Review Article

Intersections among housing, environmental conditions, and health equity: A conceptual model for environmental justice policy☆

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ABSTRACT

Housing and environment are important influences on health, wellbeing, and a strong sense of community. Housing and environmental features can have both health promoting and hazardous impacts on communities. Present day health inequities in housing and environmental conditions in the United States are linked with historic redlining, unfair zoning decisions, segregation, and restrictive housing covenants, with similar phenomena occurring in other global settings. Consequently, there are distinct spatial patterns of poor housing and environmental risks across geographic areas, including patterning of the presence/absence of health promoting features. Environmental harms and poor housing conditions are disproportionately concentrated in low-income and minoritized communities suggesting an environmental justice issue. Importantly, there are linkages between aspects of housing and the environment as they relate to health equity. However, past studies have largely studied housing, and environmental justice separately and given this intersection little attention. The objective of this review is to discuss the intersections between housing and environmental conditions in relation to health equity. This review also presents a new conceptual model to show how housing disparities is a key component in environmental justice. The intersection of aspects of housing instability such as eviction and environmental exposures suggest the need for future studies to examine their interconnectedness when assessing their health risk. In addition, some upstream public health investments are suggested for equitable housing and environmental conditions that would improve health and wellbeing. Those equity focused upstream investments include, equitable housing code enforcement, increase in housing supply and affordability, investment in greenspace, equitable land-use zoning, and continuous revision of air quality standard.

1. Introduction

Housing and environmental conditions are two types of exposures that are intricately linked to health. Poor housing and environmental conditions are significant risk factors for a variety of adverse health outcomes including asthma, diabetes, cancer, cardiovascular and kidney diseases (Bryant-Stephens et al., 2021; Golden et al., 2021; Novick et al., 2020). Housing and environmental exposures fall within the multiple domains of social determinants of health (Henize et al., 2015; Navarro, 2009). Exposure to hazardous housing and environmental conditions are driven by the presence of indoor and outdoor characteristics. Some harmful indoor housing features include mold, pests, poor ventilation, and lead paint (Chu et al., 2022), while outdoor conditions include residential proximity to point sources of air pollution, lack of greenspaces, inadequate access to healthy food, and traffic related air pollution (Frumkin, 2005; Anthony et al., 2021). Although poor housing and environmental exposures are detrimental to health, research suggests the clustering of certain environmental characteristics such as greenspace is associated with health promoting benefits (Frumkin, 2005). In addition, housing can be important in creating a sense of place and belonging, or “home” (Rolfe et al., 2020). Such a sense of home have been reported to improve mental health and wellbeing (Clapham et al., 2018; Kearns et al., 2012; Rolfe et al., 2020). However, prior literature suggests positive housing and environmental amenities are inequitably distributed (Taylor, 2018). For example, individuals of low socioeconomic (SES) status are more exposed to substandard housing and poor environmental conditions (Frumkin, 2005).

Poor housing and environmental conditions are intertwined, yet public health research has given this intersection less attention than warranted. Past studies have primarily considered issues of housing and

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the environment separately. Housing issues have been conceptualized as encompassing stability, quality/safety, affordability, and neighborhood (Swope & Hernández, 2019; Taylor, 2018). Those four components of housing are helpful to conceptualize how housing is linked with health. It is also important to understand the less tangible aspects of housing, such as the social, psychological, and cultural values of a home. The World Health Organization (WHO) refers to a shelter that supports a healthy environment (Taylor, 2018). Furthermore, housing provides a base for individual autonomy and social identity (Roelfe et al., 2020). This often develops into place attachment or emotional connection to a home (Newton, 2008). Place attachment has been linked with many positive outcomes including greater community participation and civic engagement (Anton & Lawrence, 2014). Place attachment has also been reported to increase the likelihood for individuals in a community to work together to achieve a common goal such as advocacy, and protecting the environment (Brown et al., 2002). In addition, individuals who are emotionally connected to a home report greater physical and psychological health (Tartaglia, 2015). Individuals who are not emotionally attached to their homes experience anxiety, higher stress levels, and poorer health status (Stokols & Shumaker, 1982). Often, non-attachment of the individual to place is due to poor housing and sanitary conditions (Anton & Lawrence, 2014). Housing conditions that are detrimental to health are often clustered around neighborhoods comprising individuals of low Socioeconomic Status (SES) and minority populations (Frumkin, 2005; Taylor, 2018). These populations are disproportionately exposed to environmental hazards (Morello-Frosch & Lopez, 2006; MyDzung, 2020). Those hazardous environmental exposures broadly impact health through the physical, social, and built environment (Frumkin, 2005).

There is an intersection between housing and environmental conditions and the patterns by which they reinforce health inequities. Perhaps, the most intuitive part of this intersection is centered around substandard housing and indoor environmental exposures such as lead paint, toxic chemicals, pests, mold, and contaminated drinking water. There is a historical context to housing and environmental health disparities (Beyer et al., 2016; Krieger et al., 2020). For example, discriminatory housing policies such as redlining and racially restrictive covenants, dating back to the early 1900’s, have resulted in patterns of economic disinvestment and racial segregation across U.S. Cities. Captured in a snapshot in the infamous Home Owners’ Loan Corporation (HOLC) maps that portrayed the state of U.S. cities in the 1930’s. These patterns of economic disinvestment and segregation have been linked with several housing and environmental exposures (Beyer et al., 2016; Krieger et al., 2020; Lane et al., 2022), including present-day air pollution disparities in U.S. cities (Lane et al., 2022). Formerly redlined neighborhoods have a greater risk of flood exposure (Katz, 2021). Communities with a history of redlining have higher rates of housing instability and eviction and are disproportionately exposed to environmental hazards (Lloyd, 2016). All those poor housing and environmental conditions intersect and exacerbate health disparities. This suggests issues of environmental justice encompass poor housing conditions.

The objective of this review is to examine the intersections of housing and environmental conditions as they relate to health equity. First, we describe the key components of housing and the environment, and then discusses their intersections and how they exacerbate health disparities. Second, we developed a new conceptual model to show how housing disparities is a key component in environmental justice. Finally, we suggest some actionable upstream investment for equitable housing and environment.

2. Housing

The impact of housing on health can be described using four pathways. They include stability (or residential stability), quality (conditions and safety of the building/unit), affordability (cost of housing), and neighborhood (social and environmental conditions around the neighborhood) (Swope & Hernández, 2019; Taylor, 2018). The four housing pathways also follows the National Center for Healthy Housing (NCHH) recommended principles which states that healthy homes are: dry, clean, pest-free, ventilated, safe, contaminant-free, maintained, thermally controlled, accessible and affordable (National Center for Healthy Housing, 2023). The four housing pathways can be used to support interventions that would improve healthy housing.

2.1. Stability

Residential stability encompasses several elements related to the capacity to maintain or remain in a home free from the possibility of forced moves (Swope & Hernández, 2019). Residential stability is often disrupted by involuntary moves or displacement which could arise as a result of eviction, foreclosures, natural disasters, and missed rental or mortgage payments (Desmond, 2012; Sandel et al., 2018). Forced moves from a housing unit often lead to homelessness, a form of housing instability characterized by the absence of permanent or fixed place of residence (Substance Abuse and Mental Health Services Administration, 2022). Homelessness has been linked with increased risk of respiratory diseases, depression, anxiety, skin irritation, and substance use disorders (Fralsham & Dorling, 2018; Thomson et al., 2013). In addition, homelessness is also linked with poverty (National Coalition for the Homeless, 2022). Homelessness often occurs due to lack of affordable housing, unemployment, and substance abuse (Frasnham & Dorling, 2018; National Coalition for the Homeless, 2022).

Most residential instability have been attributed to eviction from a rented occupied house (Berlin & Sikora, 2021; Collinson & Reid, 2018a; Desmond, 2012). Low-income families and renters of color are disproportionately impacted (Collinson & Reid, 2018b; Desmond, 2012). Eviction on the record of an individual, particularly through the court system, potentially limits future opportunities in the housing market (Desmond & Kimbro, 2015; Greiner et al., 2012). Increasingly, evictions may also occur as a result of the impact of climate change and natural disasters (Mahoney, 2021). In the aftermath of natural disasters such as hurricanes, many homes are destroyed. For example, after hurricane Harvey in Houston, Texas, many landlords suddenly ended thousands of leases (Berlin & Sikora, 2021). Displacement from housing increases the likelihood of unemployment (Desmond & Gershenson, 2016).

Residential instability is linked with employment insecurity (Swope & Hernández, 2019). In addition, a forced move or displacement is associated with psychological distress, severe mental illness and stress (Collinson & Reid, 2018b; Fussell & Lowe, 2014). While housing instability can be detrimental to health, there is an association between stable housing and positive health outcomes (Thomson et al., 2013). Stable housing decreases stress and anxiety and improves mental health outcomes (Desmond & Gershenson, 2016). Stable housing also increases access to health care by maintaining access to primary care facilities (Swope & Hernández, 2019).

2.2. Quality

Housing quality refers to the conditions of the environment (Taylor, 2018). Substandard housing conditions such as poor ventilation, dilapidated structures, lead exposure within and around the home, water leaks, inadequate heating and cooling systems, and indoor air pollution have all been associated with poorer health status (Bryant-Stephens et al., 2021; Jacobs, 2011). Poor housing conditions have been associated with a variety of detrimental health effects including asthma, mental health issues, cardiovascular diseases, and other physical health outcomes (Bryant-Stephens et al., 2021; Sims et al., 2020; Singh et al., 2019). This can be observed through certain metrics such as frequent emergency room visits, disease incidence, and outpatient visits (Albanti et al., 2016; Aratani et al., 2020). Low-income families and populations...
of color are disproportionately impacted (Ash & Brandt, 2006; Beck et al., 2016; Servadio et al., 2019). For example, a study in Boston, Massachusetts found that racial group identification was a significant predictor of asthma (Lemire et al., 2022). Further, neighborhoods with a lower proportion of White residents had decreased risk of asthma compared to neighborhoods with higher proportions of Black residents, even after adjusting for income and other neighborhood-level characteristics (Lemire et al., 2022). In addition, lead exposure, particularly among children, highlights racial/ethnic disparities (American Lung Association, 2020; American Lung Association, 2023; Milwaukee Health Department, 2021). A study in Milwaukee, Wisconsin reported neighborhoods with mean childhood blood lead levels greater than or equal to 5 μg/dL were majority non-White neighborhoods (Lynch & Meier, 2020).

Poor indoor environmental quality can lead to unsafe living conditions. For example, dilapidated housing structures can increase the risk of falls and unintentional injury (Sims et al., 2020). Low-income homes are often older and of poorer quality, and often need maintenance (Desmond, 2012; Sims et al., 2020). Further, low-income income families are more likely to live in overcrowded housing conditions (Taylor, 2018). However, interventions centered around housing can be beneficial to health (Jacobs, 2011; Kearsms et al., 2012). For example, reducing indoor hazards such as improving indoor air quality can reduce the risk and severity of diseases attributable to air pollution (Johnston & Mac- Donald Gibson, 2015; Mu et al., 2013).

2.3. Affordability

Affordable housing is a significant determinant of stable housing. In 2020, it was estimated that more than 1 in 7 households paid over half of their income on housing (Habitat for Humanity, 2022). Low-income families are disproportionately impacted (Desmond & Gershenson, 2016; Habitat for Humanity, 2022). Many low-income families are cost-burdened, in that they devote 50 percent or more of their income to recurring housing costs, leaving them with insufficient funds for other essential needs such as food, clothing, transportation, and health care (Kushel et al., 2006). The situation is exacerbated by the shortage of for-sale homes and affordable rental units, with most supply shortages at low-income price points (Desmond & Gershenson, 2016; Habitat for Humanity, 2022). However, severe cost burden disproportionately impact renters rather than owners (Desmond & Gershenson, 2016; Taylor, 2018).

Significant racial and ethnic disparities in housing affordability has been reported (Desmond, 2012). For example, Half of Black and Latinx families are rent-burdened compared to a third of White households (Desmond & Kimbro, 2015). Black, Latinx, and other minority households are more likely to reside in older and less energy efficient homes (Desmond, 2012). This increases the risk of exposures to extreme home temperatures (Hernández, 2016), as well as higher cost of energy use.

Homeowners at risk of foreclosure experience adverse mental and physical health outcomes (Sims et al., 2020). One study reported that foreclosures are associated with significant increases in hospital and emergency room visits for mental health issues, stroke, and hypertension (Currie & Tekin, 2015). Lack of affordable housing limits the capacity of households to purchase essential needs such as health insurance and medications (Swope & Hernández, 2019). In other words, affordable housing provides stability and health benefits for families by freeing resources for health care.

2.4. Neighborhoods

The neighborhood aspect of housing is concentrated outdoors. It comprises two main components, including the physical surroundings and the social characteristics of a particular neighborhood (Sims et al., 2020; Swope & Hernández, 2019; Taylor, 2018). The physical surroundings encompass both health promoting and hazardous features of the environment (Swope & Hernández, 2019). Desirable physical features of neighborhoods include safe places to exercise, parks, green spaces, while hazardous features for example include, waste processing facilities, and proximity to highways (Sylla et al., 2017; Weber et al., 2021). Research suggests neighborhood characteristics can impact residents’ health independent of individual level attributes (Coogan et al., 2016; Swope & Hernández, 2019; Weber et al., 2021).

The social characteristics are less visible and include issues such as discrimination, segregation and crime (Taylor, 2018). Neighborhood segregation and how it impacts health have been well documented (Anderson & Oncken, 2020; Morello-Frosch & Lopez, 2006; Williams & Collins, 2001; Zhou et al., 2017). Segregation influences access to healthcare, employment, and education (Morello-Frosch & Lopez, 2006; Williams & Collins, 2001). Although segregation can be detrimental to health, studies have also found segregation, or measures of ethnic density or ethnic enclaves, to have some protective health effects (Kramer & Hogue, 2009; Mason et al., 2009). For example, living in a segregated area may serve as a buffer against stressors related to racial discrimination compared to living in less segregated areas; residents may also benefit from the availability of some social or cultural institutions unavailable in less segregated areas (Mason et al., 2009).

3. Environment

Traditional environmental health research have focused primarily on toxic substances in the air, water, and soil (Frumkin, 2005). More recent approaches broadly include the physical/natural, social, and built environment. Those aspects of the environment are attracting greater attention in public health research.

3.1. Physical environment

The physical environment refers to the physical factors in the external surroundings and conditions that can impact health (Frumkin, 2005). Physical environmental features that are relevant to health include air pollution, water contamination, and certain built environmental conditions including access to healthy foods, parks, and healthcare (U.S. National Research Council & U.S. Institute of Medicine, 2013). The quality of the physical environment can significantly impact health. Environmental exposures such as air pollution have been found with substantial evidence to significantly impact a variety of health outcomes (American Lung Association, 2023). Air pollution have been linked with respiratory and cardiovascular diseases, adverse birth outcomes, decreased kidney function, and cancer (Bragg-Gresham et al., 2018; Eckel et al., 2016; Ha et al., 2014; Rodopoulou et al., 2015; Sylla et al., 2017). The effects of air pollution and other environmental contaminants on health motivated the need for legislation to continuously monitor and control toxic environmental substances (U.S. EPA, 2022b).

3.2. Built environment

The built environment is an aspect of the physical environment that refers to human-made or modified structures that provide spaces for living, working and recreation (U.S. EPA, 2022a; U.S. EPA, 2022b). This includes land use patterns, transportation systems, urban planning, and design features (U.S. National Research Council & U.S. Institute of Medicine, 2013). The presence and spatial patterning of health relevant resources have been linked with health behaviors (Frumkin, 2005). For example, proximity to healthy food stores have been linked to dietary behaviors (Marjin Stok et al., 2018). A study in Texas found improvement in built environmental features such as bicycle lanes, sidewalks, and safe crossings reduced the annual rates of pedestrian and bicyclist injuries by 42.5 percent (DiMaggio et al., 2015). In addition, green spaces have been found to improve heart function and mental health (Barton & Rogerson, 2017). Parks have also been found to improve
physical activity (Frumkin, 2005).

However, health promoting built environmental features are inequitably distributed (Bikomeye et al., 2021; Frumkin, 2005). For example, low-income families tend to live near major roadways, waste sites, and in areas with less greenery (American Lung Association, 2020; American Lung Association, 2023; Brewer et al., 2017). People of color tend to reside in neighborhoods that lack access to parks and greenspace (Anthony et al., 2021; U.S. National Research Council, 2013). This pattern of inequity is a key issue in environmental justice (Bullard, 2000).

3.3. Social environment

The social environment encompasses social groups, neighborhoods, organizations, characteristics, and policies that impact health (Yen & Syne, 1999). Social environmental factors relevant to health include crime, violence, social capital, social cohesion, racial segregation, and other social interactions, norms, and collective processes (Navarro, 2009; Rolle et al., 2020; Yen & Syne, 1999). Conditions in the social environment may act as stressors (U.S. National Research Council & U.S. Institute of Medicine, 2013). For example, neighborhood crime has been linked to anxiety, poor mental health, and less physical activity (Meyer et al., 2014). In addition, exposure to segregation is associated with limited economic resources, limited access to healthcare, and prevalence of cardiovascular and respiratory disease risk factors (Anderson & Oncken, 2020; Kramer & Hogue, 2009; Sims et al., 2020).

The social environment can also enhance health through social support (U.S. National Research Council & U.S. Institute of Medicine, 2013). Studies suggest social support confers resilience to stressors (Mason et al., 2009; Ozbay et al., 2007). Social cohesion can also promote health through positive and culturally specific norms (Swope & Hernández, 2019). While the social environment may have some benefits, low-income communities and minoritized populations may lack the social capital and power to advocate for better conditions and health promoting resources in their neighborhoods (Chakraborty & Maantay, 2011; Pastor & Morello-Frosch, 2016).

4. Housing and environmental justice

Many environmental and housing issues are spatially patterned (Lane et al., 2022). The historical context of housing and environmental health disparities share similarities in ways they exacerbate inequities (Katz, 2021). For example, historic patterns of redlining, zoning decisions, segregation, and restrictive covenants are associated with present-day distributions of toxic housing and environmental exposures (Lane et al., 2022; J. Maantay, 2001; Madrigano et al., 2021). Attempts to categorize housing often overlook the historical nature of housing disparities, and the intersection between housing and aspects of environmental features relevant to public health. Exposures to poor housing and environmental conditions commonly occur in low-income communities of color (Irving, 2022; Madrigano et al., 2021). This suggests disparities in housing can be considered an environmental justice (EJ) issue.

Historically, EJ developed as a response to the siting of toxic waste dumps, disproportionate burden of pollution, and inadequate regulatory enforcement in low-income and minoritized communities (Bullard, 2000; Pastor & Morello-Frosch, 2018; United Church of Christ & Commission for Racial Justice, 1987; U.S. General Accounting Office, 1983). Contemporary EJ seeks to address inequities in the distribution of environmental risks and benefits including hazards, greenspace, and safe and quality housing (Bryant & Callewaert, 2003). Housing and environmental burdens disproportionately impact low-income and minoritized communities (Pastor & Morello-Frosch, 2018). For example, low-income communities and populations of color tend to live in high traffic zones, putting them at increased risk of exposure to high levels of traffic related air pollution (American Lung Association, 2023; Mikati et al., 2018). ZIP codes with higher proportions of Black residents are more likely to be designated for expansion of toxic storage and disposal facilities (Hamilton, 1995). In addition, substandard housing, poor home maintenance, and structural damage increases the risk of exposure to extreme temperatures (MyDzung, 2020). Outdoor air pollution may also penetrate through wall openings and cracks. Poor-quality housing may also be associated with lead exposure, dust mites, mold, and rodents, which are known triggers for asthma (Joseph et al., 2005; U.S. Institute of Medicine Committee on the Assessment of Asthma and Indoor Air, 2000). Those poor housing and environmental conditions intersect and exacerbate racial health disparities. In addition, those conditions occur in neighborhoods with similar historic and demographic patterns.

Research also suggests that environmental benefits such as greenspace, bike lanes, parks, and healthy food stores are less available in neighborhoods with larger proportions of Hispanic and Black residents (Datzmann et al., 2018; Frumkin, 2005; Ramirez et al., 2019; Weber et al., 2021). Neighborhood availability of healthy food stores is linked with diets rich in fresh foods, fruits, and vegetables (Larson et al., 2009). The availability of parks decreases the risk of obesity and improves mental health (Cohen et al., 2022). Bike lanes improve physical activity, and traffic flow (Pucher et al., 2010; Standen et al., 2021). Greenspace in urban areas mitigates the impacts of climate change and air pollution and reduces urban heat waves (Diener & Mudu, 2021; Kruize et al., 2019). However, environmental benefits are inequitably distributed (Pastor & Morello-Frosch, 2018), and may increase the risk of environmental harms and disasters, particularly among low-income and minority communities. For example, greenspace can mitigate the impact of flood exposure (Kim, 2021), but Black populations and low-income communities have less greenspace and a higher risk of flood exposure (Collins et al., 2018; Lu et al., 2021).

Many issues relating to housing conditions and environmental risks commonly occur in segregated neighborhoods (Anderson & Oncken, 2020; Morello-Frosch & Lopez, 2006). For example, unfair zoning decisions and land use practices increase the tendency for siting of toxic emitting facilities and hazardous wastes in low-income and segregated neighborhoods (Pastor & Morello-Frosch, 2018; Williams & Collins, 2001). Historic redlining is also linked with present-day air pollution disparities (Lane et al., 2022). Air pollution disproportionately impacts neighborhoods with a greater proportion of Black and Hispanic populations (Tessum et al., 2021). Poor housing and environmental conditions widen the health inequality gap across a variety of metrics including, disease incidence and mortality (Son et al., 2020; Zanobetti et al., 2022). For example, poor neighborhood conditions significantly increases the risk of developing asthma among Black and Hispanic children when compared with White children (Zanobetti et al., 2022). Poor neighborhood physical environment is also linked with poorer cardiovascular health among Black populations compared with White populations (Hines et al., 2023).

The importance of connecting issues of inequitable housing and environmental exposures can also be observed through the stability pathways of housing and the environment. For example, housing instability often occurs in low-income and segregated neighborhoods (Beaudry, 2018; Collinson & Reed, 2018b; Desmond, 2012). Historic redlining have been linked with a high percentage of renter-occupied units and high rates of eviction (Beaudry, 2018; Lloyd, 2016; Wamsley, 2021). Neighborhoods with high proportions of renters, Hispanics, Black residents and other minoritized populations are more likely to be designated as sites for toxic emitting facilities (Hamilton, 1995). In addition, low-income communities are disproportionately impacted by climate change and natural disasters. For example, after hurricane Katrina in Louisiana, thousands of low-income renters faced mass eviction and illegal price hikes in renter-occupied units (Mahoney, 2021). This highlights the need for equitable mitigation to the impacts of climate change extreme weather events.
5. Vision for equitable housing and environment

Inequity in housing is closely linked to hazardous environmental conditions. Poor housing conditions and environmental risks are often clustered in low-income and minoritized neighborhoods (Morello-Frosch & Lopez, 2006; Tessum et al., 2021). Therefore, it is necessary to incorporate housing issues in environmental justice research, and environmental exposures in housing research, respectively. This review presents a conceptual model to show the intersections between inequities in housing and the environment and how they impact health (Fig. 1). The lasting effects of historical practices related to disparities in housing and the environment in the U.S. (redlining, unfair zoning practices, restrictive covenants, and segregation) can be observed through the spatial pattern of several issues relating to housing and environment. Housing and environmental problems often display strong spatial clustering patterns. Therefore, equitable public health interventions and investments must focus on upstream, geographic factors to achieve environmental justice and improve health equity for the populations living in these areas. The conceptual model highlights the major upstream issues relating to inequity in housing and the environment. Those housing issues include homelessness, eviction, high cost, home maintenance, indoor pollution, and lead exposure, among others. Upstream environmental factors include flood exposure, outdoor air pollution, waste sites, vulnerability to the impacts of climate change, and inadequate access to parks and greenspace. The conceptual model shows the interconnectedness of poor housing and environmental conditions that increases the risk of chronic diseases, injury, social isolation, and poor mental health (Frumkin, 2005; World Health Organization, 2018). To achieve equitable housing and environmental conditions that would improve health and wellbeing, a clear vision and actionable upstream investments are needed. Suggested investments should be comprehensive and multi-targeted, including the following:

A Conceptual Model for Equitable Housing and the Environment.
Equitable zoning can increase access to housing. Current land-use zoning regulations perpetuate socioeconomic and racial inequity in access to housing and exacerbate patterns of segregation (Rothwell & Massey, 2010). For example, local zoning regulations limit the construction of small, low-cost homes on expensive land. Construction of single family detached housing is prohibited in some U.S. cities (Schuetz, 2020). Regulations such as minimum lot sizes and building height caps limit the capacity to build new and affordable homes (Franke, 2015). Strict zoning regulations make some neighborhoods more exclusive, reduce housing supply, and drive prices higher. Regulatory barriers in zoning can be revised to allow equitable access to housing. In addition, siting of hazardous facilities should be distant from residential areas.

Continuous revisions of air quality standards are needed. Research suggests significant health effects of air pollution exposures even at levels below the current U.S. Environmental Protection Agency (EPA) limit (Rodopoulou et al., 2015; Tessum et al., 2021). For example, the current EPA limit for annual PM$_{2.5}$ concentration is 9 µg/m$^3$, while the World Health Organization (WHO) suggests 5 µg/m$^3$ for annual PM$_{2.5}$ (U.S. EPA, 2024; World Health Organization, 2021). This is intended for a gradual shift from higher to lower concentrations to significantly reduce health risks associated with air pollution.

Considering the historical nature and pattern of housing and environmental health disparities, the suggested upstream investments would reduce environmental injustice, promote equitable housing, environmental conditions, and improve health and wellbeing (downstream outcomes). Health equity and environmental justice research may consider the interrelationships of aspects of housing when assessing their health risks. For example, housing eviction is traditionally not considered in environmental justice studies. Prior literature suggest historically redlined communities are disproportionately impacted by eviction (Lloyd, 2016). In addition, evictions commonly occur in poor neighborhoods, and characterized by poor home maintenance, structural damage, and distinct demographic pattern (Desmond, 2012).

Health equity and environmental justice research must recognize the need to incorporate aspects of housing because they often operate against the backdrop of segregation and environmental exposures (Haberle, 2017). Further, future studies may incorporate the health risk associated with multiple indoor exposures such as lead, and indoor air pollution.

6. Conclusion

Housing and environmental conditions play important roles on health, wellbeing, and a strong sense of community. Past discriminatory housing and environmental policies are linked with present day health disparities and a variety of detrimental health effects. Low-income households and communities with larger proportions of residents of color bear the highest housing and environmental burden. In addition, improved housing and environmental conditions are less available in low-income neighborhoods and communities of color. These patterns indicate a clear environmental justice issue. This review offers a new conceptual model to show the intersections of housing and environmental exposures as they relate to health inequities and suggests approaches to achieve equitable housing and environmental conditions.

CRediT authorship contribution statement

Chima Anyanwu: Writing – review & editing. Writing – original draft, Conceptualization. Kirsten Beyer: Writing – review & editing, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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