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Built environment design and cancer prevention through the lens of inequality

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ABSTRACT

In this interdisciplinary article, we provided an evidence-based discussion on the role of the supportive built environment on cancer prevention. We also extended the theoretical thinking on the built environment-cancer links by raising possible equality challenges. Following the recent call in population-level interventions in cancer prevention, our aim is to encourage readers to think about the important potentials and limitations that are raised from the point of view of the supportive built environments in relation to cancer prevention. We focus on the key links between the built environment and cancer prevention strategies (primary, secondary, and tertiary) and discuss ways in which the built environment may reflect and contribute to inequalities in cancer.

There has been growing interest in the role of the “built environment” in the cancer prevention continuum beyond what can be attributed to individual-level factors (Gomez et al., 2015; Wray et al., 2018; Wray & Minaker, 2019). The built environment refers to “the human-made space in which people live, work, and recreate on a day-to-day basis”, including settings such as houses, shops, streets, parks, and healthcare facilities (Roof & Oleru, 2008). The built environment is also relevant in explaining inequalities in cancer – that is, some socially disadvantaged population subgroups (e.g., low-income individuals, racial/ethnic minorities, and people living with disabilities) who are at greater risk of cancer may often have lesser access to health-supportive built environments than less-disadvantaged groups.

In this interdisciplinary article, we focus on the key links between the built environment and cancer prevention strategies (primary, secondary, and tertiary) and discuss ways in which the built environment may reflect and contribute to inequalities in cancer (Fig. 1).

1. Primary prevention

The built environment can directly impact cancer rates by modifying exposure to urban carcinogenic sources such as air pollution and excessive sun exposure. The risk of ambient air pollution for lung cancer incidence has been well documented (Turner et al., 2020). Modern cities are designed for car movement, making private motor vehicles their dominant mode of transport. Road transportation is the principal source of air pollution in cities. Road infrastructure, including streets and parking lots, can occupy up to 50% of a city’s land area posing a cancer risk to residents, especially to those living near busy roads. The design of building facades and the use of urban trees to provide shade can reduce excessive sun exposure outdoors, which is the leading cause of skin cancer. Vast land consumption for road infrastructure also intensifies urban heatwave effects.

Many common cancer types such as colon, breast, and lung cancer, can be avoided by reducing modifiable behavioural risk factors, such as physical inactivity, unhealthy diet, alcohol intake, and smoking (Whiteman & Wilson, 2016). Accumulating evidence has shown that built environment attributes act as facilitators of or barriers to these behaviours. Research suggests that living in a neighbourhood with well-connected street layouts, various destinations nearby, and accessible supermarkets and retail stores supports residents’ physical activity and can encourage healthy food choices (Omura et al., 2020; Turner et al., 2021). The availability and density of alcohol and tobacco outlets in

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neighbourhoods can influence residents' alcohol intake and smoking behaviours (Pulakka et al., 2016; Seid et al., 2018). Buildings' interior design and spatial positioning of outdoor smoking areas also have effects on secondhand smoke exposure (Fu et al., 2016).

The built environment can exacerbate inequalities in cancer primary prevention in several ways. A spatial disparity pattern exists in the distribution of built environment attributes supporting health behaviours between deprived and affluent areas. Affluent areas often benefit from a more health-supportive built environment. For example, tree canopies, which reduce urban heatwave effects, appear to be less prevalent in deprived areas (Krafft & Fryd, 2016). Low-income individuals and racial/ethnic minorities are likely to live in neighbourhoods with less connected streets and low access to commercial and recreational destinations, which may further deter them from engaging in physical activity (Koohsari et al., 2020). The density of fast-food restaurants and alcohol outlets in deprived areas also seems high, making less nutritious food and alcohol easy to access (Macdonald et al., 2018). The cost of living, and in particular housing costs, constitute a major limitation that prevents socially disadvantaged populations from living in health-supportive neighbourhoods and that forces them to reside in low-quality housing in polluted areas close to busy roads and industrial areas. Since urban design renewal projects may also cause a rise in housing prices, they may further drive vulnerable groups to unpleasant neighbourhoods, exposing them to further environmental risk factors for cancer. There should be policies that assist socially disadvantaged populations in gaining access to and opportunities to reside in health-supportive built environments.

2. Secondary prevention

The built environment relates to cancer detection by shaping how individuals can access cancer screening centres. Spatial proximity to screening centres has been identified as a spatial factor affecting uptake and adherence to cancer screening, particularly in breast and colorectal cancer screening programmes. Spatial proximity can be defined in terms of geographic access and transportation options: shorter distances to screening centres and access to various transportation options, such as private motor vehicles and public transportation, can increase cancer screening coverage. Perceived urban design attributes such as aesthetics and safety from crime may also influence residents' cancer screening behavior through their relations to individuals' stress levels (Beyer et al., 2016).

The built environment can further inhibit spatial proximity to cancer centres for vulnerable groups such as rural and remote area residents, socioeconomically disadvantaged individuals, and individuals living with disabilities. For instance, residents of urban areas tend to reside at shorter distances to mammography centres and show higher breast cancer screening rates than rural residents (Khan-Gates et al., 2015). Few public transportation options, such as buses and trains, are available in rural areas. Low-income individuals may have limited access to private motor vehicles and therefore rely on public transport. A lack of public transportation options available both at home (starting point) and at cancer screening facilities (end point) prevents these disadvantaged groups from visiting screening facilities. The inaccessible interior design of buildings creates another built environment barrier that might impede people living with disabilities from regularly visiting cancer screening centres. Allocating health facilities that offer cancer screening to areas that can be well served by public transport and spatially closer to disadvantaged areas may mitigate spatial proximity disparities in access to cancer screening centres.

3. Tertiary prevention

Several cancer remission and survivorship outcomes such as physical activity, quality of life, and mental health can be affected by the built environment. Cancer patients' and survivors' spatial mobility can become substantially limited since they may experience a decline in physical function during or after the course of their disease. Such decline in physical functioning may even be permanent in many older adults cancer survivors. Therefore, cancer patients and survivors may rely heavily on built environments within and near their residences for their daily behaviours. The availability of public green spaces in particular can provide convenient neighbourhood settings for cancer survivors to engage in daily exercise and social interactions with neighbours. These public green spaces can also mitigate symptoms of anxiety and depression (Helbich et al., 2018), which are common side effects experienced by cancer survivors. Additionally, the accomplishment of regular visits to health care facilities, which play a critical role in providing suitable

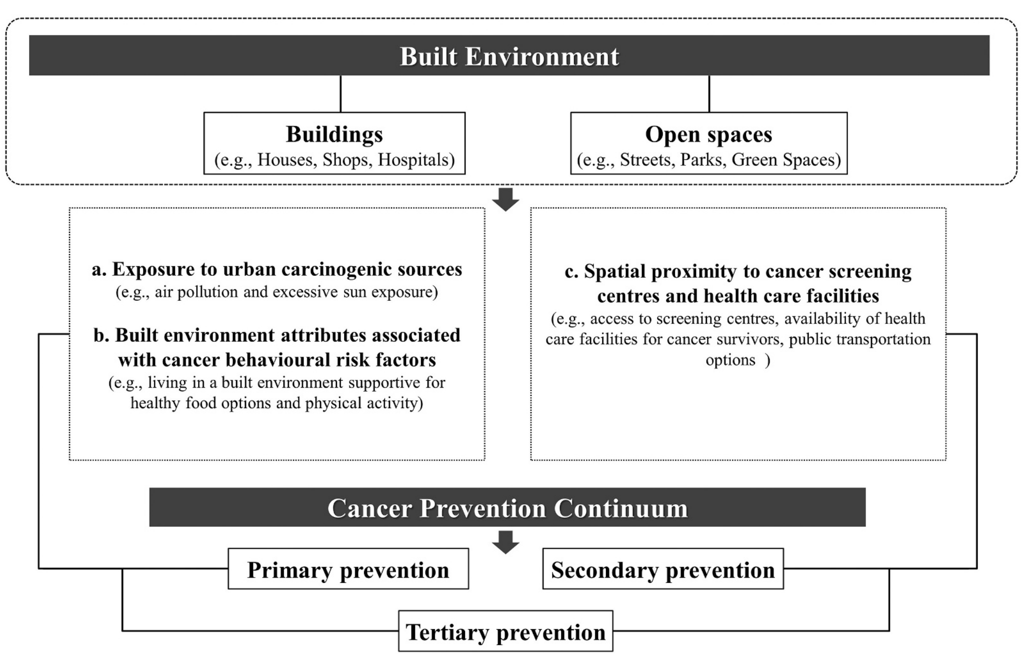

Fig. 1. The role of the built environment design across the cancer prevention continuum.

surveillance and support for cancer survivors, heavily depends on individuals' spatial proximity to these facilities.

Cancer survival rates tend to be lower among those living in deprived areas than among those in affluent areas, even after controlling for the stage of diagnosis (eg., Jansen et al., 2014). This observed inequality in cancer survival rates may be partially due to disparities in cancer treatment quality. However, built environment attributes can also play a role by exposing cancer survivors to multiple stressors, such as noise, pollution, crowding, unsafe conditions, and physical barriers to movement found in deprived areas. Since the population of older adult cancer patients and survivors is growing (Shapiro, 2018), assisting their spatial mobility will be vital to mitigating inequalities in cancer. New urban mobility transitions providing access to various travel options, such as car sharing, ride sharing, and autonomous vehicles, are becoming increasingly prevalent (Sugiyama et al., 2020). These new urban mobility options may introduce new opportunities for cancer survivors. However, specifically due to the cost of shared-transport services, these resources may still be inaccessible to socioeconomically disadvantaged cancer survivors. The spatial coverage of these services also remains largely limited to central urban areas.

4. Conclusion and future directions

This article contributed to the understanding and clarifying the role of the supportive built environment on cancer prevention. We also extended the theoretical thinking on built environment-cancer links by raising possible inequality challenges. The science of how to change the built environment to improve cancer health outcomes is still in its infancy with several unanswered questions. As the current international evidence is limited, it remains unclear which built environment attributes are important (similar or different) at the different levels of cancer prevention. Different cancers may have the same but also different built environment determinants, especially in terms of primary prevention. It is also necessary to investigate to what extent socially disadvantaged populations can benefit from each type of built environment change in relation to cancer risk. Further interdisciplinary initiatives between urban designers, epidemiologists, and clinicians linking large cancer datasets with intuitive geospatial built environment data over time will provide a robust source from which to advance knowledge on this topic.

CRediT authorship contribution statement

MJK: Conceptualization, Writing - Original Draft, Writing - Review & Editing.
TN: Writing - Original Draft, Writing - Review & Editing.
GRM: Writing - Original Draft, Writing - Review & Editing.
KO: Writing - Original Draft, Writing - Review & Editing.

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The funders had no role in preparation of the manuscript.

Declaration of competing interest

The authors declare no competing interests.

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