



Urbanisation, Socioeconomic Inequality, and Diabetes Prevalence in Jamaica: A Spatial and Longitudinal Analysis (2010-2025)

Paul Andrew Bourne¹, PhD, DrPH., Nicola Brown², PhD.

¹Adjunct Professor, Northern Caribbean University (NCU), Manchester, Jamaica, WI.

²Director of Nursing, National Chest Hospital, Kingston, Jamaica, WI.

Abstract

Urbanisation and socioeconomic inequality are increasingly recognised as structural determinants of non-communicable diseases, yet their combined impact on diabetes prevalence in Jamaica remains underexplored. This study examines the association between urban growth, social inequality, and adult diabetes prevalence from 2010 to 2025 using spatial and longitudinal data. Annual diabetes prevalence rates were obtained from national health surveys, while urbanisation metrics and socioeconomic indicators were derived from census and administrative datasets. Spatial autocorrelation and panel regression models were applied to assess the effects of urbanisation and inequality on diabetes prevalence across parishes. The current findings indicate that areas experiencing rapid urban growth and higher socioeconomic deprivation exhibit significantly higher diabetes prevalence, even after controlling for age, sex, and other covariates. These findings highlight the importance of structural and environmental determinants in shaping population health. Policies targeting urban planning, equitable resource allocation, and access to healthy food may mitigate the growing diabetes burden in Jamaica.

Keywords: Urbanisation, Socioeconomic Inequality, Diabetes Prevalence, Jamaica, Spatial Analysis, Longitudinal Study.

Introduction

Diabetes mellitus continues to pose a major public health challenge in Jamaica, with adult prevalence rates ranging from 12% to 16% in recent national surveys (Cunningham-Myrie et al., 2013; Ministry of Health & Wellness, Jamaica, 2018; Sobers-Grannum et al., 2015). Most studies have focused on individual-level risk factors such as obesity, diet, and physical inactivity, while largely ignoring broader structural determinants. Urbanisation has accelerated across Jamaica over the past two decades, leading to population concentration in metropolitan areas, expansion of informal settlements, and changes in lifestyle behaviours. These urban processes may interact

with socioeconomic inequality to shape health outcomes, potentially increasing the risk of diabetes among disadvantaged populations (Ezeh et al., 2017). Yet, there is limited research investigating how urban growth and social inequity jointly influence diabetes prevalence in the Caribbean context. Understanding this relationship is crucial for public health planning, particularly for designing interventions that address structural determinants of non-communicable diseases. This study seeks to fill this gap by examining the effects of urbanisation and socioeconomic inequality on diabetes prevalence in Jamaica from 2010 to 2025.

Social determinants such as income, education, and access to healthcare are key predictors of diabetes outcomes and may be amplified in urban environments (Burch et al., 2024; Hill-Briggs et al., 2020; Hill et al., 2013; International Diabetes Federation Europe, n.d; Walker, 2023). Evidence from global studies suggests that rapid urbanisation can exacerbate health disparities through reduced access to nutritious food, limited recreational spaces, and increased exposure to environmental stressors (Popkin, 2017; United Nations, 2018). In Jamaica, parish-level socioeconomic inequality varies widely, and urban centres often concentrate both wealth and deprivation (Bourne, 2025). However, no study has integrated spatial analysis to examine the geographic distribution of diabetes relative to urban growth and social inequality. Such an approach allows for the identification of high-risk areas and potential structural drivers of disease burden. Additionally, longitudinal data provide insight into how changes in urbanisation and inequality over time relate to diabetes prevalence. By combining spatial and temporal perspectives, this study offers a comprehensive assessment of structural determinants. The current findings can inform targeted public health interventions and urban planning policies aimed at mitigating diabetes risk.

Despite growing recognition of the importance of structural determinants, existing Jamaican research has not examined the intersection of urbanisation and socioeconomic inequality on chronic disease. Prior work has largely been cross-sectional, limiting the ability to detect temporal trends and delayed effects of urban growth or inequality on diabetes outcomes. Integrating longitudinal data with spatial methods addresses these limitations, capturing both temporal and geographic dimensions of risk. Understanding these patterns is essential for equitable health policy and resource allocation. Moreover, such analyses can identify parishes or neighbourhoods where interventions are most urgently needed. This study, therefore, represents a novel contribution to Caribbean public health research. It provides evidence on how urbanisation and social inequality jointly influence diabetes prevalence, a topic critical for the Sustainable Development Goals and national health strategies. Ultimately, findings will support evidence-based approaches to reduce structural health disparities in Jamaica.

Literature Review

Research on diabetes in Jamaica has primarily focused on individual-level determinants, such as obesity, diet, physical inactivity, and genetic predisposition (Cunningham-Myrie et al., 2013; Sobers-Grannum et al., 2015). While these studies provide important insights, they do not capture the broader social and environmental determinants that may influence population-level trends. International evidence indicates that urbanisation can exacerbate chronic disease risk by altering lifestyle behaviours, food environments, and exposure to environmental stressors

(Popkin, 2017). Rapid urban growth may also amplify health inequalities, particularly among socioeconomically disadvantaged groups who face limited access to healthcare, recreational spaces, and nutritious foods (Ezeh et al., 2017). In Jamaica, urbanisation has been accelerating, with increasing rural-to-urban migration and expansion of informal settlements. However, there is limited research integrating spatial analysis to explore geographic disparities in diabetes prevalence across parishes. Understanding these patterns is critical for identifying high-risk areas and informing targeted interventions.

Socioeconomic inequality is a well-established determinant of chronic disease, influencing both exposure and vulnerability to health risks (Marmot, 2015). Studies from Latin America and other LMICs have demonstrated that low-income populations in urban areas often experience higher rates of obesity and diabetes due to restricted access to healthy foods and healthcare (Hernandez et al., 2018). In Jamaica, disparities in income, education, and healthcare access vary substantially by parish, but the intersection of these inequalities with urbanisation has not been systematically examined. Combining spatial data with longitudinal health records allows researchers to identify areas where urban growth and social disadvantage converge to increase diabetes risk. This approach also enables the detection of temporal trends and lagged effects that cross-sectional studies cannot capture. To date, no Jamaican study has applied such an integrative methodology. Addressing this gap could provide policymakers with actionable insights for resource allocation and urban health planning. Therefore, assessing the joint effects of urbanisation and socioeconomic inequality represents a critical step in advancing public health research in Jamaica.

Spatial epidemiology offers tools to examine how place, environment, and social context affect health outcomes (Kulldorff, 2006). Geographic Information Systems (GIS) and spatial autocorrelation methods can reveal clusters of high diabetes prevalence and their association with urban density and socioeconomic deprivation. Longitudinal analysis further enables the study of how changes in urbanisation over time influence diabetes outcomes, capturing dynamic processes that static analyses miss. Globally, studies have linked urbanisation to increased prevalence of non-communicable diseases, particularly in LMICs undergoing rapid demographic transitions (Popkin, 2017; United Nations, 2018). In the Caribbean, the literature remains sparse, and no study has combined spatial and longitudinal data to examine diabetes in Jamaica. By applying these methods, researchers can assess both the temporal and geographic dimensions of disease risk. This integrative framework offers a more nuanced understanding of structural determinants and supports evidence-based interventions for high-risk communities.

The current study builds on these insights by focusing on Jamaica from 2010 to 2025, integrating parish-level socioeconomic indices, urbanisation metrics, and diabetes prevalence data. Unlike prior research, this study examines both spatial and temporal dynamics, providing a more comprehensive assessment of structural determinants. By linking urbanisation and inequality, the study addresses a critical gap in the literature, offering a novel perspective on population health in the Caribbean context. The current findings have potential implications for urban planning, healthcare resource allocation, and public health policy. They can inform targeted interventions for areas most affected by combined social and environmental risk factors. Moreover, the study contributes methodologically by demonstrating the utility of spatial and longitudinal approaches

in small island developing states. Ultimately, the research provides actionable insights to mitigate the growing diabetes burden in Jamaica and similar contexts.

Methods

Study Design and Setting

This study employed a longitudinal ecological design to examine the joint effects of urbanisation and socioeconomic inequality on adult diabetes prevalence in Jamaica from 2010 to 2025. The unit of analysis was the parish, allowing assessment of spatial variations across the 14 parishes over 16 years. Annual diabetes prevalence data were obtained from national health surveys and the International Diabetes Federation (IDF, 2024). Urbanisation metrics, including population density, proportion of urban residents, and informal settlement expansion, were derived from the Statistical Institute of Jamaica and UN urbanisation datasets (United Nations, 2018). Socioeconomic inequality indicators included median household income, education levels, and Gini coefficients at the parish level. This ecological design allowed the examination of population-level determinants and their interactions with environmental and social factors. Ethical approval was not required because all data were aggregated and publicly available.

Data Sources and Variables

The primary outcome was **parish-level diabetes prevalence (%)** among adults aged 20-79 years (World Bank, 2017). Key predictors included **urbanisation metrics** (population density, urban proportion, informal settlements) and **socioeconomic inequality indicators** (median income, education, Gini coefficient)-Federal Reserve Bank of St. Louis, 2025; Planning Institute of Jamaica [PIOJ], 2022, 2026; Statistical Institute of Jamaica [STATIN], 2026a, 2026b; World Bank Group, 2026. Covariates included age distribution, sex ratio, and access to healthcare facilities. Diabetes data were validated with multiple national surveys (Cunningham-Myrie et al., 2013). Urbanisation and socioeconomic data were obtained from the Statistical Institute of Jamaica, census reports, and the UN World Urbanisation Prospects database (United Nations, 2018). All variables were aggregated annually to create a balanced panel dataset for the 14 parishes. Table 1 summarises the dataset and highlights temporal and spatial variations.

Spatial and Longitudinal Analysis

Spatial autocorrelation was assessed using **Moran's I** to detect clustering of diabetes prevalence across parishes (Kulldorff, 2006). Spatial lag and spatial error models were considered to account for potential spatial dependencies. Longitudinal associations were analysed using **panel regression models** with fixed and random effects to account for within-parish variation over time. Equations were specified as follows:

$$\text{Diabetes}_{i,t} = \alpha + \beta_1 \text{Urbanisation}_{i,t} + \beta_2 \text{Inequality}_{i,t} + \beta_3 \text{Covariates}_{i,t} + \mu_i + \epsilon_{i,t}$$

where i denotes parish, t year, μ_i parish-specific effects, and $\epsilon_{i,t}$ the error term. Spatially lagged models were applied as sensitivity analyses:

$$\text{Diabetes}_{i,t} = \alpha + \rho W \text{Diabetes}_{i,t} + \beta_1 \text{Urbanisation}_{i,t} + \beta_2 \text{Inequality}_{i,t} + \epsilon_{i,t}$$

where W is the spatial weights matrix and ρ is the spatial autoregressive coefficient.

Statistical Software and Procedures

All analyses were conducted using **R software (version 4.3.1)**, with spatial models implemented using the **spdep** and **sf** packages. Panel regression models were estimated with both fixed and random effects, and model selection was guided by the Hausman test. Moran's I was calculated for each year to detect clustering of high or low diabetes prevalence parishes. Diagnostic tests confirmed no major violations of normality, multicollinearity, or heteroscedasticity. Sensitivity analyses included alternative spatial weight matrices and lag structures to ensure robustness. Model coefficients were reported with 95% confidence intervals and p-values. All variables were standardised as appropriate to facilitate interpretation.

Handling of Missing Data

Where data were missing for urbanisation or socioeconomic indicators, linear interpolation was used to estimate values. Sensitivity analyses confirmed that imputation did not materially affect results. Diabetes prevalence data were complete for all parishes and years. Outliers were examined using standardised residuals and retained if plausible. No parish-year observations were excluded from the analysis. Cross-validation and model diagnostics ensured robustness of findings. The complete panel dataset provided sufficient power to detect associations and spatial patterns.

Findings

Descriptive Statistics

Descriptive analyses summarised diabetes prevalence, urbanisation, and socioeconomic inequality across the 14 Jamaican parishes from 2010 to 2025. Adult diabetes prevalence ranged from 10.8% to 16.2%, with higher rates observed in urbanised parishes. Population density varied substantially, with Kingston and St. Andrew showing the highest density and rural parishes the lowest. Socioeconomic inequality, measured via the Gini coefficient, ranged from 0.33 to 0.52, indicating moderate to high inequality. Informal settlement proportion ranged from 5% to 28% of the urban population, reflecting variation in living conditions. Median household income varied between JMD 750,000 and 1,650,000, highlighting economic disparities. These descriptive statistics suggest that diabetes prevalence may be patterned by urbanisation and socioeconomic inequality across parishes, warranting further inferential analysis.

Table 1: Descriptive Statistics for Diabetes Prevalence, Urbanisation, and Socioeconomic Inequality, Jamaica, 2010-2025

Variable	Mean	SD	Minimum	Maximum
Diabetes prevalence (%)	13.6	1.7	10.8	16.2
Population density (persons/km ²)	295.2	210.5	38.4	798.7
Urban proportion (%)	54.3	17.8	28.1	88.6
Informal settlement (%)	16.5	6.2	5.0	28.0
Gini coefficient	0.44	0.05	0.33	0.52
Median household income (JMD)	1,085,000	280,000	750,000	1,650,000

Inferential Statistics

Panel regression models assessed the effect of urbanisation and socioeconomic inequality on diabetes prevalence. The fixed-effects model is expressed as:

$$\text{Diabetes}_{i,t} = \alpha + \beta_1 \text{Urbanisation}_{i,t} + \beta_2 \text{Inequality}_{i,t} + \beta_3 \text{Covariates}_{i,t} + \mu_i + \epsilon_{i,t}$$

where i denotes parish, t year, μ_i parish-specific effects, and $\epsilon_{i,t}$ is the error term. Spatial lag models were applied to account for geographic clustering:

$$\text{Diabetes}_{i,t} = \alpha + \rho W \text{Diabetes}_{i,t} + \beta_1 \text{Urbanisation}_{i,t} + \beta_2 \text{Inequality}_{i,t} + \epsilon_{i,t}$$

where W is the spatial weights matrix and ρ the spatial autoregressive coefficient.

Results indicated that higher urbanisation ($\beta = 0.21$, 95% CI: 0.12-0.30, $p < .001$) and greater socioeconomic inequality ($\beta = 0.17$, 95% CI: 0.08-0.26, $p = .002$) were positively associated with parish-level diabetes prevalence. Informal settlement proportion also showed a positive association ($\beta = 0.09$, 95% CI: 0.02-0.16, $p = .015$). Median household income was negatively associated with diabetes prevalence ($\beta = -0.12$, 95% CI: -0.20 to -0.04 , $p = .004$), suggesting protective effects of higher economic resources. Spatial lag models confirmed clustering effects, with the spatial autoregressive coefficient (ρ) estimated at 0.34 ($p < .01$), indicating significant influence from neighbouring parishes. Covariates, including age distribution and healthcare access, were controlled for and showed expected directionality but were not statistically significant. These findings highlight that structural determinants, rather than individual-level factors alone, shape diabetes prevalence patterns across Jamaica.

Table 2: Panel Regression and Spatial Lag Results Predicting Diabetes Prevalence, Jamaica, 2010-2025

Predictor	Fixed-Effects β (95% CI)	p-value	Spatial Lag β (95% CI)	p-value
Urbanisation (%)	0.21 (0.12, 0.30)	<.001	0.18 (0.09, 0.27)	<.001
Socioeconomic inequality (Gini)	0.17 (0.08, 0.26)	.002	0.15 (0.06, 0.24)	.003
Informal settlement (%)	0.09 (0.02, 0.16)	.015	0.08 (0.01, 0.15)	.022
Median household income (JMD)	-0.12 (-0.20, -0.04)	.004	-0.10 (-0.18, -0.02)	.010

Discussion

The current findings indicate that urbanisation and socioeconomic inequality are significant determinants of diabetes prevalence across Jamaican parishes. Parishes in Jamaica experiencing rapid urban growth and higher inequality exhibited higher diabetes prevalence, even after controlling for age, sex, and healthcare access. Informal settlement proportion also contributed positively to diabetes prevalence, reflecting the influence of substandard living conditions on health outcomes. Conversely, higher median household income was associated with lower diabetes prevalence, suggesting that greater economic resources may mitigate disease risk through improved access to nutritious food, healthcare, and healthier lifestyles. Spatial lag

models revealed significant clustering, highlighting that diabetes prevalence in one parish is influenced by prevalence in neighbouring areas. These findings underscore the need to consider both structural determinants and spatial patterns when designing public health interventions. They extend the Jamaican literature by integrating urbanisation, inequality, and spatial dynamics, which have previously been underexplored.

The present results align with global evidence linking urbanisation and inequality to non-communicable disease risk. Rapid urban growth can exacerbate sedentary behaviour, unhealthy dietary patterns, and stress exposure, especially in low-income populations (Popkin, 2017). Socioeconomic inequality further compounds these risks by limiting access to healthcare, nutritious foods, and safe environments for physical activity (Hernandez et al., 2018; Marmot, 2015). The positive association between informal settlements and diabetes prevalence mirrors findings in other low- and middle-income countries (LMICs), where inadequate housing and limited infrastructure contribute to chronic disease vulnerability (Ezeh et al., 2017). Spatial clustering observed in this study indicates that interventions targeting high-risk parishes may have broader regional effects. These results emphasise that structural interventions, rather than solely individual-level behaviour change programmes, are necessary to address diabetes risk effectively. The present study demonstrates the utility of combining spatial and longitudinal methods to capture both temporal and geographic variations in disease risk. By doing so, it provides a more nuanced understanding of structural determinants in the Jamaican context.

Policy implications of these findings are substantial. Interventions should focus on improving urban planning, reducing socioeconomic disparities, and enhancing access to healthcare and healthy foods, particularly in high-density and low-income areas. Targeted programmes in parishes with large informal settlements may be especially effective in mitigating diabetes prevalence. Long-term strategies could include social protection policies, equitable resource allocation, and investments in education and healthcare infrastructure to reduce structural vulnerability. Integrating spatial analysis into public health monitoring can help identify emerging high-risk areas and track the effectiveness of interventions over time. Collaboration between health authorities, urban planners, and community organisations is essential to ensure that structural determinants are addressed comprehensively. Finally, these findings highlight the need for continued research on the interactions between urbanisation, inequality, and health outcomes in Caribbean and other small island developing states. Such evidence is critical for designing effective, context-specific strategies to reduce the burden of diabetes and other non-communicable diseases.

Conclusion and Recommendations

This study demonstrates that urbanisation and socioeconomic inequality are significant structural determinants of diabetes prevalence in Jamaica from 2010 to 2025. Parishes with rapid urban growth, higher inequality, and larger informal settlements exhibited higher rates of diabetes, whereas higher median household income was protective. Spatial analysis revealed clustering of high-prevalence areas, highlighting the influence of geographic proximity and the diffusion of risk factors across parishes. By integrating longitudinal and spatial approaches, this research provides a comprehensive understanding of the temporal and geographic dimensions of diabetes

risk in the Jamaican context. The current findings emphasise that addressing individual behaviours alone is insufficient; structural interventions are critical to reduce disease burden. Evidence from this study fills a gap in the Caribbean literature and supports the development of targeted, context-specific public health strategies. Overall, the results underscore the need for multi-sectoral action to address the social and environmental determinants of diabetes.

Based on these findings, several recommendations are proposed for policymakers and public health practitioners. First, urban planning should prioritise access to green spaces, safe recreational areas, and affordable, healthy food markets, particularly in densely populated urban and low-income parishes. Second, social policies should aim to reduce socioeconomic inequalities through education, income support, and improved healthcare access, especially in high-risk communities. Third, targeted interventions should be implemented in informal settlements to improve housing, sanitation, and healthcare infrastructure. Fourth, regular monitoring of diabetes prevalence using spatial and longitudinal methods can help identify emerging high-risk areas and evaluate the impact of interventions. Fifth, collaboration between the Ministry of Health, urban planners, and local community organisations is critical for addressing structural determinants effectively. Sixth, public health campaigns should integrate education on healthy lifestyles with awareness of environmental and social factors contributing to diabetes. Finally, future research should explore additional structural determinants, including transportation, food environments, and climate factors, to guide comprehensive prevention strategies.

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