SYSTEMATIC REVIEW

ENHANCED IMMUNIZATION COVERAGE THROUGH INTERVENTIONS FOR CHILDHOOD CLUSTER DISEASES IN DEVELOPING COUNTRIES

Sheh Mureed, Ratana Somronghtong, Ramesh Kumar*, Abdul Ghaffar, Robert S Chapman**

College of Public Health Sciences Chulalongkorn University Bangkok-Thailand, *Health System and Policy Department, Health Services Academy Islamabad, **Planning Department of Health, Government of Balochistan-Pakistan

Background: Globally immunisation has to be considered as a most effective and efficient public health intervention to reduce morbidity and mortality among children. Most of the children from developing countries are still not fully immunized due to multiple factors including lack of interventions, awareness, and financial constraints and due to limited resource. Conversely, this review has identified the effectiveness of interventions to increase the immunisation coverage among children of developing countries. **Methods:** Systematic review by using PRISMA statement ("preferred reporting items for systematic reviews and meta-analyses") has been conducted in English published articles on Pub Med, Scopus, Cochrane, Medline and ISI by searching keywords like immunizations, childhood vaccination and developing countries has been accessed. Only randomised controlled trial and quasi-experimental studies designs were included in the final analysis based on quality assessment by adopting the Down and Black checklist and finally pooled analysis was done by random effect model. This systematic review has been approved and registered by University of York. **Results:** A total of 16,570 published articles were accessed and finally 10 fulfilled our criteria that were analysed and interpreted. It demonstrated that the interventions has shown significantly increase vaccine coverage for childhood cluster diseases (OR 2.136 and p <0.05).Furthermore, it has been proved that an effect was more prominent for DTP (OR 2.397 and p<0.05) and measles (OR 2.628 and p<0.05), not as much for polio (OR 2.284 and p>0.05) and full vaccination schedule (OR 1.342 and p>0.05). **Conclusions:** Systematic review has concluded that the professional interventions are an effective while in improving the child immunisation coverage for cluster diseases in developing countries, major effect on DTP and measles.

Keywords: Professional interventions, immunizations, child vaccination, cluster diseases, developing countries and systematic review

J Ayub Med Coll Abbottabad 2015;27(1):223–7

INTRODUCTION

Immunisation through vaccines has proved to be the most effective public health initiative in reducing the child morbidity and mortality across the world. World Health Organization (WHO) introduced Expanded Program on Immunisation (EPI) in 1978 for 6 vaccine preventable diseases including tuberculosis, BCG (Bacille de Calmetteet Guérin), diphtheria, whooping cough, tetanus, polio, and measles. The global DPT3 (diphtheria, pertussis, tetanus) coverage among infants aged <12 months has been increased from 5–83% in 2012. However most of the developing countries are still lagging behind the optimal target coverage of more than 90%.[1]

Multiple factors are responsible for this low coverage including the weak health systems, isolated rural areas without easy access to health facilities, poor densely populated urban areas and informal settlements, displaced populations during conflicts and wars, lack of information and misconception on immunisation, religious misbelieves, and illiteracy has been reported.[2–4] Though there are multiple stakeholders including civil societies, non-governmental organizations, public sectors and partners are continuously struggling for betterment for immunization coverage in poor and middle income countries but still have not achieved the optimal targets. Main type of intervention for this review is professional interventions, which are mainly health promotion through health education; for example distribution of educational materials, educational meetings, and local consensus processes, and educational outreach visits, also reminders.[5] Studies have identified these interventions but none have highlighted the coverage on these 7 childhood cluster diseases (CCDs) which are polio, diphtheria, Pertussis, tetanus (DTP), measles, mumps and rubella (MMR).[6] According to the WHO vaccine schedule for DTP3 and polio are before the child first birthday, and MMR between 9–12 months of age.[7]

The purpose of this systematic review was to gather information on these strategies and to assess their effectiveness using pooled data analysis. This review should be seen as a complementary to existing reviews. Further it should be taken as a challenge to investigators in the field to ensure that the systematic reviews are used to guide future hypothesis, as well as planning and policy.

MATERIAL AND METHODS

A systematic review was conducted by including published studies on randomised controlled trials (RCT) and quasi-experimental (QEC) that met criteria as per EPOC taxonomy (organizational, professional, regulatory or financial interventions) from developing countries for child immunization.[5] The search keywords are mentioned in Table-1 which were accessed through PubMed, Medline Complete, Ovid SP (Medline only), SCOPUS, ISI web of science, Pro Quest, Cochrane trials, CINHAL, Psy-articles and science direct (Elsevier) from September 2013 to July 2014. Furthermore, information extracted from identified studies included type of antigen assessed and its coverage in studied population sample, and intervention content. Vaccination coverage is calculated as the percentage of persons in the target age group who received a vaccine dose by a given age.[1] Quality assessments of accessed studies were done by using a checklist adopted from a Down and Black which consisted 25 items and risk of publication bias was assessed statistically with Egger's regression test.[8] Data extraction was done by using a data extraction form, developed by consensus of the review team and measures like Odds Ratios (OR), Confidence Intervals (CI), Z-value and *p*-values on effectiveness and increasing immunisation coverage for CCDs. Analysis was done by using random effect model to assess effect of intervention using Comprehensive Meta-Analysis software.[9] This systematic review is reported using PRISMA statement ("preferred reporting items for systematic reviews and meta-analyses").[10] Additional information's regarding this review, were in advance registered at PROSPERO (international database of prospectively registered systematic reviews in health and social care). The protocol registration number for this systematic review is CRD42014006002. This is one of the parts from a larger review in progress.

RESULTS

During this systematic review, 16,570 papers were accessed initially and finally ten papers 6 RCTs[11–16] and 4 QEC[17–20] with professional type of interventions met our review criteria and were included (Figure-1). These studies had been conducted on children aged under-five years and their caretakers. Outcome assessed were immunisation coverage for CCDs from which 7 assessed DTP[11,14–19] 4 assessed polio[13,14,19,20] 3 assessed measles vaccines[11,13,17] 4 studies had outcomes of full vaccination (FV) schedule[12–14,18] one without measles [(14)] and the rest with DTP and polio together. Among the included studies, three studies were classified as high quality studies[11,14,20] six with medium quality[12, 13,15–18] and only one study with low quality.[19]

According to Figure-2, effect size for random effect model was 2.136,95% CI (1.258–3.626), test of null z-value=2.809 with *p*-value of 0.005, test of heterogeneity I^2 98.921, *p*-value<0.001. This means that professional types of interventions increased over all immunisation coverage for CCDs. One large sized study with high quality, found negative significant effect of a professional intervention [OR of 0.618 with z-value-5.594 (p<0.001)], i.e., volunteer peer counselling for pregnant women in Malawi, Africa.[14] Another study from Nepal found no significant effect [OR=1.305(p=0.618)] of an intervention that gave health education to women during birth and on 3 month post-partum.[12] Rest of the included studies as shown in Figure-1 had significant effect of professional types of intervention on immunisation coverage for CCDs. large effect was seen in an intervention where community health workers from India provided immunisation services and health education to mother at their homes.[19]

Effect of professional type of interventions on different antigens (Table-2) for DTP there was significant increase in overall coverage [OR 2.397 95% CI (1.656–3.469) z-value 4.636 (p<0.001)]; no significant increase was found in one study only from Kurdistan, Iraq. The intervention used support of local spiritual or religious leader to increase coverage. Three studies by decreasing dropout from DTP1 to DTP3 increased coverage.[15,16,8] Four studies assessed polio, the analysis found professional interventions to show no significant effect on increasing coverage for polio in the reviewed studies [OR 2.284 (p=0.137)]. The volunteer peer counselling shows negative effect of intervention [OR 0.865 (p<0.001)].[14]

Regarding MMR, from 3 reviewed studies that used professional intervention to increase coverage, all showed significant increase in coverage (p=<0.001), none of the studies assessed Mumps and Rubella. The largest effect was seen in an intervention that firstly identified parent with missed schedules, and then 3 home visits by health workers to encourage parents to complete the schedule.[13] Four studies that included FV as outcome, this review found no significant effect [OR 1.334 (p=1.342)] of professional type of intervention in increasing coverage. One high quality study had negative impact of professional intervention on FV coverage.

For publication bias Egger's regression intercept we find (B0) is: [-0.62731, 95% CI (-13.60959, 12.35496) with t=0.11143, df=8] The 1-tailed p-value (recommended) is 0.45701, and the 2-tailed *p*-value is 0.94581. Meaning there is low chance of publication bias in this review.

Table-1: Search strategy and keywords for only Cochrane Trials

Search strategy I
1=(immunisation or vaccination or vaccine or bcg or (diphtheria vaccine) or (tetanus vaccine) or (pertussis vaccine) or (dtp vaccine) or (dpt vaccine) or (measles vaccine) or (mumps vaccine) or (rubella vaccine) or (mmr vaccine) or (polio vaccine) or opv or (hepatitis b vaccine) or (hepb vaccine) or (haemophilusinfluenzae type b) or (haemophilusinfluenzae b) or (hib vaccine)) AND (intervention or (randomised trial) or (randomised controlled trial) or rct or trial or (quasi-experimental) or (quasi experimental))
2=(immunisation coverage) or (immunisation delivery) or (child health) or (child survival) or (childhood immunisation) or (health promotion) or (health education) or (health behaviour) or (health service) or (health system) or (disease prevention) or (delivery of health care) or (primary health care) or (program evaluation) or (community participation) or campaign or (quality improvement) or (health facility) or utilization or (community-based) or (health facility based) or (hospital based) or (health center) or (community mobilization) or vaccinators or (expanded programme on immunisation) or (disease eradication programs) or (sustainability of coverage) or (community action) or (millennium development goal 4) or (mdg 4))
3=New-born OR (birth to 1 month) OR infant OR (1 to 23 months)
1 AND 2 AND 3
Search strategy II
1 (childhood cluster) or mumps or rubella or measles or diphtheria or pertussis or dtp or dpt or mmr or (whooping cough) or tetanus or polio or poliomyelitis or (oral polio vaccine) or opv) AND (intervention or trial or (randomised controlled trial) or rct or (randomised trial) or (quasi-experimental) or (quasi experimental) or (non-randomised controlled trial) or (non-randomised trial) or nrct or (time series)

Table-2: Effect of professional types of intervention on CCD antigen

Antigen	Effect size and 95% interval			Test of null (2-tail)		Heterogeneity	
	Point estimate	Lower limit	Upper limit	*z*-value	*p*-value	I^2	*p*-value
DTP[11,14–19]	2.397	1.656	3.469	4.636	<0.001	97.197	<0.001
Polio[13,14,19,20]	2.284	0.715	7.294	1.394	0.163	99.607	<0.001
MMR[11, 13,17]	2.628	1.913	3.610	5.965	<0.001	34.492	0.217
FV[12–14,18]	1.342	0.486	3.703	0.568	0.570	98.837	<0.001

Figure-1: PRISMA flowchart for identifying studies

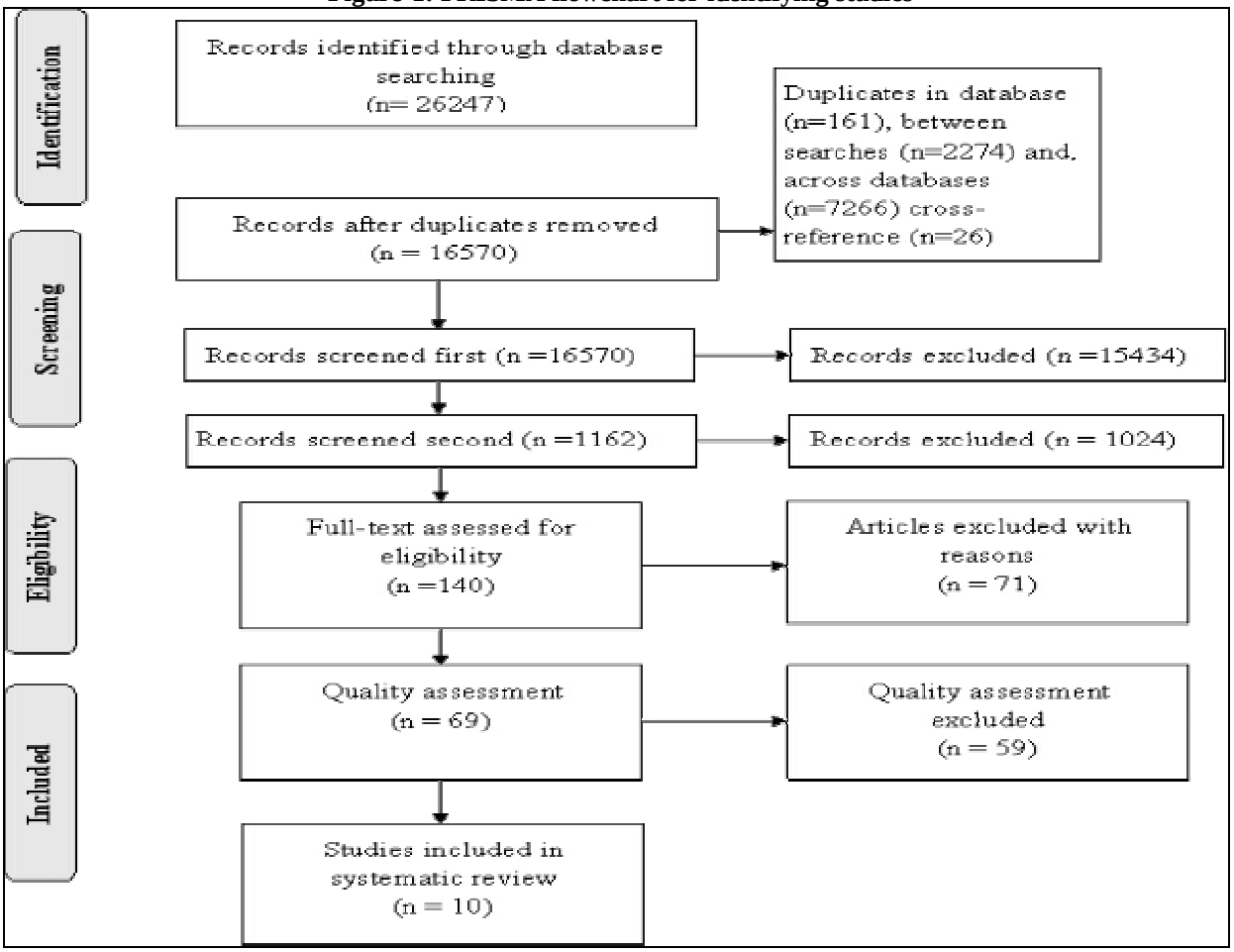
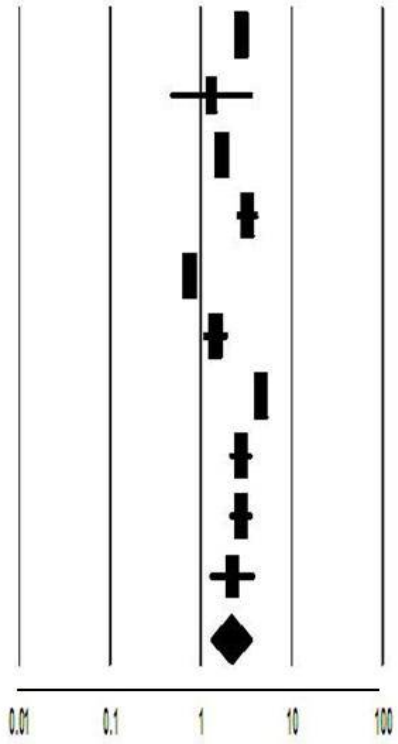


Figure-2: Forest plot of pooled analyses for professional types of interventions

Study Name	Odds ratio	Lower limit	Upper limit	Z-value	P-value
Ansderson (2009)	2.816	2.323	3.414	10.542	<0.05
Bolam (1998)	1.305	0.457	3.725	0.498	0.618
Briere (2012)	1.702	1.518	1.908	9.110	<0.05
Burgha (1996)	3.248	2.433	4.336	7.991	<0.05
Lewycka (2013)	0.785	0.687	0.835	-5.594	<0.05
Rahman (2013)	1.448	1.052	1.991	2.274	<0.05
Tandon (1992)	4.586	4.235	4.965	37.551	<0.05
Usman (2009)	2.770	2.061	3.721	6.670	<0.05
Usman (2011)	2.770	2.061	3.721	6.670	<0.05
Weiss (2011)	2.226	1.250	2.717	2.717	<0.05
Random Model	2.136	1.258	3.636	2.809	<0.05



DISCUSSION

Professional interventions such as health education through structured discussions, home visits by lady health workers or nurses to educate mothers and to immunise missed children, or health education at health centres using new and innovative strategies for example redesigns immunisation card etc. and comprehensive social mobilization can effectively increase immunisation coverage for childhood cluster diseases in the developing countries. The effect was found to be more prominent for DTP and measles not so much for FV and polio. A Cochrane systematic review also found professional interventions in moderate quality evidence such as evidence based discussion and information campaigns to increase coverage of DTP 3.[21] A review of health education also found popular health education as an effective method for enhancing empowerment and improving health.[22] It is recommended that policy makers should devise policies that include health education to improve immunisation services in their countries. Researchers should implement professional types of intervention by using latest technologies such as smart phones and tablets, or social internet platforms, to spread the messages of benefits of immunisation in communities with low knowledge of these services and also assess their effectiveness. Health managers from developing countries can use health education or professional interventions shown in this review as an effective measure for improving immunisation services for CCDs in their respective localities.

This review included studies in English language only. Different languages study results could possibly have affected the reported conclusions. Translation of identified literature in other languages was not possible due to time and financial constraints. Publications of research articles can be a rapid process or a very slow one depending on the publishers. To minimize this bias, systematic review teams gave 6 months' time period from the first initiating search. Articles were selected from 10 largest electronic databases, however not having institution login for some databases resulted in exclusion of few studies. Differences in geo political and demographics can be confounding the results. To tackle this issue random effect model was used instead of fixed effect model. Not many studies assessed mumps and rubella part in outcomes, and just used measles or measles containing vaccines. Publication bias and heterogeneity bias can occur by not including studies from the gray's literature. This review doesn't consider the baseline difference which

can also affect the outcome; however the major review in process will consider this too.

CONCLUSION

This systematic review has concluded that the professional interventions are found to be more effective while in improving immunisation coverage for CCDs in developing countries context through health education and promotion.

ACKNOWLEDGEMENT

This research is supported by Rachadapisek Sompote Fund for Postdoctoral Fellowship, Chulalongkorn University.

REFERENCES

1. World Health Organization. United Nations Children's Fund. Centre of Disease Control (CDC). Global Routine Vaccination Coverage-2012. Morbidity and Mortality Weekly Report. 2013;62(43);858–61.
2. World Health Organization. United Nations Children's Fund. The World Bank. State of the world's vaccines and Immunization (Third edition). Geneva: World Health Organization; 2009.
3. Ozawa S, Stack ML. Public trust and vaccine acceptance-international perspectives. Human Vaccines and Immunotherapeutics. 2013;9(8):1774–8.
4. Rainey JJ, Watkins M, Ryman TK, Sandhu P, Bo A, Banerjee K. Reasons related to non-vaccination and under-vaccination of children in low and middle income countries: Findings from a systematic review of the published literature, 1999-2009. Vaccine. 20116;29(46):8215–21.
5. Coelho A, Leona C, Ribeiro V, Moreira PSA , Dussault G. 2. Integrated disease management. Acta Med Port 2014;27(1):116–25.
6. Lopez AD, Mathers CD, Ezzati M, Jamison DT, Murray CJL, editors. The World Bank. Global Burden of Disease and Risk Factors. Washington (DC): Word Bank; 2006.
7. World Health Organization. WHO recommendations for routine immunization - summary tables: The World Health Organization; 2013 [cited 2013 4 October]. Available from: http://www.who.int/immunization/policy/immunization_tables/en/.
8. Downs SH, Black N. The feasibility of creating a checklist for the assessment of the methodological quality both of randomised and non-randomised studies of health care interventions. J Epidemiol Community Health 1998;52(6):377–84.
9. Higgins JP, Thompson SG. Quantifying heterogeneity in a meta-analysis. Statistics in medicine. 2002;21(11):1539–58.
10. Moher D, Liberati A, Tetzlaff J, Altman DG, The PG. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 2009;6(7):e1000097.
11. Andersson N, Cockcroft A, Ansari NM, Omer K, Baloch M, Foster AH, *et al*. Evidence-based discussion increases childhood vaccination uptake: a randomised cluster controlled trial of knowledge translation in Pakistan. BMC Int Health Hum Rights 2009;9 Suppl 1;S8.
12. Bolam A, Manandhar DS, Shrestha P, Ellis M, Costello AM. The effects of postnatal health education for mothers on infant care and family planning practices in Nepal: a randomised controlled trial. BMJ (Clinical research ed). 1998;316(7134):805–11.
13. Brugha RF, Kevany JP. Maximizing immunization coverage through home visits: a controlled trial in an urban area of Ghana. Bulletin of the World Health Organization 1996;74(5):517–24.
14. Lewycka S, Mwansambo C, Rosato M, Kazembe P, Phiri T, Mganga A, *et al*. Effect of women's groups and volunteer peer counselling on rates of mortality, morbidity, and health behaviours in mothers and children in rural Malawi (MaiMwana): a factorial, cluster-randomised controlled trial. Lancet. 2013;381(9879):1721–35.
15. Usman HR, Akhtar S, Habib F, Jehan I. Redesigned immunization card and center-based education to reduce childhood immunization dropouts in urban Pakistan: a randomized controlled trial. Vaccine. 2009 Jan 14;27(3):467–72.
16. Usman HR, Rahbar MH, Kristensen S, Vermund SH, Kirby RS, Habib F, *et al*. Randomized controlled trial to improve childhood immunization adherence in rural Pakistan: redesigned immunization card and maternal education. Trop Med Int Health. 2011;16(3):334–42.
17. Abdul Rahman MA, Al-Dabbagh SA, Al-Habeeb QS. Health education and peer leaders' role in improving low vaccination coverage in Akre district, Kurdistan Region, Iraq. East Mediterr Health J. 2013;19(2):125–9.
18. Briere EC, Ryman TK, Cartwright E, Russo ET, Wannemuehler KA, Nygren BL, *et al*. Impact of integration of hygiene kit distribution with routine immunizations on infant vaccine coverage and water treatment and handwashing practices of Kenyan mothers. J Infec Dis 2012;205 Suppl 1:S56-64.
19. Tandon BN, Gandhi N. Immunization coverage in India for areas served by the Integrated Child Development Services programme. Bull World Health Organ. 1992;70(4):461–5.
20. Weiss W, Rahman MH, Solomon R, Singh V, Ward D. Outcomes of polio eradication activities in Uttar Pradesh, India: the Social Mobilization Network (SM Net) and Core Group Polio Project (CGPP). BMC infectious diseases. 2010;11(117);1–11.
21. Oyo-Ita A, Nwachukwu CE, Oringanje C, Meremikwu MM. Interventions for improving coverage of child immunization in low- and middle-income countries. The Cochrane database of systematic reviews. 2011;(7):CD008145.
22. Wiggins N. Popular education for health promotion and community empowerment: a review of the literature. Health promotion international. 2012;27(3):356–71.

Address for Correspondence:

Dr. Sheh Mureed, College of Public Health Sciences, Chulalongkorn University, Bangkok-Thailand
Cell: +66898218070
Email: shehdr@gmail.com