1. Introduction

Cardiovascular disease (CVD) remains the number one cause of death worldwide and is responsible for an estimated 17.9 million deaths each year (31% of all deaths globally) (World Health Organization 2017). Accumulating evidence suggests that there is a socioeconomic status (SES) disparity in CVD: individuals with lower SES tend to have worse CVD risk profiles and outcomes (Schultz et al 2018). Because of the challenges in obtaining individual-level SES indicators such as education, income, and employment, area-level SES indicators based on aggregated data, often from census data, have been widely used as a proxy for the former (Pardo-Crespo et al 2013). The effects of SES on CVD may be mediated through several biological, behavioural, and social risk factors (Schultz et al 2018, Richmond-Rakerd et al 2020). For instance, a systematic review found that people with higher SES were more physically active during leisure time than those with lower SES (Beenackers et al 2012). Population-level interventions to reduce SES disparity in CVD could include those that directly improve socioeconomic conditions (e.g. universal minimum wage) or those that modify the conditions to which low SES individuals might be more greatly exposed or influenced (e.g. built environments). The focus of this paper is on the built environment, which is defined as ‘the human-made space in which people live, work, and recreate on a day-to-day basis’ such as houses, shops, work offices, streets, and green spaces (Roof and Oleru 2008). In the short and intermediate timeframes, interventions that modify the built environmental conditions under which low SES individuals live may be more amendable to change. Such built environmental interventions could have an immediate effect on CVD prevention, particularly by encouraging physical activity behaviours. In this interdisciplinary paper, we have identified key issues involved in the current knowledge on the built environments that support active behaviour and SES disparity in CVD and proposed future directions to further this research agenda (figure 1).

2. Links between physical activity, CVD disparity, and the built environment

The link between physical activity and CVD disparity has been acknowledged by previous studies. For instance, a study conducted in a multi-ethnic population in the US found that racial/ethnic minorities reported lower physical activity, which was associated with higher CVD mortality among these groups (Mathieu et al 2012). Another US study found that black adults who reported lower levels of active behaviour had a higher risk of CVD mortality (Matthews et al 2014). The role of the neighbourhood built environment in CVD prevention has been well recognised internationally (Huang and Liu 2018). Notably, there is growing scientific evidence on the effects of neighbourhood built environments in reducing physical inactivity as a key modifiable CVD risk factor (Koohsari et al 2020a). Several systematic reviews and meta-analyses have provided persuasive evidence for the relationships between neighbourhood built environment attributes and physical activity across the life course. For example, living in a safe, walkable (e.g. high access to destinations and recreational facilities, high street connectivity, and the availability of parks and green spaces) and aesthetically pleasing neighbourhood with access to a variety of destinations
was found to support older adults' physical activity (Barnett et al 2017).

The next logical question is whether changes in built environments that support active behaviour can reduce the observed SES disparity in CVD. If the answer to this question is 'yes', then the next question is 'how' can changes in to the built environment be implemented to reduce SES disparity in CVD. Although the answers to these questions may seem straightforward, the current knowledge is still scarce, and more robust scientific evidence is needed.

3. Built environments that support active behaviour and CVD disparity

We categorised the issues in built environments that support active behaviour and CVD disparity into ‘exposure’ and ‘impacts’ categories. The positive effects of built environments that support active behaviour on CVD depend on how people are exposed to their surrounding environment and how built environment attributes within the surrounding environment may impact people's behaviour.

3.1. Exposure to the surrounding built environment

Exposure to the surrounding built environment itself depends on three factors, including availability, affordability, and residential selection.

3.1.1. Availability

Several studies have shown that active behaviour supportive built environment attributes are not equally distributed across lower and higher SES areas. For instance, a national study conducted in Japan found that residents who were living in lower SES areas (measured by area-level SES indicators) were more disadvantaged in walkable neighbourhood attributes (e.g. population density, street connectivity, and the availability of commercial destinations) than those who lived in higher SES areas (Koohsari et al 2020b). In contrast, some studies found no SES disparity in the spatial availability of walkable neighbourhood built environment attributes. For example, a national study conducted in the US found a complex relationship between area-level SES and walkable neighbourhood attributes: those who lived in more disadvantaged areas or areas with more educated people had better environmental attributes conducive to walking (King and Clarke 2015). Nevertheless, the quality of active behaviour supportive environments and safety were not included in the majority of previous studies. It is unknown whether lower SES areas have high-quality and safe active behaviour supportive facilities and amenities such as attractive safe parks and quality sidewalks.

3.1.2. Affordability

Even a high-quality active behaviour supportive built environment is available in lower SES areas, it is unknown how often poorer people can use such resources in their neighbourhoods due to their other limitations (e.g. long hours of working or having many night shifts). The affordability of living in an active behaviour supportive environment is also another critical issue for lower SES groups.
Several studies, mainly conducted in the US, have shown higher costs of living in active behaviour supportive neighbourhoods (Knight et al 2018). The high costs of living in active behaviour supportive environments will inevitably exclude poor people from the health benefits of living in such neighbourhoods.

3.1.3. Residential selection
The gentrification of low SES neighbourhoods can increase demand for homes resulting in higher rents and property taxes that eventually displace low SES households from their neighbourhoods. Strategies such as policies that mandate a certain percentage of low-income households and subsidized low-income housing in active behaviour supportive neighbourhoods are needed.

3.2. Impacts of the built environment
Three factors, including the strongest effects, different impacts, and spatial locations and scales, need to be considered in relation to built environments that support active behaviour and CVD disparity.

3.2.1. Strongest effects
Although built environment changes have the potential to bring about widespread and sustainable population-level changes in behaviour, in many cases, such changes require significant resources in terms of money and time. The built environment is also unlikely to substantially change in a short period, unlike in the case of a disaster. While it is difficult to change the entire physical structure of a neighbourhood, there might be some built attributes that could be modified, even within established neighbourhoods, that could be beneficial for lower SES individuals and support them in increasing physical activity and better CVD health. Since SES disadvantaged people have limited options for mobility except for walking (as a low or no cost mode of mobility), the characteristics of the immediate surrounding built environment (e.g. neighbourhood) have a critical role in supporting their physical activity. For instance, a recent systematic review of studies conducted in Canada found that several built environment attributes such as street connectivity, green space, and availability of destinations were associated with physical activity among of low SES adults (mostly measured by household income) (Christie et al 2021). Therefore, it is critical to identify which neighbourhood built environment attributes have the strongest effects on physical activity and CVD in lower SES areas. The focus on lower SES areas instead of lower SES individuals is because the former may have a broader reach and be more sustainable. Such information can provide urban designers and public health policymakers with evidence-based knowledge on which built environment attributes need to be targeted first in their environmental interventions to improve CVD health in lower SES areas.

3.2.2. Different impacts
Another question will be whether active behaviour supportive built environments have the same effect for low versus high SES individuals (Smith et al 2017). The answer determines whether a universal design is sufficient or whether a target-based urban design is needed for low SES individuals in certain types of neighbourhoods.

3.2.3. Spatial locations and scales
The geographical locations and scales (e.g. street-level, block-level, and neighbourhood-level) at which neighbourhood built environment changes need to be implemented within lower SES areas are important. For instance, once there is a decision for ‘park renovations’ in lower SES areas, the first key question is ‘which parks’ are renovated first (spatial locations). Alternatively, if there is ‘traffic calming around schools’ in a lower SES area, the next question is ‘how far’ around schools the policy needs to be implemented (geographical scales). From a qualitative research perspective, it is also very important to engage the community in the decision-making process of such changes to the built environment. Notably, disadvantaged groups are often confounded by other characteristics (visible minorities, new immigrants, and ethnic groups), which may have different input and ideas regarding changes to the built environment. How to engage these communities in such a spatial decision-making process to support physical activity and CVD health is still an ongoing research question. With the lack of robust evidence at this stage, the answers to these questions remain rather speculative.

4. Next steps
To summarize, the following issues need to be examined to provide evidence on how creating built environments that support active behaviour can be a possible target for reducing SES disparity in CVD:

- Explore whether lower SES areas/individuals have safe access to quality built environment destinations and facilities supporting their physical activities (section 3.1.1);
- Consider the affordability of living in active behaviour supportive built environments for lower SES households (section 3.1.2);
- Develop policies that mandate a certain percentage of low-income households and subsidized low-income housing in active behaviour supportive neighbourhoods (section 3.1.3);
- Identify those built attributes that have the strongest effects on physical activity and CVD in lower SES areas (section 3.2.1);
• Explore the effects of active behaviour supportive built environments on CVD for lower versus higher SES individuals (section 3.2.2); and

• Identify the most relevant spatial locations and geographical scales for implementing built environmental interventions in consultation with community stakeholders (e.g. residents) (section 3.2.3).

These research directions are interrelated and part of the overarching goal of reducing SES disparities in CVD from the perspective of planning and designing physical activity supportive built environments.

Data availability statement

No new data were created or analysed in this study.

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Conflict of interest

The authors declare that there are no conflicts of interest.

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