Factors associated with routine childhood vaccine uptake and reasons for non-vaccination in India: 1998–2008

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ABSTRACT

Background: Despite almost three decades of the Universal Immunization Program in India, a little more than half the children aged 12–23 months receive the full schedule of routine vaccinations. We examined socio-demographic factors associated with partial-vaccination and non-vaccination and the reasons for non-vaccination among Indian children during 1998 and 2008.
Methods: Data from three consecutive, nationally-representative, District Level Household and Facility Surveys (1998–99, 2002–04 and 2007–08) were pooled. Multinomial logistic regression was used to identify individual and household level socio-demographic variables associated with the child's vaccination status. The mother's reported reasons for non-vaccination were analyzed qualitatively, adapting from a previously published framework.
Results: The pooled dataset contained information on 178,473 children 12–23 months of age; 53%, 32% and 15% were fully vaccinated, partially vaccinated and unvaccinated respectively. Compared with the 1998–1999 survey, children in the 2007–2008 survey were less likely to be unvaccinated (Adjusted Prevalence Odds Ratio (aPOR): 0.92, 95%CI = 0.86–0.98) but more likely to be partially vaccinated (aPOR: 1.58, 95%CI = 1.52–1.65). Vaccination status was inversely associated with female gender, Muslim religion, lower caste, urban residence and maternal characteristics such as lower educational attainment, non-institutional delivery, fewer antenatal care visits and non-receipt of maternal tetanus vaccination. The mother's reported reasons for non-vaccination indicated gaps in awareness, acceptance and affordability (financial and non-financial costs) related to routine vaccinations.
Conclusions: Persisting socio-demographic disparities related to partial-vaccination and non-vaccination were associated with important childhood, maternal and household characteristics. Further research investigating the causal pathways through which maternal and social characteristics influence decision-making for childhood vaccinations is needed to improve uptake of routine vaccination in India. Also, efforts to increase uptake should address parental fears related to vaccination to improve trust in government health services as part of ongoing social mobilization and communication strategies.

1. Introduction

Globally about one-third of the annual vaccine preventable child deaths or 500,000 deaths occur in India [1,2]. While most vaccine preventable deaths in India are due to pneumonia and diarrhea, complete immunization with existing routine vaccines against tuberculosis, diphtheria, pertussis and tetanus, polio,

measles, hepatitis B and *H. influenzae* type b are essential to avert the associated mortality, morbidity and to prevent future outbreaks of these vaccine preventable diseases [3]. However, despite almost three decades of the UIP, the proportion of children aged 12–23 months receiving the full schedule of vaccinations in India is around 61% and for third dose DPT (DPT3) coverage is 72%, still below the global average of 86% [4]. The persisting low routine immunization coverage implies that one in three children born every year still do not receive complete protection against the diseases currently covered by the UIP, placing them at the highest risk of mortality and morbidity [2,5].

India's slow progress to achieving universal immunization for all children has generally been attributed to its sheer population size, high growth rate, geographic and cultural diversity and limited healthcare spending [6,7]. However, large inter-state and inter-district disparities in immunization coverage have helped uncover important supply and demand-side factors associated with uptake of routine vaccinations [7–9]. Supply-side factors generally include a lack of trained personnel to manage and deliver immunization services, poor relationship between health care workers and mothers, inconvenient timing or location of immunization services and even vaccine stock outs [6,8,10]. Demand-side factors associated with routine vaccination uptake however are complex and often multi-faceted. Previous research from India tends to highlight socio-demographic characteristics associated with uptake such as child's gender, order of birth, place of delivery, maternal age at childbirth, parental education, caste and religious preference, household wealth and location (urban or rural), [6–8,11,12]. Of late, non-socio-demographic demand-side issues such as awareness regarding the need for and timing of routine childhood vaccinations, fears regarding some or all routine vaccines and parental beliefs regarding false contraindications to routine vaccinations have been reported as reasons linked to partial-vaccination and non-vaccination of Indian children [4,12,13]. As, the Indian Government aims to boost full immunization coverage of UIP vaccines to 90% through the Mission Indradhanush initiative by 2020, it is important to track the various socio-demographic and non-socio-demographic factors influencing suboptimal vaccination over the years to identify key areas of intervention and further research.

We used pre-existing, nationally-representative datasets from three rounds of India's District Level Household and facility Survey's (DLHS) conducted from 1998 to 2008 to: (1) examine the socio-demographic factors associated with vaccination status of children aged 12–23 months at the time of survey (focusing on partial-vaccination and non-vaccination) and (2) categorize the reasons reported for non-vaccination by adapting the previously published "5A's Taxonomy for Determinants of Vaccine Uptake" [14], intended for non-socio-demographic factors.

2. Methods

2.1. Data source, sampling and survey questionnaire

The DLHS cross-sectional surveys are conducted periodically to monitor and assess reproductive and child health program indicators in every district of India. To date, four rounds of the DLHS have been completed (DLHS-1 in 1998–99, DLHS-2 in 2002–04, DLHS-3 in 2007–08 & DLHS-4 in 2012–13). Data from DLHS-4 were excluded because the survey was not nationally representative (DLHS-4 covered 336 of 640 Indian districts). Each DLHS round employed a similar systematic, multi-stage stratified sampling scheme. Additional detail on the survey design and calculation of sampling weights are available in the Appendix and elsewhere [15–18].

Interviews with currently married (or ever married) women and with any adult family member (aged 18 years and above) collected information for the "women's questionnaire" and "household questionnaire" respectively. We used information from the "women's questionnaire" containing relevant information on socio-demographic characteristics and childhood immunization information. The type and number of questions providing information on child, maternal and household characteristics and immunization histories were generally similar for the DLHS surveys, however, there were more questions about child and maternal health from DLHS-1 to DLHS-4 [19] (See Appendix for more details on questionnaire). In the DLHS, immunization histories for the last two surviving children were obtained from the vaccination card of the children. If the vaccination card was not available immunization data were based on maternal recall. The study sample comprised the most recently born children aged 12–23 months at the time of survey to limit the influence of poor maternal recall on immunization histories of older children. Also, for consistency and pooling we further restricted analysis to children of mothers who were currently married (*i.e.* ever-married mothers were excluded as they were only interviewed in DLHS-3) and aged 15–44 years at the time of survey (*i.e.* mothers aged >44 years from DLHS-3 were excluded).

2.2. Socio-demographic variables

Individual, household and regional characteristics having a previously reported association with children's vaccination status and with complete data available in the survey datasets were chosen for analysis. Individual characteristics included child-specific characteristics such as gender and age in months and maternal characteristics such as mother's age at childbirth, educational attainment, antenatal participation, place of delivery and maternal tetanus vaccination status [20–23]. In addition, caste and religious preference of the head of household were selected [22,24]. Household characteristics included urban or rural location and in the absence of a readily available wealth index measure (for DLHS-1), type of dwelling (Mud, semi-cemented or cemented) was used as a proxy measure of household wealth. And, geographical region of residence in India categorized as North, Central, North-East, West and South was used as the regional indicator for adjustment [7]. Further details on the variables are provided in the Appendix.

2.3. Outcome variable

The current Indian UIP schedule recommends one dose of BCG vaccine at birth (or as soon as possible), three doses of DPT, OPV and Hepatitis B (added in 2007) or pentavalent vaccine (available in some Indian states since 2011) provided at 6, 10 and 14 weeks of age and one dose of measles vaccine at 9 months of age. The main outcome of study was the vaccination status of children 12–23 months of age, defined using EPI recommendations which were in use during the surveys as follows [22,25]:

(1) <u>Fully vaccinated</u> – Children who received one dose of BCG, three doses of DPT, three doses of OPV (excluding the zero dose) and one dose of measles vaccine by 12 months of age.

(2) <u>Partially vaccinated</u> – Children who received at least one but not all the recommended vaccines by 12 months of age.

(3) <u>Unvaccinated</u> – Children who did not receive any of the recommended vaccines by 12 months of age.