



Systematic Review

Reasons for Partial Immunization and Non-Immunization Among Children in India: A Systematic Review and Meta-Analysis

Dr. Ramesh Dharma Nikam¹, Dr. Prashant Bhusari²

¹Assistant Professor, Department of Community Medicine, SMBT Institute of Medical Sciences & Research Centre, Nashik, Maharashtra, India

²Assistant Professor, Department of Community Medicine, SMBT Institute of Medical Sciences & Research Centre, Nashik, Maharashtra, India

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Corresponding Author:

Dr. Ramesh Dharma Nikam

Assistant Professor, Department of Community Medicine, SMBT Institute of Medical Sciences & Research Centre, Nashik, Maharashtra, India.

Email:

rameshnikam@gmail.com.

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ABSTRACT

Background: Despite the Universal Immunization Programme, a large proportion of Indian children remain partially immunized or unimmunized. Many community-based studies have reported the reasons given by parents, but their findings have not been pooled. This systematic review and meta-analysis estimated the pooled proportion of each reason for partial immunization and non-immunization among children in India.

Methods: PubMed was searched for studies published up to December 2020 that reported reasons for partial immunization or non-immunization of children in India, and reference lists were checked for further PubMed-indexed articles. Quality was assessed with the Joanna Briggs Institute checklist. Reasons were grouped into lack of information, lack of motivation and obstacles. Proportions were pooled with a random-effects model; heterogeneity was assessed with I^2 and publication bias with Egger's test.

Results: A total of 12 studies with 2615 partially immunized or unimmunized children were included. The most common reasons were unawareness of the need for immunization (39.0% (95% CI 20.9 to 58.8)), an inconvenient or unknown place or time of the session (22.3%), fear of side effects (20.6%), travel or migration (20.1%) and the mother being busy (19.0%). Overall, reasons related to lack of information accounted for 36.2% of the reasons given, obstacles for 32.3% and lack of motivation for 28.0%. Heterogeneity between studies was high.

Conclusion: Lack of information about vaccination and its schedule was the leading reason for partial immunization and non-immunization in India, followed by practical obstacles and fear of side effects. Interpersonal communication by health workers, due-list based tracking and flexible session timings are needed to reach these children.

Keywords: Partial immunization; Non-immunization; Reasons; Vaccine hesitancy; Universal Immunization Programme; India; Meta-analysis.

INTRODUCTION

Immunization is one of the most cost-effective public health interventions. India's Universal Immunization Programme provides free vaccines against several vaccine-preventable diseases to all children [1], but full immunization coverage has remained below the target, with large gaps between states, wealth groups and urban and rural areas [2]. Children who are partially immunized or unimmunized are at risk of disease and sustain transmission in the community.

Understanding why children are not fully vaccinated is essential to design effective interventions. A systematic review of studies from low-income and middle-income countries grouped the reasons for non-vaccination and under-vaccination into factors related to the immunization system, family characteristics, parental attitudes and knowledge, and communication and information [3], and a review of grey literature reached similar conclusions [4]. Vaccine hesitancy, defined as delay in

acceptance or refusal of vaccines despite their availability, is shaped by complacency, convenience and confidence [5]. Factors associated with incomplete or delayed vaccination across countries include low maternal education, poverty and poor access to services [6].

In India, analyses of national survey data identified lack of knowledge about vaccination and its benefits as an important reason for non-vaccination [7]. Many community and hospital-based studies have asked parents why their children were not fully immunized [8-10], but the reasons and their frequency vary considerably between settings, and there has been no pooled estimate. This systematic review and meta-analysis was conducted to estimate the pooled proportion of each reason for partial immunization and non-immunization among children in India and to compare them across settings.

MATERIALS AND METHODS

Protocol and reporting

This review was conducted and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement [11] and the guidelines for Meta-analysis Of Observational Studies in Epidemiology (MOOSE) [12].

Search strategy

PubMed was searched for studies published up to 31 December 2020. The search combined terms for the outcome (partial immunization, incomplete immunization, non-immunization, unimmunized, under-vaccination, dropout, reasons, barriers), vaccination (vaccination, immunization, immunisation, vaccine) and children (child, infant), together with India. The PubMed search string was: ("partial immuni*" OR "incomplete immuni*" OR "non-immuni*" OR unimmuni* OR "under-vaccin*" OR dropout OR reason* OR barrier*) AND (vaccin* OR immuni*) AND (child* OR infant*) AND India. Reference lists of included studies and relevant reviews were also searched by hand, and only articles indexed in PubMed were retained.

Eligibility criteria

Studies were included if they were observational studies conducted in India among children aged up to 5 years; reported the reasons given by parents or caregivers for partial immunization or non-immunization; reported the number of partially immunized or unimmunized children and the number or percentage citing each reason; and were published in English in a PubMed-indexed peer-reviewed journal. Studies were excluded if they addressed only vaccination campaigns such as pulse polio, reported reasons only qualitatively, studied special groups only, used a case-control design, had been retracted, or were reviews, editorials or conference abstracts. When several publications reported the same population, the most complete report was included.

Definitions and classification of reasons

A fully immunized child was one who had received BCG, three doses of DPT or Pentavalent vaccine, three doses of oral polio vaccine and measles-containing vaccine by 12 months of age; a partially immunized child had missed one or more of these vaccines, and an unimmunized child had received none. Reasons were extracted as reported and grouped into three categories commonly used in Indian immunization surveys: lack of information (unaware of the need for immunization, unaware of the schedule or of the need to return for subsequent doses, wrong ideas about contraindications); lack of motivation (fear of side effects, no faith in immunization, postponement, rumours); and obstacles (child ill, mother too busy, place or time of immunization inconvenient or unknown, vaccinator or vaccine absent, long waiting time, travel or migration, family problems). Belief that oral polio vaccine was the only vaccine needed was classed as unawareness of the need for immunization, and absence of the child from home on the session day as travel or migration.

Study selection and data extraction

Titles and abstracts were screened first, and the full texts of potentially eligible studies were then assessed against the eligibility criteria. Data were extracted with a pre-designed form, recording the first author, year of publication, state, setting (urban, rural, urban slum or hospital), study design, sampling method, sample size, age group, number of partially immunized and unimmunized children, and the number citing each reason. When respondents could give more than one reason, each reason was analysed separately. When a study listed several items that fell under the same reason in our classification, the largest count was used so that no child was counted twice for one reason. When only percentages were reported, counts were calculated from the percentages and the denominator. All extracted values were checked a second time against the source articles.

Quality assessment

The methodological quality of each study was assessed with the Joanna Briggs Institute critical appraisal checklist for studies reporting prevalence data [13], with the risk of bias tool of Hoy and colleagues as a supplementary guide [14]. Studies were classified as of low, moderate or high risk of bias.

Statistical analysis

For each reason, the proportion of partially immunized or unimmunized children citing that reason was calculated with its exact 95% confidence interval. Proportions were stabilised with the Freeman-Tukey double arcsine transformation and pooled with a random-effects model using the DerSimonian and Laird method [15,16]. For each category, the share of all reasons cited that fell into that category was pooled in the same way, using the studies that tabulated the full list of reasons. Heterogeneity was assessed with Cochran's Q test and the I^2 statistic. Subgroup analyses were performed by setting (community or hospital; urban, rural or slum), region and risk of bias. Sensitivity analysis was performed by excluding studies at high risk of bias and by excluding one study at a time. Publication bias was assessed with Egger's test when at least three studies contributed to an estimate [17]. Analyses followed the metaprop approach [18] and were performed in Python 3 with the NumPy and SciPy libraries. A p-value below 0.05 was considered significant.

RESULTS

Study selection

The PubMed search identified 382 records, and 5 further PubMed-indexed records were found through reference lists. There were no duplicates, so 387 records were screened. After screening of titles and abstracts, 27 full-text articles were assessed, and 12 studies were included in the review and meta-analysis (Figure 1) [8-10,19-27]. The main reasons for exclusion were that reasons were not reported or not quantified ($n = 8$), the full text was not accessible ($n = 4$), reasons for vaccine hesitancy were reported for all families rather than for under-immunized children ($n = 1$), a case-control design ($n = 1$) and retraction of the article ($n = 1$).

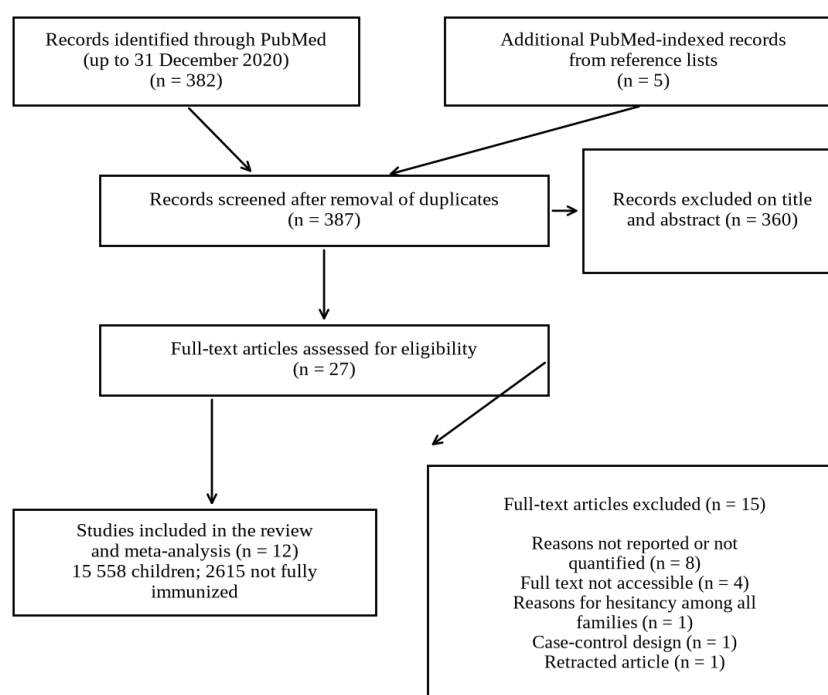


Figure 1. PRISMA flow diagram of study selection

Additional records were identified through reference lists; only PubMed-indexed articles were retained.

Characteristics of included studies

The included studies were published between 2002 and 2020 and included 15 558 children, of whom 2615 were partially immunized or unimmunized and contributed reasons. In the four studies that reported the two groups separately, 1484 children were partially immunized and 136 unimmunized. Nine studies were community-based and three hospital-based; of the community studies, three were conducted in urban areas, three in rural areas, two in urban slums or migrant settlements and one in both urban and rural areas, across nine states and union territories. The proportion of fully immunized children in the included studies ranged from 16.8% to 90.9%. Five studies were judged to be at low risk of bias, six at moderate risk and one at high risk (Table 1).

Table 1. Characteristics of included studies

First author, year	State	Setting	Design	Children studied, n	Not fully immunized, n	Fully immunized, %	Risk of bias

Mathew 2002	Delhi	Hospital-based (paediatric OPD, low-income families)	Cross-sectional	500	375	25.0	High
Punith 2008	Karnataka	Urban (Bangalore)	Cross-sectional, 30-cluster survey	220	35	84.1	Low
Kumar 2010	Delhi	Hospital-based (admitted children)	Cross-sectional	325	267	17.8	Moderate
Vohra 2013	Uttar Pradesh	Urban and rural (Lucknow)	Cross-sectional, 30-cluster survey	450	168	62.7	Low
Gupta 2013	Maharashtra	Rural (Pune)	Cross-sectional, 30-cluster survey	210	28	86.7	Moderate
Gupta 2015	Uttar Pradesh	Urban (Lucknow)	Cross-sectional	198	50	74.7	Moderate
Sharma 2015	Chandigarh	Urban slums and construction sites	Cross-sectional	310	297	16.8	Moderate
Nath 2015	Uttarakhand	Migrant settlements (Haridwar)	Cross-sectional	180	137	24.0	Moderate
Datta 2017	Tripura	Rural (lot quality assurance sampling)	Cross-sectional, LQAS	330	30	90.9	Low
Joy 2019	Kerala	Urban (Kochi)	Cross-sectional, cluster survey	310	34	89.0	Low
Singh 2019	Bihar	Rural (59 low-performing blocks)	Cross-sectional, cluster survey	12 331	1128	90.9	Low
Ratta 2020	Maharashtra	Rural health centre OPD	Cross-sectional	194	66	66.0	Moderate

OPD: outpatient department; **LQAS:** lot quality assurance sampling. Not fully immunized: number of partially immunized or unimmunized children who were not fully immunized and for whom reasons were recorded. In Sharma 2015, reasons were tabulated for 297 children (203 in slums and 94 at construction sites). Counts for Mathew 2002 were calculated from percentages in the abstract, as the full text was not available.

Pooled proportion of reasons

The most common reason for partial immunization or non-immunization was unawareness of the need for immunization, reported by 39.0% (95% CI 20.9 to 58.8) of parents, followed by an inconvenient or unknown place or time of the session (22.3%), fear of side effects (20.6%), travel or migration (20.1%) and the mother being busy or having no one to take the child (19.0%) (Table 2, Figure 2). Unawareness of the schedule or of the need to return for the next dose was cited by 18.0%, postponement by 16.9% and illness of the child at the due date by 14.6%. By category, reasons related to lack of information accounted for 36.2% (95% CI 26.4 to 46.7) of all reasons cited, obstacles for 32.3% (21.3 to 44.5) and lack of motivation for 28.0% (19.0 to 37.9).

Table 2. Pooled proportion of reasons for partial immunization and non-immunization

Reason	Studies, n	Pooled proportion, % (95% CI)	I ² , %	Egger's test p
Lack of information (share of all reasons)	8	36.2 (26.4 to 46.7)	95.6	0.28
Unaware of need for immunization	9	39.0 (20.9 to 58.8)	98.5	0.26
Unaware of schedule / need to return for next dose	5	18.0 (12.3 to 24.6)	74.9	0.61

Reason	Studies, n	Pooled proportion, % (95% CI)	I ² , %	Egger's test p
Wrong ideas about contraindications	5	6.8 (2.7 to 12.2)	82.3	0.84
Lack of motivation (share of all reasons)	8	28.0 (19.0 to 37.9)	95.5	0.80
Fear of side effects	9	20.6 (10.0 to 33.7)	97.1	0.44
No faith in immunization / rumours	6	12.2 (3.1 to 25.9)	97.8	0.16
Postponed until another time	5	16.9 (5.2 to 33.2)	97.2	0.97
Obstacles (share of all reasons)	8	32.3 (21.3 to 44.5)	96.8	0.44
Child ill at the due date	8	14.6 (8.5 to 22.0)	89.1	0.09
Mother busy / no one to take the child	4	19.0 (7.7 to 33.6)	92.1	0.58
Place or time of session inconvenient or unknown	8	22.3 (6.7 to 43.5)	98.9	0.10
Vaccinator or vaccine absent	4	2.7 (0.0 to 9.2)	96.6	0.04
Travel or migration	5	20.1 (8.3 to 35.3)	98.1	0.63
Family problems, including illness of mother	4	7.1 (2.0 to 14.8)	91.6	0.71

Random-effects model with Freeman-Tukey double arcsine transformation. Rows for single reasons give the proportion of partially immunized or unimmunized children citing that reason. Category rows give the share of all reasons cited that fell into the category, from the eight studies that tabulated the full list of reasons. Respondents could give more than one reason in some studies. CI: confidence interval.

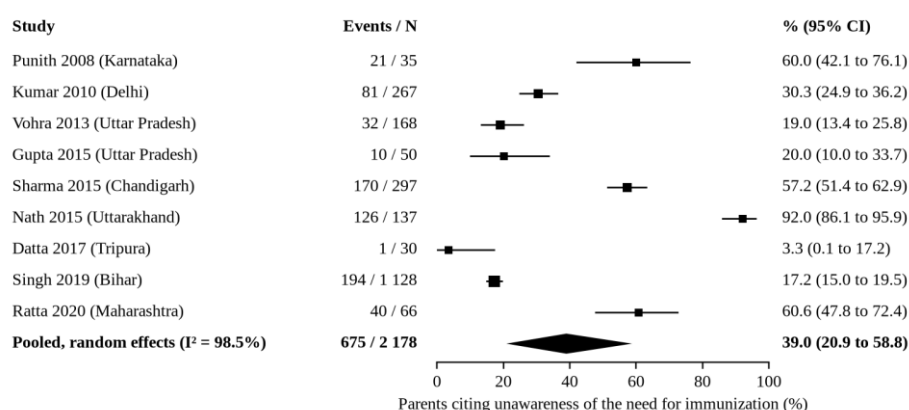


Figure 2. Forest plot of the proportion of parents citing unawareness of the need for immunization

Squares show individual study estimates with exact 95% confidence intervals, sized by the number of children; the diamond shows the pooled random-effects estimate.

Subgroup and sensitivity analyses

Lack of information was the leading category in urban (50.7%) and hospital-based (43.9%) studies, whereas obstacles were more frequent in the urban slum study (46.2%) and in rural studies (43.9%) (Table 3). None of the differences between settings was statistically significant. By region, unawareness of the need for immunization was cited by 44.5% of parents in studies from north India and 10.6% in studies from east and north-east India. Fear of side effects was reported by 19.5% of parents in community-based studies and 28.8% in the one hospital-based study that reported it. Exclusion of the study at high risk of bias did not materially change the pooled estimates; the largest change was for an inconvenient or unknown place or time of the session, from 22.3% to 24.6%. Exclusion of one study at a time gave estimates for unawareness of the need for immunization between 31.6% and 44.4%.

Table 3. Subgroup analysis by setting

Category of reason	Urban, % (95% CI)	Rural, % (95% CI)	Urban slum, % (95% CI)	Hospital-based, % (95% CI)	p for difference
Lack of information	50.7 (18.0 to 83.0)	23.8 (11.8 to 38.3)	35.6 (32.1 to 39.2)	43.9 (32.0 to 56.2)	0.17

Category of reason	Urban, % (95% CI)	Rural, % (95% CI)	Urban slum, % (95% CI)	Hospital-based, % (95% CI)	p for difference
Lack of motivation	28.9 (19.5 to 39.3)	35.5 (30.3 to 40.8)	18.2 (15.5 to 21.2)	20.3 (0.3 to 58.0)	0.33
Obstacles	16.9 (0.0 to 60.0)	43.9 (40.8 to 47.0)	46.2 (42.6 to 49.9)	31.8 (1.1 to 78.4)	0.60

Share of all reasons cited that fell into each category, from the eight studies that tabulated the full list of reasons: urban, Punith 2008 and Gupta 2015; rural, Datta 2017 and Singh 2019; urban slum, Sharma 2015 (single study, exact 95% CI); hospital-based, Kumar 2010 and Ratta 2020. Vohra 2013, which combined urban and rural areas, was not included in this analysis.

Publication bias

Egger's test was not significant for the most common reason, unawareness of the need for immunization ($p = 0.26$), or for the three categories. It was significant only for absence of the vaccinator or vaccine ($p = 0.04$), an estimate based on four studies.

DISCUSSION

This systematic review and meta-analysis found that unawareness of the need for immunization was the leading reason for partial immunization and non-immunization of children in India, reported by 39.0% of parents, followed by practical obstacles such as an inconvenient or unknown session place or time, travel or migration and lack of time, and by fear of side effects. Lack of information accounted for about a third of all reasons cited. To our knowledge, this is the first pooled estimate of these reasons in India.

Our findings are consistent with international and national evidence. In the review by Rainey and colleagues, parental knowledge and attitudes and the immunization system were the most frequently cited groups of reasons in low-income and middle-income countries [3], and a review of grey literature also highlighted lack of information and fear of side effects [4]. Analysis of Indian national survey data found that lack of knowledge was an important reason for non-vaccination [7]. Individual Indian studies from Delhi, Lucknow and other cities reported reasons related to lack of information, lack of motivation and obstacles in varying proportions [9,10,21], and a hospital-based study described similar reasons among children admitted to a tertiary-care hospital [8].

Fear of side effects and lack of faith in immunization reflect vaccine hesitancy, which is driven by complacency, convenience and confidence [5]. Rumours and previous adverse events after vaccination can spread quickly in communities, and health workers need to explain expected minor reactions and how to manage them. The belief that a sick child should not be vaccinated leads to missed opportunities that can be corrected by educating both parents and health workers about true contraindications.

Practical obstacles are likely to weigh most on working mothers, migrants and families living in urban slums, who have lower vaccination uptake [22,23,28]. Both demand-side and supply-side factors, such as inconvenient session timings, absence of the vaccinator and lack of vaccines at the session site, contribute to non-vaccination and dropout [29]. Socio-demographic factors such as maternal education and health literacy, birth order and place of delivery have been associated with incomplete vaccination in Indian studies [21,27,30], in line with an international review [6]. Inequalities by wealth and region [2] suggest that interventions should target disadvantaged groups. The high heterogeneity between studies reflects differences in setting, sampling, period and the way reasons were recorded.

These findings have implications for the Universal Immunization Programme. Since lack of information was the leading reason, interpersonal communication by ASHA and anganwadi workers, reminders before each due date and clear information on the next visit at every contact are likely to be effective. Fear of side effects can be addressed by counselling at each session and prompt management of adverse events. Flexible session timings, fixed-day sessions known to the community, tracking of migrant children and the use of every health contact to vaccinate eligible children would reduce practical obstacles [1].

Strengths and limitations

The strengths of this review are a predefined search, formal quality assessment and the use of a standard classification of reasons. It has limitations. Only PubMed-indexed studies published in English were included, and grey literature was not searched. Study selection and data extraction were done by a single reviewer, and counts for six studies were calculated from reported percentages. Not every study reported every reason, so the number of studies differs between reasons. Reasons were self-reported by parents and may be affected by recall and social desirability bias. Studies differed in setting, sampling and the way reasons were recorded, and some allowed multiple reasons, which led to high heterogeneity and

limits the comparability of pooled proportions. Subgroups by setting contained one or two studies each. Hospital-based studies may not represent the community.

CONCLUSION

Lack of information about vaccination and its schedule was the leading reason for partial immunization and non-immunization of children in India, followed by practical obstacles and fear of side effects. Improving communication between health workers and parents, tracking every child through due lists, correcting misconceptions about contraindications and making immunization sessions more accessible are key to reaching the children who are left behind.

DECLARATIONS

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Author contribution: Dr. Ramesh Dharma Nikam conceived the review, performed the literature search, study selection, data extraction, quality assessment and analysis, wrote the manuscript and approved the final version.

Data availability: All data analysed in this review are from published studies cited in the article.

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