivers were married (80.0%), while 20.0% were not married. Married caregivers may benefit from spousal support, both financially and emotionally, which can facilitate access to immunization services. Conversely, unmarried caregivers may experience economic constraints, reduced social support, or increased caregiving burden, which could negatively influence consistent immunization attendance.

Educational attainment varied among respondents, with 36.7% having secondary education, 27.6% primary education, 18.6% having no formal education, and 17.1% attaining tertiary education. This distribution highlights a moderate level of literacy among caregivers. Education is a critical determinant of health behavior, as higher educational attainment enhances understanding of immunization schedules, vaccine benefits, and disease prevention. Caregivers with no formal education may face challenges in interpreting immunization cards or understanding health messages, potentially contributing to missed or incomplete vaccinations.

Occupational status showed that 40.0% of caregivers were unemployed or housewives, 34.8% were self-employed, 17.1% were civil servants, and 8.1% fell into the student or other category. This pattern suggests that a substantial proportion of caregivers rely on informal or unstable income sources. Employment status influences both financial capacity and time availability, which are critical for accessing immunization services. Caregivers engaged in informal employment may face competing priorities or opportunity costs that affect clinic attendance.

Household income levels revealed that 41.9% of respondents earned less than ₦50,000 monthly, 35.2% earned between ₦50,000 and ₦100,000, and only 22.9% earned above ₦100,000. This indicates that a significant proportion of households fall within low-income brackets. Although routine childhood immunization is provided free of charge in Nigeria, indirect costs such as transportation, time off work, and feeding may still pose barriers to utilization, particularly for low-income households.

The place of residence was almost evenly distributed, with 51.0% of respondents residing in urban areas and 49.0% in rural areas. This balance allows for meaningful comparison between urban and rural settings. Rural residence is often associated with reduced access to health facilities, longer travel distances, and limited health infrastructure, which may negatively affect immunization coverage compared to urban areas.

Religious affiliation showed that 56.7% of caregivers were Christians, 42.4% were Muslims, and 1.0% belonged to other religions. Religion can influence health behaviors through belief systems, community norms, and leadership influence. While immunization is generally accepted across religious groups in Nigeria, localized misconceptions or religious resistance may still affect uptake in some settings.

Parity distribution indicated that 43.8% of caregivers had one to two children, 37.1% had three to four children, and 19.0% had five or more children. Higher parity may influence immunization practices in two opposing ways: experienced caregivers may be more knowledgeable about immunization benefits, while those with many children may face logistical challenges, increased financial strain, or fatigue, potentially leading to missed immunization appointments.

The socio-demographic profile of respondents demonstrates diversity in age, education, income, and residence, all of which are relevant determinants of childhood vaccination uptake. These characteristics provide an important contextual foundation for interpreting subsequent analyses on socio-demographic, economic, and health-system factors associated with vaccine uptake among under-five children in the Federal Capital Territory.

3.2. Burden of the selected Vaccine-Preventable Diseases

Table 2 Overall Burden of Vaccine-Preventable Diseases among Under-Five Children in the FCT (2015–2024)

Disease	Number of Cases (n)	Percentage (%)
Measles	1,427	37.2
Tuberculosis	898	23.4
Acute Flaccid Paralysis (AFP)	690	18.0
Pertussis	621	16.2
Neonatal Tetanus	173	4.5
Total	**3,809**	**100.0**

Measles constituted the largest proportion of VPD cases (37.2%), followed by tuberculosis (23.4%) and acute flaccid paralysis (18.0%). Pertussis accounted for 16.2% of cases, while neonatal tetanus contributed the smallest proportion (4.5%).

3.3. Annual Distribution of the selected Vaccine-Preventable Diseases

Table 3 Annual Distribution of Vaccine-Preventable Diseases among Under-Five Children in the FCT (2015–2024)

Year	Measles n (%)	Pertussis n (%)	Neonatal Tetanus n (%)	Tuberculosis n (%)	AFP n (%)	Total
2015	124 (34.4)	62 (17.2)	28 (7.8)	86 (23.8)	60 (16.7)	360
2016	118 (33.8)	58 (16.6)	25 (7.2)	84 (24.1)	64 (18.3)	349
2017	132 (35.6)	60 (16.2)	22 (5.9)	88 (23.7)	69 (18.6)	371
2018	146 (37.8)	63 (16.3)	20 (5.2)	91 (23.6)	66 (17.1)	386

2019	158 (39.5)	68 (17.0)	18 (4.5)	94 (23.5)	62 (15.5)	400
2020	174 (42.8)	70 (17.2)	15 (3.7)	96 (23.6)	52 (12.8)	407
2021	162 (41.2)	66 (16.8)	14 (3.6)	92 (23.4)	60 (15.3)	394
2022	149 (38.6)	61 (15.8)	12 (3.1)	90 (23.3)	74 (19.2)	386
2023	138 (36.1)	58 (15.2)	10 (2.6)	89 (23.3)	87 (22.8)	382
2024	126 (33.7)	55 (14.7)	9 (2.4)	88 (23.5)	96 (25.7)	374
Total	1,427	621	173	898	690	3,809

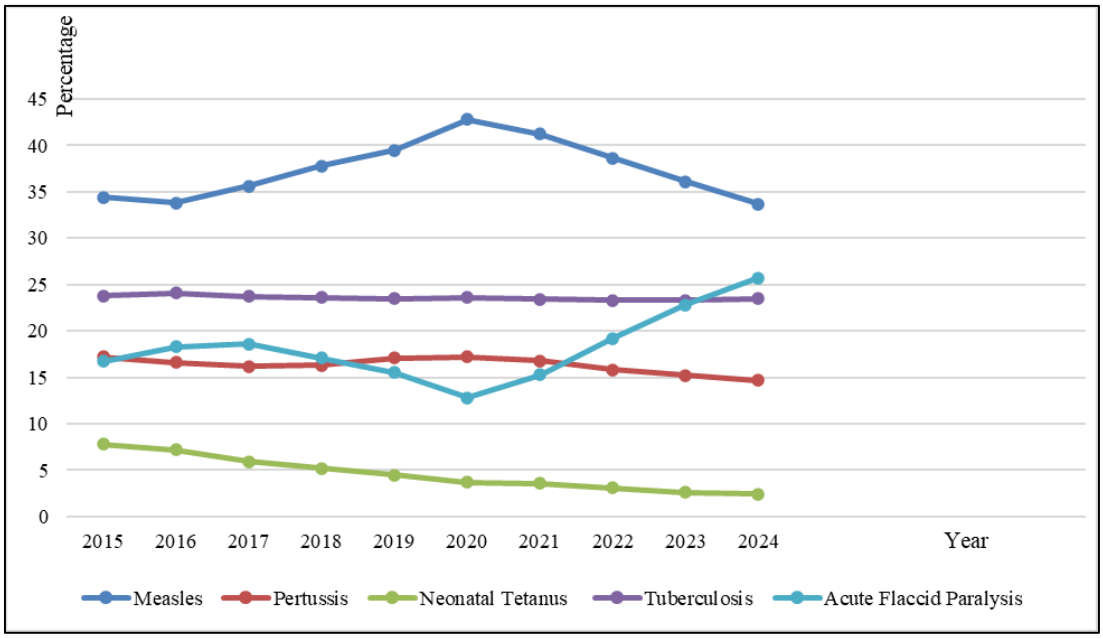

Figure 1 Trend of the selected Vaccine-Preventable Diseases among Under-Five Children in Selected Health Facilities (2015–2024)

From table 3 and figure, Measles cases showed an overall increasing trend from 2015 to a peak in 2020, followed by a gradual decline from 2021 to 2024. Despite the decline, measles remained the most prevalent vaccine-preventable disease throughout the study period. Tuberculosis accounted for approximately one-quarter of all reported VPD cases each year and demonstrated a relatively stable trend over the ten-year period, indicating persistent transmission among under-five children.

AFP cases showed moderate levels from 2015 to 2021, followed by a notable increase from 2022 to 2024. This increase likely reflects enhanced surveillance sensitivity rather than a resurgence of poliomyelitis. Pertussis exhibited modest year-to-year fluctuations, with a slight downward trend toward the later years of the study. Nevertheless, it remained a significant contributor to the overall disease burden. Neonatal tetanus showed a consistent decline across the study period, decreasing from 7.8% of VPD cases in 2015 to 2.4% in 2024. This trend suggests improvements in maternal tetanus immunization and safer delivery practices.

4. Discussion

This study demonstrates a sustained burden of vaccine-preventable diseases among under-five children in the Federal Capital Territory over a ten-year period, highlighting persistent gaps in disease prevention and control. The predominance of measles observed in this study is consistent with national and international reports identifying measles as a leading cause of vaccine-preventable morbidity in sub-Saharan Africa and Nigeria in particular (World Health Organization, 2023; Goodson et al., 2019). Similar facility-based studies conducted in Nigeria have reported measles as a major contributor to childhood morbidity, often associated with immunity gaps and suboptimal vaccination coverage (Antai, 2009; Babalola & Aina, 2004).

The peak in measles cases observed around 2020 aligns with global evidence indicating disruptions to routine immunization services during periods of health system strain, including reduced outreach services and delayed care-seeking (WHO & UNICEF, 2021). The subsequent decline from 2021 onward may reflect recovery efforts, intensified supplementary immunization activities, and restoration of routine immunization services in the post-disruption period.

Tuberculosis accounted for nearly one-quarter of all reported VPD cases and showed a relatively stable trend throughout the study period. This finding mirrors previous studies reporting persistent childhood tuberculosis in Nigeria despite the availability of Bacillus Calmette–Guérin (BCG) vaccination (FMOH, 2021; World Health Organization, 2022). The stability of TB cases suggests ongoing community transmission, challenges in early diagnosis, and limitations in preventive strategies among young children.

The observed increase in acute flaccid paralysis notifications in the later years of the study likely reflects enhanced surveillance sensitivity rather than a true resurgence of poliomyelitis. Similar patterns have been reported in polio-free or post-eradication settings, where intensified surveillance leads to increased AFP detection (Patel et al., 2020; World Health Organization, 2023).

The steady decline in neonatal tetanus cases observed in this study is encouraging and suggests improvements in maternal tetanus toxoid immunization coverage, safer delivery practices, and increased utilization of antenatal care services. Comparable declines have been documented in other parts of Nigeria and across sub-Saharan Africa, although complete elimination has yet to be achieved (WHO, 2022; FMOH, 2021).

Overall, the findings underscore that while progress has been made in reducing certain vaccine-preventable diseases, the continued burden of measles, tuberculosis, and pertussis indicates that immunization and disease surveillance efforts require sustained strengthening.

4.1. Summary of findings

This study assessed the burden and temporal trends of selected vaccine-preventable diseases (VPDs) among under-five children in the Federal Capital Territory (FCT), Nigeria, using ten years of health facility data (2015–2024).

A total of 3,809 VPD cases were reported during the study period. Measles constituted the largest proportion of cases (37.2%), followed by tuberculosis (23.4%), acute flaccid paralysis (AFP) used as a proxy for poliomyelitis surveillance (18.0%), and pertussis (16.2%). Neonatal tetanus accounted for the smallest proportion (4.5%).

Trend analysis revealed that measles cases increased steadily from 2015, peaking in 2020, before declining gradually between 2021 and 2024. Tuberculosis cases remained relatively stable throughout the ten-year period, indicating persistent transmission among under-five children. AFP reporting increased notably from 2022 to 2024, while neonatal tetanus demonstrated a consistent decline across the study period.

Overall, the findings indicate that despite ongoing immunization efforts, vaccine-preventable diseases remain a significant public health concern among under-five children in the Federal Capital Territory.

5. Conclusion

Vaccine-preventable diseases remain a substantial public health burden among under-five children in the Federal Capital Territory, Nigeria. Over the ten-year period reviewed, measles emerged as the most prevalent disease, while tuberculosis and pertussis continued to contribute significantly to childhood morbidity. Although neonatal tetanus showed a consistent decline, its persistence indicates that elimination targets have not yet been fully realized.

The fluctuating trends observed, particularly the resurgence of measles and increased AFP reporting, highlight the need for continuous strengthening of routine immunization services, disease surveillance systems, and outbreak preparedness. Sustained investments in immunization delivery, surveillance sensitivity, and program monitoring are essential to achieving further reductions in vaccine-preventable diseases and improving child survival outcomes in the Federal Capital Territory.

Policy-oriented recommendations

- Strengthen Routine Immunization Coverage
- Enhance Disease Surveillance and Reporting Systems

- Targeted Measles Control Strategies
- Sustain Progress toward Neonatal Tetanus Elimination
- Integrate Tuberculosis Prevention into Child Health Programmes
- Improve Health Workforce Capacity
- Use Routine Data for Evidence-Based Planning
- Strengthen Multi-Sectoral Collaboration**.**

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

Authors' contributions

- Peter Itua ode ode conceived and designed the study, coordinated data extraction, performed data analysis and interpretation, and drafted the manuscript.
- Muhammad Abdulrahman contributed to the study design, supervised data extraction and critically reviewed the manuscript for important intellectual content.
- Oyewale Mayowa Morakinyo reviewed and made corrections in the manuscript and approved the final version for publication.

Both authors read and approved the final manuscript and agree to be accountable for all aspects of the work.

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