



Research Article

Do Cities Improve Our Health Status? A State-Level Analysis in India

Sabyasachi Tripathi 

Department of Economics, Adamas University, Jagannathpur, Kolkata-700126, India
Email: sabya.tripathi@gmail.com

Received: 21 March 2022; **Revised:** 21 June 2022; **Accepted:** 28 June 2022

Abstract: While several cross-country level studies suggest urbanization increases health outcomes; national-level studies are missing. On the other hand, India is experiencing a very low level of urbanization due to policy failures. In this context, this study assesses the impact of urbanization on health outcomes in Indian states from the period of 1991 to 2011. Urbanization is measured by the total urban population and percentage of urban population as different states are having a different level of urbanization. Health outcomes are measured by total fertility rate, infant mortality rate, and life expectancy at birth. The static panel data models such as fixed-effect and random-effect panel data models suggest that the total urban population and the percentage of the urban population have a positive effect on life expectancy at birth and have a negative effect on the infant mortality rate and total fertility rate. Among the control variables, the percentage of urban households having access to electricity, urban monthly per capita consumption expenditure, and per capita net state domestic product has also had a similar effect on the health outcomes. Other important variables such as rural to urban migration, literacy rate, poverty rate, access to safe drinking water, labor force participation rate, and the extent of inequality also play an important role in increasing health outcomes. We also checked the robustness of our results by using the instrumental variable generalized method of moments. Our results support the Theory of Demographic Transition and suggest that Indian policymakers must support increasing the urbanization rate for achieving higher health outcomes. However, proper management of urbanization by providing basic services to urban dwellers is also very important in this regard.

Keywords: urbanization, total fertility rate, life expectancy at birth, infant mortality rate, India

JEL Codes: I10, I15, R10

1. Introduction

Recently, urbanization in developing countries works as a powerful combustion engine for economic development. The correlation between urbanization and economic growth is very strong. No country has grown from a developing to a developed economy without industrialization and modernization associated with urbanization.

On the other hand, urbanization could be the main reason behind the huge demographic and economic changes occurring across the world. Two of the most important of these changes have been the rapid decline in mortality and the rise of urbanization (Bandyopadhyay & Green, 2018). The improved modern health system is significantly responsible

for the decline in mortality around the world. But access to the modern health system may differ for rich to poor people. One of the studies by Barik et al. (2018) found that though rich people may have a greater likelihood of suffering from diabetes, high BP, and cardiac conditions the survival rate of the rich people is higher than the poor. Overall, people migrate to cities to take advantage of better public health facilities. So, there is a link between urbanization (which increases income due to higher work opportunities and higher wages) and mortality rate.

Urbanization has a strong negative on fertility rate. It could be because when a society shifts from a traditional rural agriculture-based economy to an industrialized urban economy, the economic value of the rising the cost of children in urban life declines. The economic pressure of urban life associated with rising costs for better health and education for their children prompted fertility decline in developed and developing countries (Notestein, 1945). Urban skilled works require higher education. It delays the marriage and reduces the fertility rate. These factors influence on the micro-level decision-making of the households (Becker, 1960; Schultz, 1972). The changes in the demand for children depend on the changes in family income and to changes in the relative cost of children and other consumer goods. Therefore, a higher urbanization rate is associated with fertility reduction.

The average life expectancy of birth has also increased due to urbanization. Urban dwellers earn more money and spend more for better health. On the other hand, the quality of and access to medical care consists of boasting modern and high-tech medical equipment are increasingly available due to a higher rate of urbanization and economic advances. As a result, urbanization has a positive effect on life expectancy at birth.

India is going through a transformation from its rural-based agriculture economy to an urban-based industry and service lead economy. The percentage of urbanization has increased from 17.97% in 1961 to 31.16% in 2011. The total urban population has risen from 7.9 crores to 37.71 crores during the same period. The urban population grew by 2.76% per annum from 2001 to 2011 (Bhagat, 2011). It is also important to note that for the first time since independence, the absolute increase in the urban population was higher than that in the rural population. However, though India's urbanization rate is moderate compared to its peers, the large-scale emergence of census towns in 2011 signals the rapid transformation is taking place in the rural areas in the form of non-farming activities.

The cities and towns of India constitute the world's second-largest urban system, and over 50% of the country's gross domestic products are generated by these cities and towns (Tripathi, 2013). The agglomeration economies helped to reduce poverty, increased the standard of living by increasing job opportunities, and reduced dependence on agriculture in India. Therefore, several recent urban policies such as the 100 smart cities mission, and Atal Mission for Rejuvenation and Urban Transformation (AMRUT) are put in place for the promotion of urbanization in India.

On the other hand, several states show higher achievement in health outcomes. The Total Fertility Rate (TFR) in Assam dropped from 5.7 to 2.4 in the same period. The Infant Mortality Rate (IMR) in Bihar reduced from 118 in 1981 to 44 in 2011. Life Expectancy at Birth (LEB) in Madhya Pradesh has increased from 54.7 in 1991 to 62.8 in 2011. On the other hand, Indian states are witnessing variations in their levels of urbanization. For instance, in 2011 the level of urbanization in Mizoram was 52% whereas it was only 11% in Bihar. Hence, the assessment of the relationship between state-level urbanization and health outcomes is very important for the promotion of urbanization in India.

In this paper, we assess the impact of urbanization on health outcomes in Indian states. Health outcomes are measured by total fertility rate, infant mortality rate, and life expectancy at birth. On the other hand, urbanization is measured by the total urban population and the percentage of the urban population. The analysis is conducted using state-level data in India from the period of 1991 to 2011. We use static panel data models and the instrumental variable generalized method of moments for the analysis. The results are very important to promoting urbanization in India in achieving sustainable economic development.

2. Brief review of literature

Earlier below-replacement fertility was evidenced in the developed regions of the world as urbanization strongly reduces fertility rate. Thompson (1935) found that the rural fertility rate was observed to be significantly higher than the urban rate. Later Jaffe (1942) and Notestein (1945) further extended research on the association between urbanization and fertility reduction in the context of developing countries such as Latin-American countries and suggested that urban-rural differences in the fertility rate are far more widespread than was originally thought. Thereafter Becker

(1960) and Schultz (1972) considered such factors in micro-level decision making. The study by Eckert and Kohler (2014) presented an organized review of the impact of urbanization on health in developing countries. They found that a reduction in fertility rate and lower chances of giving birth were evidenced in urban regions. Several studies such as Fobil et al. (2011), Allender et al. (2011), Antai and Moradi (2010), Firestone et al. (2011), Van de Poel et al. (2009), Miljkovic and Glazyrina (2015) are conducted in the context to specific countries to estimate the impact of urbanization on health outcome. Other studies, for example Van de Poel et al. (2007) and Bergh and Nilsson (2010) have considered several countries for the analysis.

Some empirical studies have systematically studied the relationship between health outcomes and urbanization. Bandyopadhyay and Green (2017), using cross-national panel data, found evidence of a robust negative correlation between crude death rates and urbanization. They also found robust evidence that mortality decline is correlated with urbanization through the creation of new cities rather than promoting urban growth in already-extant cities. Jedwab and Vollrath (2017) pointed out that much of the recent growth of cities in the developing countries is due to their relatively low mortality rates, unlike cities in Western Europe in the past. Fink and Hill (2013) found that urbanization declines under-five mortality in developing countries. However, the results can be different for specific age groups and different countries' perspectives. For instance, Brueckner (2019) found that there is no significant negative association between urbanization and adult mortality in sub-Saharan Africa. And urban health quality is considerably lower in sub-Saharan Africa than all the others part of the world.

In the context of life expectancy at birth, Bergh and Nilsson (2010) scrutinized the association between life expectancy and globalization by considering 92 countries in the world. The study found that urbanization, globalization, education, public health measures, nutrition, and income were all positively related to life expectancy. The estimated results are highly significant except for the impact of urbanization on life expectancy in developing countries. Torres et al. (2019) found that in the absence of the urbanization penalty Scottish life expectancy at birth could have reached higher values by the starting of the twentieth century.

However, most recent studies are more focused on urbanization quality and management as a new measure for urbanization globally. To measure the urbanization quality and management different measures are used as follows: the percentage of the urban population having access to electricity (Ali et al., 2020) and basic drinking water services (Badhan et al., 2021; Nafi'Shehab et al., 2021), to assess the impact of these variables on urbanization. On the other hand, important variables such as the impact of employment (Yu, 2021), inequality (Kundu, 2006), poverty (World Bank, 2010), and gross domestic product (Tripathi, 2013) on urbanization are assed in this study.

Indian literature is mainly concentrated on how city-specific urbanization levels impact urban health. For instance, Saravanan et al. (2016) analyzed the water-borne diseases in the city of Ahmedabad, India. Butsch et al. (2012) demonstrated that urban health is closely connected with the specifics of India's urbanization. Differences in lifestyle and access to resources result in polarisation: the healthiest and the least healthy citizens now live in urban India. Kumar et al. (2018) suggested that there is a strong need to set up a primary healthcare system in urban areas and systematically deal with urban health challenges in terms of vector-borne diseases, rising incidence of non-communicable diseases, air pollution and acute respiratory infections, road traffic accidents, trauma, and injuries. Singh et al. (2011) found that urbanization and coverage of safe delivery were not associated with either infant or under-five mortality.

A brief review of Indian literature suggests that the overall impact of urbanization on health is not assessed comprehensively and systematically. Therefore, it is very much important to assess the impact of urbanization on the overall health of the Indian states.

3. Regression results

Our regression analyses aim to quantify the relationship between urbanization and health outcome. As our data set is a panel, we estimate the following equation:

$$Healthoutcome_{it} = \alpha + \mu_{it} + \lambda_{it} + \beta Urbanization_{it} + \epsilon_{it} \quad (1)$$

where $Healthoutcome_{it}$ is the health outcome of state i in year t , μ_{it} is a state fixed effect (to measure state-specific factors

such as culture and geography, λ_{it} is a year fixed effect (to measure state-invariant time shocks or trends), ϵ_{it} is a well-behaved error term. Our independent variable is level urbanization. The analysis is done by considering 35 states and union territories in India. Based on review of literature we expect a positive effect of urbanization on state level health outcomes in India.

Due to limited availability, we use data from the 1991 Census to the latest 2011 census with a ten years interval [India conducted full decennial Census from 1881 to 2011. However, 2021's Census was postponed due to Covid-19 pandemic. Latest reports suggest that India will not have its 2021 Census soon. Therefore, we had to use 2011, the latest available Census data]. Life expectancy at birth is fetched from quinquennial surveys and was not available before 1991. Therefore, we consider 1991-1995 as 1991, 1997-2001 as 2001, and 2007-2011 as 2011. Data for TFR, IMR, and LEB are collected from the Sample Registration System (SRS) Bulletin various issues, Office of the Registrar General & Census Commissioner. LEB data before 1995-1999 are collected from the Economic Survey, Government of India. The percentage of urbanization, total urban population, total rural to urban migration, literacy rate, percentage of urban households having access to electricity, and the percentage of urban households having safe drinking water are collected from the Census of India, Government of India. State-level poverty is estimated using the National Sample Survey (NSS) unit-level data on consumption expenditure as suggested by Tendulkar Committee for the years 1993-1994, 2004-2005, and 2011-2012. Using unit-level NSS consumption expenditure data, we also estimated state-level urban monthly per capita consumption expenditure and Gini coefficients. Finally, state-level Per Capita Net State Domestic Product (PCNSDP) at factor cost (Current Prices) for the years 1991, 2001, and 2011 are sourced from the Central Statistical Organization, Government of India.

Table 1 shows the descriptive statistics of all variables used for regression analysis. Life expectancy at birth, per 1,000 labor force participation rate in urban area, and percentage of urban households having electricity present small differences in their means, indicating a more equal distribution. Nevertheless, total rural to urban migration, total urban population, and per capita net state domestic product have higher coefficients of variations, and differences in its means are significant.

Table 2 presents the correlation estimation results of the correlation coefficients. The mortality rate (or fertility rate) has a negative association with literacy rate, urban monthly per capita consumption expenditure, urban labor force participation rate, and per capita net state domestic product and it has a positively correlated with the poverty rate. The life expectancy at birth has a negative correlation with the poverty rate and the percentage of urban households having safe drinking water. However, it positively correlated with all other independent variables. Among the independent variables, the correlation between per capita net state domestic product and urban monthly per capita consumption expenditure is very high (0.95). Therefore, we tested the multicollinearity problem by calculating the Variance Inflation Factor (VIF). Table 1 presents the results of VIFs. As the VIF scores are less than 10 we conclude that multicollinearity problem is absent in our regression analysis.

Before we choose the appropriate panel models, we do several diagnostic tests for regression models 1-14. Tables 3 and 4 show the statistically significant F-test and compel us to go for the fixed-effect model over the pooled model. The statistically significant values of the Breusch-Pagan Lagrange Multiplier (LM) test indicate that the random effect models are appropriate. To decide between the random and fixed-effect models, we run the Hausman test. The statistically significant values of the Hausman tests support the estimation of fixed-effect models for regression models 1 to 5. On the other hand, statistically insignificant values of the Hausman tests support the estimation of random-effect models for regression models 6 to 14. After that, we test for heteroskedasticity using the STATA command *xttest3*. We found that the errors of all models suffer from heteroskedasticity. Therefore, to ensure the validity of the regression results, we must obtain robust estimations. To do that, we use a 'robust' option with the fixed-effect/random-effect model estimation to obtain heteroscedasticity-robust standard errors (also known as Huber/White or sandwich estimators). The robust estimation results are presented in Tables 3 and 4. As our data point is not typically macro panels as with 10 years intervals, we do not find any problem with serial correlation. The significant values of *F* statistics or Wald chi2 for regressions 1-13 indicate that the overall models are statistically significant. Regressions 1, 6, and 10 show the estimates of the full model, which includes all variables for a maximum number of available observations. Other regression models list results for a parsimonious model, excluding controls that are not found to be statistically significant or matched with the expected sign of the regression parameters. More specifically, as a result of the paucity of data, we have presented the results of the best fit models in terms of predicted signs, the significance level of the

variables, and the goodness of fit of the regressions, according to the different number of observations of the variables available. We focus more on parsimonious regression results than the full model estimation as in the former, the effect of one independent variable may be changed due to the influence of other independent variables.

Table 1. Descriptive statistics

Variable	Observation	Mean	Standard deviation	Minimum	Maximum	Coefficient of variation	Variance inflation factor
Total fertility rate (tfr)	91	2.520879	0.940037	0.7	5.1	37.29	
Infant mortality rate (imr)	98	45.19388	24.32031	7	124	53.81	
Life expectancy at birth (leab)	48	64.27708	4.67425	54.7	74.4	7.27	
Percentage of urban population (% urban)	101	33.91287	21.00094	8.47	97.5	61.93	2.03
Total urban population (urban population)	105	8,388,524	11,085,58	12	50,818	132.15	7.48
Total rural to urban migration (migration)	101	1,573,330	2,465,525	2,110	1.35E + 07	156.71	6.94
Literacy rate (literacy)	104	68.86096	13.71601	37.49	94	19.92	4.83
Poverty rate (poverty)	99	23.7798	12.93742	1	55	54.41	2.93
Urban monthly pre-capita consumption expenditure (mpce_u)	85	1,548,364	890,8531	353	4,547.27	57.54	5.79
Per 1,000 labour force participation rates in urban area (lpr_u)	99	363.7172	40.53646	267	463	11.15	1.56
Urban inequality (gini_u)	88	0.323841	0.056188	0.174	0.435	17.35	1.55
Per capita net state domestic product (pnsdp)	91	31,666.02	33,700.62	2,660	168,024	106.43	5.3
Percentage of urban household having electricity (electri_u)	98	88.3002	10.33059	58.77	99.7	11.70	4.13
Percentage of urban household having safe drinking water (water_u)	101	82.2005	20.50838	5	99.8	24.95	1.89

Source: Author's calculation

Table 2. Correlation coefficient of the variables used in regression model

	tfr	imr	leb	% urban	Urban population	migration	literacy	poverty	mpece_u	lpr_u	gini_u	pnsdp	electri_u	water_u
tfr	1.00													
imr	0.75	1.00												
leb	-0.77	-0.93	1.00											
% urban	-0.41	-0.35	0.39	1.00										
Urban population	-0.05	-0.17	0.12	0.49	1.00									
migration	-0.20	-0.29	0.24	0.39	0.87	1.00								
literacy	-0.83	-0.82	0.82	0.35	0.15	0.35	1.00							
poverty	0.62	0.66	-0.77	-0.35	-0.06	-0.19	-0.63	1.00						
mpece_u	-0.61	-0.65	0.65	0.06	0.17	0.33	0.67	-0.60	1.00					
lpr_u	-0.74	-0.45	0.47	0.49	0.08	0.11	0.57	-0.39	0.25	1.00				
gini_u	-0.27	-0.27	0.25	0.20	0.35	0.35	0.46	-0.18	0.36	0.16	1.00			
pnsdp	-0.61	-0.63	0.63	0.20	0.25	0.38	0.64	-0.60	0.95	0.30	0.28	1.00		
electri_u	-0.61	-0.54	0.62	0.39	0.24	0.37	0.65	-0.83	0.69	0.35	0.35	0.68	1.00	
water_u	0.10	0.05	-0.01	0.07	0.31	0.29	-0.12	-0.29	0.26	-0.32	-0.04	0.27	0.47	1.00

Note: See Table 1 for variable definitions
The correlation coefficients are based on 44 observations

Table 3. Determinants of total fertility rate and infant mortality rate: Panel Regression results

Variables	Dependent variable									
	Total fertility rate					Infant mortality rate				
	Fixed effect estimation					Random effect estimation				
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	
Percentage of urbanization	-0.0122* (0.00638)		-0.0267*** (0.00723)			-0.0131* (0.00713)			-0.0959 (0.120)	
Total urban population	-3.56e - 05*** (1.15e - 05)								-0.000309 (0.000326)	-0.000418** (0.0002065)
Total rural to urban migration	3.96e - 08** (1.75e - 08)		-4.43e - 08* (2.34e - 08)			-8.58e - 08** (3.16e - 08)			8.77e - 07 (1.24e - 06)	-1.01e - 06** (4.05e - 07)
Literacy rate	-0.0532*** (0.00508)								-1.375*** (0.286)	
Poverty rate	-0.0129** (0.00622)								-0.305 (0.233)	0.629*** (0.226)
Urban monthly per-capita consumption expenditure	-0.000134 (0.000129)								-0.00213 (0.00407)	
Urban labour force Participation rates	-0.000750 (0.00134)								0.0396 (0.0625)	-0.0245 (0.0735)
Urban inequality	0.640 (1.163)								100.4** (48.30)	-1.636 (48.29)
Per capita net state domestic product	3.15e - 06 (2.78e - 06)								8.73e - 05 (6.28e - 05)	-0.000129*** (4.93e - 05)
Percentage of urban household having electricity	-0.00337 (0.00993)								-0.682* (0.364)	
Percentage of urban household having safe drinking water	0.0128** (0.00580)								0.0872 (0.135)	0.204 (0.236)
Constant	6.632*** (1.148)		8.321*** (0.801)			4.982*** (0.919)			159.1*** (54.45)	26.87 (40.07)
Overall F test/Wald chi ²	181.77***		14.25***			13.64***			97.13***	34.88***
Observations	66		75			78			80	85
R-squared	0.5031		0.3370			0.0481			0.2892	0.6385
Number of groups	28		33			29			31	29
F-test										
LM-test										
Hausman test										
Wald test										

Robust standard errors in parentheses
 *** p < 0.01, ** p < 0.05, * p < 0.1

Table 4. Determinants of life expectancy at birth: Panel Regression results

Variables	Dependent variable				
	Life expectancy at birth				
	Random effect estimation				
	Model 10	Model 11	Model 12	Model 13	Model 14
Percentage of urbanization	0.0316 (0.0463)		0.0841 (0.0856)	0.0856* (0.0502)	
Total urban population	6.27e - 05 (4.53e - 05)		7.63e - 05** (3.77e - 05)		0.0002*** (6.29e - 05)
Total rural to urban migration	-2.45e - 07** (1.24e - 07)				9.14e - 08 (1.96e - 07)
Literacy rate	0.203*** (0.0362)				
Poverty rate	-0.137*** (0.0399)				
Urban monthly per-capita consumption expenditure	0.00165** (0.000744)				
Urban labour force participation rates	0.00174 (0.00744)	0.0242 (0.0189)			0.0372*** (0.0110)
Urban inequality	-21.82*** (8.012)				
Per capita net state domestic product	-2.63e - 05 (2.48e - 05)	4.18e - 05*** (9.47e - 06)		6.76e - 05*** (1.65e - 05)	
Percentage of urban household having electricity	-0.0320 (0.0503)	0.145*** (0.0478)	0.238*** (0.0521)		
Percentage of urban household having safe drinking water	-0.0220 (0.0209)	0.0417 (0.0660)	0.00284 (0.0820)	0.107 (0.101)	0.179* (0.103)
Constant	63.05*** (4.790)	38.65*** (5.954)	40.52*** (3.780)	51.16*** (8.468)	32.67*** (9.700)
Wald chi ²	965.57***	141.10***	150.59***	60.99***	104.93***
Observations	44	44	45	47	48
R-squared	0.8189	0.4465	0.3583	0.2291	0.0611
Number of groups	16	16	16	17	17
F-test			9.10***		
LM-test			14.68***		
Hausman test			2.64		
Wald test			8.8e + 28***		

Robust standard errors in parentheses
 *** p < 0.01, ** p < 0.05, * p < 0.1

Regression model 1 indicates that both the total urban population and the percentage of the urban population have a negative and statistically significant effect on the total fertility rate. The results support our expected hypothesis. Total rural to urban migration has also a negative effect on the total fertility rate in regression models 3 to 5. These results indicate a higher level of urbanization that occurs through rural to urban migration reduces the fertility rate. A higher level of education which is measured by literacy rate negatively effect on fertility rate. Regression model 5 shows that a higher poverty rate increases the fertility rate. Per capita net state domestic product also has a negative effects on the fertility rate. Urban specific factors such as per capita consumption expenditure, labor force participation rate, and extent of inequality have also negative effects on fertility rate. This indicates that a higher level of development is negatively related to the fertility rate. Urban quality and management variables such as the percentage of urban households having electricity and safe drinking water have a negative and statistically significant effect on the fertility rate.

Regressions 6 to 9 show a negative effect of percentage of urbanization and total urban population on the infant mortality rate. A 10% increase in the percentage of urbanization (or total urban population) reduces mortality rate 2.4% (or 0.004%). A higher rural to urban reduces the mortality rate. On the contrary, a higher poverty rate and urban inequality increase it. Other variables related to a higher level of economic development such as literacy rate, per capita net state domestic product, urban monthly per capita consumption expenditure, and urban labour force participation rate have a negative effect on the mortality rate. The percentage of urban households having electricity is negatively related to the mortality rate. This indicates that a higher level of urbanization, economic development, and better management of urbanization reduces the mortality rate.

Regression models 10 to 14 consider life expectancy at birth as the dependent variable. Regression models 12 and 14 indicate that the total urban population has a positive and statistically significant effect on life expectancy at birth. Regression model 13 shows that a 1 percent increase in the percentage of urbanization positively increases 0.0856 percent of life expectancy at birth. Total rural to urban migration reduces the life expectancy at birth. A higher level of literacy rate also increases it. A higher level of poverty and urban inequality reduces life expectancy at birth. Higher economic development measured by urban monthly per capita consumption expenditure, urban labor force participation rate, and per capita net state domestic product has a positive and statistically significant effect on the life expectancy at birth. A 10% increase in urban monthly per capita expenditure and labour force participation rate increases life expectancy at birth by 0.02% and 0.4%, respectively. Urban quality management variables i.e., the percentage of urban households having electricity and safe drinking water have a positive effect on the life expectancy at birth. This also implies that urbanization, higher economic development, and quality of urban management have a positive effect on the life expectancy at birth.

3.1 Robustness check

A serious concern about the relationship between health outcomes and urbanization is the question of reverse causality. Does urbanization increase health outcomes, or, do higher health outcomes increase urbanization? The reality is possibly a mix of both. On one hand, life expectancy is caused by urbanization, but it is also true that the increase in life duration has a positive effect on increasing the total amount of population and consequently the urbanization level. By considering this phenomenon, we use an Instrumental Variable (IV) the Generalized Method of Moments (GMM), regression model, to check the robustness of our regression results. We use '*ivregress gmm*' STATA command to perform the test.

The suitable instruments are considered in such a way that they have a very strong relationship with urbanization but are exogenous, i.e., not anyway associated with health outcomes. Keeping in mind all these issues we find the following instruments for urbanization; first, the state-wise total rural to urban migration that has a relationship with urbanization; as higher rural to urban migration increases urbanization by increasing urban population. Second, is the percentage of urban households having safe drinking water, as it represents the availability of a higher level of infrastructure and provision of basic services that facilitate urbanization. In the context of exogeneity, we find that all these instruments do not have any strong effect on health outcomes. The simple correlation between state-wise infant mortality rate and rural to urban migration (or the percentage of urban households having safe drinking water) is 0.0895 (or 0.1126). The simple correlation between state-wise life expectancy at birth and rural to urban migration (or the percentage of urban households having safe drinking water) is 0.2685 (or 0.0055). The simple correlation between state-wise total fertility rate and rural to urban migration (or the percentage of urban households having safe drinking

water) is 0.0458 (or 0.0775).

Table 5. Determinants of health outcomes: Instrumental variable regression results

Variables	Dependent variable					
	Total fertility rate		Infant mortality rate		Life expectancy at birth	
	Instrumental variable generalized method of moments estimation					
	Model 15	Model 16	Model 17	Model 18	Model 19	Model 20
Percentage of urbanization	-0.0356 (0.0427)			-0.304 (0.605)	0.337** (0.160)	
Total urban population		5.32e - 06 (4.81e - 06)	0.000164 (0.000138)			6.11e - 05* (3.20e - 05)
Literacy rate	-0.0268 (0.0193)	-0.0444*** (0.00690)	-1.436*** (0.206)	-1.316*** (0.446)		
Poverty rate	-0.00381 (0.0111)	-0.000656 (0.00564)	0.0482 (0.219)	0.0784 (0.346)	-0.226*** (0.0578)	-0.265*** (0.0317)
Urban monthly per-capita consumption expenditure	-0.000733 (0.000704)	-0.000129* (6.66e - 05)	-0.000675 (0.00236)	-0.00724 (0.0121)	0.00912** (0.00394)	
Urban labour force participation rates	-0.00844*** (0.00194)	-0.00693*** (0.00160)	0.0790 (0.0577)	0.0854 (0.0743)		
Urban inequality	4.343 (3.269)	0.988 (1.202)	93.26** (40.78)	145.4** (66.40)	-20.97 (18.01)	
Per capita net state domestic product	1.69e - 05 (1.92e - 05)		-1.29e - 05 (5.56e - 05)	0.000132 (0.000297)	-0.000194* (0.000114)	
Percentage of urban household having electricity	0.00609 (0.0136)		-0.226 (0.323)	-0.0663 (0.356)	-0.236** (0.0963)	
Constant	7.298*** (1.674)	8.030*** (0.655)	106.4*** (33.64)	81.65** (38.58)	80.42*** (6.285)	69.54*** (0.957)
Wald chi ²	201.16***	297.20***	191.66***	148.79***	71.89***	72.45***
Observations	66	78	71	68	44	48
R-squared	0.615	0.773	0.666	0.656	0.614	0.586

Robust standard errors in parentheses
 *** p < 0.01, ** p < 0.05, * p < 0.1

Table 5 presents the estimated regression results obtained from the instrumental variable generalized method of moments' estimation. The results show that urbanization has a statistically significant positive effect on health outcomes measured by life expectancy at birth. Regression model 19 indicates that a 10% increase in the percentage of urbanization increases life expectancy at birth by 3.3%. However, urbanization does not have any statistically significant effect on infant mortality rate and total fertility rate. Among the control variables, the state-level literacy rate reduces the total fertility rate and infant mortality rate. This indicates that the level of education is important for achieving higher health outcomes.

A higher poverty rate is bad for life expectancy at birth as it reduces it. A higher urban monthly per capita consumption expenditure reduces the total fertility rate and increases life expectancy at birth. These results support our expected hypothesis. The urban labor force participation rate also reduces the total fertility rate. Urban inequality is responsible for a higher mortality rate as it has a positive effect on it. Surprisingly, per capita net state domestic product and the percentage of urban households having electricity have a negative effect on the life expectancy at birth.

4. Discussion

The “Theory of Demographic Transition” in the demographic literature (e.g., Notestein, 1945; Davis, 1949; Stolnitz, 1964; Lee, 2003) stated that through the economic development and social changes, fertility and mortality rates decline. Amonker and Brinker (2007) supported this theory for India and suggested that modernization, health, education, and family planning are inversely related to fertility rates (crude birth rate and total fertility rate) among the states of India. There is also evidence that urbanization was responsible for about 22% of the decrease in TFR between 1982 and 2008 (Guo et al., 2012).

This paper suggests that India’s urbanization also has a similar effect on the total fertility rate. Urbanization is associated with higher economic development through higher engagement in education and work. This reduces fertility rates. Higher economic development that is associated with a higher rate of urbanization in India has demanded higher medical facilities. This, in turn, reduces the infant mortality rate. Urban dwellers with higher income secure more medical insurance than rural areas. In 2014, 14.1% of rural people have health insurance whereas 18.1% in urban areas [<https://economictimes.indiatimes.com/news/economy/policy/18-population-of-urban-area-covered-under-health-insurance-government/articleshow/52149871.cms?from=mdr>]. It is important to note that 68% of the people in India live in rural areas in 2011. Finally, life expectancy at birth is higher for urban dwellers than for rural people. The difference in life expectancy between urban and rural India was about 4.7 years in 2013-2017. Urban dwellers benefit from advances in healthcare services. They also become conscious of making themselves healthy. Therefore, we suggest that urbanization is essential for achieving higher overall health outcomes in India.

It is also important to mention that India’s urbanization rate is very slow and low compared to its peers. For instance, while 52% of people lived in urban China and 74% of people lived in Urban Russia, India had only 31% urbanization in 2011. Therefore, it is essential, that Indian policymakers must facilitate and promote a higher rate of urbanization in India.

Along with general urbanization, it is also important to manage the quality of urbanization by providing basic services to urban dwellers. This paper suggests that access to electricity and safe drinking water is very important. The 2011 Census data shows that in Bihar only 67% urban households had accessed to electricity, whereas 97% urban households in Gujarat had access to it. Therefore, it suggested that urban quality and management have to be improved by adequate provisioning of basic urban services.

Along with urbanization, we also require to manage or reduce poverty and inequality. Level of education also has to be improved. Finally, employment also has to improve.

5. Conclusions and policy implications

The relationship between urbanization and health outcome is assessed in this study for Indian states from 1991 to 2011. Urbanization is measured by the total urban population and the percentage of the urban population. On the other hand, health outcome is measured by the total fertility rate, infant mortality rate, and life expectancy at birth. We employ static panel data and a generalized method of moments’ regression models for the analysis.

This paper finds that total urban population and the percentage of urban population have a positive effect on life expectancy at birth, and it has a negative effect on infant mortality rate and total fertility rates. Therefore, we conclude that urbanization has a positive effect on the overall health outcomes of the Indian States. Along with urbanization, migration, literacy rate, monthly per capita consumption expenditure, labor force participation rate, and per capita net state domestic product also have positive effect on the health outcomes in Indian states. It is also important to

reduce poverty and inequality for higher health outcomes. Finally, the management of urbanization by providing basic minimum services such as access to electricity and safe drinking water enhances the urban health outcomes.

Based on these findings we suggest that India must promote and facilitate higher rate of urbanization for achieving higher health outcomes. The higher quality and better management of urbanization through the provision of basic urban services is also required. We also need to reduce poverty rate and inequality for the same. In addition to that, we also need to improve migration, literacy rate, monthly per-capita consumption expenditure, labour force participation rate, and per-capita net state domestic product for better health status.

Finally, by lowering the fertility rate urbanization can control the population in India. Prime Minister Narendra Modi in his Independence speech pointed out that population growth is a major concern in India. Indian delegate Karan Singh in the 1974 Conference on Population and Development declared that 'development is the best contraceptive'. It is proved that in developing countries such as India urbanization and development go hand-in-hand. Therefore, we suggest urbanization may also control population size in India with higher health outcomes.

In the end, we suggest results can be revised using different advanced panel data models once data for more periods are available in the future. The innovation technology also plays a key role in the urbanization, and consequently health outcomes. Due to the paucity of data, we cannot use innovation variables in the study. However, the role of technological innovation on urbanization and health outcome is a topic for future research.

Conflict of interest

The author declares no conflict of interest.

References

- Ali, H. S., Nathaniel, S. P., Uzuner, G., Bekun, F. V., & Sarkodie, S. A. (2020). Trivariate modelling of the nexus between electricity consumption, urbanization and economic growth in Nigeria: fresh insights from Maki Cointegration and causality tests. *Heliyon*, 6(2), e03400.
- Allender, S., Wickramasinghe, K., Goldacre, M., Matthews, D., & Katulanda, P. (2011). Quantifying urbanization as a risk factor for noncommunicable disease. *Journal of Urban Health: Bulletin of the New York Academy of Medicine*, 88(5), 906-918.
- Antai, D., & Moradi, T. (2010). Urban area disadvantage and under-5 mortality in Nigeria: The effect of rapid urbanization. *Environmental Health Perspectives*, 118(6), 877-883.
- Amonker, R. G., & Brinker G. (2007). Reducing fertility in India. *International Journal of Sociology of the Family*, 33(2), 328-348.
- Badhan, G. M., Ali, R., & Kamal, S. (2021). Urban development and water supply system: A case study on comilla city corporation. In *International Conference on Water Energy Food and Sustainability* (pp. 772-784). Springer, Cham.
- Bandyopadhyay, S., & Green, E. (2018). Urbanization and mortality decline. *Journal of Regional Science*, 58(2), 483-503.
- Barik, D., Desai, S., & Vanneman, R. (2018). Economic status and adult mortality in India: Is the relationship sensitive to choice of indicators? *World Development*, 103, 176-187.
- Becker, G. (1960). An economic analysis of fertility. *National Bureau of Economic Research*. Columbia University Press. <https://www.nber.org/chapters/c2387.pdf>
- Bergh, A., & Nilsson, T. (2010). Good for living? On the relationship between globalization and life expectancy. *World Development*, 38(9), 1191-1203.
- Bhagat, R. B. (2011). Emerging pattern of urbanisation in India. *Economic and Political Weekly*, 46(34), 10-12.
- Brueckner, M. (2019). Adult mortality and urbanization: Examination of a weak connection in sub-Saharan Africa. *World Development*, 122, 184-198.
- Butsch, C. P., Sakdapolrak, P., & Saravanan, V. S. (2012). Urban health in India. *Internationales Asienforum*, 43(1-2), 13-32.
- Davis, K. (1949). *Human Society*. Macmillan, New York, NY.
- Eckert, S., & Kohler, S. (2014). Urbanization and health in developing countries: A systematic review. *World Health and Population*, 15(1), 7-21.

- Fink, G., & Hill, K. (2013, June). *Urbanization and Child Mortality - Evidence from Demographic and Health Surveys*. Working Paper Harvard School of Public Health. <http://globalhealth2035.org/sites/default/files/working-papers/urbanization-and-child-mortality.pdf>
- Firestone, R., Punpuing, S., Peterson, K. E., Acevedo-Garcia, D., & Gortmaker, S. L. (2011). Child overweight and undernutrition in Thailand: Is there an urban effect? *Social Science and Medicine*, 72(9), 1420-1428.
- Fobil, J. N., Kraemer, A., Meyer, C. G., & May, J. (2011). Neighborhood urban environmental quality conditions are likely to drive malaria and diarrhea mortality in Accra, Ghana. *Journal of Environmental and Public Health*, 2011(9), 484010.
- Guo, Z., Wu, Z., Schimmele, C. M., & Li, S. (2012). The effect of urbanization on China's fertility. *Population Research and Policy Review*, 31(3), 417-434.
- Jedwab, R., & Vollrath, D. (2017, April 15). *The urban mortality transition and poor country urbanization*. Unpublished manuscript, George Washington University, Washington DC. https://growthecon.com/assets/Jedwab_Vollrath_Web.pdf
- Jaffe, A. J. (1942). Urbanization and Fertility. *The American Journal of Sociology*, 48(1), 48-60.
- Kumar, S., Kumar, S., & Gupta, B. (2018). Urban health: Needs urgent attention. *Indian Journal of Public Health*, 62(3), 214-217.
- Kundu, A. (2006). *Trends and Patterns of Urbanization and their Economic Implications*. India Infrastructure Report 2006, Chapter 2, pp. 27-41. Oxford University Press, New Delhi.
- Lee, R. (2003). Rethinking the evolutionary theory of aging: transfers, not births, shape senescence in social species. *Proceedings of the National Academy of Sciences*, 100(16), 9637-9642.
- Miljkovic, D., & Glazyrina, A. (2015). The impact of socio-economic policy on total fertility rate in Russia. *Journal of Policy Modeling*, 37(6), 961-973.
- Nafi'Shehab, Z., Jamil, N. R., Aris, A. Z., & Shafie, N. S. (2021). Spatial variation impact of landscape patterns and land use on water quality across an urbanized watershed in Bentong, Malaysia. *Ecological Indicators*, 122, 107254.
- Notestein, F. W. (1945). Population - the long view. In T. W. Schultz (Ed.), *Food for the World*. Chicago: University of Chicago Press.
- Saravanan, V. S., Idenal, M. A., Saiyed, S., Saxena, D., & Gerke, G. (2016). Urbanization and human health in urban India: Institutional analysis of water-borne diseases in Ahmedabad. *Health Policy and Planning*, 31(8), 1089-1099.
- Singh, A., Pathak, P. K., Chauhan, R. K., & Pan, W. (2011). Infant and child mortality in India in the last two decades: A geospatial analysis. *PLoS ONE*, 6(11), e26856.
- Stolnitz, G. J. (1964). The demographic transitions, from high to low birth rates. In Freeman, R. (Ed.), *Population, the Vital Revolution*. Doubleday and Co., New York, NY.
- Schultz, T. P. (1972). Long-term changes in personal income distribution: Theoretical approaches, evidence, and explanations. *American Economic Review*, 62(2), 361-362.
- Thompson, W. (1935). *Population Problems*. New York: McGraw-Hill Book Co.
- Torres, C., Canudas-Romo, V., & Oeppen, J. (2019). The contribution of urbanization to changes in life expectancy in Scotland, 1861-1910. *Population Studies*, 73(3), 387-404.
- Tripathi, S. (2013). Do large agglomerations lead to economic growth? Evidence from urban India. *Review of Urban and Regional Development Studies*, 25(3), 176-200.
- World Bank (2010). *Perspectives on Poverty in India: Stylized Facts from Survey Data*, India Poverty Assessment, Poverty Reduction and Economic Management Network, The World Bank, Washington DC.
- Van de Poel, E., O'Donnell, O., & Van Doorslaer, E. (2007). Are urban children really healthier? Evidence from 47 developing countries. *Social Science and Medicine*, 65(10), 1986-2003.
- Van de Poel, E., O'Donnell, O., & Van Doorslaer, E. (2009). Urbanization and the spread of diseases of affluence in China. *Economics and Human Biology*, 7(2), 200-216.
- Yu, B. (2021). Ecological effects of new-type urbanization in China. *Renewable and Sustainable Energy Reviews*, 135, 110239.