

# Inequalities in child immunization coverage in Togo: an analysis of Decomposition

Yaovi TOSSOU (✉ [tossouyaovi@yahoo.fr](mailto:tossouyaovi@yahoo.fr))

FASEG/University of Lomé

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## Research article

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**Inequalities in child immunization coverage in Togo: an analysis of  
Decomposition**

**Presented by:**

**TOSSOU Yaovi**

*Doctorate in economics  
Teacher-Researcher*

*Member of the Research Team in Institutional Economics (ERECI) (FASEG/University of Lomé)  
E-mail: [tossouyaovi@yahoo.fr](mailto:tossouyaovi@yahoo.fr)*

**Abstract :**

**Background:** Child vaccination is recognised as a mechanism to improve child survival and health by reducing child deaths. However, there are significant inequalities in the coverage of different childhood vaccinations in both urban and rural areas. In this article, we examine the inequalities between rural and urban areas in the vaccination of children in Togo.

**Methods:** Using data from the 2017 MICS6 Survey, we examine the probability that a child aged 12-59 months will receive the required vaccinations and break down the sources of inequalities in immunisation coverage between rural and urban areas. This is done using the Oaxaca-Blinder decomposition technique, which identifies the sources and factors that explain differences in outcomes between groups.

**Results:** Analysis of the results shows that the characteristics of the child, the mother and the household influence the immunization status of the child. For example, children in rural areas are more likely to complete the required vaccinations. We find that a pro urban advantage in characteristics is observed.

**Conclusion:** There is also a need to specifically target vulnerable children in urban areas, in order to maintain the focus on women's empowerment and to pay special attention to children from poor households.

**Keywords:** Immunisation coverage, Vaccination, Inequality of health care, Decomposition, Rural-urban

## **Introduction**

Improving children's health has been at the centre of efforts in most developing countries over the past four decades. Vaccination coverage helps to protect children from the risk of contracting the serious infectious diseases targeted by vaccines. It is recognised as one of the most effective measures to prevent child mortality, morbidity and complications of infectious diseases in children. It also aims to vaccinate children to prevent illness, disability and death from vaccine-preventable diseases. Vaccination is a proven tool to control and eliminate potentially fatal infectious diseases. It is estimated that 2 to 3 million deaths can be prevented each year (Louis et al. 2016). It is one of the investments in health, with proven strategies that make it accessible to even the most hard-to-reach and vulnerable populations.

Although the world saw a considerable reduction in child mortality between 1990 and 2015, sub-Saharan Africa is still characterised by a high rate of under-five deaths. In 2019, under-five mortality is 76% deaths per 1000 live births in Sub-Saharan Africa compared to 67% per 1000 live births for under-fives in Togo (Chan and Lake 2012). A quarter of these deaths are preventable through interventions such as immunisation coverage. Reports have indicated that current vaccines can prevent about 25% of deaths in children under 5 years of age. In Togo, in 2018, one child in five years of age was still missing out on immunisation, which means that nearly 10.7 million children under one year of age are exposed to deadly yet preventable diseases such as measles, tuberculosis, BCG. Etc. (Golding et al. 2017) estimate that sub-Saharan Africa will account for 60% of child deaths by 2030. There is therefore an urgent need to achieve universal coverage of immunization as a mechanism to reduce child mortality and prevent other infectious diseases.

With this in mind, the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) have developed the various immunization strategies, with the aim of increasing the number of children immunized against preventable diseases, integrating other interventions and achieving universal immunization coverage. This effort was also reflected in Togo, where the Expanded Programme on Immunization (EPI) was introduced in the country in 1979. These global commitments and particularly in Togo have led to increased public and private investment in promoting accessible child health intervention programmes, particularly in nutrition and immunization services. There is therefore an urgent need to achieve universal full immunisation coverage as a mechanism to achieve the goals of Sustainable Development (SDO). This provides African countries, and Togo in particular, with the mechanisms to guarantee an equitable rate of vaccination coverage. Furthermore, it is imperative to examine

and understand the factors that contribute to the use of vaccination in different areas in order to ensure effective and targeted services for the implementation of the vaccination programme. These mechanisms help to achieve equity in childhood immunization involving the creation of equal opportunities for all eligible children. This facilitates access to these health services and identifies disadvantaged and vulnerable children at risk of not being vaccinated.

A number of socio-economic factors have been identified in previous studies to influence the immunisation coverage of children in order to enable certain numbers of children to achieve immunisation coverage. In developing countries, spatial inequalities in the availability of and access to health care are major barriers for rural households that are underserved in essential basic health services. This is the case (Abadura et al. 2015 ;Bugvi et al. 2014;Antai 2012), which report on disadvantages in immunization among rural children in Ethiopia, Nigeria and Pakistan respectively.

The results of previous studies have shown that household characteristics are important factors in the immunization coverage of children. Studies such as those in (Corsi et al. 2009;Mulder et al. 2016) find gender disparities in child immunization in India, and that girls are more disadvantaged than boys. In contrast, (Antai 2012) finds that girls are more likely to receive full immunisation in Nigeria, while (Tsawe et al. 2015; Landoh et al. 2016) no significant gender differences in immunisation coverage in Swaziland and Togo. On the one hand, (Singh, Jasilionis, and Oksuzyan 2018) find that inequalities in immunisation coverage disadvantage children living in low-income households. On the other hand, (Barata et al. 2012) finds a low rate of vaccination among children from households with high socio-economic characteristics in Brazil.

However, gaps in health systems in the uptake of vaccines in children in different settings have led to an increase in child morbidity and mortality. From all of the above, there is a need to find some answers to the problems raised, hence the following research question:

In order to be able to answer this research question, the objectives of this article are :

- To identify the socio-economic factors that explain the different vaccinations received by children under five years of age.
- To analyse the breakdown of inequalities in the use of vaccination coverage among children.

On the side of the political decision-makers, this article helps to awaken the decision-makers to the implications of adequate policies in order to avoid a significant increase in infant mortality rates, chronic diseases, and to decrease the life expectancy of children in Togo.

The outline of this article is organised as follows, with Section 1 focusing on methodological approaches referring to the different analyses of immunisation coverage. Section 2 deals with the source of the data and the description of the statistical variables. Section 3 is divided into two parts: The first part deals with the results obtained on the determinants of child immunization coverage, while the second part focuses on the results of the decomposition of inequalities. Finally, a conclusion follows on the implications of economic policies.

### **Methodological approach**

The analysis of socio-economic inequalities in health uses approaches such as the concentration index and inequality graphs (Kakwani, Wagstaff, and Van Doorslaer 1997). Moreover, this technical method does not explain the ways in which socio-economic factors influence observed inequalities in access to and use of health care. (Wagstaff et al. 2009) proposes a methodology for decomposing the concentration index which shows the contribution of each characteristic to the concentration index, which is the part of the inequality that can be explained by the variations in contribution, the differentiation of factors between socio-economic groups. However, the approach proposed by (Wagstaff and Doorslaer 2003) is appropriate for the decomposition of well-founded socio-economic inequalities. The use of the logit model makes it possible to examine the determinants of immunisation coverage and then to decompose the observed differences in immunisation coverage between rural and urban areas using a non-linear decomposition technique. This section first examines the determinants of the status of immunisation coverage among children and then uses the decomposition technique to assess the source and extent of inequalities between rural and urban areas in Togo.

### **Determinants of immunisation coverage in children under five years of age**

The immunization status ( $I_{ijh}$ ) of child  $i$  from mother  $j$  in household  $h$  is modelled as a non-linear function of child specific characteristics ( $C_{ijh}$ ), maternal characteristics ( $M_{jh}$ ), household socio-economic characteristics ( $Z_h$ ), including place of residence, and an error term ( $\varepsilon_{ijh}$ ).

$$I_{ijh} = F(C_{ijh}; M_{jh}; Z_h; \varepsilon_{ijh}) \quad (1)$$

A reduced model form is estimated in which the variable explained is binary and takes the value of 1 if the child has achieved full immunization coverage and 0 if not. The specific model is written as follows:

$$I_{ijh} = \pi + \alpha_i C_{ijh} + \beta_i M_{ijh} + \delta_i Z_h + \varepsilon_{ijh} \quad (2)$$

where  $\pi$  is a constant term and  $\alpha$ ,  $\beta$ , and  $\delta$  are parameters to be estimated. The error term is random and is assumed to be a constant variance and a mean of zero.

The functional form of the model estimated is reduced as follows:

$I = X'\beta$  where **I represents the child's immunization coverage**,  $X$  is a vector of explanatory variables and  $\beta$  is a vector of coefficient to be estimated. The probability that a child is fully vaccinated is :

$$\Pr(I = 1|X) = \Lambda(X'\beta) = \frac{e^{X'\beta}}{1+e^{X'\beta}} \quad (3)$$

where  $\Lambda$  is the cumulative density function of logistics distribution. The coefficient is by a logit regression technique. In these models, marginal effects represent the effect of a change in covariance on the probability of full immunization coverage. Thus, the marginal effects of the logit model are presented to facilitate interpretation and discussion. Thus, the marginal effect is represented as follows

$$\frac{\partial \Pr(I=1|X)}{\partial X_i} = \Lambda(X'\beta) [1 - \Lambda(X'\beta)] \beta_i \quad (4)$$

### **Analysis of the decomposition of inequalities by children's vaccination status.**

The decomposition technique proposed by (Oaxaca 1973;Blinder 1973)provides a common approach to examining differences in ongoing outcomes between groups. The Oaxaca-Blinder decomposition technique allows for the identification of sources and factors that explain differences in outcomes between groups. The first component of the observed difference is the explanatory effect. It captures differences in the outcome of interest that arise from differences in characteristics between groups. The second component is called the coefficient or feedback effect. The feedback effect is unexplained and is attributed to the difference in the performance of characteristics between groups. The classic Oaxaca-Blinder decomposition technique has been extended to binary and other non-linear data. In (Fairlie 2005; Fitzenberger, Kohn, and Wang 2011) the technique of decomposing differences between groups was applied when the explained variables are binary. The non-linear decomposition model assumes that the

conditional expectation of the probability of a child's immunisation status is a non-linear function of a characteristic vector.

Then the estimated models for rural and urban areas are defined as follows:

$$I_R = \Lambda(X'_R \beta_R) \text{ represents the characteristics of children in rural areas (5)}$$

$$I_U = \Lambda(X'_U \beta_U) \text{ represents the characteristics of children in urban areas (6)}$$

To decompose inequalities in immunisation coverage ( $\Delta I$ ) among children between rural and urban areas, the equation is rewritten as follows:

$$\Delta I = I_R - I_U = \overline{\Lambda(X'_R \beta_R)} - \overline{\Lambda(X'_U \beta_U)} \quad (7)$$

Consider a counterfactual conditional probability of immunization status ( $I^*$ ) which estimates the probability of the child's immunization status if the coefficients in rural and urban areas are the same.  $I^* = \overline{\Lambda(X'_R \beta_U)}$  (8)

The breakdown of the differences is as follows :

$$\Delta I = I_R - I^* + I^* - I_U = \overline{\Lambda(X'_R \beta_R)} - \overline{\Lambda(X'_R \beta_U)} + \overline{\Lambda(X'_R \beta_U)} + \overline{\Lambda(X'_U \beta_U)} \quad (9)$$

The first term measures the returns  $\overline{\Lambda(X'_R \beta_R)} - \overline{\Lambda(X'_R \beta_U)}$  represents the endowment effect while the second part  $\overline{\Lambda(X'_R \beta_U)} + \overline{\Lambda(X'_U \beta_U)}$  represents the endogenous effect .

The decompositions in equations 4 and 5 can be seen as special cases of a more general decomposition. Hence, equation 6 returns to :

$$\Delta I = I_R - I_U = \Delta X'_R \beta_R + \Delta X'_U \beta_U + \Delta \beta X \quad (10)$$

$$= E + C + CE$$

so that the difference in average scores can be considered as resulting from a difference in allocations (E), a difference in coefficient (C), and a difference resulting from the interaction of allocations and coefficients (CE). Indeed, the first decomposition places the interaction in the unexplained part, while the second in the explained part.

### **An approach to related decompositions :**

The decomposition of Oaxaca can also be written as a special case of another decomposition :

$$\Delta I = I_R - I_U = \Delta X(D\beta_U + (I - D)\beta_R) + \Delta \beta(X'_U(I - D) + X'_R D) \quad (11)$$

Where I is the identity matrix and D is a weight matrix. In the simple case, where x is a scalar and not a vector, I is equal to one, and D is a weight. In our case, D = 0 in the first decomposition.

Other formulations have been proposed: Cotton (1988) suggested weighting the difference in the x's by the mean of the vector coefficients, giving us :

$$\beta^* = \frac{1}{2}\beta_U + \frac{1}{2}\beta_R \quad (12)$$

(Reimers 1983)suggested weighting the vector coefficients by the proportions in the two groups:

$$\beta^* = \frac{n_{urban}}{n_{urban}+n_{rural}}\beta_U + \frac{n_{rural}}{n_{urban}+n_{rural}}\beta_R \quad (13)$$

There is a fifth decomposition proposed by (Neumark 1988), which uses the coefficients obtained from the regression of pooled data,  $\beta^P$ :

$$\Delta I = I_R - I_U = \Delta X\beta^P + (X'_R(\beta_R - \beta^P) + (X'_U\Delta X'_U(\beta^P - \beta_U)) \quad (14)$$

#### **Source of data**

The data used are from the 2017 MICS6 Survey. It represents a series of nationally representative samples of households, children aged 0-5 years, women aged 15-49 years and men aged 15-59 years. The survey was conducted by the Togolese Directorate of Statistics with financial and technical support from UNICEF, USAID and UNFPA, and the Ministry of Health. The basic objective is to verify the various indicators of maternal and child health. The information collected usually covers nutrition, immunization coverage, health care utilization, health insurance coverage, socio-economic characteristics, etc. The information is then used to develop a national strategy for maternal and child health.

A predetermined number of households are randomly selected from each cluster to form the total household sample size. All women aged between 15 and 49 who are either permanent residents of the household or visitors who stayed in the household the night before the survey can be interviewed. The birth history of each woman was collected. For children under the age of five, the vaccination status of each child was obtained either from their vaccination or from a verbal reminder from the mother. Estimates for full immunisation coverage from the sixth Multiple Indicator Cluster Survey (MICS6, 2017) are based on children aged 12-23 months and 24-35 months.

## **Description of variables**

The explained variable is a binary indicator of a child's immunization status. It indicates whether or not the child has received the basic immunizations required by WHO standards. For example, WHO and UNICEF recommend that a child receive one dose of BCG and one dose of measles and three doses of polio and DTP vaccines.

## **Explanatory variables :**

### **The choice of these variables is influenced by previous studies.**

Child characteristics include age in months, sex of the child, and place of birth. The age of the child in months was classified into four groups: 12-23 months, 24-35 months, 36-47 months and 48-59 months. In addition, the place of delivery is essential because it determines whether or not a child will receive the required vaccinations. The characteristics of the mother such as marital status, level of education, age at birth are taken into account in this article. In addition, the sex of the child is included to examine the presence of gender differences in the child's immunization process. The child's birth order reflects the mothers' attitudes towards immunization coverage as the number of children increases.

## **Descriptive statistics**

Table 1 presents the descriptive statistics of the variables used for the empirical analysis in children under five with immunization coverage. The survey notes that about 20% of children aged 0-59 months have received the basic immunizations required by WHO and UNICEF standards. Male children make up about 51% of the sample in 2017. The proportion of children giving birth in health facilities is 74.52% compared with 25.48% at home. Similarly, the proportion of mothers with health insurance coverage is 4.41%. A policy of free health insurance for children was launched in 2017 as a mechanism to enable pupils to access health care, hence an extension to children under five years of age would be a positive step towards achieving the MDG target in 2030. As a result, increasing the proportion of health insurance coverage for women will promote an increase in the provision of basic services for children. Furthermore, women's level of education remains crucial in their decision-making. The number of years of full schooling for mothers remains low. Women with no level of education account for 38.55% compared with 33.7% in primary school and 27.75% in secondary/senior school. The proportion of households in rural areas is 57.87% in 2017 compared to 32.13% in urban areas. The summary statistics according to the wealth index show the differences in the socio-economic characteristics of households in 2017. Households with low socio-economic status (poor households) have a proportion of 46.24%, while 33.37% belong to the category of persons

with high socio-economic status. Compared to previous years, the change in the socio-economic status of households reflects a relatively stable economic growth observed during this period with a decrease in the poverty rate in the country.

**Table 1: Descriptive analyses of the variables.**

**Determinants of immunisation coverage in children under five**

Table 2 presents logit regressions of the immunization status of children under five years of age in both rural and urban areas. The results show that there are significant differences between rural and urban areas in the probability that a child will be fully vaccinated according to the basic principles of the WHO MICS6 survey in 2017. More specifically, the results show that, compared to children in urban areas, children living in rural households are about 8% more likely to have received the required basic vaccinations. The results thus found diverge from previous studies in most developing countries that report a statistically significant rural disadvantage in child immunization coverage (Abadura et al. 2015; Antai 2012).

In terms of child-specific characteristics, there are no gender disparities in the immunisation status of children in Togo. Indeed, the results of gender differences in immunisation coverage have been widely reported in studies conducted in South Asian countries where son preference is endemic (Corsi et al. 2009; Pal et al. 2006). However, there is a significant difference between immunization status and different age modalities in children under five years of age. Compared to children aged 12 to 23 months, children aged 36 to 47 months and 48 to 59 months are less likely to receive a basic full course of immunization recommended by the World Health Organization. These results in the age difference in immunization coverage among children have been reported in previous studies. The results indicate a negative effect of a child's birth order on the likelihood that a child will receive the vaccine in 2017. (Abadura et al. 2015) report that children of a higher birth order are less likely to receive the required vaccinations in Nigeria, and (Corsi et al. 2009) report the same for India. The results suggest neglect in the vaccination of mothers, as their interest in vaccinating their children declines as the number of children increases (Adedokun et al. 2017) In contrast, (Antai 2012) argues that the low probability of full immunisation coverage of children of a higher birth order reflects the existence of relationships between children (girls and boys) that limit the available household resources, leading to neglect in their vaccination.

Firstly, the result may reflect the increased opportunity cost. Mothers' indirect wages in household production increase as the number of children increases. Thus, as a high opportunity cost, time spent in a health centre to vaccinate a child of a higher birth order reduces the likelihood that the child will be fully vaccinated. In addition, young mothers can be better educated and informed about family planning and child health. Improved education of the mother reflects the high probability that a child will be fully immunized. The results indicate a positive relationship between the mother's age at birth and the likelihood that the child will be fully vaccinated in 2017. The effects of the mother's age at birth therefore shed light on the possibilities.

The use of health insurance facilitates the use of health services and reduces out-of-pocket expenses (Schellenbacher et al. 2013). (Brugiavini and Pace 2016) find a positive effect of health insurance uptake on the use of maternal health care in Ghana. The results show that mothers with health insurance are more likely to have full basic immunization for their children. In addition, the health status of the mother favours the use of health care because having health insurance can usually or when their child is sick. Health workers can use this opportunity to make up for missing vaccinations, resulting in higher coverage in this group. Similarly, the positive relationship between health insurance and basic immunization of children may reflect possible financial difficulties, which may result in a financial burden for these households. However, mothers without health insurance face health care expenses through financial payments for child immunizations. In addition, the results reveal a disadvantage suffered by households with low socio-economic status in 2017. The coefficient of the variable is negative and significant. The presence of inequality in child immunisation against households with high socio-economic status departs from a majority of studies on socio-economic inequalities in children's health outcomes.

**Table 2: Analyses of the determinants of immunization among children under five years of age by residence.**

### **Analysis of the breakdown of rural-urban inequalities in immunisation coverage in 2017.**

This section presents the summary analysis of the results of the decomposition of inequalities between rural and urban areas in the immunisation coverage of children in Togo in 2017. The rural zone represents the reference category for this breakdown in terms of immunisation coverage. The results reveal the existence of disparities between rural and urban areas in terms of the probability that a child will receive the basic vaccinations (BCG, Polio and DPT3). Contrary to logit estimates, the decomposition analysis reveals the direction of the disparities in the immunisation coverage of children in Togo.

In 2017, the average probability that a child will be able to receive a full basic immunisation in rural areas is 0.137 compared to an average probability of 0.136 in urban areas. The rural-urban difference in average probability is not statistically significant for a child to be vaccinated. In terms of the source of disparities, the probability of these results indicates that the explained endowment or effect contributes about 7.39% of the difference. Indeed, differences in endowments or characteristics favour children of urban residents. This suggests that, on average, children residing in urban areas have higher levels of endowment compared to children in rural areas. The unexplained coefficient or effect, however, favours children in rural areas. This result implies that in the health system in Togo, the conditions of child immunization services are favourable to households with a higher standard of living for the same level of characteristics compared to urban households.

#### **Table 3: Decomposition of Oaxaca**

Table 4 shows the breakdown of the vaccination gap between urban and rural areas into three components; a gap due to the difference in the level of the determinants, a gap due to the difference in the effect of the coefficients and a gap due to the interaction. The next step will be to carry out the Oaxaca decomposition test. Four tables will then be obtained according to the results obtained. The results in Table 2 show the average values of immunisation coverage of children under five years of age for the two groups. Table 4 then shows the contributions attributable to differences in initial allocations (E), coefficients (C), and interactions (EC).

#### **Table 4: Breakdown of explained and unexplained portions of the vaccination gap in rural and urban areas.**

Furthermore, the results of the decomposition in Table 5 show how the explained and unexplained portions of the rural-urban gap vary according to the decomposition used. The first two columns of Table 5 correspond to the Oaxaca decomposition with  $D = 0$  and  $D = 1$  respectively. The third and fourth columns correspond to the decompositions of (Cotton 1988) where the diagonal of  $D$  is equal to 0.5 and  $D = 1$ , respectively.  $F_{np} 0,267$ . The last column corresponds to the decomposition of (Neumark 1988). In contrast to the usual results where it is the mean values of the variables that explain most of the differences in the inequality of immunisation coverage between children from rural and urban areas, which gives us contrasting results for Togo. The breakdowns in (Cotton 1988) are the third and fourth columns respectively. The last column, named \*, refers to the decomposition of (Neumark 1988) which uses pooled regression coefficients. Indeed, although the first Oaxaca decomposition ( $D = 0$ ), the decomposition of (Cotton 1988) (unlike the second Oaxaca decomposition and the Neumark decomposition) shows that differences in the mean values of the different variables explain inequalities in immunisation coverage between rural and urban children much better than differences in the effects of determinants. It should be noted, however, that differences in the effects of determinants also play an important part in explaining inequalities in immunisation coverage. In each decomposition, they explain at least 1695.2 of the inequalities in vaccination coverage. It then appears that discrimination at this level exists in access to health care services in rural areas to appropriate health care and acceptable living conditions.

**Table 5: Results of the decomposition of the urban-rural gap in immunization coverage**

The breakdown in Table 6 shows the results of the decomposition for each variable. It presents the contribution of each determinant in the overall explained rural-urban gap in Togo, identifying the factor that explains the largest part of the overall gap. In other words, the table gives the possibility to observe the contribution of each variable to the total explained gap. By considering for example the column for the decomposition of (marked by), it can be seen that all the variables apart from the variables such as the wealth index, the mother's level of education, the region, disadvantage children in rural areas against vaccination. The difference explained in this breakdown is mainly due to the age of the child being between 24 and 35 months. Thus, in families from rural areas, the higher the age of the child, the lower the inequalities in vaccination coverage. This table shows the results of the inequality in immunisation coverage between urban and rural areas, which is determined by the age of the child. Other factors have a minimal effect in explaining immunization among children under five years of age. Referring to the results on the decomposition of (Neumark 1988) last column

of the table, we find that the difference in the age of the child in taking the different vaccines between urban and rural areas is made up of 34.2% of the explained difference.

**Table 6: Identification of the variable that explains most of the gap between urban and rural areas in terms of vaccination.**

Table 7 gives estimates of coefficients, means, and predictions for each variable in each group, the "high group" in this case being the urban area and the "low group" being the rural area. For the first decomposition of Oaxaca, columns 2 and 3 of the table allow us to determine how the gap in each of the coefficients  $\beta$  contributes to the overall unexplained gap. For the other decompositions, the contributions of the individual  $\beta$  coefficients can be found by taking the difference between the groups in the predictions of the specific variables given in the following table and subtracting the explained part given in Table 4.

**Table 7: Estimates of coefficients, averages, and predictions for each variable in each group.**

Figure 1 shows the detailed results of estimating the decomposition of immunization coverage among children under five years of age by residential areas, with error bars representing confidence intervals. As shown in Figure 1, children under five years of age have better immunization coverage. The decomposition estimates show that inequalities in the child's age structure, birth order, child sex, health insurance and economic regions largely explain the disparities in access to the different components of immunization between the two areas (rural and urban). If children have health insurance coverage, the gap in inequalities would be reduced between rural and urban areas. Similarly, if the economic regions have adequate infrastructure to carry out vaccination campaigns on a recurrent basis, there would be a reduction in inequalities among children in these localities. Moreover, the negative sign in the unexplained component indicates that the wealth gap is narrowing between children in the two environments.

**Figure 1:** Detail of estimated breakdown of immunization coverage among children under five years of age.

## **Discussion**

This article aims to identify the socio-economic factors that influence the inequality of immunisation coverage in both rural and urban areas in Togo. In relation to these trends, the average probability of vaccination coverage is 0.14 in rural areas compared to 0.136 in urban areas. As a source of disparities, the probability of a difference in contribution is 7.39% between

these zones, which indicates the explained effect of this contribution. This difference is due to the vaccination programmes of political decision-makers and development partners who give importance to vaccination in the fight against infectious diseases. In addition, the increased empowerment of women, and the level of education can over time increase the mother's decision-making power over the use of child health services, such as vaccination.

Significantly, there is a difference between vaccination coverage and age in children under five years of age. Compared to children aged 12 to 23 months, there is a small proportion of children vaccinated in rural areas, and therefore less likely to receive a basic vaccine recommended by the World Health Organization. This finding confirms the results found in Ethiopia (Abadura et al. 2015).

Decomposition analyses also indicate a positive relationship between child vaccination and maternal education in urban residential settings. This difference is observed in the vaccination status of children between mothers with no education compared to mothers with a high level of education. Thus, it is found that children who are not vaccinated are from mothers with a low level of education who are more likely to receive late vaccination. This has been supported by the empirical literature which has indicated that improving maternal education has been promoted as a mechanism for improving child health (Grépin and Bharadwaj 2015) and (Adedokun et al. 2017) in Nigeria. This could be due to the fact that an extra year of schooling by a mother has a positive effect on the likelihood of a child receiving basic immunisations. This improves access to and use of health facilities and the availability of the information required for a child's health status. All this contributes to a better understanding of the vaccination calendar and practices as they are indicated in Togo (Landoh et al. 2016)

The household wealth index has a positive impact on the use of health services. Peter, 2017 observes a reduction in inequalities in child immunisation due to the ratio of the highest to the lowest wealth quintile. This is probably due to the fact that low income is associated with both low levels of education and low literacy, which could affect mothers' awareness of disease prevention strategies, such as childhood immunization (Schellenberg et al. 2003)

Similarly, the analysis showed that wealth-related inequalities in the use of child immunisation coverage favour the rich over the poor. This result is corroborated by that of (Grépin and Bharadwaj 2015) in Zimbabwe, which through a concentration index and concentration curve indicates that the distribution of fully immunised children is concentrated in the wealthiest households. (Halder and Kabir 2008) Bangladesh. Thus, a possible justification could be that

households with low wealth index can devote their time to income-generating activities to support household living standards. As a result, the poor prioritize income rather than preventive health services, such as childhood vaccinations. Furthermore, this disparity linked to the wealth index by mothers in the use of vaccinations to the attitudes and practices of poor households with regard to their health status and ignorance of vaccination against different diseases. In addition, indirect costs such as travel costs to vaccination centres or time lost due to income-generating activities make it difficult for poor households to access and use health facilities. Hence poverty is considered to be the major cause of health inequalities.

## **Conclusion**

The aim of this document is to study the inequalities between rural and urban areas in terms of immunisation coverage in Togo based on the 2017 MICS 6 survey in order to improve child health. The results obtained are one of the most important objectives in developing countries, particularly in sub-Saharan Africa.

Analysis of the breakdown of rural-urban inequalities in child immunization coverage reveals that there are significant disparities in ensuring that a child receives basic immunization. However, there is a disadvantage in the immunisation coverage of children in rural areas. The gap in immunisation coverage is dominated by the effect explained. This coefficient is negative and significant in the vaccination coverage of children. This shows the emergence of urban vaccination at a low rate. This disadvantage may reflect the neglect of primary health care in some cities and the growing informal settlements in urban areas that favour primary health care. The coefficient or unexplained effect as a dominant source is a coverage deficit in 2017, reflecting the concentration on vaccination campaigns and improved access to primary health care in rural areas.

The conclusions drawn from this article are based on indications for achieving universal child immunization coverage. As economic policy implications: Firstly, emphasis would be placed on policies to reduce socio-economic inequalities in the health of children, especially the most vulnerable children in urban areas, especially in the urban agglomerations of the city of Lomé. In addition, a public health policy must be put in place in response to the demands of a growing urban population in Togo. In addition, vaccination campaigns should be targeted at mothers and children on the outskirts of town centres and the mobilisation of urban communities as a means of increasing the coverage of vaccination services in these areas. In addition, school vaccination campaigns should be intensified and expanded to improve immunization coverage

in urban areas. In addition, vaccination campaigns should focus on children aged 24-35 months. As such, child health interventions should be part of broader strategies for women's empowerment and decision-making within the household by improving women's education and employment, which are factors promoting or hindering the use of routine childhood immunization.

**Each author's affiliation and qualification (BSc, MA, PhD...):** University of Lome, Faculty of Economics and Management (FASEG), Doctorate in economics (PhD), Teacher-Researcher

**Ethical Approval-if no ethical approval was required for the research please note the reason:**

**Ethics approval**

Not required

**Consent to participate**

The National Statistical Services of Togo, provided ethical clearance for household surveys. All participants in surveys provided informed, signed consent. The study was approved by the Institutional Review Board of the Directorate of Scientific and Technical Research (DRST) of the University of Lomé (Togo). The data used can be found on the World Bank's website, which can however be downloaded.

World Development Indicators | [DataBankdatabank.worldbank.org](https://databank.databank.worldbank.org)

**Conflict of interest**

None declared

**Consent for publication**

I fully agree to the publication of this manuscript. And I fully share the results obtained

**Availability of data and materials**

The data supporting the conclusions of this article are available at the National Statistical Services of Togo data repository and can be obtained with a written permission.

**Competing interests**

The author declares that he/she has no competing interests.

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## **Author's contributions**

The author read and approved the final manuscript.

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## **Data availability**

The data sets used and/or analysed in this study are available from the corresponding National Institute of Statistics and Economic and Demographic Studies (INSEED) upon reasonable

## **References:**

- Abadura, Samir. Wondwosen. Lerebo, Usha Kulkarni, and Zeleke A. Mekonnen. 2015. "Individual and Community Level Determinants of Childhood Full Immunization in Ethiopia: A Multilevel Analysis." *BMC Public Health* 15 (1): 972.
- Adedokun, Sulaimon T., Olalekan A. Uthman, Victor T. Adekanmbi, and Charles S. Wiysonge. 2017. "Incomplete Childhood Immunization in Nigeria: A Multilevel Analysis of Individual and Contextual Factors." *BMC Public Health* 17 (1): 236.
- Antai, Diddy. 2012. "Gender Inequities, Relationship Power, and Childhood Immunization Uptake in Nigeria: A Population-Based Cross-Sectional Study." *International Journal of Infectious Diseases* 16 (2): e136–45.
- Barata, Rita Barradas, Manoel Carlos Sampaio de Almeida Ribeiro, José Cássio de Moraes, Brendan Flannery, and Vaccine Coverage Survey 2007 Group. 2012. "Socioeconomic Inequalities and Vaccination Coverage: Results of an Immunisation Coverage Survey in 27 Brazilian Capitals, 2007–2008." *J Epidemiol Community Health* 66 (10): 934–41.
- Blinder, Alan S. 1973. "Wage Discrimination: Reduced Form and Structural Estimates." *Journal of Human Resources*, 436–55.

- Brugiavini, Agar, and Noemi Pace. 2016. "Extending Health Insurance in Ghana: Effects of the National Health Insurance Scheme on Maternity Care." *Health Economics Review* 6 (1): 7.
- Bugvi, Ayesha Siddiqa, Rahla Rahat, Rubeena Zakar, Muhammad Zakria Zakar, Florian Fischer, Muazzam Nasrullah, and Riffat Manawar. 2014. "Factors Associated with Non-Utilization of Child Immunization in Pakistan: Evidence from the Demographic and Health Survey 2006-07." *BMC Public Health* 14 (1): 232.
- Chan, Margaret, and Anthony Lake. 2012. "WHO/UNICEF ON ENDING PREVENTABLE CHILD DEATHS." *The Lancet* 379 (9832): 2119–20.
- Corsi, Daniel J., Diego G. Bassani, Rajesh Kumar, Shally Awasthi, Raju Jotkar, Navkiran Kaur, and Prabhat Jha. 2009. "Gender Inequity and Age-Appropriate Immunization Coverage in India from 1992 to 2006." *BMC International Health and Human Rights* 9 (S1): S3.
- Cotton, Jeremiah. 1988. "On the Decomposition of Wage Differentials." *The Review of Economics and Statistics*, 236–43.
- Fairlie, Robert W. 2005. "An Extension of the Blinder-Oaxaca Decomposition Technique to Logit and Probit Models." *Journal of Economic and Social Measurement* 30 (4): 305–16.
- Fitzenberger, Bernd, Karsten Kohn, and Qingwei Wang. 2011. "The Erosion of Union Membership in Germany: Determinants, Densities, Decompositions." *Journal of Population Economics* 24 (1): 141–65.
- Golding, Nick, Roy Burstein, Joshua Longbottom, Annie J. Browne, Nancy Fullman, Aaron Osgood-Zimmerman, Lucas Earl, Samir Bhatt, Ewan Cameron, and Daniel C. Casey. 2017. "Mapping Under-5 and Neonatal Mortality in Africa, 2000–15: A Baseline Analysis for the Sustainable Development Goals." *The Lancet* 390 (10108): 2171–82.
- Grépin, Karen A., and Prashant Bharadwaj. 2015. "Maternal Education and Child Mortality in Zimbabwe." *Journal of Health Economics* 44: 97–117.
- Halder, Amal K., and M. Kabir. 2008. "Inequalities in Infant Immunization Coverage in Bangladesh." *Health Services Insights* 1: HSI-S927.
- Kakwani, Nanak, Adam Wagstaff, and Eddy Van Doorslaer. 1997. "Socioeconomic Inequalities in Health: Measurement, Computation, and Statistical Inference." *Journal of Econometrics* 77 (1): 87–103.
- Landoh, Dadja Essoya, Farihétoú Ouro-Kavalah, Issifou Yaya, Anna-Lea Kahn, Peter Wasswa, Anani Lacle, Danladi Ibrahim Nassoury, Sheba Nakacubo Gitta, and Abdramane

- Bassiahi Soura. 2016. "Predictors of Incomplete Immunization Coverage among One to Five Years Old Children in Togo." *BMC Public Health* 16 (1): 968.
- Louis, David N., Arie Perry, Guido Reifenberger, Andreas Von Deimling, Dominique Figarella-Branger, Webster K. Cavenee, Hiroko Ohgaki, Otmar D. Wiestler, Paul Kleihues, and David W. Ellison. 2016. "The 2016 World Health Organization Classification of Tumors of the Central Nervous System: A Summary." *Acta Neuropathologica* 131 (6): 803–20.
- Mulder, R. L., H. J. H. Van Der Pal, G. A. Levitt, R. Skinner, L. C. M. Kremer, M. C. Brown, E. Bardi, R. Windsor, G. Michel, and E. Frey. 2016. "Transition Guidelines: An Important Step in the Future Care for Childhood Cancer Survivors. A Comprehensive Definition as Groundwork." *European Journal of Cancer* 54: 64–68.
- Neumark, David. 1988. "Employers' Discriminatory Behavior and the Estimation of Wage Discrimination." *Journal of Human Resources*, 279–95.
- Oaxaca, Ronald. 1973. "Male-Female Wage Differentials in Urban Labor Markets." *International Economic Review*, 693–709.
- Pal, Ranajit, Shixia Wang, V. S. Kalyanaraman, B. C. Nair, Stephen Whitney, Timothy Keen, Lindsey Hocker, Lauren Hudacik, Nicolas Rose, and Innocent Mboudjeka. 2006. "Immunization of Rhesus Macaques with a Polyvalent DNA Prime/Protein Boost Human Immunodeficiency Virus Type 1 Vaccine Elicits Protective Antibody Response against Simian Human Immunodeficiency Virus of R5 Phenotype." *Virology* 348 (2): 341–53.
- Reimers, Cordelia W. 1983. "Labor Market Discrimination against Hispanic and Black Men." *The Review of Economics and Statistics*, 570–79.
- Schellenbacher, Christina, Kihyuck Kwak, Dieter Fink, Saeed Shafti-Keramat, Bettina Huber, Christoph Jindra, Helena Faust, Joakim Dillner, Richard BS Roden, and Reinhard Kirnbauer. 2013. "Efficacy of RG1-VLP Vaccination against Infections with Genital and Cutaneous Human Papillomaviruses." *Journal of Investigative Dermatology* 133 (12): 2706–13.
- Schellenberg, D., J. R. M. Schellenberg, A. Mushi, D. de Savigny, L. Mgalula, C. Mbuya, and Cesar Gomes Victora. 2003. "The Silent Burden of Anaemia in Tanzanian Children: A Community-Based Study." *Bulletin of the World Health Organization* 81: 581–90.
- Singh, Prashant Kumar, Domantas Jasilionis, and Anna Oksuzyan. 2018. "Gender Difference in Cognitive Health among Older Indian Adults: A Cross-Sectional Multilevel Analysis." *SSM-Population Health* 5: 180–87.

- Tsawe, Mluleki, Amos Moto, Thendo Netshivhera, Lesego Ralesego, Cassandra Nyathi, and A. Sathiya Susuman. 2015. "Factors Influencing the Use of Maternal Healthcare Services and Childhood Immunization in Swaziland." *International Journal for Equity in Health* 14 (1): 32.
- Wagstaff, Adam, and Eddy van Doorslaer. 2003. "Catastrophe and Impoverishment in Paying for Health Care: With Applications to Vietnam 1993–1998." *Health Economics* 12 (11): 921–33.
- Wagstaff, Adam, Winnie Yip, Magnus Lindelow, and William C. Hsiao. 2009. "China's Health System and Its Reform: A Review of Recent Studies." *Health Economics* 18 (S2): S7–23.

# Figures

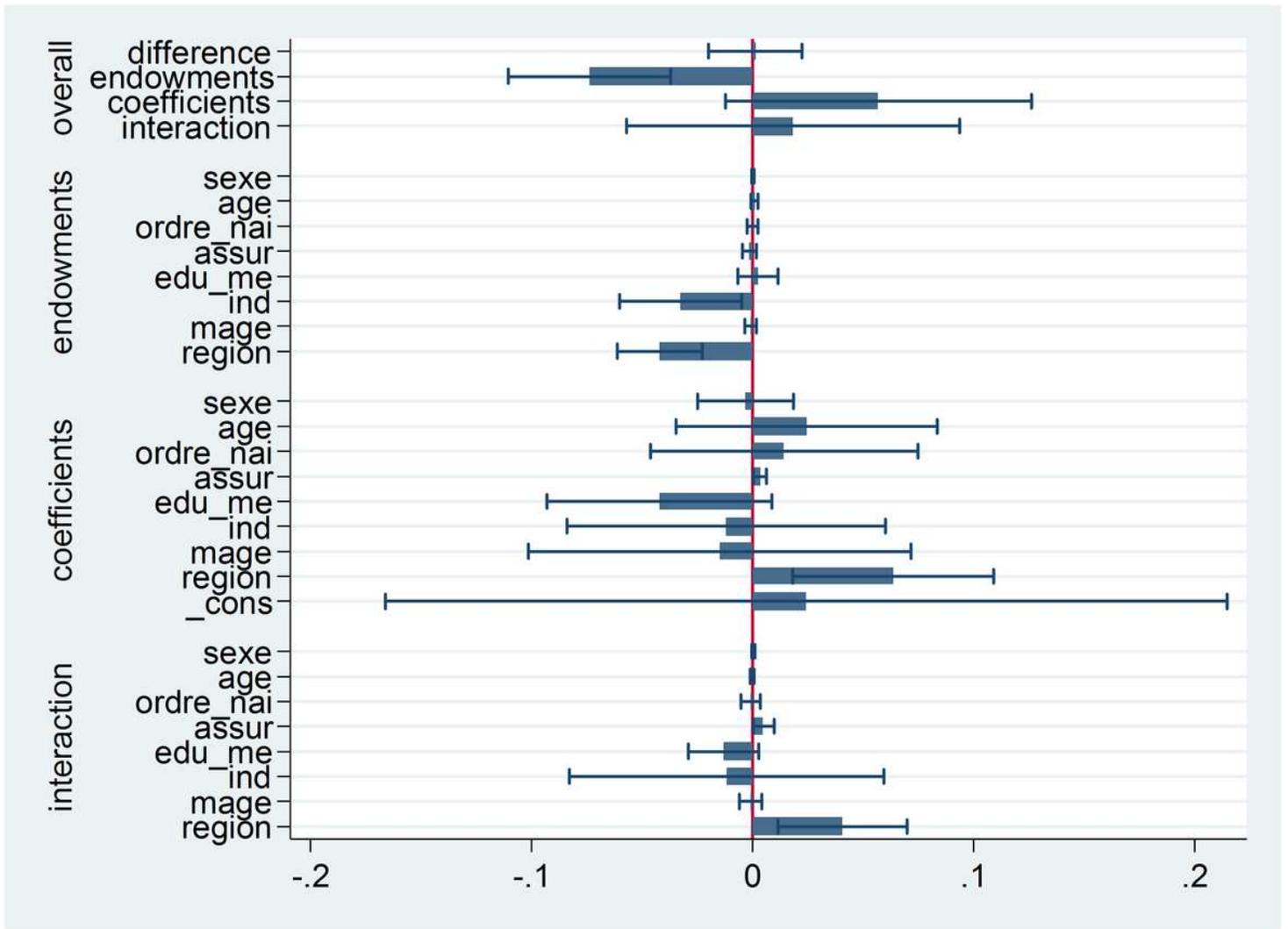


Figure 1

Detail of estimated breakdown of immunization coverage among children under five years of age.

Source: Author based on data from MICS 6, 2017.