The context of urban immunization services: The case of Sodo town, Wolaita Zone, South Ethiopia

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Research Article

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Abstract

Introduction:

The world continued to be urbanized with approximately 55% of the world's population and it is expected to increase to 68 per cent by 2050. Urban areas generally have better healthcare resources and higher immunization coverage compared to rural one. However, the challenge of zero doses and under-immunization exist in urban. These variation within urban communities exist due to factors such as population mobility, socio-economic and demographic disparities, and vaccine hesitancy. Therefore, this study tried to assess factors that enhance or affect the delivery of immunization services in Wolaita Sodo town.

Methods

A community-based cross-sectional study design was conducted among 411 children aged 0–35 months. Participants were selected using simple random sampling method through a multi-stage approach. Data were collected using a structured questionnaire using ODK (Open Data Kit) mobile app. The collected data were analyzed using the Statistical Package for the Social Sciences software version 25 (SPSS). Bivariate and multivariable logistic regression analysis was performed.

Results

Fully vaccinated and vaccinated for their age as per the national schedule were 56.7% and 29.4%, respectively. And, 7.8% experienced vaccination dropouts and 6.1% of children were never vaccinated. Significant associations were found between the completion of child immunization schedules and factors such as Antenatal Care follow-up AOR = 0.082 with 95% CI (0.009–0.777), facility delivery AOR = 0.18 with 95% CI (0.046–0.703), Community Health Insurance enrollemen OR = 34 with 95% CI (0.125–0.923), and health service access AOR = 0.11 with 95 CI (0.04–0.32).

Conclusion

Children aged 0–35 months who properly attended their immunization schedule fell below the required optimum level of 95%. Efforts should be made to strengthen vaccination delivery points, promote ANC follow-up and facility deliveries, and enhance the enrollment of the CBHI scheme to improve immunization services in Sodo town.

Introduction

The global trend of urbanization persists, encompassing approximately 55% of the world's population (1). Projections suggest a further increase to 68% by 2050, with a substantial 90% surge expected in Asian

and African countries (2, 3). Urbanization contributes positively to economic growth, poverty reduction, and human development (4, 5). Recognizing and addressing obstacles, along with implementing effective strategies to enhance equity in urban settings, are crucial for achieving the targets outlined in the Sustainable Development Goals and Immunization Agenda 2030 (6). Notably, significant disparities in immunization coverage exist within urban areas, with lower coverage observed among the urban poor in numerous countries (7). This situation also elevates the risk of vaccine-preventable diseases (VPDs) due to the concentration of people in urban slums and existing disparities in health services between urban populations (4, 5).

Vaccination plays a crucial role in preventing childhood illnesses and has demonstrated effectiveness in protecting children against vaccine-preventable diseases (9, 10, 11). Initially, vaccination coverage in urban areas seemed higher, but there is now a reversal as urbanization progresses (8). This shift has resulted in notable disparities in vaccination services between urban and rural populations, with coverage in urban slum areas now comparable to that in remote rural communities (4, 5). Globally, around 30% of children who have not received essential vaccines reside in urban areas (6).

A significant number of children in Africa remain unvaccinated or under-vaccinated, often due to limited access to effective interventions (12). It is essential to comprehend vaccine coverage and the barriers in urban slum areas (5). Despite the global impact of immunization, saving millions of lives each year, vaccine-preventable diseases still contribute to over 2 million deaths among children under five annually, with sub-Saharan Africa being the most affected region (13). Inadequate health service delivery, geographical challenges, and conflicts hinder efforts to meet targeted immunization services (14).

Communicable diseases contribute to 60–80% of health problems and a notable portion of under-five mortality in Ethiopia is attributed to vaccine-preventable diseases (15). Achieving full vaccination against these preventable diseases remains a significant and persistent public health challenge in the country (16). The expansion of immunization services is one of the child survival strategies aimed at protecting an estimated 2 million children from vaccine-preventable diseases annually. However, a substantial number of children still go unvaccinated. Consequently, many children, particularly those in urban settings, experience the acquisition of vaccine-preventable diseases, and the occurrence of epidemic outbreaks is frequent (17).

Despite urban populations having a greater number of service provision points compared to rural areas, a significant portion of the urban populace encounters restricted access to healthcare due to economic, social, and cultural factors (11). The increased mobility from rural to urban increases the susceptibility of people contracting vaccine-preventable diseases during the epidemics (18). Furthermore, elements such as insufficient health infrastructure, socioeconomic disparities, and limited health service accessibility collectively impact immunization services in urban communities. Tailored immunization initiatives targeting urban areas hold promise for improving access, coverage, and equity of immunization services for underserved urban communities (19). Hence, this study aimed to assess urban immunization services

and provide possible recommendations to address factors contributing to the rising number of children with zero doses and under-vaccinated children.

Methods and materials

Study design and settings

A community-based cross-sectional study took place from June 13–23, 2023 in Wolaita Sodo town of Wolaita zone, Ethiopia. Wolaita Sodo town serves as the administrative seat of the South Ethiopia region and is known for its high population density, estimated population over 250,000 people. Administratively, the town is divided into 3 sub-cities and 25 kebeles (20).

Study population

The study population was caregivers of children ages 0 to 35 months living in Sodo town.

Inclusion criteria

Children aged 0–35 months who were living in randomly selected villages of Sodo town were included in the study.

Exclusion criteria:

Children who had no mother/caretaker in the household during the survey were excluded from the study. Moreover, in households with two or more children aged 0–35 months, the older child was excluded from the study to reduce recall biases, duplication of information and to obtain an accurate representation of the recent status of immunization services in the town.

Sample Size determination

The sample size was calculated using the single population proportion formula. Based on a previous study conducted in South Ethiopia's Demba Gofa woreda, which reported immunization coverage of 47% (21), the following single population proportion formula was employed to determine the sample size of 421 children aged 0–35 months.

$$n = \frac{Z\,(\alpha/2)^2\,P\,(1\text{-}P)}{d2}$$

Where:

n = sample size

Z = value corresponds to a 95% level of significant = 1.96

d = Margin of error = 5%

P = proportion = 47% then, = $(1.96)^2$× (0.47) (1-0.47)/ $(0.05)^2$

Non-response rate of (10%) making the total sample size to be 421.

Sampling procedure

Multi-stage simple random sampling was utilized in Wolaita Sodo town. The town comprised 25 kebeles and 123 villages. From these, 13 kebeles were chosen via simple random sampling (lottery method). Following this selection, a proportional allocation method was employed to randomly select 39 villages from the 13 chosen kebeles for inclusion in the study. Data collectors then generated lists of households within each village and systematically selected 10 to 11 households, resulting in a total of 421 children aged 0–35 months participating in the study. If the targeted households did not have the targeted children, data collection proceeded to subsequent households until the required number of study subjects was reached in each village.

Data collection procedures

The study engaged a team of 9 data collectors and 5 supervisors who underwent a comprehensive two-day training session to acquire the necessary skills for gathering data from the mothers or caretakers of 421 children. Data collectors were from different disciplines such as midwives, nurses, and health officers with prior experience in data collection. They had Bachelor of Science degrees from health science colleges and Universities. Supervisors, holding bachelor's degrees and above qualifications in public health were used to supervise the overall data collection process.

Structured questionnaires were used for data collection. The tool has been developed after reviewing different immunization service-related research and was pretested to ensure it captured the intended information. The questionnaires were collected house to house and administered in a face-to-face manner by trained data collectors.

Data regarding immunization services were collected from vaccination card records, which could be standard Expanded Program on Immunization (EPI) cards or any documents indicating the immunization status of children. These vaccination service registration cards were provided by vaccination service providers). Additionally, verbal reports from mothers or caretakers were obtained, including information on the timing of vaccine administration, the number of vaccines received, the site (route) of administration, and the presence of immunization scars, particularly for BCG (Bacillus Calmette-Guérin) specially for those who did not showed their child immunization cards.

Variables

Dependent variables

The dependent variable in this study was children who completed their immunization services as per national schedules.

Independent variables

Marital status, mothers' education, mothers' occupation, husbands' education, occupation of the husband, age of the child, sex of the child, perceived wealth status, productive safety net program, CBHI, ANC follow-up, TD2+, place of birth, GMP, average distance, health service accessibility and PNC.

Operational definitions

Dropout: Dropout rate (DOR): The rate difference between the initial vaccines (BCG or Pentavalent I) and the final vaccines (Pentavalent III or Measles) (29).

Fully immunized

A child is considered fully vaccinated if he or she took one dose of BCG vaccine, three doses of Diphtheria Pertussis-Tetanus-Hepatitis B and Haemophilus influenza type B (DPT-HepB-Hib), three doses of the polio vaccine and one dose of IPV and measles vaccine (13).

Zero doses

A child who has not received any vaccine at all (25).

Data quality control

Before the main data collection, researchers conducted a pre-test to evaluate the effectiveness and appropriateness of the measuring instruments. Instruments have demonstrated reliability and validity through rigorous testing. Data collectors received training on the research protocols, data collection procedures, and ethical considerations. Double-entry or verification procedures are implemented during data entry to detect and correct errors. After data entry, data cleaning has been done to identify errors, inconsistencies, and outliers in the dataset. By implementing these data quality control methods, researchers enhanced the trustworthiness and credibility of research findings.

Data analysis

The collected data were exported to version 25 SPSS statistical software for analysis. The collected data underwent a cleaning process using SPSS. Descriptive statistics, including mean, median, standard deviation, percent, and frequency, were employed for analysis. Bivariate logistic analysis was conducted, considering all explanatory variables with a p-value < 0.25 for inclusion in the multivariable logistic regression analysis (22). The final multivariable analysis, at a significance level of P-value < 0.05, with Adjusted Odds Ratios (AOR) and 95% Confidence Intervals (CI), was employed to measure the degree of association between independent variables and the outcome variable (23). The study results are ultimately presented through tables and figures.

Ethical clearance

The study was approved by Wolaita zone health department Research Review Committee (Ethics Approval Number: WZH/5955/224 Dated 25/09/2015 EC). All procedures and methods performed adhere to ethical principles. Informed consent was obtained from all caretakers who voluntarily participated in the study. The participant information sheet helped them read and ask questions before consenting in writing (face to face) before the interviews.

Results

Socio-demographic characteristic

A 97.6% response rate was obtained out of 421 eligible children, 411 children between the ages of 0 and 35 months who voluntarily took part in the study. Among the enrolled children, 51.3% (211) were male. The minimum age of children was 1 month while the maximum was 35 months with the mean and standard deviation of 17.2 and 9.4 months respectively. The birth order of the children ranged from 1 to 7, with a mean of 2.3 and a standard deviation of 1.2. The majority of mothers or caretakers 97.1% (399) were married, while a small proportion 2.9% (12) were single, being either widowed or divorced. In terms of maternal education, 8.8% (36) of mothers or caretakers were unable to read and write and 21.1% (87) completed a diploma or above (Table 1).

Table 1. Socio-demographic characteristics of participants in Sodo town, Wolaita zone, South Ethiopia, June 2023 (N=411)

Variables		Frequency	Percent
Sex of the child	Female	200	48.7
	Male	211	51.3
Age of the child	less than 9 months	114	27.7
	9 to 15 months	69	16.8
	15-24 months	117	28.5
	24-36 months	111	27.0
Mothers marital status	Married	399	97.1
	Divorced	5	1.2
	Widowed	7	1.7
Mothers educational	Diploma and above	87	21.2
	Secondary education (9-12)	96	23.4
	Primary (1-8) education	154	37.5
	Read and write	38	9.2
	Unable read and write	36	8.8
Fathers education	Unable to read and write	12	2.9
	Read and write	32	7.8
	Primary education (1-8 grade)	131	31.9
	Secondary education (9-12 grade)	113	27.5
	Diploma and above	114	27.7
	No husband	9	2.2
Fathers occupation	Farmer	60	14.6
	Daily laborer	78	19.0
	Governmental employee	110	26.8
	Merchant	113	27.5
	Other*	50	10.5
Wealth status	High	2	.5
	Medium	316	76.9
	Low	93	22.6

Living in the risk area	Yes	141	34.3
	No	270	65.7

*Other: drivers, brokers, evangelists, No husband
Regarding fathers' educational status, 2.9% (12) were unable to read and write, and 27.7% (114) completed a diploma and above. One hundred ten (26.8%) fathers were government employees, and 27.5% (113) were engaged in merchant occupations (Table 1).

Regarding the perceived economic status of the families, the majority 76.9% (316) reported a medium economic status, while 22.3% (93) indicated a low economic status. Nearly two-thirds (65.7%) of the children were residing in areas where immunization services were accessible (Table 1).

Coverage of key immunization service indicators

The immunization status of children in this study revealed that 93.9% (386) received the BCG vaccine, 92.7% (381) received the first dose of the pentavalent vaccine, 92.0% (380) received the first dose of both PCV and Polio vaccines, and 88.8% (378) received the first dose of the Rota vaccine. Regarding the continuity of the immunization schedule, 91.0% (374) received the recommended three doses of the pentavalent vaccine, 91.2% (375) received all three Oral Polio vaccines, 92.5% (380) received the second recommended dose of the Rota vaccine, and 91% (374) received the recommended single dose of IPV (Inactivated Poliovirus Vaccine). Children who received the first and the second dose of measles were 293 (71.3%) and 270 (65.7.6%) respectively (Fig. 1).

The overall vaccination status of children was 56.7% (233) children were fully vaccinated, 29.4% (121) were vaccinated for their age, 7.8% (32) experienced dropout in their vaccination, and 6.1% (25) children were zero doses (Fig. 2). Reasons cited for not vaccinating their children included a lack of information, lack of motivation, and obstacles related to the place and time of vaccination. Among children who received at least one dose 77.8% (301) were provided with EPI cards, and 141 of them showed the cards to interviewers, resulting in a card retention rate of 46.8%.

Factors Affecting Immunization Services

Mothers' education, Husband's education, Occupation of the husband, Perceived wealth status, Community-Based Health Insurance (CBHI), Antenatal Care (ANC) follow-up, Tetanus Toxoid 2 + vaccination (TD2+), Place of birth, Growth Monitoring and Promotion (GMP), accessibility of health facility, and Postnatal Care (PNC) were found to have a P-value less than 0.25 in the binary logistic regression and then included in the multiple logistic regression analysis.

Women who did not attend ANC were 92% less likely to vaccinate their children according to the schedule, compared to mothers who attended ANC follow-up (Adjusted Odds Ratio [AOR] = 0.082, 95% Confidence Interval [CI]: 0.009–0.777). Similarly, children who were born at home were 82% less likely to receive their immunization services as per schedule compared to those born at a facility level (AOR = 0.18, 95% CI: 0.046–0.703). Families not enrolled in the CBHI scheme were 66% less likely to vaccinate their children

according to the vaccination schedules compared to those who paid for CBHI services (AOR = 0.34, 95% CI: 0.125–0.923). Children living in less health service-accessible areas were 89% less likely to vaccinate their children according to the schedule compared to those living within accessible areas (AOR = 0.11, 95% CI: 0.04–0.32) (Table 2).

Variables such as Mothers' education, Husbands' education, Occupation of the husband, Perceived wealth status, TD2+, Growth Monitoring and Promotion (GMP), and PNC showed no statistically significant association with child vaccination ($p > 0.05$).

Table 2, Table Odds ratios from multinomial logistic regression on immunization service with socioeconomic status, Wolaita, Sodo town, SNNPR, July 2022 (AOR 95% CI) (N=420).

Variable		Immunization status		95% CI of OR	
		Fully immunized (n=354)	Not Fully immunized (n=57)	COR	AOR
Mothers education	Diploma and above	80 (92.0%)	7 (8.0%)	4.39 (1.51 12.71)	2.65 (0.37 19.08)
	Primary education	128 (83.1%)	26 (16.9%)	1.89 (0.81 4.39)	1.33 (0.29 6.060)
	Read and write	31 (81.6%)	7 (18.4%)	1.70 (0.57 5.10)	3.72 (0.49 28.07)
	Secondary education	89 (92.7%)	7 (7.3%)	4.89 (1.69 14.12)	2.47 (0.44 14.07)
	Unable read and write	26 (72.2%)	10 (27.8%)	1	1
Husband education	Diploma and above	104 (91.2%)	10 (8.8%)	10.40(2.82 38.33)	2.92 (0.16 52.31)
	Not available	2 (22.2%)	7 (77.8%)	3.50(0.50 24.27)	2.05 (0.09 46.54)
	Primary education	111 (84.7%)	20 (15.3%)	5.550 (1.63 18.94)	5.01 (0.59 42.56)
	Read and write	23 (71.9%)	9 (28.1%)	2.56(0.65 10.05)	9.60 (0.81 114.22)
	Secondary education	103 (91.2%)	10 (8.8%)	10.30 (2.79 37.97)	4.20 (0.40 43.67)
	Unable to read and write	6 (50.0%)	6 (50.0%)	1	1
Occupation of the husband	Daily laborers	65 (84.4%)	12 (15.6%)	1	1
	Farmer	40 (66.7%)	20 (33.3%)	0.37(0.16 0.84)	3.90 (0.62 24.51)
	Governmental employee	100 (90.9%)	10 (9.1%)	1.85 (0.75 4.52)	0.74 (0.11 4.99)
	Merchant	104 (92.0%)	9 (8.0%)	2.13 (0.85 5.34)	0.87 (0.26 2.95)
	Others	45 (88.2%)	6 (11.8%)	1.38 (0.48 3.96)	0.38 (0.08 1.80)
Wealth status	Medium	290 (91.2%)	28 (8.8%)	4.69 (2.61 8.43)	2.00 (0.71 5.67)

	Low	64 (68.8%)	29 (31.2%)	1	1
CBHI	Not participated	237 (83.7%)	46 (16.3%)	0.48 (0.24 0.97)	0.34 (0.12 0.92)*
	Participated	117 (91.4%)	11 (8.6%)	1	1
ANC follow-up	Not attended	237 (83.7%)	46 (16.3%)	0.02 (0.01 0.06)	0.082 (0.01 0.78)*
	Attended	117 (91.4%)	11 (8.6%)	1	1
TD2+	No	19 (47.5%)	21 (52.5%)	0.10 (0.05 0.20)	0.50 (0.14 1.75)
	Yes	335 (90.3%)	36 (9.7%)	1	1
Place of birth	Health facility	338 (91.8%)	30 (8.2%)	1	1
	Home	16 (37.2%)	27 (62.8%)	0.05 (0.03 0.11)	0.18 (0.05 0.70)*
GMP	No	313 (85.1%)	55 (14.9%)	0.28 (0.06 1.18)	1.114 (0.21 5.94)
	Yes	41 (95.3%)	2 (4.7%)	1	1
Access to health facilities	One to five KM	317 (92.4%)	26 (7.6%)	1	1
	Six and above KM	37 (54.4%)	31 (45.6%)	0.10 (0.05 0.18)	0.11 (0.04 0.32)*
PNC	No	226 (83.1%)	46 (16.9%)	0.42 (0.21 0.84)	0.56 (0.20 1.54)
	Yes	128 (92.1%)	11 (7.9%)	1	1

*** Significant at P value less than 0.05**

Discussion

Among children who enrolled in the study 92.7% (381) and 91.0% (374) received the first and third doses of pentavalent vaccines respectively. Similarly, 293 (71.3%) children received MCV1 and 270 (65.7.6%) received MCV2 vaccines. The overall vaccination status of children was 56.7% were fully vaccinated, 29.4% were vaccinated for age as per national standard, 7.8% dropped their vaccination and 6.% were never vaccinated. Factors such as ANC visits, facility deliveries, enrollment of community health insurance, and access to health service-providing facilities were found to have a statistically significant association with immunization services.

The coverage of all key antigens in this study did not reach the optimum level of 95%. However, it was higher than what was reported in the 2019 preliminary Ethiopian Demographic and Health Survey (EDHS) (24). This difference may be attributed to variations in the timing of the studies and improvements in the urban immunization program in Sodo town. The prevalence of zero doses was consistent in this study and a national-level study conducted by Project HOPE in 2022, which were 6.1% and 6.2% respectively (25).

In the study conducted by Tamirat and Sisay involving further analysis of the 2016 Ethiopian Demographic and Health Survey (EDHS) (13), ANC follow-ups and skilled delivery assisted by health workers at the facility level had statistically significant associations with child immunization. This finding aligns with the results of the current study, indicating that mothers who did not attend ANC follow-up were 92% less likely to adhere to their child's immunization schedules compared to mothers who attended ANC follow-up. Similarly, mothers who gave birth at home were 82% less likely to vaccinate their children compared to those who gave birth at health facilities assisted by healthcare providers. These findings suggest that attending ANC services and delivering at health facilities might serve as motivating factors for mothers to follow through with vaccinating their children according to immunization schedules.

As indicated in the study conducted by Gashaw et.al at the national level, the absence of health facilities in remote kebeles or inaccessibility due to distance or topographic barriers is a major challenge for reaching unvaccinated children (25). In this study, children who were living in less health service-accessible areas were 89% less likely to vaccinate their children according to the schedule compared to those who were inaccessible areas. This finding is consistent with the study conducted in Nigeria, specifically in Anambra States by Sibeudu, Uzochukwu, and Onwujekwe, which identified distance as one of the factors significantly associated with not vaccinating children (26). Constructing health facilities that provide comprehensive healthcare within the community might improve the immunization uptake of children. CBHI is believed to increase the health-seeking behavior of the community. In this study, families who were not involved in the CBHI scheme were 66% less likely to vaccinate their children according to the vaccination schedules compared to those who paid for CBHI services, indicating that CBHI services have an impact on the uptake of immunization services.

Vaccination cards are crucial tools used to ensure that children receive all recommended vaccinations according to schedule (24). The 2019 Ethiopian mini-demographic health survey obtained vaccination coverage information from written vaccination cards, mothers' verbal reports, and health facility records (27). Similarly, the data in this study were obtained from any card providing information on child immunization history and mothers' verbal reports. The card retention rate in this study was 46.8% which is much lower than in the study conducted in the mini-2019 EDHS (28), where the card retention rate was 62%. The low card availability in this study might be attributed to the inadequate supply of EPI cards from the Regional health bureau and zonal health department since 2021. The low provision and retention of EPI cards could impact understanding the status of EPI services and monitoring EPI programs in Sodo town.

Conclusions

The coverage for all examined antigens in the study fell below the recommended threshold of 95%, indicating a risk of vaccine-preventable disease outbreaks in the community. Factors such as mothers attending ANC services and giving birth at health facilities were identified as strong motivators for proper adherence to their child's vaccination schedule. Additionally, access to health facilities or outreach immunization services played a crucial role in encouraging mothers or caretakers to attend their children's immunization sessions. Enrollment CBHI scheme also proved to be effective in incentivizing mothers or caregivers to seek healthcare services at health facilities or vaccination services.

Abbreviations

DOR Dropout rate

DPT Diaphteria, Petisussia and Tetanus

EPI Expanded Program of Immunization

IPV Inactivated Polio Vaccine

MCV measles-containing vaccine

PCV Pneumococcal Conjugated Vaccine

Penta Pentavalent vaccine

TD Tetanus Toxoid and diphtheria

VPD Vaccine-Preventable Diseases

Declarations

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Authors' contributions

HB wrote the proposal, study design, methods and drafting of the manuscript; DS contributed to the study design, data collection and conducted the statistical analysis; SG conceived the methodology and provided overall guidance, and collaborated on the manuscript draft; TS contributed to drafting the final versions of the manuscript; MM collaborated on statistical analysis and manuscript draft; AS

collaborated on the methodology and manuscript draft and initiated publication of the study; SB contributed in the study design and proofreading. All authors read and approved the final manuscript.

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Data Availability

The authors confirm that the data supporting the findings of this study are available and it can be presented on request from the corresponding author.

Ethics approval and consent to participate

The study was approved by Wolaita Zone Health Department Research Review Committee (Ethics Approval Number: WZH/5955/224 Dated 25/09/2015 EC). All procedures and methods performed adhere to ethical principles. Informed consent was obtained from all caretakers who voluntarily participated in the study. The participant information sheet helped them read and ask questions before consenting in writing (face to face) before the interviews.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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Figures

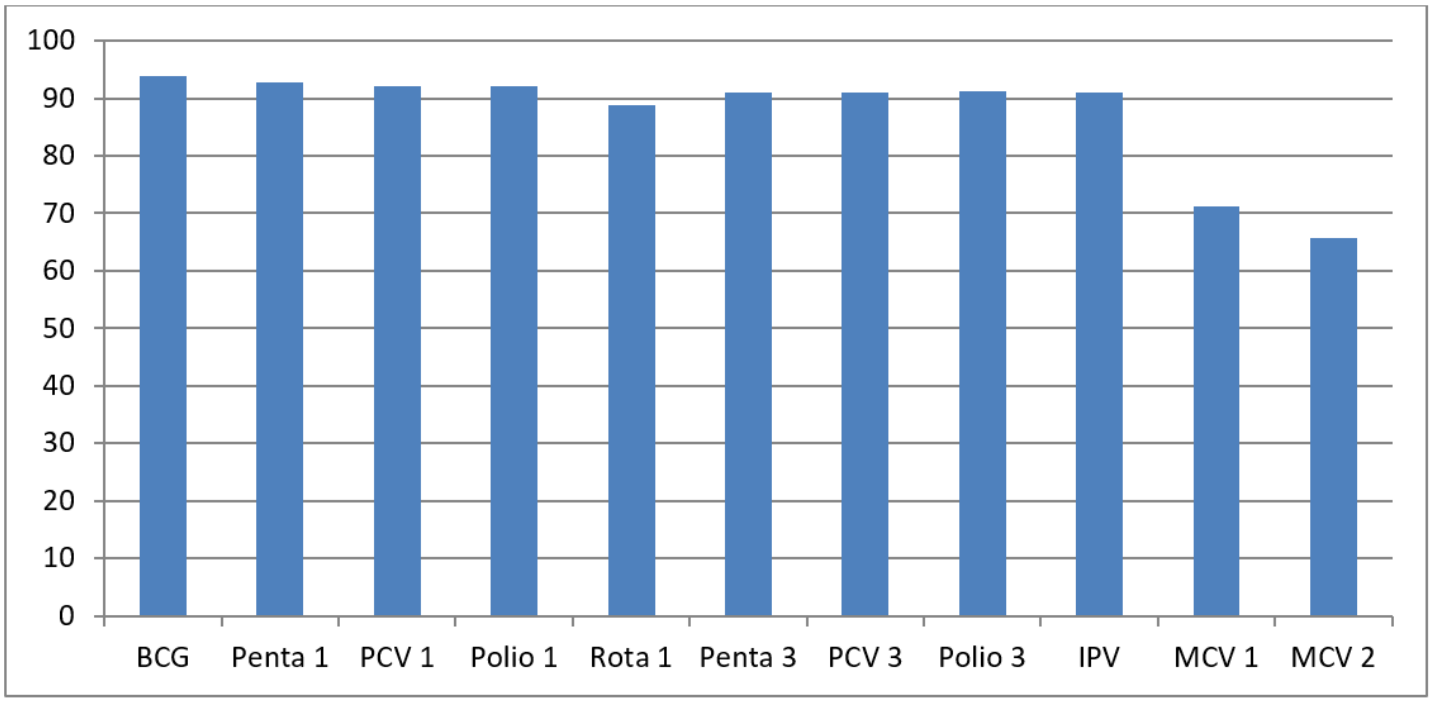

Figure 1

Key antigen received by children aged 0-35 months of age, July 2023, Sodo town.

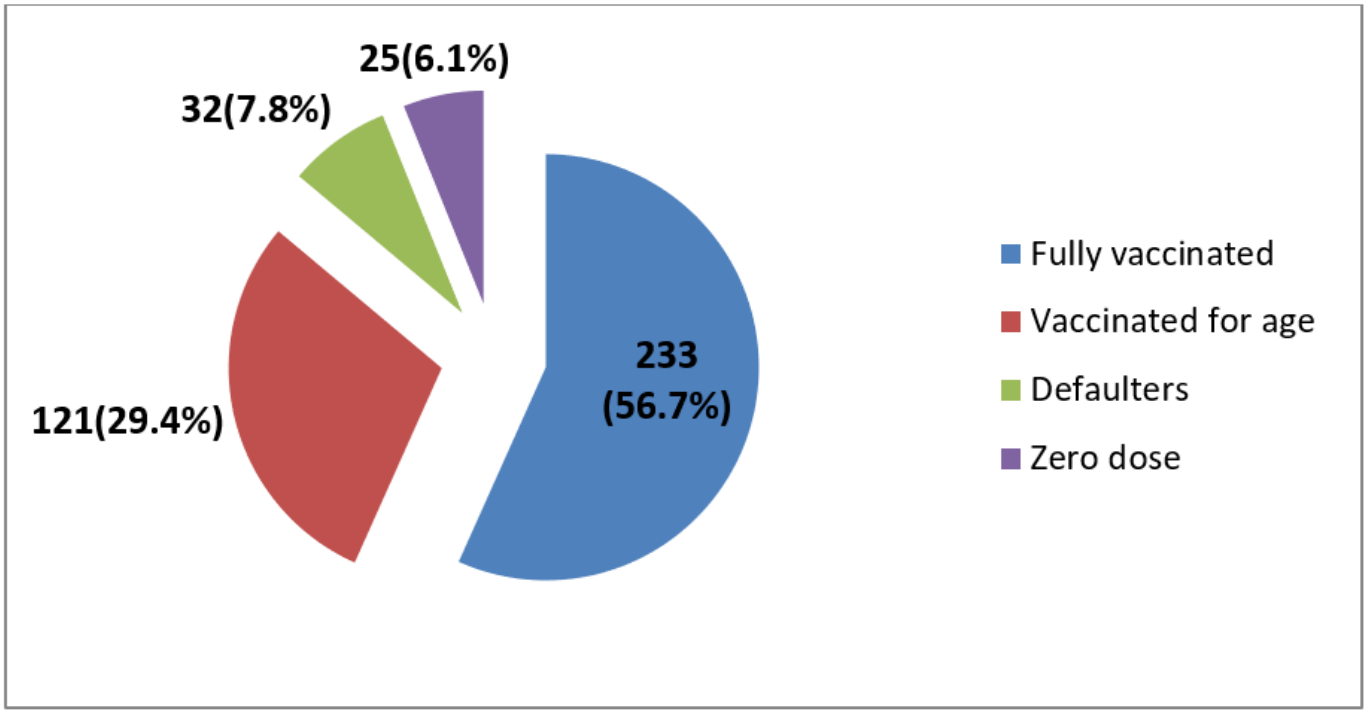

Figure 2

Vaccination status of children aged 0-36 months in Sodo town, Wolaita, June 2023