University of Dongola

Faculty of Medicine and Health Sciences

Department of Community Medicine

Graduation Research Project – Batch (23)

RESEARCH PROPOSAL

Factors Associated with Incomplete Routine Childhood Immunization Among Children Aged 12–59 Months in Dongola City, Northern State, Sudan:2026

Submitted by:

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1. Introduction

1.1 Background

Childhood immunization is one of the most effective and cost-effective public health interventions; it prevents millions of deaths each year and protects children against diseases such as measles, diphtheria, pertussis, tetanus and poliomyelitis. The Expanded Programme on Immunization (EPI) was established by the World Health Organization in 1974 to make routine vaccines available to all children (Williams et al. [1]). A child is considered fully immunized when he or she has received all the vaccine doses scheduled in the national programme for his or her age. A child who has not received any routine vaccine is called a “zero-dose” child, while a child who has received only some of the doses is under-vaccinated (partially immunized) (Williams et al. [1]).

Globally, the latest WHO/UNICEF estimates show that in 2025 about 90% of infants received at least one dose of a diphtheria-tetanus-pertussis (DTP) containing vaccine and 85% completed the three-dose series, yet an estimated 13.5 million children did not receive a single vaccine dose in their first year of life (WHO/UNICEF [2]). In sub-Saharan Africa, gaps in coverage persist, weakening herd immunity and exposing communities to recurrent outbreaks (Melese et al. [3]).

In Sudan, routine immunization has been seriously disrupted by the armed conflict that started in April 2023 (see Section 3.3).

1.2 Problem Statement

Immunization services in Sudan are provided through the public health system, yet a large proportion of children still do not complete the routine schedule. National coverage collapsed during the conflict (DTP3 39% in 2024) and recovered only partially in 2025 (71%) (UNICEF Sudan [4]), leaving many children unprotected against measles, polio, pertussis and other vaccine-preventable diseases. The consequences are outbreaks, preventable child illness and death, and a growing pool of zero-dose and under-vaccinated children (UNICEF Sudan [4]).

National estimates hide large differences between states and Cities, and the reasons why children miss vaccines differ from one community to another. For example, the two Nigerian states studied by Cockcroft et al. differed in their main determinants of vaccination (Cockcroft et al. [8]), and studies from Ethiopia, Somalia and Nigeria found different combinations of maternal, household, health-system and gender-related factors (Melese et al. [3]; Mohamud et al. [6]; Taiwo et al. [7]). Dongola City is the capital locality of Northern State, and to the best of the authors’ knowledge no published community-based study has examined the factors associated with incomplete routine immunization among under-five children in this City. Without local evidence, the State EPI programme and the City Health Office cannot know whether the main problem in Dongola is caregivers’ knowledge, access to services, vaccine supply, household decision-making, or displacement-related factors, and therefore cannot target their limited resources effectively.

1.3 Justification

This study is needed for the following reasons:

- It will provide the first city -level estimate of incomplete routine immunization (including zero-dose children) among children aged 12–59 months in Dongola, which can serve as a baseline for the EPI programme.

- By identifying the factors that are independently associated with incomplete immunization, it will show which barriers are modifiable (for example knowledge, waiting time, vaccine availability, male involvement) and can be addressed by the State Ministry of Health and the City Health Office. Health education, community leader involvement and integration of services are examples of strategies with some supporting evidence (Oyo-Ita et al. [10]).
- It will use a structured, comparable set of variables drawn from studies in neighbouring and similar African settings (Melese et al. [3]; Mohamud et al. [6]; Taiwo et al. [7]; Cockcroft et al. [8]; Musuka et al. [9]), allowing the results to be compared with those settings.
- It supports the global "zero-dose" and equity agenda of Immunization Agenda 2030 by describing who is being missed in a community that has also hosted families affected by the ongoing conflict.
- It fulfils the requirements of the graduation research project of the Department of Community Medicine and trains the authors in community-based research methods.

1.4 Research Question

What is the proportion of incomplete routine immunization among children aged 12–59 months in Dongola City, Northern State, Sudan, and which caregiver, household, child, health-service and decision-making factors are associated with it in 2026?

1.5 Hypothesis

Null hypothesis (H0): There is no association between the studied factors (sociodemographic characteristics, caregiver knowledge and perception, health-service related factors and household decision-making) and incomplete routine immunization among children aged 12–59 months in Dongola City.

Alternative hypothesis (H1): There is a statistically significant association between at least one of these factors and incomplete routine immunization among children aged 12–59 months in Dongola City.

2. Research Objectives

2.1 Main Objective

To determine the factors associated with incomplete routine childhood immunization among children aged 12–59 months in Dongola City, Northern State, Sudan, in 2026.

2.2 Specific Objectives

1. To determine the proportion of children aged 12–59 months in Dongola City who have incomplete routine immunization, including zero-dose children.
2. To describe the sociodemographic characteristics of the caregivers, households and children in the study.
3. To assess caregivers' knowledge of and perception towards routine childhood immunization.

4. To examine the associations between caregiver-related, household, health-service-related,

and household decision-making factors and incomplete routine childhood immunization, and to describe caregivers' reported reasons for missed or delayed vaccinations.

5. To identify independent predictors of incomplete routine childhood immunization using multivariable analysis.

3. Literature Review

3.1 International Evidence

Globally, systematic reviews of low- and middle-income countries have examined the social determinants of childhood immunisation (Williams et al. [1]), and the latest WHO/UNICEF estimates show that many children still miss vaccines despite overall progress (WHO/UNICEF [2]).

Intervention evidence suggests that health education, home-based vaccination records, involvement of community leaders and integration of immunization with other services may improve vaccine uptake, although the certainty of this evidence is low to moderate (Oyo-Ita et al. [10]). Choosing the right intervention, however, depends on first understanding which barriers operate in the local community.

3.2 African Evidence

Evidence from settings similar to ours shows that incomplete immunization is not explained by a single factor. In Southern Ethiopia, maternal illiteracy, rural residence, home delivery and poor maternal knowledge increased the odds of incomplete immunization, whereas antenatal and postnatal care attendance were protective (Melese et al. [3]). In Mogadishu, Somalia, only 45.2% of children under five years were fully immunized, and vaccine availability at the time of the visit, affordability, place of birth, father's education, family income and caregiver knowledge, practice and perception were associated with full immunization (Mohamud et al. [6]). In Kaduna State, Nigeria, only 15.6% of children were fully immunized according to their cards, most mothers had unsatisfactory knowledge, and long distance to the health facility and lack of faith in vaccination were the commonest reasons given for missed vaccination (Taiwo et al. [7]). In two other Nigerian states, negative attitudes, fear of side effects, informal payments demanded by health workers and lack of knowledge were reported by parents as reasons for not vaccinating (Cockcroft et al. [8]). A recent review from sub-Saharan Africa also highlighted gender-related factors such as mothers' decision-making autonomy and the involvement of fathers (Musuka et al. [9]).

The three papers below were selected because they study the determinants of incomplete or low routine immunization coverage among young children in African communities, using community-based designs and methods comparable to ours.

Paper 1: Melese et al. (2026), Koore Zone, Southern Ethiopia

Item	Summary
Citation	Melese A, Wondirad M, Melke A, Tamiso A, Yoseph A. Determinants of incomplete childhood immunisation among children aged 12–23 months in Koore Zone, Southern Ethiopia: a community-based case-control study. BMJ Paediatrics Open. 2026;10:e004245. [3]

Aim	To identify factors associated with incomplete immunisation among children aged 12–23 months in Koore Zone.
Design and setting	Community-based unmatched case-control study, 15 April–20 May 2025, in 10 kebeles (the smallest administrative unit) of Koore Zone.
Sample and sampling	279 children: 93 incompletely immunised (cases) and 186 fully immunised (controls). Sample size calculated with Epi Info 7.1 (double population proportion; 95% confidence, 80% power, ratio 1:2), a design effect of 1.5 and 10% non-response. Kebeles were selected purposively (high dropout), then children by simple random sampling.
Data collection and analysis	Structured interviewer-administered questionnaire adapted from WHO/UNICEF tools, translated into Amharic and back-translated; pre-test on 5% of the sample; data collected with KoBo Toolbox; status verified by card or caregiver recall. SPSS 25; bivariable and multivariable logistic regression (VIF, Hosmer–Lemeshow test) and a Poisson regression sensitivity analysis.
Main findings	Higher odds of incomplete immunisation with maternal illiteracy (AOR 1.82; 95% CI 1.30–2.50), rural residence (AOR 4.0; 2.0–8.1) and home delivery (AOR 2.30; 1.27–4.1). Protective factors: antenatal care (AOR 0.51; 0.28–0.9), postnatal care (AOR 0.46; 0.25–0.8) and satisfactory maternal knowledge (AOR 0.30; 0.16–0.5). Among mothers of cases, fear of side effects (41%) and lack of awareness (37.8%) were the commonest reasons.
Limitations	Recall and social desirability bias; kebeles selected purposively; no data on timeliness of doses; causality cannot be inferred.
Relevance to our study	We adopt its grouping of variables (sociodemographic, maternal health service use, behavioural, health-system), the knowledge score cut-off at the mean, verification by card then recall, and pre-testing on 5% of the sample.

Paper 2: Mohamud et al. (2020), Mogadishu, Somalia

Item	Summary
Citation	Mohamud MHT, Magan MA, Mohamed LM, Mohamud MA, Muse AA. Barriers for full immunization coverage among under 5 years children in Mogadishu, Somalia. J Family Med Prim Care. 2020;9(6):2664–9. [6]
Aim	To assess barriers to complete vaccination among children under five years in Mogadishu.
Design and setting	Community-based cross-sectional study, April–July 2019, in two divisions of Wadajir district, Mogadishu.
Sample and sampling	Cochran formula (prevalence 40%, precision 0.05, design effect 2) gave a minimum of 738; with 10% non-response the sample was 820 households; 741 caregivers were interviewed (response rate 90.4%). Two-stage cluster sampling followed by systematic random sampling; one child aged 12–59 months per household.

Data collection and analysis	Pre-tested structured interviewer-administered questionnaire (English translated into Somali) covering sociodemographic, immunization status and barriers; status from cards or maternal recall with verification of BCG scar. SPSS 20; bivariate analysis then multivariate logistic regression.
Main findings	Only 45.2% of children were fully immunized (38% of them confirmed by card). Immunization was associated with vaccine availability at the time of the visit (AOR 6.147; 95% CI 1.943–19.441), affordability of cost (AOR 1.951; 1.238–3.076), birth in a health facility (AOR 1.517; 1.104–2.086), good caregiver knowledge (AOR 1.125), good practice (AOR 2.756) and positive perception of vaccines (AOR 4.976; 2.183–11.340), as well as father's education, family income, caregiver marital status, child age and birth order.
Limitations	Recall bias (most children had no card); no qualitative component to explain "why"; other predictors not captured.
Relevance to our study	Closest to our design: same age group (12–59 months), Cochran sample-size approach with a 10% non-response allowance, multistage sampling with systematic selection of households, and the same analysis strategy.It also supplies the health-system and sociocultural variables.

Paper 3: Taiwo et al. (2017), Kaduna State, Nigeria

Item	Summary
Citation	Taiwo L, Idris S, Abubakar A, Nguku P, Nsubuga P, Gidado S, et al. Factors affecting access to information on routine immunization among mothers of under 5 children in Kaduna State, Nigeria, 2015. Pan Afr Med J. 2017;27:186. [7]
Aim	To examine the associations between knowledge, perception and information on routine immunization received by mothers/caregivers.
Design and setting	Community-based cross-sectional study, April–June 2015, in Kaduna State (rural and semi-urban settlements); caregivers of children aged 12–23 months.
Sample and sampling	Minimum 345 (single-proportion formula, expected proportion 34%, precision 0.05), increased by 10% to 379 respondents. Multistage sampling: 3 senatorial zones → 2 LGAs each → 2 wards → 2 settlements; 16 questionnaires in contiguous households, first household identified by spinning a bottle.
Data collection and analysis	Pre-tested interviewer-administered questionnaire (socio-demographic factors, sources of information, immunization record, reasons for non-immunization, knowledge and perception). Knowledge and perception were scored and dichotomised. Epi Info 7; bivariate analysis and logistic regression.

Main findings	Only 15.6% of children were fully immunized by card; 64.4% of mothers had unsatisfactory knowledge and 55.5% poor perception; about 70% had received no information on routine immunization in the previous 12 months, and radio was the commonest source (61.6%). Education (AOR 1.9; 1.1–3.3) and good perception (AOR 2.6; 1.5–4.5) were associated with receiving information. Among 320 caregivers whose child was not fully vaccinated, the commonest reasons were distance (37%) and no faith in vaccination (25%); vaccine unavailability was reported by 4%.
Limitations	Recall bias; health workers' knowledge and male involvement were not explored.
Relevance to our study	Supports our multistage sampling procedure and the scoring of knowledge and perception, and the inclusion of a question on the sources of immunization information and reasons for missed vaccines.

3.3 Sudanese Evidence

In Sudan, routine immunization has been seriously disrupted by the armed conflict that started in April 2023, which displaced millions of people and damaged health facilities and supply chains. Sudan accounted for 42% of all zero-dose children in the Middle East and North Africa region in 2024, when national DTP3 coverage fell to 39% (UNICEF Sudan [4]). The 2026 WHO/UNICEF estimates show a marked recovery, with DTP3 coverage rising to 71% in 2025, the largest improvement among fragile and conflict-affected countries (UNICEF Sudan [4]; Gavi [5]). This is encouraging, but it is still below the 90% coverage target (WHO/UNICEF [2]), which means that many Sudanese children remain incompletely immunized.

However, these figures are national estimates and say little about the community-level reasons for missed vaccines in individual cities.

3.4 Research Gap

Most of the available evidence comes from Ethiopia, Somalia and Nigeria, and these studies found different combinations of maternal, household, health-system and gender-related factors (Melese et al. [3]; Mohamud et al. [6]; Taiwo et al. [7]); the two Nigerian states studied by Cockcroft et al. even differed in their main determinants (Cockcroft et al. [8]). National estimates for Sudan hide differences between states and cities. To the best of the authors' knowledge, no published community-based study has examined the factors associated with incomplete routine immunization among under-five children in Dongola City. This study aims to fill this gap.

4. Materials and Methods

4.1 Study Design

Analytical cross-sectional acommunity-based study.

4.2 Study Area

The study will be conducted in Dongola City, the capital city of Northern State, situated along the River Nile in northern Sudan. Routine immunization in the city is delivered by the State Ministry of Health through fixed health facilities and outreach sessions, within the national

EPI. Data on the population of the City, the number of administrative units and the number of immunization sites will be obtained from the Dongola City Health Office and inserted in the final proposal.

4.3 Study Population

Source population: all children aged 12–59 months living in Dongola City.

Study population: children aged 12–59 months living in the selected households during the data collection period. The respondent is the mother or, if she is not available, the primary caregiver who is responsible for the child's immunization.

Rationale for the age group: the routine schedule is expected to be completed during the first year of life, so children younger than 12 months may still be within the vaccination period (Melese et al. [3]). The upper limit of 59 months keeps the study consistent with the "under-five" population.

4.4 Inclusion Criteria

Inclusion criteria: children aged 12–59 months whose family has lived in the City for at least six months (including displaced families), and whose caregiver is present and gives consent.

4.5 Exclusion Criteria

Exclusion criteria: caregivers who are seriously ill or unable to communicate; households in which the caregiver is not found after two visits.

4.6 Sample Size Determination

The sample size was calculated using Cochran's formula for a single proportion (Cochran [11]), which is appropriate for a cross-sectional study with a large source population (the exact number of children aged 12–59 months in Dongola City is not available):

$$\mathbf{n = Z^2 \times p \times q / d^2}$$

where Z = 1.96 (95% confidence level); p = expected proportion of children with incomplete immunization; q = 1 − p; d = margin of error (0.05). Because the prevalence of incomplete immunization in Dongola City is not known from previous studies, p was taken as 0.30 (30%), based on the national DTP3 coverage of 71% in 2025 (UNICEF Sudan [4]), which suggests that about 29–30% of children are not fully immunized (100% − 71% = 29%, rounded to 30%).

$$n = (1.96)^2 \times 0.30 \times 0.70 / (0.05)^2 = 3.8416 \times 0.21 / 0.0025 = 322.69 \approx \mathbf{323}$$

Adding 10% for non-response (323 × 1.10 = 355.3, rounded up), the final sample size is a definite number of **356 children (households)**.

4.7 Sampling Technique

The sampling technique is probability (random) multistage cluster sampling, in three stages (clusters by simple random sampling, households by systematic random sampling, and one child per household by lottery):

Stage 1: A list of all administrative units (villages/neighbourhoods) in Dongola City will be obtained from the Locality Health Office. Exactly 20 units (clusters) will be selected by simple random sampling (lottery method), and the sample of 356 will be distributed equally among them: 16 clusters × 18 households + 4 clusters × 17 households = 356 households.

Stage 2: In each selected cluster, households will be selected by systematic random

sampling. The sampling frame is the updated list/sketch map of households in the cluster, and the sampling interval (k) = number of households in the cluster ÷ the households allocated to it (17 or 18). The first household will be chosen randomly (random number or spinning a bottle at the centre of the cluster), and every k-th household after that will be visited (Mohamud et al. [6]; Taiwo et al. [7]).

Stage 3: In each selected household with eligible children, one child aged 12–59 months will be enrolled. If more than one child is eligible, one will be chosen by lottery. If no eligible child lives in thehousehold, or the caregiver is absent after two visits, the researchers will move to the next household.

4.8 Data Collection Tools

Data will be collected by face-to-face interviews with mothers/caregivers using a structured, interviewer-administered questionnaire (Annex B). The questionnaire was developed in English from previous studies (Melese et al. [3]; Mohamud et al. [6]; Taiwo et al. [7]; Cockcroft et al. [8]) and WHO tools (WHO [12]), and will be translated into Arabic and back-translated to check consistency. It has seven sections: (A) sociodemographic characteristics; (B) child and maternal health service use; (C) immunization status and reasons for missed vaccines; (D) caregiver knowledge; (E) perception and attitude; (F) health-service and access factors; and (G) household decision-making.

Immunization status: the EPI card (home-based record) will be checked first. If the card is not available, the caregiver's recall will be used, supported by checking for a BCG scar, as done in similar studies (Melese et al. [3]; Mohamud et al. [6]). The source of information (card or recall) will be recorded for every child.

Data quality: the two researchers will personally conduct all the interviews, working together under the supervision of the supervisor; no additional data collectors will be used. Before data collection, the two researchers will hold a joint session to agree on the study objectives, ethics, the Arabic wording of the questions and the way of filling the questionnaire, so that both interview in the same standardized way. The questionnaire will be pre-tested on about 5% of the sample (around 18 households) in a cluster that is not included in the study, and modified as needed. Completed questionnaires will be checked for completeness and consistency every day, with each researcher reviewing the other's forms. Data collection will take place from 4 to 22 October 2026.

4.9 Data Management and Analysis

Data will be checked, coded and entered into SPSS (IBM SPSS Statistics, version 26 or the available version). Descriptive statistics (frequencies, percentages, means and standard deviations) will be used to describe the participants and the proportion of children with incomplete immunization. The association between each independent variable and immunization status will be examined first by the chi-square test and bivariable logistic regression. Variables with a p-value below 0.25 in the bivariable analysis will be entered into a multivariable logistic regression model. Crude and adjusted odds ratios with 95% confidence intervals will be reported, and a p-value below 0.05 will be considered statistically significant. Multicollinearity will be checked using the variance inflation factor, and model fit using the Hosmer–Lemeshow test (Melese et al. [3]). Results will be presented in tables and figures.

Anticipated limitations: recall bias where the EPI card is not available; social desirability bias; the cross-sectional design does not allow causal inference; and the sampling clusters may slightly reduce precision. These will be minimised through card verification, careful preparation and pre-testing, and will be discussed in the report.

4.10 Ethical Considerations

- Approval of the proposal will be sought from the Department of Community Medicine and the research/ethics committee of the Faculty of Medicine and Health Sciences, University of Dongola.
- Permission to conduct the study will be obtained from the Northern State Ministry of Health and the Dongola City Health Office.
- The purpose and procedures of the study will be explained to every caregiver, and informed consent (Annex A) will be obtained before the interview. Participation is voluntary and the caregiver may refuse or withdraw at any time without any consequence.
- No names or identifying information will be recorded on the questionnaire; data will be kept confidential, used for research only and stored securely by the researchers.
- The study involves no invasive procedure. Caregivers whose child is found to have missed vaccines will be advised and referred to the nearest health facility for catch-up vaccination.

4.11 Study Variables

Dependent variable

Routine immunization status of the child (complete = 0, incomplete = 1).

Operational definitions

- **Complete (fully) immunized:** a child aged 12–59 months who has received all the vaccine doses due for his/her age according to the current national EPI schedule of the Federal Ministry of Health, Sudan.
- **Incomplete immunization:** a child who has missed at least one dose of the vaccines due for his/her age; this includes zero-dose and partially immunized children.
- **Zero-dose child:** a child who has not received any routine vaccine dose.
- **Good knowledge:** a knowledge score equal to or above the mean score of the respondents; below the mean is poor knowledge (Melese et al. [3]; Taiwo et al. [7]).

Independent variables

Group	Variables	Scale
Caregiver and household	Age of caregiver; relationship to the child; marital status; education of mother and father; occupation of mother and father; monthly household income; household size; number of under-five children; residence (urban/rural); displacement status (resident/displaced/returnee)	Categorical / continuous
Child	Age (months); sex; birth order; possession of birth certificate	Categorical / continuous

Maternal and child health service use	Antenatal care visits; place of delivery; postnatal care; possession of EPI card	Categorical
Knowledge, perception and attitude	Knowledge score; perception/attitude score; fear of side effects; misconceptions; trust in health workers	Score, then categorical
Health service and access	Distance/time to the nearest facility; vaccine availability at the visit; health worker absence; waiting time; payments for vaccination; health worker attitude; outreach in the area; reminders/home visits; source of immunization information	Categorical
Household decision-making and gender	Who decides on vaccination; father's support; caregiver's freedom to take the child to the facility; family objection to vaccination	Categorical

5. References

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6. Time-line

The time-line follows the schedule of the Department of Community Medicine for Batch (23) graduation research projects.

No.	Activity	Period
1	Submission of research proposals	20–24 September 2026
2	Presentation of research proposals	27 September – 01 October 2026
2a	Preparation of tools, joint preparation session of the two researchers and pre-test (in parallel, after proposal approval)	27 September – 03 October 2026
3	Data collection	04–22 October 2026
4	Data analysis	25 October – 05 November 2026
5	Writing the results and discussion	08–19 November 2026
6	Writing the final report	22 November – 03 December 2026
7	Electronic submission of the research to the Department of Community Medicine	06–10 December 2026
8	Review (refereeing) of the research	13–24 December 2026
9	Amendments to the research	27–31 December 2026
10	Research defence (discussion)	03–04 January 2027

7. Budget

Quantities are estimated from the study plan. Unit costs are to be completed with current market prices before submission.

No.	Item	Description / quantity	Unit cost (SDG)	Total (SDG)
1	Stationery and printing	≈ 500 questionnaires and consent forms (about 6 pages each); pens, clipboards, folders		300,000
2	Transport	Transport to the clusters for the two researchers, about 15 field days		500,000
3	Researchers’ field work	15 field days for the two researchers: meals and refreshments		300,000
4	Communication	Airtime/internet for coordination and literature search		150,000
5	Data entry and analysis	Typing, printing of tables and figures		300,000

6	Reports and binding	Copies of the proposal and the final report		250,000
7	Contingency	10% of the total		200.000
8	**Total**			2.000.000

8. Annexes

Annex A: Informed Consent Form

Title of the study: Factors Associated with Incomplete Routine Childhood Immunization Among Children Under Five Years in Dongola City, Northern State, Sudan, 2026.

Researchers: Samah Munwar Abdullah Tombal and Reem Bada Ibrahim Ali, Faculty of Medicine and Health Sciences, University of Dongola. **Supervisor:** Ahmed Mohamed Zein.

Peace be upon you. We are medical students at the University of Dongola conducting a research project about routine childhood vaccination in Dongola City. The aim is to understand why some children do not complete their vaccines so that vaccination services can be improved.

If you agree, we will ask you questions about yourself, your family, your child and your child's vaccinations. We may ask to see your child's vaccination card. The interview takes about 15 minutes. There is no risk to you or your child. You will not receive money for taking part, but you will receive advice about your child's vaccines, and if any vaccine is missing we will tell you where to go for it.

Your participation is completely voluntary. You may refuse to answer any question or stop the interview at any time without any effect on the services you or your child receive. We will not write your name on the questionnaire; your answers will be kept confidential and used only for research.

Do you agree to participate? Yes ☐ No ☐

Respondent's signature/thumbprint: _____ Date: _____

Name of interviewer / signature: _____

Annex B: Questionnaire

This questionnaire will be translated into Arabic before use.

Cluster code: _____ Household no.: _____ Date: __ / __ / 2026 Interviewer: _____

Section A: Caregiver and household characteristics

A1. Relationship of the respondent to the child
1. Mother 2. Father 3. Grandmother 4. Other (specify): _____

A2. Age of the caregiver (years): _____

A3. Marital status of thecaregiver
1. Married 2. Single 3. Divorced/separated 4. Widowed

A4. Education of the mother
1. Illiterate 2. Khalwa (Quranic) only 3. Primary 4. Secondary 5. University and above

A5. Occupation of the mother
1. Housewife 2. Government employee 3. Private work/trader 4. Farmer 5. Other

A6. Education of the child's father
1. Illiterate 2. Khalwa (Quranic) only 3. Primary 4. Secondary 5. University and above

A7. Occupation of the father
1. Government employee 2. Private work/trader 3. Farmer 4. Daily labourer 5. Unemployed 6. Other

A8. Approximate monthly household income (SDG): _____ (categories will be defined after the pre-test)

A9. Number of persons living in the household: _____ Number of children under five: _____

A10. Place of residence
1. Urban 2. Rural (village)

A11. Residence status of the family
1. Long-term resident 2. Internally displaced (since April 2023) 3. Returnee

Section B: Child and maternal health service use

B1. Sex of the child
1. Male 2. Female

B2. Age of the child (months): _____

B3. Birth order of the child: _____

B4. Place of birth
1. Health facility 2. Home 3. Other

B5. Number of antenatal care visits during pregnancy with this child
1. None 2. 1–3 visits 3. Four or more

B6. Did the mother attend a postnatal care visit within six weeks after delivery?
1. Yes 2. No

B7. Does the child have a birth certificate?
1. Yes 2. No

Section C: Immunization status

C1. Does the child have an EPI vaccination card?
1. Yes, card seen 2. Yes, but not seen 3. Lost 4. Never had a card

C2. Record the vaccines received (fromthe card, or from the caregiver's recall if there is

no card). The list must match the current national EPI schedule (to be verified with the Northern State EPI office before data collection).

Vaccine / dose	Received (card)	Received (recall)	Not received
BCG			
OPV at birth			
OPV 1 / 2 / 3			
IPV			
Pentavalent 1 / 2 / 3			
PCV 1 / 2 / 3			
Rotavirus 1 / 2			
Measles / MR (all doses due)			
Other vaccines on the schedule			

C3. Is a BCG scar present? (if no card)
1. Yes 2. No

C4. Immunization status (completed by the researcher)
1. Complete 2. Incomplete – partially immunized 3. Zero-dose

C5. If incomplete: what are the reasons why the child missed vaccines? (tick all that apply)
1. Fear of side effects 2. Not aware ofthe need 3. Did not know when/where to return 4. Child was sick 5. Health facility too far 6. Vaccine not available 7. Health worker absent/session cancelled 8. Long waiting time 9. Payment demanded/cost 10. Mother too busy 11. Husband/family objection 12. Insecurity/displacement 13. Does not believe vaccines protect 14. Other (specify): _____

Section D: Caregiver knowledge (correct answer in brackets; correct = 1, wrong or "don't know" = 0)

D1. Vaccines protect children from serious diseases. (Yes)
Yes / No / Don't know

D2. A child should start vaccination at birth. (Yes)
Yes / No / Don't know

D3. A child needs more than one visit to complete all vaccines. (Yes)
Yes / No / Don't know

D4. Can you name at least three diseases prevented by vaccines? (Yes = names three)
Yes / No

D5. Do you know when the next vaccine dose is due for your child? (Yes)
Yes / No

D6. Routine vaccination in government facilities should be free of charge. (Yes)
Yes / No / Don't know

D7. A child with mild fever or cough can still be vaccinated. (Yes)

Yes / No / Don't know

D8. Mild fever or pain at the injection site is a common and harmless reaction. (Yes)
Yes / No / Don't know

D9. Vaccines cause infertility later in life. (No)
Yes / No / Don't know

D10. Only sick children need vaccines. (No)
Yes / No / Don't know

D11. Giving several vaccines in one visit overloads the child's immune system. (No)
Yes / No / Don't know

D12. A card is needed to record the vaccines the child has received. (Yes)
Yes / No / Don't know

Total knowledge score = ____ /12. Good knowledge = score ≥ mean of all respondents.

Section E: Perception and attitude (Agree / Neutral / Disagree)

E1. Vaccines are safe and useful for my child.

E2. I trust the health workers who give vaccines.

E3. I am worried about the side effects of vaccines.

E4. Going for vaccination is a waste of time.

E5. Community and religious leaders in my area support vaccination.

Scoring: positive statements (E1, E2, E5) agree = 2,neutral = 1, disagree = 0; negative statements (E3, E4) reversed. Positive perception = score ≥ mean.

Section F: Health service and access

F1. Time taken to reach the nearest immunization site
1. Less than 30 minutes 2. 30–60 minutes 3. More than 60 minutes

F2. Usual means of transport to the facility
1. Walking 2. Public transport 3. Private vehicle/motorcycle/donkey cart 4. Other

F3. Was the vaccine ever unavailable when you went for vaccination?
1. Yes 2. No

F4. Was the vaccinator absent or the session cancelled when you went?
1. Yes 2. No

F5. Usual waiting time at the vaccination site
1. Less than 30 minutes 2. 30–60 minutes 3. More than 60 minutes

F6. Are the vaccination days and hours convenient for you?
1. Yes 2. No

F7. Did you ever pay money for vaccination or for the vaccination card?
1. Yes 2. No

F8. How do you describe the attitude of the health workers at the vaccination site?
1. Respectful 2. Neutral 3. Disrespectful

F9. Did a health worker or volunteer visit you or remind you about your child's vaccination?
1. Yes 2. No

F10. Was there an outreach session or vaccination campaign in your area in the last 12 months?
1. Yes 2. No 3. Don't know

F11. Did you receive any information about routine vaccination in the last 12 months?

1. Yes 2. No

F12. If yes, main source of information

1. Health facility 2. Radio 3. Television 4. Social media 5. Relatives/neighbours 6. Mosque/church 7. Community meeting 8. Other

Section G: Household decision-making

G1. Who usually decides whether the child is vaccinated?

1. Mother alone 2. Father alone 3. Both parents 4. Grandparents/other relatives

G2. Does the father help with vaccination (transport, cost, accompanying the mother)?

1. Yes 2. No

G3. Can you take your child to the health facility without needing permission?

1. Yes 2. No

G4. Has any family member objected to your child's vaccination?

1. Yes 2. No

Thank you for your cooperation.

Annex C: Research Plan

1. Literature review and preparation of the proposal, including sample size calculation and questionnaire development.
2. Presentation of the proposal to the Department of Community Medicine and incorporation of comments.
3. Ethical approval and permission from the State Ministry of Health and the City Health Office; obtaining the list of administrative units.
4. Translation of the questionnaire, joint preparation session of the two researchers and pre-test.
5. Data collection in the selected clusters, with daily supervision and checking of questionnaires.
6. Data entry, cleaning and analysis.
7. Writing of results and discussion, then the final report.
8. Electronic submission to the Department, review, amendments and final defence.