Evaluating Strategies to Reduce Child Mortality: A Multicenter Study in Low-Resource Countries

Augusto Ernesto Rojas Cruz[1], Blanca Herminia Cruz Basantes[2], Lino Arturo Rojas Pérez[3], Lino Arturo Rojas Cruz[4]

[1]*augusto.rojas@espoch.edu.ec, Escuela Superior Politécnica de Chimborazo, https://orcid.org/0000-0002-6680-2087*
[2]*blanca.cruz@espoch.edu.ec, Escuela Superior Politécnica de Chimborazo, https://orcid.org/0000-0002-3895-6281*
[3]*linoarojas@espoch.edu.ec, Escuela Superior Politécnica de Chimborazo, https://orcid.org/0000-0003-0396-1766*
[4]*lino91_rojas001@hotmail.com, Universidad Nacional de Chimborazo, https://orcid.org/0000-0003-3857-6876*

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ABSTRACT:
Infant mortality remains a critical problem in low-resource countries, despite advances in global health policies and technologies. This study analyzes intervention strategies implemented in multicenter settings, focusing on improving child survival. A comparative analysis of programmes based on primary care, maternal training, immunization and access to safe drinking water was conducted in three selected regions of Africa, Asia and Latin America. The results highlight the effectiveness of maternal education and access to health services as determining factors in reducing infant mortality rates. It is concluded that a combination of integrated strategies, adapted to local needs, is crucial to address this public health challenge.

Introduction

Child mortality is a persistent and multifaceted challenge that disproportionately affects low-resource countries, where structural, economic, and social factors converge to hinder access to essential health services (UNICEF, 2021). According to recent data, more than five million children under the age of five die annually, and a significant proportion of these deaths could be prevented with proven interventions, such as immunizations, access to clean water, and primary health care (WHO, 2023). Although global rates have declined in recent decades, the gaps between developed countries and those with fewer resources remain significant, highlighting deep inequalities in health systems (Liu et al., 2021).

In low-income countries, the leading causes of child mortality include neonatal complications, respiratory infections, diarrheal diseases, and severe malnutrition, all related to lack of access to quality health services and basic resources such as clean water and sanitation (Chowdhury et al., 2023). Not only are these causes mostly preventable, but they are also treatable with appropriate interventions, highlighting the urgent need for effective and sustainable policies in these regions (Nguyen et al., 2021). In addition, young mothers, especially in rural and marginalized contexts, face significant barriers to accessing health care, exacerbating child health disparities (Gates Foundation, 2022).

The United Nations Sustainable Development Goals (SDGs) have set specific targets to reduce child mortality to less than 25 deaths per 1,000 live births by 2030, underscoring the importance of comprehensive interventions that include not only improvements in medical services, but also in socio-economic and educational conditions (UNICEF, 2021). However, progress towards this goal has been uneven and limited in many countries, mainly due to a lack of financial and human resources, as well as political and economic instability (WHO, 2023).

Among the most prominent strategies to reduce infant mortality, maternal education plays a crucial role, as informed mothers are more likely to seek timely medical care, practice exclusive breastfeeding, and adhere to immunization programs (Liu et al., 2021). Likewise, the training of community health workers and traditional birth attendants has proven to be an effective measure in rural areas, where institutionalized medical care is limited (Nguyen et al., 2021). Access to basic services, such as clean water and adequate sanitation, has also shown a significant impact on reducing diarrheal diseases and other infections (Gates Foundation, 2022).

The present multicenter study aims to evaluate the effectiveness of various strategies implemented in low-resource countries and to provide evidence-based recommendations that can be adapted to different cultural and geographic contexts. The selected regions include sub-Saharan Africa, South Asia and Latin America, areas that represent some of the greatest challenges in terms of child mortality. Through a comparative analysis of interventions, it seeks to identify successful practices and key lessons that can be replicated in similar contexts, thus contributing to the design of more effective and sustainable public policies. This approach is essential to address fundamental questions, such as: What strategies are most effective in reducing child mortality in low-resource contexts? How can these interventions be tailored to the specific barriers faced by these communities?

With a comprehensive and evidence-based perspective, this work aims to provide new ideas and approaches for the reduction of child mortality, aligning with the global goals of health equity and sustainable development.

Theoretical Framework

1. Conceptualization of Infant Mortality

Infant mortality is defined as the number of deaths of children under five years of age per 1,000 live births in a given year. This indicator is widely used to assess the health status of a population, as it reflects the social, economic, and health conditions of communities (UNICEF, 2021). According to the World Health Organization (WHO, 2022), the leading causes of infant death include neonatal complications, respiratory infections, diarrhea, and malnutrition, all of which are largely preventable or treatable.

The following table presents the main causes of infant mortality and their percentage distribution in low-resource countries (WHO, 2023):

Cause	Percentage of infant deaths (%)
Neonatal complications	45%
Respiratory infections	20%
Diarrhoeal diseases	15%
Malnutrition	10%
Other causes	10%

2. Determinants of Infant Mortality

Social and economic determinants play a central role in high infant mortality rates. Poverty, low educational attainment of mothers, lack of access to health services, and food insecurity are some of the most prominent factors (Chowdhury et al., 2023). In addition, limited access to basic services, such as clean water and adequate sanitation, exacerbates children's vulnerability to preventable diseases, especially in rural and marginalized areas (Liu et al., 2021).

A recent analysis highlights that, in low-income countries, more than 60% of child deaths are related to the lack of basic health and sanitation services (Gates Foundation, 2022). This problem is exacerbated by gender inequalities, as women in these communities often have limited access to education and resources, which directly affects their children's health (Nguyen et al., 2021).

3. Strategies to Reduce Child Mortality

A number of strategies have proven effective in reducing child mortality, many of which focus on improving access to basic services, promoting maternal education and strengthening health systems.

a. Interventions based on primary health care:

Primary care, which includes services such as immunization, prenatal check-ups, and treatment of common diseases, is one of the most effective strategies to reduce infant mortality (WHO, 2022). In particular, vaccination programmes have significantly reduced the incidence of preventable diseases, such as measles and pneumonia.

b. Maternal education:

Mothers' education has a direct impact on child health, as informed women tend to seek timely medical care and adopt healthy practices, such as exclusive breastfeeding (Chowdhury et al., 2023). In recent studies, maternal education was associated with a 25% reduction in infant mortality rates (Liu et al., 2021).

c. Access to safe drinking water and sanitation:

Access to safe drinking water and improved sanitation facilities significantly reduce the incidence of diarrhoeal diseases, one of the leading causes of death in children under five years of age. According to UNICEF (2021), water and sanitation programs have reduced child deaths related to waterborne diseases in vulnerable communities by 30%.

The following table summarizes the most effective strategies to reduce infant mortality, with their respective impacts:

Strategy	Impact (%)	Reference
Vaccination programs	40% reduction in preventable diseases	WHO (2022)
Maternal education	25% reduction in infant mortality	Liu et al. (2021)
Access to safe drinking water and sanitation	30% reduction in diarrhealdiseases	UNICEF (2021)
Training of health workers	35% improvement in community health coverage	Nguyen et al. (2021)

4. Challenges in Implementing Strategies in Low-Resource Countries

Although many of these interventions have shown positive results, their implementation in low-resource countries faces significant challenges. These include insufficient financial resources, lack of health infrastructure, and cultural barriers that make it difficult to accept certain practices, such as family planning (Gates Foundation, 2022). Likewise, political instability and armed conflict are additional factors that limit the scope of these strategies (Nguyen et al., 2021).

Methodology

The methodological design of this multicenter study is a mixed approach, combining quantitative and qualitative methods to analyze the effectiveness of strategies aimed at reducing child mortality in low-resource countries. The study period spanned from January 2022 to June 2024, and was carried out in three selected regions: sub-Saharan Africa, South Asia, and Latin America, representing contexts with high infant mortality rates and common socio-economic challenges (UNICEF, 2021; WHO, 2023).

1. Study Design

The study included:

- **Quantitative components**: Collection of statistical data on indicators of infant mortality, vaccination coverage, access to basic services, and prevalence of preventable diseases in the selected communities.
- **Qualitative components**: Semi-structured interviews with mothers, community leaders, and health professionals to assess the perception and acceptance of the strategies implemented.

2. Population and Sample

12,000 households were selected equally distributed among the three regions, with specific criteria to ensure representativeness:

- **Inclusion criteria**: Households with at least one child under five years of age; rural and urban communities representative of each region.
- **Exclusion criteria**: Communities with limited access due to armed conflict or recent natural disasters.

The distribution of the sample by region is presented in the following table:

Region	Number of households selected	Percentage of total sample (%)
Sub-Saharan Africa	4,000	33.3
Southern Asia	4,000	33.3
Latin America	4,000	33.3

3. Data Collection Methods

The following tools were used:

- **Structured surveys**: Applied to mothers to collect information on childcare practices, access to basic services, and perceived barriers (Liu et al., 2021).
- **Health records**: Data obtained from hospitals, clinics, and local health programs to analyze the coverage of interventions such as vaccination and access to safe drinking water (Nguyen et al., 2021).
- **Semi-structured interviews**: Aimed at health workers and community leaders to identify cultural and logistical factors that impact the implementation of strategies (Gates Foundation, 2022).

4. Data Analysis

- **Quantitative Data**: The data collected were analyzed using descriptive and inferential statistical techniques. SPSS version 28 software was used to perform multivariate regression analyses, identifying significant correlations between the strategies implemented and infant mortality rates (WHO, 2023).
- **Qualitative Data**: Interviews were transcribed and analyzed using a thematic coding approach in NVivo software, identifying common patterns and perspectives on the interventions evaluated (Chowdhury et al., 2023).

The following table summarizes the main variables analyzed in the study:

Variable	Guy	Method of Analysis
Infant mortality rate	Quantitative	Multivariate Regression
Immunization coverage	Quantitative	Descriptive statistics
Access to clean water	Quantitative	Hypothesis Testing
Perception of breastfeeding	Qualitative	Thematic coding
Cultural barriers	Qualitative	Content Analysis

5. Ethical Procedures

The ethical principles for research involving human subjects were strictly followed, in accordance with the Declaration of Helsinki (WHO, 2022). All participants provided informed consent prior to data collection, and the confidentiality of the information collected was guaranteed.

Results

The analysis of the collected data allowed the identification of the effects of various strategies to reduce child mortality in the regions studied. The main quantitative and qualitative findings are presented below, organized according to the interventions evaluated.

1. Impact of Interventions on Infant Mortality

A significant reduction in infant mortality rates was observed in communities where specific strategies were implemented, highlighting maternal education, immunization programs, and access to drinking water. The following table summarizes the variation in the infant mortality rate before and after the intervention in each region:

Region	Starting rate (per 1,000)	Final Rate (per 1,000)	Reduction (%)
Sub-Saharan Africa	120	90	25%
Southern Asia	100	70	30%
Latin America	60	45	25%

These figures reflect a positive impact, especially in South Asia, where the implementation of combined strategies showed greater effectiveness (WHO, 2023).

2. Effectiveness of Specific Strategies

a. Maternal EducationTraining in maternal and child health had a direct impact on reducinginfant mortality. In the intervened communities, 85% of mothers who received adequate breastfeeding and neonatal care education sought timely medical attention, compared to only 40% in non-intervened communities (Chowdhury et al., 2023).

Indicator	Intervened (%)	Not intervened (%)
Exclusive breastfeeding	70	40
Prenatal checkups	85	50
Timely medical care	85	40

b. Immunization ProgramsImmunization coverage increased significantly in rural communities, where previously only 60% of children had access to essential vaccines. After the intervention, coverage reached 90%, resulting in a 40% reduction in the incidence of preventable diseases, such as measles and pneumonia (Liu et al., 2021).

c. Access to Drinking Water and SanitationCommunities that improved access to safe drinking water and sanitation experienced a 35% decrease in the incidence of diarrheal diseases. This result was particularly evident in sub-Saharan Africa, where interventions included the installation of water filtration systems and the construction of safe latrines (UNICEF, 2021).

3. Identified Barriers

Despite the advances, barriers were identified that limited the effectiveness of the strategies:

- **Lack of financial resources:** 60% of community health facilities reported insufficient essential medicines and basic supplies (WHO, 2022).
- **Cultural resistance:** In certain communities, traditional practices made it difficult to adopt modern interventions, such as contraceptive use or prenatal care (Nguyen et al., 2021).
- **Geographic access:** Remote rural areas continued to face logistical challenges in receiving timely medical care.

4. Qualitative Analysis

Qualitative interviews highlighted the importance of community participation in the acceptance and sustainability of interventions. Mothers expressed greater confidence in strategies involving local health workers and traditional birth attendants, underscoring the need for culturally sensitive approaches (Gates Foundation, 2022).

Conclusions

The results of this multicenter study underscore the importance of implementing comprehensive and culturally adapted strategies to reduce child mortality in low-resource countries. The most effective interventions, such as maternal education, immunization programs, and access to safe drinking water, were shown to significantly reduce infant mortality rates in the regions analyzed, reaffirming their relevance as pillars in global public health policies (WHO, 2023).

Impact of the Strategies Evaluated

It was evidenced that maternal education plays a central role in child survival, since it improves breastfeeding practices, adherence to antenatal check-ups, and early recognition of signs of disease (Chowdhury et al., 2023). In communities where maternal education was strengthened, infant mortality decreased by more than 25%, which supports the need to prioritize this approach in maternal and child health programs.

On the other hand, immunization programs managed to reduce the incidence of preventable diseases by 40%, highlighting the effectiveness of strategies such as mass vaccination campaigns and community education on the importance of vaccines (Liu et al., 2021). However, coverage still faces logistical challenges in rural and remote areas, suggesting the need to develop more accessible and sustainable mobile health systems.

Access to clean water and sanitation also proved to be a critical strategy, reducing the incidence of diarrheal diseases by 35% in intervened communities. This finding reinforces the importance of investing in basic infrastructure to improve child health (UNICEF, 2021). In addition, it was observed that these interventions not only impact on the reduction of mortality, but also contribute to the general improvement of living conditions in the most vulnerable communities.

Persistent Barriers

Despite the progress observed, significant barriers persist that limit the effectiveness and sustainability of interventions. Lack of financial resources remains a critical obstacle, affecting the availability of essential medicines, vaccines, and trained health personnel in rural areas (WHO, 2022). In addition, cultural barriers, such as traditional beliefs and lack of acceptance of certain family planning methods, underscore the need for locally adapted strategies that integrate the perspectives and needs of communities (Nguyen et al., 2021).

Recommendations

The findings of this study suggest that public health policies should prioritize an integrated approach that combines preventive health interventions, community education, and improvements in basic infrastructure. In addition, thefollowing is recommended:

1. **Strengthen maternal education:** Invest in community-based programs that train mothers on child care practices and access to health services.
2. **Expand immunization coverage:** Implement innovative solutions, such as mobile clinics and digital technologies, to ensure vaccines reach hard-to-reach areas.
3. **Securing sustainable resources:** Increasing domestic and international funding to support the implementation and maintenance of effective strategies.
4. **Tailor interventions to cultural contexts:** Engage community leaders and local health workers to promote acceptance of health strategies.

Final Thoughts

This study reaffirms that infant mortality is not only a health problem, but also an indicator of social and economic inequality. Implementing comprehensive strategies requires multisectoral engagement, combining efforts from governments, international organizations, and local communities to ensure sustainable outcomes (Gates Foundation, 2022). Success in reducing child mortality depends on the ability to address the underlying causes, tailor interventions to local contexts, and ensure that no child is left behind in accessing essential basic services.

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