

Urbanization's Impact on Child Health Outcomes in Bangladesh

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Abstract

The rapid expansion of Bangladeshi urban centers has fundamentally altered environmental living conditions, creating complex correlations between densely populated infrastructure and pediatric health outcomes. This study examines the impact of urbanization on child health outcomes in Bangladesh, focusing on trends in respiratory diseases and population density over recent decades and measuring their association. The study has two purposes: one, to examine trends in urbanization and respiratory diseases over time; the other, to explore the effect of urbanization on health, such as under-5 children's respiratory health. The source of data is the Bangladesh Demographic and Health Survey (BDHS) for 2011, 2014, and 2022, in addition to census figures from the Bangladesh Bureau of Statistics (BBS) for the years 2011 and 2022. The analysis is built on panel data at the district level. To analyze the trend of respiratory diseases in urban areas over the years, we employed logistic regression, which shows a slight fall in the prevalence of respiratory disease among under-5 children of 2011, from 37% in 2014 to 26% in 2022. Urbanization trends were analyzed through exponential regression models, primarily in terms of urban population density, in which it's reported a continued rise of 22% to 30% over the decade in urban areas. A fixed-effects panel model was used to investigate the effect of urbanization on respiratory findings of under-five children. Overall, the findings indicate a significant causal association between urbanization and overall respiratory infections of children under 5 at $\alpha = .051$ in urban settings. Improved water sources, clean fuel, improved sanitation, and other facilities sometimes influence the reduction of health outcomes. Strengthened healthcare infrastructure has successfully matched the pace of urbanization, contributing to better health outcomes among children.

1.Introduction

1.1 Background

Urbanization, the movement of people from rural to urban areas, has increased dramatically in recent decades, particularly in low- and middle-income countries. For the first time in human history, over 50% of the world's population lived in cities in 2008, marking an inconspicuous but significant turning point. The population of the developing world will account for almost 80% of the global urban population in the next 20 years (UN-Habitat, 2008). It is anticipated that 68% of people on Earth will dwell in cities by 2050, primarily due to growth in low- and middle-income nations (Cai et al., 2021). To identify urban settlements and measure urbanization based on the city's population and the percentage of people living there, organizations employ national data, censuses, and administrative criteria when compiling the World Urbanization Prospects.

Bangladesh is experiencing rapid urbanization, which is fundamentally transforming its society and economy. This process, while contributing to economic growth, also poses significant challenges to public health, particularly for the urban poor and children. According to new UN estimates, over 35 million people, or 25% of Bangladesh's total population, now reside in urban areas, up from just 8% when the country gained its freedom. As a result, unplanned urbanization is making people more

vulnerable, which is demonstrated by the various calamities that have recently struck urban regions (New York Academy of Medicine, 1957). Urbanization's impact on health has generated debate. Urban people lead more sedentary lives and consume unhealthy foods, which raises the incidence of obesity and associated diseases (Liang et al., 2019). Some studies contend that urbanization produces a variety of environmental issues (Han et al., 2023) such as water and air pollution (Xian et al., 2023; Patil, 2014), alters human behavior (Lambert et al., 2015), and results in mood disorders (Ezeh et al., 2017), all of which can weaken human health. A study emphasized how informal urban settlements contribute to the spread of disease because of the environmental risks and restricted access to healthcare. Among the most alarming consequences of this concentration in cities is the increase in respiratory diseases, aggravated by issues like air pollution, overcrowding, and poor sanitation conditions, often higher in areas of urban density (Puzzolo & Pope, 2017). Respiratory diseases, comprising chronic obstructive pulmonary disease (COPD), asthma, and acute respiratory infections (ARI), have become some of the main health-related problems in urban Bangladesh. The trend is more marked among growing cities like Dhaka as well as Chittagong (Howlader et al., 2023). Acute Respiratory Infections (ARI) affect almost 18% of children in Bangladesh every year, and children under 5 years of age are still most vulnerable to this condition (Rahamn et al., 2021). Also, over half of those with ARI symptoms did not seek care from qualified providers; combined with the increased mortality risk associated with prolonged symptoms, this reveals a significant gap in access to healthcare (Tune et al., 2025). Acute respiratory infections (ARIs) are a persistent child health concern because children in metropolitan settings are disproportionately exposed to environmental risk factors, such as air pollution, congestion, and other unsanitary facilities (Tune et al., 2025).

Additionally, A study conducted a meta-analysis that showed urban residents have a higher prevalence of psychiatric disorders compared to their rural counterparts (Alirol et al., 2011). Poor sanitation, overcrowding, and inadequate water supply in urban slums contribute to the spread of communicable diseases such as cholera, dengue, and tuberculosis (Kondo et al., 2018). Globally, urbanization without adequate planning is a serious problem, particularly in developing countries' rapidly expanding megalopolises. People's health is directly threatened by a number of issues stemming from Dhaka City's unrestrained and fast growth (Lai et al., 2019).

On the contrary, in some situations, urbanization has been demonstrated to improve health (Hou et al., 2019), one of the positive benefits of urbanization is improved access to healthcare facilities. Cities generally host a denser network of hospitals, clinics, pharmacies, and specialists. Urban areas typically offer better maternal and child health services than rural regions, contributing to reduced mortality rates (Xie et al., 2025). Urbanization also facilitates economic growth, which can lead to improved living standards. With better opportunities for employment, higher incomes, and greater social mobility, urban areas may be less economically deprived, a condition that is strongly associated with good mental and physical health (Burkart et al., 2011). Cities typically have more educational institutions and higher literacy rates, which sometimes correlate strongly with improved health behaviors.

The link between urbanization and health outcomes in Bangladesh is thus extremely essential. Although there are still few studies examining the causal relationship between comprehensive urbanization and health outcomes, they are primarily limited to cross-sectional studies on self-rated health. The goal of our study is to thoroughly determine the trajectory of respiratory ailments over the previous few decades, as well as the degree of urbanization and its effects on health outcomes among children.

1.2 Conceptual Framework

A conceptual framework proposed by Freudenberg, Galea, and Vlahov (2002) for urban health that highlights the complex interplay between the physical and social environment, socioeconomic factors, public policies, and individual behaviours in determining health outcomes in urban settings. This conceptual framework therefore follows the assumptions of the Urban Health Model (Vlahov & Galea, 2002), complemented by principles from the Social Determinants of Health Framework, which emphasizes how environmental and infrastructural influence health inequalities. When taken as a whole, these models support the inclusion of both environmental exposures (such as pollution and population density) and infrastructure determinants (such as electricity and sanitation) as interacting factors that affect respiratory health in rapidly urbanizing settings.

2. Methods and Materials

2.1 Study Population and Data

The study uses a quantitative secondary research design to investigate how urbanization affects health outcomes, with a particular focus on respiratory illnesses among Bangladeshi children. This is a longitudinal study design that combines both cross-sectional and time series data. The research first conducts a trend analysis to explore changes in the level of urbanization and the prevalence of respiratory diseases over the past decade. Subsequently, panel data techniques are employed to investigate the relationship and causal impact of urbanization on respiratory health outcomes across districts and over time. Children under five in all Bangladeshi cities were the demographic of attention. Children under the age of five are particularly vulnerable to the health implications of rapid urbanization, such as increased exposure to pollutants, poor housing, restricted access to clean water and sanitation, and overcrowded health systems. Focusing on this age group allows for a clearer understanding of how urban living conditions affect the most sensitive segment of the population.

This study utilized three waves of the Bangladesh Demographic and Health Survey (BDHS) conducted in 2011, 2014, and 2022 that provide crucial, current data on demographic trends and health indicators across the country. The Population and Housing Census reports released by the Bangladesh Bureau of Statistics (BBS) included population data and urbanization indicators. Afterward, the panel data were created by district and year. Here, each observation represented a single district within a single survey year, and datasets were harmonized using a common district identity and survey year. The final panel dataset comprised 64 districts observed over three intervals of time (2011, 2014, and 2022), generating a total of 191 district-year observations suitable for longitudinal analysis.

2.2 Variables

The key independent variables represent the level and intensity of urbanization at the district level, derived from the BBS and BDHS surveys. These include indicators such as the percentage of urban population, population density of 64 districts, and availability of urban infrastructure such as electricity, piped water, and sanitation. The dependent variables capture the health outcomes related to respiratory diseases such as cough, shortness of breath, and fever among children under 5 in Bangladesh. Here, the respiratory disease indicators such as cough, shortness of breath, and fever were combined to create one respiratory indicator to easily measure the impact. A respiratory variable was generated in STATA, which contains the average percentage of the three variables. As the categories of the variables are Yes = 1 and No = 0, another variable was generated named respiratory disease before creating the panel, which indicates occurrence of respiratory disease (Yes = 1) if it is > 0.5 and indicates respiratory disease has not occurred if it is < 0.5 , and is considered it as No = 0.

Drinking water Source, type of toilet facility, household electricity access, and cooking fuel type are the major covariates associated with the indicator of urbanization in our study. Here the source of drinking water was categorized as 'improved' (piped into dwelling, piped to yard/plot, public tap/standpipe, piped to neighbor, tube well or bore hole, protected well, protected spring, rainwater, tanker truck, cart with small tank, bottled water) and 'unimproved' (unprotected well, unprotected spring, surface water (river/dam/lake/pond/stream/canal/irrigation channel and other) for the current study. Type of toilet facilities was recategorized into 'improved' (flush to piped sewer system, flush to septic tank, flush to pit latrine, flush don't know where, pit latrine ventilated improved pit, pit latrine with slab, composting toilet) and 'unimproved' (flush to somewhere else, pit latrine without slab/open pit, bucket toilet, hanging toilet/latrine, others) and Electricity access (yes/no) (Apanga & Kumbeni, 2021). Cooking fuel type was reclassified into 'clean fuel' (electricity, liquefied petroleum gas, natural gas and biogas) and 'polluted fuel' (coal/ lignite, charcoal, wood, straw/shrub/grass, crops and animal dung).

2.3 Statistical Analysis

To determine the progress of urbanization (population density), the study uses an exponential growth model to account for the likelihood that urbanization may change over time at a constant proportional (%) rate rather than a constant absolute rate. In this study, Logistic regression model and Poisson model is employed to analyze trends of respiratory disease prevalence throughout 2011–2014 and 2022. The purpose of using logistic regression was to examine how the probability of a respiratory disease varies with time, while controlling potential covariates and other socioeconomic factors. Furthermore, The Poisson regression model allows us to estimate the speed of change in the number of respiratory disease cases with time, particularly for count data. In the context of this paper, it supports to quantify how respiratory disease prevalence has changed in several years (2011, 2014, and 2022) controlling for the following urbanization and other district-level features.

The fixed effect panel regression model is applied to examine the effect of urbanization on health outcomes, such as respiratory disease prevalence of children across districts of Bangladesh over time in this study. The direct and indirect effects of urbanization on health outcomes are estimated using a fixed-effect panel regression model. The fixed-effects model is best for this panel data as it controls for time-invariant individual heterogeneities that might affect both urbanization and health outcomes, thus providing more accurate estimates of the association between these variables of interest. Consequently, it is a highly useful way to look at the asymmetric features of the variables of interest (Borozan, 2018).

All statistical computations were carried out using STATA and Microsoft Excel, following a structured workflow to ensure accuracy and comparability across data sources.

3. Results and Discussions

3.1 Progress of Urbanization and Trend of Respiratory Disease over the Decade

Urbanization has been accelerating over the past decade because of population growth and economic expansion.

Table 1
Population Density and Percentage of Urban Population over the Years

Year	Population Density per square	Urban Percentage (%)
2011	1056	22.5207
2014	1116	24.6942
2022	1297	30.7001

Table 1 shows that Population density increased from 1056 persons per square km in 2011 to 1116 in 2014, and further to 1297 in 2022, indicating a consistent intensification of land use and an increasing concentration of people within the available geographic space. Similarly, the mean urban population percentage increased from 22.52% in 2011 to 24.69% in 2014, reaching 30.70% by 2022, reflecting a persistent shift toward urban living. According to Worldometer, the urbanization percentage in Bangladesh is 41.6% in 2025. This increasing tendency demonstrates that ongoing urbanization is driven by migration, population growth, and the expansion of urban centers. Overall, the findings show that Bangladesh has become more urbanized and densely populated over time, which could have a big impact on infrastructure, housing, health care, and environmental sustainability.

Overall, there is an increased tendency in every division, suggesting a national trend over the past ten years toward urban living (Fig. 3). In the end, this shows how migration, economic expansion, and

infrastructural development are driving Bangladesh's continuous transition into a more urbanized country.

Table 2
Trend of Respiratory Disease Over the Timeframe.

Year	Respiratory disease% (Urban)	Respiratory disease% (Rural)
2011	40.89	56.26
2014	37.64	44.09
2022	26.29	32.14

The above Table 2 and Fig. 5 both show the trend in the prevalence of respiratory diseases from 2011 to 2022. Rural areas continuously had higher percentages of respiratory illness than urban ones throughout the period that might be because of lower awareness of preventive practices, inadequate sanitation, and limited access to healthcare centers in rural areas compared to urban areas. However, the data reveal a positive trend in the reduction of respiratory diseases in both urban and rural areas over the timeframe. This could be attributed to improvements in healthcare, environmental factors, or public health initiatives aimed at reducing respiratory illnesses.

The diagram in Fig. 6 depicts the variation of Acute Respiratory Infection (ARI) prevalence in children under 5 according to divisions in 2011, 2014 and 2022. The overall prevalence of ARI, which combines both the variable cough and breathing problems, was higher in 2011 and 2014, with several divisions including Dhaka, Chattogram, Rajshahi and Rangpur having significantly higher rates in those years. In 2022, the prevalence of ARI has dropped significantly in all divisions, revealing remarkable progress in child respiratory health. Values in the early years also differ significantly between regions, but all 2022 estimates are lower, indicating increased access to medical care, increased health awareness, and better protection against major diseases across almost the entire country.

Table 3
Urbanization Trends Using Exponential Model

In Population density	Model (Exponential)	
	Coefficient	P value
Year (base:2011)		
2014	0.0127123	0.025
2022	0.1176477	0.005
Observation	191	
Constant	-1.53564	0.034

Table 3 shows the output of an exponential model that was applied to extract the trend for urbanization as per population density from 2011 onwards. The rate of change in population density for 2014 and 2022 is depicted in the model, which visibly indicates an exponential urbanization effect. With a complete panel dataset, the modeling indicates that urbanization (as measured by population density) can be described as exponential growth over the past decade with explicit impulses during the years 2014 and 2022.

Table 4
The Respiratory Disease Trend Using the Following Model in Panel Data

Variable	Poisson (Model 1)		Logistic (Model 2)	
Y (Respiratory disease)	Coefficient	p-value	coefficient	p-value
2014	-0.022	0.49	-0.012	0.106
2022 (ref 2011)	-0.141	0.04	-0.292	0.000
Observation	191		191	
Constant	-0.274	0.05	-0.226	0.000

In the Poisson regression model, the dependent variable (Y) represents the prevalence of respiratory diseases and for the logistic regression model, the dependent variable (Y) represents the occurrence of respiratory disease among children. Table 4 shows the results of two regression models, Poisson and logistic regressions, used to estimate the trend of respiratory diseases over time. These models aim to inform the change in prevalence of respiratory disease between (i) 2014 and (ii) 2022, relative to 2011.

For model 1, the Poisson regression model is used to predict the number of respiratory events based on the year variable, specifically comparing the years 2014 and 2022 to the base year 2011. In this model, the outcome variable Y is the number of respiratory events, and year is the key explanatory variable representing different years (2011,2014,2022) with 2011 as the reference group. The coefficient for 2022 is – .140832, with a p-value of 0.042. This outcome is statistically significant, indicating that the rate of respiratory events in 2022 is significantly lower than in 2011. This significant reduction could reflect improvements in health outcomes such as sanitation, healthcare, or urban infrastructure, which may be linked to urbanization efforts during this period.

The logistic regression model, however, is suitable when the response (yes or no) needs to be modeled, which is the case with respiratory diseases here. The coefficient for 2022 is -0.2924751 with a p-value of 0.000, indicating a statistically significant decrease in the likelihood of respiratory disease occurrence, suggesting that disease rates may have decreased in 2022 compared to 2011. The coefficient is -0.29247 with a p-value of 0.000, indicating that by 2022, the respiratory prevalence of under-5 children is 29% lower, which is highly significant, indicating that the baseline level of respiratory disease occurrence is also significantly lower. The model highlights that the trend over time has resulted in a decline in respiratory disease rates among children, especially in 2022.

The findings provide consistent results, confirming the downward trend in respiratory diseases over time. Overall, we can say that urbanization has increased over the past decade, and the respiratory disease trend is declining over the past decade in urban areas of Bangladesh due to some urban-related improvements.

3.2 Evaluating the Impact of Urbanization on Respiratory Health Outcomes of Children under five

Urbanization-related factors are causally related to the rising or decreasing incidence of respiratory infections, such as fever, cough, and short and rapid breaths among children under five, by analyzing data from various urban regions to understand the patterns and trends of this disease. It also explores the socio-economic determinants, including access to improved drinking water, access to electricity, type of cooking fuel, and sanitation facilities in urban areas, which influence the health outcomes of urban children sometimes positively, sometimes negatively. By tracking the challenges of urbanization, the goal of this study is to give a comprehensive understanding of how these changes influence child health in cityscapes.

Table 5
Fixed-effect Panel Regression Model for Measuring the Impact of Population Density on
Fever Prevalence Associated with Other Covariates

Variables	Coefficient	Robust Standard Error
Fever (Y)		
Population Density	0.0001***	0.0005
Type of cooking fuel: clean	-0.112	0.2034
Source of drinking Water: Improved	-0.154***	0.1892
Toilet facilities: Improved	-0.002	0.0636
Electricity facility: Yes	-0.085	0.0622
Year (base:2011)		
2014	-0.0087	0.0221
2022	-0.4603***	0.0336
Constant	0.58598***	0.2076
Rho = 0.707	Sigma_u = 0.1749	F-Statistic = 121.57
	Sigma_e = 0.1135	
Note: **p < 0.05, ***p < 0.01		

The sigma and rho values in the model provide insights into the variance and correlation structure of the panel data, which is crucial for understanding the underlying data distribution and model performance. In this instance, a rho of 0.7037 denotes a moderate to strong relationship, indicating that the observed variation in the fever incidence of children is considerably influenced by the unique features of each district, such as the degree of urbanization. And the F test is significant at the 10% level of significance; that's why the fixed-effects model is appropriate rather than the random-effects model.

The model shows us that population density has a significant and positive effect on the fever of children, with a coefficient value of 0.0001 and a p-value equaling 0.008. This indicates that with a higher population density, the probability of fever rises slightly but significantly. That can happen because the urban heat island effect can lead to dehydration and heat stress, with fever being a common symptom of heat-related illness and, of course, associated with other causes. The prevalence of such types of disease may also be high due to poor health penalties, less healthcare awareness (Allender et al., 2011).

The findings suggest that using clean cooking fuel may have a modest positive effect on reducing fever, but this impact does not appear to be meaningful. The coefficient indicates that improved drinking water sources appear to be associated with a lower prevalence of fever, underscoring the importance of clean water to health. The results indicate that urbanization has significant impacts on health, but the implementation of basic services can be more effective in reducing fever prevalence among children.

Table 6
Fixed Effect Panel Regression Model for Cough Prevalence

Variables	Coefficient	Robust Std. Error
Cough (Y)		
Population Density	-0.00011**	0.00031
Type of cooking fuel: clean fuel	0.0293	0.02656
Source of drinking Water: Improved	-0.0047	0.06586
Toilet facilities: Improved	-0.0450**	0.02125
Electricity facility: Yes	-0.0696**	0.02611
Year (base:2011)		
2014	-0.000	0.0035
2022	-0.655***	0.0180
Constant	1.1454***	0.0740
Note: **p < 0.05, ***p < 0.01		

According to the fixed-effects model fitted to panel data in the following table, the probability of coughing decreases with increasing population density. It implies that an average child in a denser environment may be less likely to experience cough symptoms, possibly as a result of improved access to healthcare, greater treatment compliance, or better urban air quality. Availability of improved sanitation facilities is positively associated with a lower likelihood of coughing, implying that better sanitation may contribute to better urban respiratory health. The coefficient implies that having electricity in a house is related to a reduced probability of cough. That may be because places with electricity have better health infrastructure, or they're able to access cleaner sources of energy, and thus experience better overall living conditions (Hossain et al., 2022).

Table 7
Fixed Effect Panel Regression Model for Breathing Prevalence:

Variables	Coefficient	Robust Std. Error
Breath (Y)		
Population Density	0.00044**	0.0004
Type of cooking fuel: clean fuel	0.20369	0.1280
Source of drinking Water: Improved	-0.8679**	0.3252
Toilet facilities: Improved	-0.0659	0.1197
Electricity facility: Yes	-0.0759	0.1088
Year (base:2011)		
2014	-0.0644	0.0370
2022	-0.3676***	0.0533
Constant	1.31811***	0.3508
Note: **p < 0.05, ***p < 0.01		

The coefficient for population density is barely significant, which implies that higher population density can affect the probability of having short and rapid breathing problems among children under 5. This is due to the fact that poor air quality, which can cause respiratory issues, particularly for vulnerable populations like children and the elderly, is a result of high population density and heavy traffic. Improved access to drinking water can reduce the likelihood of having breathing problems, as the role of clean water in lowering respiratory problems is an essential factor. The coefficient for the year 2022 is -0.3676 with a p-value of 0.000, which suggests that breathing problems have significantly decreased compared to the reference year (2011). This also indicates that health or environmental enhancements benefited this low breathing issue prevalence rate.

Table 8: Fixed-Effect Panel Regression Model for Overall Respiratory Health

Here we have fitted a fixed-effect regression model for panel data to see whether there is any impact of urbanization on respiratory diseases (fever, cough, and breath) associated with other covariates (Fig. 7).

The coefficient of population density indicates that population density has an effect on respiratory infections, but the effect is marginally significant at the 10% significance level. Though this effect is quite small, this indicates that increasing population density in urban areas has an impact on respiratory infections because of many causes such as higher regional levels of pollution, reduced areas for effective ventilation, enhanced exposure to traffic-related pollutants, overpopulated shelters, and a higher spread of airborne disease in cramped quarters (Rahaman et al., 2023). As improved drinking water increases, there is a measurable improvement in the studied health outcomes and a reduction in risk factors, which highlights the importance of access to safe and clean drinking water in public health and child health. Access to electricity is linked to a reduction in the prevalence of respiratory infections. Perhaps that is because of better living conditions and cleaner forms of energy, which improve indoor air quality and cut the risks to health. The model's overall statistical significance is confirmed by the F-statistic with a p-value of 0.000, indicating that the independent factors collectively significantly affect respiratory infections.

To evaluate the robustness of the findings, a fixed-effect panel regression model with robust standard errors was used to take potential heteroskedasticity and unobserved district-level variability into consideration. The fixed-effects specification controls for time-invariant characteristics of each district, thereby reducing omitted variable bias arising from unobserved confounders.

3.3 Discussion

The analysis we carried out shows that the urbanization process under way is an important determinant of respiratory health problems in childhood. The respiratory health outcomes improved over time despite increased urbanization. Thus, the association between urbanization and child health is not always negative and may be very dependent on the availability and quality of urban services. The occurrence of respiratory diseases among children under five years of age was consistently greater in rural areas than in urban areas for all the years of the study. The higher prevalence in rural areas can be a pointer to inequalities in health care, health knowledge, sanitation and basic household amenities. Rural populations may have more difficulty accessing healthcare facilities and preventive treatment due to their geographical location and socio-economic status.

The fixed effects results indicate the potential to further investigate the relationship between urbanization and respiratory health problems of children in urban areas. Fever and breathing difficulties were positively associated with the population density and in general respiratory infections were marginally positively associated with population density. Cough was negatively correlated with population density. The findings indicate that urbanization has both benefits and drawbacks for child health. Densely populated urban areas are often better off in terms of access to healthcare, vaccination,

better sanitation, improved availability of safe drinking water, and improved housing conditions. All of these contribute toward better child health outcomes and a general decline in respiratory illnesses (Hossain et al., 2022). “Between 2011 and 2022, Bangladesh has experienced a 4.7% increase in the percentage of the population using safe drinking water, a 5% increase in the percentage of the population with access to sanitation services and an almost 40% increase in access to electricity,” the World Bank states. Conversely, fast, unplanned, and unregulated urban development can increase children’s exposure to traffic emissions, household crowding, pollution, and waterborne pathogens, which can increase the risk of specific respiratory symptoms (Rahaman et al., 2023). Also, in some rapidly urbanizing areas, unequal distribution of essential services has resulted in limited access to healthcare, poor sanitation, insufficient access to clean water, and other basic amenities, which increase health risks.

Importantly, the results underscore the protective role of basic domestic services. The results of our model indicate that better drinking water and improved sanitation were significantly associated with less fever, breathing problems and overall respiratory infection. That is because lowering exposure to contaminated water reduces the chance of spreading an infection. Children living in households with access to improved water sources are more likely to have better opportunities for handwashing, food preparation, and general hygiene, which can reduce exposure to infectious agents. Based on the findings of this study, it can be inferred that better urban services play an important role in improving child health. Thus, urban planning should be prioritized toward planned urbanization rather than population growth, and interventions for children’s health should be spatially targeted. Inadequate housing, ventilation, sanitation, waste disposal, transportation, and health care infrastructure can make increasing population density a health hazard, especially for young children.

To summarize, our findings suggest that at the district level, population density, along with a few other covariates, availability of clean drinking water, and electricity access seem to have significant effects on childhood respiratory health outcomes among children under 5. While urbanization is mostly discussed in terms of its adverse effects on health, a few studies have also examined its positive effects. The adverse health effects of urbanization highlight the need to enhance urban public health by increasing access to key services and infrastructure (Allender et al., 2011).

4. Conclusion

This study on how urbanization affects health outcomes in Bangladesh, with a focus on respiratory illnesses in children under five, offers insightful information on the patterns and connections between urbanization and health during the previous few decades. The fixed-effect model found a significant association between population density and the prevalence of child fever and short, rapid breaths. This suggests that urbanization and proximity to healthcare facilities may increase children's risk for these diseases due to overcrowding, pollution, and the burden on public services. According to this study, Bangladesh's urbanization, as evidenced by population density, appears to have an impact on respiratory health. Although the effect is not great, the study underscores the importance of good infrastructure in

urban settings, like the supply of pure water and electricity. These findings highlight how crucial basic services and high-quality infrastructure are to lowering respiratory illnesses, particularly in metropolitan areas. To make urbanization healthier and more sustainable for all segments of the population, it will be crucial to develop urban planning, environmental regulations, and healthcare access in the future.

Declarations

Author Contribution

Conceptualization: Shanzida Shahrin, Md. Fuad Hassan
Methodology: Md. Fuad Hassan
Formal analysis: Md. Fuad Hassan
Visualization: Md. Fuad Hassan, Khandakar Md. Mostafizur Rahman, Farid Ullah Bhuyian
Writing – original draft: Shanzida Shahrin
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Data Availability

Publicly available in a repository: The following link for
BDHS: https://dhsprogram.com/data/dataset/Bangladesh_Standard-DHS_2022.cfm
Population and Housing Census link: <https://bbs.gov.bd/pages/static-pages/6922e0ff933eb65569e297dc>

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Tables

Table 8 is available in the Supplementary Files section.

Figures

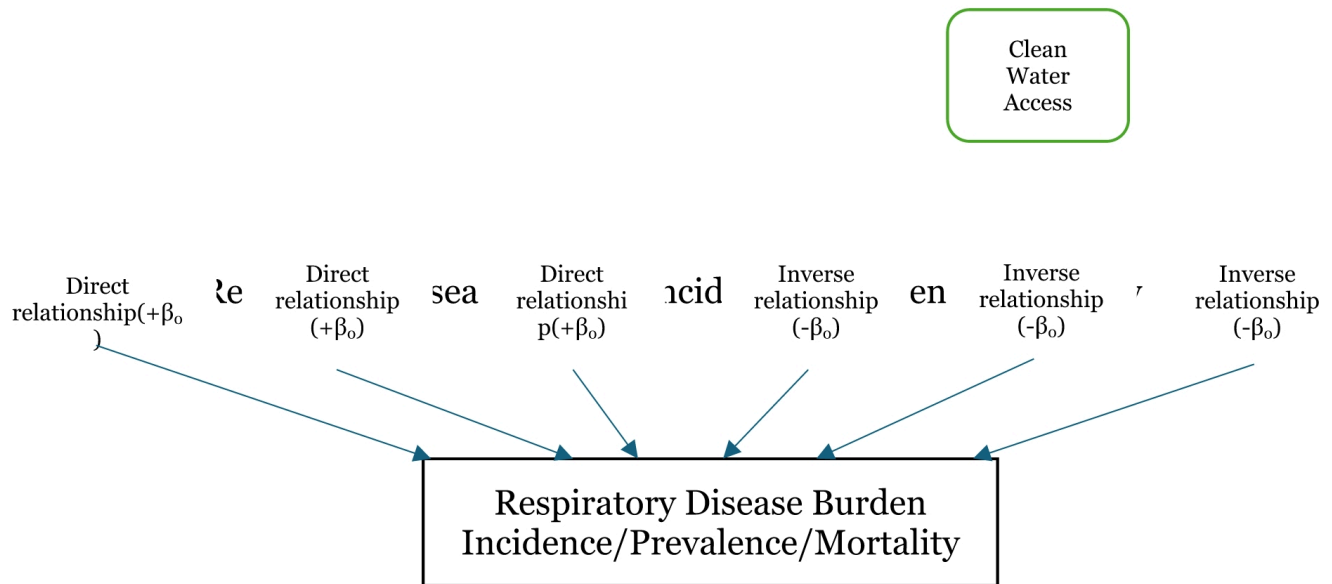


Figure 1

Conceptual Framework for Determinants of Respiratory Disease Burden

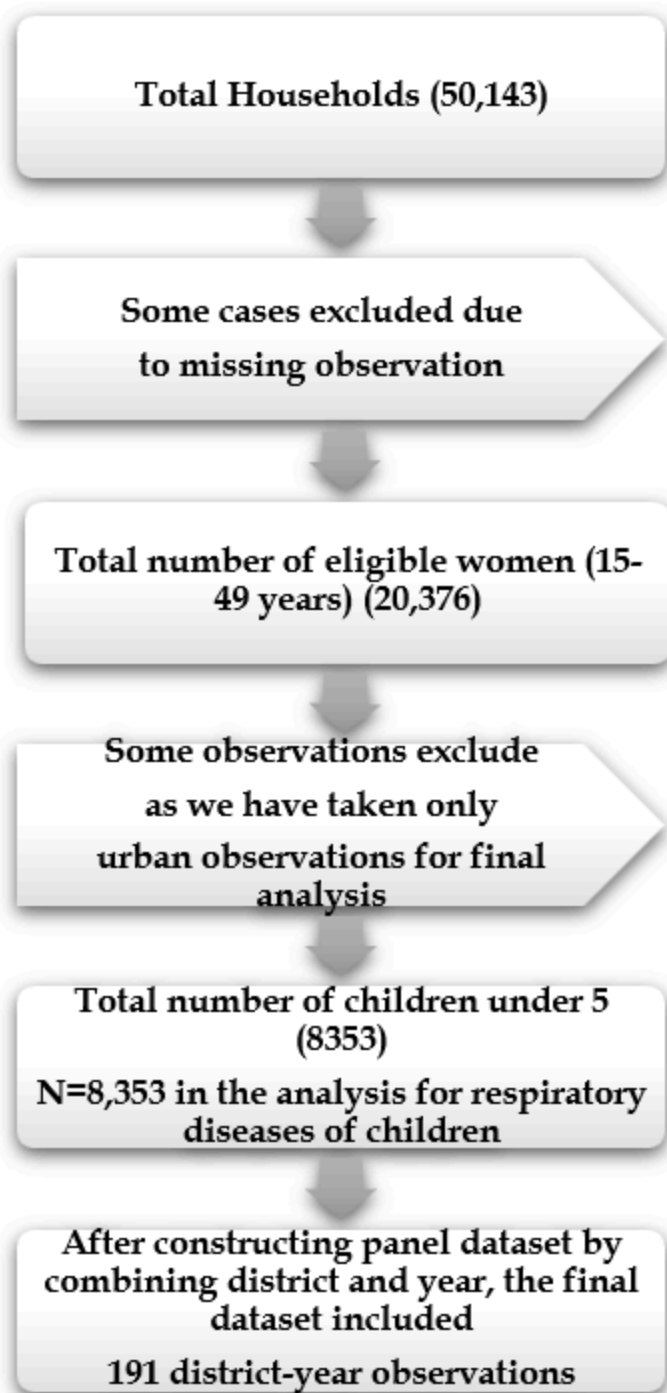


Figure 2

Flowchart for the Participants of the Data

Urban (%)

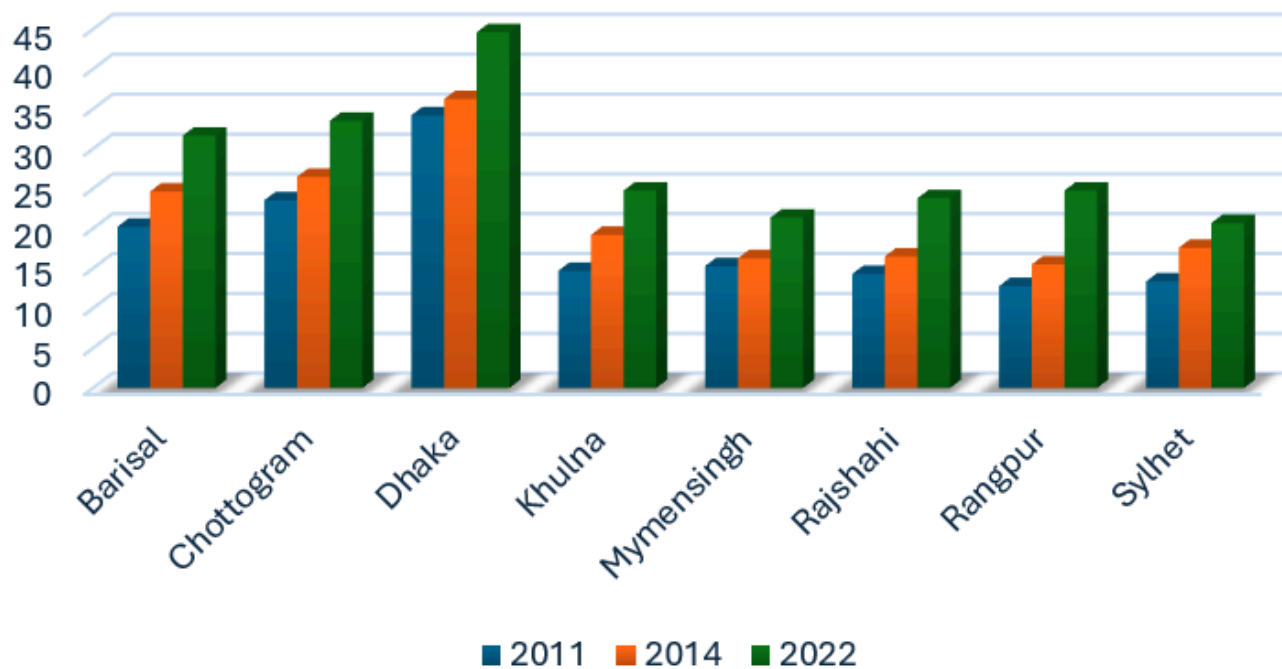
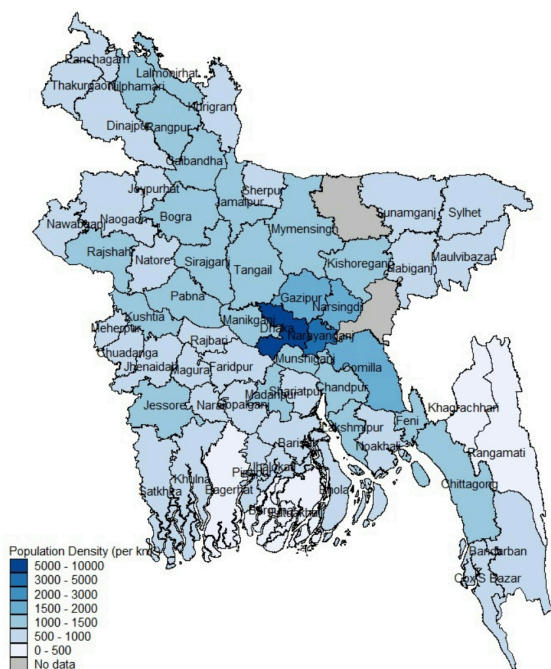


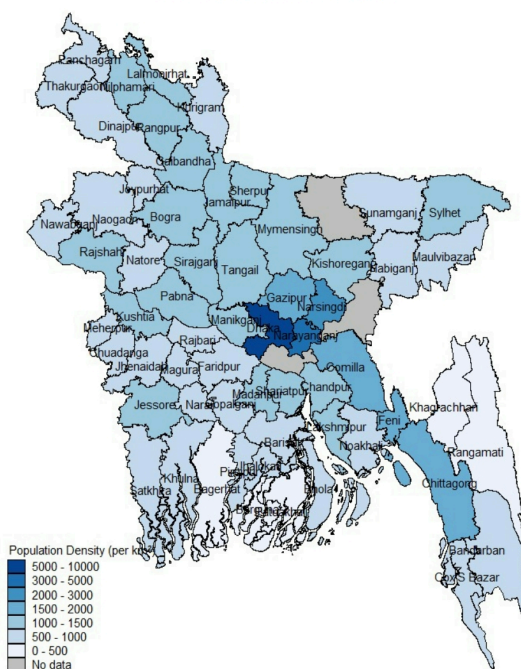
Figure 3

Histogram of Urban Growth at Division Level

Population Density in Bangladesh by District, 2011
Indicator of Urbanization



Population Density in Bangladesh by District, 2014
Indicator of Urbanization



Population Density in Bangladesh by District, 2022
Indicator of Urbanization

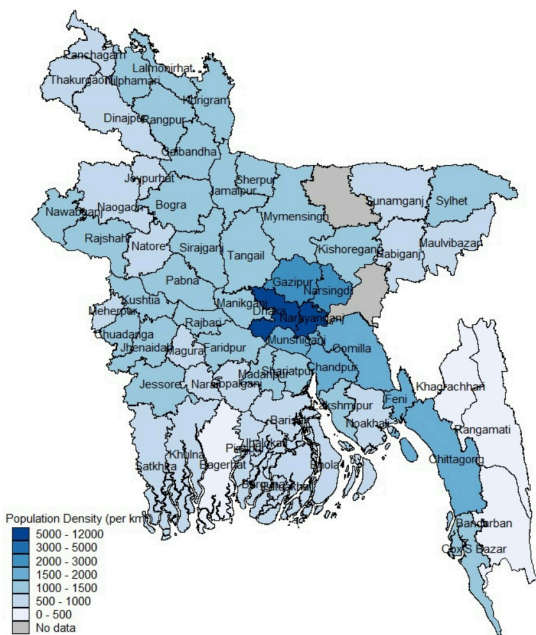


Figure 4

District-wise urbanization heatmap over time

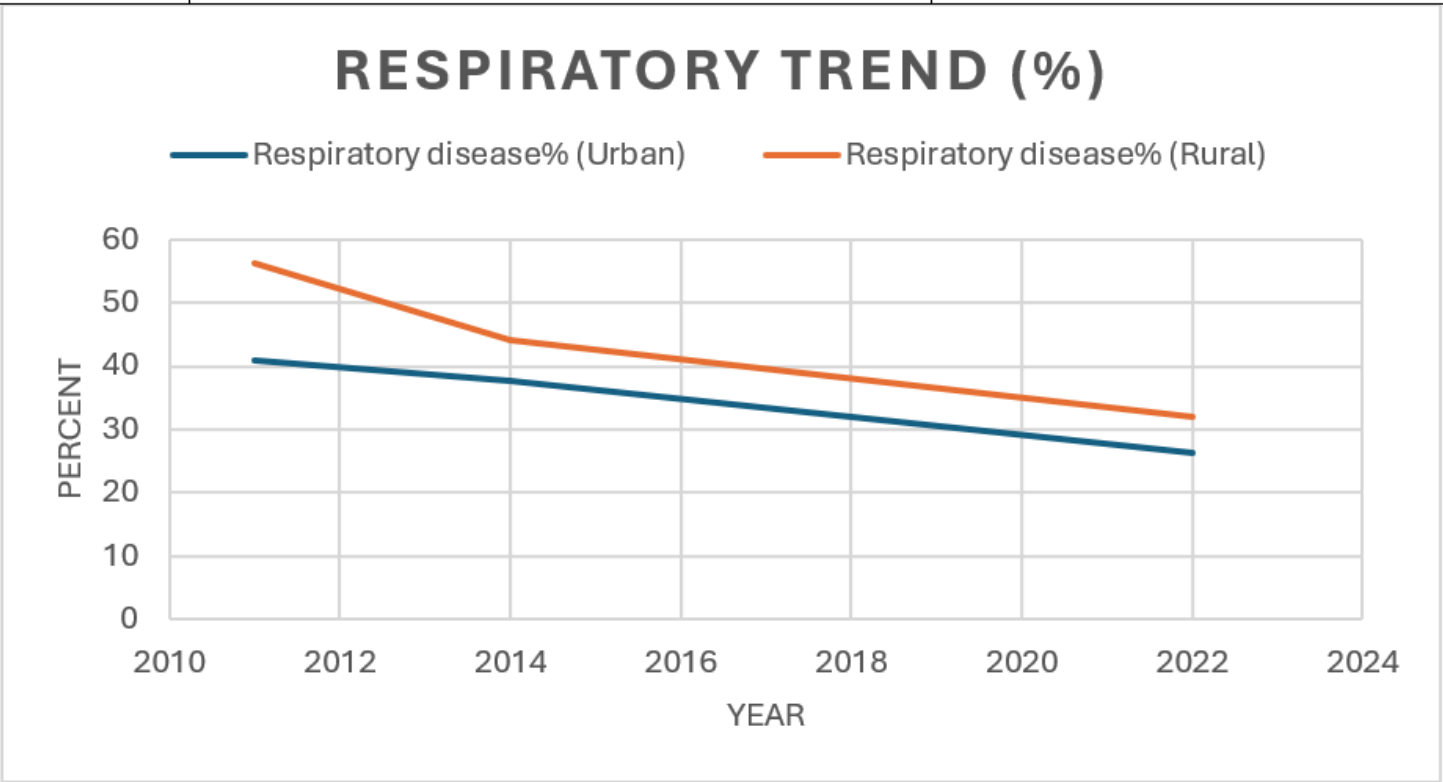


Figure 5

Respiratory Disease Prevalence Trends by Residence (urban vs rural)

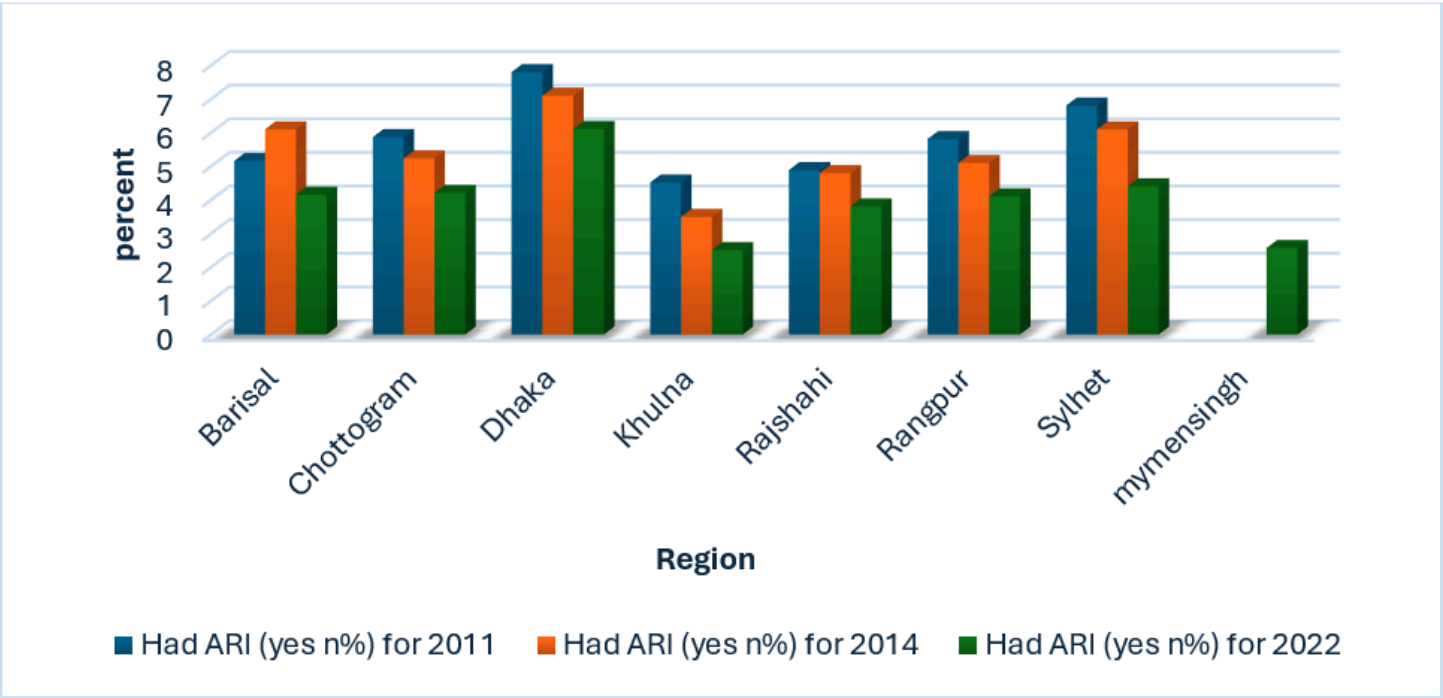


Figure 6

Regional Trends of Respiratory Infections of Children Under 5 over the Time Period.

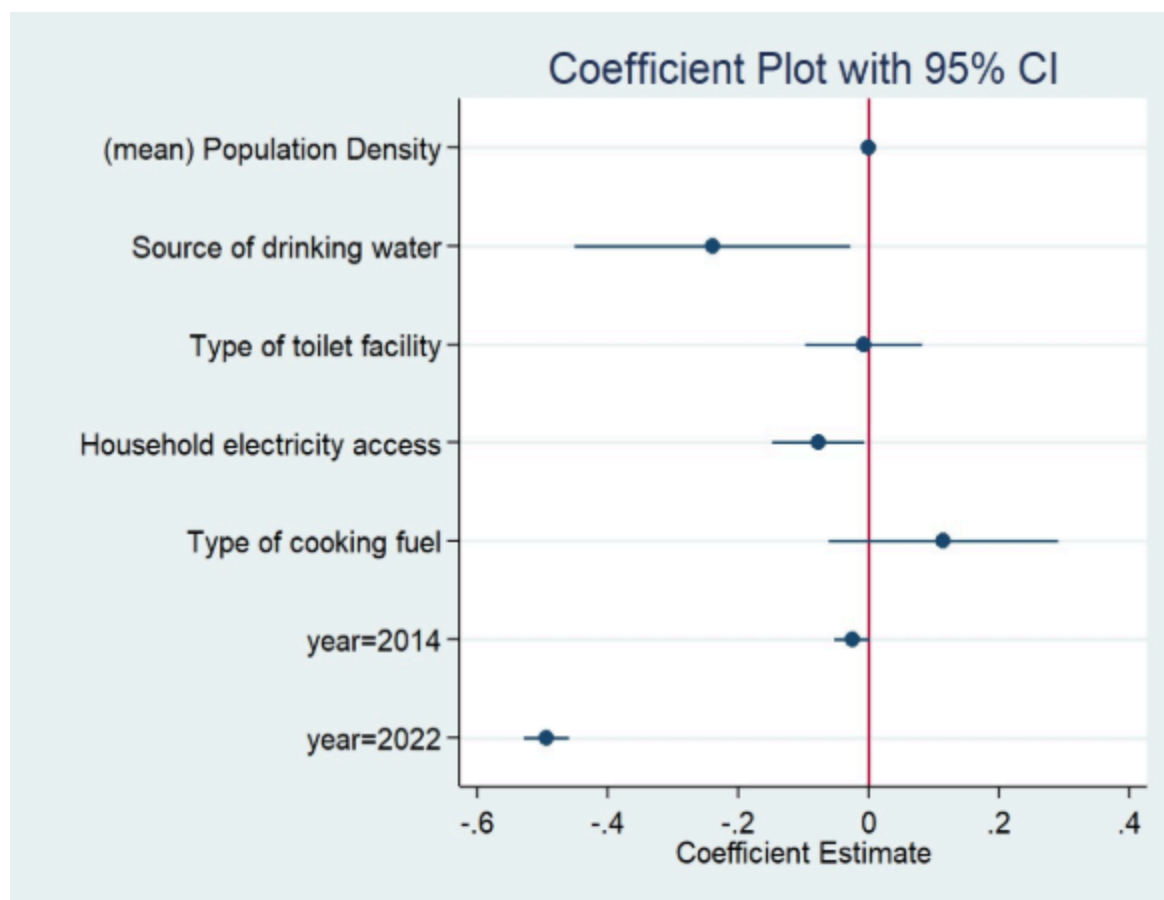


Figure 7

Fixed-Effect Panel Regression Model for Overall Respiratory Health

Supplementary Files

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