

Educational intervention to increase childhood immunization uptake in rural Pakistan

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Abstract

Background: Childhood immunization uptake in rural Pakistan is low, due mostly to myths and misunderstanding regarding its importance.

Aim: To determine the effect of an educational intervention on childhood immunization uptake for infants aged ≤ 16 weeks in 5 rural districts of Sindh Province, Pakistan.

Methods: This quasi-experimental study was conducted from September 2023 to January 2024 among parents of 1200 children aged 3–5 weeks enrolled in intervention and control villages. Education campaigns that included face-to-face sessions and distribution of print and video information materials were conducted with families of children in the intervention group. Multivariable Cox regression was used to assess the effect of the intervention on immunization uptake.

Results: After the initial immunization at birth, 19.8% of infants in the intervention villages and 24.8% in the control villages had not completed their Expanded Programme on Immunization vaccinations at age 16 weeks. Children in the intervention villages were significantly more likely to have been completely vaccinated at 14 weeks. Age, gender, household monthly income, place of birth, maternal education, and distance from immunization facility were not significantly associated with uptake.

Conclusion: Educational interventions, including use of social media, can help increase childhood immunization uptake in rural areas of developing countries like Pakistan.

Keywords: immunization, health education, vaccination uptake, infant health, awareness, education, EPI, Pakistan

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Introduction

The global annual under-5 mortality has decreased from 12.8 million to 5 million in the last 3 decades (1). Vaccination is reported to be the most cost-effective public health intervention for reducing child mortality and it prevents around 4 million deaths annually (2). Vaccination coverage throughout the world has improved remarkably and is estimated at an average of 81%; however, almost all nonvaccinated children live in low and low-to-middle income countries (3). Vaccination coverage in Pakistan varies from 66% to 76.5% according to latest national surveys (4,5). Coverage in Sindh Province and in rural areas is lower still, ranging from 49% to 64.7% (6). Myths and poor understanding regarding the importance of vaccination are the most important barriers to vaccine uptake in Pakistan (7–9). A mixed methods study in Karachi in 2021 reported that insufficient or incomplete information about vaccines caused discontinuation of vaccination and failure to complete the doses (10). A study in 2023 highlighted anxiety about adverse effects of vaccines and negative sociocultural beliefs as important reasons for nonvaccination of children (11). Health education interventions for behavioural change,

including face-to-face and electronic communications, are important for improving uptake of routine childhood immunization. This is done mainly through creating awareness and dispelling misconceptions regarding vaccines (12,13). Focused and innovative efforts are required to increase the demand for vaccines and dispel the associated myths. With widespread access to mobile phones, the use of social media for educational interventions as well as its study is increasing (14).

This study aimed to determine the effect of educational intervention on uptake of routine immunization among children aged 3–5 weeks in 5 rural districts of Sindh Province, Pakistan.

Methods

Study design

This study was a collaborative project between APPNA Institute of Public Health, Jinnah Sind Medical University and the non-government organization, organization Thardeep Rural Development Program. It was a quasi-experimental study with intervention and control groups. Assignment of villages as intervention

and control was not randomized due to the higher cost of covering randomized villages.

Study setting

Sindh has the second largest population and third largest area among the provinces of Pakistan (15). However, childhood immunization coverage in the rural population of the province is lower than in the 2 larger provinces (6). This study was conducted in the rural areas of 5 Sindh districts, Dadu, Tharparkar, Matiari, Jamshoro and Umerkot. From each district, 30 villages were randomly selected and divided into 75 intervention and 75 control villages. Five heads of local support organizations were trained from each district to conduct the campaigns in their respective areas. The trained heads randomized the villages under their jurisdiction into 15 intervention and 15 control villages in each of the 5 districts. The study was conducted from September 2023 to January 2024.

Study procedure

The intervention comprised an educational campaign to create awareness on the importance of childhood immunization. The content included information on the importance of childhood immunization and its schedule, the diseases against which childhood immunization protects, and dispelling the common myths surrounding vaccination. The campaign materials were translated into Sindhi and disseminated through educational sessions, house-to-house distribution of educational pamphlets and sharing of educational video through social media. The video was sent via WhatsApp to parents or caretakers of children aged 6, 10 and 14 weeks to remind them of their immunization schedule.

Sample size

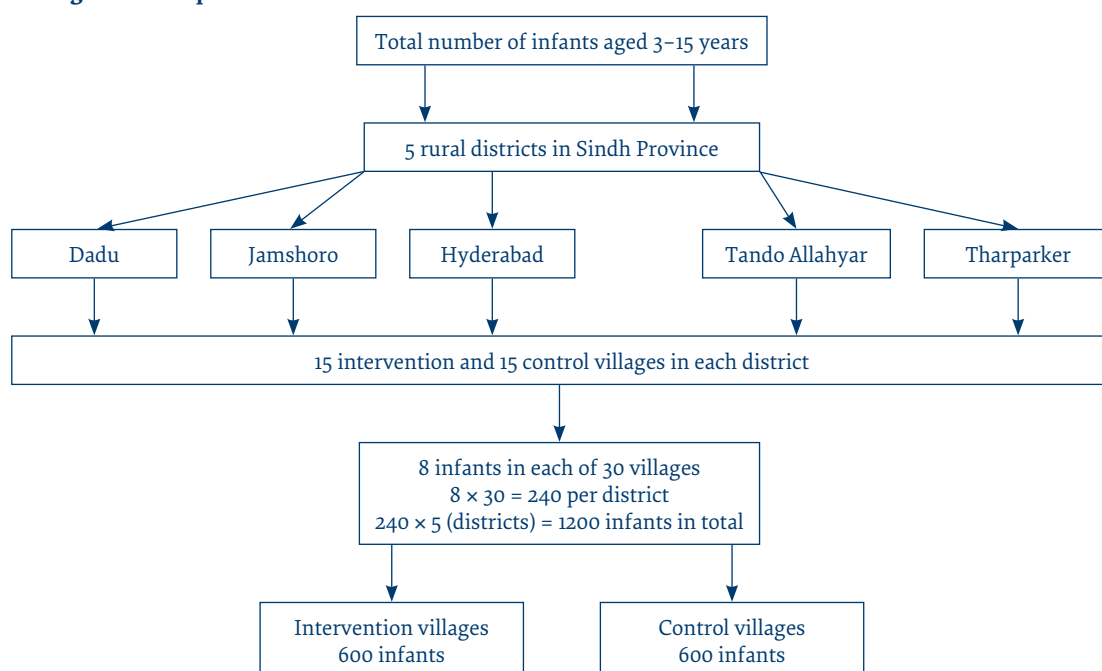
The sample size was estimated using the WHO sample size calculator for measuring immunization coverage (16). At an expected coverage of full immunization in the control districts of 60% and 80% in intervention districts, 95% confidence interval (CI), power of 80%, design effect of 1.3, and nonresponse inflation of 10%, the sample size was 592 children in each arm (1184 overall).

Local support organizers working for Thardeep Rural Development Program in rural areas of the selected districts were hired as project implementers and assessors. They were well trained and had experience in conducting community education sessions. From every district, 5 local support organizers were trained on the implementation plan and its assessment. The trained local support organizers were instructed to implement the intervention in 15 villages randomly selected by themselves. They were also asked to select 15 villages in which the intervention was not implemented (control villages). From each of the 30 villages, They were directed to enrol 8 newborn children aged 3–5 weeks (before the first dose of the pentavalent pneumococcal vaccine was due). All these children were followed for 3 months until they reached age 15 weeks (1 week after the third dose of pentavalent pneumococcal vaccine was due). The recruitment and follow-up processes are summarized in Figure 1.

Data collection

Educational campaign was implemented in the 15 intervention villages in each district (75 villages overall) from 15 to 30 September 2023. Simultaneously, 240 children aged 3–5 weeks were enrolled from 15 intervention villages and 15 control villages in each district (1200 children overall). All enrolled children were

Figure 1 Flow diagram of sample selection



followed for 3 months, after which their immunization status was reassessed. Immunization status was categorized as nonvaccinated, partially vaccinated (received any 1 dose up to 14 weeks) and completely vaccinated (received all doses up to 16 weeks).

Statistical analysis

Characteristics and differences in immunization status of enrolled children in the intervention and control villages were compared using the χ^2 test. Frequencies and percentages of reasons for nonvaccination or partial vaccination were calculated separately for the intervention and control groups. Multivariable Cox regression was used to analyse the effect of intervention and other covariates on complete vaccination, including age, sex, household monthly income, distance from immunization facility, education status of parents, place of birth and district of residence. Unadjusted and adjusted relative risks with 95% CI were calculated as measures of association of different covariates with complete immunization. The data were analysed using SPSS version 22.

Ethics considerations

Ethics clearance was obtained from the Independent Review Board of Jinnah Sindh Medical University (JSMU/IRB/2023/814). The project implementors were hired after an agreement with their parent organization, Thardeep Rural Development Program. Informed consent was obtained from the participants after verbally explaining their rights because most of them were not sufficiently educated. Privacy and confidentiality of the study participants was ensured by coding the questionnaires and limiting access to the data.

Results

We enrolled 600 children each from intervention and control villages. Final analysis was performed on 572

children from intervention villages and 578 from control villages because of missing data and loss to follow-up.

In the intervention villages, 74% of the children were completely vaccinated and 26% were partially or unvaccinated. In the control villages, 63.0% were completely vaccinated and 36.9% were partially or unvaccinated.

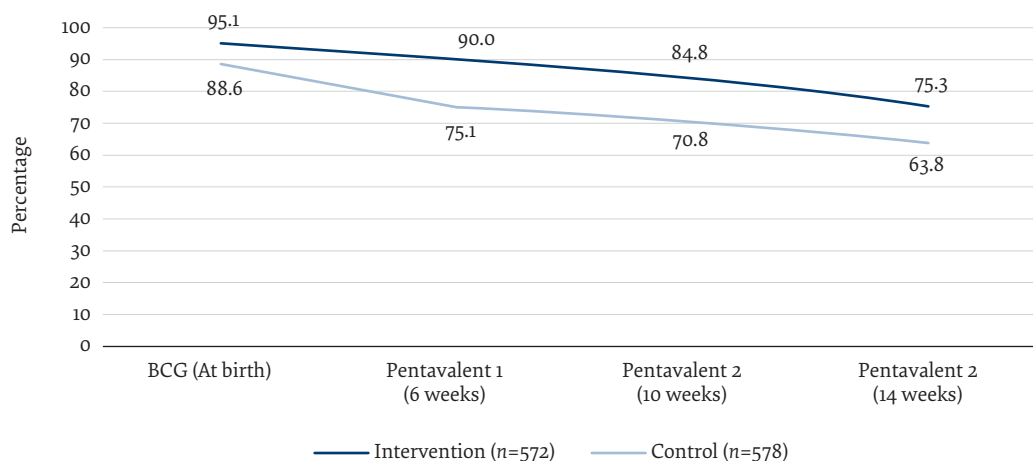
Figure 2 presents the trends in vaccination status of children at birth and age 6, 10 and 14 weeks in the intervention and control villages. In the intervention villages, there was a 19.8% decrease in the number of children not completing vaccination compared with 24.8% in control villages.

Figure 3 presents the reasons for nonvaccination and partial vaccination in the intervention and control villages. In the intervention villages, common reasons included fear or experience of side effects (31.5%), vaccination facility being too far (22.2%) and perception of vaccines being ineffective (17.4%). In the control villages, common reasons included the perception that vaccines are harmful (28.2%), lack of knowledge about importance of vaccination (22.5%) and the perception that vaccines are not necessary (15%).

Table 1 compares the sociodemographic characteristics of children in the intervention with the control villages. No significant difference was observed with regard to sex, household monthly income, parental education, place of birth of child and distance of home from immunization facility.

Table 2 presents the unadjusted and adjusted relationship between intervention and different sociodemographic factors with likelihood of being completely vaccinated. Children in the intervention villages were significantly more likely to be completely vaccinated (adjusted relative risk = 1.18, a CI = 1.02–1.36). Giving birth at a private facility and receiving maternal education showed a significant positive relationship with completing immunization in the univariate model,

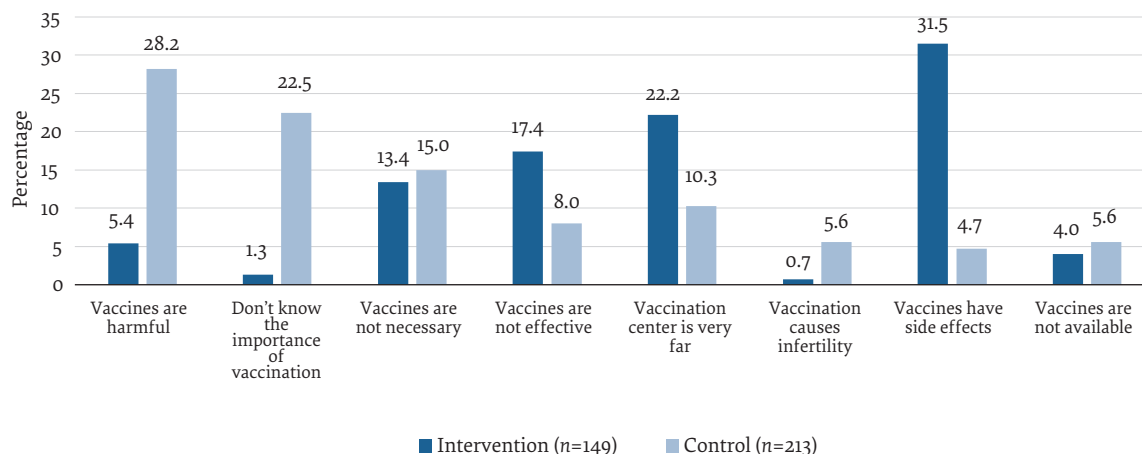
Figure 2 Trends in vaccination status of children at birth, 6, 10 and 14 weeks of age in intervention and control villages



BCG = Bacillus-Calmette-Guerin vaccine given at birth for tuberculosis

Pentavalent is a combination vaccination given three times at 6,10 and 14 weeks after birth that protects against five pathogens

Figure 3 Reasons for non-vaccination and partial vaccination in the intervention and control villages



but the relationship became nonsignificant in the multivariable model. Similarly, distance of immunization facility > 5 km was significantly negatively associated with the outcome in the univariate model but after adjustment it became nonsignificant. Age, sex, paternal education and socioeconomic status had no significant relationship with being completely vaccinated.

Discussion

This study assessed the effect on vaccine uptake of educational intervention using face-to-face counselling sessions, distribution of infographics and sharing an informative video through social media. The results showed a positive difference of 10.9% in attaining complete immunization in the intervention compared with control

villages. Similar effects of educational interventions to improve immunization coverage have been reported in the literature. According to a systematic review and meta-analysis, the effect of educational interventions on immunization coverage in developing countries ranges from 14% to 62% (17). Another systemic review and meta-analysis in India in 2022 was closer to our results, in which community development activities such as health education, were helpful in improving immunization rates by 6–23% (18). International studies have shown that multicomponent educational interventions, including face-to-face sessions and multimedia platforms, are effective in reducing vaccine hesitancy (19–21).

Another important finding of our study was a 19.8% decrease in completion of the immunization schedule after acquiring the first vaccine dose at birth in the

Table 1 Comparison of sociodemographic characteristics of the children in the intervention and control villages

Characteristics	Intervention (n = 572) % (No.)	Control (n = 578) % (No.)	P
Age at enrolment, days	Mean = 28.13, SD = 5.01	Mean = 27.86, SD = 4.74	0.364
Gender of child			
Male	55.9 (320)	54.3 (314)	0.581
Female	44.1 (252)	45.7 (264)	
Place of birth of child			
Home	29.5 (169)	27.0 (156)	0.391
Private facility	16.8 (96)	19.6 (113)	
Government facility	53.7 (307)	53.5 (309)	
Maternal education			
No formal education	82.5 (472)	81.5 (471)	0.650
Formally educated	17.5 (100)	18.5 (107)	
Paternal education			
No formal education	54.2 (310)	51.6 (298)	0.391
School education	37.2 (213)	41.0 (237)	
College education and above	8.6 (49)	7.4 (43)	
Household monthly income			
PKR 11 000–19 000	69.1 (395)	68.2 (394)	0.883
PKR 20 000–29 000	23.1 (132)	23.2 (134)	
PKR ≥ 30 000	7.9 (45)	8.7 (50)	
Distance from vaccination facility			
< 5 km	60.5 (346)	61.6 (356)	0.702
≥ 5 km	39.5 (226)	38.4 (222)	

Table 2 Predictors of complete vaccination among children (n = 1150)

	Complete vaccination		P
	Unadjusted RR (95% CI)	Adjusted RR (95% CI)	
Area control (n=578)	Reference	Reference	
Intervention (n=572)	1.17 (1.01–1.34)*	1.18 (1.02–1.36)*	0.020
Age (days)	0.99 (0.98–1.01)	0.99 (0.81–1.008)	0.346
Gender			
Male (n=634)	Reference	Reference	
Female (n=516)	0.94 (0.82–1.09)	0.93 (0.60–1.07)	0.350
Place of delivery			
Home (n=325)	Reference	Reference	
Private facility (n=209)	1.27 (1.03–1.55) [†]	1.14 (0.90–1.43)	0.270
Government facility (n=616)	1.05 (0.88–1.24)	1.07 (0.89–1.28)	0.445
Maternal education			
No formal education (n=943)	Reference	Reference	
Some education (n=207)	1.21 (1.02–1.44) [†]	1.16 (0.95–1.41)	0.126
Paternal education			
No formal education (n=608)	Reference	Reference	
School education (n=450)	1.03 (0.89–1.20)	0.98 (0.83–1.16)	0.884
College education (n=92)	1.01 (0.77–1.32)	0.90 (0.62–1.31)	0.595
Socioeconomic status			
PKR 11 000–19 000 (n=789)	Reference	Reference	
PKR 20 000–29 000 (n=266)	1.05 (0.89–1.24)	1.01 (0.83–1.20)	0.995
PKR ≥30 000 (n=95)	1.07 (0.84–1.38)	1.02 (0.72–1.46)	0.872
District			
Tharparkar (n=227)	Reference	Reference	
Umerkot (n=226)	1.08 (0.86–1.35)	1.07 (0.85–1.35)	0.547
Jamshoro (n=240)	1.32 (1.06–1.64) [†]	1.20 (0.94–1.52)	0.128
Matiari (217)	1.09 (0.86–1.37)	1.07 (0.84–1.36)	0.547
Dadu (240)	0.93 (0.74–1.18)	0.87 (0.68–1.12)	0.303
Distance from vaccination facility			
< 5 km (n=702)	Reference	Reference	
5 km (n=448)	0.86 (0.74–0.99) [†]	0.87 (0.75–1.01)	0.087

*P < 0.05; **P < 0.01; ***P < 0.001. CI = confidence interval; RR = risk ratio.

intervention villages compared with a 24.8% decrease in the control villages. Children in the intervention villages were significantly more likely to be completely vaccinated. This observation is in line with a randomized controlled trial conducted in Karachi in 2018, which concluded that health education measures, such as sending text messages in local languages, resulted in a 5–10% increase in complete immunization coverage in the intervention compared with control groups (22). This shows that health education measures, including the use of social media, enhance the chances of completing immunization.

The findings of this study show that negative perceptions related to vaccines in the intervention villages were lower than in the control villages. The primary reasons for nonvaccination in the intervention villages were difficulty in reaching immunization centres and fear of side effects, whereas misperceptions such as vaccines being harmful for children and lack of awareness about the benefits of immunization were higher in the control villages. These findings corroborate several studies citing lack of awareness about the need for immunization, its schedule, concerns about safety, the immunization centre being far from the place of residence and other systemic issues related to poor

service provision (9, 23, 24). This suggests that along with educational interventions, efforts should be directed at enhancing the reach of vaccines and their safe administration to enhance coverage.

Maternal education was nonsignificant in the multivariable model; however, it was positively associated with completing immunization in the unadjusted model, which is consistent with previous studies in developing countries (25–28). The positive association of Jamshoro District with completing immunization indicates a well-developed healthcare system with a higher number and accessibility of healthcare facilities in the area. Similarly, distance of immunization facility > 5 km had a negative association with completing immunization which is consistent with the literature (5, 29).

Our study showed no significant relationship between gender and completing immunization, which indicated no gender discrimination. There was also no direct association with socioeconomic status; however, socioeconomic status was a positive predictor of immunization in previous studies (5, 26). The lack of association with sociodemographic characteristics in this study may be because the study was conducted in poor rural areas with low income variations.

The strengths of this study were that the educational campaign used conventional face-to-face sessions and distribution of information materials but also used social media platforms to enhance the effectiveness of the messages being conveyed. Reminders about immunization were sent in local language during the campaign and the immunization status was verified with an immunization card. The intervention was implemented by local support organizers who had good rapport with the communities.

This study also had some limitations. Selection of clusters was not randomized because of financial restrictions. Similarly, the scope of the project was limited to 6 months; therefore, the follow-up period was only 3 months and uptake of measles and rubella vaccine scheduled at 9 and 15 months could not be

assessed. This may have resulted in higher coverage of complete immunization. Insufficient funding meant that the control group could not be given the educational intervention later; however, the results were reported to the provincial directorate of the Expanded Programme of Immunization for further action.

Conclusion

Multicomponent educational measures can help in upscaling immunization uptake and coverage in rural areas. Other barriers to immunization related to distance and availability of vaccines should be managed effectively to achieve the desired optimum immunization coverage. This will ultimately contribute to lower infant and under-5 mortality rates.

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Conflict of interest: None declared.

Intervention éducative pour accroître le recours à la vaccination des nourrissons dans les zones rurales du Pakistan

Résumé

Contexte : Le recours à la vaccination des nourrissons est faible dans les zones rurales du Pakistan, principalement en raison des mythes et des malentendus concernant son importance.

Objectif : Déterminer l'effet d'une intervention éducative sur la vaccination des nourrissons âgés de 16 semaines ou moins dans cinq districts ruraux de la province du Sindh (Pakistan).

Méthodes : La présente étude quasi-expérimentale a été menée de septembre 2023 à janvier 2024 auprès des parents de 1200 enfants âgés de trois à cinq semaines inscrits dans des villages d'intervention et des villages témoins. Des campagnes d'éducation comprenant des séances en présentiel et la distribution de matériels d'information imprimés et vidéo ont été menées auprès des familles des enfants du groupe d'intervention. La régression multivariée de Cox a été utilisée pour évaluer l'effet de l'intervention sur le recours à la vaccination.

Résultats : Après la vaccination initiale à la naissance, 19,8 % des nourrissons dans les villages d'intervention et 24,8 % dans les villages témoins n'avaient pas achevé leurs vaccinations dans le cadre du Programme élargi de vaccination à l'âge de 16 semaines. Les enfants des villages d'intervention étaient beaucoup plus susceptibles d'avoir été complètement vaccinés à 14 semaines. L'âge, le sexe, le revenu mensuel du ménage, le lieu de naissance, l'éducation de la mère et la distance par rapport au centre de vaccination n'étaient pas significativement associés au recours à la vaccination.

Conclusion : Les interventions éducatives, y compris l'utilisation des médias sociaux, peuvent contribuer à accroître le recours à la vaccination dans les zones rurales des pays en développement tels le Pakistan.

التدخلات التثقيفية لزيادة معدل الإقبال على تطعيم الرضع في الريف الباكستاني

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الخلاصة

الخلفية: يُعد الإقبال على التطعيم في المناطق الريفية في باكستان منخفضاً، ويرجع ذلك في معظمه إلى الخرافات وعدم إدراك أهميته.

الهدف: تحديد تأثير تدخل تعليمي على التطعيم لدى الرضع في خمس دوائر ريفية في مقاطعة سندھ خلال 16 أسبوعاً وأولاً في سن 16 أسبوعاً. تم استخدام تدخل تعليمي متعدد الوسائط في المناطق الريفية. تم استخدام تحليل الانحدار اللوجستي لتقييم تأثير التدخل على التطعيم. لم تكن العمر، الجنس، الدخل الشهري للأسرة، مكان الميلاد، والتعليم الأم أو المسافة عن مركز التطعيم مرتبطة بشكل كبير بالوصول إلى التطعيم.

طرق البحث: أُجريت هذه الدراسة شبه التجريبية على آباء 1200 طفلٍ تتراوح أعمارهم بين 3 و5 أسابيع من المسجلين في قرى التدخل والضبط، في الفترة من سبتمبر/ أيلول 2023 إلى يناير/ كانون الثاني 2024. ونُظمت حملات تثقيفية شملت عقد جلسات وجهاً لوجه مع أسر الأطفال في مجموعة التدخل، وعرض مواد إعلامية مطبوعة ومرئية عليهم. واستُخدم انحدار كوكس المتعدد المتغيرات لتقييم أثر التدخل في معدل الإقبال على التطعيم.

النتائج: بعد التطعيم الأولي عند الولادة، لم يستكمل 19.8% من الرضع في قرى التدخل و24.8% في قرى الضبط تطعيماتهم في البرنامج الموسع للتمنيع عند عمر 16 أسبوعاً. وكانت احتمالية حصول الأطفال على تطعيماتهم كاملة عند عمر 14 أسبوعاً أكبر كثيراً في قرى التدخل. ولم يكن هناك ارتباط كبير بين العمر والنوع والدخل الشهري للأسرة ومكان الولادة ووعي الأمهات وبعُد مرفق التطعيم وبين الإقبال على التطعيمات.

الاستنتاجات: من الممكن أن تساعد التدخلات التثقيفية، بما في ذلك استخدام وسائل التواصل الاجتماعي، على زيادة الإقبال على التطعيم في المناطق الريفية في البلدان النامية، مثل باكستان.

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