

# Reporting immunization coverage inequalities in Pakistan

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## Abstract

**Background:** Immunization coverage in Pakistan is unequally distributed. Understanding the current status of reporting of immunization coverage inequalities in Pakistan can help to identify gaps and opportunities for strengthened monitoring and reporting.

**Aims:** To assess the published literature on immunization coverage inequality measurement and reporting in Pakistan.

**Methods:** We performed a literature search in PubMed in April 2019 to obtain articles reporting inequalities in immunization coverage in Pakistan. A data extraction rubric was applied to collate information about data sources, immunization indicators and dimensions of inequality.

**Results:** We included 42 studies in our analysis. Most studies reported data from household surveys or research studies. Dimensions of inequality reflected geography (primarily provinces/territories), economic status, place of residence, education level, sex and occupation. District-level comparisons were featured in 5 studies that were subnational in scope.

**Conclusions:** Expanded monitoring at district level is warranted as a major way forward in characterizing immunization inequalities in Pakistan.

Keywords: Pakistan, inequality, immunization coverage

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## Introduction

Despite recent national improvements to immunization coverage in Pakistan (1), the country has not yet realized the full benefits of immunization. The reasons why Pakistan trails behind in terms of immunization can be traced to political, geographical and sociocultural forces, which are experienced differently throughout the country (2,3). As a result, Pakistan has high levels of immunization coverage inequality, with marked differences according to parental education, household economic status, subnational region and other factors (4,5).

Health inequality monitoring methods can be used to measure and track immunization coverage differences between subgroups within a target population (6,7). Inequality monitoring can help to identify where immunization coverage inequalities exist, and the characteristics of disadvantaged subgroups. Among other factors, the inequality monitoring process is premised on data availability and the identification of population subgroups that reflect relevant (and actionable) dimensions of inequality.

A comprehensive overview of how inequality monitoring efforts have assessed immunization coverage in Pakistan is warranted to characterize the current scope of monitoring, reveal gaps in monitoring, and indicate opportunities to strengthen and expand monitoring. Here, we report the results of a systematic survey of published literature about immunization coverage inequality in Pakistan between 2000 and 2019, with a

focus on data sources and dimensions of inequality. The authors alone are responsible for the views expressed in this article and they do not necessarily represent the views, decisions or policies of the institutions with which they are affiliated.

## Methods

Two of the authors performed a systematic literature on PubMed (Medline) in April 2019. The search strategy used Boolean operators, Medical Subject Headings terms and title/abstract keywords to search for articles on Pakistan and immunization. Filters were applied to refine the search criteria according to language (English) and date (after 2000) of publication. The search results were screened in 2 stages: first by title and abstract, and then by full text. The following inclusion criteria were applied: (1) full text of article available online; (2) article pertained to humans; (3) article reported immunization coverage for Pakistan; (4) article contained disaggregated data for immunization coverage in Pakistan; (5) article stated the data source; and (6) article reported monitoring of immunization coverage according to demographic, sociocultural or geographic factors, or other perceived sources of systemic discrimination. Articles that evaluated the impact of an intervention or trial were not included. A data extraction rubric was used to extract key information from articles included at the full-text review stage. The rubric collected standardized and freeform information, including: publication details, target population, data sources, immunization indicators, disaggregation criteria and

population subgroups. Both authors contributed to article screening and data extraction, and incongruities were resolved through discussion and consensus. Detailed information about the search strategy and data extraction rubric is available from the authors upon request.

## Results

### Characteristics of included articles

The literature search yielded 42 relevant articles (Table 1). The included articles were published in international ( $n = 28$ ), regional ( $n = 6$ ) or national ( $n = 8$ ) journals, and predominantly reported on the national population ( $n = 24$ ) or geographically determined subnational populations ( $n = 15$ ). The majority of articles were original research studies ( $n = 31$ ), followed by reports ( $n = 8$ ) and reviews ( $n = 3$ ). A complete list of included articles is available in Appendix 1. The articles reported coverage of single vaccines, including polio ( $n = 17$ ), diphtheria, tetanus, and pertussis ( $n = 7$ ), measles ( $n = 7$ ) and hepatitis B ( $n = 5$ ), or coverage of multiple vaccines ( $n = 13$ ).

### Data sources

The data used to measure inequalities in immunization coverage were sourced from international or national household surveys ( $n = 16$ ) or collected as part of a research study ( $n = 16$ ), with 10 additional articles reporting World Health Organization/United Nations Children's Fund (WHO/UNICEF) modelled estimates based on official country estimates. Household survey sources included 2 prominent international surveys: the Pakistan Demographic and Health Survey (PDHS) ( $n = 11$ ) and the Multiple Indicator Cluster Surveys (MICS) ( $n = 1$ ). While articles using PDHS data were national in scope, the PDHS excludes certain geographical areas [e.g. the 2012–2013 PDHS did not include Azad Jammu and Kashmir (Pakistan-administered Kashmir) and Federally Administered Tribal Areas]. Since 2010, MICS has been

conducted on a rotating basis by province/territory. The article using MICS data reported on subnational populations in Balochistan and Punjab. Other household surveys included the Pakistan Social and Living Standards Measurement ( $n = 4$ ), Pakistan Integrated Household Survey (or Pakistan Integrated Economic Survey) ( $n = 3$ ), Expanded Programme on Immunization surveys ( $n = 2$ ), National Nutrition Survey ( $n = 1$ ) and Maternal and Child Health Program Indicator Survey ( $n = 1$ ). Articles that reported data collected as part of a research study ( $n = 16$ ) all represented populations within specific provinces or territories: Sindh ( $n = 7$ ), Khyber Pakhtunkhwa ( $n = 6$ ), Balochistan ( $n = 1$ ), Azad Jammu and Kashmir ( $n = 1$ ) and multiple provinces (Sindh, Khyber Pakhtunkhwa and Punjab) ( $n = 1$ ).

### Dimensions of inequality

Over half of the articles disaggregated immunization coverage by subnational region ( $n = 25$ ). Other major dimensions of inequality included: economic status ( $n = 18$ ), rural–urban place of residence ( $n = 18$ ), education level ( $n = 16$ ), sex ( $n = 15$ ) and occupation ( $n = 9$ ). Of the 25 articles that reported subnational region as a dimension of inequality, data were most often disaggregated by provinces and territories ( $n = 20$ ). These articles drew from WHO/UNICEF estimates ( $n = 10$ ), PDHS ( $n = 5$ ) or national household surveys ( $n = 5$ ), and were national in scope. Five articles, subnational in scope, reported district or subdistrict inequalities in coverage (Table 2).

## Discussion

This literature review demonstrates the scope of immunization inequality reporting in Pakistan. Although many studies were national in scope, some geographical regions were not covered by major household surveys and thus not reported in the studies. It is a concern that conflict-affected and unstable areas are not included in regular data collection, as they are also areas where vac-

**Table 1** Articles excluded at literature search and review stages

Stage of search/review	Reason for exclusion (no. of articles)	No. of articles
Titles identified through database searching		1231
Applied filter: articles published since 2000	Articles published outside of specified timeframe ( $n=184$ )	1047
Duplicates removed	( $n=192$ )	855
Applied filter: articles published in English	Articles published in Spanish ( $n=5$ ), Danish ( $n=2$ ), French ( $n=2$ ), Japanese ( $n=2$ ), Dutch ( $n=1$ ), German ( $n=1$ ), Serbian ( $n=1$ ) or Swedish ( $n=1$ )	840
Removed items catalogued as "Species: other animals" for content unrelated to humans	Article did not contain information about human subjects <sup>a</sup> ( $n=103$ )	734
Title and abstract review	Articles did not contain information about human subjects; did not report immunization coverage for Pakistan; did not contain disaggregated data for Pakistan; did not disaggregate data by relevant demographic, socioeconomic, cultural, or geographic factors ( $n=650$ )	87
Full-text review	Article did not report immunization coverage for Pakistan ( $n=40$ ) Article did not disaggregate data by relevant demographic, socioeconomic, cultural, or geographic factors ( $n=3$ ) Full text of article was not available ( $n=2$ )	42

<sup>a</sup>These titles were reviewed for potentially relevant articles, and one article was retained.

**Table 2 Articles that reported subnational regional inequality in immunization coverage at district or subdistrict levels**

First author (ref)	Title of article	Data source	Study location	Subnational regions
Cockcroft (14)	One size does not fit all: local determinants of measles vaccination in 4 districts of Pakistan	Research study	Sindh, Punjab and North West Frontier province <sup>a</sup>	Select districts: Khairpur, Haripur, Khanewal, Sialkot
Imran (11)	Routine immunization in Pakistan: comparison of multiple data sources and identification of factors associated with vaccination	MICS	Balochistan and Punjab	District groups within Balochistan and districts within Punjab
Khowaja (18)	Routine EPI coverage: subdistrict inequalities and reasons for immunization failure in a rural setting in Pakistan	Research study	Matiari district, Sindh	Matiari district talukas and union councils
Riaz (19)	Reasons for nonvaccination and incomplete vaccinations among children in Pakistan	Research study	Sindh	Select districts: Karachi, Hyderabad, Matriari, Jamshoro, Thatta, Sujawal, Tando Muhammad Khan, Tando Allah Yar
Siddiqi (20)	Ethnic disparities in routine immunization coverage: a reason for persistent poliovirus circulation in Karachi, Pakistan?	Research study	Periurban Karachi	Communities: Baldia, BinQasim, Gadap, Gulberg, Gulshan, Jamshed, Kemari, Korangi, Landhi, Liaqatabad, Lyari, Malir, New Karachi, North Nazimabad, Orangi, Saddar, Shah Faisal, SITE

<sup>a</sup>now known as Khyber Pakhtunkhwa.

EPI = Expanded Programme on Immunization; MICS = Multiple Indicator Cluster Surveys.

cine-preventable diseases are likely to be more prevalent or problematic. The transmission of wild poliovirus, for instance, originates from regions, including Federally Administered Tribal Areas, where surveillance systems are suboptimal and immunization activities, routinely compromised (8).

The results indicate a reliance on household survey and research data, with low use of data from administrative sources (records from routine encounters with the health system, which are taken into account in the WHO/UNICEF modelled estimates). Administrative data have important potential for inequality monitoring, as they can provide timely information gathered from all members of a population, with high geographical precision. The quality of administrative data, however, relies on accurate and coordinated reporting systems as well as denominator estimates (typically generated through censuses) (9). Unfortunately, Pakistan's health information system lacks capacity (10), and therefore immunization coverage estimates derived from this system tend to be discrepant from survey-derived estimates (11).

Given the decentralization of the health system in Pakistan since 2011 – which devolved national responsibilities to provincial and district-level officials, raising equity concerns (10,12) – and the practical importance of area-based inequality monitoring (13), geographical monitoring is particularly important to close coverage gaps. To date, published inequality analyses conducted at the district or subdistrict level are

small in number, and appear to be primarily undertaken for specific research purposes rather than as part of routine inequality monitoring. Notably, however, coverage estimates within districts of the same province were variable, and thus provincial data did not necessarily reflect the situation within a particular district (14). No study included in this analysis reported district-level inequalities across the entire country.

A wider survey of publicly available grey literature (i.e., published online by the Government of Pakistan Ministry of National Health Services, Regulation and Coordination, and organizations involved in promoting immunization) presented some district-level disaggregation of immunization coverage, although detailed background documents about these analyses were not readily available (15,16). Consultations with national and international immunization experts have revealed that immunization data at a district level (aligning with national administrative units) were preferred by country-level immunization experts, and that small-area estimations were ranked as a top research priority (17). Participants in that consultation, however, also noted the costly nature of collecting data with district-level granularity, and cited quality and logistical complexities.

Overall, the results of this preliminary analysis suggest an international and national interest in monitoring immunization inequalities in Pakistan, with a predominant focus on geographically defined inequalities (noting that other dimensions are also

monitored). Expanded monitoring at district level is a major way forward in characterizing immunization inequalities and targeted responses, and should be pursued on a national scale, especially including geographical areas that are less well represented in prominent data sources. Additionally, further studies are warranted to expand upon the methods used in this preliminary analysis, including multiple databases

and handsearching of relevant unindexed journals. The results of this analysis draw attention to the continued need for regular inequality monitoring of immunization coverage as a central part of national efforts to ensure the full benefits of immunization for all.

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**Competing interests:** None declared.

## Rapport sur les inégalités en matière de couverture vaccinale au Pakistan

### Résumé

**Contexte :** La couverture vaccinale au Pakistan est inégale. Comprendre la situation actuelle concernant la notification des inégalités en matière de couverture vaccinale au Pakistan peut aider à identifier les lacunes et les possibilités de renforcement du suivi et de la notification.

**Objectifs :** Évaluer la littérature publiée sur la mesure et la notification concernant les inégalités liées à la couverture vaccinale au Pakistan.

**Méthodes :** Nous avons réalisé une recherche de littérature dans PubMed en avril 2019 pour obtenir des articles signalant des inégalités dans la couverture vaccinale au Pakistan. Une grille d'extraction des données a été utilisée pour recueillir des informations sur les sources de données, les indicateurs de vaccination et les dimensions des inégalités.

**Résultats :** Nous avons inclus 42 études dans notre analyse. La plupart des études ont fourni des données issues d'enquêtes auprès des ménages ou d'études de recherche. Les dimensions de l'inégalité reflètent la géographie (principalement les provinces/territoires), le statut économique, le lieu de résidence, le niveau d'études, le sexe et la profession. Des comparaisons au niveau des districts ont été présentées dans cinq études de portée infranationale.

**Conclusions :** Un suivi étendu au niveau des districts est nécessaire pour permettre une meilleure caractérisation des inégalités en matière de vaccination au Pakistan.

### التبليغ بأوجه التفاوت في التغطية بالتحصين في باكستان

نيكول بيرجن، جريس زو، كاثرين كيركي

#### الخلاصة

الخلفية: يتسم توزيع التغطية بالتحصين في باكستان بعدم التكافؤ. ويمكن أن يساعد فهم الوضع الحالي للتبليغ بأوجه عدم التكافؤ في التغطية بالتحصين في باكستان في تحديد الثغرات والفرص المتاحة لتعزيز الرصد والتبليغ.

الأهداف: هدفت هذه الدراسة إلى تقييم الأدبيات المنشورة حول قياس التفاوت في التغطية بالتحصين والتبليغ به في باكستان.

طرق البحث: أجرينا استعراضاً للمؤلفات باستخدام برنامج PubMed في أبريل/ نيسان 2019 للحصول على مقالات أبلغت بعدم التكافؤ في التغطية بالتحصين في باكستان. وطبقت إرشادات استخراج البيانات لجمع المعلومات حول مصادر البيانات، ومؤشرات التحصين، وأبعاد عدم التكافؤ.

النتائج: أدرجنا 42 دراسة في تحليلنا. وأبلغت معظم الدراسات عن بيانات مستمدة من مسوحات منزلية أو دراسات بحثية. واتضحت أبعاد عدم التكافؤ في الجغرافيا (بصورة أولية المقاطعات/ الأقاليم)، والوضع الاقتصادي، ومكان الإقامة، ومستوى التعليم، ونوع الجنس، والمهنة. وظهرت مقارنات على مستوى المناطق في 5 دراسات تمت على نطاق دون وطني.

الاستنتاجات: هناك ما يبرر إجراء رصد موسع على مستوى المناطق بوصفه سبيلاً رئيسياً للمضي قدماً في تحديد خصائص أوجه عدم التكافؤ في التحصين في باكستان.

Appendix 1. Articles included in the review (n = 42)

Authors	Article title	Year published	Journal	Article type	Population
Alexander JP et al.	Progress and peril: poliomyelitis eradication efforts in Pakistan, 1994–2013.	2018	J Infect Dis	Research	National
Asif M et al.	Hepatitis B vaccination coverage in medical students at a medical college of Mirpurkhas.	2011	J Pak Med Assoc	Research	Professional group
Attaullah S et al.	Prevalence of HBV and HBV vaccination coverage in healthcare workers of tertiary hospitals of Peshawar, Pakistan.	2011	Virology J	Research	Professional group
Batool S, Ahmed AM.	Achievements of healthcare services vis a vis the MDG targets: Evidence from Pakistan.	2017	J Pak Med Assoc	Research	National
Bugvi AS et al.	Factors associated with nonutilization of child immunization in Pakistan: evidence from the Demographic and Health Survey 2006–2007.	2014	BMC Public Health	Research	National
CDC	Progress toward poliomyelitis eradication – Pakistan, January 2012–September 2013.	2013	MMWR Morb Mortal Wkly Rep	Report	National
CDC	Progress toward poliomyelitis eradication – Afghanistan and Pakistan, January 2010–September 2011.	2011	MMWR Morb Mortal Wkly Rep	Report	National
CDC	Progress toward poliomyelitis eradication – Afghanistan and Pakistan, 2009.	2010	MMWR Morb Mortal Wkly Rep	Report	National
CDC	Progress toward poliomyelitis eradication – Afghanistan and Pakistan, 2008.	2009	MMWR Morb Mortal Wkly Rep	Report	National
Cockcroft A et al.	One size does not fit all: local determinants of measles vaccination in four districts of Pakistan.	2009	BMC Int Health Hum Rights	Research	Subnational
Farag NH et al.	Progress toward poliomyelitis eradication – Afghanistan and Pakistan, January 2013–August 2014.	2014	MMWR Morb Mortal Wkly Rep	Report	National
Farag NH et al.	Progress toward poliomyelitis eradication – Pakistan, January 2014–September 2015.	2015	MMWR Morb Mortal Wkly Rep	Report	National
Hasan Q et al.	A review of EPI progress in Pakistan towards achieving coverage targets: present situation and the way forward.	2010	East Mediterr Health J	Review	National
Hosseinpoor AR et al.	State of inequality in diphtheria–tetanus–pertussis immunisation coverage in low-income and middle-income countries: a multicountry study of household health surveys.	2016	Lancet Global Health	Research	National
Hsu C et al.	Progress toward poliomyelitis eradication – Pakistan, January 2017–September 2018.	2018	MMWR Morb Mortal Wkly Rep	Report	National
Hsu CH et al.	Progress toward poliomyelitis eradication – Pakistan, January 2015–September 2016.	2016	MMWR Morb Mortal Wkly Rep	Report	National
Husain S, Omer SB.	Routine immunization services in Pakistan: seeing beyond the numbers.	2016	East Mediterr Health J	Review	National
Imran H et al.	Routine immunization in Pakistan: comparison of multiple data sources and identification of factors associated with vaccination.	2018	Int Health	Research	Subnational
Imran W et al.	What is causing high polio vaccine dropout among Pakistani children?	2018	Public Health	Research	National
Khan MT et al.	Maternal education, empowerment, economic status and child polio vaccination uptake in Pakistan: a population based cross sectional study.	2017	BMJ Open	Research	National
Khowaja AR et al.	Parental awareness and coverage of mass measles vaccination drive 2011: cross-sectional survey in the metropolitan city of Karachi, Pakistan.	2015	Asia Pac J Public Health	Research	Subnational

## Appendix 1 Articles included in the review (n = 42) (concluded)

Authors	Article title	Year published	Journal	Article type	Population
Khowaja AR et al.	Routine EPI coverage, subdistrict inequalities and reasons for immunization failure in a rural setting in Pakistan.	2015	Asia Pac Journal of Public Health	Research	Subnational
Kols A et al.	Provincial differences in levels, trends, and determinants of childhood immunization in Pakistan.	2018	East Mediterr Health J	Research	National
Malik SM, Ashraf N.	Equity in the use of public services for mother and newborn child health care in Pakistan: a utilization incidence analysis.	2016	Int J Equity Health	Research	National
Mitchell S et al.	Equity and vaccine uptake: a cross-sectional study of measles vaccination in Lasbela District, Pakistan.	2009	BMC Int Health Hum Rights	Research	Subnational
Murtaza F et al.	Determinants of nonimmunization of children under 5 years of age in Pakistan.	2016	J Fam Commun Med	Research	National
Naeem M et al.	Coverage and causes of missed oral polio vaccine in urban and rural areas of Peshawar.	2011	J Ayub Med Coll Abbottabad	Research	Subnational
Naeem M et al.	Coverage and causes of missed Haemophilus influenzae type B vaccination in urban and rural areas of Peshawar.	2011	J Ayub Med Coll Abbottabad	Research	Subnational
Naeem M et al.	Coverage and factors associated with tetanus toxoid vaccination among married women of reproductive age: a cross sectional study in Peshawar.	2010	J Ayub Med Coll Abbottabad	Research	Subnational
Naeem M et al.	Factors associated with low hepatitis B vaccination; a user and provider perspective study in Peshawar.	2011	J Pak Med Assoc	Research	Subnational
Noh JW et al.	Factors affecting complete and timely childhood immunization coverage in Sindh, Pakistan: A secondary analysis of cross-sectional survey data.	2018	PLOS one	Research	Subnational
Owais A et al.	Pakistan's expanded programme on immunization: an overview in the context of polio eradication and strategies for improving coverage.	2013	Vaccine	Review	National
Raza O et al.	Differential achievements in childhood immunization across geographical regions of Pakistan: analysis of wealth-related inequality.	2018	Int J Equity Health	Research	National
Rehman SU et al.	Coverage and predictors of routine immunization among 12–23 months old children in disaster affected communities in Pakistan.	2017	Int J Health Sci	Research	Subnational
Riaz A et al.	Reasons for non-vaccination and incomplete vaccinations among children in Pakistan.	2018	Vaccine	Research	Subnational
Shah M et al.	Resistance of polio to its eradication in Pakistan.	2011	Virology J	Research	National
Shaikh S et al.	Coverage and predictors of vaccination among children of 1–4 years of age in a rural sub-district of Sindh.	2010	J Coll Physicians Surg Pak	Research	Subnational
Siddiqi N et al.	Assessment of EPI (expanded program of immunization) vaccine coverage in a peri-urban area.	2007	J Pak Med Assoc	Research	Subnational
Siddiqui NT et al.	Ethnic disparities in routine immunization coverage: a reason for persistent poliovirus circulation in Karachi, Pakistan?	2014	Asia Pac J Public Health	Research	Subnational
Singh PK, Parsuraman S.	Sibling composition and child immunization in India and Pakistan, 1990–2007.	2014	World J Pediatrics	Research	National
Yousafzai MT et al.	Hepatitis B vaccination among primary health care workers in Northwest Pakistan.	2014	Int J Health Sci	Research	Professional group
Zaidi SM et al.	Coverage, timeliness, and determinants of immunization completion in Pakistan: evidence from the Demographic and Health Survey (2006–07).	2014	Hum Vaccin Immunother	Research	National

CDC = Centers for Disease Control and Prevention; HBV = hepatitis B virus.

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