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The Built Environment and Health Comorbidities in Urban Informal Settlements: Mechanisms, Evidence, and Interventions

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1 ABSTRACT

The built environment, encompassing housing quality, sanitation infrastructure, neighbourhood characteristics, and urban design, is a fundamental determinant of health and plays a critical role in shaping the burden of chronic diseases and multimorbidity in urban populations, particularly in informal settlements of low- and middle-income countries. This paper examines the complex relationships between built environment characteristics and the development of comorbidities (multiple coexisting chronic conditions) in residents of informal settlements. Drawing on extensive empirical evidence from diverse geographic contexts, we explore how poor housing conditions, inadequate water and sanitation infrastructure, environmental hazards, and neighbourhood disadvantages create pathways to chronic disease development and multimorbidity. The paper identifies key mechanisms linking built environment factors to comorbidity burden, including biological pathways (disease exposure, stress physiology), behavioural pathways (reduced physical activity, unhealthy food consumption), and psychosocial pathways (chronic stress, depression, social isolation). We examine evidence on housing conditions, neighbourhood safety, green space access, and environmental quality as determinants of comorbidity patterns. Finally, we propose integrated interventions addressing built environment improvements as a strategy for reducing comorbidity burden and health disparities. The paper concludes that addressing built environment deficits is essential for reducing the disproportionate burden of multimorbidity in informal settlement populations globally.

Keywords: Built environment, comorbidities, multimorbidity, informal settlements, health disparities

2 INTRODUCTION

The built environment, the physical structures, infrastructure, and spatial organisation of neighbourhoods and communities, profoundly shape human health and are increasingly recognised as a critical determinant of chronic disease development and multimorbidity (the simultaneous presence of multiple chronic conditions) (Weimann and Oni, 2019). The relationship between housing conditions, neighbourhood characteristics, and health outcomes has become particularly salient as cities in low- and middle-income countries experience rapid, often unplanned urbanisation, resulting in the proliferation of informal settlements characterised by severe infrastructural deficits (Priyadarshini and H. Gundimeda, 2024). Informal settlements are residential areas lacking durable housing, adequate living space, access to basic infrastructure, water, sanitation and other services, and secure tenure (Weimann and Oni, 2019). Residents of these settlements face profound health challenges, yet the mechanisms linking specific built environment characteristics to the development and clustering of chronic diseases remain incompletely understood. This paper synthesises evidence on how built environment factors in informal settlements contribute to comorbidity burden, identifies biological and social pathways connecting environmental exposures to multiple disease development, and examines intervention opportunities.

Understanding these pathways is critical because multimorbidity imposes substantial health, economic, and social costs. Research in urban slum populations demonstrates that multimorbidity is significantly prevalent, with rates as high as 62.5% among older adults aged 65 years in some urban slum settings (Yogesh et al., 2024). The burden of multimorbidity is strongly associated with poor health-related quality of life, reduced functioning, increased healthcare utilisation, and increased mortality risk (Yogesh et al., 2024). Yet populations most burdened by multimorbidity residents of informal settlements often have the least access to integrated healthcare and support services.

3 METHODOLOGY

This study employed a systematic literature review to examine research on the relationship between the built environment and health comorbidities in urban informal settlements. The Web of Science database served as the primary data source, ensuring the inclusion of peer-reviewed and high-quality scholarly outputs. Following a screening and eligibility assessment, 34 articles were retained for analysis. These articles were thematically analysed to identify key research trends, thematic areas, and the evolution of scholarship within this field.

4 FINDINGS AND DISCUSSION

Poor housing conditions represent one of the most direct pathways through which the built environment influences health and comorbidity development (Jabali et al., 2025). Housing quality encompasses multiple dimensions: structural integrity, moisture and mould presence, indoor air quality, crowding, access to utilities, and thermal comfort (Jabali et al., 2025). Each of these dimensions has distinct health consequences, yet residents of informal settlements typically experience multiple simultaneous housing deficits (Brown et al., 2018). Research examining the nexus between housing conditions and health outcomes reveals significant associations across physical, mental, and psychological well-being (Jabali et al., 2025). Palestinians living in smaller households, with higher family incomes, and in private homes report better health across all domains compared to those in overcrowded, rental, or refugee camp settings (Jabali et al., 2025). This relationship holds across multiple disease outcomes. In Swedish immigrant populations, poor housing conditions, particularly dampness and mould, were associated with current asthma and asthma medication use, while mould was associated with headache (Oudin et al., 2016). The presence of cockroaches was associated with emergency care visits, colds, headaches, difficulty falling asleep, and worse general health (Oudin et al., 2016). The mechanisms linking housing quality to chronic disease development are multifaceted. Damp housing promotes mould growth and dust mite proliferation, both of which are associated with respiratory disease and asthma (Nix et al., 2020). Poor ventilation in informal settlement housing contributes to the accumulation of indoor air pollutants and moisture, creating environments conducive to the development of respiratory infections and chronic respiratory disease (Mahadevia et al., 2024). Inadequate heating or cooling systems contribute to physiologic stress and temperature-related illness (Jabali et al., 2025). .

Thermal Environment and Cardiometabolic Morbidity

The thermal characteristics of housing, which are often severely compromised in informal settlements, directly influence cardiometabolic health and contribute to comorbidity development (Weimann and Oni, 2019). Informal settlement housing, typically constructed with heat-absorbing materials (corrugated metal, concrete blocks), minimal insulation, and poor ventilation, creates extreme indoor thermal conditions in hot climates and insufficient heating in cold climates (Sims et al., 2020). These thermal extremes impose direct physiologic stressors and contribute to the development of hypertension, cardiovascular disease, and metabolic dysfunction (Weimann and Oni, 2019).

Research on housing conditions and thermal comfort in informal settlements reveals widespread heat stress (Mahadevia et al., 2024). Indoor temperatures in informal dwellings frequently exceed 30°C during 50-60% of working hours, prompting residents to adopt maladaptive coping strategies such as increased window opening (compromising security), adjusting work schedules (reducing economic productivity), and utilising inadequate cooling strategies (Handayani et al. 2024). These environmental stressors, compounded with poor housing quality and overcrowding, create multiple cardiometabolic risk pathways.

Crowding, Infectious Disease, and Secondary Comorbidities

Housing density and crowding in informal settlements create conditions ideal for rapid disease transmission (Priyadarshini and H. Gundimeda, 2025). High household density and crowding were associated with increased risk of COPD incidence and were identified as significant environmental hazards (Brown et al., 2018). Beyond immediate infectious disease transmission, crowding creates chronic stress exposures and limits privacy, both of which contribute to mental health comorbidities (Handayani et al. 2024). Crowded households during the COVID-19 pandemic were associated with worse mental health outcomes, including loneliness, anxiety, and reduced life satisfaction (Colombo et al., 2023). The persistent threat of infectious disease in crowded informal settlement housing creates chronic vigilance stress, which has been linked to

cardiometabolic disease development, hypertension, and metabolic dysregulation through neuroendocrine and inflammatory pathways.

Water, Sanitation, and Hygiene Infrastructure: Pathways to Comorbidity

Waterborne Disease and Gastrointestinal-Associated Comorbidities

Inadequate water and sanitation infrastructure in informal settlements creates direct pathways to infectious disease and contributes to multimorbidity through multiple mechanisms (Jabali et al., 2025). Poor sanitation facility access was strongly associated with diarrheal infections in Abidjan, in Nairobi). Diarrheal disease in early childhood, a consequence of poor water and sanitation, is associated with impaired linear growth, cognitive development, and long-term chronic disease risk (Priyadarshini and Gundimeda, 2025). Beyond acute gastrointestinal illness, chronic exposure to contaminated water and sanitation creates opportunities for persistent parasitic infections, which contribute to malnutrition, anaemia, and reduced immune competence, compounding risk for other infections and chronic diseases.

Environmental Contamination and Multiple Disease Pathways

In informal settlements lacking adequate water, sanitation, and waste management, environmental contamination creates multiple simultaneous disease exposures (Nix et al., 2020). In urban Nigeria, inadequate housing and sanitation conditions were significantly correlated with communicable disease rates, including malaria (27.6%), typhoid (23%), and diarrhoea (10.3%), with inadequate water supply, unsanitary environments, and overcrowding identified as key drivers (Yusuf et al., 2025). These communicable diseases, particularly when occurring repeatedly or chronically, contribute to the development of immune-mediated chronic diseases, nutritional deficiencies, and secondary comorbidities.

Neighbourhood Disadvantage, Social Stress, and Mental Health Comorbidities

Neighbourhood-Level Determinants of Mental Health

Neighbourhood disadvantage operates as a powerful determinant of mental health comorbidities through multiple pathways. Research demonstrates that residential neighbourhoods with higher deprivation, lower safety perceptions, and reduced social cohesion are associated with substantially higher rates of depression, anxiety, and stress-related disorders (Wong et al., 2024). In Hong Kong, neighbourhood quality was significantly associated with common mental disorders over 3 years, and for participants in substandard housing, high neighbourhood quality significantly alleviated mental health impacts.

Environmental Hazards and Occupational Exposures in Informal Settlements

Air Pollution and Respiratory-Cardiometabolic Comorbidity Clusters

Informal settlements are frequently located adjacent to industrial facilities, waste sites, transportation corridors, and other pollution sources, exposing residents to severe air pollution (Brown et al., 2018). Neighbourhood environmental burden encompassing air pollution, hazardous sites, built environment deficits, transportation infrastructure, and water pollution was associated with significantly higher rates of hypertension, diabetes, and obesity in highly burdened versus minimally burdened neighbourhoods (Kulchar et al., 2024). The associations were strongest in socially vulnerable neighbourhoods, suggesting compounded effects of multiple disadvantages. Ozone exposure during pregnancy and in early life was associated with reduced birth weight (approximately 33g per 10 ppb increase) and increased development of respiratory disease later in childhood and adulthood (Lusk et al., 2024).

Occupational Exposures and Secondary Comorbidities

Residents of informal settlements often engage in informal sector occupations characterised by hazardous exposures waste picking, street vending, and informal construction work (Osrin et al., 2011). These occupations expose workers to chemical hazards, dust, infectious agents, and biomechanical stressors. Occupational exposures contribute directly to chronic respiratory disease, dermatological conditions, musculoskeletal disorders, and infectious diseases, which then interact with poverty-related comorbidities to create complex multimorbidity patterns (Fottrell et al., 2024).

Neighbourhood Access to Health-Promoting Resources

Green Space Access and Mental Health Protection

Access to neighbourhood green space provides protective effects against mental health comorbidities and appears to buffer against neighbourhood disadvantage effects (Brown et al., 2018). Higher block-level greenness was associated with 18% reduced risk of Alzheimer's disease and 28% reduced depression risk in older adults (Roe et al., 2020). Importantly, greenness effects were particularly pronounced in low-income neighbourhoods, where a 1 standard deviation increase in greenness was associated with 37% lower odds of depression compared to 27% and 21% in medium- and high-income neighbourhoods, respectively [20]. Walking in green versus grey (built-up commercial) urban environments showed significant positive effects on emotional well-being and stress physiology, with walking in green areas associated with improved happiness and lower stress activation as measured by heart rate variability (Heredia et al., 2021).

Walkability, Physical Activity, and Metabolic Disease Prevention

Neighbourhood walkability and availability of recreational facilities influence physical activity patterns and are inversely associated with obesity, diabetes, and cardiovascular disease risk (Khan et al., 2024). Lack of nearby shops was associated with 26% increased C-reactive protein values (indicating systemic inflammation) and lower odds of meeting physical activity guidelines (Brown et al., 2018). For older adults ageing with disability, residing in neighbourhoods with a greater density of recreational establishments and parks was associated with reduced risk of incident cardiometabolic disease (Khan et al., 2024).

Housing Insecurity and Eviction-Related Health Impacts

Eviction as a Comorbidity Driver

Housing instability and eviction represent acute disruptions to health and are associated with increased comorbidity development. Poor housing conditions and evictions are both independently associated with cardiovascular disease, depression, and injuries, yet the relationship between these two negative housing outcomes has received limited research (Sonik and Herrera, 2022). In New York City public housing, adjusted predicted probabilities of eviction increased from 34% to 43% with a rodent inspection and from 34% to 46% with an indoor environmental inspection, indicating that formal recognition of unsafe housing conditions preceded evictions (Khan et al., 2024).

Residential Instability and Long-Term Health Trajectories

Children who moved from high to low neighbourhood deprivation showed larger improvements in educational outcomes than those who moved between high-deprivation neighbourhoods, suggesting that residential moves to better neighbourhoods provide tangible health and development benefits (Bravo et al., 2024). However, residential instability itself, frequent moves, was associated with worse outcomes. These findings indicate that stable housing in adequate conditions is preferable to instability, even in disadvantaged environments, yet moves to improved environments provide the greatest health benefits.

Mechanisms and Pathways: Toward Integrated Understanding

Multiple Simultaneous Disease Pathways

The built environment influences comorbidity development through multiple simultaneous, often interacting pathways (Weimann and Oni, 2019). . A framework for understanding these pathways includes:

- Biological pathways: Infectious disease exposure (through poor sanitation); environmental hazard exposure (air pollution, lead, other toxins); thermal stress; nutritional deficiency; and immune dysregulation from chronic stress (Yogesh, et al., 2024).
- Behavioural pathways: Reduced physical activity opportunities; unhealthy food consumption reflecting food environment characteristics; tobacco and alcohol use patterns; and reduced healthcare-seeking behaviour (Patel, 2020).
- Psychosocial pathways: Chronic stress from neighbourhood violence and disadvantage; social isolation and reduced social cohesion; depression and anxiety related to housing insecurity and environmental conditions (Patel, 2020).
- Systems-level pathways: Limited access to healthcare resources; poor quality of available services; and health system fragmentation in serving informal settlement populations (Yogesh, et al., 2024).

Interventions: From Built Environment Improvements to Comorbidity Reduction

Housing Upgrading and Health Benefits

Housing upgrading interventions have been associated with health improvements, though the evidence is more developed for specific outcomes (infectious disease, respiratory disease) than for integrated comorbidity assessment (Weimann and Oni, 2019). Cool roof interventions in informal settlements reduced indoor temperatures by 1-1.5°C during peak summer, with potential for reducing heat-related illness and thermal stress-related cardiometabolic disease (Brown et al., 2018). However, longitudinal evidence on whether housing upgrades prevent or reduce multimorbidity development remains limited (Weimann and Oni, 2019).

Water, Sanitation, and Infrastructure Investments

Improving water and sanitation infrastructure prevents waterborne disease and reduces communicable disease burden, addressing one critical pathway to comorbidity in informal settlements (Priyadarshini and H. Gundimeda, 2024). Combined with hygiene promotion, comprehensive WASH interventions significantly reduce diarrheal disease incidence and provide protection against malnutrition-related immunodeficiency and secondary comorbidities (Priyadarshini and H. Gundimeda, 2024).

Neighbourhood Green Space Development

Expanding access to green spaces in informal settlement neighbourhoods offers co-benefits for mental health, physical activity, and social cohesion (Brown et al., 2018). Green space development can reduce depression and Alzheimer's disease risk while providing space for community gathering and social connection (Brown et al., 2018).

Participatory Planning for Built Environment Transformation

Effectively built environment improvements require participation of informal settlement residents in planning and design processes (Weimann and Oni, 2019). Participatory approaches ensure that interventions align with residents' priorities and constraints, increase the likelihood of sustainability, and strengthen community agency in addressing health determinants.

5 CONCLUSION

The built environment is a fundamental determinant of multimorbidity in urban informal settlement populations through multiple interconnected pathways, including infectious disease exposure, environmental hazards, chronic stress, and limited health-promoting resources. The evidence demonstrates that poor housing, inadequate water and sanitation infrastructure, neighbourhood disadvantage, and environmental hazards are not merely correlates of comorbidity but direct contributors to chronic disease development and clustering. Addressing built environment deficits represents a critical public health opportunity for reducing comorbidity burden and health disparities in informal settlement populations globally (Weimann and Oni, 2019). However, as the evidence also demonstrates, housing upgrades and infrastructure improvements must be comprehensive, participatory, and integrated into broader health system strengthening efforts to achieve sustainable health improvements (Weimann and Oni, 2019). Future research utilising longitudinal designs must assess whether built environment improvements actually reduce the incidence and progression of multimorbidity over time in informal settlement populations.

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