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Demographic, socio-economic and geographic determinants of seasonal influenza vaccine uptake in rural western Kenya, 2011

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ABSTRACT

Influenza-associated acute lower respiratory infections cause a considerable burden of disease in rural and urban sub-Saharan Africa communities with the greatest burden among children. Currently, vaccination is the best way to prevent influenza infection and accompanying morbidities.

We examined geographic, socio-economic and demographic factors that contributed to acceptance of childhood seasonal influenza vaccination among children living in a population-based morbidity surveillance system in rural western Kenya, where influenza vaccine was offered free-of-charge to children 6 months–10 years old from April to June, 2011. We evaluated associations between maternal and household demographic variables, socio-economic status, and distance from home to vaccination clinics with family vaccination status.

7249 children from 3735 households were eligible for vaccination. Of these, 2675 (36.9%) were fully vaccinated, 506 (7.0%) were partially vaccinated and 4068 (56.1%) were not vaccinated. Children living in households located >5 km radius from the vaccination facilities were significantly less likely to be vaccinated (aOR = 0.70; 95% CI 0.54–0.91; $p = 0.007$). Children with mothers aged 25–34 and 35–44 years were more likely to be vaccinated than children with mothers less than 25 years of age (aOR = 1.36; 95% CI 1.15–1.62; $p < 0.001$; and aOR = 1.35; 95% CI 1.10–1.64; $p = 0.003$, respectively). Finally, children aged 2–5 years and >5 years of age (aOR = 1.38; 95% CI 1.20–1.59; $p < 0.001$; and aOR = 1.41; 95% CI 1.23–1.63; $p < 0.001$, respectively) and who had a sibling hospitalized within the past year (aOR = 1.73; 95% CI 1.40–2.14; $p < 0.001$) were more likely to be vaccinated.

Shorter distance from the vaccination center, older maternal and child age, household administrator's occupation that did not require them to be away from the home, and having a sibling hospitalized during the past year were associated with increased likelihood of vaccination against influenza in western Kenya. These findings should inform the design of future childhood seasonal influenza vaccination campaigns in rural Kenya, and perhaps elsewhere in Africa.

1. Introduction

An estimated 28,000–111,500 children younger than five years old died worldwide in 2008 due to causes attributable to influenza-associated acute lower respiratory infections (ALRI), and 99% of these deaths occurred in developing countries [1]. While the burden of influenza has traditionally been assumed to be minor in Africa with respect to other causes of severe disease, global concerns surrounding influenza A (H5N1) and pandemic preparedness provided resources to support surveillance systems that have better characterized the epidemiology of influenza in Africa [2]. Surveillance reports from the Cote d' Ivoire, Democratic Republic of Congo, Gabon, Gambia, Kenya, Madagascar, and Senegal all indicate that influenza circulates annually in Africa, causing regular epidemics [3]. Many other countries in Africa including Ghana, Egypt and Morocco, also have some limited data on influenza circulation [4]. A trivalent influenza vaccine is commercially available in

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Kenya. However in this country of 37 million people, the Government does not yet routinely procure influenza vaccine, as influenza vaccination is not covered by Kenya's Expanded Programme on Immunization. Fewer than 40,000 doses are sold annually within the private sector [5].

Vaccination is currently the most cost-effective intervention to reduce hospitalization and treatment costs due to influenza [6]. While the Expanded Programme on Immunization successfully led the eradication of smallpox [7] and has made immense public health gains by reducing the burden of poliomyelitis, measles, diphtheria and pertussis, influenza remains prevalent in developing countries. The World Health Organization's Strategic Advisory Group of Experts (SAGE) on immunization recommends that children aged 6 months–5 years be vaccinated against influenza annually [8], and that immunologically naive children be given two doses of vaccine. SAGE further stresses the prioritization for vaccination based on burden of disease, cost-effectiveness, feasibility and other appropriate considerations. Influenza is found in 10% of Severe Acute Respiratory Illness (SARI) cases in Africa and children aged less than 5 years old account for approximately half of all influenza-like illness (ILI) and SARI cases [9]. Furthermore, surveillance data in Kenya suggest ALRI cause a considerable burden of disease in rural and urban communities, with the greatest burden among children [10].

Although routine vaccination is a major tool in the primary prevention of influenza [11,12], a significant proportion of the population is reluctant to receive vaccines [13,14]. We examined demographic, socio-economic and geographic factors that contributed to acceptance of childhood seasonal influenza vaccination among families in rural western Kenya. Existing literature from other countries suggest important determinants of childhood vaccine uptake [15–20]. Analyses from demographic and surveillance systems (DSS) have found different socio-demographic factors associated with childhood vaccination; In Bangladesh, diphtheria–tetanus–pertussis and oral polio vaccination were independently associated with higher maternal age, lower maternal education and birth order of the child [15]. In Malawi, maternal education was found to be among major determinants of the immunization status of the child [16], Moreover, findings from DSS in Ghana showed positive relationship between socio-economic status and vaccination status [17].

Cross-sectional surveys have similarly suggested important determinants of childhood vaccination; a survey in Khartoum State of Sudan observed an increased vaccination rate with an increase in the age of the children and the education level of the mother, subsequently children of older mothers were more likely to have had the correct vaccinations [18]. A survey in Ghana found distance to be the most important factor that influences the utilization of health services [19]. Moreover, a survey in Kenya found that immunization rate ratios were reduced with every kilometer of distance from home to vaccine clinic [20]. Researches on factors associated with vaccination among children in Africa have focused on vaccinations covered by EPI programs. None of these studies, however, draws attention on the issue raised in our work and to best of our knowledge determinants of childhood vaccination in the context of influenza vaccination remains an ignored expedition for sub-Saharan Africa. Understanding the determinants of children's vaccine uptake in Kenya is therefore important for guiding future immunization policies.

2. Materials and methods

2.1. Study site and population

The CDC's International Emerging Infections Program in collaboration with KEMRI has conducted population-based infectious disease surveillance (PBIDS) in Asembo Division, Siaya County since late 2005 [21]. Asembo has an area of 200 km^2 and lies northeast of Lake Victoria in Nyanza Province in western Kenya. The PBIDS area comprises approximately 100 km^2 with an overall population density of about 325 persons per square kilometer. The surveillance population includes approximately 25,000 persons living in 33 villages. All study participants must have resided permanently in the area for 4 calendar months and have been registered into the KEMRI/CDC Health and Demographic Surveillance System (HDSS) [22]. The population is predominantly subsistence farmers and fishermen belonging to the Luo ethnic group. Rain falls year-round, but is usually heaviest between March and May, with a second smaller peak in October and November [23]. The area has high child mortality; in 2009, it had a mortality ratio of 180.5 per 1000 live births in children under age five [24]. At the time of the vaccination campaign, Asembo still had no paved roads, except on its northern border. Few public transport vehicles serviced the area and walking was the most common mode of transport.

KEMRI/CDC established the HDSS in 2001 with an objective of providing an infrastructure for future evaluation of population-based public health interventions [22]. Data generated by the HDSS stratified by age, sex, socio-economic status (SES), educational level, and geographic location can be used to generate hypotheses and address the causes of morbidity and mortality in subgroups of the population. The SES score is derived using multiple component analysis (MCA) [25], for all households under HDSS. The MCA is generated based on household assets, namely occupation of household head, primary source of drinking water, main source of cooking fuel, in-house possession (lantern lamp, sofa, radio bicycles and TV) and livestock ownership (goats, cattle, donkeys, pigs and sheep). All houses in the HDSS area were mapped using a differential global positioning system (GPS) as part of the insecticide treated net malaria trial [26], and maps are updated at least annually to take account of new construction.

We implemented a seasonal influenza vaccination campaign from April 4 to June 24, 2011, offering free trivalent inactivated influenza vaccine to children aged 6 months–10 years old who are participants of the population-based morbidity surveillance in rural western Kenya. The trivalent vaccine included a pandemic influenza A (H1N1) 2009 component, an influenza A (H3N2) component and an influenza B component. Children aged 6 months–8 years, and those that were vaccine naive, were scheduled to receive 2 doses while those aged 9–10 years old were scheduled to receive only one dose. The two doses were administered 4 weeks apart. Influenza vaccines were administered from three designated health facilities; St. Elizabeth Lwak Mission Hospital, Mahaya Health Center and Ong'ielo Sub-district Hospital. These three health facilities are spread within the surveillance area to allow ease in access to healthcare. The vaccines were available at the facilities on weekdays from 9 am to 3 pm.

Community members, hired and trained by KEMRI/CDC on standardized and consistent messages conducted a community sensitization campaign one month prior to vaccine administration through door-to-door mobilization of all households with eligible children; fliers were left behind in homes where parents were away at the time of mobilization. We also held meetings with community members and distributed posters and fliers at market places, schools and health facilities within the surveillance area. Mobilization messages included signs and symptoms of seasonal influenza, ways of preventing and controlling influenza, benefits of seasonal influenza vaccine and designated clinics for seasonal influenza vaccination. Mobilization continued throughout the vaccination administration period. Data on vaccination were collected at 3 vaccination clinics by use of netbooks.

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