Journal of Immune Based Therapies, Vaccines and Antimicrobials, 2025, 14(1), 1-11
https://www.scirp.org/journal/jibtva
ISSN Online: 2168-1554
ISSN Print: 2168-1546

A Study of a Six-Year Trend of Pentavalent 1 and 3 Coverage in Imo State from 2018 to 2023

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How to cite this paper: Linda, O.C., Williams-Bassi, W., Ayobami, A.A., Oluwaseyi, A.A., Izegbune, A., Ugba, F.E., Ineife, A., Iheyi, N.V., Chinwe, E.E., Enebeli, U., Ojule, I.N., Anthony, K.U., Casmir, O.E., Ruth, O.T. and Ngefechukwu, G.B. (2025) A Study of a Six-Year Trend of Pentavalent 1 and 3 Coverage in Imo State from 2018 to 2023. *Journal of Immune Based Therapies, Vaccines and Antimicrobials*, **14**, 1-11.
https://doi.org/10.4236/jibtva.2025.141001

Received: January 12, 2025
Accepted: January 28, 2025
Published: January 31, 2025

Abstract

Vaccination is widely regarded as the most successful and cost-effective intervention in public health to combat infectious diseases. A pentavalent vaccine, also known as a 5-in-1 vaccine, is a combination vaccine with five individual antigens conjugated into one. Pentavalent vaccine protects against diphtheria, tetanus, whooping cough, hepatitis B, and Haemophilus influenzae type B, and it is generally used in middle- and low-income countries, where polio vaccine is given separately. This study investigated a six-year trend of Pentavalent1 and 3 vaccination coverage in Imo State from 2018 to 2023. Data was extracted from the DHIS2 platform and analyzed using Excel, QGIS, and Health Mapper. The result shows that in 2018, Penta 1 and Penta 3 coverage was 87% and 81% respectively; in 2019 there was 84% coverage for Penta 1 and 79% for Penta 3. In the year 2020, the coverage for Penta 1 and Penta 3 was 75% and 69%; for 2021 the coverages dropped further at 72% for Penta 1 and 66% for Penta 3. In 2022, coverages were 71% and 65% respectively for Penta1 and Penta 3 and a further drop to 63% and 59% respectively in 2023. The State dropout rate never exceeded the national dropout rate of 10% throughout the study period. The decline in vaccination coverage in 2020-2021 may be attributed to the Covid-19 pandemic; further drop in coverages to 2023 may be attributable to rising state of insecurity in the state. Future studies would require a more in-depth analysis of confounding socio-economic

factors and other barriers to immunization access.

Keywords

Immunization, Vaccination, Pentavalent, Dropout Rate

1. Background

Vaccination is widely regarded as the most successful and cost-effective intervention in public health to combat infectious diseases [1] [2]. It has significantly contributed to reducing the spread of diseases, preventing complications, and saving lives [3] [4]. Immunization is playing a critical role in achieving the SDGs, especially in low- and middle-income countries. Immunization directly impacts health (SDG3) and contributes to 14 out of the 17 SDGs, such as ending poverty, reducing hunger, and reducing inequalities [5].

The third Sustainable Development Goal (SDG) aims to reduce childhood mortality from preventable deaths by ensuring universal vaccination coverage. Estimates suggest that immunization saves 2 - 3 million lives per year [5]. Expanding access to immunization is crucial to achieving the SDGs, as vaccinations not only prevent sickness and death associated with infectious diseases such as measles, pneumonia, polio, whooping cough, and diarrhea, but also contribute to broader gains in education and economic development. Immunization is a key component of primary health care, an indisputable human right and a crucial component of the Child Survival Program [6].

A pentavalent vaccine, also known as a 5-in-1 vaccine, is a combination vaccine with five individual vaccines conjugated into one [7] [8]. Pentavalent vaccine frequently refers to the 5-in-1 vaccine protecting against diphtheria, tetanus, whooping cough, hepatitis B, and Haemophilus influenzae type B, which is generally used in middle- and low-income countries, where polio vaccine is given separately [7]. Diphtheria, tetanus, and pertussis (DTP) vaccines have been in use since the 1950s and were combined with HepB and/or Hib in the 1990s [9]. Pentavalent vaccine is estimated to avert the largest number of deaths and disability-adjusted life-years [9]. The third dose of the pentavalent vaccine is a crucial indicator for assessing the performance of immunization programs, because it reflects the completeness of a child's immunization schedule [5] [10]. The Global Vaccine Action Plan (GVAP) set a dual target for pentavalent vaccination at 90% in national coverage and 80% for other administrative units by the year 2020 [5]. The first dose of the pentavalent vaccine is given when a child is six weeks old, and the second and third doses are given at ten and fourteen weeks of age, respectively [10]. The coverage of pentavalent vaccination has improved over time, but it is still below the GVAP goal of achieving 90% by the year 2020 [5]. Immunization coverage for the first and third dose of diphtheria, pertussis, and tetanus (DPT3) and hepatitis B (Hep B) vaccines is 71.5% and 58.9%, respectively [11] [12]. If an infant defaults

to the three doses of the pentavalent vaccine, it indicates an access problem, while a high dropout rate suggests a problem with vaccine acceptance.

2. Statement of the Problem

Vaccination serves as a cornerstone of preventive healthcare, safeguarding the well-being of children by offering protection against vaccine-preventable diseases [4]. The administration of Penta 1 and Penta 3 vaccines, comprising a series of essential immunizations, is crucial for reducing child morbidity and mortality [10].

The utilization of initial core vaccines like BCG, DTP, Polio, and measles has shown significant improvement, rising from 5% in 1974 to exceeding 86% in 2018 [4]. Despite these impressive global figures, variations in vaccine coverage both between and within countries persist, leading to an estimated 19.4 million children without immunization in 2018. Most of these unvaccinated children come from countries in sub-Saharan Africa (SSA), where the mortality rate among children under five from vaccine-preventable illnesses remains one of the highest in the world., there remain significant gaps in achieving optimal coverage rates, leading to potential outbreaks and public health concerns [5].

3. Justification for the Study

Vaccination coverage directly correlates with the prevention of vaccine-preventable diseases and subsequent reductions in morbidity and mortality among children. By evaluating the coverage rates of Penta 1 and Penta 3 vaccines, this study aims to contribute to the overall improvement of child health and well-being. Despite extensive efforts to promote immunization, there persist significant disparities in vaccination coverage rates. This study's focus on Penta 1 and Penta 3 vaccines is vital for understanding coverage gaps, which can inform targeted interventions to reach under-vaccinated populations. It will also provide information on where health systems need strengthening—be it in terms of healthcare facilities, outreach programs, or community engagement. It will also contribute to data-driven decision-making and improved program accountability. Incomplete vaccination coverage can result in susceptibility to disease outbreaks. By identifying coverage gaps, this research can help public health agencies proactively address areas at risk and respond effectively to potential outbreaks.

The study outcomes also have the potential to positively impact child health, reduce disease burden, enhance vaccination strategies, promote equity in healthcare access, and contribute to broader public health objectives.

4. Objective

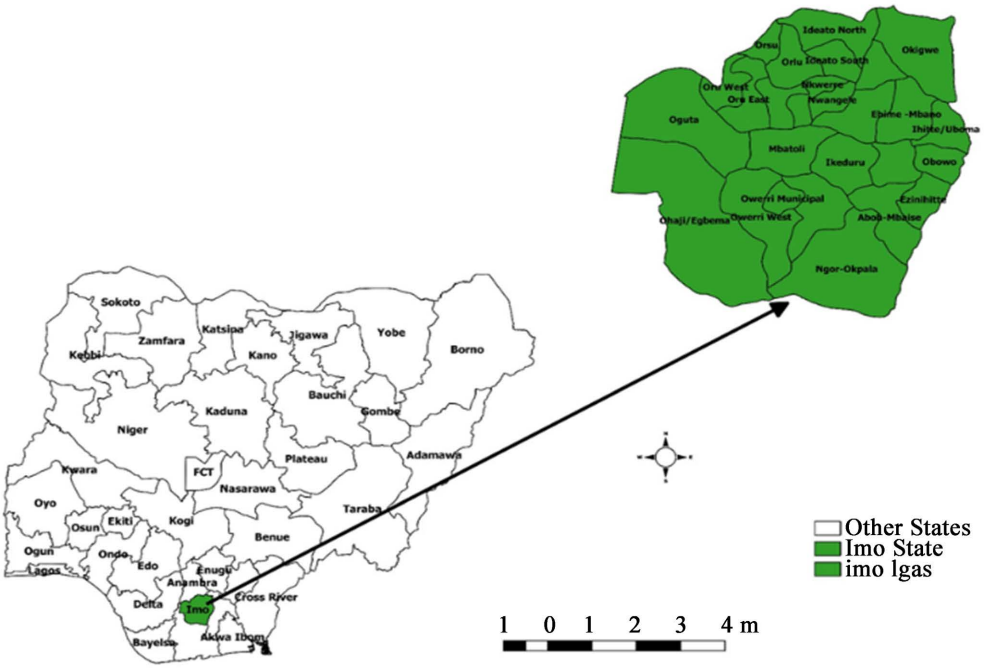
To describe a six-year trend of Pentavalent 1 and 3 coverages in Imo state from 2018-2023.

5. Methods

Imo State (Igbo: Ọra Imo) is a state in the Southeast of Nigeria, bordered to the

north by Anambra State, Rivers State to the west and south, and Abia State to the east [5]. It takes its name from the Imo River which flows along the state's eastern border. The state capital is Owerri and its state nickname is the Eastern Heartland. Imo State consists of 27 local government areas and 418 wards (see **Map 1**).

The state has 560 Public health facilities offering routine immunization and 210 Private health facilities offering routine immunization. The Public health facilities are under the primary health care development agency which oversees the implementation of the immunization program in the state.



Map 1. Map of imo state.

The study is a descriptive study of pentavalent 1 and3 vaccination coverages in Imo State from 2018 to 2023 among all under-one children population who received Pentavalent 1 and 3 vaccinations in Imo state from 2018 to 2023. Data of all children under the age of one year captured in the District Health Information System (DHIS2) was downloaded into Microsoft Excel® version 2016 and analysis was conducted using the excel spreadsheet, QGIS, and Health Mapper 4.0. Variables downloaded from the DHIS2 included the pentavalent 1 and 3 coverages and drop-out rates across the 27 local government areas of the State between 2018 and 2023.

6. Results

Figure 1 and **Figure 2** show the trend of Penta 1 and Penta 3 monthly coverage in Imo state from January 2018 to December 2023 while **Figures 3-8** show the trend Maps of Imo State pentavalent 1 coverage from 2018 to 2023. **Figure 9** to **Figure 10** shows the Penta 1 to Penta 3 drop-out rate in Imo State from 2018 to 2023.

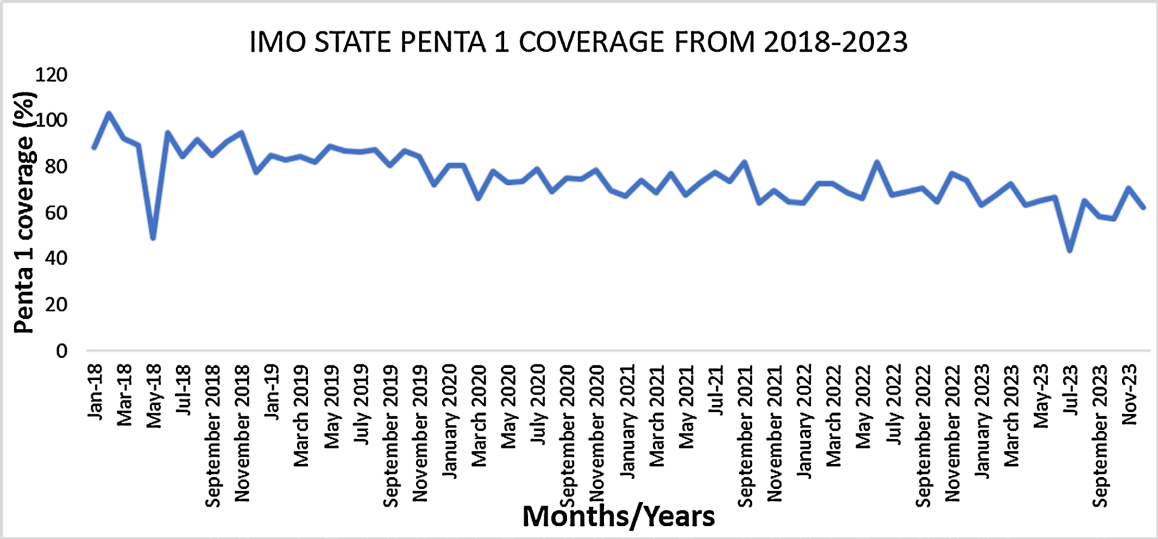


Figure 1. Trend of pentavalent 1 coverage in Imo State from 2018 to 2023.

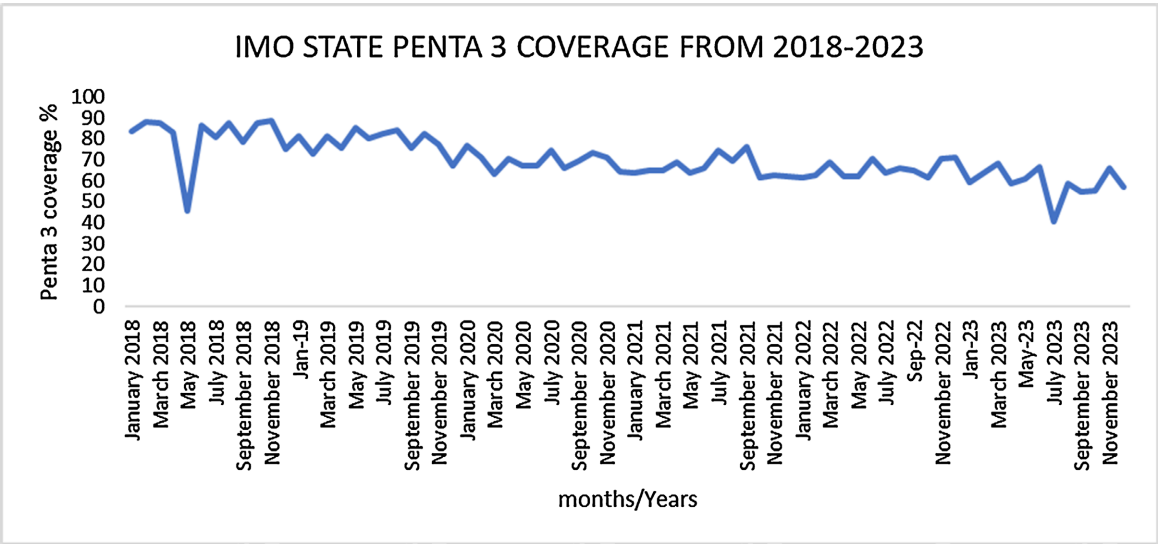


Figure 2. Trend of pentavalent 3 coverage in Imo State from 2018 to 2023.

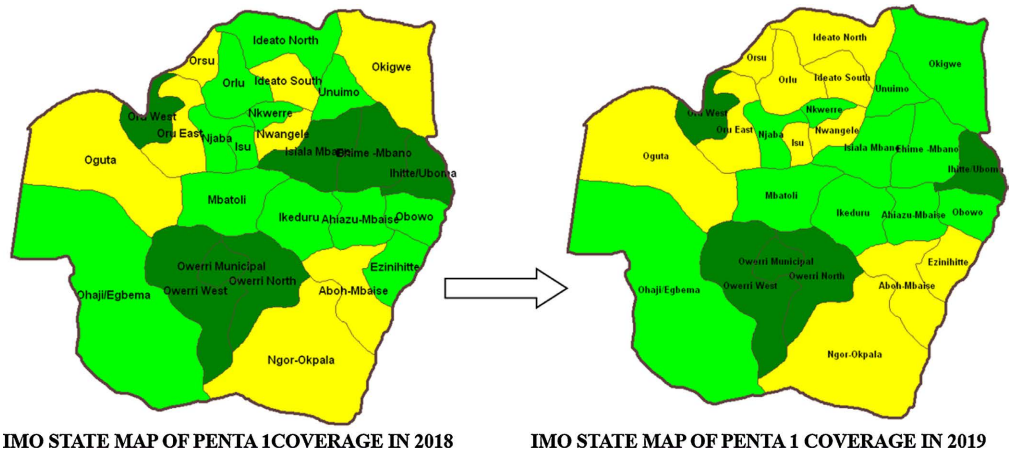
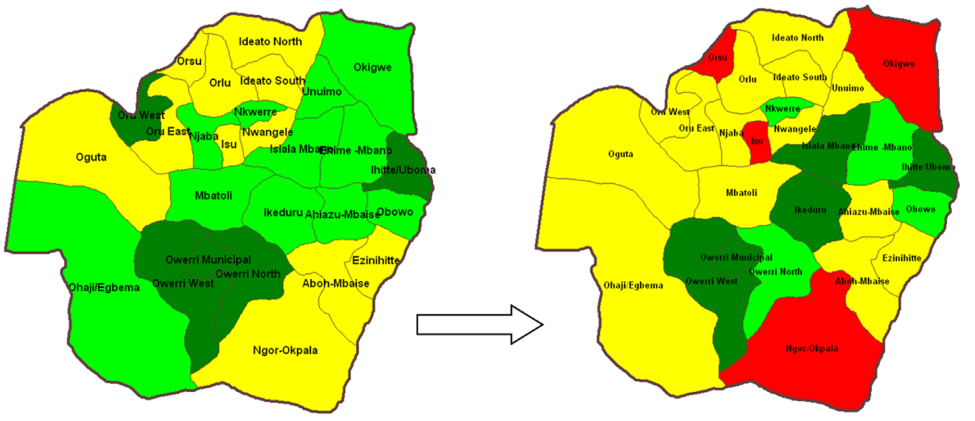
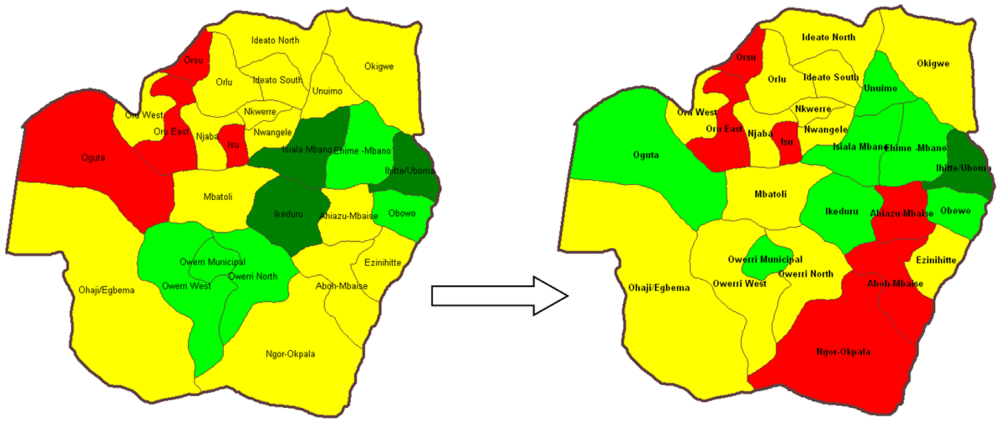


Figure 3. Maps of Imo State pentavalent 1 coverage in 2018 and 2019.



IMO STATE MAP OF PENTA 1 COVERAGE IN 2020 **IMO STATE MAP OF PENTA 1 COVERAGE IN 2021**

Figure 4. Maps of Imo State pentavalent 1 coverage in 2020 and 2021.

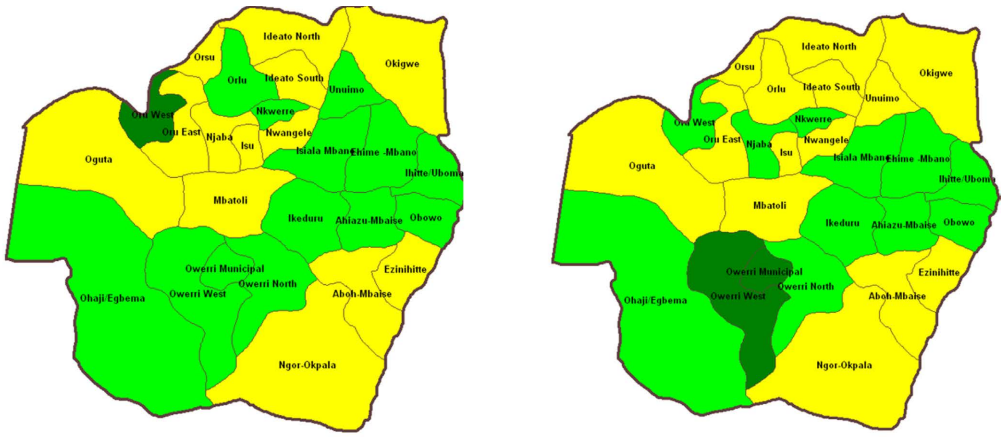


IMO STATE MAP OF PENTA 1 COVERAGE IN 2022 **IMO STATE MAP OF PENTA 1 COVERAGE IN 2023**

LEGEND

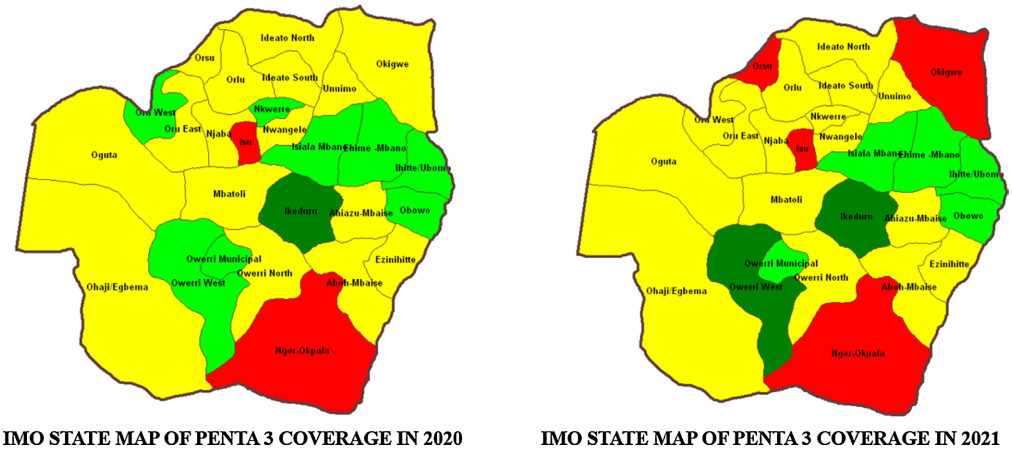
Less than 50% coverage	
50% to 80% coverage	
80% to 100% coverage	
More than 100% coverage	

Figure 5. Maps of Imo State pentavalent 1 coverage in 2022 and 2023.



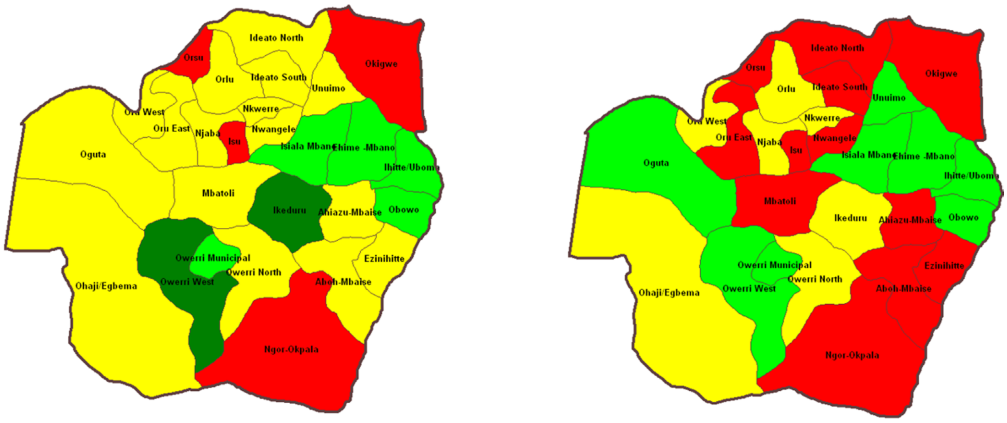
IMO STATE MAP OF PENTA 3 COVERAGE IN 2018 **IMO STATE MAP OF PENTA 3 COVERAGE IN 2019**

Figure 6. Maps of Imo State pentavalent 3 coverage in 2018 and 2019.



IMO STATE MAP OF PENTA 3 COVERAGE IN 2020 **IMO STATE MAP OF PENTA 3 COVERAGE IN 2021**

Figure 7. Maps of Imo State pentavalent 3 coverage in 2020 and 2021.



IMO STATE MAP OF PENTA 3 COVERAGE IN 2022 **IMO STATE MAP OF PENTA 3 COVERAGE IN 2023**

LEGEND

Less than 50% coverage	
50% to 80% coverage	
80% to 100% coverage	
More than 100% coverage	

Figure 8. Maps of Imo State pentavalent 3 coverage in 2022 and 2023.

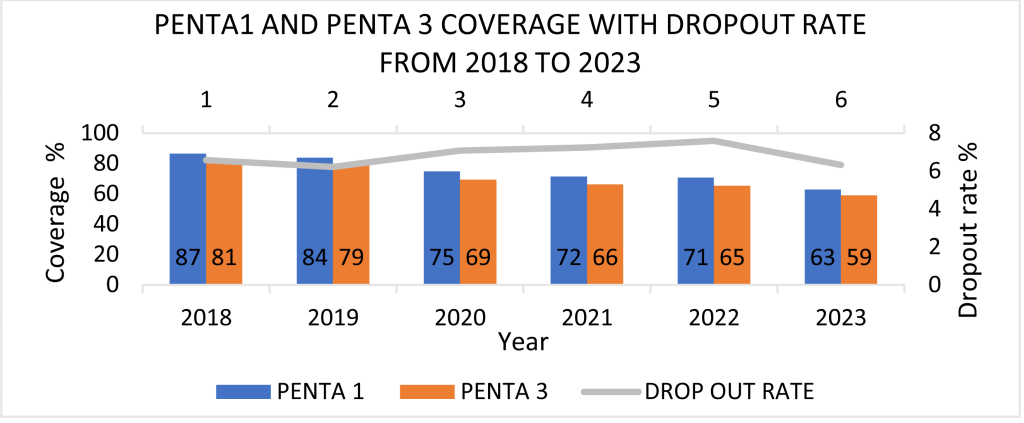
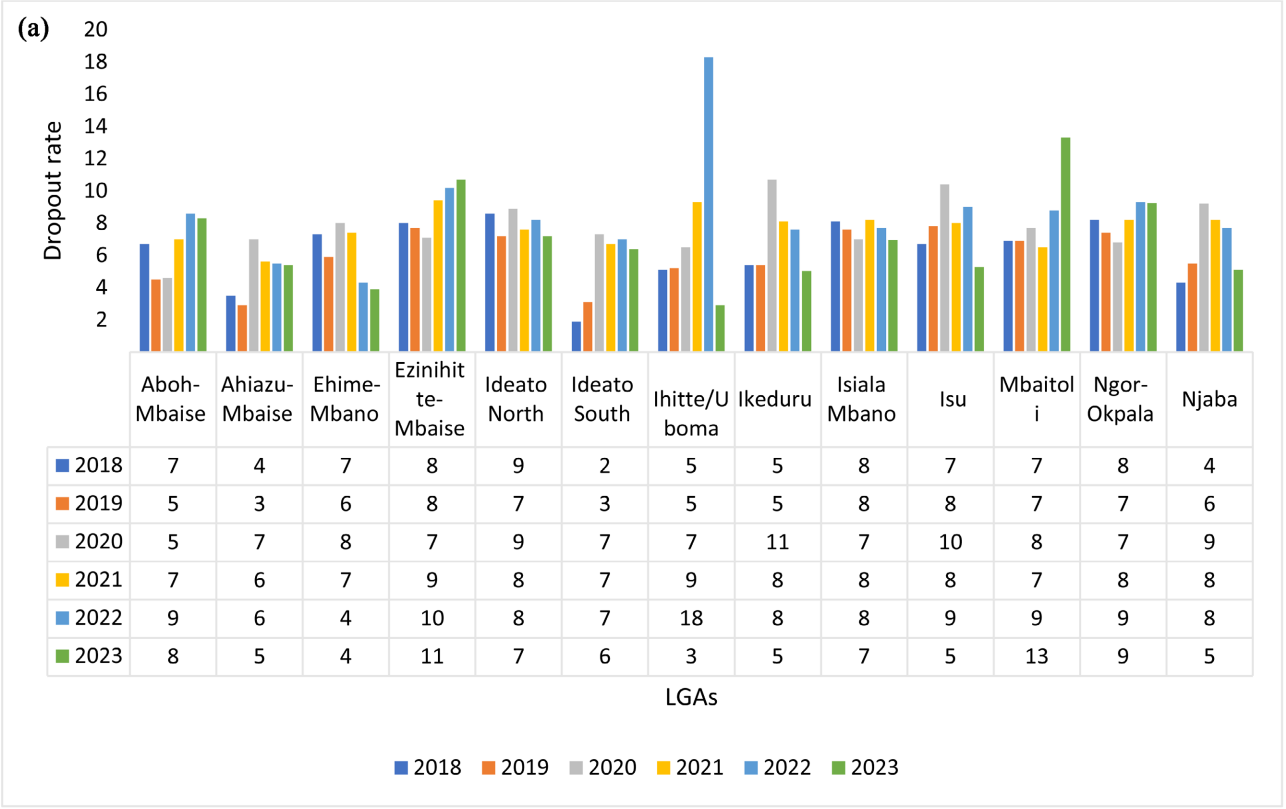
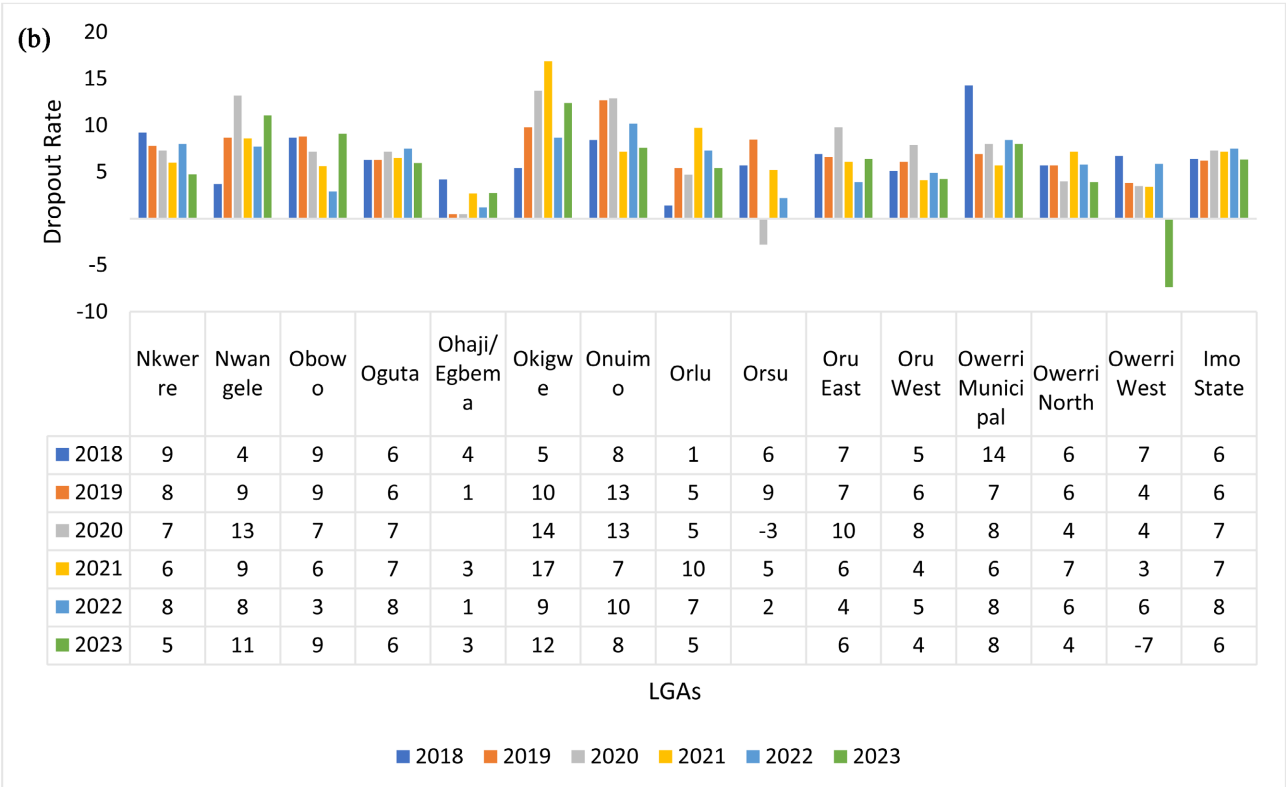


Figure 9. Comparison between Penta 1 and Penta 3 in Imo State with their dropout rate from 2018 to 2023.



	Aboh-Mbaise	Ahiazu-Mbaise	Ehime-Mbano	Ezinihite-Mbaise	Ideato North	Ideato South	Ihitte/Uboma	Ikeduru	Isiala Mbano	Isu	Mbaitoli	Ngor-Okpala	Njaba
2018	7	4	7	8	9	2	5	5	8	7	7	8	4
2019	5	3	6	8	7	3	5	5	8	8	7	7	6
2020	5	7	8	7	9	7	7	11	7	10	8	7	9
2021	7	6	7	9	8	7	9	8	8	8	7	8	8
2022	9	6	4	10	8	7	18	8	8	9	9	9	8
2023	8	5	4	11	7	6	3	5	7	5	13	9	5



	Nkwerre	Nwangele	Obowo	Oguta	Ohaji/Egbema	Okigwe	Onuimo	Orlu	Orsu	Oru East	Oru West	Owerri Municipal	Owerri North	Owerri West	Imo State
2018	9	4	9	6	4	5	8	1	6	7	5	14	6	7	6
2019	8	9	9	6	1	10	13	5	9	7	6	7	6	4	6
2020	7	13	7	7		14	13	5	-3	10	8	8	4	4	7
2021	6	9	6	7	3	17	7	10	5	6	4	6	7	3	7
2022	8	8	3	8	1	9	10	7	2	4	5	8	6	6	8
2023	5	11	9	6	3	12	8	5		6	4	8	4	-7	6

Figure 10. (a) Dropout rate of the different LGAs in Imo State and the state from 2018 to 2023; (b) Dropout rate of the different LGAs in Imo State and the state from 2018 to 2023.

7. Discussion

This study aims to determine the coverage and trend of Penta 1 and Penta 3 vaccination in Imo state from 2018-2023. The result shows that there was a steady rise in Penta 1 coverage in 2018 which correlates with National Penta 1 coverage of 72% coverage [13]. These improvements are also validated by the 2018 NDHS results. During 2015-2019, the Government of Nigeria implemented numerous activities to improve the reach and quality of service delivery, including the Optimized Integrated Routine Immunization Sessions (OIRIS) [13] [14]. The decline observed in pentavalent administrative coverages from March to May 2018 may be due to the transitions from DVDMT platform to DHIS2 that was fully implemented by the end of 2018. This decline could be attributable to multiple activities conducted to improve data quality rather than true declines in coverage [13]. There was, however, a rapid decline in the penta1 coverage from 2020 to 2021 which also is attributed to the COVID-19 pandemic in the country and Africa [13] [15] and it also reflects the country coverage of 64% [13]. There has been a continuous decline in the state coverage till 2023 which may also be due to the continued security challenges in the state.

The Penta 3 coverage all tolled the way of the Penta 1 coverage for the state which also reflects the national coverage and that of Africa. In 2020 and 2021, the COVID-19 pandemic severely disrupted the health system and routine immunization in the African Region, leading to a significant decline in immunization coverage [15]. It is well known that routine immunization programs rely on functioning health facilities and stable communities.

The 2022 WUENIC estimates have shown that immunization services in the African Region have not yet fully recovered from the disruptions caused by the COVID-19 pandemic which also reflects in Imo State immunization performance [15]. There are anticipated fears of vaccine-preventable diseases associated with poor pentavalent vaccine uptake like diphtheria, pertussis and Hemophilus influenza. Over the course of 6 years, the dropout rate is within the acceptable limit of 10% which is a good development, because it shows that there is good utilization of the immunization services notwithstanding the declining immunization coverage.

This study concludes that the decline in Pentavalent 1 and 3 coverages in the State, attributable to the COVID-19 pandemic and prevalent insecurity in the State calls for public health concern in order to avert the emerging and re-emerging of vaccine preventable diseases in the State.

8. Study Limitation

This work, based on secondary data analysis primarily describes the observed trends without delving into the underlying factors contributing to the decline in coverage beyond the general attribution to COVID-19 and insecurity. Future studies would require a more in-depth analysis, including exploring socio-economic factors, healthcare access barriers, community perceptions of vaccines, and

the effectiveness of specific interventions. Future studies would also do deeper analysis into the surveillance system for diseases that may be attributable to poor pentavalent uptake.

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