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Persistent socioeconomic disparities in childhood vaccination coverage in Tanzania: Insights from multiple rounds of demographic and health surveys

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ABSTRACT

Objectives: This study examined the trends, disparities, and factors associated with childhood vaccination coverage in Tanzania between 2010 and 2022.

Methods: We used data from three recent Tanzania Demographic and Health Surveys. We included a total of 5637 children aged 12–23 months and their mothers. Socioeconomic disparities in childhood vaccination coverage were evaluated using concentration curves and indices, and decomposition analysis was performed to identify the contributing factors. Poisson regression analysis was conducted to determine the factors associated with childhood vaccination uptake in Tanzania.

Results: Full vaccination coverage remained stable at approximately 75.6 % from 2010 to 2015 but declined to 70.5 % by 2022. Throughout all three survey rounds, children from households with a lower socioeconomic position consistently had lower full vaccination coverage than those from families with a higher socioeconomic position. The concentration index for full vaccination coverage was 0.1531 in 2010 ($p < 0.001$), 0.1466 in 2015 ($p < 0.001$), and 0.1314 in 2022 ($p < 0.001$), indicating persistent but slightly decreasing inequality favoring upper-class children (F-stat = 3.27, $p = 0.038$). The key contributors to these inequalities were maternal illiteracy, poverty, and lack of exposure to mass media. Factors that increased childhood vaccination uptake included higher socioeconomic position, facility-based childbirth, antenatal care utilization, proximity to healthcare facilities, and having fewer children under the age of five in the household.

Conclusion: Despite Tanzania's considerable overall childhood vaccination coverage, the findings indicated significant socioeconomic disparities. Urgent action is needed to close these gaps and ensure that every child in Tanzania receives life-saving protection regardless of their background or circumstances.

1. Introduction

Vaccines are one of the most successful, long-lasting, and cost-effective public health investments [1], and are expected to avert approximately 5.2 million deaths annually during the decade from 2021 to 2030 [2]. Despite their effectiveness, certain groups–particularly the poorest, most marginalized, and most vulnerable–still have limited or no access to immunization services [3]. Globally, nearly 20 million infants do not receive a complete course of basic vaccines, highlighting the persistent gaps in coverage. The Immunization Agenda 2030 aspires to ensure that everyone, everywhere, and at every age fully benefits from vaccines for optimal health and well-being [4].

Tanzania's routine immunization schedule for children under two years of age includes the Bacillus Calmette-Guérin (BCG) vaccine, administered at birth or during the first healthcare contact. The oral polio vaccine (OPV) is provided at birth, 6, 10, and 14 weeks, while the

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Table 1
Full childhood vaccination coverage by socioeconomic indicators.

Socioeconomic indicators	Total	Fully vaccinated	*p*-value
N	5637	4157 (73.7)	
Household wealth			<0.001
Poorest	1234	780 (63.2)	
Poorer	1173	856 (72.9)	
Middle	1100	823 (74.8)	
Richer	1158	937 (80.9)	
Richest	972	761 (78.3)	
Mother's education			<0.001
Illiterate	1241	784 (63.2)	
Incomplete primary	715	498 (69.6)	
Complete primary	2482	1906 (76.8)	
Incomplete secondary	574	458 (79.8)	
Secondary/higher	625	511 (81.8)	
Mother's occupation			0.077
Not working	1312	985 (75.1)	
Agriculture	2557	1826 (71.4)	
Manual work	1268	953 (75.2)	
Other jobs	94	71 (75.5)	
Professional	406	322 (79.3)	
Mass media exposure			<0.001
Unexposed	1535	1035 (67.4)	
Exposed	4102	3122 (76.1)	

Table 2
Prevalence of full vaccination coverage by participants' characteristics.

Variables	Total	Fully vaccinated	p-value
N	5637	4157 (73.7)	
Socioeconomic position			<0.001
Lower class	1191	762 (63.9)	
Lower-middle	1145	806 (70.4)	
Middle class	1098	810 (73.8)	
Upper-middle	1108	873 (78.8)	
Upper class	1095	906 (82.7)	
Sociodemographic characteristics			
Mother's age			0.403
15—24 years	1851	1349 (72.9)	
25—34 years	2496	1860 (74.5)	
35—49 years	1290	948 (73.5)	
Marital status			0.011
Single	358	277 (77.4)	
Married	3775	2802 (74.2)	
Cohabiting	973	707 (72.7)	
Widowed/separated	531	371 (69.9)	
Children under five years of age			<0.001
0—1	2021	1578 (78.1)	
2	2377	1791 (75.4)	
≥3	1239	7,88 (63.6)	
Place of residence			0.027
Urban	1372	1068 (77.8)	
Rural	4265	3089 (72.4)	
Healthcare access and utilization			
Place of delivery			<0.001
Home/elsewhere	1898	1264 (66.6)	
Healthcare facility	3739	2893 (77.4)	
Antenatal visits			<0.001
None	275	157 (57.1)	
Don't know	306	212 (69.3)	
1—3	2166	1546 (71.4)	
≥4	2890	2242 (77.6)	
Distance to facility			<0.001
Big problem	1890	1310 (69.3)	
Not a big problem	3747	2847 (75.9)	

inactivated polio vaccine (IPV) is administered at 14 weeks. Infants also receive the rotavirus vaccine, pneumococcal conjugate vaccine (PCV13), and pentavalent vaccine (which protects against diphtheria, pertussis, tetanus, hepatitis B, and *Haemophilus influenzae* type b) at 6, 10, and 14 weeks of age. The measles-rubella (MR) vaccine is administered at 9 and 18 months.

Disparities in immunization access and coverage, both within and across countries, prompted the establishment of the Decade of Vaccines (DoV) initiative, which ran from 2011 to 2020. Its vision was to create "*a world in which all individuals and communities enjoy lives free from vaccine-preventable diseases.*" To support this vision, the Decade of Vaccines Collaboration was launched in 2010 to develop a comprehensive strategic framework for implementation. The collaboration was led by the World Health Organization (WHO), the United Nations Children's Fund (UNICEF), Gavi, the U.S. National Institute of Allergy and Infectious Diseases (NIAID), and the Bill & Melinda Gates Foundation [5].

Although the DOV initiative has led to significant progress in the introduction of new vaccines and expanding access, challenges in reaching underserved populations persisted [1]. Moreover, the coronavirus disease 2019 (COVID-19) pandemic disrupted immunization programs and shifted the focus away from other vaccines [6]. In addition, rising vaccine hesitancy fueled by misinformation has further eroded public trust [7]. These issues and logistical and political challenges have hindered the achievement of the DoV's goals, particularly in ensuring equitable vaccine access and uptake [4].

To maximize vaccination coverage, the Tanzanian government employs several strategies, including detecting and reaching the unreached population, integrating immunization with other life-saving initiatives, and exempting users from fees [8]. Despite these efforts, disparities in accessing immunization services in Tanzania persist, largely influenced by socioeconomic and demographic factors [9–11]. Children from low-income families and those living in rural or remote areas face significant barriers to timely vaccination owing to limited access to healthcare facilities, lack of transportation, and financial constraints [9,10]. Nomadic communities and populations in hard-to-reach regions often experience lower vaccination rates because of the difficulties in delivering healthcare services to these areas [11].

Several studies have identified some socioeconomic and geographic barriers to immunization [9–11]. However, limited research specifically explores how trends in vaccination coverage have evolved over time in relation to these factors during the DoV period. Additionally, little is known about the specific determinants of vaccination disparities within different socioeconomic groups, especially in the context of recent challenges like the COVID-19 pandemic and vaccine hesitancy. This study addresses these gaps by analyzing trends, disparities, and key determinants of childhood vaccination coverage in Tanzania, focusing on socioeconomic characteristics during the DoV period.

2. Methods

2.1. Study design

This study is based on a secondary analysis of the three most recent Demographic and Health Surveys (DHS) conducted in Tanzania in 2010, 2015–16, and 2022. The DHS are nationally representative surveys collecting data on key health and demographic indicators, including fertility, family planning, maternal and child health, and nutrition. The surveys were implemented by the National Bureau of Statistics (NBS) in collaboration with the Ministry of Health, with technical assistance from ICF International through the DHS Program. The program is primarily funded by the United States Agency for International Development (USAID), with additional contributions from other development partners. Data are collected through face-to-face interviews using standardized questionnaires. Notably, the response rates among eligible women exceeded 96 % across all three surveys, ensuring high data representativeness. These surveys provide detailed information to support informed decision-making by policymakers, researchers, and organizations [12–14].

2.2. Sampling design

Data collection was performed using a two-stage stratified cluster sampling design. In the first stage, clusters were chosen using a

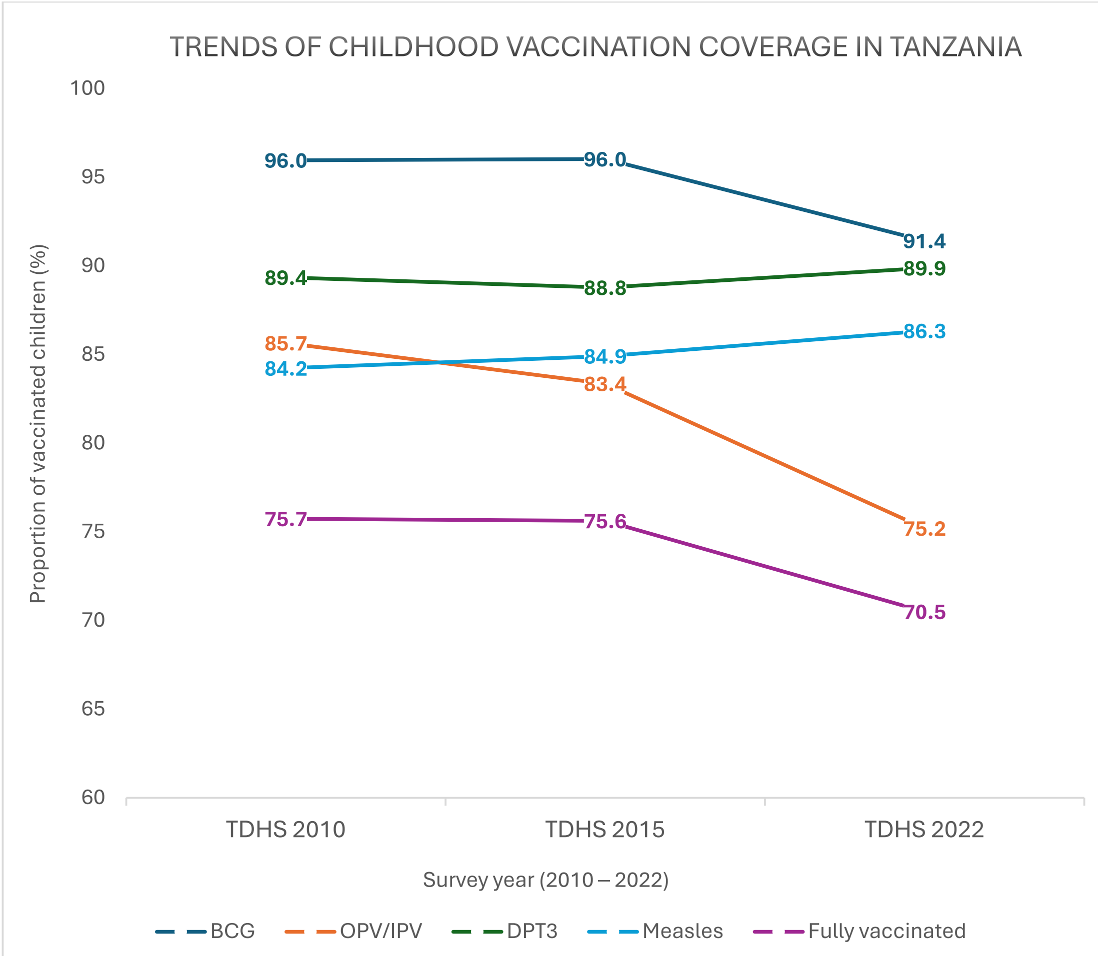

Fig. 1. Trends of childhood vaccination coverage in Tanzania.
Abbreviations: BCG: Bacillus Calmette-Guérin; DPT: diphtheria, pertussis, and tetanus vaccine; IPV: inactivated polio vaccine; OPV: oral polio vaccine; TDHS: Tanzania Demographic and Health Survey.

probability proportional to the size of each sampling stratum, defined by the region. In the second stage, households were systematically selected from each cluster. All eligible women from selected households who agreed to participate were interviewed [12–14].

2.3. Inclusion criteria

The DHS datasets included vaccination data for children aged 12–35 months. However, our analysis was restricted to children aged 12–23 months, as this age range is commonly used to assess routine childhood vaccination coverage and enables comparison with global benchmarks [15]. To ensure data accuracy and reliability, we excluded 213 respondents who were not usual residents, resulting in a final sample of 5637 mother-child pairs.

2.4. Outcome variable

The outcome of interest was childhood vaccination coverage, which was analyzed as a categorical variable (full vaccination) and count variable (vaccine count). Full vaccination is a binary variable indicating whether or not a child has been fully vaccinated with basic antigens, according to the definition of DHS [16]. Children were classified as fully vaccinated if they had received a complete series of basic vaccines, including one dose of BCG, three doses of a DPT-containing vaccine, three doses of a polio vaccine, and one dose of the measles vaccine. The polio vaccination requirement was either three doses of OPV (excluding the dose at birth) or a combination of two OPV doses and at least one IPV dose [14,16]. The vaccine count was calculated as the total number of basic vaccine doses received by the child. Information about childhood immunization status was obtained from written vaccination records or from the mothers' reports when the records were unavailable [12–14].

2.5. Socioeconomic position

Socioeconomic position (SEP) served as the main explanatory variable. SEP refers to the social and economic factors that influence the societal positions of individuals or groups [17]. To capture this construct, we developed an SEP index using four key indicators based on evidence from the literature: household wealth, mother's education, mother's occupation, and exposure to mass media [17,18].

Household wealth was assessed using a wealth index based on ownership of consumer goods and housing characteristics. Principal component analysis was used to calculate wealth scores, which were assigned to each household member and aggregated to rank the population into wealth quintiles [12–14]. Exposure to mass media was defined as engaging with any of the following media sources at least once a week: reading newspapers or magazines, listening to the radio, or watching television.

The SEP index was developed in two steps. First, each key indicator was standardized to a mean of zero and a standard deviation of one to ensure comparability. Second, we performed principal component analysis of the standardized indicators and used eigenvectors to

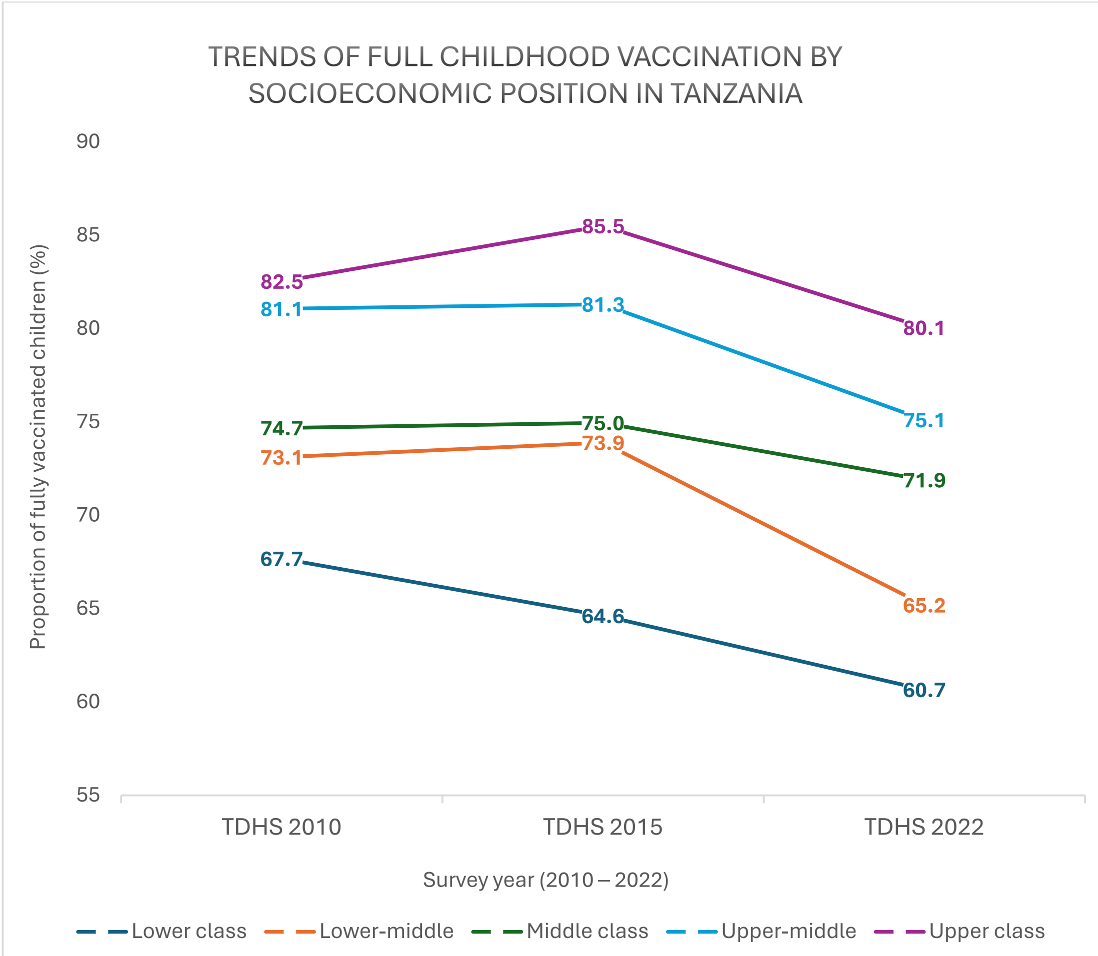

Fig. 2. Trends of full childhood vaccination coverage by socioeconomic position in Tanzania.
Abbreviations: TDHS: Tanzania Demographic and Health Survey.

calculate the scores for the first principal component, which served as the SEP index. The SEP index was then ranked into quintiles to develop the SEP variable [19].

2.6. Covariates

Covariates encompassed a range of maternal sociodemographic, healthcare access, and healthcare utilization factors. Maternal sociodemographic factors included age, marital status, place of residence, and number of children under five years of age in the household. Healthcare access and utilization factors included place of delivery, frequency of antenatal visits during pregnancy, and proximity to healthcare facilities.

2.7. Data analysis

Descriptive statistics were summarized using frequencies and percentages. Pearson's chi-square test was used to determine associations between the outcome variable (full vaccination) and categorical covariates [20]. Line charts were used to present trends in full childhood vaccination coverage over time.

Concentration curves and indices were used to assess the socioeconomic disparities in childhood vaccination coverage. The concentration curve plots the cumulative share of the outcome (y-axis) against the cumulative percentage of the population (x-axis) ranked from poorest to richest [21]. The concentration curve lies above the equality line if the outcome is concentrated in the lower class. The curve lies below the equality line if the outcome is concentrated in the upper class. If the outcome was equally distributed, the curve coincides with the line of equality [22]. The gap between the concentration curve and the equality line indicates the magnitude of inequality [21].

The concentration index was defined as twice the area between the concentration curve and equality line. Theoretically, this lies between -1 and $+1$ [23]. Negative values indicate that vaccination coverage is more prevalent among lower socioeconomic groups, whereas positive values suggest a higher concentration among wealthier groups. A concentration index of zero signifies the absence of socioeconomic-related inequality. Values closer to zero indicate minimal inequality, while those further from zero reflect greater disparities [24,25]. For the binary outcomes, the concentration index does not lie within these limits; therefore, Erreygers normalization was applied [23,26].

To understand the factors contributing to inequities, the concentration index was decomposed using a regression-based approach [24,25]. When interpreting the results of the decomposition analysis, we reported the elasticities of full vaccination coverage in relation to socioeconomic indicators, the concentration index for each indicator, and the contribution of each indicator to the concentration index of the outcome. Elasticity indicates the extent to which socioeconomic inequality in vaccination coverage responds to a one-unit positive change in the independent variables. A positive elasticity suggests an increase in inequality, while a negative elasticity indicates a decrease in inequality following a positive change in the independent variables [27,28]. The percentage contribution of each factor in the decomposition of the concentration index reflects its relative influence on the overall socioeconomic-related inequality in vaccination coverage [25,28]. This

Table 3
Decomposition of concentration indices for full childhood vaccination coverage.

Survey year	Sample	Concentration index	Standard error	p-value
2010	1484	0.1531	0.0248	<0.001
2015/16	2067	0.1466	0.0209	<0.001
2022	2086	0.1314	0.0228	<0.001
Overall	5637	0.1418	0.0131	<0.001
Socioeconomic indicators	Elasticity	Concentration index	Absolute contribution	Percentage contribution
Household wealth				
Poorest	−0.0196	−0.7609	0.0596	42.01
Poorer	−0.0028	−0.5623	0.0062	4.37
Middle	−0.0045	−0.2661	0.0048	3.41
Richer	0.0041	0.1264	0.0021	1.48
Richest	0	0.5248	0	0
Mother's education				
Illiterate	−0.0247	−0.6777	0.0669	47.13
Incomplete primary	−0.0089	−0.3776	0.0135	9.49
Complete primary	−0.0051	−0.0014	0	0.02
Incomplete secondary	0	0.3901	0	0.00
Secondary/ higher	0	0.5978	0	0
Mother's occupation				
Not working	0.006	−0.0847	−0.002	−1.44
Agriculture	0.0091	−0.3274	−0.012	−8.44
Manual work	0.0004	0.2623	0.0004	0.31
Other jobs	−0.001	0.2414	−0.0009	−0.66
Professional	0	0.5967	0	0
Mass media exposure				
Unexposed	−0.0093	−0.666	0.0248	17.50
Exposed	0	0.1582	0	0

Note: data is weighted.

contribution is calculated as the product of the sensitivity of the health outcome to that factor and the extent of income-related inequality associated with it [25]. Factors with near-zero contributions have minimal impact on inequality. A positive contribution from an indicator indicated that it increases inequality, disfavoring the lower class, whereas a negative contribution indicated a reduction in inequality [25,29].

Poisson regression was used to adjust for confounders and identify other determinants of childhood vaccination coverage in Tanzania. To assess the goodness-of-fit for our Poisson regression model, we examined both the deviance and Pearson chi-square statistics. The deviance goodness-of-fit statistic was 4025.40 (p = 1.000), and the Pearson goodness-of-fit statistic was 2584.73 (p = 1.000). Both statistics indicated that the model fit the data well [30]. The results were presented using incidence risk ratios (IRRs) and their 95 % confidence intervals. Statistical significance was set at $p < 0.05$.

Sampling weights are adjustment factors applied to each case in a dataset to correct for differences in selection probability and response rates. They compensate for variations introduced by the survey design and non-response, ensuring that the findings accurately reflect the characteristics of the target population [16]. Therefore, sampling weights from the DHS datasets were applied to improve the representativeness of the sample. Data curation and statistical analyses were performed using Stata (version 17.0; Stata Corp LP, College Station, Texas, USA).

3. Results

Of the 5627 respondents, nearly half were aged 25–34 years. Three-quarters resided in rural areas, and two-thirds were married. Close to three-quarters were exposed to mass media at least once per week, while nearly half had completed primary education. In terms of healthcare utilization, just over half of the respondents attended at least four antenatal care visits during pregnancy, and two-thirds gave birth in healthcare facilities (Tables 1 and 2).

Between 2010 and 2015, full vaccination coverage remained relatively stable at approximately 75.6 %. However, by 2022, this rate had declined to 70.5 %. This reduction was primarily driven by reductions in the coverage of the BCG vaccine, which decreased from 96 % in 2015 to 91 % in 2022, and OPV/IPV coverage, which decreased from 83.4 % in 2015 to 75.2 % in 2022. In contrast, the coverage of the DPT3 and measles vaccines showed an upward trend during the same period (Fig. 1).

Across all three survey rounds, children from households in the lower class consistently exhibited lower full vaccination coverage than those from households in the upper class (Fig. 2). In 2010, full vaccination coverage had a concentration index of 0.1531 ($p < 0.001$), indicating a higher concentration among upper-class children. This trend continued in 2015, with a concentration index of 0.1466 (p < 0.001), and in 2022, with a concentration index of 0.1314 (p < 0.001). A decrease in the concentration indices indicates a consistent reduction in disparities between 2010 and 2022 (F-stat = 3.27, p = 0.038). The positive concentration indices (Table 3) and their corresponding concentration curves (Fig. 3) consistently demonstrated that full vaccination coverage was more prevalent among upper-class children.

The poorest wealth category contributed significantly to the overall inequality in vaccination rates, accounting for 42 % with negative elasticity. Likewise, individuals with no formal education contributed 47 % to the inequality, also with negative elasticity. Additionally, lack of exposure to mass media contributed 17.5 % to the inequality, again exhibiting negative elasticity. In contrast, the agricultural category had a notable negative contribution to inequality (−8.8 %), suggesting that it reduced overall inequality (Table 3).

After adjusting for confounders in the Poisson regression, the results indicated that higher socioeconomic position was associated with increased childhood vaccination rates. Specifically, children in the upper socioeconomic class showed a 6 % higher rate of receiving more vaccine doses than those in the lower socioeconomic class. Children whose mothers delivered in healthcare facilities were 7 % likelier to have higher vaccination rates than those whose mothers gave birth elsewhere. Children whose mothers attended at least four antenatal care visits were 19 % more likely to receive a higher number of vaccine doses than those whose mothers did not attend antenatal care. Better access to healthcare facilities was also associated with higher vaccination rates. On the other hand, households with three or more children under the age of five years had lower vaccination rates (Table 4).

4. Discussion

This study used data from the three most recent rounds of DHS in Tanzania to present the trends of full childhood vaccination in relation to socioeconomic position. The findings provide evidence of persistent socioeconomic disparities in childhood vaccination coverage over the past decade. Furthermore, this study identified the key factors contributing to these disparities and explored a range of potential factors influencing childhood vaccination uptake.

The stable rate of full vaccination coverage from 2010 to 2015 was followed by a moderate decline from 2015 to 2022, likely due to disruptions in childhood immunization services during the COVID-19 pandemic [6] and a rise in vaccine hesitancy [7]. These disruptions may have contributed to the 2022 polio outbreak in Malawi and a confirmed case in Tanzania [31]. In response, Tanzania launched a polio vaccination campaign targeting children born after 2016 in six regions bordering Malawi. Although such targeted approaches are vital, broader recovery measures, including strengthened routine immunization programs and efforts to address vaccine hesitancy, are necessary to restore

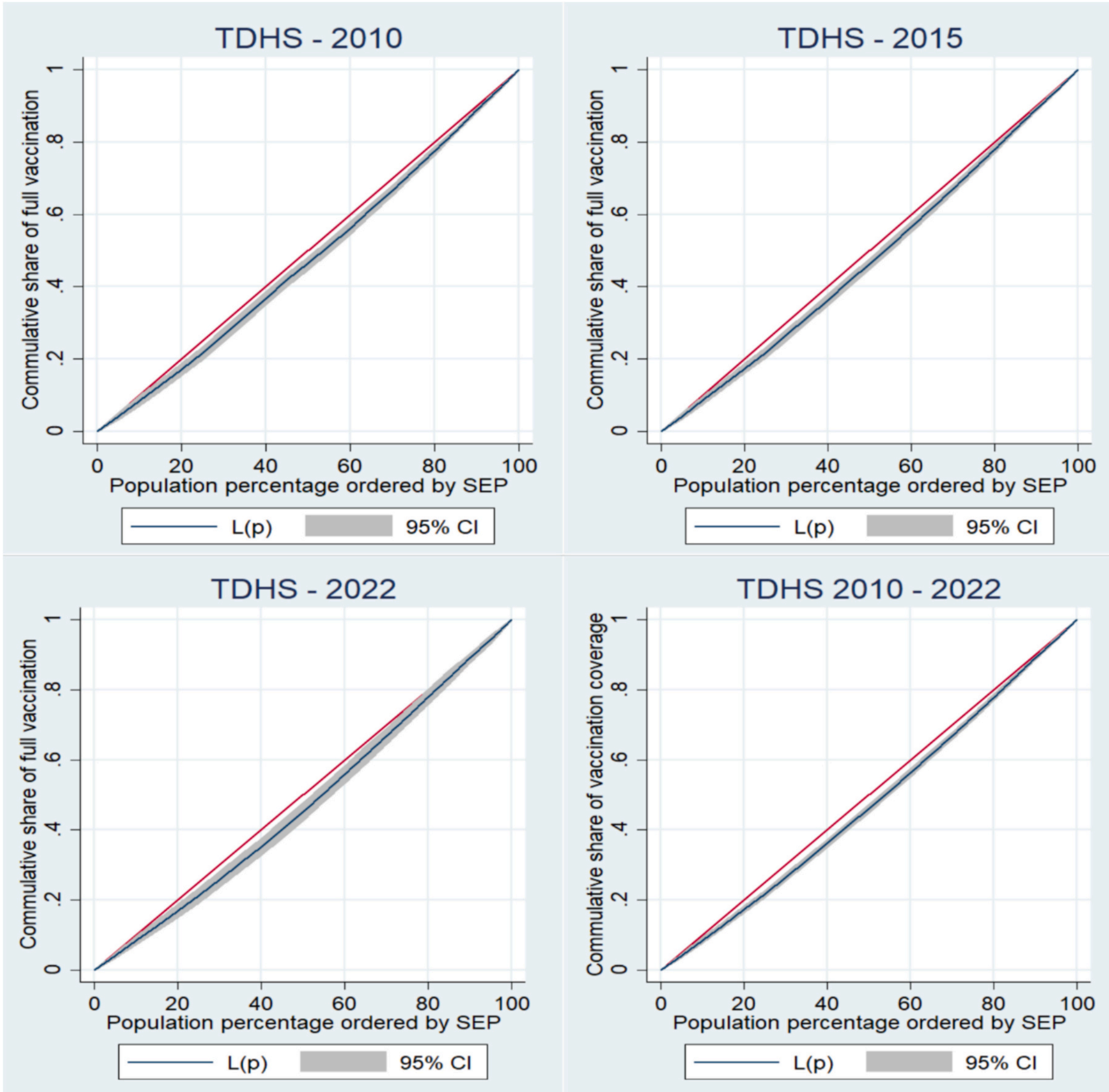

Fig. 3. Concentration curves showing socioeconomic disparities in full childhood vaccination coverage in Tanzania.
Abbreviations: SEP: socioeconomic position; TDHS: Tanzania Demographic and Health Survey.
Note: Data is weighted

pre-pandemic vaccination levels and ensure widespread protection.

Despite the overall decline in full vaccination coverage between 2015 and 2022, the coverage of the DPT3 and measles vaccines steadily increased, both approaching 90 %. Although BCG coverage slightly declined during this period, it remained consistently above the 90 % threshold. Evidence has shown that herd immunity is established when at least 90 % of the population has vaccine-induced protection [32,33]. Therefore, the WHO proposed achieving at least 90 % vaccination rates for essential vaccines administered in childhood and adolescence by 2030 [4]. These trends suggest a strong resilience in Tanzania's immunization program.

Our analysis revealed consistently low full vaccination coverage among children from lower-class households across the three survey rounds, despite the availability of free childhood vaccines in Tanzania. Our findings are consistent with those of studies conducted in low- and middle-income countries, including India [34], Ethiopia [35], and Tanzania [36]. These disparities suggest that structural barriers such as limited healthcare access [11] and indirect costs, including transportation expenses [9,10], significantly hinder vaccine uptake. Our decomposition analysis identified maternal illiteracy, poverty, and lack of exposure to mass media as the primary contributors to the observed inequalities. These findings align with the broader trends observed across Sub-Saharan Africa [37], where socioeconomic disparities undermine public health initiatives, even in the context of universal healthcare policies. The persistence of these inequalities highlights the need for targeted interventions that address not only the direct costs of healthcare but also the socioeconomic determinants that disproportionately affect vulnerable populations.

Our analysis revealed that although socioeconomic disparities in vaccination coverage decreased over time, as indicated by a reduction in the disparity index from 2010 to 2022, significant gaps persisted. The observed decrease in disparities can likely be attributed to several targeted strategies, including expanding outreach services, integrating vaccination programs with other essential child health initiatives, and providing vaccines at no direct cost to families [8]. These efforts have undoubtedly contributed to narrowing the equity gap. However, the persistence of significant disparities highlights the need for continued and enhanced interventions to ensure that all children, regardless of

Table 4
Poisson regression models for identifying the factors associated with childhood vaccination coverage, $n = 5637$.

Variables	IRR (95 % CI)	p-value	aIRR (95 % CI)	p-value
Socioeconomic position				
Lower class	1		1	
Lower-middle	1.06 (1.03, 1.09)	<0.001	1.04 (1.01, 1.07)	0.007
Middle class	1.09 (1.06, 1.12)	<0.001	1.06 (1.03, 1.08)	<0.001
Upper-middle	1.11 (1.08, 1.14)	<0.001	1.07 (1.04, 1.10)	<0.001
Upper class	1.12 (1.10, 1.15)	<0.001	1.06 (1.03, 1.09)	<0.001
Sociodemographic characteristics				
Mother's age				
15—24 years	1		1	
25—34 years	1.01 (0.99, 1.02)	0.918	1.01 (0.99, 1.03)	0.209
35—49 years	1.00 (0.98, 1.02)	0.754	1.01 (0.99, 1.04)	0.276
Marital status				
Single	1		1	
Married	0.96 (0.94, 0.98)	0.699	0.98 (0.95, 1.00)	0.091
Cohabiting	0.97 (0.94, 0.99)	0.317	0.99 (0.96, 1.02)	0.433
Widowed/separated	0.96 (0.93, 0.99)	0.515	0.98 (0.94, 1.01)	0.185
Children under five years of age				
0—1	1		1	
2	0.99 (0.97, 1.01)	0.914	1.01 (0.99, 1.02)	0.526
≥3	0.91 (0.88, 0.93)	<0.001	0.95 (0.92, 0.97)	<0.001
Place of residence				
Urban	1		1	
Rural	0.95 (0.93, 0.97)	<0.001	1.01 (0.99, 1.03)	0.334
Healthcare access and utilization				
Place of delivery				
Home/elsewhere	1		1	
Healthcare facility	1.10 (1.08, 1.12)	<0.001	1.07 (1.05, 1.09)	<0.001
Antenatal visits				
None	1		1	
Don't know	1.14 (1.04, 1.23)	0.002	1.15 (1.06, 1.24)	0.001
1—3	1.16 (1.07, 1.24)	<0.001	1.15 (1.08, 1.24)	<0.001
≥4	1.21 (1.13, 1.31)	<0.001	1.19 (1.11, 1.27)	<0.001
Distance to facility				
Big problem	1		1	
Not a big problem	1.04 (1.02, 1.06)	<0.001	1.02 (1.01, 1.04)	0.037

Note: Data are weighted; aIRR, adjusted incidence rate ratio; IRR, incidence rate ratio.

socioeconomic status, have equal access to life-saving vaccines.

Our analysis identified several key factors that promote childhood vaccination uptake, including higher socioeconomic position, facility-based childbirth, antenatal care utilization, easy access to nearby healthcare facilities, and fewer children under the age of five years within the family. These findings align with evidence from studies conducted in Sub-Saharan Africa [35,37], reinforcing the importance of maternal and healthcare-related factors in promoting vaccination uptake. The consistent association of these facilitators across diverse contexts underscores their critical role in enhancing vaccine coverage. Thus, strengthening these areas could improve childhood immunization rates in Tanzania and similar environments.

The present study draws on the three most recent rounds of DHS data from Tanzania, providing a comprehensive and up-to-date analysis of childhood vaccination trends over the past decade. The use of nationally representative data ensured a robust assessment of vaccination trends, making the findings highly relevant for health policies seeking to address inequalities in childhood immunization coverage. One notable strength of this study is its ability to offer valuable insights into the factors contributing to socioeconomic disparities in vaccination uptake, which are critical for designing targeted interventions.

However, there are some limitations to consider. First, due to the cross-sectional nature of the data, we could not establish causal relationships from the observed associations. Second, the use of mothers' reports to determine a child's vaccination status when vaccination cards were unavailable may have introduced a recall bias. Despite these limitations, the DHS provided nationally representative and reliable data, allowing robust nationwide analysis of vaccination trends and disparities.

5. Conclusions

The present study highlights the trends, disparities, and factors associated with childhood vaccination coverage in Tanzania from 2010 to 2022. While Tanzania has made considerable strides in achieving high coverage of basic childhood vaccinations, urgent action is required to address the persistent socioeconomic disparities. Closing these gaps is essential to ensure that every child in Tanzania, regardless of their background or circumstances, receives life-saving protective vaccines. By targeting these inequities, we can move closer to a future in which all children benefit equally from the nation's immunization efforts.

Ethical considerations

This study is based on a secondary analysis of anonymized data from the DHS program. Informed consent was obtained from all the participants prior to data collection. All the methods used in this study adhered to the ethical standards and regulations outlined in the Declaration of Helsinki [38].

Data availibility

The datasets used in this study are accessible through the DHS program upon request at https://dhsprogram.com/data/available-datasets.cfm

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CRediT authorship contribution statement

Anderson Bendera: Writing – original draft, Investigation, Formal analysis, Data curation, Conceptualization. **Keiko Nakamura:** Supervision, Funding acquisition, Conceptualization. **Xuan Minh Tri Tran:** Writing – original draft, Conceptualization. **Ntuli A. Kapologwe:** Writing – review & editing. **Elice Bendera:** Writing – review & editing. **Dina Mahamba:** Writing – review & editing. **Eugene Benjamin Meshi:** Writing – original draft, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data availability

The datasets used in this study are accessible through the DHS program

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