Urbanization and Child Health Outcomes in Nigeria

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Abstract

Against the rising trend of urbanization in Nigeria and the accompanying dramatic changes in the urbanization process, this study explores the health advantage of urbanization in Nigeria. The study specifically examines the relationship between various child health outcomes. Secondary data on neonatal, infant, and under-5 mortalities were used to measure child health outcomes. By obtaining cointegration among the collected data, the study investigates the long-run relationships between the degree of urbanization and the various child health outcomes using the Fully Modified Ordinary Least Squares (FM-OLS) estimator. The results suggest the existence of positive relationships between urbanization and child health indicators. In particular, the results show that there exist child health advantages of urbanization, with urbanization having reducing impacts on the mortality indicators. Also, public health expenditure, literacy rate, and health aids are negatively correlated with measures of children mortality. In all the estimated models, the economic growth proxy by Gross Domestic Product (GDP) has an insignificant effect on all the measures of child health outcomes. The result implies the need to pay attention to the urbanization process for an effective health plan.

Keywords

Child health; cointegration; FM-OLS; immunization; Nigeria; urbanization

Introduction

Following the unprecedented rural-urban mobility at the turn of the twentieth century, the issue of urbanization has garnered significant attention within the global community. In turn, this interest has been accompanied by an increasing wave of both policy and empirical debates on the influence of urbanization on various aspects of human life. Both theoretical and empirical evidence have shown that urbanization has profound implications for almost all aspects of society, including socioeconomic development, environmental sustainability, and human capital development (Gross & Ouyang, 2020; Iroye, 2016; Nguyen & Nguyen, 2018). Although extant literature in urbanization studies is dominated by economic growth and the environmental effects of urbanization, there also exists a growing strand of literature focusing on the impact of urbanization on health outcomes.

An assessment of the health effect of urbanization is critical, given the unmistakable role of health in achieving economic prosperity and sustainable development. In recent times, the socioeconomic consequences of health have become topical in policy debates with a documented strong correlation between better health and various indicators of economic performance, including labor supply, productivity, earnings, consumption, savings, and the growth of economic output (Adedeji & Akinlo, 2016; Bloom & Canning, 2004; Bloom et al., 2020). The welfare consequences of urbanization and poor health are particularly strong in developing economies where the rural-urban drift is largely unplanned and inadequately managed and where a substantial proportion of the population is engaged in low-income jobs requiring physical strength (United Nations, 2014, 2019). Also, institutions and infrastructural facilities which could mitigate the hazardous effects of urbanization are lacking in most developing countries (Boadi et al., 2005; Collier &Venables, 2016).

Like in many developing economies, the twin issues of urbanization and poor health are taking the center of developmental problems and policies in Nigeria. In tandem with rapid population growth, the urbanization process in Nigeria has taken a drastic turn, growing from 9% in 1950 to 51.2% in 2019 (United Nations, 2019). Moreover, together with India and China, Nigeria is expected to account for 37% of the projected 2.5 billion increase in global urban population between 2014 and 2050 (United Nations, 2019). Urbanization in Nigeria is characterized by a high level of socioeconomic inequalities (Akerele et al., 2012; Deinne & Ajayi, 2021). A continuous unabated influx of people to urban centers with limited socioeconomic opportunities has led to a rise in unemployment, crimes, pollution, overcrowding, and acute housing problem with attendant pressure on limited and collapsing infrastructure (Aliyu & Amadu, 2017; Amao, 2012; Momoh et al., 2018; Oyeleye, 2013). In addition, high reliance on non-renewable energies for domestic and industrial use in Nigerian urban cities and towns has led to a significant increase in carbon dioxide emissions (Iroye, 2016; Maijama & Musa, 2020).

In the same vein, the challenge of poor health in Nigeria has generated national and global attention (United Nations, 2020; WHO, 2019). While the tropical geographical location has made the country susceptible to infectious diseases, the burden of chronic communicable diseases is also growing (WHO, 2019). Despite the global progress in tackling communicable diseases, HIV/AIDS, tuberculosis, and malaria have accounted for a larger proportion of morbidity in Nigeria (Global Fund, 2014). Similarly, other health measures such as maternal and child health outcomes are poorly rated in Nigeria. In Nigeria, an estimated 262,000 babies die at birth annually. That is about 20% of global maternal death (UNICEF, 2021; WHO, 2019).

In fact, child mortality among children in Nigeria ranks among the highest in the world. All child health indicators in Nigeria fall below the global standards (World Bank Group, 2019).

Despite the recorded declines, in 2020, Nigeria ranked just after India in mortality among under-5 children standing at a high of 57.7%, and infant and neonatal deaths at 250 per 1,000 live births. While progress has been made in immunization coverage, Nigeria has the lowest vaccination rate in the entire African region. Only one in four Nigerian children are fully vaccinated, with greater rural-urban disparities and variations among income levels (Obanewa & Neweli, 2020; Sibeudu et al., 2019). Furthermore, only 17% of the estimated 260,000 children (0-14 years) living with HIV/AIDS have access to antiretroviral treatments (UNICEF, 2021).

Although theoretical and empirical discussions on urbanization have not been ignored in Nigerian literature, studies investigating the implications of urbanization for health outcomes in Nigeria are few. The existing studies on the nexus between urbanization and health are primarily descriptive and have focused more on health measures such as life expectancy, public health systems, the prevalence of diseases, mental health, nutritional status, and maternal mortality (Adewoyin & Adeboyejo, 2016; Ekpenyong, 2015; Philip, 2014), with less concentration on child health outcomes such as children mortality and immunization coverage (Antai & Moradi, 2010) This study, therefore, contributes to the growing literature on the health effect of urbanization in Nigeria by assessing the relationship between urbanization and child health outcomes. While urbanization could affect children in diverse ways, assessing the impact on children's health is worth considering in Nigeria, a country characterized by a flawed health care system.

Urbanization and health linkages

Both theoretical and empirical evidence has identified various channels through which urbanization may impact on population health, especially in low- and middle-income countries. For instance, due to an increase in income stemming from higher-productivity employments in urban centers, more people can afford better living conditions and good nutrition, as well as quality healthcare, which serves as an impetus for a healthier living (Turok & McGrahanan, 2013; UNFPA, 2007; UN-Habitat, 2010; World Bank, 2018). On the other hand, increase in income coupled with the popularity of the 'keeping up with the Joneses' phenomenon and easier access to quick and easy food in urban centers have led to a nutritional transition towards Western-style diets characterized by more processed food and higher calorie intakes in most developing economies. This has been linked to a surge in the prevalence of significant risk factors for chronic diseases such as obesity and diabetes among adults and children (Lancet, 2017).

Increasing urbanization has also been linked to a rapid shift towards more sedentary lifestyles and occupations with minimal energy expenditure. Physical inactivity and sedentary lifestyles have been identified as the fourth most prominent risk factors of global mortality (WHO, 2018). With technological advancement, men and women maintain sitting positions for several working hours. This has likewise contributed to an increase in non-communicable diseases (NCDs) such as cardiovascular diseases, diabetes, and other ailments associated with bad posture (e.g., sclerosis), particularly among the high-income groups.

Moreover, urbanization is positively related to increasing female labor force participation. The Goldin (1994) U-shaped labor force participation function postulated that as the economy develops, there is an employment shift from homemaking and other domestic activities to factory work often available in urban centers. While the increasing-income effect has led to significant improvement in household welfare, including better health (Jarvis & Vera-Toscano, 2004; Kurz & Johnson-Welch, 2001), it may also result in adverse implications for households' nutrition and health, particularly those of the children (Garenne, 2010; Heath & Jayachandran, 2016). Due to work pressure and difficulty navigating through urban centers, mothers are unlikely to have much time for childcare, thus entrusting the child's welfare to caregivers. As they have to return to work, many mothers are unable to adequately breastfeed their babies for the medically advised period (Sivakami, 1997; Strang & Broeks, 2016).

Furthermore, a large body of research has established a causal link between urbanization and environmental degradation on the one hand and environmental degradation and poor health on the other (Diao et al., 2020; Flies et al., 2019; Lindahl and Magnusson, 2020). Harmful gaseous emissions such as carbon monoxide and nitrous oxide contribute in no measure to the environmental degradation effect of urbanization. The impacts might be much more severe in Nigeria due to a high dependence on non-renewable energies for domestic and industrial use resulting in a high volume of vehicular emissions and activities of oil exploration multinationals. These negatively affect air quality and cause respiratory diseases, with the outcome being more adverse for children with a less developed immune system (Mustapha et al., 2011; Smith et al., 2000).

A contrary opinion of child health advantages in urban areas also exists. Urban dwellers are better off in terms of nutrition due to financial capabilities and knowledge of healthy living. Hence, absolute poverty and malnutrition are primarily a rural phenomenon in developing countries. With nourishing diets, urban children are spared from the scourge of death from common childhood infections (Amare et al., 2020). Also, due to the better terrain of most metropolitan cities and metropolises relative to the rural areas, both Routine Immunization (RI) and Supplemental Immunization Activities (SIAs) have broader coverage in urban centers than in the rural areas (Hu et al., 2019).

In both developed and developing economies alike, urban residents are often more educated than their rural counterparts. The higher educational attainment is linked to many socioeconomic dividends, including access to improved healthcare and better health (Fang et al., 2015). For instance, mothers' education is a critical factor in the health and cognitive development of children. Children of educated mothers have higher chances of getting vaccinated in the various immunization programs and are better trained in hygienic practices with attendant benefits of better health. Moreover, contraception awareness is higher in an urban setting, leading to fewer children and manageable family size. Parents are thus able to adequately provide better living conditions for the families in terms of better housing, better nutrition, medical care, and improved hygiene.

In another vein, urbanization in most low-income African countries, including Nigeria, is not growth-driven; hence, many poor urban residents live in sub-standard conditions. These barriers have led to overcrowding in most urban centers in Nigeria with the substantial implications of inadequate ventilation, the quick spread of infectious diseases, poor sanitation, all of which aggravate poor health in the country.

Lastly, there is low access and poor quality of infrastructural facilities in Nigeria, which could mitigate the negative impacts of urbanization on health. For instance, while there have been declines in the proportion of the urban population practicing open defecation in Nigeria, open defecation stood at a high of 8.82% of the dense urban population in 2017. In the same period, the percentage of the urban population using safely managed sanitation and safely managed drinking water remained at 29.5% and 24.6%, far below the global averages of 47% and 85.2%, respectively. Moreover, although public health expenditure as a percentage of total government expenditure has increased since the return to democracy, it was at a low of 4.6% in 2017 (World Bank Group, 2019).

Literature review

Following the increasing recognition of the various socioeconomic implications of urbanization, the literature has been replete with theoretical and empirical investigations on the nexuses between urbanization and various macroeconomic variables. While the role of urbanization in economic growth and sustainable environment have been the focal points of a large chunk of such investigations (Cobbinah et al., 2015; Gross & Ouyan, 2020; Nguyen & Nguyen, 2018; Sulemana et al., 2019), there exists a growing strand of literature focusing on the nexuses between urbanization and human health. In particular, a review of the extant literature revealed that a heated debate in both cross-country and country-specific analyses exists on the role of the increasing rate of urbanization in population health. While some studies argued that increasing urbanization is deleterious to health (Antai & Moradi, 2010; Diao et al., 2020; Lindahl & Magnusson, 2020), others opine that urbanization promotes health (Amare et al., 2020; Fasina et al., 2020). Also, the assessments span across diverse categories of health. While sizeable evidence abounds on the relationship between urbanization and human health measured by life expectancy, survival to age 65, and adult mortality (Diao et al., 2020; Menashe-Oren & Stecklov, 2018), some studies have examined the nexus for maternal and child health (Heo et al., 2020), while others have focused on the prevalence of both communicable and non-communicable diseases (Connolly et al., 2020). However, a common characteristic of the different strands of the literature is a diversity of findings.

Among studies that explored the influence of urbanization in population health proxy by indicators such as life expectancy and mortality, evidence indicated that while there are urbanization-induced improvements in health in some contexts, in others, urbanization was found to adversely affect health. For example, recent studies such as Diao et al. (2020) and Torres et al. (2019) found that reduction in longevity and survival rate was strongly related to the environmental-pollution effect of urbanization in 338 cities of China and Scotland, respectively. Similar findings were documented by Menashe-Oren and Stecklov (2018) and Santana et al. (2015) for adult mortality in sub-Saharan Africa and the Lisbon Metropolitan Area of Portugal. Urban area disadvantage of an increasing mortality rate was also demonstrated by Antai and Moradi (2010) in a time series analysis on Nigeria. While Brueckner (2019) established a significant negative correlation between global adult mortality and urbanization, no substantial negative nexus exists in the sub-Saharan Africa sub-sample of the analysis.

Despite the near-consensus on adverse health effects of urbanization, sizeable evidence of the pro-health effect of urbanization exists in the literature. For instance, Bloom and Canning (2004) claimed that the availability of a more extensive pool of health care workers in the urban centers and probable specialization in medicine are likely to yield dividends of better health for urban dwellers. Paciorek et al. (2013) found that urban children were better nourished than their rural contemporaries with attendant benefits of better health and cognitive development. In a cross-country analysis, Bandyopadhyay and Green (2018) similarly established a robust correlation between a decline in death rates and urbanization. In an earlier study by Garenne (2010), significant decreases in child mortality were linked with improved sanitation, water, higher socioeconomic status, and better childcare in developed countries' urban centers. And for sub-Saharan Africa, Arouri et al. (2014) demonstrated that life expectancy rises with the urban share of the population. Furthermore, the findings of Fink and Hill (2013) suggested that a significant reduction in under-5 mortality is connected to the urbanization process in developing countries.

As regards the relationship between urbanization and disease prevalence, studies such as Ahmed et al. (2019), Angkurawaranon et al. (2014), Contaldo et al. (2015), and Lindahl and Magnusson (2020) documented the existence of a link between the rate of urbanization and prevalence of both communicable and non-communicable chronic diseases. In particular, Van de Poel et al. (2009) showed that urbanization increases the risk factors of affluence diseases, including overweight and hypertension in China. A similar finding was upheld by Angkurawaranon et al. (2014) in a study on Southeast Asia. Urban exposure was positively correlated to coronary heart diseases, diabetes, and respiratory disease in children. Contaldo et al. (2015) also established the influencing role of urbanization in childhood obesity in the Campania region of Southern Italy. In a more recent exploratory analysis of the role played by urbanization in the transmission of infectious diseases, Ahmed et al. (2019) argued that the increasing movement of humans and animals due to urbanization is linked to the prevalence of zoonotic diseases. Fei et al. (2018) found that urbanization constitutes a significant risk factor for thyroid cancer in China.

With a focus on Thailand's urbanization process, Lim et al. (2009) concluded that urbanization is a vital factor of the Thai health-risk transition. Armstrong et al. (2018) documented the influential role of urbanization in increased cardiovascular disease-related mortality in Brazil. Additionally, Alirol et al. (2011) asserted that while increasing urbanization in developed economies has drastically reduced the spread of infectious diseases consequent upon improvement in living conditions, hygienic lifestyles, and access to better healthcare, a rash of chronic diseases has been on the rise sequel to changes in dietary pattern and improved diagnostic capacities of health systems. Flies et al. (2019) affirmed that urban features such as pollution, sedentary lifestyle, and unhealthy diet are positively correlated with widespread infectious and chronic non-communicable diseases. Quantifying the effect of urbanization on human health in China, Hui (2018) showed that the increasing rate of urbanization is linked to gastrointestinal conditions, including stomach cancer, Hepatitis B and C, liver cancer, and ulcers. In other related studies, Inoue et al. (2017) concluded that living in urbanized cities of China is linked to chronic kidney diseases, while Karki et al. (2019) argued that urban sedentary lifestyles and dietary patterns of junk and high-calorie food are strongly related to obesity among school children in Lalitpur Metropolitan of Nepal.

Methodology

Data source and definition of variables

Annual time series models from 1970 to 2018 were employed for the analyses. All data were sourced from the 2019 edition of the World Development Indicators (WDI) database of the World Bank Group (2019). While the study explores the relationship between urbanization and child health, other macroeconomic variables identified as determinants of child health were included as control variables to avoid misspecification errors. A strong correlation has been established between the level of income and health outcomes (Adedeji & Akinlo, 2016; O'Hare et al., 2013). Thus, the Gross Domestic Product (GDP) growth rate is included in the analysis to assess the impact of income on child health outcomes in Nigeria.

Evidence of a strong correlation between child health and literacy rate, health aid, and public expenditure also abound in the literature. Educated parents or guardians tend to be knowledgeable in caring for children, while increased public expenditure makes healthcare resources available. Hence, literacy rates measured by Gross Primary School Enrolment, health aid, and public spending are incorporated in the model. For this empirical investigation, health aid is proxied by official development assistance provided by the United Nations International Children Fund (UNICEF). Rather than aggregate Development Assistance for Health (DAH), this study adopts DAH supplied by UNICEF to eliminate the effect of DAH not targeted towards children and precisely account for the impact of aid targeted at child health.

The definitions of the variables employed in this study and the adopted codes and units of measurements are presented in Table 1.

Table 1: Definitions of Adopted Variables

Variables codes	Definitions	Units of measurement
NEO	Neonatal mortality rate (per 1,000 live births)	Per 1,000 live births
INF	Infant mortality rate	Per 1,000 live births
UND5	Under-5 mortality rate (per 1,000 live births)	Per 1,000 live births
URB	Urbanization rate	Percent
DAH	Net official flow from UN agencies (UNICEF)	US$
GDPG	GDP growth rate	Percent
GEXP	Public health expenditure (% of GDP)	Percent
SCHP	Primary school enrolment	Percent

Note: Author's computation based on data from World Bank Group (2019)

Technique of analysis

This study adopted the time series data analysis to evaluate the impact of urbanization on child health outcomes in Nigeria. Hence, to estimate the long-run coefficients of the time series model, the fully modified ordinary least squares method (FM-OLS) was employed. The FM-OLS has been regarded as more efficient in comparison to the ordinary least squares (OLS). The OLS estimates may suffer from serial correlation and heteroscedasticity when applied to cointegrating series, thereby producing inconsistent and biased estimates. Phillips & Hansen (1990) developed the FM-OLS technique of analysis to correct the deficiencies associated with the OLS estimator by modifying the least squares to account for serial correlation effects and endogeneity arising from cointegration among variables of interest.

According to Phillips (1993), FM-OLS has an important intent of providing a framework for estimating time series by taking advantage of the non-stationarity of the series and potential cointegrating relationships among the series of interest without preliminary testing explicitly stating the model form. Based on the initial work of Phillips & Hansen (1990), the FM-OLS method estimator was initially developed to estimate cointegrating relationships having a combination of I(1) regressors. However, the estimator framework was extended in Phillips and Solo (1992) to permit the evaluation of the asymptotic behavior of the FM-OLS method in models with full rank I(1) regressors as well as those having combinations of I(1) and I(0) regressors. In all, the FM-OLS estimator has been found useful for robust estimation of both time series and panel data analyses, producing asymptotically unbiased and normally distributed estimated coefficients (Kao & Chiang, 2001; Phillips & Hansen, 1990; Phillips & Solo, 1992). Moreover, aside from mitigating the challenge associated with correlation among series and the problem of endogeneity, FM-OLS has been found to be efficient in small sample sizes (Pedroni, 2004).

The following linear model is formulated to uncover the long-run relationship between urbanization and the selected child health indicators.

$$Chd = f(Urb, Dah, Gdpg, Gexp, Schp) \quad (1)$$

where chd is a vector of various indicators of child health used in the study: infant mortality rate, neonatal mortality rate, and under-5 mortality rate. $Urb, Dah, Gdpg, Gexp, and\ Schp$ are as defined in Table 1.

In order to explore how urbanization impacts various dimensions of child health, equation (1) is transformed into three distinct econometric models, each estimating the impact of urbanization on each category of child health. Thus, following equation (1), the following equations are estimated.

Model 1

$$Infm = \propto_0 + \propto_1 Urb + \propto_2 Dah + \propto_3 Gdpg + \propto_4 Gexp + \propto_5 Schp \quad (2)$$

Model 2

$$Neom = \beta_0 + \beta_1 Urb + \beta_2 Dah + \beta_3 Gdpg + \beta_4 Gexp + \beta_5 Schp \quad (3)$$

Model 3

$$Und5 = \partial_0 + \partial_1 Urb + \partial_2 Dah + \partial_3 Gdpg + \partial_4 Gexp + \partial_5 Schp \quad (4)$$

Results

This section focuses on the presentation of the econometric results as well as the discussion of the findings. Specifically, it presents the data description, the techniques of analysis, and interpretation and discussion of the results.

Table 2: Summary Statistics of the Variables

Variables	Urb	Inf	Neo	Und5	Dah	GDPg	Gexp	Schp
Mean	2.58	4.65	3.80	5.15	16.76	3.18	56.66	94.13
Median	2.58	4.72	3.87	5.23	16.75	4.21	55.68	93.49
Maximum	2.71	4.83	3.96	5.35	17.88	15.33	86.92	113.08
Minimum	2.49	4.33	3.58	4.79	14.99	13.13	11.61	78.66

Variables	Urb	Inf	Neo	Und5	Dah	GDPg	Gexp	Schp
Std. Dev.	0.07	0.19	0.13	0.21	0.83	5.54	19.19	8.81
Skewness	0.09	-0.46	-0.44	-0.47	-0.32	-0.87	-0.45	2.57
Kurtosis	1.71	1.56	1.50	1.57	2.22	4.53	2.71	2.69

Note: Author's computations utilizing EViews 9 (EViews, 2015).

Descriptive statistics

Based on the descriptive statistics reported in Table 2, all the variables show a high level of consistency as each variable's mean and median values are within the reported minimum and maximum values. Except for the GDP Growth Rate (GDPg), public health expenditure (Gexp), and Gross Primary School Enrolment (Schp) series, which have high standard deviation ranging between 5.5 and 19.2, all other data have low standard deviation values (ranging between 0.07 and 0.83). While the series with high standard deviation values are widely spread around the mean, the low standard deviation values indicate that the individual data for those series are clustered around the mean. In all, the series for the degree of urbanization has the least deviation from the mean with a standard deviation of 0.07. In contrast, the highest degree of dispersion is exhibited by the public health expenditure series.

For the inference on the normality assumption, the measure of the asymmetry of the probability distribution of each series around its mean indicated by the skewness statistics show that all the series except the degree of urbanization are negatively skewed (leftward), indicating that they are asymmetric and not normally distributed.

Furthermore, the degree of peakedness of the series' distribution evidenced in the kurtosis values provides varying information about the distribution of the series of interest. For a normally distributed series, the coefficient of the kurtosis is expected to be 3.0, and such a distribution is said to be mesokurtic. It is a relatively high peak distribution (leptokurtic) if the kurtosis value is higher than 3 and a relatively high flat-topped distribution (platykurtic) when the kurtosis value is lesser than 3. Thus, the reported kurtosis values for the adopted series indicate that aside GDP growth rate, which is leptokurtic, every other series is platykurtic. This corroborates the skewness statistics, which indicate that none of the series is normally distributed.

Unit root test

Most series of economic variables exhibit trending behavior in the mean; they have non-stationarity property. Employing such series in econometric analyses tend to produce spurious estimates. Hence, in order to determine the existence or otherwise of long-run relationships among the variables of interest, this study tests for the stationarity of the series of the variables using some of the tests offered in the statistical theory. Specifically, this study adopts the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests which have been popularized in the literature (Jalil & Rao, 2019).

Table 3: Results of the Augmented Dickey-Fuller and Phillips-Perron Unit Root Tests

Variables	Augmented Dickey-Fuller (ADF)		Phillips-Perron (PP)	
	Level	*1st Difference*	*Level*	*1st Difference*
Inf	1.2950	3.9011*	1.8789	1.1181
Neo	1.6011	4.1013*	0.3891	0.5611
Und5	1.5858	3.5192*	1.3122	1.1148
Urb	5.4523*	3.0394**	2.3488	4.3529*
DAH	1.6723	5.2190*	1.8849	6.8926*
GDPg	4.1062*	9.9317*	4.1204*	10.2501*
Gexp	2.0419	5.4382*	2.0517	8.6086*
Schp	2.7124	3.5603**	1.5052	3.6521*

*Note: * and ** indicate statistical significance at 1 and 5 %, respectively. Author's computations utilizing EViews 9 (EViews, 2015).*

The results presented in Table 3 show that using both tests, all the variables are non-stationary at levels except GDP growth rate and urbanization (GDPg and Urb). However, at the first difference, except for Gross Primary School Enrolment (Schp) and degree of urbanization (Urb), which are only stationary at 5% level of significance, all other series are stationary at a 1% level of significance for the ADF test. On the other hand, for the PP test, the null hypothesis of the presence of unit root could not be rejected even at the first difference for all the mortality series (infant [Inf], neonatal [Neo], and under-5 [Und5]). Thus, following the establishment of stationarity of the selected data, the study proceeds to test for the existence or otherwise of long-run relationship among the variables using the Johansen cointegration test.

Johansen cointegration test

For the purpose of testing for a long-run relationship among the variables, the study adopts the Johansen cointegration test, which uses the results of the trace statistics and maximum eigenvalues to test for the cointegration ranks among series (Hjalmarsson & Österholm, 2007). In particular, we conduct separate tests for each model of the child outcome indicators. The results are shown in Table 4. All the estimated cointegrating models show evidence of long-run relationships indicating at least three cointegrating equations each.

Table 4: Results of Johansen Cointegration Test

Model	Hypothesized No of CE(s)	Eigen value	Trace statistics	Prob value
Infant mortality	None	0.9025	166.8928	0.0000
	At most 1	0.8322	101.7235	0.0000
	At most 2	0.5738	51.7506	0.0206
	At most 3	0.4832	27.8745	0.0820
	At most 4	0.2350	9.3896	0.3306
	At most 5	0.0653	1.8895	0.1693
Under-5 mortality	None	0.9336	187.5171	0.0000
	At most 1	0.8853	111.5880	0.0000
	At most 2	0.5795	50.9707	0.0248
	At most 3	0.4721	26.7116	0.1089
	At most 4	0.2194	8.8243	0.3819
	At most 5	0.0653	1.890	0.1691
Neonatal mortality	None	0.9054	150.4522	0.0000

Model	Hypothesized No of CE(s)	Eigen value	Trace statistics	Prob value
	At most 1	0.6614	84.4143	0.0022
	At most 2	0.6274	54.0935	0.0116
	At most 3	0.4725	26.4502	0.1158
	At most 4	0.2622	8.5423	0.4094
	At most 5	0.0010	0.0281	0.8669

Note: Author's computations utilizing EViews 9 (EViews, 2015).

Fully Modified Ordinary Least Squares (FM-OLS) estimator result

The results of the FM-OLS regression are displayed in Table 5. The results show the coefficients, direction, and significance of the effects of the independent variables on child health outcomes in Nigeria.

Table 5: Summary of the FM-OLS Regressions

Variables	Model 1 (Infm)	Model II (Neom)	Model III (Und5)
Degree of urbanization (Urb)	-0.8629*	-0.7125*	-0.9812*
GDP growth rate (GDPg)	0.0044**	0.0013	0.0050**
Public health expenditure (Gexp)	-0.0045*	-0.0029*	-0.0050*
Literacy level (Schp)	-0.0066*	-0.0044*	-.0.0073*
Development assistance for health (Dah)	-0.1233*	0.0816*	-0.1381*
Adjusted R^2	0.9510	0.9662	0.9519

*Note: *, ** and*** indicate statistical significance at 1, 5, and 10%, respectively. Author's computations utilizing EViews 9 (EViews, 2015).*

A different model is estimated for each of the adopted indicators of child health, and the result for each model is reported in columns I to III. Specifically, column I show the result for the infant mortality model, while the estimates of the neo mortality and under-5 mortality are reported in columns II and III, respectively. From column I, the estimated coefficient on urbanization indicates that urbanization has a negative relationship with infant mortality in Nigeria and the effect is statistically distinguishable from zero. Quantitatively, a percent increase in the urbanization rate is related to a reduction of about 0.9% in infant mortality. The results for neo and under-5 mortalities models displayed in columns II and III are similar to that obtained for the infant mortality model. The estimated coefficients on urbanization for the neonatal mortality model indicate that a 1% increase in urbanization rate is associated with a respective decline of 0.7 and 0.9% in neonatal and under-5 mortality. In addition, it can be rejected that the estimated coefficients on urbanization in both models are not different from zero at the 1% level of significance.

In all, the child health advantage of urbanization in Nigeria is highest for under-5 mortality followed by infant and neonatal mortalities, respectively. This finding is corroborated in the UNICEF Report (2020), which acknowledges that Nigeria has a long way to achieve the SDG health goals. However, remarkable signs of progress have been made in the last two decades. In particular, the report asserts that over the past 15 years, there have been declines of 31%, 26%, and 20%, respectively, in under-5, infant, and neonatal mortalities in Nigeria.

Discussion

In the context of Nigeria, diverse explanations can be offered for the urban child health advantage suggested by the findings. For example, the dynamic interactions between urbanization, level of education, and socioeconomic status on the one hand, and socioeconomic status, level of education, and child health, on the other hand, have been extensively documented in the literature (Huang & Jiang, 2017; Miao & Wu, 2016). Hence, the obtained findings might be stemming from improvement in education status in the Nigerian urban centers (Arouri et al., 2014). Urban parents are more educated and are thus more knowledgeable in childcare.

Due to the increasing rate of awareness campaigns and exposure to media, more pregnant and nursing mothers in the urban centers are being attended to by skilled health professionals for antenatal and postnatal care. Also, the number of births attended by qualified health staff has significantly increased in Nigeria, with a substantial proportion in the urban metropolis (Sunkanmi & Olufunsho, 2013). Consequent upon better access to antenatal and postnatal care, there is wider access to health information, and women are better trained to care for their children. Furthermore, through greater household income and media exposure pathways, urban women can provide better nutrition for their children with attendant benefits of raising healthier children and higher survival rates (Abdulkadir & Abdulkadir, 2017; Fadare et al., 2019).

Moreover, despite the gaps in immunization coverage in Nigeria, a more significant number of urban children are vaccinated compared to their rural counterparts due to reasons such as parental economic and educational status and better terrains which permits wider coverage in the urban centers (UNICEF, 2020). Vaccine-preventable diseases (VPDs) are the leading causes of child under-5 mortality in developing regions (Ijarotimi et al., 2018). Thus, more comprehensive access to routine immunization by the urban children tend to yield higher health premium evidenced in reduced mortalities (Ijarotimi et al., 2018; Zhang et al., 2018).

A further explanation for the estimated negative correlation between urbanization and child mortality may be due to the fertility reduction effect of urbanization. With an increased rate of female schooling and participation in the workforce, women tend to have fewer children. Sequel to smaller family sizes, parents are able to make a substantial investment in child health, resulting in healthy lives and a significant decline in mortality among children (Keats, 2018). The declining fertility trend due to urbanization has also been documented for Nigeria (Flückiger & Ludwig, 2017; Ushie et al., 2011).

Bearing in mind the possibility that income may be a pathway through which increasing urbanization rate reduces mortality among children (O'Hare et al., 2014; Ward & Vine, 2017), income proxy by GDP growth rate is included in the model as a control variable. This is done to test whether the results are exclusively due to urbanization impacting child mortality through income. For the estimated models, income has quantitatively small but positively affects the adopted categories of child mortality. While the result is statistically indistinguishable from zero for the neonatal mortality model, the hypothesis that income affects infant and under-5 mortalities is equal to zero is rejected at the 1% significance level.

This finding contrasts with extant literature, which has documented a significant negative correlation between income and child mortality (Neal & Falkingham, 2014; O'Hare et al., 2014;

Ward & Vine, 2017). In support of previous literature that has established similar results, education, public health spending, and Development Assistance for Health (DAH) are found to be negatively associated with the different categories of child mortality. For all the models, the coefficients are statistically different from zero.

Moreover, while the coefficients for school enrolment and public health spending are quantitatively small in all the estimated models, DAH provided by UNICEF has fairly large coefficients in all the models. This indicates that DAH provided by UNICEF has a relatively larger effect on child mortality compared to education and government health expenditure. The health premium effect of DAH has been corroborated by a substantial number of studies on the effectiveness of health development assistance (Yogo & Mallaye, 2015). In the same vein, the pro-health impacts of education and government expenditure have been documented by Adeosun and Faboya (2020), Andriano and Monden (2019), and Sunkanmi and Olufunsho (2013).

Conclusion

The study examined the effect of urbanization on different categories of child health, namely, infant mortality, neonatal mortality, and under-5 mortality. The aim is to test whether there exist child health advantages or disadvantages due to urbanization. Using FM-OLS, the empirical analyses reveal that urbanization has a health advantage effect on infant mortality and neonatal and under-5 mortalities. In other words, urbanization is correlated with a reduction in all the categories of child mortalities.

An important policy implication emerges that policymakers should pay attention to the process of urbanization to support health improvement. In particular, harnessing the potential health benefits of urbanization should be prioritized by policymakers.

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