The Reality of Children's Immunization under Five years of Age in Algeria: An Analytical Study on the Light of Algeria's MICS 2019 Data

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Abstract
This article examines the current state of vaccination among children under five in Algeria through an in-depth analysis of data from the Multiple Indicator Cluster Survey (MICS6), conducted in Algeria during 2018–2019 under the supervision of the Ministry of Health, Population, and Hospital Reform, in collaboration with UNICEF. The article examined vaccination coverage rates for the various vaccines included in the Expanded Program on Immunization (EPI) and highlighted the disparities observed across geographic regions and socioeconomic levels. The results revealed that coverage for the tuberculosis vaccine (BCG) reached 97.7% in the 12–23-month age group, while the rate of full vaccination dropped to only 61.0% in the 24–31-month age group according to the new national schedule, with significant gaps favoring the northeastern region compared to the central highlands and the south. These findings underscore the need to strengthen vaccination interventions in vulnerable areas and among families with low educational levels.
Keywords: *vaccination; children under five; Expanded Program on Immunization (EPI); Multiple Indicator Cluster Survey (MICS); Algeria; social disparities*

Introduction
Vaccination represents one of the most significant preventive achievements in the history of modern medicine; researchers and public health experts agree that it is an exceptionally effective preventive measure, as it helps curb the spread of infectious diseases and significantly reduces child mortality rates. André and colleagues estimated that vaccination prevents between two and three million deaths annually worldwide (André et al., 2008). Studies conducted by Black and colleagues also showed that specific diseases such as measles and meningitis were among the leading causes of death among children under five, and that vaccination constitutes the most effective protective shield against them (Black et al., 2010).

In Algeria, efforts have been made for decades to invest in the immunization system through the Expanded Program on Immunization (EPI), which has enabled the country to achieve tangible health gains, including the elimination of polio, diphtheria, and pertussis, and a reduction in infant mortality rates, which fell to 21 per 1,000 live births in 2019 (Ministry of Health, Population, and Hospital Reform; UNICEF 2020).

Starting in April 2016, the program underwent a major update with the inclusion of new vaccines such as the pentavalent vaccine, the pneumococcal vaccine, and the yellow fever vaccine, which gave additional momentum to prevention efforts.

However, aggregate figures alone do not paint the full picture, as the disparities resulting from socio-economic and geographic factors may obscure groups of children who are not receiving the desired vaccination coverage. Hence the scientific importance of this article, which seeks to paint an accurate

and objective picture of the reality of vaccination in Algeria, based on data from the 2019 Multiple Indicator Cluster Survey (MICS6), as the most comprehensive and up-to-date national statistical reference on this subject.

II. Research Problem and Objectives

1. Research Problem

Despite all efforts made in the field of vaccination in Algeria, questions regarding the extent to which universal and equitable coverage has been achieved remain at the forefront of demographic and health research. Do national coverage rates reflect a homogeneous reality, or are there fundamental disparities between regions and social groups? Which vaccines are most likely to show a decline in full-dose coverage rates?

This study seeks to answer the following key question: What is the reality of vaccination coverage for children under five in Algeria according to data from the 2019 Multiple Indicator Cluster Survey, and what are the most significant socio-demographic and geographic disparities associated with it?

Objectives of the Study

This study aims to achieve the following objectives:

- Monitor vaccination coverage rates for each vaccine in the National Immunization Program among children aged 12–23 months and 24–31 months.
- Analyze geographical disparities in vaccination coverage across the seven program regions in Algeria (North-Central, Northeast, Northwest, Central High Plateaus, Eastern High Plateaus, Western High Plateaus, and South).
- Exploring the impact of socio-economic determinants, such as maternal education level and economic well-being indicators, on vaccination rates.
- Providing evidence-based recommendations to strengthen the national immunization response.

III. Theoretical Framework and Literature Review

1. Vaccination as a Public Health Priority

The World Health Organization has adopted a clear strategy to strengthen vaccination globally, embodied in the launch of the Global Vaccination Action Plan 2011–2020 (GVAP), followed by the formulation of the Immunization Agenda 2030 (IA2030), which aims to achieve a better life by vaccinating everyone everywhere (World Health Organization, 2021). This agenda includes explicit commitments to reduce the gap in vaccination coverage between and within countries.

Within the framework of the 2030 Sustainable Development Goals, indicator SDG 3.b.1, which measures the proportion of the target population covered by vaccinations included in the national program, constitutes a central benchmark for monitoring progress. André et al. confirm that vaccination significantly reduces disease, disability, mortality, and inequality worldwide (André et al., 2008).

2.Determinants of Vaccination Coverage from a Demographic Perspective

The determinants of vaccination coverage can be categorized into geographic, societal, and individual dimensions. At the geographic level, for example, the distance to healthcare centers and the roads leading to them contribute to significant disparities in vaccine access. At the social level, maternal education, income level, and social status top the list of determinants influencing vaccination decisions. Maternal education is an important indicator closely linked to her level of health awareness and her ability to interact with the formal health system (Victora et al., 2003).

Black et al. have documented that the causes of deaths among children under five are largely preventable, and that expanding vaccination coverage is one of the most important health investments of all (Black et al., 2010). Comparative studies between rich and poor countries have also revealed a marked disparity in access to vaccination services.

3. The Vaccination Program in Algeria

The history of the Expanded National Immunization Program in Algeria dates back to the 1980s, during which time the list of available free vaccines has undergone continuous expansion. Following amendments to the national immunization schedule in April 2016, the program now includes the BCG vaccine against tuberculosis, polio vaccines (VPO, VPI), and the pentavalent vaccine (DTP-HepB-Hib), in addition to the pneumococcal vaccine (PCV) and the measles, mumps, and rubella (MMR) vaccine in two doses, as well as the yellow fever vaccine (Ministry of Health and UNICEF, 2020). This vaccination series is completed during the child's first year of life, with the exception of the second dose of the ROR vaccine, which is administered at 18 months of age.

IV. Methodological Framework

1. Data Source

This study is based entirely on data from the 2019 Multiple Indicator Cluster Survey (MICS6) for Algeria, which is the fifth survey of its kind in Algeria and the sixth globally. This survey was conducted between December 2018 and April 2019, under the supervision of the Population Directorate of the Ministry of Health, Population, and Hospital Reform, with technical and financial support from the United Nations Children's Fund (UNICEF) and the United Nations Population Fund (UNFPA).

2. Sample and Characteristics

The survey adopted a two-stage cluster sampling method and included 31,325 selected households. Interviews were successfully conducted with 29,919 of them, yielding a response rate of 96.7%. Data collection covered 14,873 children under the age of five, for whom their mothers or caregivers were interviewed. The Computer-Assisted Personal Interviewing (CAPI) system was used, marking its first implementation in Algeria for this purpose.

3. Measuring Vaccination Coverage

Vaccination information for all children less than three years of age was collected from health records or from statements provided by the mother or caregiver in the absence of official documentation. Individual vaccine coverage was calculated based on children aged 12–23 months, while full coverage was measured for children aged 24–31 months in accordance with the new national schedule in effect since April 2016, which requires the vaccination series to be completed by the 18th month.

4. Analysis Methods

The study relied on descriptive statistical analysis of coverage indicators, along with the use of comparative analysis at both the geographic level (the seven programmatic regions) and the socio-economic level (mother's education level and the household wealth index). The data were reweighted using appropriate weighting to ensure national representativeness. In addition, dropout rates for each vaccination series were analyzed according to the formula: (coverage of the first dose − coverage of the third dose) / coverage of the first dose × 100. To identify the independent determinants of full immunization after adjusting for confounding variables, a binary logistic regression (Logistic Regression) was conducted on a sample of children aged 24–31 months (N=1,981), with full

immunization as the dependent variable (yes=1 / no=0), and the independent variables being: geographic region, mother's education level, and household wealth index.

V. Results and Analysis

1. Vaccination Coverage by Vaccine Type

Table 1 presents vaccination coverage levels for the various vaccines included in the national program, classified by source (vaccination booklet or mother's declaration) and by age group: 12–23 months and 24–31 months.

Table 1: Vaccination coverage rates by vaccine type – MICS6 Algeria

Vaccine	General Coverage 12-23 months	General Coverage 24-31 months
BCG	97.7%	96.7%
Hepatits B at Birth	97.1%	96.4%
VPO	96.9%	96.0%
VPO1	92.1%	90.8%
VPO2	84.2%	83.5%
VPO3	58.2%	73.3%
VPI	92.6%	90.9%
DTC-HepB-Hib2	95.5%	94.1%
DTC-HepB-Hib2	87.6%	86.5%
DTC-HepB-Hib) 3	62.1%	77.3%
PCV1	94.2%	90.9%
PCV 2	85.0%	82.7%
PCV) 3	56.4%	72.9%
ROR 1	84.1%	90.7%
ROR2	21.2%	61.7%
Total full Vaccination – National rate	21.1%	61.0%

Source: Authors' compilation from Ministère de la Santé, de la Population et de la Réforme Hospitalière & UNICEF (2020). Multiple Indicator Cluster Survey – MICS6 Algeria 2019: Survey Findings Report. Table TC.1.1, p. 228.

A review of this table reveals a clear pattern: the initial doses—administered at birth and during the first few months—have very high coverage rates exceeding 90%, whereas coverage for later doses shows a significant decline. The VPO3 dose did not exceed 58.2% in the 12–23-month age group before rising to 73.3% in the 24–31-month age group. This gradual decline reflects what is known in public health literature as the "dropout rate," meaning a decrease in adherence across doses within a single vaccination series. It is noteworthy that full vaccination in the 24–31-month age group did not exceed 61.0%, meaning that approximately four out of every ten children did not complete the vaccination schedule stipulated in the National Immunization Calendar.

2. Supplement. Immunization dropout rates

Immunization dropout rates reveal a notable structural phenomenon: despite the high uptake of initial doses, completion declines sharply as the series progresses. In the 12–23 months age group, the dropout rate reaches approximately 40.1% for the PCV series, 35.0% for DTCoq-HepB-Hib, and 36.8% for OPV. Considering the full pathway from BCG to complete immunization, the dropout rate amounts to 78.4% in the 12–23 months age group, decreasing to 36.9% in the 24–31 months age group.

Table (2): Immunization Dropout Rates by Vaccine Series – MICS6 Algeria 2019

Vaccine Series	Dose 1 (12–23)	Dose 3 (12–23)	Dropout %	Dose 1 (24–31)	Dose 3 (24–31)	Dropout %	Assessment
VPO	92.1%	58.2%	36.8%	90.8%	73.3%	19.3%	High
DTCoq-HepB-Hib	95.5%	62.1%	35.0%	94.1%	77.3%	17.9%	High
PCV	94.2%	56.4%	40.1%	90.9%	72.9%	19.8%	High
ROR	84.1%	21.2%*	74.8%*	90.7%	61.7%	32.0%	High
BCG → Full	97.7%	21.1%	78.4%	96.7%	61.0%	36.9%	Critical

Source: Authors' compilation from Ministère de la Santé, de la Population et de la Réforme Hospitalière & UNICEF (2020). Multiple Indicator Cluster Survey – MICS6 Algeria 2019: Survey Findings Report. Table TC.1.2, p. 229.

* The dropout rate for ROR in the 12–23 months age group is high because the second dose is scheduled at 18 months.

3. Geographical Disparities in Vaccination Coverage

To gain a deeper understanding of the distribution of vaccination coverage, Table 2 presents BCG and VPO3 vaccinations and full vaccination rates categorized by the seven program areas adopted by the survey.

Table 3: Vaccination coverage by geographic program area – MICS6 Algeria 2019.

Programmation	BCG 12-23 months	VPO3 12-23 months	Total Vaccination 24-31 months
National Level	58.2%	61.0%	97.7%
North Centre	63.9%	63.0%	96.6%
North East	70.9%	70.6%	99.5%
North West	59.6%	57.4%	98.5%
Central High Plains Region	31.7%	30.2%	95.2%
Eastern High Plains Region	54.7%	54.0%	96.9%
Western High Plains	52.1%	50.9%	96.6%

South	52.5%	51.7%	99.1%

Source: Authors' compilation from Ministère de la Santé, de la Population et de la Réforme Hospitalière & UNICEF (2020). Multiple Indicator Cluster Survey – MICS6 Algeria 2019: Survey Findings Report. Table TC.1.2, p. 229.

These data reveal disparities across different geographic regions. The northeastern region leads the rankings by a clear margin, recording 70.6% for full vaccination and 70.9% for VPO3, compared to the central highlands, which recorded the lowest rates at only 30.2% for full vaccination—a sharp disparity exceeding 40 percentage points between two regions within the same country. The BCG vaccine—administered in the hospital at birth—remains relatively high across all regions (95.2%–99.5%), indicating that the issue lies not in access to the healthcare system but in continuity and follow-up throughout the vaccination stages.

The southern region ranks in the middle in terms of full coverage (51.7%), with a relatively high BCG rate (99.1%), indicating that mothers are willing to have their children vaccinated in the hospital but do not complete the subsequent doses at health centers near their homes. This may reflect the reality of population dispersion and the difficulty of transportation, particularly in remote areas and vast desert regions.

4. The Impact of the Mother's Educational Level on Vaccination Coverage

Survey data reveal a clear correlation between the mother's educational level and the quality of vaccination coverage for her children. As the mother's educational level increases, coverage rates rise, particularly for doses administered after the fourth month of life (Ministry of Health, UNICEF 2020).

Table 4: Vaccination Coverage by Mother's Educational Level

Mother's Educational Level	VPO3 12-23 Months	BCG 12-23 months	Total Vaxination 24-31 months
Uneducated	41.3%	96.3%	46.8%
Primary School Level	54.5%	97.9%	52.2%
Middle school Level	59.7%	98.2%	63.9%
Secondary School Level	63.2%	97.6%	68.3%
Gratduate Level	61.2%	97.7%	63.1%

Source: Authors' compilation from Ministère de la Santé, de la Population et de la Réforme Hospitalière & UNICEF (2020). Multiple Indicator Cluster Survey – MICS6 Algeria 2019: Survey Findings Report. Table TC.1.2, p. 230.

The data show that the gap in full vaccination coverage (for children aged 24–31 months) between children of mothers with no education (46.8%) and children of mothers with a secondary education (68.3%) is approximately 21.5 percentage points, a highly significant disparity. In contrast, this gap does not exceed 1.9 percentage points for the BCG vaccine, which is administered at birth in the hospital. It is noted that mothers with a secondary education outperform their counterparts with a university education in terms of coverage (68.3% versus 63.1%), suggesting that factors such as full-time caregiving may outweigh the factor of education alone.

5. The Impact of Household Economic Well-being

The National Cluster Surveys focus on household economic well-being as one of the most reliable indicators for highlighting disparities among households in accessing basic services, particularly childhood vaccination.

Table 5 shows that the economic well-being index reveals significant disparities, though these are less pronounced than those associated with education. In the poorest quintile, the full vaccination rate stands at 51.2%, while it rises to 61.9% in the richest quintile. It is noteworthy that the fifth and top fifth do not show a statistically significant disparity between them, suggesting that the greatest impact of wealth is concentrated among the poorer groups.

Table 5: Vaccination Coverage by Household Economic Well-being Index.

Economic Wellbeing Indicator	VPO3 %	BCG %	Total Vaccination 24-31 months
The Poor Fifth	**51.8%**	**97.2%**	**51.2%**
The Second Fifth	**61.2%**	**98.6%**	**59.4%**
The Medium Fifth	**58.8%**	**97.3%**	**58.5%**
The Fourth Fifth	**58.9%**	**97.6%**	**56.8%**
The Richest Fifth	**62.2%**	**97.7%**	**61.9%**

Source: Authors' own calculations based on MICS6 Algeria 2019 (Table TC.1.1, p. 228), using the dropout rate formula: (Dose 1 coverage − Dose 3 coverage) / Dose 1 coverage × 100.

6. Binary Logistic Regression Analysis — Independent Determinants of Full Immunisation

To isolate the independent effect of each determinant after adjusting for all other variables, a binary logistic regression was performed on the subsample of children aged 24–31 months (N=1,981). The results presented in Table 6 reveal that geographical region constitutes the strongest determinant overall: the odds of full immunisation in the Central High Plateaus are 82% lower than in the Central North (OR=0.18, p<0.001), and 68% lower in the Western High Plateaus (OR=0.32, p<0.001). With respect to maternal education, the secondary level exerts the greatest effect (OR=1.63, p=0.004), whereas the effect of tertiary education fails to reach statistical significance (OR=1.11, p=0.593) — a finding that accounts for the descriptive superiority of mothers with secondary education over their university-educated counterparts. Regarding economic welfare, the model reveals a non-linear pattern: the middle quintile records the highest odds ratio (OR=1.95, p<0.001), while the fourth quintile does not differ significantly from the poorest quintile (OR=1.21, p=0.233), suggesting that crossing the threshold of extreme poverty is the more influential factor, rather than a gradual increase in income.

Table 6: Logistic Regression Results — Determinants of Full Immunisation (Age Group 24–31 Months) | N=1,981 | Pseudo R^2 = 0.082

Variable	OR	95% CI	p-value	Significance
Geographical Region — Reference: Central North				
North-East	1.12	[0.74 – 1.69]	0.597	—
North-West	0.59	[0.39 – 0.88]	0.010	*
Central High Plateaus	0.18	[0.12 – 0.26]	<0.001	***
Eastern High Plateaus	0.60	[0.40 – 0.89]	0.011	*
Western High Plateaus	0.32	[0.22 – 0.47]	<0.001	***

South	0.41	[0.28 – 0.59]	<0.001	***
Maternal Education Level — Reference: No Education				
Primary	1.15	[0.81 – 1.61]	0.438	—
Middle	1.40	[1.03 – 1.90]	0.034	*
Secondary	1.63	[1.16 – 2.28]	0.004	**
University	1.11	[0.76 – 1.61]	0.593	—
Economic Welfare Index — Reference: Poorest Quintile				
Second Quintile	1.64	[1.24 – 2.17]	<0.001	***
Middle Quintile	1.95	[1.44 – 2.63]	<0.001	***
Fourth Quintile	1.21	[0.88 – 1.66]	0.233	—
Richest Quintile	1.49	[1.04 – 2.16]	0.032	*

**** p<0.001 ** p<0.01 * p<0.05 — Not significant | OR: Odds Ratio | 95% CI: 95% Confidence Interval*

Source: Authors' own calculations based on MICS6 Algeria 2019 microdata (ch.sav). Binary logistic regression; dependent variable: complete vaccination (yes=1/no=0); sample restricted to children aged 24–31 months (N=1,981). Reference categories: Nord Centre (region), no education (maternal education), poorest quintile (wealth index).

VI. Discussion of Results

The findings of this article present a composite picture of the immunisation landscape in Algeria, one that combines tangible achievements with persistent gaps requiring continuous and targeted intervention. On the one hand, the high BCG coverage rates (97.7%) reflect household confidence in the health system and its readiness for vaccination at birth. On the other hand, the full immunisation rate (61.0% among children aged 24–31 months), accompanied by elevated dropout rates, reveals that the fundamental challenge lies not in access to initial doses but in sustaining the complete immunisation schedule. The logistic regression model confirms that this dropout is not random, but rather concentrated within specific regions and social groups.

The poor performance of the Central High Plateaus region — where full immunisation coverage does not exceed 30.2% descriptively and registers a logistic regression odds ratio of OR=0.18 relative to the North — constitutes the most salient issue identified. This underperformance most likely reflects the convergence of multiple structural factors: low health infrastructure density, geographic distance from immunisation centres, low educational and economic levels among households in the region, as well as cultural factors that warrant in-depth qualitative investigation. This finding aligns with observations from other studies indicating that geographical disparities in immunisation coverage in middle-income countries frequently mirror deeper inequalities in the distribution of health resources.

Regarding the education determinant, its impact extends beyond mere awareness of the importance of vaccination; it is also linked to a mother’s ability to read the vaccination schedule, coordinate her appointments with the health facility, and understand the risks of interrupting the vaccination series. This calls for the development of awareness-raising materials in various formats, such as radio and

television broadcasts and advertisements across all available media that can reach mothers regardless of their educational level.

These findings align with the recommendations of the World Health Organization's Immunization Agenda 2030, which emphasizes the need to identify gaps within each country and work to narrow them as much as possible through a collaborative approach involving the government, local communities, and international organizations (World Health Organization, 2021).

Conclusion and Recommendations

This study reveals that the current state of vaccination in Algeria is characterized by a key dichotomy: widespread availability and good uptake of first doses, contrasted with a marked decline in rates of completing vaccination series. Analysis of MICS6 data revealed that this decline is exacerbated in the Central and Southern Highlands, and among families with low educational attainment and lower incomes. Based on these findings, the article offers a set of recommendations:

- At the national policy level: Develop an integrated information system to track each child's vaccination status, along with reminder mechanisms for families via SMS or smartphone apps.
- At the field intervention level: Intensify neighborhood vaccination sessions in the most underserved areas, particularly in rural and remote regions.
- At the awareness and outreach level: Design awareness campaigns specifically tailored for uneducated mothers, explaining the stages of the vaccination schedule in simple terms.
- At the scientific research level: Conduct qualitative studies to explore the underlying causes of incomplete vaccination in the most disadvantaged areas, in coordination with national statistical agencies to conduct periodic surveys.

Ultimately, universal vaccination remains a top-priority demographic and health issue, and the Algerian health system bears the responsibility of redoubling its efforts to close the coverage gaps identified by the MICS6 survey, which could jeopardize the health of a significant number of children and impact their lives.

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