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## Original paper

# Factors that Influence Pneumococcal Vaccine Uptake among Children Aged 14-52 weeks in Uasin Gishu County, Kenya

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## Abstract

**Background:** The Pneumococcal Vaccine Serotype 10 (PCV10) was launched on the 14<sup>th</sup> of February 2011 in Kenya under the Division for Vaccination and Immunization (DVI) program at the Ministry of Health (MoH). PCV10 is a part of the immunization schedule for under-fives and is offered in three doses alongside the pentavalent vaccine. Upon its launch, the PCV10 was expected to lower mortality and morbidity due to streptococcal infections in under-fives. However, to date, its uptake and factors that influence its uptake have not been studied sufficiently in rural areas.

**Objectives:** To evaluate the factors influencing the uptake of the pneumococcal PCV10 vaccine among children aged 14-52 weeks in Uasin Gishu, Kenya.

**Design:** This was a descriptive cross-sectional study.

**Methodology:** The study was done in Huruma Estate in Uasin Gishu County, Kenya. Cluster sampling was used to recruit 185 children aged 14-52 weeks and a structured questionnaire used to interview caregivers on the immunization history of children. The socio-demographic data of children and caregivers and the knowledge and attitudes of caregivers on the PCV10 vaccine evaluated. Data analysis was done using version 21 of the Statistical Package for Social Scientists (SPSS). Questionnaires were screened for

inconsistencies and data extracted and coded in SPSS. Socio-demographic data were explored, PCV10 uptake computed, and the chi-square test and logistic regression used to determine factors that influence the uptake of the PCV10.

**Results:** The uptake of the PCV10 vaccine was 96.8%. The awareness of the PCV10 among caregivers was 68.7%, a majority of whom (68%) gained knowledge from health facilities. Awareness was higher among caregivers with a primary education (OR (CI) = 2.6 (1.26 - 5.3),  $p < 0.05$ ) and youths (OR (CI) = 2.39 (1.3 - 4.6),  $p < 0.05$ ). However, the age, marital status, and the education level of caregivers and social factors such as the distance to the immunization site and behavior of facility staff did not statistically influence uptake significantly ( $p > 0.05$ ).

**Conclusion:** The uptake of the PCV10 in Huruma was 96.8%, which was higher than the national rate of 86%. Knowledge of PCV10 and attitudes towards immunization were good. However, knowledge, attitudes, socio-demographic characteristics of caregivers and children, or the social factors studied were not associated with the uptake of the PCV10 vaccine.

**Key words:** PCV10, Pneumococcal vaccine, Pneumonia, Knowledge

## Introduction

Pneumonia is a common infectious disease of children, whose commonest causative agent is *Streptococcus pneumoniae* (1). According to the World Health Organization (WHO), it is the leading cause of death worldwide for under-fives with about one million deaths reported every year (2). In East Asia and the Pacific, pneumonia accounted for 16% of deaths of children under five in 2008. In the same year, 14% of deaths of under-fives in sub-Saharan Africa (SSA) and 16% of neonatal deaths in Kenya were due to pneumonia despite it being a preventable disease (3). At the Eldoret District Hospital, the morbidity and mortality rates of under-fives with pneumonia were 26.8% and 20.4% respectively in 2018 (4).

In 2000, the Pneumococcal Conjugate Vaccine serotype seven (PCV7) was launched in the United

States of America (USA). This resulted in the reduction of pneumonia-induced morbidity in under-fives and under-twos by 77% and 39% (5). By 2003, uptake of the PCV7 was 69%, with its availability cited as the main predictor for its utilization (7). By August 2008, 26 countries had integrated the PCV7 in immunization schedules, with its uptake estimated to 50% (5,6). However, since the PCV7 was ineffective against some serotypes of *Streptococcus pneumoniae*, it was replaced by a decavalent vaccine in 2012, PCV10, which was effective against ten serotypes of the pneumococcus namely 1, 4, 5, 6B, 7F, 9V, 14, 18C, 19F, and 23F (7).

In 2007, the first formal meeting on the WHO and UNICEF yielded the Global Action Plan for Prevention of Pneumonia (GAPP), with pneumococcal vaccination as its cornerstone. GAPP proposed that countries should achieve 90% uptake of the pneumococcal

vaccine by 2015 to attain the Millennium Development Goal (MDG) number four of 2000 – reducing child mortality in United Nations (UN) countries by 75%. In 2001, uptake of the pentavalent vaccine in Mathare, Kenya was 62.2%, with poor knowledge, negligence, and the costs associated with access to the PCV7 increasing non-compliance (8). However, since the adoption of the PCV10 on 14<sup>th</sup> February 2011, its uptake in a rural setting such as Huruma has not been explored sufficiently, although it is part of the DVI with the pentavalent vaccine.

## Materials and methods

This was a descriptive cross-sectional study in Huruma Estate – a peri-urban settlement in Uasin Gishu County, located 7 km from Eldoret town. Children aged 14-52 weeks were targeted. According to the Ministry of Health (MoH), the administration of the final dose of the pneumococcal vaccine should be at 14 weeks. However, by the time we were doing the study, children who had received the pneumococcal vaccine in 2011 had attained the age of two years, hence the upper limit of 52 weeks. Consent was sought from a parent or a caregiver for a child to qualify for the study.

Cluster sampling was used to recruit 185 children. The study site was divided into five clusters and two clusters were chosen randomly. Households with children aged 14-52 weeks were identified, consent administered, and participants recruited until the sample size was attained. An interviewer-administered questionnaire was used to collect data. The socio-demographics of caregivers and immunization history of children were captured. The knowledge and attitudes of caregivers on PCV10. To compute attitude scores, six questions evaluating the perceptions of caregivers on the PCV10 were administered and scored as 1 for a good perception and 0 for bad. Then, an overall attitude score was generated, a cumulative attitude score (%) calculated for participants, and scores interpreted as described by Rubaish (9). At 60% cut-off, participants with a cumulative score of <60% were deemed to have a bad attitude while those with a cumulative score ≥60% a good attitude towards the PCV10. Social factors that influenced access to the PCV10 vaccine were also captured on the questionnaire.

Data analysis was done using version 21 of the Statistical Package for Social Scientists (SPSS) software. Questionnaires were scrutinized for inconsistencies such as missing data, errors, and omissions and participants with >20% missing data eliminated. Then, data were coded in an SPSS worksheet, and frequency

distributions explored. The uptake of the PCV10 vaccine was evaluated and computed following the guidelines of the Centers for Disease Control (CDC). To test attitudes on PCV10, six questions were scored as 0 for negative responses and 1 for positive responses. The scores were summed into an attitude score and scores interpreted as 0–3 for negative attitude and 4-6 positive attitudes. Correlation analyses were done to identify the factors that influence the uptake of the PCV10.

## Results

### Demographic characteristics

a) *Caregivers*: One hundred and eight-five participants comprising mothers, fathers, and providers of care were recruited and interviewed. Mothers (n=179) constituted 76% of our respondents. Most caregivers were aged between 20 and 34 years 90 (48.6%), married 168 (90.8%), and had a primary level of education 91(49.2%) (Table 1).

**Table 1:** Socio-demographic characteristics of caregivers (N=185)

Age (year)	Frequency	(%)
18-24	87	47.0
25-34	90	48.6
35-44	7	3.8
45+	1	0.5
Sex		
Male	4	2.2
Female	181	97.8
Marital status		
Single	14	7.6
Married	168	90.8
Separated	1	0.5
Widowed	2	1.1
Occupation		
Self-employed	58	31.4
Unemployed	106	57.3
Employed	21	11.4
Education		
Primary	91	49.2
Secondary	73	39.5
Tertiary	19	10.3
None	2	1.1

b) *Children*: One hundred and eight-five children were recruited. Most were aged 12-52 weeks 85 (45.9%), male 99 (53.5%), and had siblings 116 (62.7%) – mostly one 68 (36.8%) (Table 2).

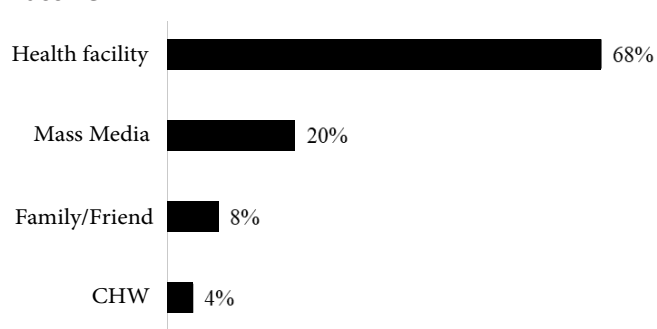
**Table 2:** Socio-demographic characteristics of children (N=185)

	Frequency	(%)
<b>Age (weeks)</b>		
<24	33	17.84
24-48	67	36.22
49-96	85	45.95
<b>Sex</b>		
Male	99	53.51
Female	86	46.49
<b>Presence of siblings</b>		
Yes	116	62.70
No	69	37.30
<b>No. of siblings</b>		
0	67	36.22
1	68	36.76
2	30	16.22
3	12	6.49
4	5	2.70
5	3	1.62

### Immunization

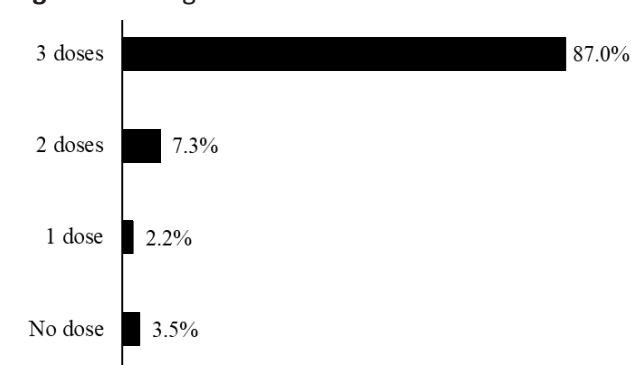
a) *PCV10 awareness*: Approximately 127 (68.7%) of respondents were aware of the PCV10 pneumococcal vaccine. Of those who were aware, 95 (74.8%) were knowledgeable on the mode of administration of the PCV10, while 93 (73.2%) knew the correct number of doses that should be administered to children. A majority of respondents 86 (72%) gained information about the vaccine from health facilities, while 26 (20.5%) were informed by mass media such as the radio and television. Community Health Workers (CHWs) informed only 4% of subjects (Figure 1).

**Figure 1:** Source of information on PCV10 pneumococcal vaccine



b) *PCV10 uptake*: At least 179 (96.8%) of children received at least one dose of the PCV10 pneumococcal vaccine. However, only 124 (67.0%) of cases were confirmed from the MoH immunization card. About 161 (87.0%), 14 (7.6%), and 4 (2.2%) received three, two, and one dose (Figure 2). Lack of knowledge 3 (12.5%), delay in immunization 6 (25.0%), and lack of vaccines 6 (16.7%) were the most typical reasons for non-compliance to the immunization schedule.

**Figure 2:** Dosage for the PCV10 vaccine



c) *Attitudes towards immunization*: Most respondents, 184 (99.5%) had a positive attitude towards pneumococcal immunizations. Even though caregivers with a negative attitude were more likely to skip vaccinations ( $r=-0.013$ ), attitude did not influence the uptake of the PCV10 vaccine significantly ( $p=0.855$ ).

### Factors that influence PCV10 uptake

Socio-demographic characteristics of caregivers were not associated with non-compliance with immunization. The age ( $p=0.861$ ), marital status ( $p=0.611$ ), occupation ( $p=0.800$ ), and educational level ( $p=0.087$ ), did not influence uptake of PCV10 significantly. The attributes of children and social factors analyzed were not associated with PCV10 uptake, (Table 2).

**Table 2:** Link between caregiver and children attributes and social factors on PCV10 uptake

	Uptake of PCV10	
	r	P-value
<b>Caregiver's attributes</b>		
Age	0.013	0.861
Marital Status	0.038	0.611
Occupation	0.019	0.800
Education level	-0.126	0.087
<b>Children's attributes</b>		
Age	0.108	0.144
Presence of siblings	0.048	0.516
No. of siblings	0.010	0.893
<b>Social factors</b>		
Distance to immunization site	0.062	0.402
Behavior of facility staff	0.060	0.416
Unavailability of vaccine	0.105	0.154

## Discussion

The uptake of PCV10 in Huruma Estate in Uasin Gishu County was 96.8%, which was 10.8% higher than uptake of the pentavalent vaccine nationally (86.0%) (10). This was in contrast to the findings of Kamau *et al.* (8) in 2001 in which uptake of the pentavalent vaccine in Mathare Valley, Nairobi was 62.2%. The high uptake of the PCV10 might be because the PCV10 was administered with a pentavalent vaccine during postnatal clinics and thus had an already-established immunization schedule. In most cases, health care workers administered PCV10 alongside a pentavalent whether they were knowledgeable about it or not. Moreover, 68% of caregivers were knowledgeable on PCV10, 99.5% of whom had a positive attitude, and were knowledgeable of the immunization schedule, which improves acceptance of new aspects of healthcare (11,12). Parents with a positive attitude towards immunization and have access to health care have also been reported to consider vaccination as a requirement for all children and are willing to return later for vaccinations during vaccine stock-outs.

Because health facilities were the primary source of education for caregivers, there is a need to beef up health education in national and county hospitals to boost the awareness of PCV10 further.

In a study by Danis *et al.* (13) maternal age and the education level of caregivers had an inverse relation to the uptake of the PCV10. Also, Kamau *et al.* (8) reported that children born to married women were more likely to complete immunization schedules as required. However, we found different results. Demographic characteristics of caregivers such as age, marital status, and education level did not influence the uptake of the PCV10 statistically. Moreover, demographic characteristics of children and social factors such as the distance to immunization site, the behavior of staff, and the availability of vaccines did not influence the uptake of the PCV10 vaccine statistically. However, because the sample size was small, we could have underestimated the relationship between demographic and social factors studied and uptake of PCV10 in Huruma in Uasin Gishu County in Kenya. Follow-up studies with a larger sample size are required to corroborate our findings or show statistical differences.

## Conclusion

Uptake of the pneumococcal vaccine, PCV10, is almost universal (96.8%) in Huruma Estate of Uasin Gishu County, Kenya and slightly higher than the national uptake of the pentavalent vaccine (86%). Awareness of the PCV10 was high, with a majority of caregivers having a positive attitude on immunization. The socio-demographic characteristics of caregivers and children and social factors of the study area did not influence the uptake of PCV10 vaccine.

## Conflict of interest

The authors have declared no conflict of interest

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