



Adapting the environmental risk transition theory for urban health inequities: An observational study examining complex environmental risks in seven neighborhoods in Global North cities

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ARTICLE INFO

Keywords:

Environmental justice
Environmental risk transition
Gentrification
Health equity

ABSTRACT

Theories of epidemiologic transition analyze the shift in causes of mortality due to changes in risk factors over time, and through processes of urbanization and development by comparing risk factors between countries or over time. These theories do not account for health inequities such as those resulting from environmental injustice, in which minority and lower income residents are more likely to be exposed to environmental hazards or have less access to environmental goods. Neighborhoods with histories of environmental injustice are also at risk for gentrification as they undergo environmental improvements and new greening projects. We aimed to understand how environmental injustice, urban renewal and green gentrification could inform the understanding of epidemiologic risk transitions. We examined 7 case neighborhoods in cities in the United States and Western Europe which were representative in terms of city region and type, which 1) had experienced a history of environmental injustice and 2) exhibited evidence of recent processes of urban renewal and/or gentrification. In each city, we conducted semi-structured qualitative interviews (n = 172) with city representatives, activists, non-profits, developers and residents. Respondents reported health implications of traditional (heavy pollutants, poor social conditions), transitional (decontamination, new amenities), new (gentrification, access to amenities), and emerging (displacement, climate-related risks, re-emergence of traditional exposures) exposures. Respondents reported renewed, complexified and overlapping exposures leading to poor mental and physical health and to new patterns of health inequity. Our findings point to the need for theories of environmental and epidemiologic risk transitions to incorporate analysis of trends 1) on a city-scale, acknowledging that segregation and patterns of environmental injustice have created unequal conditions within cities and 2) over a shorter and more recent time period, taking into account worsening patterns of social inequity in cities.

1. Introduction

As cities redevelop formerly industrialized and contaminated sites and increasingly replace them with green infrastructure and other nature-based interventions, little is known about the impact of these changes on the health of marginalized residents living in the

surrounding neighborhoods. For instance, evidence is still needed to understand whether such residents, often those harmed by environmental racism and uneven urban development, benefit from environmental improvements, or whether these interventions trigger processes that keep them at higher risk for poor health than other groups or even produce new risks. Such unanswered questions are key for

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<https://doi.org/10.1016/j.socscimed.2021.113907>

Received in revised form 18 December 2020; Accepted 1 April 2021

Available online 3 April 2021

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understanding neighborhood and residential environmental justice trajectories and creating more just and healthy green cities for all.

1.1. Epidemiologic and environmental risk transitions

Based on trends in fertility and mortality rates over the course of modern history, the epidemiologic transition theory describes changes in patterns of health and disease and interactions between these patterns and their social, demographic and economic consequences (Omran, 1971). This trend is closely linked to the demographic transition showing steady population growth followed by a leveling off due to reductions in fertility. A long-term change in disease patterns is also apparent, transitioning from periodic infectious disease epidemics and famine, to what Omran termed “degenerative and man-made diseases” (i.e., non-communicable diseases) as the primary cause of premature mortality. In addition to examining historical trends, theories of epidemiologic transition also draw on differences observed by level of economic development, comparing causes of disease and death and demographics between Global South (majority) and Global North (minority) countries (Smith and Ezzati, 2005).

Building on this theory, and following the logic that shifts in causes of disease and death must be preempted by changes in risk factors, the risk transition theory argues that changes in environmental risk factors at the household, community, and global scales accompany economic development and urbanization and ultimately lead to epidemiologic transition (Smith, 1994). This theory holds that factors increasing risk for infectious disease are largely at the household level (e.g., lack of access to clean water and basic sanitation) and these diminish with economic development (Smith, 1994). Meanwhile, more “modern” environmental risk factors, including exposures at the community (e.g., air pollution in cities) or global (e.g., increasing global levels of greenhouse emissions) scales are more likely to lead to non-communicable diseases. A third category of risk factors, injuries from accidents or violence, may not be directly linked with patterns of development. Risk transitions are also related to global urbanization patterns. As societies become more urbanized, specific risk factors are likely to change—for example, a shift to higher energy diets accompanied by lower levels of physical activity among urban residents are linked to cardiovascular and metabolic diseases (Yusuf et al., 2001).

Country-level analyses show that mortality associated with all three risk categories—household, community and global—declines with development, suggesting that the assumption of the epidemiologic transition theory that non-communicable diseases simply replace infectious ones in the disease burden of more developed countries may be erroneous (Smith and Ezzati, 2005). Thus, focusing on risk factors rather than cause of mortality may be more informative, as they reveal the more nuanced ways in which different types of risks change with development. For example, household-level risk factors decline with development “nearly uniformly” whereas community-level risk factors seem to peak in middle-income countries and decline in high-income countries. Secondly, focusing on risk transitions also allows for identifying distal versus proximate causes and multiple causes of disease rather than examining only trends in mortality. Therefore, this approach is more useful for informing potential interventions to improve health. Smith and Ezzati also present three types of “risk overlap” that acknowledge the likelihood of overlap between substantial household and community risk (a likely circumstance among urban slum populations for instance). Such scenarios may result in 1) the *genesis* of new types of risks, 2) *transfer* of risk, in which the presence of one risk decreases or increases the importance of another or 3) *risk synergy*, in which the sensitivity to one risk factor is heightened as new risk factors are added (Smith and Ezzati, 2005).

1.2. Urban environmental justice and health equity

Despite emphasis on the role of urbanization in risk transitions, the

theory of environmental risk transition lacks interpretation of inequities occurring within cities in the context of uneven urban development, where exposures to different types of risk factors at the household and community level vary by neighborhood, resulting from unequal environmental conditions and racial and class segregation seen within cities across the development spectrum (Friel et al., 2011). Past research has demonstrated that residents of neighborhoods suffering from environmental injustices (Brender et al., 2011), in which largely minority and low-income populations reside, suffer worse outcomes related to having greater exposure to toxic waste, air pollution, flooding and other environmental hazards—a phenomenon known as environmental racism. Living near environmental hazards has been shown to be associated with higher risk for poor birth outcomes, childhood cancer, cardiovascular and respiratory illnesses, and others (Brender et al., 2011; Bryant and Mohai, 1992). Since the late 1970’s, the environmental justice movement has brought attention to these unjust outcomes through the fight for the clean-up of former toxic waste facilities and other unsafe living conditions (Brulle and Pellow, 2006).

Environmental justice research also highlights the reciprocal relationship between poor social conditions and the built environment, which generates unjust conditions for marginalized populations (Friel et al., 2011; Abel and White, 2011). In the United States, hazardous waste facilities have been predominantly sited in lower income and Black or Hispanic neighborhoods (Bullard and Wright, 1990; Pulido, 2017; Justiceoffor, 1987). A long history of racial and class segregation created and sustained by racist laws and practices during the 20th century, such as redlining, or the placement of transportation infrastructure, have strained social cohesion, created additional environmental hazards, and led to devastating health impacts. Once vibrant Black communities have also been placed in harm’s way due to zoning decisions. Many areas zoned as industrial are also historic homes of Black communities (Bullard and Robert, 2000; Mohai and Saha, 2015). In addition to increased industrial pollutant exposure, this reality prevents such communities from making improvements such as upkeeping homes due to the lack of residential designation. Furthermore, underfunded and segregated schools, widespread poverty, and crime, among other conditions, have further affected the health of communities of color (Desmond, 2016; Sharkey, 2013). Environmental justice literature in Europe is much more recent, and only a few studies address ethnicity as a social dimension, relying on place of birth or citizenship as a proxy due to the dearth of existing data (Pasetto et al., 2019). Existing European studies show similar patterns in terms of the relative disadvantage, and greater exposure to environmental hazards, among lower class and foreign-born residents (Pasetto et al., 2019; Agyeman and Evans, 2004).

Unjust distribution of environmental amenities (such as parks and other green spaces) in cities has also been raised as a contributor to poorer health outcomes among marginalized communities such as people of color (Anguelovski et al., 2019a). Concurrent to unjust exposures to environmental hazards, the distribution, quality and safety of green spaces has also been historically uneven, adversely affecting these same communities (Connolly and Anguelovski, 2021; Nardone et al., 2021; Williams et al., 2020). Recent literature points to new health inequities resulting from green gentrification among residents of these same neighborhoods historically experiencing elevated exposure to environmental health risk. Green gentrification, often driven by green boosterism (Garcia-Lamarca et al., 2021), demonstrates that lower income and minority residents are increasingly excluded, either physically or culturally, from benefiting from new or improved environmental amenities, often those that the same communities fought for, and from the clean-up of long-lasting environmental hazards (Abel and White, 2011; Gould and Lewis, 2017; White and Abel, 2019; Anguelovski et al., 2020). Past research shows, for example, that although residents of gentrifying neighborhoods were more likely to benefit from living near green spaces, these benefits were limited to higher income residents and those with higher levels of education, rather than residents of lower social classes who are often long-term residents of gentrifying

neighborhoods (Cole et al., 2019). Both the inequitable distribution of environmental hazards, and the process of gentrification that may result from environmental improvements associated with urban renewal processes, contribute to within-city variation in risk exposures.

Changes in environmental risk exposures are constant and ongoing, despite there being a longer lag time between exposures and non-communicable diseases than for infectious diseases (Smith and Ezzati, 2005). Thus, a model that takes into account these ongoing changes to urban environments, and the re-distribution of populations that occurs due to gentrification and displacement over a period of just a few years, rather than over generations, may be more effective in identifying modifiable risk factors than the traditional risk transition theory which is based on slower, less geographically specific development processes. Furthermore, the increased likelihood of neighborhoods that historically suffered from environmental injustices to also be a target for gentrification (Gould and Lewis, 2017) points to the need to adopt a more dynamic model that takes into account ongoing change, including the unintended consequences of urban renewal (Mehdipanah et al., 2015; Cole et al., 2017), rather than only analyzing risk factors present at one given point in time. This may be more informative for addressing the complex nature of urban health inequities.

1.3. Environmental health justice risk transitions

While emphasizing environmental risk rather than causes of disease and death may lead to more applicable evidence for designing health-promoting policies and development practices, failing to examine equity in exposure to risk factors within cities has the potential to deepen already extreme social and health inequities. By applying an environmental justice lens to theories of environmental risk transition, we point to the need to examine environmental risk transitions along two novel additional dimensions: 1) on a city-scale, acknowledging that segregation and uneven patterns of urban development and environmental injustices have created unequal conditions within cities, even in the Global North, which are not accounted for in the traditional discussion of risk and epidemiologic transitions; and 2) over a shorter and more recent time period, taking into account the existing and worsening patterns of social inequity within cities occurring in recent decades. To do so, we examine the overlapping, synergistic and new risk factors over the course of environmental risk transitions of neighborhoods in seven mid-sized cities in the Global North which have experienced histories of extreme environmental degradation followed by recent urban renewal and, in several cases, green gentrification. Specifically, we ask: How do environmental health riskscape change as neighborhoods experiencing histories of environmental justice go through processes of urban renewal and (green) gentrification? What are the implications of environmental risk transitions for historically marginalized urban residents?

2. Materials and methods

2.1. Case selection

The cities and neighborhoods were selected from a larger EU-funded research project which aimed to compare green gentrification dynamics in mid-sized cities in Canada, the United States, and Western Europe. From an initial sample size of 99 cities in these regions with populations between 500,000 and 1.5 million, and whose greening trajectories over the last two or three decades can be rigorously traced, we conducted fieldwork in 24 cities representing a variety of geographic areas and city types (i.e., industrial, post-industrial, economically growing or shrinking). From among these 24 cities, where field work was conducted in one or several neighborhoods in each city, we selected the seven neighborhoods meeting the following criteria: 1) a history of environmental degradation (elevated exposure to environmental risk) and 2) recent processes of urban renewal and/or green gentrification. The study was approved by the institutional review board at the Autonomous University of Barcelona.

2.2. Case presentations

Descriptions of the seven cities and embedded neighborhoods or districts are summarized in Table 1. These neighborhoods shared several characteristics. For instance, each had a long history of contaminating industries (in keeping with the selection criteria); was located near a large body of water; and in a location prone to high levels of air pollution. The location of the neighborhoods and the presence of contaminating industries revealed the importance of focusing on environmental amenities to enhance overall quality of life, livability, and attractiveness. As a result, each had then undergone a process of large-scale environmental remediation in more recent decades. During or immediately after the period of remediation, the neighborhoods had experienced processes of urban renewal, and in most cases, gentrification. Each neighborhood received some form of large-scale redevelopment with both private and public sector funding, with often strong economic impacts. Accompanying urban renewal processes, each neighborhood also has several large-scale, often luxury or at least mixed-income projects including housing, retail, and new amenities such as parks. Here we borrow the term “luxury” housing from the real estate industry in reference to the strategy used to rebrand and remarket neighborhoods undergoing redevelopment. (Green) gentrification has also been observed in most neighborhoods as recent environmental clean-ups and amenities have attracted higher income residents, changing their overall demographic and social character.

Despite these commonalities, cases also had unique and contrasting characteristics. For example, Glasgow and Cleveland are still largely struggling from a health and social equity standpoint, with continuing deep inequalities and fragile economic bases. Meanwhile, Boston, San Francisco, and Seattle have experienced pronounced and rapid economic growth through which both long-term and newer residents are still exposed to polluting industries and/or increasingly to dangerous flood levels. The Amsterdam case embodies the transformation of a peripheral working-class neighborhood into a gentrified creative hub. In Dallas, while gentrification is not very advanced, new development and recent greening interventions have led to the erasure of several cultural enclaves. Current activity in the West Dallas section suggests similar outcomes. Although most areas consist of a single neighborhood, West Dallas, Glasgow’s East End and Amsterdam Noord are conglomerations of several small neighborhoods, bound together due to their common exposures to contamination and histories of disinvestment but also representing distinct communities in the growing US South, and post-industrial Northern UK and the Netherlands. In the case of West Dallas, these small communities are largely divided by race/ethnicity with approximately half being predominantly Latino and half predominantly Black, while most of the East End is White and throughout Amsterdam Noord there is a mixture of immigrants from the Global South and lower income White residents.

3. Data collection

3.1. Primary data collection

For each city and neighborhood, one co-author spent approximately one month during 2019 conducting semi-structured interviews with local residents, activists, municipal employees and elected officials, developers and representatives of community-based or non-profit organizations. We interviewed at least two respondents from each type identified through internet searches, review of local media articles and snowball sampling and proceeded with interviews until reaching saturation. All participants provided informed consent for participation. For those who agreed, interviews were audio-recorded and transcribed.

Interviews were conducted using a semi-structured protocol designed for the parent study. Each interview included specific questions on the following themes: history of local urban development, baseline and changes in environmental exposures for residents,

Table 1

Summary of historic exposures to environmental hazards, recent or planned public investments and recent private developments for the 7 neighborhoods. Information extracted from interviews in each city and consultation with grey literature and city webpages (see Supplemental Materials for a list of consulted sources).

Neighborhood, City	Urban development history and main features	Sources and types environmental exposures (20th century- Present)	Current observed conditions	Recent or planned public investments in environmental amenities	Recent private developments
Amsterdam Noord, Amsterdam	Separated from the city by River IJ Historical peripheral urban functions First “garden villages” (tuindorp) for industry workers Recent conversion into waterfront redeveloped “creative hub”	Late 19th century – 1980’s: Various (Shipyard, chemical industries and aircraft factory) • Noise • Lead • Toxic brownfields Roadways • Noise • Air pollution Waterfront location • Flooding	Many trees Good walkability and bike-ability Direct Transport Connection to city center Limited remaining industrial activity Endured contamination of some sites Existing lead plumbing	2018: New metro line 2014-present: Noorderpark and swimming pool 2015: Waterfront greenway	Creative industries New luxury housing Redevelopment of garden-villages into private housing
East End, Glasgow	Historical industrial haven Multiple cycles of state-led slum clearances and regeneration (1970s and 1980s) Large-scale regeneration through the Clyde Gateway partnership	Early 19th century – 1970’s: Heavy industry (J&J White chemical company, Dalmarnock Gas Works, Dalmarnock Power Station) • Chromium IV • Total and free cyanides • Thiocyanates • Polycyclic aromatic hydrocarbons (PAH) • Other heavy metals and chemicals Riverfront location • Flooding • Air pollution	Bike lanes and cycle paths along the Clyde River Rapid train connection to downtown Glasgow Food desert Continued presence of vacant and derelict land	2010 to present: Remediation of 750 ha of vacant and derelict land 2016 – Cuningar Loop woodland park 2012 – present: small scale blue and green infrastructure across the East End, usually connected to development sites Public space improvements	Recruitment of existing creative industries in Glasgow’s West End to relocate to the East End Commonwealth Games village (social and private) Other mixed housing developments
East Boston, Boston	Built on infill connecting small islands to be used for industrial activities Since 1839, port of entry and employment for many immigrant groups Transportation hub for ships, subway, and major traffic arteries Large-scale new development along cleaned-up waterfront Recent and ongoing transformation into green climate resilient district	1920’s to present: Expansion of Logan International airport • Air pollution Highways • Noise • Air pollution Waterfront (harborside and river) location • Gas tanks along river • Air pollution • Salt piles • Coastal and inland flooding • Future sea-level rise	Enduring airport and industrial contamination Rapid transit connection to downtown Boston Good walkability Poor access to grocery stores Support to equitable food options (farmers’ market and CSA) from the local health center Few neighborhood trees	Buffer parks such as Bremen St Park (2007) and the East Boston Greenway (2007) Climate resilience planning and parks (Porzio and Piers Park; ongoing) New neighborhood parks such as Lopresti Park (ongoing) East Boston living shoreline Proposed controversial electrical substation	Shoreline Esplanade (Harborwalk) Luxury housing developments, such as Clippership Wharf and Portside at East Pier
Detroit Shoreway, Cleveland	Long industrial history anchored around transportation, machinery, and iron-and-steel companies One of the most segregated cities in the US coupled with high crime rate Drastic economic and population decline Recent large-scale redevelopment instigated by proximity to downtown and to transportation corridors	1890’s to 1999: Various industries (Eveready Battery Company; Walker Manufacturing, later Westinghouse, etc.): • Mercury • Asbestos • Other heavy metals Housing (houses built pre-1978) • Lead from house paint Waterfront location • Exposure to sewage, algae and agricultural toxins in water	Sidewalks well extended throughout the neighborhood. Cycling lanes, public transport, retail, sit-down restaurants, cultural amenities and safety heterogeneously distributed within the neighborhood. Few street trees No significant ongoing industrial activity	2013: Edgewater Park improvements Ongoing: Sewage system improvements Lakefront bikeway connector Redline Greenway and Whiskey Island Connector	New luxury housing Gordon Square Arts District
West Dallas, Dallas	Composed of small neighborhoods historically divided along racial lines, across the river from downtown Dallas but isolated by highway infrastructure Recent development housing and entertainment boom Top-down mega-project designed to establish a new “regional attraction” along the riverfront	1934–1983: RSR (formerly Murphy Metals) lead smelting plant • Lead in soil and dust Ongoing: Other various industries (concrete plant, metal recycling, others) • Various heavy metals and toxins Riverfront location • Flooding • Air pollution from downtown Dallas	Few sidewalks Areas with unpaved side roads Limitations in sewage infrastructure Concrete plant now in the center of the neighborhood and many other industries still active Poor access to grocery stores	1990’s: Decontamination via superfund program 2014: New bridge connects the neighborhood directly to downtown Ongoing: Improvements to small local parks Planned: Harold Simmons Park (public/private) Planned: Stormwater management infrastructure	Trinity Groves development (housing, retail, restaurants) Various luxury housing developments

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Table 1 (continued)

Neighborhood, City	Urban development history and main features	Sources and types environmental exposures (20th century- Present)	Current observed conditions	Recent or planned public investments in environmental amenities	Recent private developments
Bayview-Hunter's Point, San Francisco	History of heavy industry and several scrapyards, diesel freight transportation and two freeway lines Site of a 500 acres new redevelopment plan for the San Francisco southeastern waterfront (green and sustainable design) Overall, sought-after by the real estate sector as one of San Francisco's last development "frontiers" Last vestige of a formerly robust set of African-American neighborhoods on the eastern waterfront	1945 to 1974: Navy Shipyard and Naval Radiological Defense Laboratory (1948–1960; used for clean-up, disposal and experiments involving radioactive materials): <ul style="list-style-type: none"> Petroleum fuels Polychlorinated biphenyls (PCBs) Other toxins and metals Various industries: <ul style="list-style-type: none"> Lead Air pollution Waste dumping Trains and roadways <ul style="list-style-type: none"> Noise Air pollution Waterfront location <ul style="list-style-type: none"> Flooding Sewage and water pollution Waste Disposal <ul style="list-style-type: none"> Major wastewater treatment plant in the area 	Terminus of the only rail transit line built in the city since the 1960s, completed in the 2010s Mix of remaining heavy industry and residential uses Poor access to food amenities Several longstanding community gardens and neighborhood scale greenspaces	2000's: Decontamination via superfund program Ongoing: India Basin project (waterfront park, residential and commercial) to make the waterfront more integrated and accessible for a decaying infrastructure stock within a contaminated area. "Blue Greenway" project along the entire eastern waterfront is extending to the neighborhood	New housing with up to 13,000 homes, with 32% meant for affordable housing Major ongoing construction of large new housing development on the site of the former Candlestick Park baseball stadium Large scale planned development following from similar large scale projects further up the eastern waterfront
South Park, Seattle	Historically home to many immigrant communities, displaced or emigrated over time (i.e., Italian and Japanese farmers, currently Latino and various Asian and African communities) Late incorporation into the city led to heavy industry alongside residential areas Rapid gentrification across the entire city largely related to the tech industry (Amazon and other), leaving South Park as one of Seattle's "last affordable neighborhoods"	Early 1900's to present: Various industries (Boeing airplane factory, metal recycling, others) <ul style="list-style-type: none"> Heavy metals found in river water (PCBs, arsenic, others) Air pollution (arsenic, chromium) Airport flight path <ul style="list-style-type: none"> Noise Air pollution Waterfront location <ul style="list-style-type: none"> Flooding 	Many streets away from the main commercial area lack sidewalks Areas with unpaved roads Less green space than elsewhere in the city Across the river from an airplane plant, a metal recycling plant, and other heavy industries, and others remain in the neighborhood No grocery store Not connected to the rest of the city by bike or pedestrian infrastructure	Early 2000's and ongoing: Decontamination through superfund program 2014: New 14th Ave bridge (after 4 years without bridge connection to the rest of the city) In process: Renewal of small local parks In process: Stormwater infrastructure projects and new pump station Planned: New South Park Plaza	New luxury housing throughout neighborhood

inclusion and equity issues in regard to those changes, and health impacts for residents (for specific questions, see Supplemental Material). In each city, interviewees spoke to experiences, knowledge and expertise regarding the specific case neighborhood, and broader overlapping perspectives such as city- or region-wide policy or planning processes. The final dataset included 172 transcribed interviews (see Table 2).

Table 2
Interviewees by type and neighborhood/city (N = 172).

	Residents, Activists or Civic Groups	Non-Profits	Municipal Representatives	Developers	Total
Amsterdam Noord	9	4	8	3	24
East End, Glasgow	6	8	8	3	25
East Boston	14	9	3	6	32
Detroit	16	4	8	4	32
Shoreway, Cleveland					
West Dallas	8	6	4	4	22
Bayview-Hunter's Point, San Francisco	4	7	2	3	16
South Park, Seattle	7	4	8	2	21

3.2. Secondary data sources

In addition to primary data, we collected relevant secondary data to complement our understanding of local urban development changes and equity issues for each case: 1) documents and fact sheets, reports, or policy documents produced by a variety of local organizations, 2) newspaper articles, and 3) city planning documents concerning the specific case or that addressed health and well-being or social equity in each city. Information from these sources was used to triangulate and verify the accounts of interviewees, and to identify information such as specific pollutants, dates of relevant events, or results of un-published studies which were referenced by respondents. Grey literature, along with published academic literature, also provided an understanding of the history of each area, industries which had come and gone, and city planning efforts (summarized in Table 1).

3.3. Analysis and interpretation of results

We created a detailed coding scheme based on the main conceptual and analytical themes we sought to understand. Meetings were conducted to ensure consistent understanding and intercoder reliability. Each interview was coded using NVivo software. After all coding was complete, we selected specific codes in order to more deeply understand the perceived health impacts of the historical and enduring environmental hazards in the neighborhood, how respondents understood the health benefits of greening and how residents perceived the health impacts of gentrification and other urban renewal processes.

4. Results

We present our findings on the environmental risk transitions of neighborhoods in seven mid-sized cities in the Global North which have experienced histories of extreme environmental degradation followed by recent urban renewal and, in most cases, green gentrification, to understand the impact of these processes on the environmental health riskscape of each neighborhood. Subsections correspond to this trajectory, presenting results on traditional, transitional, new and emerging exposures. We include supporting quotes selectively to illustrate our findings.

4.1. Traditional environmental health outcomes and exposures

Traditional risk factors were those relating to the neighborhoods' histories of poor environmental and social conditions.

- General and physical health outcomes

Interviewees reported multiple health effects of living in neighborhoods with histories of environmental degradation and industrial waste exposures. Respondents also linked poor health to social conditions. They pointed to neighborhood-level exposures, household exposures, and inequities by race and class resulting in intergenerational poor health. Many respondents pointed out that uneven urban development had resulted in the neglect of these neighborhoods which was most visible when comparing their neighborhoods to other parts of the same city. When referring to statistics on health, most data cited by respondents and identified in the grey literature also highlighted poorer health outcomes for the study neighborhoods vis-à-vis other neighborhoods or the city.

Respondents referred to general health and to specific conditions that illustrated the historic and enduring environmental exposures and social conditions faced by historically marginalized groups. For example, in San Francisco, Bayview-Hunter's Point residents mentioned specific health conditions such as asthma and other respiratory infections, cancer, low birth rates, and diabetes, which they linked to long term neglect from responsible federal agencies and years of contaminant industrial activity. This trend also extended to multiple generations. One San Franciscan explained, "yeah I have asthma, I've been in Bayview [...] my family's been in Bayview for several generations and everybody in my family has asthma [...] it's like so commonplace".

Respondents from several neighborhoods spoke about general poor health manifesting as lower life expectancies in case neighborhoods, often pointing to existing reports. For instance, respondents in Glasgow referred to the 'Glasgow effect' (Walsh et al., 2010), a term coined by epidemiologists due to their inability to understand why, despite similar levels of deprivation as other post-industrial cities in the UK, Glasgow has a much higher mortality rate. East End residents of Glasgow in particular have poor health and notoriously low life expectancies, with a 15-year gap in male life expectancy between the wealthiest West End neighborhood (81.7 years old) and the most deprived East End neighborhood (66.2 years old) (Nixon, 2016; Cowley et al., 2016). In Cleveland, respondents pointed to data showing a 23-year difference in life expectancy between the suburbs and the inner city (89 years vs 63 years, respectively).

- Mental health outcomes

In each of the study cities, the previously mentioned statistics were engrained in the minds of local people, and respondents pointed to the statistics themselves as having an impact on health, explaining that widespread knowledge of these notoriously poor outcomes, reinforced by media accounts, have a psychological effect on residents. This worked in combination with poor social and physical environments to reproduce patterns of poor health. As one Glaswegian East End resident

explained: "it wasn't just about lack of opportunity in areas like this, as I say it was about what that perception of that area does to you in here [points to chest] and your perception about yourself and wider community ... For me that has massive health impacts".

In most neighborhoods, respondents spoke of life-long residence in their neighborhoods, lengthening their exposure over their entire life-course and cementing poor expectations about improved wellbeing and social or economic mobility. Respondents in Glasgow explained the deep stigma internalized by residents over generations, described by the slogan 'hard life, early death', which is often used to describe the East End neighborhood of Calton. This means that on top of living in poverty with ill health, substance abuse and other difficulties, residents limit themselves in terms of their own aspirations, adding an important mental health dimension to the material realities impacting people's health and well-being.

- Household, occupational and neighborhood environmental exposures

Asthma and other respiratory difficulties were mentioned as endemic health conditions in all the neighborhoods, and these were linked to enduring air pollution and occupational exposures. Air pollution was a commonality of all neighborhoods due to their low-lying locations, being along airplane flight paths (South Park and East Boston), being near roadways or train tracks (West Dallas, Detroit Shoreway, Bayview-Hunter's Point, Amsterdam Noord), and being near industries emitting particulate matter (East End, South Park, West Dallas, Bayview-Hunter's Point). Respondents explained that respiratory illnesses had multiple and overlapping causes: "there's asthma rates but that relates to air but the air also relates to workforce and then, you know we connect a lot of things [...]" [South Park activist]. Occupational exposures were common among the many residents who work in nearby industries. This is particularly relevant given the histories of many of the neighborhoods, which for generations have housed workers from local industries and their families, who now are also hired on construction sites for the new real estate developments on previously vacant and often contaminated land in neighborhoods like East Boston and West Dallas.

Respondents also mentioned household contamination exposures made even more dire by the substandard housing of many low-income residents. In Amsterdam, the testing of tap water in 2020 in a garden-village in Amsterdam Noord revealed that it contained 78.7 µg of lead per liter, significantly more than the WHO maximum recommended threshold of 10 µg per liter (Amsterdam. Frequently, 2020). Yet the housing corporation that manages these estates did little to respond to these health violations. In Cleveland, respondents were concerned about lead exposure via the paint of the many older houses in Detroit Shoreway as well as in soil throughout the neighborhood, referring to it as an "equal opportunity" exposure, further explaining that many children in the neighborhood suffer from learning disabilities attributed to lead.

All neighborhoods also faced a lack of health promoting resources. For instance, in East Boston, Detroit Shoreway, West Dallas, South Park and East End Glasgow, there was limited access to fresh fruit and vegetables in the neighborhoods and residents lamented the lack of good quality grocery stores. In Detroit Shoreway and East Boston, respondents linked the scarcity of access to healthy food, along with a lack of safe parks and recreation spaces, to obesity, particularly among children. "We have a very high rate of childhood obesity in the neighborhood and I think that's probably the most significant health issue that folks face [...]" explained a health center representative from Boston.

- Neighborhood social environments

Social conditions in the neighborhoods such as concentrated poverty and racial segregation were thought to exacerbate health problems. Most neighborhoods were home to minority and immigrant communities, and all were predominantly low-income (until recently). In

addition, unsafe conditions, particularly high levels of street violence and drug use were cited as being harmful to the physical and mental health of residents. In Glasgow's East End, arguably the oldest industrial landscape in the world, many toxic heavy industries were in operation for over a century. They largely shut down in the 1960s and 1970s, contributing in part to the accumulation of vacant, derelict and abandoned land found across the area, which was reported to attract drug use and illicit behaviors. In West Dallas, respondents explained how racial tension between Hispanic and Black residents, who are often segregated by small neighborhoods within the area, each having separate and active drug distribution networks, exacerbates drug-related violence and prevents law enforcement from addressing the issue. Gang activity was mentioned by respondents in South Park, Bayview-Hunter's Point, East Boston, and East End Glasgow, particularly among youth.

Traditional exposures were never simple or isolated. Some residents acknowledged multiple exposures, or simply highlighted the difference in health outcomes between their neighborhood and others as reason for concern and action. One community activist in Dallas stated "we've had problems with the soil, we've had problems with the quality of air, you know, the water, the run offs from the contamination from all the factories that used to be here." Even in neighborhoods where one specific exposure seemed predominant, interviewees mentioned the presence of other environmental exposures and complex social issues, all with clear implications for health, such as crime, violence, substandard housing (often resulting in additional environmental exposures via lead paint, mold, etc.), lack of access to affordable and healthy foods, and others.

4.2. Transitional environmental health exposures

Respondents mentioned many exposures relating to recent physical changes in the neighborhood environments.

- Decontamination

Although decontamination processes had taken place in many of the neighborhoods, respondents of all types expressed mistrust that these processes had fully mitigated health risks. All neighborhoods experienced delays in the closure of certain industries and subsequent clean-up efforts. Land in all neighborhoods has long been identified as having much higher than the recommended threshold of at least one environmental hazard. Three of the US neighborhoods (West Dallas, Bayview-Hunter's Point and South Park) included areas deemed Superfund sites, highly polluted lands which are determined to be unsafe for use and to need remediation by the U.S. Environmental Protection Agency (EPA) at various points over the past 3 decades.

Many sites had been contaminated by multiple industries and companies over various decades, resulting in exposure to multiple toxins and in difficulty to identify responsible parties (and to hold them responsible for the cost of remediation). In West Dallas, for instance, although the Superfund designation was established based on lead in soil and dust linked to a specific company which had operated a lead smelting plant in the neighborhood for over 50 years, the neighborhood is also contaminated by a metal recycling company, a concrete plant and other industries that have operated nearby over the years, many of which continue operations.

- New Parks and Greening

As residents from the study neighborhoods continued to endure health hazards from the legacy of industrial environments, they had also started to benefit from investments over the last decade in new or planned public parks or other green spaces, or newly renovated green spaces. Most often physical and mental health benefits of green spaces were highlighted by interviewees, citing multiple pathways for this relationship. First, several respondents mentioned that greening provides protection from environmental exposure by cleaning air pollution

or shielding exposures, specifically in the context of tree planting or conversion of contaminated or vacant lots into gardens or parks. Second, respondents spoke about the health benefits of engaging with nature more generally. For instance, one Glasgow city planner cited health and well-being as one of the key drivers of the city's open space plan, stating, "I don't think you can overestimate how important it is to walk out your door in the morning and hear the birds sing for example, just giving people that opportunity to engage with, but then there's all the other benefits nature provides us with, including pollination, including cleaning our water and cleaning our air and all these sorts of things". Positive impacts on mental health were also highlighted by a municipal representative in Detroit Shoreway, with green spaces offering "chances to be outside and breathe cleaner air and recreate and just as much physical health as it is up here in your head".

However, park use varied by neighborhood social characteristics. In some cases, new green projects had been developed directly on top of brownfields or derelict land, and residents worried that despite these areas being designated as safe for reuse, exposure to existing hazards may outweigh the health benefits of using such spaces for recreation. One activist in San Francisco described a conflict among community members around a new green space planned as part of the India Basin development: "[...] but y'all don't understand we don't have any parks. And so, these parks, you know, we're real excited about having these parks. And we were like, well, what about the toxic soil that the park is going to be on and the toxic air that you're going to be in?" Meanwhile, in Detroit Shoreway, recent improvements to maintenance and staffing in a park after its management was moved from the city to a regional entity appeared to encourage active use and deter drug consumption or dealing.

4.3. New environmental health exposures

New exposures included those related to specific social phenomena occurring just after transitional exposures.

- Gentrification

All seven neighborhoods had seen substantial municipal and private investment over the past decade (see [Table 1](#)) that brought many new real estate development projects catering to the means and needs of new higher-class residents. In most cases, long-term residents also viewed such investments and other improvements as leading to gentrification, which they felt further put them at risk for displacement or excluded them socially or culturally from their neighborhoods. Many long-term residents thus spoke about stress, sometimes leading to severe mental health problems: "They're stressing out. [...] youth saying 'our family's getting displaced, I don't know what to do, I feel suicidal' or 'in general what's happening in the world is beating down on me and my people, I feel desperate'."

At the same time, a lack of basic resources seems to be an enduring barrier to good health among residents. Many respondents noticed that new developments were favoring high-end restaurants and unaffordable organic food shops over the construction of needed grocery stores: "There's not even grocery stores here. I mean, we're a food desert, you know" [West Dallas]. In addition, institutional resources such as schools and health care facilities faced complex long-term challenges in meeting the needs of residents due to rapid changes in population, reduced budgets and coping with dilapidated facilities.

At the same time, the demands of new residents seemed to lead to improvements in the built environment which may benefit non-displaced long-term residents. As one public health official in Cleveland explained:

I think their [new residents'] demands, [...] so there's expectations that they are doing more with the built environment. Some mitigation of, even traffic flows, slowing it down, the painting of bicycle

lanes, the expectation that people are going to actually walk to restaurants etc. So they are investing in the built environment, making it, incentivizing people to use that, and also working very, very closely with police, public safety to make sure that it is safer

Some local residents spoke positively about the potential political clout held by new wealthier residents, who they hoped may be able to make headway in their efforts to clean up their neighborhoods and gain more health-promoting resources. In some cases, neighborhood leaders and activists mentioned reaching out to new residents or developers to gain their support for neighborhood improvement causes, putting aside feelings of mistrust, such as one West Dallas activist described:

It's been taking me several years to break the cocoon of fear, that [the neighborhood] has been in all this time, and to help them realize, they don't have to be our enemy, they can be our partners and help better our community. So, so now, I even had to break down my own, let go of my own mistrust and resentment, I guess you could say, you know, to begin that healing process myself.

- Access to new parks and greening

Processes of (green) gentrification in almost all the neighborhoods also led to tension around green space that had implications for the ability of residents to access, use, or benefit from spaces. For instance, new green amenities appeared as part of new luxury buildings or developments, and in these cases, access was often physically denied, or the spaces were not welcoming for long-term residents (i.e., Clippership Wharf in Boston). In another instance, a green space within a mixed-income development in Glasgow's East End was slated to be opened for public use after the Commonwealth Games, but in the end the area remained fenced-in at the insistence of the wealthier residents on the private, market-rate side of the development where the green space is located, creating unequal access to this new green space.

Even in cases where exclusion was not as visible, processes of gentrification and underlying systemic and interpersonal racism led to social or cultural exclusion from spaces through perceptions of being out-of-place that prevented engagement of residents with these spaces, which ultimately may reduce the benefit of such spaces or create sharp divides in who benefits and who is excluded. For instance, in East Boston, such processes led to a fear that young people could not access green spaces for recreation and physical activity, as one interviewee who ran a youth program in the neighborhood explained about a new park: "So, when we have the soccer tournament ... Some of my youth mentions like, it's kind of weird how it feels like we shouldn't be here." and this barrier was linked to high rates of childhood obesity. In Boston, several new or renovated green spaces are juxtaposed with massive luxury condos, creating a physical and cultural access barrier to the waterfront and the parks for long-term Latino or Italian immigrants. Social dynamics between new, White, higher-class residents and long-term residents created tensions and feelings of exclusion among long-term residents, who often felt that they were not afforded the benefit of new amenities.

Respondents also pointed to subtle reminders of systemic racism that had been symbolically embedded in many of the neighborhoods, and perceived as social exclusion. For example, one respondent in Amsterdam pointed out that the names of the buildings of housing remain the names of colonial slave traders. In West Dallas, although a park was named Martyr Park for three black men who were hanged on the banks of the river after being wrongfully accused of setting a fire, the signage and city website about this park do not mention this meaningful history, meaning that it fell short of contributing toward efforts at reparation for past injustice. In the same neighborhood, the wealthy businessman for whom a new park will be named (whose foundation also funded this park) made much of his wealth via the same industries that polluted the neighborhood over decades, contributing to many risk factors.

In other cases, respondents pointed to cultural preferences that may

limit use of the park by long-term residents, particularly in cases such as the Noorderpark in Amsterdam Noord, which had been designed as a metropolitan park to attract daytime visitors rather than according to preferences of residents. One local entrepreneur pondered: "It still puzzles me why for instance all these people, lower income people with small houses ... Why they don't use the park. There is a lot of people from Mediterranean origin here, Moroccan, Turkish and I mean: What stops them from going into the park with the families and the barbecues?" As the experience of Noorderpark illustrates, access is thus not merely spatial proximity to green spaces. It depends on park amenities and design feeling inclusive and able to meet different needs, identities, and preferences and to respond to diverse senses of place. In other cities in our wider study but not included in our sample, we note the case of the Superkilen park in Copenhagen, whose design and construction reflected an inclusive community engagement process with, for instance, objects and art from more than 90 nationalities – the nationalities of the wider Norrebro neighborhood – included in the park. Of significance is also the Parc Central de Nou Barris in Barcelona, where residents had a strong say on the layout and structure of the parc, and co-created a space that supports the relational wellbeing needs of local children (Pérez del Pulgar et al., 2020).

4.4. Emerging environmental health exposures

Emerging exposures related to recent experiences of participants as well as those which they anticipated in the near future.

- Displacement

Respondents explained how gentrification-driven displacement exacerbated or continued historical exposures, and divided exposures by population. These observations align with critical understandings of how urban space is expropriated (Harvey, 2008), which highlight how surplus is extracted from cities through new real estate growth in order to expand the frontiers of capital accumulation and to move ahead in the race for competitive urbanism while dispossessing and displacing working-class residents. For instance, although new, safer housing stock is being built in Detroit Shoreway, these homes were available only for higher-income residents who could pay more. Long-term, lower-income residents continue to live in poor-quality homes, often with lead paint exposure. In the garden village of Van der Pekbuurt in Amsterdam Noord after 40 years of disinvestment and under-maintenance, the housing corporation decided to renovate these homes, leading to the displacement of long-term residents, many of whom are of Turkish or Moroccan decent: "The renovation was needed. In the end, if you don't invest in your house for 40 years ... then you end up with crappy quality. And of course ... the people that live there, went and they don't come back. So they go to another city". Similarly, in South Park, housing activists noted that many low-income and minority residents were being displaced outside of the city to equally poor-quality housing with associated health risks. Furthermore, those forced out of Seattle would no longer be partially protected by municipal housing legislation regarding quality standards for rental property.

- Climate-related risk

All seven neighborhoods were along waterfronts and all except Detroit Shoreway were also at risk for flooding. Some experts and residents pointed to the added pressure of this risk, stating that flooding may cause loss of land and housing in their neighborhoods, and in some cases, that constant flooding was known to heighten exposure to buried toxins or to further expose residents to pollutants, sewage, or toxic algae (particularly in the lake waters adjacent to Detroit Shoreway and the coastal waters of the Bayview-Hunters Point area). Respondents also mentioned the increasing risk of flooding due to encroaching climate change. Waterfronts also contributed to other exposure routes;

respondents in San Francisco suggested the risk faced by residents who use the bay for subsistence fishing, which for some is an important source of food.

In several cities, in response to climate-related risks, green resilient infrastructure was planned or implemented, but, again, such infrastructure might not be accessible to all or may be linked to the gentrification processes (Shokry et al., 2020). In Glasgow, several riverside sites have been decontaminated using Sustainable Urban Drainage System infrastructure integrated into new mixed-income housing developments. The proportion of social and affordable housing, however, is significantly lower than market rate housing, and the latter is located on more optimal parcels of land – for example, with river views. In East Boston, green resilient infrastructure such as the shoreline park border luxury condominiums and discourage landscape and social integration with the rest of the neighborhood (Anguelovski et al., 2019b).

- Re-emergence of traditional exposures

Finally, both long-term residents and new residents worried that new construction in their neighborhoods was creating additional pollution and re-exposing old pollutants. For instance, in formerly polluted areas that had been decontaminated, some respondents pointed out that cleanup efforts only dealt with surface-level contamination, ensuring that only the top layer soil is decontaminated (Superfund Lead-Contaminat, 2003). However, new construction uncovered buried polluted soils by exposing soil from farther below the surface, thus reintroducing these exposures. As a respondent from East Boston explained: “Now with the new buildings, the concern is not the building themselves, but the sites you are digging up – the quality of the soil and what is going through the air”.

5. Discussion

We aimed to understand environmental risk transitions in neighborhoods in seven mid-sized cities in the Global North facing historic environmental degradation followed by recent urban renewal. By examining the overlapping and complex layers of health risk factors over the course of urban renewal and (green) gentrification processes, in addition to the enduring effects of environmental racism via unjust

exposure to environmental hazards, we present the complex riskscape that lead to within-city urban spatial health inequities. In Fig. 1, we present the resulting modern urban environmental justice riskscape framework which traces the evolution of the environmental riskscape for long-term residents as traditional historical exposures are replaced or compounded, over a relatively short period of time, as new and emerging environmental health risk exposures are revealed when neighborhoods undergo urban renewal, urban greening, and gentrification. Below we discuss our findings, relating them to the concepts of risk overlap presented by Smith and Ezzati, and further commenting on the elements of time and space which shape our understanding of neighborhood environmental riskscape.

5.1. Risk overlap: genesis, transfer, and synergy of risks

In line with the environmental risk framework presented by Smith and Ezzati, our findings show many examples of ‘risk overlap’ (Smith and Ezzati, 2005). For instance, our results reveal how urban renewal may transfer risk from the social and physical conditions associated with neighborhoods experiencing disinvestment (such as environmental hazards, violence/crime, poor access to healthy food, etc.) to new, less visible risks from social and physical exclusion resulting from processes of (green) gentrification, both affecting the same marginalized residents. We observed that in most cases environmental hazards were not simply replaced by new risks, but that a synergistic relationship occurred in which risk of exposure to these hazards was heightened by urban renewal such as new construction projects or the failure of comprehensive environmental remediation. In contrast to the framework presented by Smith and Ezzati, we find that in the neighborhoods we studied, community and global exposures such as air pollution and climate risk are still quite salient, despite being in highly developed countries. Our findings reveal that, at least relative to the cities as a whole, the concentration of such exposures in neighborhoods struggling for environmental justice contributes to within-city health inequities.

We observed many examples of household risks enduring in the neighborhoods we studied, despite the circumstance that these are hypothesized by the environmental risk transition paradigm to decrease with development. For instance, poor housing quality, and thus exposure to lead and/or mold, was mentioned by respondents in almost every

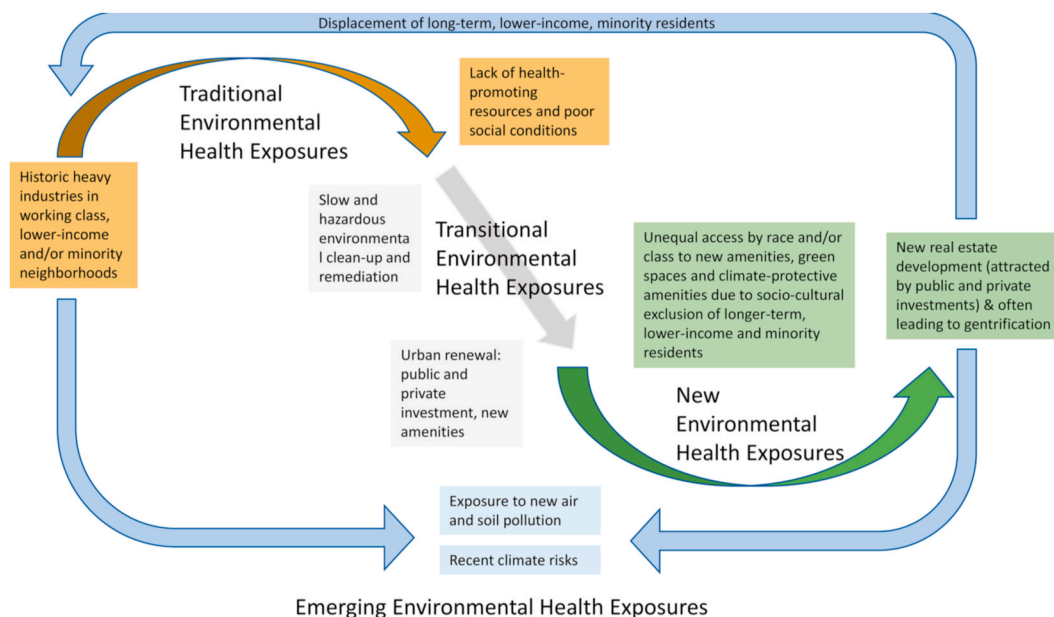


Fig. 1. A Modern Urban Environmental Justice Riskscape Framework. Evolution of and compounding of environmental health exposures as neighborhoods suffering from historic environmental injustices undergo processes of urban renewal and gentrification, which, along with existing segregation, exacerbate urban health inequity.

city. Despite construction of new higher quality housing, these exposures continued for lower-income and minority residents, often lifelong or multigenerational neighborhood residents, who cannot afford these new safer, but expensive, residences. In addition, increased housing-related costs and/or living in social housing prevent such residents from investing in home environmental and climate safety improvements. Some lower income residents in Seattle, Boston, and Amsterdam are being displaced from their neighborhoods, having to move into similarly poor-quality housing elsewhere, often in other cities or towns with worse pollution (Gould and Lewis, 2017). These findings indicate that reducing household exposures depends on the quality and the accessibility of better quality housing (Sharpe et al., 2018).

The risk overlap we observed is contrary to the singular exposures examined by most environmental epidemiological studies, as calculating epidemiologic risk relies on isolating specific exposures which are then studied individually (see Klompmaker et al., 2019 and Vrijheid et al., 2014 for exceptions). As noted by Wing, such observations do not reflect the true nature of complex exposures experienced by residents of areas with long histories of neglect and environmental degradation (Wing, 2016). Similarly, past studies often focus on a single health outcome, but our respondents were concerned about multiple physical, mental and developmental issues, pointing to a more complex and comprehensive picture of health with co-dependent or mutually reinforcing negative environmental exposures. Qualitative methods are particularly suited for understanding overlapping, complex environmental exposures (Brown, 2003; Scammell, 2010). Similar to past studies, our findings point to the need to develop epidemiologic methods that respond more to the overlapping risks experienced by many urban residents (Humphrey et al., 2019).

5.2. Time and neighborhood transitions

We find that risk factors evolve along with neighborhoods, with visible and important changes to neighborhood built and social environments occurring relatively quickly, over months to a few years, along with remediation of hazards, construction, and displacement of residents. Neighborhoods in which riskscapes described by environmental justice literature and activists (Bullard and Robert, 2000; Elliott et al., 1999; Lebrón et al., 2019) occur are quickly changing with urban renewal, and often gentrification. New risks are introduced as historic environmental risks remain, even if there are (slow and costly) efforts of mitigation (Mehdipanah et al., 2015; Lebrón et al., 2019). Thus, in addition to the overlapping complexity of risks, characterizing the exposures of a neighborhood at one point in time may be misleading. Time is also of concern to environmental epidemiologists in studying the health effects of environmental exposures, but discussions of time are often motivated by the need to determine the level or length of exposure. In contrast, our findings show that in addition to the length of exposure (especially as many residents are lifelong or multi-generational residents of the same neighborhoods), changes to the physical and social environments of neighborhoods have important implications for the study of environmental health impacts and for understanding multiple changing and overlapping drivers of health inequities.

5.3. Geographic scale and health inequity

Finally, we find that studying risk transitions and associated health impacts at a finer geographic scale than country reveals that exposures faced by residents move from immediate risks in the material lived environments (e.g., air pollution, lack of healthy food stores, etc.) to also include more subtle risks linked to exclusion from new amenities or resources, those which could be termed commercial determinants of health (De Lacy-Vawdon and Livingstone, 2020) (i.e., safer but inaccessible housing, cost-prohibitive healthy food stores, or enclosed or privatized green spaces). Recent urban renewal in these same neighborhoods lead to a combination of material risks and exclusionary

socio-cultural risks which overlap in the experiences of residents. These patterns of environmental exposures are only revealed at the neighborhood scale, and often require the examination of individual-level data to understand the nuances of environmental exposures that vary by race, ethnicity, or social class within the neighborhood. As social and health inequality in cities increase (Marmot, 2020), understanding this variation and the environmental exposures that marginalized urban residents faced is essential for improving population health and health equity.

5.4. Strengths and limitations

Our cross-sectional design limited our ability to test causality for the environmental risk factors we explored. However, our methods have distinct, novel advantages over the use of quantitative methods. For instance, relying on emic knowledge informs the development of new theory, filling gaps left by quantitative methods, such as the identification of potential causal pathways. This is the case in our identification of the risk factor-disease link between both the historic environmental exposures and the more recent exposures to urban renewal and gentrification processes experienced. Reliance on self-reported outcomes and exposures is particularly important in the context of examining issues relating to environmental injustices for which a lack of scientific evidence have contributed to the ongoing, unjust exposure to toxic environmental conditions (Brown, 2003). Our study also does not include the re-emerging threat of infectious diseases, which have important implications for population health and health equity. Initial evidence from several U.S. cities points to the unjust burden of the COVID-19 pandemic among urban residents of color, immigrants, and low-income communities. These are many of the same communities affected by environmental injustices, reflecting additional complexities of the health risk factors found in such neighborhoods. Longer term impacts of COVID-19 and trends in the frequency of pandemics may lead to another turn in the epidemiologic transition story.

This study also did not delve into specific policy and legislation that guide the enforcement of environmental clean-up, which may have led to differences between cities, especially those in different countries. However, we note that the Superfund program is unique in our sample and comparison for its clean-up scope and duration although The Netherlands has the oldest hazardous waste cleanup program in Europe. However, the European Commission notes that “the extent, severity and type of damages – is for the whole of Europe more or less the same as the universe of damages in the United States,” which does point to a common failure of contamination regulation across capitalist economies (Stone McGuigan, 2000). This paper focuses instead on the current implications at the local level of environmental contamination. In addition to its theoretical implications, our study also points to the need to develop municipal policy and planning interventions that address historic environmental injustices while preventing displacement and/or social or cultural exclusion that arise from processes of (green) gentrification. Decontamination programs may not take into account the multiple and overlapping pathways of exposure as reported by our respondents and pointed out by others, and therefore are largely inadequate for preventing health inequity associated with environmental exposures (Lebrón et al., 2019). We also noted that in many cases, the success of urban renewal initiatives in terms of improving neighborhood conditions were touted by those less intimately involved in the neighborhoods (such as municipal representatives) or by those investing in real estate projects (such as developers and architects) whereas residents and others working in the neighborhoods were more likely to point to social impacts such as exclusion or tensions between social groups. This observation points to the need for participatory planning processes in which the views of residents are valued and upheld in decision-making.

6. Conclusions

Our results have important implications for epidemiologic theory and methods. We find that studying epidemiologic risk transitions on a finer geographical scale and over shorter timeframes than traditional theories linking risk transitions to larger-scale development illuminates important nuances to identifying risks that contribute to socio-spatial health inequity in cities. Theories of epidemiologic transition have described the evolution of causes of morbidity and mortality as populations move through phases of development, often emphasizing the contribution of riskscapes in urban settings as exposures are modified via urbanization. However, the epidemiologic and environmental risk transition frameworks fail to identify more finite patterns resulting from exposure to persistent, transitional, new, and emerging environmental risks which are inequitably distributed within cities inequalities due to the ongoing impact of environmental racism (Friel et al., 2011). Failing to account for the resulting overlapping and synergistic risk factors, as often happens using a traditional epidemiologic approach, may lead to an underestimation of a population's true burden of exposure and to the inability of cities to address historic and new health injustices. By examining the perceived health-related risks of physical and social changes occurring in environmental justice neighborhoods over the past few decades, we reveal the importance of looking at more localized and rapid changes in environmental risk resulting in both new and sustained urban health inequities.

Contribution Statement

Helen V. S. Cole: conceptualization, formal analysis, investigation, writing-original draft and editing, Isabelle Anguelovski: funding acquisition, methodology, supervision, investigation, formal analysis, writing-original draft and editing drafts, James J. T. Connolly: investigation, supervision, formal analysis Melissa Garcia Lamarca: investigation, formal analysis, writing-original draft and editing, Carmen Pérez del Pulgar: investigation, formal analysis, writing-original draft and editing, Galia Shokry: investigation, formal analysis, writing-original draft and editing, Margarita Triguero-Mas: investigation, formal analysis, writing-original draft and editing.

Acknowledgements

The study was funded by the European Research Council under grant agreement [No 678034]. MTM, MGL and HC are funded by Juan de la Cierva fellowships [FJCI-2017-33842, FJCI-2016-30586, IJC-2018-035322-I] awarded by the Spanish Ministry of Economy and Competitiveness. None of the funding organizations were involved in the design, analysis or writing of this article.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.socscimed.2021.113907>.

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