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Original Research Article

Impact of Mobile Health Education on Immunization Coverage in Under-Five Children: An Original Research Study

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Abstract

Background: Under-five morbidity and mortality is preventable due to incomplete and delayed immunization. Mobile health education has the potential to enhance caregiver awareness, attendance at appointments, and timely vaccine uptake. The aim of this study was to assess the effect of a structured mobile health education intervention on immunization coverage among under-five children.

Methods: A quasi-experimental community-based study was carried out with 360 caregiver-child pairs in two similar community areas in rural primary health centres. The intervention group was provided with weekly mobile health education messages and vaccine reminders for six months, and the comparison group was provided with routine services. Caregiver knowledge and child immunization status (by card or health record) were documented during baseline and endline assessments.

Results: Baseline immunization coverage was comparable between the intervention and comparison groups, with 62.8% vs 61.1% of children being fully immunized, respectively ($p = 0.741$). The intervention group had a higher rate of coverage at 6 months (86.1% vs. 68.3%, $p < 0.001$). Mean caregiver knowledge score improved from 12.4 ± 3.1 to 18.7 ± 2.6 in the intervention group and from 12.1 ± 3.4 to 13.6 ± 3.2 in the comparison group ($p < 0.001$). The intervention group saw a significant increase in timely vaccine uptake from 54.4% to 79.4%. At endline, mobile health exposure continued to be independently associated with full immunization (AOR 3.42, 95% CI 2.02-5.79).

Conclusion: Mobile health education had a significant effect on the knowledge, full immunization coverage, and timeliness of under-five children. Combining localised mobile reminders with the delivery of routine immunisation services can reinforce public health services.

Keywords: mobile health; immunization coverage; under-five children; vaccine reminder; health education; routine immunization; caregivers.

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Introduction

Vaccination is one of the most powerful public health tools to prevent child morbidity, mortality, disability and inequity [1-3]. Although significant strides have been made, millions of children are not fully immunized or receive their shots on time, especially in low- and middle-income countries and in rural areas that are not well-served [4,5].

Failure to attend immunisation appointments, misconceptions about immunisation, migration, poor reminder systems, poor access, and poor communication between health workers and families are all potential causes of immunisation gaps [6]. Mobile phone access has grown fast even in rural areas, providing opportunities for low-cost health communication. Short message service reminders, voice calls, and app alerts have been found to be effective mobile health interventions for enhancing maternal and child health behaviours [7-12]. Reminders can be used to remind people that they are forgetful, the importance of vaccines, and to prompt people to attend immunization outreach sessions. But effectiveness relies on the language of the message, the frequency of the message, cultural acceptability, caregiver literacy, and the integration of the message into routine health services.

Mobile reminders have been shown to enhance immunization coverage and timeliness in previous

trials and reviews, with mixed findings depending on the context [7-9,13-15]. In many rural areas of India, the caregivers may have basic phones instead of smartphones, and health education should be brief, easily comprehended and connected to the existing health-worker networks. Pragmatic community-based interventions are therefore crucial for informing the planning of scalable strategies.

The present study aimed to assess the effect of a structured mobile health education intervention on under-five immunization coverage. It measured the difference in the knowledge of caregivers, completion of full age-appropriate immunizations, and timeliness of immunizations between intervention and comparison areas at six months.

Materials and Methods

The study was carried out in two similar rural PHC areas, using a quasi-experimental design. To minimize contamination, one area was designated as the intervention group and the other as the comparison group. The study population comprised caregivers of children aged 0-59 months in selected villages who had lived there for at least six months.

Children who had not been vaccinated for any reason (including contraindications) after repeated attempts at verification of immunization status were not included.

The sample size was determined to be able to detect a difference of 15% between groups in full immunization coverage with 80% power, 95% confidence, and 10% allowance for loss to follow-up. There were 360 caregiver-child pairs, 180 in each group. Systematic random sampling was done from the updated lists of anganwadi and health-workers to select households. Baseline data consisted of caregiver education, socio-economic status, distance from immunization site, phone ownership, immunization card availability, and knowledge about vaccine-preventable diseases.

The intervention was a 6-month series of weekly mobile health education messages. SMS and voice messages in the local language were used. Vaccine benefits, awareness of vaccine schedule, common minor side effects, danger signs to seek care, importance of maintaining immunization cards, and reminders prior to village health and nutrition days. Voice messages were sent to caregivers who were not text literate. Accredited social health activists strengthened messages through regular home visits. The comparison group received routine immunization services, but not extra mobile education.

The main outcome was full age-appropriate immunization coverage (6 months) confirmed by immunization card, Mother and Child Protection card or health-centre record. Secondary outcomes were caregiver knowledge score, timely vaccine uptake, missed session frequency and card retention. Paired and independent comparisons were used to analyse data. Coverage change was calculated using difference-in-differences. Predictors of full immunization at endline were identified using logistic regression. A p value < 0.05 was deemed to be statistically significant.

Results

A total of 360 caregiver-child pairs completed the study. There were no significant differences between groups in baseline characteristics. The majority of the caregivers were mothers (86.7%) and 71.4% had a personal or shared mobile phone. At baseline, 78.9% of the intervention group had an immunization card available compared to 77.2% of the comparison group. The immunization coverage rates were comparable between the intervention and comparison groups at baseline (62.8% vs 61.1%, $p = 0.741$). At 6 months, the intervention group had 86.1% coverage, while the comparison group had 68.3% ($p < 0.001$). The absolute difference was 23.3 percentage points in the intervention group, and 7.2 percentage points in the comparison group, yielding a difference-in-differences effect of 16.1 percentage points.

The intervention group showed a significant increase in knowledge, from 12.4 ± 3.1 to 18.7 ± 2.6, while the comparison group increased from 12.1 ± 3.4 to 13.6 ± 3.2. Timely uptake of vaccines was higher in the intervention group (79.4% compared to 54.4%) than in the comparison group (59.4% compared to 53.3%). Logistic regression revealed that mobile health exposure, maternal education, having an immunization card, and distance of less than 3 km from the session site were independently associated with full immunization at endline. (Table -3)

Table 1: Baseline characteristics of study participants

Characteristic	Intervention (n = 180)	Comparison (n = 180)	p value
Mean child age (months)	24.8 ± 14.6	25.3 ± 15.1	0.748
Mother as respondent	157 (87.2%)	155 (86.1%)	0.762
Maternal education ≥ secondary	102 (56.7%)	98 (54.4%)	0.669
Distance <3 km from session site	128 (71.1%)	125 (69.4%)	0.733
Immunization card available	142 (78.9%)	139 (77.2%)	0.703
Full immunization at baseline	113 (62.8%)	110 (61.1%)	0.741

Table 2: Effect of mobile health education on immunization outcomes

Outcome	Intervention baseline	Intervention endline	Comparison baseline	Comparison endline	p value at endline
Full age-appropriate immunization	113 (62.8%)	155 (86.1%)	110 (61.1%)	123 (68.3%)	<0.001
Timely vaccine uptake	98 (54.4%)	143 (79.4%)	96 (53.3%)	107 (59.4%)	<0.001
Missed session in previous 3 months	51 (28.3%)	19 (10.6%)	54 (30.0%)	42 (23.3%)	0.002
Immunization card retention	142 (78.9%)	164 (91.1%)	139 (77.2%)	145 (80.6%)	0.006
Knowledge score	12.4 ± 3.1	18.7 ± 2.6	12.1 ± 3.4	13.6 ± 3.2	<0.001

Table 3: Predictors of full age-appropriate immunization at endline

Predictor	AOR	95% CI	p value
Mobile health intervention exposure	3.42	2.02-5.79	<0.001
Maternal education ≥ secondary	1.89	1.12-3.18	0.017
Immunization card available	2.47	1.35-4.51	0.003
Distance <3 km from session site	1.76	1.02-3.04	0.041
Higher caregiver knowledge score	1.18 per point	1.09-1.28	<0.001

Discussion

This study showed that mobile health education using a structured approach was effective in increasing immunization coverage and timeliness among under-five children. The intervention group had a greater gain in full age-appropriate immunization than the comparison group, demonstrating the benefit of multiple, low cost reminders delivered within routine services. The results are in line with trials and reviews that have demonstrated the effectiveness of mobile reminders for increasing vaccine uptake, especially when the reminders are associated with scheduled vaccination visits [7-9,13-15].

The change in the knowledge of the caregivers was significant. The importance of knowledge gain is that missed vaccination is not solely due to access barriers, but is also a result of misconceptions about fever following vaccination, poor awareness of due dates, fear of adverse events, and underestimation of disease risk. Short, repeated messages in the local language can help to reinforce messages from frontline health workers and increase the likelihood of caregivers attending outreach sessions.

There was a significant improvement in timely uptake of vaccines in the intervention area. The clinical significance of timeliness is that if the coverage seems adequate, the length of time that children remain susceptible to vaccine-preventable diseases is extended if they are not vaccinated in time [4]. Reminder messages prior to the village health and nutrition days are likely to have decreased forgetfulness and enhanced planning. Voice messages were helpful for caregivers who were not very literate, indicating that mobile health interventions should not be based entirely on text in rural settings. After adjusting for maternal education, distance and availability of the card, mobile health exposure was still independently associated with full immunization. This finding suggests that the intervention added to the socio-demographic advantage. Health worker reinforcement, however, enhanced the effect. Mobile messages should therefore be used in conjunction with, and not as a replacement for, frontline workers. Linking with routine immunization microplans and digital due-list tracking can enhance sustainability.

There are some limitations to the study. It was quasi-experimental, not individually randomized, and there is a possibility of residual confounding. The follow-up period was six months, and therefore long-term retention of behaviour was not measured. Some immunization status verification depended on records that may have minor documentation errors. However, the study employed similar areas, card or record verification, and intervention elements appropriate for public health implementation.

Conclusion

Mobile health education had a significant effect on increasing the knowledge of caregivers, full age-appropriate immunization coverage, and timely uptake of vaccines among under-five children. Frontline health workers can deliver locally tailored SMS and voice reminders as part of routine immunization programmes to minimise missed opportunities and enhance child health outcomes.

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