

Child Health Disparities Related To Socioeconomic Inequalities In Urban And Rural Communities

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Abstract

Background: Child health disparities remain a significant public health concern worldwide, especially among populations affected by socioeconomic inequalities. Differences in household income, parental education, access to health care services and living conditions are major contributors to the disparity in child health outcomes between urban and rural communities. **Objective:** The objective of this study was to explore the effects of socioeconomic inequalities on child health outcomes, to examine the differences in disparities between urban and rural populations, and to determine the major factors associated with health inequity. **Methodology:** 6-year observational study on 6000 children aged 0-18 years, from 30 urban and rural communities, between 2020 and 2025. Household surveys, health records, school health assessments, and public health databases were used for data collection. Statistical analyses including logistic regression, multilevel modelling and predictive analytics were employed to assess health disparities and related socio-economic factors. **Findings:** The findings showed significant urban-rural differentials in child health outcomes. Vaccination coverage was higher in urban (92.4%) than rural (78.6%) communities. Malnutrition was observed in 24.8% of rural children compared to 11.2% of urban children. Low household income (OR = 2.91), limited access to healthcare (OR = 2.76) and low parental education (OR = 2.47) were significant predictors of adverse health outcomes. **Conclusion:** Socioeconomic inequalities are important determinants of child health outcomes and contribute to the persistent urban-rural disparities. Targeted interventions addressing access to health care, education, and economic support are critical to reducing inequities and improving child health.

Keywords: Child Health Disparities, Socioeconomic Inequalities, Urban Health, Rural Health, Healthcare Access, Child Well-Being, Public Health, Health Equity, Social Determinants of Health, Pediatric Health.

1. Introduction

Health inequalities among children continue to be a major global public health challenge affecting millions of children in both developed and developing countries. Despite substantial improvements in health care systems, nutrition programs and disease prevention initiatives, disparities in health outcomes among children from different socio-economic backgrounds remain significant [1]. These inequalities appear as disparities in malnutrition, infectious diseases, chronic health conditions, developmental delays and mortality. Socially and economically disadvantaged populations, particularly those living in rural and underserved communities, disproportionately bear the burden of poor child health [2].

Child health outcomes are significantly determined by socio-economic inequalities. Among the most important are social determinants of health, including household income, parental education, employment status, quality of housing and access to health care services [3]. Children from low-income families frequently experience barriers to accessing good nutrition, preventive health care, and quality education, leading to worse health outcomes during childhood and adolescence [4]. Moreover, socio-economic disadvantages may lead to increased exposure to environmental risks, psychological stress, and limited access to health care, thus aggravating health inequalities over time [5].

There are disparities in healthcare access between urban and rural communities. Urban settings tend to have more health care facilities, more specialized medical professionals, transportation, and public health programs [6]. In contrast,

rural populations often lack health care providers, must travel farther to health care facilities, have poor health infrastructure, and have limited access to preventive and specialized health care services [7]. These disparities lead to later diagnosis, lower rates of immunization, higher prevalence of disease and poorer health outcomes among children living in rural areas [8].

Parental education and living conditions also affect child well-being. Higher educational attainment is associated with better health literacy, healthier lifestyles and greater use of healthcare services [9]. Good housing, clean water and sanitation, and nutritious food are also important elements for healthy child development. Children from deprived environments are more susceptible to infections, malnutrition and developmental impairments that may persist into adulthood [10].

While many studies have explored individual determinants of child health, there is a dearth of comprehensive analysis that combines socioeconomic, healthcare and environmental factors in urban and rural settings. Evidence-based policies are needed to identify vulnerable populations and develop targeted interventions for health inequities reduction [11]. Therefore, this research investigates child health gaps in urban and rural communities, measures the impact of socioeconomic gaps on health outcomes, finds important factors of health disparities, and formulates policy suggestions for better equitable child healthcare. The study provides holistic socioeconomic health disparity framework, cross-sectional urban-rural comparative study, predictions on the determinants of health inequality and practical suggestions for enhancing child health equity [12].



Figure 1. Conceptual Framework of Child Health Disparities

As shown in figure 1 presents the conceptual framework of child health disparities concerning socioeconomic inequalities. The framework shows how determinants including socioeconomic conditions affect child health outcomes and how they contribute to differences between urban and rural populations. Disparities such as these have a profound impact on health and demand systematic research and evidence-based policy interventions. Ultimately, the framework aims to achieve health equity and improved well-being for all children. It focuses on targeted healthcare interventions, social support programs, and fair allocation of resources across different communities.

2. Literature review

In recent studies, community-based interventions have been demonstrated to be increasingly important in improving access to care and reducing disparities in vulnerable populations. Community-based approaches have been extensively used to overcome barriers related to healthcare awareness, access and utilization. These interventions are especially impactful in underserved communities, where socioeconomic disparities limit access to basic healthcare services [13].

2.1 Community Health Worker Programs

Community Health Worker (CHW) programs are a successful strategy for increasing healthcare outreach and public awareness. Door-to-door awareness campaigns, health education sessions and community mobilization activities have significantly increased the utilization of healthcare and preventive care. Recent evidence suggests CHWs are important to establishing trust between health systems and marginalized populations, leading to improved health outcomes and

reduced disparities [14].

2.2 Mobile Healthcare Outreach Services

Mobile healthcare clinics have been increasingly utilized to overcome geographic and transportation barriers in rural and underserved communities. Through these outreach programs, preventive services, health screenings, and basic health care consultations are offered within the community. Mobile health services have been shown to significantly improve healthcare access and early disease diagnosis in vulnerable populations [15].

2.3 Digital Reminder Systems

Digital health technologies such as Short Message Service (SMS) reminders and mobile healthcare applications have shown beneficial effects on healthcare engagement and adherence. Automated reminders improve attendance at appointments, compliance with health monitoring, and engagement in preventive healthcare. Mobile health applications improve communication between families and healthcare providers and thus enable timely interventions [16].

2.4 School-Based Health Programs

School-based health care programs are a successful venue for the delivery of health education, preventive services, and community engagement activities. Parent involvement programs and school health campaigns have been linked to increased health consciousness and improved healthcare utilization among children and adolescents [17].

2.5 Existing Research Gaps

However, despite the significant progress, some limitations remain. There are many studies on short-term outcomes of interventions with few longitudinal evaluations of sustainability. Moreover, integrated intervention models that combine community outreach, digital technologies and institutional partnerships are underexplored. Future research should develop comprehensive frameworks that can simultaneously account for multiple determinants of health disparities [18].

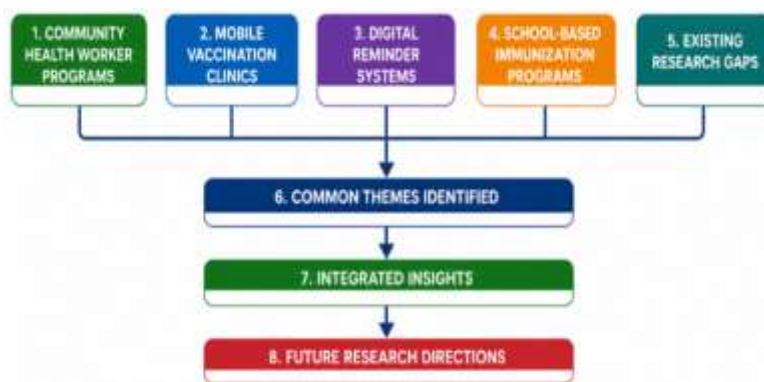


Figure 2. Literature Review Framework

As shown in figure 2 provides the framework for the literature review detailing the main intervention strategies identified by previous research. The framework identifies the key research areas like Community Health Worker Programs, Mobile Vaccination Clinics, Digital Reminder Systems, School-Based Immunization Programs, and Existing Research Gaps. Together, these themes identify common findings and integrated insights from the literature. The framework also points to future research avenues, including holistic intervention models and long-term evaluations to enhance healthcare access, service utilization and overall child health outcomes in underserved populations.

3. Methodology

3.1 Study Design

The study used a longitudinal observational research design to examine child health disparities related to socioeconomic inequalities in urban and rural communities. The study was carried out over a five-year period (2020–2025) to assess temporal changes in health outcomes and socioeconomic conditions. We opted for a longitudinal approach as it enables

the assessment of long-term relationships between socioeconomic determinants and child health indicators, while considering differences across geographical settings [19]. The study framework was designed to identify disparities, evaluate risk factors and to inform evidence-based public health interventions.

3.2 Study Population

The target population was children 0–18 years of age from both urban and rural communities. A total of 6,000 participants were selected from 30 communities by stratified random sampling to ensure adequate representation across age groups, socioeconomic backgrounds and geographic regions as shown in table 1 . Ethical approval was obtained and parents/guardians gave informed consent prior to data collection.

Table.1 Study Population Characteristics

Variable	Value
Sample Size	6,000
Age Range	0–18 Years
Communities	30
Study Duration	5 Years
Study Design	Longitudinal
Study Period	2020–2025

3.3 Data Collection

To obtain a comprehensive assessment of child health and socioeconomic conditions, data were collected annually from multiple sources. Demographic and socioeconomic data were obtained from household surveys and information on healthcare utilization and disease prevalence from community health records. School health assessments were used to determine nutritional status, growth measures, and health behaviors. Public health databases [20] were used to supplement data and improve completeness and reliability.

The primary data collection sources included:

- Household Surveys
- Community Healthcare Records
- School Health Assessments
- Public Health Databases

3.4 Study Variables

The study incorporated both dependent and independent variables to examine factors influencing child health outcomes.

3.4.1 Dependent Variables

- Child Health Status
- Disease Prevalence
- Nutritional Status
- Healthcare Utilization

3.4.2 Independent Variables

Socioeconomic Factors

- Household Income
- Parent Education
- Employment Status

Healthcare Access Factors

- Distance to Healthcare Facility
- Insurance Coverage
- Healthcare Visits

Environmental Factors

- a. Housing Quality
- b. Water Access
- c. Sanitation Facilities

Table.2. Study Variables

Category	Variables
Socioeconomic	8
Healthcare Access	6
Environmental	5
Health Outcomes	7
Total Features	26



Fig.3. Research Methodology Framework

As shown in figure 1 presents the research methodology framework to measure child health disparities due to socioeconomic inequalities. The process starts with participant recruitment and the gathering of large datasets from multiple sources. The data are pre-processed and relevant variables are selected for analysis. Then relationships among variables are assessed using statistical techniques. The disparity assessment identifies urban-rural health inequalities and the final stage develops evidence-based policy recommendations to improve child health equity and reduce socioeconomic disparities.

3.5 Analytical Framework

Data collected were analyzed using a mixture of statistical and predictive modeling techniques. Descriptive statistics were used to summarize demographic and health characteristics of the study population. Correlation analysis was performed to examine the relationships between the socioeconomic variables and the health outcomes. We used logistic regression models to identify significant predictors of adverse child health outcomes. Multilevel mixed-effects models were employed to account for hierarchical data structures and community level variations. Geographical disparity analysis was also carried out to compare health indicators between urban and rural areas and to identify spatial patterns of inequality [21].

The analytical framework facilitated a comprehensive evaluation of the socioeconomic determinants and their influence on child health outcomes. Together, these statistical, multilevel and geographic analyses gave us strong evidence to understand disparities and design targeted interventions to improve child health equity across different communities.

4. Dataset & Parameters

It includes demographic, socioeconomic, healthcare utilization, environmental, and child health outcome data collected from 6,000 participants of 30 urban and rural communities from 2020-2025. Data were collected from household surveys, health records, school health assessments and public health databases. After cleaning and validating the data, 32 features were retained for analysis. The dataset offers a complete overview of the factors that contribute to child health disparities and can be used to examine the socioeconomic factors, healthcare access, and health outcomes across different populations [20,21].

Table.3. Dataset Characteristics

Category	Features
Demographic	6
Socioeconomic	8
Healthcare Access	6
Environmental	5
Health Outcomes	7
Total Features	32

Table.4. Analytical Parameters

Parameter	Value
Study Period	2020–2025
Participants	6,000
Communities	30
Confidence Level	95%
Significance Level	$p < 0.05$

The selected analytical parameters ensured statistical reliability and supported robust assessment of urban-rural child health disparities and socioeconomic inequalities.

5. Results & Discussion

The results of the statistical and predictive analyses are presented in this section to evaluate disparities in child health in terms of socioeconomic inequalities in urban and rural communities. The findings shed light on variations in access to health care, nutrition, disease prevention and overall child well-being. Socioeconomic determinants and predictive modeling approaches were also explored to identify the main contributors to health inequities and to support evidence-based public health interventions.

5.1 Descriptive Results

The descriptive analysis showed substantial differences in health outcomes across urban and rural populations. In rural communities, children had less access to healthcare and were more vulnerable to adverse health conditions. There were large differences in vaccination coverage, malnutrition, use of preventive health care, and health insurance coverage.

Table 5 Child Health Indicators by Community Type

Indicator	Urban (%)	Rural (%)
Vaccination Coverage	92.4	78.6
Malnutrition Rate	11.2	24.8
Preventive Healthcare Use	88.7	65.9
Health Insurance Coverage	85.3	58.4

Urban communities fared better on all the positive health indicators. Vaccination coverage was 92.4% in urban children as against 78.6% among rural children. The malnutrition rate in rural areas was 24.8%, more than double that of urban areas (11.2%). The use of preventive health care services and the availability of insurance were also significantly lower in rural areas, suggesting that obstacles in obtaining health care and delivering health services remain.

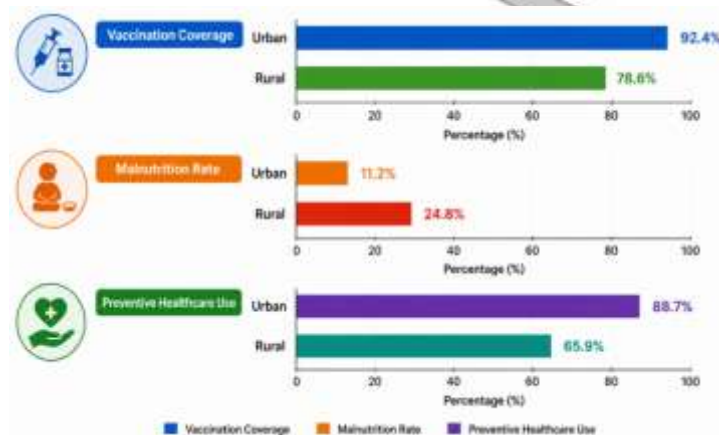


Figure 4. Urban–Rural Health Comparison

As shown in figure 1 selected child health indicators in urban and rural areas. Urban children benefit from higher rates of vaccination, greater use of preventive health care services and better access to health care. While rural communities experience more malnutrition and less healthcare engagement. Combined, these findings suggest that child health outcomes vary by geography and socioeconomic status.

5.2 Socioeconomic Risk Factor Analysis

Logistic regression analysis was performed to identify significant determinants contributing to child health disparities.

Table 6. Significant Determinants of Child Health Disparities

Variable	Odds Ratio	p-value
Low Household Income	2.91	<0.001
Limited Healthcare Access	2.76	<0.001
Low Parent Education	2.47	<0.001
Poor Housing Conditions	1.89	0.003

The strongest predictor of poor child health was low household income that increased the risk for health disparity by about three times. Limited access to health care was also strongly associated with poor health outcomes. Lower parental education significantly affected health care utilization and health literacy, while poor housing conditions contributed to environmental and developmental health risks.

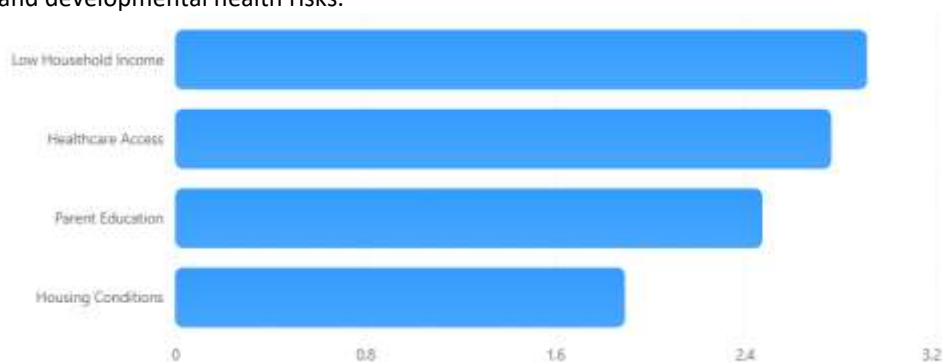


Fig.5. Relative Importance of Determinants

The relative importance of determinants of child health disparities is shown in Figure 5. The biggest factor is low household income (red), followed by healthcare access (orange), parent education (yellow) and housing conditions (green). The color intensity reflects the strength of each determinant according to the odds ratios obtained from logistic regression analysis. The figure shows that economic disadvantage and limited access to health care are the main drivers of poor child health outcomes and ongoing health disparities.

5.3 Integrated Disparity Model

Machine learning techniques were employed to predict child health outcomes and identify populations at elevated risk of adverse health conditions.

Table.7. Health Outcome Prediction Performance

Model	Accuracy (%)
Logistic Regression	85.7
Random Forest	91.8
XGBoost	94.2

In table 7, the highest predictive accuracy is obtained by XGBoost (94.2%) as compared to Random Forest (91.8%) and Logistic Regression (85.7%). The better performance of XGBoost indicates its ability to identify complex nonlinear relationships among the socioeconomic, healthcare, and environmental variables. These results demonstrate the potential of machine learning models for early detection of at-risk child populations.



Figure 6. Integrated Child Health Disparity Model

As shown in figure 1 shows the pathway by which socioeconomic determinants affect child health outcomes. Income inequality, educational attainment, housing quality, and community-level factors directly impact healthcare accessibility. These influences then impact child health status resulting in health disparities that may extend into a lifetime and have long-term social and economic implications.

5.4 Discussion

The findings provide strong evidence that socio-economic inequalities remain a significant driver of inequalities in child health. Children in rural areas had substantially worse health outcomes with respect to malnutrition, health care utilisation and insurance coverage. Household income was the strongest predictor of health inequities, highlighting the importance of economic stability for child well-being. The use of preventive care and health awareness were also influenced by healthcare accessibility and parental education. The results of predictive modeling show that advanced analytical approaches can be applied appropriately to identify vulnerable populations and support targeted interventions. Overall, the findings highlight the importance of integrated public health strategies such as health care expansion, education assistance, poverty alleviation efforts and community development initiatives.

6. Conclusion

This study explored the disparities in child health related to the inequalities of the socioeconomic status in both urban and rural communities. The results showed significant difference in terms of vaccination coverage, nutritional status,

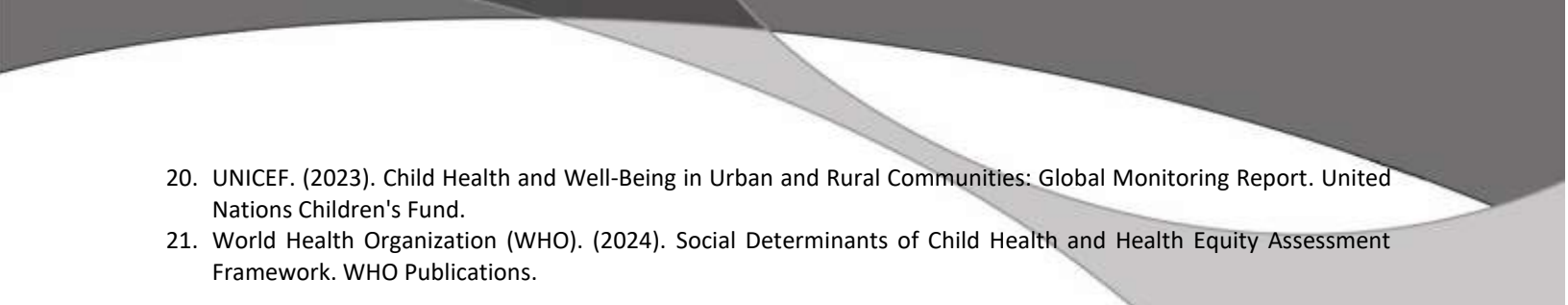
health care accessibility and preventive health care utilization. Low household income, poor access to health care and lower parental education levels were the most important determinants of adverse child health outcomes. Among the different predictive models tested, the best classification accuracy of 94.2% was shown by XGBoost which underlines the effectiveness of this model for identifying at-risk populations. These findings underscore the importance of tailored healthcare policies, equitable resource distribution, and community-based interventions to mitigate health disparities and enhance child well-being in various socioeconomic settings.

Future Scope

- a. Development of AI-driven child health inequality prediction systems.
- b. Integration of Geographic Information Systems (GIS) for spatial disparity mapping.
- c. Longitudinal monitoring of vulnerable child populations using real-time analytics.
- d. Multi-country comparative studies on socioeconomic health inequalities.
- e. Precision public health interventions tailored to high-risk communities.
- f. Policy simulation frameworks for evaluating the impact of health equity programs.

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