Towards Preventative Urban Health Resilience

A Case Study of Cairo's Heliopolis

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Abstract

The increasing prevalence of diseases in urban populations caused by poor living conditions and social inequities is a primary concern for cities, especially after the COVID-19 pandemic, highlighting a significant vulnerability to health disasters. This research identifies specific urban determinants of health, aims to bridge the gap between urban health and urban resilience, and examines the health risks associated with changes in urban mobility and green space. Through a literature review and empirical research of the case study of Heliopolis, Cairo, where site observations, satellite images and semi-structured interviews provide data for findings relating social and physical determinants with potential population health outcomes. Heliopolis is undergoing an urban mobility project intending to turn it into a large mobility axis. The findings underlined a significant reduction in walkable spaces, percentages of greenery, and a sense of safety, affecting the resident's lifestyles and space-use patterns and potentially leading to increased health risks, pollution, and disaster vulnerability. This research calls for relinking urban health and resilience, adopting a more preventative approach to health promotion, especially in global south cities.

Keywords

Preventative Urban Health, Urban Resilience, Mobility, Green Space, Cairo

1. Introduction

Historically, health has played a significant role in shaping urban planning through changes in living conditions, disease outbreaks, and mass urbanization, amongst others. However, the link between urban planning and public health has gradually weakened, partly due to paradigmatic shifts in medicine and public health; where the focus moved from studying environmental factors to more focus on individual factors with the nineteenth century's 'germ theory' proposed by Koch (Rodger, 2019). Furthermore, changes in prevalent disease profiles to chronic long-term diseases, increased life expectancies, and improvements in medical treatments accelerated this decoupling (Corburn, 2004).

With changes in spatial planning, mobility, and urbanization, cities have become more polluted and densely populated than ever before (Nieuwenhuijsen, 2016), with an expected rise in the percentage of people living in urban settings to reach 60% by 2030 (United Nations, 2018). This strains the capacity of local governments and municipalities to provide services and amenities, with starkly inequitable disease distribution in urban populations –especially in global south cities. Propelled by the Covid-19 pandemic, multiple initiatives are addressing these challenges, notably in global north cities.

From this vantage point, the conceptual framework provides a basis for understanding the gap between urban health and resilience in urban planning. The case study examines the neighborhood of Heliopolis, Cairo, which recently underwent a massive grey-infrastructure mobility project and significant systemic reductions in green spaces. Greenspace in Cairo is estimated to be around 2 m² per capita, which does

not reflect the unequal distribution amongst different groups where many have access to less than 0.5 m² per capita (Kafafy and Al-betawi, 2020). This study analyzes the spatial and social aspects of these urban changes in mobility and greenspace and correlates the findings with associated health risks and vulnerability.

2. Literature Review

Exploring Urban Health and Urban Resilience

Urban Health

The term 'urban health' refers to the study of "the relation between the urban context and population distribution of health and disease" (Galea & Vlahov, 2005, p. 342). Keyes and Galea posit that cities are ubiquitous exposures, shaping population health through urban contexts, environments, how people interact with these environments, and their daily behaviors (Keyes and Galea, 2016). Urban health determinants operate on upstream and downstream factors from federal-level policies to individual-level actions and behaviors. This research identifies and examines the following determinants for the study: social environment, physical environment, provisioning of health services, population composition, and good governance (Vlahov, 2002; Galea and Vlahov, 2005; Marmot, 2005; Vlahov *et al.*, 2007; Braubach and Grant, 2010; Corburn, 2015; Hoisington *et al.*, 2019). These determinants and their pathways of influence inequitably shape population health due to various factors such as gender, socioeconomic group, disability, and age, amongst other factors (op. cit).

Identified Determinants of Urban Health

Social Determinant of Health

Social and socioeconomic factors affecting vulnerable communities could have significant effects on their health. This determinant includes community properties, socioeconomic status, crime and violence, the inclusion of marginalized populations, degree of participation in decision making, social cohesion, and social isolation. Multiple authors have studied social environments and community interactions by looking into poverty and space-based poverty. However, it is critical to note the heightened potential predisposition of different socioeconomic groups to develop adverse health outcomes caused by poor living conditions and health inequities. (Vlahov and Galea, 2003; Corburn, 2015; Wulff, Donato and Lurie, 2015; Hoisington *et al.*, 2019). Studies have demonstrated that social cohesion is associated with reduced stresses and increased social support and could lead to increased community resilience (Friel *et al.*, 2011; Hoisington *et al.*, 2019).

Spatial or Physical Determinants of Health

Spatial determinants include access to basic and essential services and access to efficient public transport, walkable areas, and green spaces. Corburn adds by including access to housing and the land-use allocation to active travel, public spaces, recreational areas, and parks compared to allocating areas for cars and motorized transport (op. cit). These pathways lead to potential increases in the prevalence of chronic physical diseases and mental disorders; respiratory and cardiovascular diseases (CVDs), cancers, stress, and mental disorders, amongst others (Vlahov, 2002; Groenewegen *et al.*, 2006; Vlahov *et al.*, 2007; Braubach and Grant, 2010). Spatial determinants of health rely on more quantifiable data, facilitating Health Impact Assessments for proposed urban planning and development projects. Furthermore, sprawled urban planning puts more strain on public transport systems and hinders active travel. Spatial aspects also affect social determinants of health through cultural activities, pedestrian zones, the probability of social interaction, and potential reductions in feelings of isolation. In

comparison, larger infrastructural projects such as highways contribute to cyclical urban stressors such as air and noise pollution, traffic jams, and gender-based violence *ibid*. These projects limit green and open spaces due to land use allowances within city boundaries.

Provisioning of Health and Social Services

Access to primary, secondary, and tertiary healthcare in urban and peri-urban areas is crucial for health improvement, with a significant shortage in low and middle-income countries (LMICs) (Vlahov, 2002; Corburn, 2005). Moreover, access to secure livelihoods affects access to healthcare depending on national health policies. According to David and Galea, spatial factors such as transport and mobility can hinder access to health services in terms of speed and distances crossed, causing significant differentials between different neighborhoods and socioeconomic groups.

Population Composition

Age and gender demographic distribution, density, genetic factors, health beliefs, and increased stressful urban lifestyles are critical factors shaping population health (Carmichael *et al.*, 2019). Carmichael also notes that this determinant profoundly affects pollution rates and may potentially decrease access to public health services and healthier lifestyles. Urbanization is associated with a higher prevalence of non-communicable diseases NCDs, posing more health risks and vulnerabilities, especially for elderly groups (Eckert and Kohler, 2014).

City Governance and Leadership

City governance and leadership affect the inclusion of communities in decision-making activities relating to their social and spatial surroundings, amongst many aspects of their lives (Wulff, Donato and Lurie, 2015). The presence of active local NGOs and CBOs can improve urban areas on the neighborhood level and center citizen participation in decision-making. According to Grant *et al.*, participation creates planning decisions that are more directed towards the needs of the people due to debates about the impacts and their needs (Grant *et al.*, 2017). Bottom-up strategies and urban activism can improve urban health outcomes through embedding environmental justice in urban policies (Brulle and Pellow, 2006).

Complexity in the urban determinants of health

The complex interactions between these determinants in the ubiquity of cities led more urban planning academics to call for interdisciplinary research relinking urban planning, public health, and epidemiology. (Vlahov and Galea, 2003; Corburn *et al.*, 2019; Galea, Ettman and Vlahov, 2019). Several authors center environmental justice in their arguments for urban health equity, citing theories of 'differential vulnerability' and highlighting how health stressors affect people differently according to their socioeconomic status (Pearlin, 1999 cited in Galea, Ettman and Vlahov, 2019)

Urban Health Resilience:

Many cities include urban resilience as part of their development goals -often in climate disaster mitigation schemes or for reasons ranging from global economic competitiveness to climate change adaptation. This concept has evolved to gain multiple nuances related to the definition of urban, the state of equilibrium, the positivity of said resilience, means of achieving it, understandings of (mal)adaptation, and timescale of action. Meerow and colleagues raised these nuances and questioned urban resilience using a systems-thinking approach that looks into the cities as a resultant of interactions between connected yet autonomous systems to achieve a more holistic and logical definition (Meerow, Newell and Stults, 2016). This research is theoretically structured based on the concept of 'urban planning as preventative medicine' by (Corburn, 2015). This understanding describes an approach that promotes health from a preventative perspective, not explicitly outbreak and pandemic control, but also

reducing the prevalence of non-communicable and chronic diseases and promoting physical and mental wellbeing.

Contrasting City Resilience Index (CRI) with the preventative urban health resilience framework, the 'Health and Wellbeing' goal showed specific gaps in addressing health promotion (Gad, 2020). Moreover, requiring more measures to limit the prevalence of communicable and non-communicable diseases, obesity, pollution, social anxiety, and poor mental wellbeing in the built environment.

Mobility and Green Space

Mobility and greenery often compete for land-use allocation and are manifestations of land-use mix policies, affecting health through the social and spatial determinants of health. Transport is associated with increased mortality, NCD prevalence, and comorbidities, mainly affecting cardiovascular and respiratory diseases, cancers, obesity, diabetes. Authors also associate transport with stress, one of the most influential factors affecting physical and mental wellbeing. Nieuwenhuijsen and Khreis established nine pathways in which transport can affect our health; Motor Vehicle Crashes (MVC); Transport Related Air Pollution (TRAP); noise; increased local heat exposures; reduced green space exposure; decreased physical activity; and climate change, multiple sources cited in (Nieuwenhuijsen and Khreis, 2019). Whereas green space 'usage and exposure' are associated with reductions in mortality and cardiovascular disease prevalence, stress reduction, pollution control, as well as improved mental health and increased social activity (Nieuwenhuijsen, 2016). Shading from green space can ameliorate the temperature, reduce UV rays and sun exposure, and promote active travel. The presence of greenery has been associated with increased physical activity, further increasing its capacity to affect people's health and wellbeing (Fong *et al.*, 2018). However, exposure to greenery could increase skin cancer and Lyme disease risks *ibid.*, and may increase feelings of unsafety depending on the design, visibility, and type of greenery used (Rydin *et al.*, 2012; Li, Zhang and Li, 2015).

3. Research Methodology and Design

The conceptual framework is based on a review of pertinent literature on the urban determinants of health and at the intersection of urban health and urban resilience. It examines the correlation between urban changes and their associated health risks, mainly focusing on non-communicable diseases (NCDs). The conceptual framework aims to promote a preventative approach to health promotion and fostering urban resilience. The case study is the neighborhood of Heliopolis, Cairo. The author uses qualitative and quantitative data gathering techniques to understand the social and spatial aspects of the urban development project on space-use and conducts a physical analysis of primary and secondary sources to compare the extent of urban changes. The sampling of interviewees uses a snowballing technique based on existing social networks of residents with a sample size (n=14). The limitations of which are having less representative results of the wider population. The selected population belongs to upper-middle income groups. Primary data is gathered by conducting semi-structured interviews and mapping exercises with residents, built environment experts, and a public-health expert. The data provides a deeper understanding of the consequences of these urban changes on people's space use patterns and mobility. The author reviews and gathers primary data through site visits and observations due to the lack of available publications about the ongoing urban project. Secondary data is gathered by reviewing historical maps and satellite images to understand the morphology of the neighborhood. The case study selection provides an example of urban planning decisions that could be detrimental to population health and could significantly lead to increased vulnerability to natural hazards and health disasters.

4. Case study background

The neighborhood of Heliopolis is an affluent neighborhood with a notable area of green space and was the last to maintain a functioning tram infrastructure in Cairo. The neighborhood underwent sudden and significant urban changes in September 2019 with an urban development project aiming to transform it into a highly motorized mobility axis. The project created massive road widening and removed the remaining tram infrastructure attempting to improve traffic flow. Additionally, seven flyovers were constructed to improve traffic conditions and ease congestion. In addition to removing green areas and green roundabouts with an estimated 378,000 m² and between 2500~3000 trees (Mokhtar, 2020).

The current trend of suburbanization and outmigration to satellite cities and gated communities in Cairo increases motorized and car-centric mobility, potentially widening inequity gaps and social segregation, and overburdening public transport systems. Distant work opportunities and inefficient modes of mobility affect residents from more disadvantaged groups inequitably, where they bear the economic burden and adverse effects related to commuting and harmful health exposures (Rydin *et al.*, 2012). This highly motorized streetscape associated diminishing 'eyes on the street', a factor of safety and security in cities, affects women and girls disproportionately due to significant challenges related to mobility and access to space in addition to high rates of gender-based violence in Cairo (Jacobs, 1961; Batabyal, 2016).

5. Analysis and Discussion

Analysis of Heliopolis Through Physical and Social Determinants of Health

The analysis below is based on the findings from the semi-structured interviews and gathered empirical data. The findings are grouped and analyzed with relation to the conceptual framework and the spatial and social factors identified in the literature review. The neighborhood's spacious major roads (approx. 60m wide) allowed for the implementation of the recent mobility project, which turned its streets essentially into 'highways'. Figure 1 presents a more extensive scale understanding of the changes in the neighborhood; road design changes, flyover construction, and demolition of roundabouts.

Figure 1 Map of urban changes in the Heliopolis, showing affected roads and roundabouts, and constructed bridges. Source: Google Earth, illustrations by author.

This project created an urban environment with an inequitable distribution of car roads compared to spaces for people. Additionally, narrow, walkable spaces bring forth concerns about crowding and physical distancing regarding COVID-19, illustrating one example of how non-car users could be further disadvantaged in this scenario. The street sections show an approximated car capacity rather than the number of lanes. Figure 2 shows the magnitude of urban changes in individual streets, comparing pre and post-implementation street studies, highlighting the mass motorization, loss of greenery and open spaces, and narrow pedestrian areas.

Figure 2 Before/after street sections of some roads that have been affected by the urban changes. The author approximates road capacities according to multiple satellite images of the streets. Source: Google Earth and Google Maps, illustrations by author.

Transport and Mobility

Changes in used modes of mobility were studied in terms of variation and frequency. Findings show significantly increased car use and ride-hailing, a slight increase in carpooling, and reductions in public transport use. The interviewees reported general reductions in non-vehicular mobility and decreased physical activity and active travel, affecting residents who regularly opt for walking within the neighborhood. **Inner neighborhood mobility** has also changed drastically. Many interviewees reported dependency on car use for short trips, causing gridlocks on the neighborhood scale. Most residents also expressed grave concerns that road widening has led to a notable increase in driving speeds and unregulated traffic flow, raising concerns for vehicular crashes. **Reductions in physical activity and increased sedentary behavior** are associated with increased prevalence of CVDs, type-2 diabetes, cancers, obesity, and reduced life expectancies, putting the health of residents at significant risks. In addition to adverse effects on mental wellbeing such as increased stress levels, depression, where time spent in cars is associated with increased risks of poor mental health (multiples sources cited in Giles-Corti *et al.*, 2016). Figures 3 and 4 below show the high rates of motorization as well as the reported differences in mobility and transport.

Figure 3 Diagram of the interviewees' self-reported changes in used modes of mobility before and after the project, showing significant reductions in active travel and majors increases in vehicular mobility.

Figure 4 Diagram showing changes in the mobility experience affecting the interviewees.

Site visits and observations combined with street section analysis show significant reductions in **safe walking and cycling infrastructure**, where data from interviews showed a significant increase in feelings of unsafety. Respondents who primarily relied on car use noted little change in their space usage. **Traffic-related injuries and deaths** were reported as common concerns, where the number of deaths from car-related accidents was estimated to be thirty-five deaths (as of March 2020). Expert interviewees associated the enormous death toll due to an observed lack of regulatory measures controlling vehicular flow (i.e., road crossings, speed bumps, good sidewalks, traffic lights, etc.), further resounding the term "highways" used by several interviewees. **Proximity to major roads** has a compounded effect on indoor air quality, thereby increasing exposure to toxic indoor air and allergens, inequitably affecting houses with lower-quality indoor environments (Corburn, 2015).

Perceptions of safety were also affected, where eleven respondents felt significantly less safe in the neighborhood, raising concerns for children and the elderly, gender-based violence, people with disabilities, as well as crowdedness. Moreover, increased fear of car-related injuries and traffic flow affects the residents' mental wellbeing and is associated with increased stress levels and decreased physical activity (ibid). Many respondents reported severe and increased **fears of sexual harassment/assault**, adding that the street often creates spaces of 'entrapment' with limited escape routes from potential assaults. Additionally, the consequent reduction in the number of people in the street further increases safety concerns, especially for women and girls. **Urban fear** could lead to decreased physical activity and increased social isolation. Issues in way-finding and neighborhood attractiveness have also been reported to affect several people, increasing their sense of alienation and urban fear for multiple interviewees. Figure 5 shows street sections with changes that could worsen gender-based violence due to decreased visibility and the lack of safe, walkable spaces.

Figure 5 Before/after street sections of some roads that have been affected by the urban changes. The author approximates road capacities according to multiple satellite images of the streets. Source: Google Earth and Google Maps, illustrations by author.

Green Space

The **use of public green space** was reportedly low before the project, where eight interviewees reported decreased green space use. **On the other hand, exposure to green space** was reported to be significantly decreased by all interviewees, five of whom reported substantial reductions due to the proximity of their residence to the affected roads. Greenspace use and exposure are related to reductions in mortality and prevalence of CVDs, and improvements to mental health, social interaction, sleep patterns. In addition to promoting physical activity, stress reduction, and reductions in noise and air pollution.

Pollution

Many respondents reported concerns for reductions in air quality, air pollution, and Particulate Matter (PM) resulting from massive construction works and the loss of trees and green space. Some respondents reported exacerbated respiratory problems and allergic reactions from the construction works. **Exposure to air pollution** is significantly correlated to increased mortality, affecting prevalence and comorbidities of lung diseases, CVDs, diabetes, premature mortality, obesity, increased risks of cancer, damage to the nervous system, etc., (Mueller *et al.*, 2016; Samet, 2019). Pollution could also aggravate pre-existing conditions such as asthma, allergies, etc., creating vulnerabilities to respiratory diseases and outbreaks such as COVID-19.

Noise exposure and duration were reported to be significantly increased by all residents and are associated with increased prevalence of CVD mortality and morbidity, sleep disturbances, elevated blood pressures, reductions in cognitive performance, and increased stress levels and anxiety (Hoisington *et al.*, 2019). The effects on **mental wellbeing** resulting from the urban modifications were also studied. Six respondents suffered increased stress and anxiety associated with driving and reduced green spaces, noting exacerbation due to noise pollution. It is also worth mentioning that there are three airports near Heliopolis, significantly increasing noise pollution in the area.

Community cohesion was found to have been weak before the project; all the interviewees felt socially isolated from their neighbors and communities. However, five residents reported further reductions in

social interactions and random chance encounters. Two respondents noted that activities such as dog-walking often encouraged social interactions. **Social isolation** is associated with poor mental health, negative lifestyle behaviors, increased premature mortality, as well as elevated blood pressure, reduced stress-recovery, low birth weights, increased infant deaths, cognitive problems, obesity, CVDs, etc., (Corburn, 2005; Giles-Corti *et al.*, 2016). Residents reported reduced **neighborhood attractiveness** which is associated with decreased physical activity and social isolation (Sugiyama *et al.*, 2010; Ekel and Vries, 2016).

Disaster Vulnerability

Large-scale infrastructural changes concerned built environment experts with regards to the neighborhood's capacity to withstand future disasters. The notable reductions in green space pose threats for increased urban heat island effect, loss of biodiversity, flooding, reduced street-runoff absorption, and increased carbon emissions and pollutants. Socioeconomic vulnerabilities such as loss of livelihoods and decreased community resilience, and gender inequity could further worsen the situation and create compounded vulnerabilities.

6. Discussion Summary

This paper investigated the link between urban health and urban resilience to call for preventative health promotion through urban planning to create more resilient cities or 'Preventative Urban Health Resilience'. The physical analysis showed a significant reduction in overall walkability, active travel, and public transport, paired with an increase in grey infrastructure, essentially aiming to facilitate motorized transport. Semi-structured interviews with the residents offered a qualitative understanding of the multiple variables affecting their use of mobility and greenery and the resulting changes in their lifestyles and space use patterns. The data were analyzed and correlated with potential health risks based on the literature review findings. This paper establishes an understanding of the potential health consequences of urban planning decisions, particularly on NCDs and mental wellbeing.

Further research would be needed to include different socioeconomic groups and potentially study the changes in health on a more longitudinal basis. Complex systems thinking approaches should be adopted in urban planning decisions in Cairo with Health Impact Assessments, where there is a critical need to put health in the center of all policies (HiAP). Cities realized the dire need for health-promoting urban planning and health resilience, and it is crucial to rethink the urban planning decisions and learn from the covid-19 pandemic.

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7. References

- Batabyal, A. A. (2016) *Review of 'Eyes on the Street: The Life of Jane Jacobs by Robert Kanigel'*.
- Braubach, M. and Grant, M. (2010) *Evidence review on the spatial determinants of health in urban settings, Urban Planning, Environment and Health: From Evidence to Policy Action. Meeting Report*. Denmark. Available at: http://www.euro.who.int/__data/assets/pdf_file/0004/114448/E93987.pdf?ua=1.
- Brulle, R. J. and Pellow, D. N. (2006) 'Environmental Justice: Human Health and Environmental Inequalities', *Annual Review of Public Health*, 27, pp. 103–24. doi: 10.1146/annurev.publhealth.27.021405.102124.
- Carmichael, L. et al. (2019) 'Land Use Policy Urban planning as an enabler of urban health : Challenges and good practice in England following the 2012 planning and public health reforms', *Land Use Policy*. Elsevier, 84, pp. 154–162. doi: 10.1016/j.landusepol.2019.02.043.
- Corburn, J. (2004) 'Confronting the Challenges in Reconnecting Urban Planning and Public Health', *American Journal of Public Health*, 94(4), pp. 541–546. doi: 10.2105/AJPH.94.4.541.
- Corburn, J. (2005) 'Urban planning and health disparities: Implications for research and practice', *Planning Practice and Research*, 20(2), pp. 111–126. doi: 10.1080/02697450500414652.
- Corburn, J. (2015) 'City planning as preventive medicine', *Preventive Medicine*. Elsevier Inc., 77, pp. 48–51. doi: 10.1016/j.ypmed.2015.04.022.
- Corburn, J. et al. (2019) 'Urban Health Education: Global Challenges and Opportunities', *Journal of Urban Health*. Journal of Urban Health, 96(4), pp. 510–513. doi: 10.1007/s11524-019-00366-0.
- Eckert, S. and Kohler, S. (2014) 'Urbanization and health in developing countries: a systematic review.', *World health & population*, 15(1), pp. 7–20. doi: 10.12927/whp.2014.23722.
- Ekkel, E. D. and Vries, S. De (2016) 'Landscape and Urban Planning Nearby green space and human health : Evaluating accessibility metrics', *Landscape and Urban Planning*. Elsevier B.V., 157, pp. 214–220. doi: 10.1016/j.landurbplan.2016.06.008.
- Fong, K. et al. (2018) 'A Review of Epidemiologic Studies on Greenness and Health: Updated Literature Through 2017', *Current Environmental Health Reports*, 5(1), pp. 77–87. doi: 10.1007/s40572-018-0179-y.
- Friel, S. et al. (2011) 'Urban Health Inequities and the Added Pressure of Climate Change: An Action-Oriented Research Agenda', *Journal of Urban Health*, 88(886).
- Gad, M. A. (2020) *Towards Preventative Urban Health Resilience : A Case Study of Cairo's Heliopolis*.
- Galea, S., Ettman, C. K. and Vlahov, D. (2019) *Urban Health*. 1st edn. Edited by S. Galea, C. K. Ettman, and D. Vlahov. New York: Oxford University Press.
- Galea, S. and Vlahov, D. (2005) 'Urban Health: Evidence, Challenges, and Directions', *Annual Review of Public Health*, 26(1), pp. 341–365. doi: 10.1146/annurev.publhealth.26.021304.144708.
- Giles-Corti, B. et al. (2016) 'City planning and population health: a global challenge', *The Lancet*. Elsevier Ltd, 388(10062), pp. 2912–2924. doi: 10.1016/S0140-6736(16)30066-6.
- Grant, M. et al. (2017) 'Cities and health: an evolving global conversation', *Cities & Health*. Routledge, 1(1), pp. 1–9. doi: 10.1080/23748834.2017.1316025.
- Groenewegen, P. P. et al. (2006) 'Vitamin G: Effects of green space on health, well-being, and social safety', *BMC Public Health*, 6(149), pp. 1–9. doi: 10.1186/1471-2458-6-149.
- Hoisington, A. J. et al. (2019) 'Ten questions concerning the built environment and mental health', *Building and Environment*. Elsevier, 155(March), pp. 58–69. doi: 10.1016/j.buildenv.2019.03.036.
- Jacobs, J. (1961) *The Death and Life Cities of Great American Cities*.
- Kafafy, N. and Al-betawi, Y. (2020) 'Urban Green Space Benefits and the Pivotal Role of Conservation, Cairo's Case - Egypt', in, pp. 1–13. Available at: <https://core.ac.uk/download/pdf/19396743.pdf>.
- Keyes, K. M. and Galea, S. (2016) 'Setting the agenda for a new discipline: Population health science', *American*

Journal of Public Health, 106(4), pp. 633–634. doi: 10.2105/AJPH.2016.303101.

Li, X., Zhang, C. and Li, W. (2015) 'Does the visibility of greenery increase perceived safety in urban areas? Evidence from the place pulse 1.0 dataset', *ISPRS International Journal of Geo-Information*, 4(3), pp. 1166–1183. doi: 10.3390/ijgi4031166.

Marmot, M. (2005) 'Social determinants of health inequalities', *The Lancet*, 365(9464), pp. 1099–1104. doi: 10.1016/S0140-6736(05)74234-3.

Meerow, S., Newell, J. P. and Stults, M. (2016) 'Defining urban resilience: A review', *Landscape and Urban Planning*. Elsevier B.V., 147, pp. 38–49. doi: 10.1016/j.landurbplan.2015.11.011.

Mokhtar, M. (2020) *Unofficial Study: Lost Areas of Greenery in Heliopolis' Recent Development Project*. Cairo.

Mueller, N. *et al.* (2016) 'Urban and transport planning related exposures and mortality: A health impact assessment for cities', *Environmental Health Perspectives*, 125(1), pp. 89–96. doi: 10.1289/EHP220.

Nieuwenhuijsen, M. (2016) 'Urban and transport planning, environmental exposures and health-new concepts, methods and tools to improve health in cities', *Environmental Health: A Global Access Science Source*. Environmental Health, 15(Suppl 1). doi: 10.1186/s12940-016-0108-1.

Nieuwenhuijsen, M. and Khreis, H. (2019) 'Transport and Health', in Galea, S., Ettman, C. K., and Vlahov, D. (eds) *Urban Health*. 1st edn. New York: Oxford University Press, pp. 52–58. doi: 10.1093/oso/9780190915858.001.0001.

Pearlin (1999) 'Stress and mental health: A conceptual overview', in *A handbook for the study of mental health: Social contexts, theories, and systems*, pp. 161–175.

Rodger, R. (2019) 'Urban Health - A historical perspective', in Galea, S., Ettman, C. K., and Vlahov, D. (eds) *Urban Health*. 1st edn. New York: Oxford University Press, pp. 169–178. doi: 10.1093/oso/9780190915858.001.0001.

Rydin, Y. *et al.* (2012) 'Shaping cities for health: complexity and the planning of urban environments in the 21st century', *The Lancet*, 379(9831), pp. 2079–2108. doi: 10.1016/S0140-6736(12)60435-8.

Samet, J. M. (2019) 'Pollution', in Galea, S., Ettman, C. K., and Vlahov, D. (eds) *Urban Health*. 1st edn. New York: Oxford University Press, pp. 112–128. doi: 10.1093/oso/9780190915858.001.0001.

Sugiyama, T. *et al.* (2010) 'Associations between recreational walking and attractiveness, size, and proximity of neighborhood open spaces', *American Journal of Public Health*, 100(9), pp. 1752–1757. doi: 10.2105/AJPH.2009.182006.

United Nations (2018) *The World's Cities in 2018, The World's Cities in 2018 - Data Booklet*.

Vlahov, D. (2002) 'Urbanization, Urbanicity, and Health', *Journal of Urban Health: Bulletin of the New York Academy of Medicine*, 79(4), pp. 1–12. doi: 10.1093/jurban/79.suppl_1.S1.

Vlahov, D. *et al.* (2007) 'Urban as a Determinant of Health', *Journal of Urban Health: Bulletin of the New York Academy of Medicine*, 84(1), pp. 16–26. doi: 10.1007/s11524-007-9169-3.

Vlahov, D. and Galea, S. (2003) 'Urban health: a new discipline', *The Lancet*, 362(9390), pp. 1091–1092. doi: 10.1016/S0140-6736(03)14499-6.

Wulff, K., Donato, D. and Lurie, N. (2015) 'What is Health Resilience and How Can We Build it?', *Annual Review of Public Health*, 2015(36), pp. 361–74. doi: 10.1146/annurev-publhealth-031914-122829.