

A review of childhood immunization coverage in Pakistan

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Abstract

Background: The Pakistani Government has prioritized and invested substantial resources in expanding childhood immunization, aiming to increase coverage to > 90%. It is therefore important to track progress towards achieving this target.

Aim: To track progress on childhood immunization coverage in Pakistan at baseline, at endline, and at 2 important milestones (2005 and 2010).

Methods: Using 2001 as baseline, we collected milestone data (2005, 2010, 2015) on childhood immunization from the Pakistan Social and Living Standard Measurement Survey for children aged 1–5 years. We analysed the data using STATA version 15.1 and used the concentration index for bound variables to analyse equity in coverage.

Results: Immunization coverage did not follow a consistent upward trend, and it varied by province. Over the 15-year (2001–2015) period, childhood immunization coverage increased substantially. Although more than 80% of 1–5-year-old children were vaccinated by 2015 at the national level, Pakistan missed the Millennium Development Goals targets for childhood immunization. Only Punjab Province achieved the targets for childhood immunization (92.0% in Punjab vs 82.5% at national level). Higher socioeconomic status increased the odds of being vaccinated while living in rural areas decreased the odds.

Conclusion: To improve childhood immunization coverage in Pakistan and achieve the related Sustainable Development Goals targets, it is important for the government to set targets at the provincial level, allocate more resources and continue to track progress regularly until 2030.

Key words: childhood immunization, vaccination, equity, coverage, SDG, Pakistan

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Introduction

Pakistan, a country of 230 million people in South Asia, has 4 provinces [Punjab, Sindh, Khyber Pakhtunkhwa (KPK) and Baluchistan] and 4 main ethnic groups. It is a low- to middle-income country, striving for continuity in democratic governance and the implementation of the rule of law in a hostile geopolitical region, and facing continual sectarian and ethnic unrest. The population encountered immense social and political unrest during the Millennium Development Goals (MDGs). Daily life was severely disrupted due to numerous incidents such as terrorist attacks, suicide bombings, military operations, internal displacements, earthquakes, record-breaking heat waves and floods (1,2). Conflict and social unrest are known to hamper the provision of public health services, especially for the most vulnerable populations. In this study, we have chronicled the progression of the coverage and equity in immunization services during the turbulent period 2001–2015 and across all 4 provinces.

In 2001, Pakistani health system faced critical challenges of poor access and under-utilization of health services. Due to weaknesses in the delivery of health services, the unmet need for immunization services was high and nearly 40% of children were unvaccinated

(3). During 2000–2015, successive government health policies promised to target the most vulnerable segments of the population and the most inaccessible areas of the country (3,4). The government prioritized expanding childhood immunization coverage to > 90% (3). With foreign aid, substantial resources were invested in the health delivery system to address the situation.

The national Expanded Programme on Immunization (EPI) is the sole provider of childhood immunization to the target population free of cost, either at existing health facilities or through outreach activities. The national programme is managed by the Federal Ministry of Health, with a presence in provincial health departments and district health offices. Generally, immunization staff are employed by the district health offices. However, other resources such as vaccines, cold chain, staff training and transportation are provided by the EPI at national and provincial levels. EPI receives substantial support from development partners, including Gavi. Although there is an EPI team dedicated solely to the programme, the Lady Health Worker programme contributes significantly to immunization activities at grassroots levels.

Pakistan has been characterized as an under-performer in the health sector. In particular, the situation

vis-à-vis vaccination and maternal and child health is weak (3,5–11). Pakistan missed MDG target 4 on infant mortality rate and childhood immunization coverage: along with the numerous other challenges, tracking of immunization progress during this period was limited in scope, period of analysis and level of analysis. Different reports used a variety of definitions for variables and coverage. For example, the Countdown to 2030 analysis of the 2006–2007 Pakistan Demographic and Health Survey (<http://nhsrsc.pk/dashboards/pdhsselect.html>) defined immunization coverage as reported on the immunization cards only, while a similar analysis in the 2012–2013 survey (<http://nhsrsc.pk/dashboards/pdhsselect.html>) defined immunization coverage as reported on immunization cards along with respondents' recall on immunization (12–14), thus making comparison of progress challenging. None of these reports included any analysis at the subnational level (3,6,9–11,14).

The objective of this paper was to track progress on the coverage and equity in coverage of childhood vaccination in Pakistan at baseline (2001), at the endline (2015), and at 2 other important milestones during 2001–2015. Province-level analysis was conducted to explore inter-province variation across all 4 provinces and to identify sources of variation in the national estimates (11).

The underlying hypothesis tested was that progress in childhood vaccination was the same across the 4 provinces and that it followed a stable increasing trend between baseline and endline during the MDG era.

Methods

To estimate policy-relevant coverage and equity in coverage of childhood immunization, 4 milestones were selected for this paper: 2001, 2005, 2010 and 2015. We used 2001 as the baseline and 2015 as the endline of the analysis period, i.e. the MDG era, while 2005 and 2010 were important policy-relevant milestones: 2005 marked the adoption of the National Maternal, Neonatal and Child Health Strategic Framework, while 2010 marked the dissolution of the Federal Ministry of Health and the decentralization of maternal and child health programmes to the provinces (6,15). Coverage and equity in coverage were estimated at national and subnational/provincial levels.

To track progress on immunization coverage, we used datasets from the Pakistan Social and Living Standard Measurement Survey (PSLM). This is the largest national-level survey in terms of sample size and number of rounds carried out: it allows for comparison of coverage and equity in coverage over time and across provinces (16,17). The Government of Pakistan has designated the PSLM as the official source of information for tracking progress in the social sectors, including health and poverty (17), and from 2000 to 2015, 12 rounds of the PSLM were conducted. This survey uses a 2-stage stratified random sampling method, where the first stage uses rural and urban stratification, including big cities. In the second stage, households are selected from enumeration blocks

in urban areas and villages in rural areas by probability methods proportional to size sampling techniques. Although the refusal rate was minimal in the PSLM surveys, selection bias could not be completely ruled out (18). For example, around 2% of the population living in military-restricted areas and the whole of the population living in the northern areas (the state of Azad Kashmir and the tribal areas of Pakistan) are excluded from the PSLM sampling frame.

The childhood immunization schedule included one dose of *Bacillus Calmette–Guérin* (BCG) vaccine; 3 doses of diphtheria, pertussis and tetanus (DPT) vaccine; 3 doses of poliomyelitis vaccine, and one dose of measles vaccine. In 2010–2011, the BCG vaccine was replaced by the pentavalent vaccine. In 2014–2015, a second dose of measles vaccine was added (17).

To avoid data censoring, since most of the immunization schedule had not been completed in the child's first year, the sample was restricted to children aged 1–5 years who had completed the recommended dose(s) of each vaccine. This strategy reduced the sample included in the survey by nearly 10% (Table 1). Coverage as “fully vaccinated” was defined as a child (1–5 years) who had received one dose of BCG, 3 doses of DPT/PV, 3 doses of polio vaccine and one dose of measles vaccine reported by both recall and record card methods. Table 1 describes the demographic characteristics and socioeconomic status of the respondents of the surveys included in this paper.

To analyse equity, the concentration index for bound variables was estimated for the vaccines included in this analysis (19,20). All estimates of coverage and equity of coverage were population-representative at the national and provincial levels; this was ensured by taking into consideration the population-adjusted sampling weights and survey design effect.

Estimation methods and *STATA* codes provided in a previous publication (21) were used for estimating the concentration index of bound variables; indices were scaled to 100 concentration (–100 to +100) (22,23).

A wealth index was constructed as a proxy for the socioeconomic status of the household. Information on household assets such as television, radio, furniture, etc. and conditions such as source of water and source of lighting were used to construct the wealth index. Using principal component analysis, the wealth indices were constructed from the data on those aspects of the socioeconomic status of the household that were available in the datasets for each round of the PSLM (17).

We explored the factors correlating with the immunization of children with a 2-way fixed effect logistic regression for time-invariant and time-varying factors influencing immunization coverage, controlling for demographic and household characteristics, for example sex of the child, rural residence and socioeconomic status of the household.

To validate progress on immunization coverage and equity in coverage, we obtained data on political,

Table 1 Demographic characteristics of the sample, children aged 1–5 years in Pakistan

Characteristic	Year			
	2001–2002 (%)	2004–2005 (%)	2010–2011 (%)	2014–2015 (%)
Children (1–5 years)				
Age (years)	2.63	2.73	2.75	2.14
Male sex (%)	50.22	51.27	49.76	51.1
Rural residence	67.31	65.32	65.54	84.53
Household wealth quintile^a				
Poorest	17.75	18.92	21.15	31.68
Poorer	18.05	19.45	20.16	25.45
Middle	17.8	19.98	19.49	19.09
Richer	23.61	20.87	19.58	13.57
Richest	22.8	20.78	19.62	10.21
Sample size (No.)	15 425	11 126	11 035	56 712

^aWealth quintiles are based on a wealth index constructed on information on household assets in the respective rounds of the Pakistan Social and Living Standard Measurement Survey (17).

economic, social, cultural and environmental factors across provinces and across years of analysis. For this purpose, we searched literature and online data from the official online resources of the public sector and the United Nations agencies. All analyses were carried out using STATA, version 15.1.

Results

The political and social context of the MDG era generated a variety of outcomes, both positive and negative. In 2000–2001, the military dictatorship led the country at national and provincial levels. In 2004–2005, a pro-military political alliance was installed at national and provincial levels. In 2008, the military dictatorship ended, and in the following years, the political governments started functioning independently. Details of these changes in government are outlined in Table 2. In 2010, the 18th constitutional amendment devolved many functions of the federal government to the provinces, including functions related to delivery of services via the Federal Ministry of Health to the provincial health departments. Among the provinces, Punjab was governed by the conservative parties, Sindh by the democrats, while KPK and Baluchistan followed mixed trends.

The combined sample of children aged 1–5 years covered in 4 rounds of the PSLM survey was 94 298. The proportions according to sex and mean age did not follow any time trends over the years of analysis. The

proportion of the population ranked as “poorest” and “poorer” households increased from 17.75% to 31.68% and from 18.05% to 25.45% respectively over the analysis period (Table 1).

Our findings on vaccination coverage negated the hypothesis: coverage did not follow a consistent upward trend, nor did the provinces perform homogeneously (Table 3). Over 15 years (2001–2015), childhood immunization coverage increased substantially. By 2015, at the national level, more than 80% of children aged 1–5 years had been vaccinated. Polio immunization coverage reached around 97% (Table 3), thus achieving the target set in the MDGs. However, the trend was not entirely upward, slowing for example during 2005–2010 when immunization coverage remained stagnant or even decreased in many cases (Table 3).

At the national level though, except for polio immunization, Pakistan missed the targets for immunization coverage; only Punjab achieved the MDG targets set for childhood immunization: for all types of childhood immunization, including those fully vaccinated, Punjab outperformed the other provinces as well as the national-level coverage. In KPK, the MDG targets for childhood immunization coverage were missed by a narrow margin. Immunization coverage was lowest in Baluchistan Province; however, in relative terms, the achievements in Baluchistan during 2000–2015 were substantial because it had the weakest baseline in

Table 2 Political governments in Pakistan, 2001–2015

Province	2001–2002	2004–2005	2010–2011	2014–2015
Federal	Military	PML (Q)	PPP	PML (N)
Punjab	Military	PML (Q)	PML (N)	PML (N)
Sindh	Military	PML (Q)	PPP	PPP
KPK	Military	MMA	ANP	PTI
Baluchistan	Military	MMA	PPP-led coalition	PML (N)-led coalition

KPK = Khyber Pakhtunkhwa; PML = Pakistan Muslim League; (Q) = Quid-e-Azam; (N) = Nawaz Sharif; PPP = Pakistan People's Party; MMA = Mutahida Majlis-Amal; ANP = Awami National Party; PTI = Pakistan Tehreek-e-Insaf

Table 3 National and provincial immunization coverage among children aged 1–5 years in Pakistan, 2001–2015

Vaccine	Year	Province				
		National (%)	Punjab (%)	Sindh (%)	KPK (%)	Baluchistan (%)
BCG ^a	2001–2002	64.1	70.1	55.1	70.6	26.5
	2004–2005	82.5	90.5	71.3	80.5	55.5
	2010–2011	83.3	89.2	79.0	80.6	50.5
	2014–2015	86.5	95.7	79.0	81.6	44.5
DPT/PV	2001–2002	64.0	73.6	50.3	62.7	36.8
	2004–2005	81.2	89.2	70.4	79.0	54.9
	2010–2011	81.9	87.4	78.5	78.6	50.9
	2014–2015	85.2	94.6	76.6	81.1	44.4
Polio	2001–2002	68.5	74.4	57.5	75.8	42.2
	2004–2005	82.3	89.7	71.4	82.6	55.4
	2010–2011	96.3	96.2	98.5	96.5	88.3
	2014–2015	97.3	97.9	96.5	97.9	94.1
Measles	2001–2002	61.1	70.3	48.2	59.6	35.0
	2004–2005	80.0	87.9	69.2	77.9	53.9
	2010–2011	80.3	85.6	76.8	77.5	50.7
	2014–2015	83.0	92.4	73.9	79.4	43.7
Fully vaccinated	2001–2002	56.2	63.4	47.0	58.3	19.3
	2004–2005	79.4	87.1	69.1	77.1	53.7
	2010–2011	75.1	85.2	56.9	76.8	45.9
	2014–2015	82.5	92.0	73.1	79.2	43.2

Coverage is defined as proportion of children aged 1–5 years, who had been vaccinated, as reported by recall and record methods for the years 2001–02, 2004–05.

Since 2010–11, the option of vaccination on immunization days was added to the question on vaccination.

KPK = Khyber Pakhtunkhwa; BCG = Bacillus Calmette–Guérin vaccine; DPT/PV = diphtheria, tetanus, pertussis vaccine combined with inactivated poliovirus vaccine.

^aIn 2010–11, the BCG vaccine was replaced by the pentavalent vaccine.

2000; for instance, polio immunization coverage doubled between 2001–2002 and 2014–2015 (Table 3). Generally, coverage followed steady growth trends in Punjab and KPK. In Sindh, the coverage for DPT/PV, polio and measles immunization was highest in 2010–2011 while in Baluchistan coverage for BCG, DPT/PV and measles immunization was highest in 2004–2005 (Table 3).

Equity in all provinces and at the national level remained pro-wealthy. In Sindh and Punjab and at the national level, equity improved for all types of immunization coverage. In KPK, equity was somewhat stagnant, while in Baluchistan equity worsened over the years for most types, except for polio vaccination (Table 4).

In the analysis of factors associated with immunization coverage, we found a time-invariant factor: lower odds of a child being vaccinated if they lived in Sindh, KPK or Baluchistan than in Punjab (Table 5). The differences were less pronounced for polio immunization than for the other types. The time-varying differences in immunization coverage indicated greater odds of being vaccinated in the later years (particularly 2010–2011 and 2014–2015) than in 2001–2002. Among household-level and individual-level characteristics, for better immunization coverage, the effect of better socioeconomic status was more pronounced than the other covariates. For polio vaccination, the effect of time

variation was more pronounced in 2010–2011 [adjusted odds ratio (aOR) 15.47] and 2014–15 (aOR 26.92) than time-invariant factors (Table 5).

Discussion

Our findings support the need for subnational level analysis to track the progress of health policies in highly populous countries, and justify intermittent analyses over long periods along with before and after comparisons. The findings in these analyses are robust in terms of common data sources, definitions of the variables, estimation methods, timespan, and policy-relevant time intervals of the analyses. The uneven pace of coverage and of equity in coverage highlights the effects of multiple factors and the complex nature of health-seeking behaviour among mothers and their children.

The achievements in regard to immunization coverage and equity in coverage between 2001–2002 and 2004–2005 may have been associated with 3 factors: accelerated growth of the economy, an unprecedented enhancement of budgetary allocation to the health ministry (14% in 2003–2004 and 16% in 2004–2005) and a relatively peaceful period, given that the Taliban insurgency and military operations started in the later years (6,24,25).

Over the period 2005–2010, coverage for fully vaccinated children decreased in all provinces. Coverage

Table 4 Equity in immunization in Pakistan

		National		Punjab		Sindh		KPK		Baluchistan	
BCG	2001–2002	13.5	***	10.5	***	20.0	***	8.6	***	14.6	**
	2004–2005	7.7	***	3.7	***	12.6	***	8.8	***	13.1	**
	2010–2011	9.6	***	6.0	***	10.0	***	12.2	***	23.6	***
	2014–2015	6.8	***	0.9	***	12.4	***	10.1	***	22.9	***
DPT/PV	2001–2002	13.2	***	9.6	***	21.6	***	9.7	***	13.9	**
	2004–2005	7.8	***	3.7	***	12.8	***	9.4	***	13.1	**
	2010–2011	9.8	***	6.3	***	10.1	***	12.4	***	23.3	***
	2014–2015	7.1	***	1.2	***	12.8	***	10.4	***	22.4	***
Polio	2001–2002	11.1	***	8.6	***	16.8	***	6.4	***	10.1	**
	2004–2005	7.4	***	3.8	***	12.2	***	7.1	***	12.6	*
	2010–2011	0.8	**	0.7	**	0.0		1.2		2.3	*
	2014–2015	0.4	**	0.3	**	–0.2		0.7	***	1.2	**
Measles	2001–2002	13.9	***	11.0	***	21.0	***	9.4	***	18.0	***
	2004–2005	8.2	***	4.3	***	12.8	***	9.5	***	13.7	**
	2010–2011	9.9	***	6.4	***	10.1	***	12.6	***	23.2	***
	2014–2015	7.5	***	1.6	***	13.0	***	10.4	***	23.3	***
Fully vaccinated	2001–2002	15.3	***	12.8	***	21.4	***	9.8	***	19.2	**
	2004–2005	8.2	***	4.2	***	12.9	***	10.0	***	13.7	**
	2010–2011	11.8	***	6.4	***	15.9	***	12.6	***	24.2	***
	2014–2015	7.6	***	1.6	***	12.9	***	10.5	***	23.7	***

^aConcentration indices are estimated by the methods provided by O'Donnell et al. 2008 (22).

***, **, * = statistically significant at the 1%, 5% and 10% level respectively.

Coverage is defined as proportion of children aged 1–5 years, who had been vaccinated, as reported by recall and record methods for the years 2001–02, 2004–05. Since 2010–11, the option of vaccination on immunization days was added to the question on vaccination.

KPK = Khyber Pakhtunkhwa; BCG = Bacillus Calmette–Guérin vaccine; DPT/PV = diphtheria, tetanus, pertussis vaccine combined with inactivated poliovirus vaccine.

^bIn 2010–11, the BCG vaccine was replaced by the pentavalent vaccine.

for measles, DPT and BCG immunization decreased in all provinces except Sindh: this was probably because Sindh was less affected by the Taliban insurgency than other provinces, where the war on terror was most intense.

There was a remarkable increase in polio immunization coverage and equity in coverage during this period because of the local and international focus on polio and the door-to-door immunization campaigns organized during the national immunization days.

Between 2004–2005 and 2010–2011, progress was sporadic at the national and provincial levels (and even declined in a few cases), including coverage of fully vaccinated children. The year 2010 marked the decentralization of the health sector from federal to provincial government. The roles of the health sector most affected were the vertical primary health care projects, including the EPI and lady health worker programmes, both of which are crucial to childhood immunization (26). In 2010–2011, immense uncertainty prevailed among the vaccinators and the lady health workers regarding their future after the transfer of these programmes to the provincial health departments. However, the circumstances of both programmes improved later. For example, post-devolution, the health sector budget increased almost 4-fold (from PKR 55 billion to PKR 199 billion) (27).

In a few cases, coverage in Punjab was comparable to that in KPK over the study period, for example, polio and tetanus toxoid immunization, but Punjab outpaced KPK in its progress on equity in immunization coverage. Punjab had been relatively less affected by the consequences of the war on terror than KPK, where most of the military operations and internal displacements happened (28). Due to the 2 successive tenures of the Pakistan Muslim League in Punjab and the Pakistan People's Party in Sindh, these provinces had benefited from a continuity of policies (Table 1). The performance in Sindh was not affected by the heat waves and floods of 2010 and 2011: the specific immunization plan for flood-affected areas implemented by the provincial health department proved to be an effective strategy during this emergency (29).

Our estimates of childhood immunization coverage were generally higher than those reported by Countdown to 2030 for 2006–2006 and 2012–2013 (3,6). We found fewer inequities in childhood immunization than reported by Countdown to 2030 (3,6,12). Estimation of immunization coverage varies in different analyses due to the multiplicity of definitions and reporting procedures used. We used immunization as reported by both recall and records; analyses by Countdown to 2030 on the DHS 2006–2007 defined immunization as reported on the immunization card only (3), while analyses for the DHS 2012–2013 used the immunization card records and respondents' recall (30). This may be a

Table 5 Logistic regression estimates for time invariant determinants of childhood (age 1–5 years) vaccination in Pakistan, 2001–2015 (n = 94 292)

Determinant	Vaccine				Fully vaccinated
	BCG aOR (95%CI)	DPT/PV aOR (95%CI)	Polio aOR (95%CI)	Measles aOR (95%CI)	AOR (95%CI)
Year					
2001–2002	–	–	–	–	–
2004–2005	3.29*** (2.75–3.93)	2.95*** (2.49–3.5)	2.07*** (1.78–2.41)	2.97*** (2.53–3.48)	3.83*** (3.27–4.5)
2010–2011	3.72*** (3.13–4.43)	3.34*** (2.83–3.95)	15.47*** (12.54–19.08)	3.28*** (2.8–3.83)	2.84*** (2.42–3.35)
2014–2015	3.61*** (3.16–4.11)	3.29*** (2.9–3.72)	26.92*** (23.27–31.13)	3.16*** (2.81–3.55)	4.09*** (3.63–4.6)
Province					
Punjab	3.61*** (3.16–4.11)	3.29*** (2.9–3.72)	26.92*** (23.27–31.13)	3.16*** (2.81–3.55)	4.09*** (3.63–4.6)
Sindh	0.27*** (0.24–0.3)	0.26*** (0.24–0.29)	0.56** (0.49–0.65)	0.31*** (0.28–0.34)	0.3*** (0.27–0.33)
KPK	0.22*** (0.19–0.25)	0.21*** (0.19–0.24)	0.83** (0.7–0.98)	0.25*** (0.23–0.29)	0.28*** (0.25–0.32)
Baluchistan	0.06*** 0.06–0.07	0.08*** (0.07–0.09)	0.26*** (0.22–0.3)	0.1*** (0.09–0.11)	0.09*** (0.08–0.1)
Male sex	1.05** (1.01–1.08)	1.03* (1–1.07)	1.01 (0.96–1.06)	1.03** (1–1.07)	1.04** (1.01–1.07)
Rural residence	0.62*** (0.54–0.69)	0.66*** (0.59–0.74)	0.81*** (0.7–0.94)	0.71*** (0.64–0.79)	0.72** (0.65–0.8)
Socioeconomic status (quintile)					
Poorest	0.11 (0.09–0.13)	0.11 (0.1–0.13)	0.21 (0.17–0.26)	0.13 (0.11–0.15)	0.13*** (0.11–0.15)
Poor	0.24*** (0.21–0.28)	0.24*** (0.21–0.28)	0.32*** (0.27–0.39)	0.26*** (0.23–0.3)	0.27*** (0.23–0.3)
Middle	0.39*** (0.34–0.46)	0.4*** (0.35–0.46)	0.41*** (0.34–0.49)	0.42*** (0.37–0.48)	0.42*** (0.37–0.48)
Rich	0.6*** (0.52–0.7)	0.6*** (0.52–0.7)	0.57*** (0.47–0.69)	0.63*** (0.55–0.72)	0.6*** (0.53–0.68)
Richest	–	–	–	–	–

BCG = Bacillus Calmette–Guérin vaccine; DPT/PV = diphtheria, tetanus, pertussis vaccine combined with inactivated poliovirus vaccine aOR = adjusted odds ratios; CI = confidence interval. ***, **, * = statistically significant at 1%, 5% and 10% level respectively.

factor in the substantial achievements in immunization coverage and equity of coverage between 2006 and 2012 as estimated in these reports (3,6).

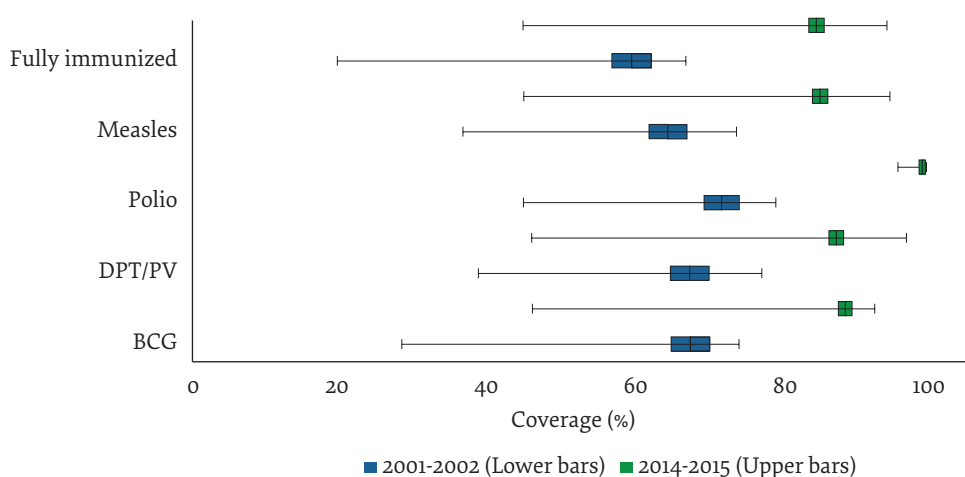
Due to the number of factors involved, our coverage estimates were higher than those reported in the 2020–2021 Third-Party Verification Immunization Coverage Survey (TPVICS). We associate the lower values for immunized children reported in the TPVICS (89.9% in Punjab, 61.1% in Sindh, 68.4% in KPK, 37.6% in Baluchistan) to the different age groups in each survey: the TPVICS sampled children aged 11–23 months while we sampled children aged 1–5 years in our analysis. Other factors accounting for the higher estimates in our analysis include differences in period of analysis, sampling design, etc. (31).

Although the national level MDG targets for immunization coverage were set at 90%, we could not identify any efforts at provincial level to adopt these targets. This was crucial, as baseline levels of

immunization coverage differed substantially between the provinces. For example, national coverage for BCG was 86% in 2015, almost achieving the MDG target, whereas Baluchistan missed this target by a large margin (44.5%). However, the BCG coverage at baseline in Baluchistan was less than half (26.5%) the national baseline coverage (64.1%). Consequently, setting a target of > 90% coverage for Baluchistan was extremely ambitious: this not only undermined the progress of immunization coverage in the province but also dragged down the national level coverage (Figure 1).

We could not find any specific target-setting on equity in coverage in the national policy and planning documents of the government or the development partners except for tracking in the districts which recorded low coverage. In national surveys on equity, such as the Pakistan DHS and PSLM reports, immunization coverage is reported by income quintile or socioeconomic status quintile.

Figure 1 Comparison of interprovincial variation and national vaccination coverage among children aged 1–5 years in 2001–2002 and 2014–2015 in Pakistan



Boxes represent (Punjab), means and 95% confidence intervals. Whiskers are minimum coverage (Baluchistan) and maximum coverage (Punjab), except that BCG and polio coverage was highest among provinces in 2001-2002

The greater odds recorded for time (year of survey) than for other determinants for all types of immunization, particularly in the case of polio vaccine coverage, may be associated with such factors as the improvement in law and order, control of militant insurgencies, and decentralization of health care to the provinces in 2010. The greater impact of time on polio immunization coverage than the other types is an indication of the effect of the door-to-door polio eradication immunization campaigns, which improved access and overcame household cost barriers on childhood immunization. The adjusted odds of not being vaccinated for polio in Baluchistan were similar to the adjusted odds of not being vaccinated for BCG and DPT/PV in Sindh and not being vaccinated for measles in KPK. This implies that, along with certain other factors, improving access in areas of low population density in Baluchistan will improve coverage for these vaccines to the levels seen in KPK and Sindh provinces.

In our efforts to validate our findings, we explored the immunization coverage reported in the most recent round of the PSLM in 2019–2020. Coverage for all types of vaccines included in this analysis was reported in the Social and Living Measurement Survey 2019–2020 (Table 6) (17). Pakistan falls short on immunization coverage targets except for the BCG vaccine (91% in 2019–2020). Ranking of the provinces in terms of immunization coverage followed a similar trend as during the MDG era: Punjab was ahead of the national average and of the other provinces, followed by KPK and Sindh, and seems to have achieved the target. This strengthens our finding that the provincial ranking for immunization coverage is a time-invariant factor (Table 5). These findings call for stringent and innovative strategies to increase immunization coverage in Sindh and Baluchistan, otherwise, Pakistan will most likely miss the immunization coverage targets set for the Sustainable Development Goals up to 2030.

To correlate the slow progress on childhood immunization in Baluchistan with financing of the EPI programme, we identified a few financial documents that covered the analysis and forecasting of public budgetary expenditure and sources of funding (32,33). Masud et al analysed previous expenditure on the EPI coupled with immunization coverage to forecast additional requirements based on certain assumptions regarding immunization coverage (34). In estimating the cost of a fully vaccinated child, they suggest the cost was higher in Baluchistan (US\$ 95) than at national level (US\$ 75) or in the other provinces (Punjab US\$ 71, Sindh US\$ 77, KPK US\$ 82) (34). However, using immunization coverage as the denominator for their cost estimates, the authors did an injustice to the efforts of the immunization programme in Baluchistan by classifying it as being more expensive than the other provinces (34).

Our analyses have provided some explanation of the time trends for immunization coverage and equity in coverage in Pakistan during the study period, yet they did not establish causality: no association was identified with the level of effort of the federal government nor with any socioeconomic or climate factors. Aggravated

Table 6 Childhood vaccination coverage (%) in Pakistan, 2019–20

Province	BCG	DPT/PV	Polio	Measles	Fully vaccinated
National	91	85	88	84	81
Punjab	96	92	90	91	89
Sindh	85	76	84	77	73
KPK	89	84	91	79	75
Baluchistan	65	58	78	58	50

Source: Pakistan Social and Living Measurement Survey 2019–20 (17).

BCG = Bacillus Calmette–Guérin vaccine.

DPT/PV = diphtheria, tetanus, pertussis vaccine combined with inactivated poliovirus vaccine.

KPK = Khyber Pakhtunkhwa.

inequities in Baluchistan and KPK provinces require further research to explore behavioural and managerial aspects of service delivery, especially in cases where performance is challenging. Our findings indicate that further research is required to evaluate coverage and equity in coverage of childhood immunization in respect to some of the strategic reforms that have been enacted, such as devolution of the health sector in Pakistan in 2010.

Conclusion

Pakistan has made substantial progress on immunization coverage yet it missed the childhood immunization

targets set in the MDGs. Our analysis provides some simple guidelines for developing an appropriate strategy for tracking progress on childhood immunization. During the Sustainable Development Goals, we had proposed setting targets at subnational levels and tracking progress at regular intervals over the period 2015–2030. We propose a somewhat similar strategy for financing the Sustainable Development Goals: realistic forecasting and phasing of financial targets.

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Examen de la couverture vaccinale des enfants au Pakistan

Résumé

Contexte : Le Gouvernement pakistanais a accordé la priorité à l'expansion de la vaccination des enfants et investi des ressources substantielles dans ce domaine, en vue d'accroître la couverture vaccinale pour qu'elle dépasse 90 %. Il est donc important de suivre les progrès accomplis pour atteindre cet objectif.

Objectif : Suivre les progrès réalisés en matière de couverture vaccinale chez les enfants au Pakistan, au début et à la fin de l'étude ainsi que lors de deux jalons intermédiaires importants (2005 et 2010).

Méthodes : En prenant l'année 2001 comme référence, nous avons collecté des données importantes (2005, 2010, 2015) sur la vaccination des enfants dans le cadre de l'enquête sur l'évaluation des conditions sociales et du niveau de vie au Pakistan pour les enfants dont l'âge était compris entre un et cinq ans. Nous avons analysé les données à l'aide du logiciel STATA version 15.1 et estimé l'indice de concentration pour les variables associées afin d'analyser l'équité en matière de couverture.

Résultats : La couverture vaccinale ne suivait pas une tendance constante à la hausse et variait selon la province. Au cours de la période de 15 ans (2001-2015), la couverture vaccinale des enfants a connu une augmentation considérable. Même si plus de 80 % des enfants d'un ans à cinq ans étaient vaccinés en 2015 au niveau national, le Pakistan n'a pas atteint les cibles des objectifs du Millénaire pour le développement en matière de vaccination de l'enfant. Seule la province du Pendjab a atteint les cibles en matière de vaccination des enfants (92,0 % au Pendjab contre 82,5 % au niveau national). Un statut socio-économique plus élevé augmentait la probabilité d'être vacciné, tandis que le fait de vivre en zone rurale la diminuait.

Conclusion : Pour améliorer la couverture vaccinale des enfants au Pakistan et atteindre les cibles des objectifs de développement durable correspondants, il est important que le Gouvernement fixe des cibles au niveau provincial, alloue davantage de ressources et continue à suivre régulièrement les progrès réalisés jusqu'en 2030.

استعراض التغطية بالتطعيم في مرحلة الطفولة في باكستان

محمد أشعر مالك، محمد منيب الله صديقي

الخلاصة

الخلفية: أولت حكومة باكستان الأولوية لتوسيع نطاق تطعيم الأطفال، واستثمرت موارد ضخمة في توسيعه، بهدف زيادة التغطية إلى أكثر من 90%. ولذلك من المهم تتبع التقدم المحرز نحو تحقيق هذه الغاية.

الأهداف: هدفت هذه الدراسة إلى تتبع التقدم المحرز في التغطية بالتطعيم في مرحلة الطفولة في باكستان عند خط الأساس وخط النهاية وعند مرحلتين رئيسيتين مهمتين (2005 و2010).

طرق البحث: باستخدام عام 2001 خطًا للأساس، جمعنا بيانات مرحلية (2005 و2010 و2015) عن تطعيم الأطفال من "مسح قياس المستوى الاجتماعي والمعيشي في باكستان" للأطفال الذين تتراوح أعمارهم بين سنة واحدة و5 سنوات. وقد حللنا البيانات بالإصدار 15.1 من برمجية STATA، وقدرنا مؤشر التركيز للمتغيرات المقيدة لتحليل الإنصاف في التغطية.

النتائج: لم تتبع التغطية بالتطعيم اتجاهاً متصاعداً متسقاً، وتفاوتت بحسب الإقليم. وعلى مدار 15 عاماً (2001–2015)، زادت تغطية الأطفال بالتطعيم زيادة ملحوظة. وعلى الرغم من تطعيم أكثر من 80٪ من الأطفال الذين تتراوح أعمارهم بين سنة واحدة و5 سنوات بحلول عام 2015 على المستوى الوطني، لم تحقق باكستان غايات الأهداف الإنمائية للألفية الخاصة بتطعيم الأطفال. ولم يحقق الغايات المتعلقة بتطعيم الأطفال سوى إقليم البنجاب (92.0٪ في البنجاب مقابل 82.5٪ على المستوى الوطني). وقد أدى ارتفاع الحالة الاجتماعية والاقتصادية إلى زيادة احتمالات الحصول على التطعيم، بينما انخفضت هذه الاحتمالات في المناطق الريفية.

الاستنتاجات: لتحسين التغطية بالتطعيم في مرحلة الطفولة في باكستان وتحقيق غايات أهداف التنمية المستدامة ذات الصلة، من المهم أن تحدد الحكومة غايات على مستوى الأقاليم، وأن تخصص المزيد من الموارد، وأن تواصل التتبع المنتظم للتقدم الذي تجرزه حتى عام 2030.

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