Pneumococcal Immunisation Coverage Among Infants Between 4-12 Months in Nyamira County, Kenya

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Abstract

Background: Pneumonia is the leading killer among all infectious diseases worldwide. Though treatable, it often results in high mortality and morbidity therefore putting pressure on available health resources. The best intervention for pneumonia is prevention through vaccination.

Objective. To determine pneumococcal vaccine coverage among infants between 4-12 months in Nyamira County

Methods: A cross sectional design was used in this study. Using questionnaires. Caregivers were interviewed and a checklist was used to review the vaccination records. Data was analyzed using descriptive statistics and inferential statistics.

Results: The results indicated that coverage of 82.5% for PCV 10 vaccine is below the recommended 90%. Caregivers were predominantly female, 97% and in informal employment. Among the demographic factors of the cohort, level of education was found to be statistically significant with p values of 0.029 as calculated using Fischer’s Exact. Care Givers were asked whether they had other children that were below 5 years so as to determine whether their previous experience with their children made any impact on the vaccine coverage. This demographic factor was also found to be significant with a P value of 0.019 as calculated using Chi Square. the number of other children Caregivers had (besides the infant being studied) that were below 5 years were found to and respectively.

Conclusion and Recommendations: Coverage of pneumococcal vaccine in Borabu Sub-County, Nyamira County was (82.5%), still below the internationally recommended target of 90%. Uptake of PCV 10 vaccine was found to be influenced by Knowledge about the PCV 10 vaccine, level of education of Caregivers and the age of children that Caregivers had who were below 5 years. The coverage of PCV 10 vaccine in Borabu Sub County in Nyamira County can be enhanced by increasing knowledge of Caregivers on PCV 10 vaccine and by increasing compliance to the vaccination schedule. This can be done through various channels such as use of mobile phone-based reminders and community sensitization campaigns. A study can be done to identify effective interventions for delivering health education about pneumococcal vaccine in rural populations. In addition, interventional studies may be done to test effectiveness of reminder systems on immunization uptake.

Keywords: uptake, coverage, PCV 10, pneumococcal vaccine.

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Pneumonia is a lower respiratory tract infection that affects one or both lungs and is one of the leading causes of death in children below 5 years worldwide and a leading killer among all infectious diseases. It is most prevalent in South Asia and sub-Saharan Africa (WHO, 2016). It can be prevented through immunization, proper nutrition and management of environmental factors. While the bacterial infection can be treated with antibiotics, only a third of the children who get sick are able to access the antibiotics due to various reasons including cost. Bacterial Pneumonia is caused by Streptococcus pneumonia and may result in invasive pneumococcal diseases (IPD) such as bacteraemia, meningitis and bacteremic pneumonia, or in non-IPD, such as pneumonia, sinusitis and Otitis media (McClure, Ford, & Wilson, 2006). Children younger than 5 years are at highest risk of both IPD and non-IPD. Preventive measures must therefore be provided at the earliest age possible because the vulnerability is highest at the young age.

One of the vaccines that are available against pneumonia is PCV-10 vaccine; a ten-valent vaccine that targets 10 strains of S. pneumonia that cause IPD; this form of pneumonia is the most fatal. The vaccine has demonstrated 100% Efficacy against IPD (Tregnaghi et al., 2014).

Compared with the other vaccines available for childhood vaccination, PCV is one of the vaccines whose coverage remains low. By 2017, PCV had been introduced to 135 countries and the global coverage was estimated at 44% compared with DPT at 90% in 123 countries, (WHO, 2018). Sub-Saharan Africa is one of the regions where the coverage of PCV remains low achieving coverage less than 60% as indicated by (WHO, SAGE, 2017). The recommended routine vaccination of PCV is either three doses with DPT or 2 doses before 6 months of age, plus booster dose at 9-15 months of age, (WHO, 2018). Kenya has adopted the former routine.

Immunization coverage is critical as a determinant of the number of children that can be saved from the infections. Since introduction, 190,000 deaths have been averted, (WHO, 2017); the more reason why uptake of
PCV 10 vaccine in Kenya is critical. In Kenya, six per 1000 deaths in under five were caused by pneumonia contributing to 15% of all child deaths in 2018, (Mugo, 2020). Pneumonia was identified as the leading killer disease in 2012 ahead of malaria with 19,011 cases, accounting for 10.9% deaths (Kenya National Bureau of Statistics, 2013). In addition, “Statistics from the Ministry of Public Health and Sanitation indicate that one in every five deaths in the country is attributed to pneumonia” (University of Nairobi, 2013).

In 2013, Nyamira County’s leading cause of death was pneumonia different from the national, which was HIV/AIDS, (Department of Health Services, 2014). In addition, under five leading cause of death was reported as pneumonia (KNBS, 2015) making this an important county of study. In 2018, while the national under five mortalities due to pneumonia was six per 1000, Nyamira was among the 12 counties with more than double the rate: 12-14 deaths per 1000, (Mugo, 2020). Despite the availability of the vaccine (PCV 10) for prevention of the disease, the uptake has continued to decline in the county compared with national. The national Full Immunization Coverage (FIC) for children below one year decreased by 3% between 2016 and 2017 in Kenya while in Nyamira County it decreased by 23% between the same period, (Kenya National Bureau of Statistics, 2018). Similarly, the coverage of PCV 10 was even lower in Borabu Sub County compared to the County. In 2017, the PCV 10 coverage in the County was 64% while Borabu Sub County was 61% for the third dose, (County Government of Nyamira, 2018). In Borabu Sub-County, coverage of PCV 10 decreased from 83% in 2013 to 61% in 2017 (County Government of Nyamira, 2018).

In Kenya, an efficacy study in Kilifi established that PCV 10 results in an estimated 42.7% reduction in pneumococcal disease episodes and a 6.1% reduction in childhood deaths, (WHO, 2015). PCV 10 reduces pneumococcal bacterium in the population by two thirds therefore offering not just individual protection but also herd immunity (Hammit, 2014). It is therefore a key pillar in reduction of pneumonia infections and deaths. On the other hand, S. pneumonia, one of the causes of pneumonia has shown resistance to antibiotics used in treatment. Reducing the number of infections will help preserve the antibiotics. In Kenya, few studies exist in the country that could inform the intervention on PCV 10 vaccine uptake.

Methods and Materials.
Study Area, Period and Design
The study location was Borabu Sub-county in Nyamira County. A cross sectional study design was applied to assess the PCV vaccination uptake among Caregivers between February 1st and February 27th 2020.

Study Population
Caregivers of children between the ages of 4 to 12 months.

Sample size and sample size determination
The Statistical Cochran equation was applied to determine sample: size
\[ n_0 = \frac{Z^2pq}{e^2} \]
Where; \( n_0 \) = sample size, \( Z \) is the abscissa of the normal curve that cuts off an area \( \alpha \) at the tails; at the desired confidence level of 95% \( Z = 1.96 \); \( p \) is the estimated proportion of an attribute that is present in the population; \( p = 0.67 \) (percentage of infants between 4-12 months that are likely to be immunized based on administrative immunization coverage for 2017 at 67%), (County Government of Nyamira, 2018).

Sampling Technique
Nyamira County and Borabu Sub County were purposively selected for this study due to the low PCV 10 immunization coverage (County Government of Nyamira, 2018). Simple random sampling was used for the wards, the Community Health Units (CHU) and the households within the Sub County. Community Health Extension Workers (CHEWs) assigned to the respective units helped in random sampling of the households within each community unit for Caregivers of 4-12 months’ infants. For households with more than one Caregiver of 4-12 months’ infant, simple random sampling was applied.

Eligibility Criteria
- Inclusion criteria
  All resident Caregivers of infants between 4 to 12 months that were in Borabu sub county between February 1st and February 27th 2020 of June 1 to June 30, 2018.
- Exclusion Criteria
  Caregivers of infants between 4 to 12 months that had visited the Sub County and those that did not consent to the study and were excluded.

Data collection instrument
The data was collected by use of interviewer-administered questionnaires. The research assistants were taken through basic training on interviewing techniques to enhance validity of the data collected. A checklist was used
to obtain objective data on the child’s immunisation status.

**Data Quality Assurance**
Before actual implementation of the study, a pre-test of the questionnaires was done on a sample of households selected randomly from Bosamaro ward in Nyamira South Sub County, Nyamira County to ensure that the questionnaire produced similar results on repeated interviews. Any questions that were generating varied responses on repeated administration were revised to enhance consistency. The questionnaires were subjected to reviews by experts in child health to ascertain the content validity of the questions in assessing immunization status of the eligible infants and knowledge of caregivers about the vaccine. Data collected was first checked for completeness and accuracy then analysis was conducted using descriptive and inferential statistics.

**Ethical Considerations**
The study attained approvals from the relevant bodies including, Kenyatta University Ethical Review Committee and the National Commission for Science and Technology (NACOSTI). Permission to collect data was also sought from the county administrative offices before commencement of fieldwork. Privacy and confidentiality of the information from the respondents was ensured by having all interviews done in private. Before participation in the study, all respondents signed an informed consent form after being informed of the purpose and their expected roles in the study. The questionnaires were anonymous.

**Results**
The sample predominantly comprised of females (96.8%, n=349) and only 3.2 % were male (Table 1.1). The median age of children between 4 to 12 months was 9 months. Most caregivers had some form of education. The number of caregivers with secondary level of education was the highest at 57.9% followed by primary at 32.1% while the university level had the least population at 2%, (Table 1.1). Most caregivers were in informal employment (90.49%) and only 6.05% were formally employed, (Table 1.1). The level of education of caregivers was found to be significant in terms of association with the vaccine uptake; (P=0.029) (Table 1.2).

| Characteristic | Frequency | % |
|----------------|-----------|---|
| Sex (n=348)    |           |   |
| Men            | 11        | 3.2 |
| Female         | 337       | 96.9|
| Education (n=349) |         |   |
| None           | 1         | 0.39|
| Primary        | 112       | 32.1|
| Secondary      | 202       | 57.9|
| College        | 27        | 7.7 |
| University     | 7         | 2   |
| Occupation (n=347) |         |   |
| Unemployed     | 12        | 3.46|
| Informally employed | 314    | 90.49|
| Formally employed | 21    | 6.05|
| Number of other children the Caregiver had that were below 5 years (n=351) | | |
| 1-3            | 334       | 95.16|
| > 3            | 17        | 4.84|

Similarly, the number of other children that the Caregivers had that were below 5 years was also significantly associated with the vaccine uptake (χ²=29; df=1; p=0.019) (Table 1.2), a higher percentage (95.16) of Care Givers that had other children between 1 and 3 years (besides the infant being studied) vaccinated their children. This compares to only 4.84% of the Care Givers with children >3 years but below 5 years (besides the infant being studied). The age and occupation of the caregivers were not statistically significant in terms of association with the vaccine uptake with p values of 0.28 and 0.30 respectively, (Table 1.2). the age of the Caregiver and their occupation did not determine whether they took the infants for vaccination or not.
### Table 1.2: Bivariate analysis of association of socio-demographic factors to vaccine uptake

| Variable                              | Pneumococcal vaccination uptake | Test | Test Significance |
|---------------------------------------|---------------------------------|------|------------------|
|                                       | Not fully vaccinated (%)        |      |                  |
|                                       | Fully vaccinated (%)            |      |                  |
|                                       | Totals                          |      |                  |
| **Level of education**                |                                 |      |                  |
| None                                  | 1 (100)                         | 0 (0)| 1 (100)          |
| Primary                               | 27 (24.11)                      | 85 (75.89) | 112 (100)     |
| Secondary                             | 31 (15.35)                      | 171 (84.65) | 202 (100)     |
| College                               | 2 (7.41)                        | 25 (92.59)  | 27 (100)       |
| University                            | 0 (0)                           | 7 (100)     | 7 (100)        |
| Age of caregivers                     | Mean age: 27.9 years            | Mean age: 27.1 years | t-test | 0.31 |
| Occupation                            |                                 |      |                  |
| Unemployed                            | 0 (0)                           | 12 (100)    | 12 (100)      |
| Informally employed                   | 58 (18.47)                      | 256 (81.53) | 314 (100)     |
| Formally employed                     | 3 (14.29)                       | 18 (85.71)  | 21 (100)      |
| Number of other children below 5 years |                                 |      | Chi square, $X^2= 29$ df=1 | 0.019* |
| 1-3                                   | 55 (16.47)                      | 279 (83.53) | 334 (100) |
| >3                                    | 6 (40.00)                       | 9 (60.00)    | 15 (100)      |

**Coverage of pneumococcal vaccine among infants between 4 to 12 months**

The objective of this study was to determine pneumococcal immunization coverage of infants between 4 to 12 months. Data on the vaccination uptake was obtained by first asking the caregivers whether their children had been vaccinated, and then going further to verify the details from child’s immunization card. The overall uptake of pneumococcal vaccine was dichotomized into fully vaccinated (all three doses given) and not fully vaccinated (less than three doses).

A breakdown of the number of pneumococcal vaccine doses received and the overall vaccine uptake is presented in Table 1.3. Overall, a majority (82.5%) of the infants had been fully vaccinated for PCV 10 while 17.48% were not fully vaccinated, (Table 1.3). Of the children that were not fully vaccinated (6%) had received none of the three vaccine doses that are recommended, 4.3% had received only one dose and 6.88% had received two doses (Table 1.3). Among the infants who had been partially vaccinated, (62%) of them received only two doses while 38% received only one dose among the not fully immunized children (Figure 1.2).

### Table 1.3: Pneumococcal vaccine uptake

| Variable                              | Frequency |
|---------------------------------------|-----------|
| Number of PCV vaccine doses received (n=349) |           |
| None                                  | 22 (6.3%) |
| One dose                              | 15 (4.3%) |
| Two doses                             | 24 (6.88%)|
| Three doses                           | 288 (82.52%)|

| PCV uptake n=(349) |
|--------------------|
| Not fully vaccinated| 61 (17.48%) |
| Fully vaccinated    | 288 (82.52%) |
**Conclusion and Recommendations**

Coverage of pneumococcal vaccine in Borabu Sub-County, Nyamira County was (82.5%), still below the internationally recommended target of 90%. Based on the findings from this study it is recommended that in order to increase vaccine coverage, adherence to the vaccination schedule should be enhanced with reminders and increased capacities of lower level health facilities. The Health system should consider mass sensitization campaigns to increase awareness and knowledge about the PCV 10 vaccine in Nyamira County. This study presents opportunity for further research one of which would be to identify effective interventions for delivering health education about pneumococcal vaccine in rural populations. Intervventional studies may also be done to test effectiveness of reminder systems on immunization uptake.

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