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Original Research Article

Vaccination coverage among children aged 1–59 months admitted to four health facilities in Brazzaville

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ABSTRACT

Background: Immunization is an effective intervention for preventing morbidity and complications associated with infectious diseases in children. Objectives were to contribute to improving vaccination coverage among children aged 1-59 months admitted to hospitals in Brazzaville.
Methods: A cross-sectional study on childhood vaccination coverage was conducted between January and October 2021 in four health facilities in Brazzaville. Children aged 1-59 months who were hospitalized and whose parents provided consent were included. Study variables included sociodemographic characteristics, parental knowledge of immunization, and children's vaccination status. Statistical tests used were chi-square and odds ratio with a significance level of $p<0.05$.
Results: A total of 217 children were included, 53% of whom were boys (sex ratio=1.1). Children older than 2 years accounted for 36.4% (n=79). The rate of vaccination card ownership was 48.4% (n=105). Among these, 75.2% (n=79) were up to date with their vaccines up to the age of 9 months. The dropout rate between BCG and measles vaccine (VAR) was 53.3%, and the lowest coverage was observed for measles and yellow fever vaccines at 46.7% (n=49). Gender, maternal education level, and mothers' knowledge of target diseases significantly influenced vaccination coverage ($p<0.05$).
Conclusions: Improving the low vaccination coverage among children aged 1-59 months requires revitalizing the expanded program on immunization (EPI).

Keywords: Vaccination coverage, Immunization, Pediatric patients, Brazzaville/Congo

INTRODUCTION

Immunization is an effective intervention for preventing morbidity and complications associated with infectious diseases in children.[1,2] Its success and cost-effectiveness as a public health strategy are well established.[3] Vaccination has contributed to the eradication of diseases such as smallpox, poliomyelitis, and neonatal tetanus in several developing countries. Today, it remains the most effective strategy for combating infectious diseases worldwide, particularly in Africa.[1-4] The world health organization (WHO) estimates that each year, immunization prevents 3 million deaths and 750,000 physical, mental, and neurological disabilities among children globally.[5-8] Due to the number of deaths averted and its financial benefits, vaccination is ranked among the ten most cost-effective public health interventions.[1-3] To prevent certain diseases and reduce disabilities and deaths caused by vaccine-preventable illnesses, WHO launched the EPI in 1974.[1] Since then, governments,

international organizations, and donors have continuously strengthened EPI coverage worldwide, particularly in Africa, and introduced new vaccines.[1] Among the strategies developed is the global vaccine action plan, jointly prepared by WHO and UNICEF. This document, adopted during the 56th session of the WHO regional committee for Africa, envisions a world where every child, adolescent, and adult has equitable access to immunization services. It recommends achieving at least 90% national coverage and at least 80% coverage in every health district.[9] Despite these strategies, thousands of children remain unvaccinated or only partially vaccinated, and vaccine-preventable diseases continue to cause morbidity and mortality. According to WHO statistics, in 2012, 12.6 million children did not receive the first dose of the diphtheria-tetanus-pertussis (DTP) vaccine, and 22.6 million did not receive the third dose.[10] The Republic of Congo adopted a health policy focused on preventive medicine and primary health care in 1979, and EPI has been implemented since 1981. The EPI schedule has undergone several modifications following the introduction of new vaccines.[11] Until 2019, it covered only children under one year of age; currently, it includes children from birth to 18 months.[12] Despite efforts by the Congolese government and its partners, full vaccination coverage among children aged 12-23 months remains low, and issues related to vaccination quality persist as a public health concern.[13,14] To help improve vaccination coverage among children aged 1-59 months admitted to hospitals in Brazzaville, this study aimed to determine vaccination coverage in this population, assess parental knowledge and attitudes toward immunization, identify factors influencing vaccination status, and explore reasons for non-vaccination.

METHODS

Type, period and setting of the study

This was a multicentre cross-sectional study with prospective data collection, conducted between 1 January and 31 October 2021 in the paediatric departments of four healthcare facilities in Brazzaville, which were selected at random: the Brazzaville University Hospital (with the exception of the neonatal unit), the Talangaï and Makélékélé referral hospitals, and the Blanche Gomez Mother and Child Specialised Hospital.

Study population

The general population consisted of all children hospitalised in the paediatric wards of the four hospitals in Brazzaville mentioned above during the study period. We included children aged 1 to 59 months hospitalized for any condition whose parents/guardians consented to participate in the study.

Children whose parents/guardians were not available when the investigator visited and those whose usual place of residence was not the Congo were not included.

Sampling

We used a random draw without replacement from level 2 and 3 hospitals in the Brazzaville health department to select the four health facilities. Patients meeting the inclusion criteria were identified consecutively as they were admitted. The sample size was calculated using the SWARTZ formula:

$$N=P\,(1-P)\,\frac{Z_{\alpha}^{2}}{i^{2}}$$

P is the prevalence, i-is the margin of error or precision, and Z is the margin coefficient derived from the confidence level). For a confidence level of 95% and a margin of error of 5%, Z was equal to 1.96. The prevalence P considered is 16.8%, based on the 2014-2015 MICS5 Congo multiple indicator cluster survey.[15] The minimum sample size required for statistical analysis was 215 patients. The survey data were collected through interviews with parents/guardians and consultation of health records (vaccination records, weight charts, follow-up notebooks), which were then recorded on a pre-established survey form completed by the interviewer and entered into an application designed using CSPRO7.5 software.

Study variables

Vaccination coverage was the dependent variable; there were two types of independent (explanatory) variables:

Those related to parents/guardians

Sociodemographic characteristics (age, gender, educational level, occupation, marital status, socioeconomic status, religion), knowledge about vaccination (diseases targeted by the EPI, vaccination schedule, post-immunization adverse events or reactions (PIAE), child's vaccination status).

Those related to the child

Sociodemographic characteristics (age, sex, birth order, nutritional status), medical history (chronic disease, congenital malformation, adverse reaction to vaccination), vaccination status (fully vaccinated, partially vaccinated, unvaccinated, missed vaccination opportunities, vaccination abandonment).

A child was considered to be properly vaccinated if they had a BCG scar and had received all EPI vaccines within the minimum time intervals specified by the Republic of Congo's national policy (first dose of DTP/OPV at six weeks of age at the earliest, with an interval of at least four weeks between doses, and measles vaccine at nine months of age at the earliest). A child was considered partially immunized if they had missed at least one of the recommended vaccines. The vaccination dropout rate was

defined as the difference in rates between the first and last doses or the difference in rates between the initial vaccine and the last vaccine. A missed vaccination opportunity was defined as a child attending a health facility or community site and not receiving the vaccination to which they were entitled.

For parents/guardians, knowledge of EPI target diseases was considered non-existent if they did not name any diseases, insufficient if they named fewer than five diseases, acceptable if they named five to seven diseases, and good if they named more than seven diseases. Knowledge of the EPI vaccination schedule was considered zero if the parent gave no answer, insufficient if they were only partially familiar with the vaccination schedule, and good if they were fully familiar with the vaccination schedule. Finally, knowledge of AEFIs was considered non-existent if the parent did not mention any AEFIs, insufficient if they mentioned 1 or 2 AEFIs, acceptable if they mentioned 3 to 4 AEFIs, and good if they mentioned more than 4 AEFIs.

Statistical analysis

Data were analyzed using SPSS version 25. Quantitative variables were expressed as means with standard deviations or medians with quartiles, and qualitative variables as frequency tables (absolute and relative). To identify factors associated with incomplete vaccination, a univariate analysis was performed. The dependent variable was cross-tabulated with each independent variable. Crude odds ratios (OR) with 95% confidence intervals were calculated to determine the strength of association. Pearson's Chi-square test was used for proportion comparisons, and Fisher's exact test was applied when expected counts were less than five. The significance threshold for all statistical tests was set at $p<0.05$.

RESULTS

Sociodemographic characteristics

The sociodemographic characteristics of the study population are shown in Table 1.

Medical history of children

Among the enrolled children, 22 (10.1%) were homozygous for sickle cell disease, six (2.7%) had congenital heart disease (including two cyanotic cases), three were HIV-positive, and two had trisomy 21.

Vaccination aspects

Vaccination card

During the study period, 105 children (48.4%) had a vaccination card, while 112 (51.4%) did not. Among those without a card, it was either forgotten at home (n=92; 82.1%) or lost (n=20; 17.9%).

Table 1: Sociodemographic characteristics of the study population.

Variables	N	Percentages (%)
Age (in months)		
<2	3	1.4
2-4	3	1.4
4-9	44	20.3
9-15	40	18.4
15-24	48	22.1
>2 years	79	36.4
Sex		
Male	115	53
Female	141	47
Average age of mothers	29.46±1.5 years (Extremes 16 and 45 years)	
Mothers' level of education		
Primary	14	6.4
Secondary	152	70
Higher	49	22.6
No schooling	21	
Mothers' occupations		
Formal sector	11	4.8
Informal sector	99	45.7
Unemployed	64	29.5
Other	43	20
Socio-economic level of households		
Low	119	54.8
Medium	96	44.2
High	2	1

Vaccination coverage by EPI antigens

For the 105 children with a vaccination card, coverage by antigen before nine months of age is shown in Table 2.

After nine months, coverage was 8.6% (9 cases) for the measles-rubella vaccine, 3.8% (4 cases) for the first pentavalent booster, and one case each for pneumococcal, meningococcal, and typhoid vaccines.

Completeness of vaccination and dropout rate

Before nine months of age, 79 children (75.2%) were fully vaccinated according to the EPI, while 26 (24.8%) were only partially vaccinated.

The dropout rate between BCG and measles vaccine was 53.33%, and 13.46% between the first and third doses of the pentavalent vaccine.

The main reasons for non-vaccination or dropout were: lack of parental information (n=34; 15.7%), child illness (n=33; 15.2%), vaccine unavailability, and maternal death (seven cases each).

Parental knowledge of vaccination

Among respondents, 94 (43.3%) reported awareness of vaccination. The main sources of information were health personnel (83%), family (34%), media (22.3%), school (5.1%), and pre-campaign training (1.1%). The most commonly known EPI target diseases were measles (152 cases; 70%), yellow fever (140; 64.5%), poliomyelitis (138; 63.6%), and tuberculosis (120; 55.3%).

Knowledge of the vaccination schedule was good in 42.9% of cases and insufficient in 57.1%. Knowledge of adverse events following immunization (AEFI) was absent in 21.6%, insufficient in 75.6%, and acceptable in 2.8%.

Factors associated with vaccination coverage

Female children and those whose mothers had good knowledge of target diseases were three times more likely to be vaccinated ($p<0.04$). Conversely, children of mothers with secondary education were less likely to be vaccinated ($p<0.05$).

Table 2: Vaccination coverage by EPI antigen at 9 months.

Antigens	N	Percentage (%)
BCG	105	100
OPV	102	97.1
Pentavalent 1	104	99
OPV1	104	99
Pneumo 1	104	99
Rota 1	104	99
Pentavalent 2	98	93.3
OPV 2	97	92.4
Pneumo 2	98	93.3
Rota 2	97	92.4
Pentavalent 3	90	85.7
Pneumo 3	90	85.7
IPV	90	85.7
Measles (VAR)	49	46.7
Yellow fever (VAA)	49	46.7
Vitamin A	51	48.6

DISCUSSION

In this study, possession of a vaccination card among hospitalized children in Brazzaville was low (48%), compared to reports from other African authors where rates ranged from 70% to 95%.[16-18] Forgetting the card at home in emergency situations, loss of the card, and the exclusion of vaccines from the child's health booklet explain this low rate. Discontinuation of vaccination is another contributing factor.

In Brazzaville, 75% of hospitalized children were up to date with EPI vaccines up to nine months of age. This represents a significant improvement compared to the 46% reported in the 2012 demographic and health survey (DHS).[9] In Guinea-Conakry, coverage was 24% in 2020. Although relatively high and similar to rates in Nigeria, Togo, Senegal, Gabon, and the Democratic Republic of Congo, this coverage still needs improvement to reach or exceed the WHO target of 80% per health district.[6,19-21] Congolese mothers, like those in other African countries, are familiar with the vaccination schedule only up to nine months, contributing to low national coverage beyond this age. Efforts should focus on strengthening information regarding vaccines outside the EPI, particularly for children older than nine months.

BCG and oral polio vaccine coverage was satisfactory in this study, as in Mali.[22] The difference between BCG (100%) and oral polio (97%) in Brazzaville is explained by temporary suspension of OPV administration in some centers due to circulation of wild poliovirus in Congo. Coverage for Penta1 + PCV13 + Rota1 + Polio1 was 99%, higher than in Burkina Faso (94%), Cameroon (90%), and Madagascar (75%).[23,24] These disparities reflect differences in national health policies and supply chain reliability. Coverage for Penta + PCV13 + Rota + Polio decreased progressively to 85% by the third dose.

Coverage for measles vaccine (VAR) and vitamin A (VAA) was low (46%), similar to findings by Diallo in Mali.[25] In contrast, Ndiaye in Senegal and Sackou in Côte d'Ivoire reported higher rates.[18,26] The low coverage for VAR and VAA observed here is inconsistent with national data and may be related to the age distribution of patients or missed vaccination opportunities, highlighting the need for catch-up immunization within flexible schedule.

The dropout rate between BCG and measles/vitamin A vaccines was high (53.3%) compared to national data (23%). Aissata in Mali reported a dropout rate of 9.9%, and Tagnan in Burkina Faso reported 18%.[27,30] Girls were twice as likely to be fully vaccinated (OR: 2.93; $p=0.040$) compared to boys, similar to findings in Burkina Faso.[4] Several studies have demonstrated the influence of socioeconomic status on vaccination coverage. For example, Kalambayi reported that children from poor households were nearly twice as likely to be unvaccinated compared to those from wealthier households.[4]

Children of mothers with secondary education were less likely to be fully vaccinated compared to those whose mothers had higher education (OR: 0.24; $p=0.034$), a finding also reported by Sackou in Côte d'Ivoire and Dilé in Guinea.[28,29] However, in Uganda, Nigeria, and Ethiopia, the situation differs.[30-32] Children whose mothers had an acceptable level of knowledge about EPI-targeted diseases were better vaccinated, but those whose mothers had good knowledge of the vaccination schedule were the most completely vaccinated.

The reasons for non-vaccination or incomplete vaccination identified in this study were similar to those

reported in Togo, Senegal, Mali, and Burkina Faso: lack of parental information about the vaccination schedule, child illness, social problems, and the high cost of vaccines outside the EPI.[33-36]

CONCLUSION

Vaccination coverage among children aged 1-59 months hospitalized in Brazzaville health facilities is low and decreases with age, with dropout rates varying by antigen. Only 75% of children were fully vaccinated up to nine months of age. Mothers had an acceptable level of knowledge about vaccination and the schedule but poor knowledge of vaccine side effects.

The main reasons for non-vaccination were insufficient parental information, child illness, and the cost of vaccines outside the EPI. It is essential to revitalize the EPI, emphasizing communication for behavior change. However, improving sociocultural conditions remains the primary axis for intervention.

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