



Predictors of optional immunization uptake in an urban south Indian population



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ABSTRACT

Background: In Tamil Nadu, India, bacille Calmette–Guérin, diphtheria–tetanus–pertussis, oral poliomyelitis, hepatitis B, and measles vaccines are part of the routine immunization schedule and are available free from government health centers. All other vaccines are optional and available in the private sector at a cost to families. This study assesses immunization rates of routine and optional vaccines and examines parental attitudes toward vaccines in Pallavapuram, Tamil Nadu.

Methods: The cluster sampling method was used to estimate immunization coverage. Seven children 18 to 36 months old were selected from 30 clusters for a total sample of 210 children. Demographics and vaccination data were collected from interviews and immunization records. Predictors of vaccination status were identified with logistic regression models. In addition, 21 parents participated in semi-structured interviews regarding their attitudes toward vaccination. Interviews were analyzed qualitatively for themes.

Results: Eighty one percent of children were fully immunized with routine vaccines. However, only 21% received all “major” optional vaccines, defined as 3 doses of *Haemophilus influenzae* type b vaccine, one dose of measles, mumps, rubella vaccine, and one dose of varicella zoster virus vaccine. Birth in a private hospital (OR 5.6, 95% CI 1.3 to 22.9, $P < 0.01$), higher income ($P = 0.03$), and maternal completion of high school (OR 6.4, 95% CI 1.5 to 27.6, $P < 0.01$) were significant predictors of receiving all major optional vaccines. Elucidated themes from interviews included (1) strong parental support for immunizations, (2) low concern for side effects, and (3) low uptake of optional vaccines due to high cost and lack of awareness.

Conclusions: Coverage of optional vaccines is low despite positive attitudes toward immunizations. Efforts to reduce cost and increase awareness of these vaccines particularly among low-income families or to include these vaccines in the routine schedule may increase uptake and reduce morbidity and mortality from vaccine-preventable diseases.

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1. Introduction

Immunizations are widely considered to be the most important public health intervention of the last century and are estimated to prevent 6 million deaths annually [1]. At its initiation in 1974, the World Health Organization's expanded

programme on immunization (EPI) recommended inclusion of bacille Calmette–Guérin (BCG), diphtheria–tetanus–pertussis (DTP), oral poliomyelitis (OPV), and measles vaccines in routine immunization schedules. Although several additional vaccines, such as *Haemophilus influenzae* type b (Hib); hepatitis B (HBV); pneumococcal conjugate (PCV); measles, mumps, rubella (MMR); varicella zoster virus (VZV); and rotavirus vaccines have since become available, they are not all part of routine immunization schedules which vary among low- and middle-income countries.

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In the south Indian state of Tamil Nadu, the routine immunization schedule for infants less than one year of age includes 1 dose of BCG, 4 doses of OPV, 3 doses of DTP, 3 doses of HBV, and 1 dose of measles vaccine. Routine vaccines are provided free at government health centers. Through door-to-door surveys, the 2005–2006 National Family Health Survey and 2009 UNICEF Coverage Evaluation Survey reported that 78 to 81% of children under one year of age in Tamil Nadu were fully immunized with routine vaccines [2–4]. In comparison, in all of India, 61% of children were fully immunized by one year of age. Although Tamil Nadu has one of the highest rates of vaccine coverage in India, it has not yet achieved the target vaccination rate of 90% set forth by the WHO and UNICEF's Global Immunization Vision and Strategy framework [5].

Although many of the newly developed vaccines are not included in the routine immunization schedule, the Indian Academy of Pediatrics recommends that infants receive 3 doses of Hib, 3 doses of PCV, 3 doses of rotavirus vaccine, 1 dose of MMR, and 1 dose of VZV before 18 months of age in addition to those on the routine schedule. These additional vaccines, called "optional vaccines," are not subsidized by the government and are only available at privately owned clinics for families to purchase. Immunizations on the routine schedule can also be purchased in the private sector if so desired by the child's family. In late 2011, after this study was conducted, Hib vaccine was added to the routine schedule in Tamil Nadu; in this study, it is reported as an optional vaccine. Unlike the routine vaccines, little is known about coverage of optional vaccines, factors affecting their uptake, and parental attitudes toward these immunizations in Tamil Nadu.

The objectives of this study were to (1) measure coverage of both routine and optional vaccines in children 18 to 36 months of age in Pallavapuram, India, (2) determine whether particular socio-demographic factors are associated with vaccine uptake, and (3) examine parental attitudes toward immunizations in this population.

2. Methods

This is a mixed-methods study with two parts: (1) quantitative design to measure immunization rates and (2) qualitative design to assess parental attitudes. Data were collected from July to August 2011.

2.1. Study area

The study was conducted in Pallavapuram municipality, an urban area located in Kanchipuram district in the state of Tamil Nadu, India. It is about 15 km from Chennai, which is the largest city in Tamil Nadu. The population of Pallavapuram is 213,800. Urban areas in Kanchipuram district have an infant mortality rate of 19 per 1000 live births and literacy rate of 79% [6]. The mean per capita monthly income in Tamil Nadu is Rs. 6083 (\$134), and the urban poverty line is defined as a per capita monthly income of less than Rs. 937 (\$20) [7,8]. Two government primary health centers in the municipality provide the routine immunizations (BCG, OPV, DTP, HBV, and measles vaccines) and the state government also distributes OPV during pulse polio vaccination campaigns. Numerous private clinics throughout the municipality provide optional immunizations (Hib, PCV, rotavirus, MMR, VZV, and influenza vaccines) at a cost to families.

2.2. Quantitative study design

We utilized the EPI's validated '30 × 7' cluster sampling method, which rapidly estimates immunization coverage with a precision of approximately ±10% [9,10]. Pallavapuram was separated into 30

clusters based on ward divisions and population; 7 children were sampled in each cluster for a total sample size of 210 children. Immunization data for children between 18 and 36 months of age were collected. If multiple children were present in a household, only the youngest child in that age range was included. Although the EPI recommends sampling children between 12 and 23 months of age, we sampled a slightly modified age range in order to calculate the rate of uptake of MMR and VZV. The starting street in each cluster was randomly selected from a ward street list, and the starting house was the lowest number house on this street. Subsequent houses were sampled based on closest proximity to the prior house until seven participants who met inclusion criteria were interviewed in each cluster.

Demographic information was collected with a verbal survey, and immunization records were reviewed. If written records were not available, parental recall was used. The interviewer asked the parent which vaccines by name and how many injected and oral doses the child received at each recommended age similar to the procedure used in Demographic and Health Surveys [11]. If the child was missing any routine vaccines or did not receive any optional vaccines, parents were asked why the child was incompletely immunized. Answers were recorded verbatim.

2.3. Vaccine outcomes

Validity of each immunization dose was determined for each participant. The dose was considered valid if the vaccination record or parental recall indicated that the child received the vaccine at the appropriate time. For BCG vaccine, the presence of a scar on the arm consistent with vaccination was considered evidence of a valid dose. Vaccine doses were considered invalid if (1) no record of receipt was available and parents were unable to recall receipt or (2) if the vaccine was given at an inappropriate age or time interval from the prior dose. In addition to describing the rates of immunization for each routine and optional vaccine, we defined two outcome measures: (1) complete vaccination with all routine vaccines which includes 1 valid dose of BCG, 4 valid doses of OPV, 3 valid doses of DTP, 3 valid doses of HBV, and 1 valid dose of measles vaccine and (2) complete vaccination with all "major" optional vaccines which we defined as 3 valid doses of Hib, one valid dose of MMR, and one valid dose of VZV. These vaccines were chosen as the "major" optional vaccines because they were the most widely available.

2.4. Statistical analyses

To assess the association between socio-demographic characteristics and outcome measures, logistic regression models were fit via generalized estimating equations (GEE) to account for sampling cluster. Odds ratios and 95% confidence intervals were determined. For each vaccination outcome, characteristics that were found to be significant predictors in the univariate model were entered into a multivariate GEE model. All analyses were performed using SAS version 9.3.

2.5. Qualitative study design

We recruited a convenience sample of parents with children between 18 and 36 months of age from the waiting room of Pallavaram Children's Medical Centre, a private clinic in Pallavapuram, and from their homes in Pallavapuram. Ten to twenty minute interviews were conducted in Tamil by the principal investigator. Interviews followed a semi-structured guide exploring parents' knowledge and attitudes toward vaccines. Recruitment continued until thematic saturation was attained.

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