Climate-cultural Conscious Design Approach to the Post-COVID-19 Built Environment

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Abstract

The pandemic has accelerated the digital transformation, by enabling current work activities to be done online more efficiently. With the movement control restrictions being lifted, the conventional workspace is no longer stationary. The role of the built environment as a health determinant in the post-COVID-19 era should consider co-mitigation interventions for non-communicable and communicable diseases through physical activity campaigns. This study aims to provide a perspective on the influence of micro-climate-conscious design in various built environments in hot climate countries on physical activity behaviour. The challenges to the social context, the cultural aspects, and the environmental aspects of the cultural-climate design measures in existing built environments are synthesised from analytical themes made in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standards. The implications for future research are discussed. The finding recognises the importance of spatial heterogeneity in the cultural-climate-conscious built environment design approach. This study provides insights for policymakers and employers to better understand the dynamic roles of built environment perceptions in the post-COVID-19 era in hot climate regions at different intervention levels.

Keywords: Post-Covid-19; Physical activity; Built environment; Multifaceted factors; Cultural-climate; Micro-climate conscious; Health awareness

1 Introduction

The COVID-19 pandemic has reshaped how we occupied our built environment, especially indoor spaces through rigorous climate-controlled application changes. The significance of healthy buildings via ventilation technology improvements and crowd control is vital to eradicate the transmission of the COVID-19 virus. Moreover, due to the movement control restrictions, residential, public and commercial buildings are operating to allow for a higher intake of fresh air and increased natural ventilation.

After a dramatic fall in the number of deaths following the global vaccine roll-out programme in 2021, many nations have welcome a new normal shift that provides hope to revive the economy and most importantly the people's spirit. As a determinant of health, the built environment in this post-COVID-19 era is anticipated to offer a more resilient quality that prioritises communicable disease mitigation interventions. However, the said interventions should not adopt the one-size-fits-all approach and addressed the climate and cultural uniqueness of a local context.

The pandemic has accelerated digital transformation, highlighting the fact that most of the activities

of the current world can be done online more efficiently than by manual operations. The possibility that the working space can expand beyond the office building has been proven through the practice of work-from-home culture enforced during the movement control restrictions. Operating in an increasingly volatile global environment requires conventional workplaces to build resilience and to re-design their operational activities making use of technological innovations. Due to the changing nature of technology, the physical activity behaviour of working adults may improve by expanding their workspace outside of the office building. Building for the post-COVID-19 era means more than just environmental effort, but also planning for co-mitigation interventions of non-communicable diseases (NCD) without compensating people's changing working culture.

Earlier reviews of physical activity suggest that it is the key to combating metabolic syndrome and can be based on complex interactions between individual, environmental and sociocultural factors (Dinu, Pagliai, Macchi & Sofi, 2019; Nunan, Mahtani, Roberts & Heneghan, 2013; Rawlings, 2019; Saunders, Green, Petticrew, Steinbach & Roberts, 2013). However, the unsafe built environment features, a lack of facilities providing healthy food and sensory pollution lead to the emergence of obesogenic environments in the cities. Reports have shown that sedentary office workers comprise the majority of obese individuals worldwide due to a lack of physical activity during work and non-work hours (Addo, Nyarko, Sackey, Akweongo & Sarfo, 2015; Cheng, 2016; Heinen & Darling, 2009; MalayMail, 2016; Nor, 2018).

In another alarming report, 73% of all recorded deaths were caused by NCDs that are evidenced to be preventable by changing one's physical activity behaviour (Economist, 2017; IPH, 2015). Moreover, obtaining a better understanding of obesogenic features of the built environment in hot climate regions by identifying distinct types of neighbourhoods may offer solutions to the growing physical inactivity in this region. That is why built environment design decision-makers need to be aware of the direct and indirect impacts their decisions have on longstanding health and societal welfare, given that they are primarily determined by environmental factors (Fitzpatrick, Shi, Willis, & Niemeier, 2018; Lee, Choi, Lee & Choi, 2019).

As a health determinant, the role of the built environment in the post-COVID-19 era should have equal considerations to reduce the spread of both communicable and non-communicable diseases. The promotion of physical activity both inside and outside of a building is seen as the most sustainable preventive strategy for both types of diseases following the global vaccine roll-out. It is more possible now especially in the hot climate regions thanks to our better understanding of epidemiology and the fourth industrial revolution. In response to that light, this paper aims to discuss through thematic synthesis (i) perspectives on climate-cultural conscious design approach shifts in built environments located in hot climate regions, and (ii) the available interventions designed to reduce the effects of obesogenic environments through physical activity.

2 Methodology

Our search includes four databases (Science Direct, PubMed, ProQuest and Google Scholar) and is made in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standards. Keywords used are, 'post COVID-19', 'built environment', 'physical activity', 'NCD prevention', 'thermal transient condition perceptions', 'obesogenic environment', and 'walkability'. We include sources with samples consisting of working-age adults (18 to 60 years old) with minimal physical activity in their daily routine from both quantitative and qualitative studies. All included sources are published in peer-reviewed English journals.

Search activities were managed using Endnote X9 software. The thematic synthesis aims to determine to what extent interventions in the current tropical built environment address the factors that predominantly influence sedentary workers' participation in physical activity. By using NVivo 11, the data was organised into three stages, namely, line-by-line coding, descriptive themes coding, and analytical theme coding.

3 Results and Discussion

A total of 1374 titles and abstracts were identified following duplication removal. Subsequently, 1126 records were screened and deemed to be irrelevant to this search based on their article type, title, and abstract. A total of 248 full texts were screened implying 218 excluded records. The outcome of the previous screening was discussed to clarify the interpretation of inclusion criteria. The 30 included studies were further divided into 23 quantitative and seven qualitative or mixed-method studies. Only three records were found with the combined 'post-COVID-19' and 'built environment' keywords. However, all three were not peer-reviewed journal articles. The three themes synthesised are namely, micro-climate conscious design, obesogenic environment, and facilitating behavioural changes. The themes discuss the climate-culture consciousness in built environment design deemed suitable to deter NCD via physical activity. It is well documented that a healthy and active lifestyle helps to boost one's immune system.

3.1 Micro-climate-conscious design

People in hot climate countries preferred thermally cooler and dryer living, commuting and working environments, (Dahlan & Gital, 2016; Krüger et al., 2015; Le Gouais et al., 2020; Vidyarini & Maeda, 2019; Wan Omar et al., 2013). The use of air-conditioning systems has an effect on thermal sensation in the short term, which emphasises the relationship between micro-climatic conditions and the overall bodily thermal response. Behavioural changes such as an increase in perceived alertness and thermal satisfaction among office workers were observed following large indoor-outdoor air temperature differences (Cheung et al., 2017; Vidyarini & Maeda, 2019).

The design of indoor and outdoor spaces with interchangeable transient and stationary conditions elicit behavioural responses, as seen in inhabitants' choices in time spent, clothing insulation and type of activity. The provision of shade and protection from direct solar radiation is essential to promote participation in physical activity (Karuppannan & Sivam, 2013; McKay, 2015; Vidyarini & Maeda, 2019). Willingness to cycle and walk for daily trips is strongly influenced by the midday heat, the availability of trees or shaded pathways, and whether heavy sweating can be avoided or not (Hashim et al., 2017; Vidyarini & Maeda, 2019; Wan Omar et al., 2013). With considerable outdoor street designs, such as covered pathways, rain shelters and covered street furniture, inhabitants are prepared to participate in physical activity but only within a reasonable distance (Ahmed, 2003). In Bahrain, where the humidity level is lower than those in Malaysia, Singapore and India, engaging in walking during light rain is a pleasant experience (Silva & Akleh, 2018).

In Singapore, the use of an apartment void deck is preferred by residents over neighbourhood open spaces. This is because the former spaces are covered, equipped with facilities, thermally comfortable with cross ventilation, and well-lit, making them suitable for social activities and studying while being connected to main pedestrian pathways (Karuppannan & Sivam, 2013). Micro-climate-conscious designs are commonly complemented with comprehensive pedestrian networks located in mixed land-use development and within close distances of the inhabitants' homes and workplaces, making them ideal for walking and cycling (Adlakha et al., 2016; Dahlan & Kurmanbekova, 2019; Pinelo

Silva & Akleh, 2018 Hashim et al., 2017). Wider streets were interpreted as attractive, safe and inviting given that pedestrians were seen to stay longer in them and engage in more physical activity compared to narrower streets (Ahmed, 2003; Richards et al., 2020; Wijesundara & Wijekoon, 2017).

3.2 Obesogenic environment

The rise in obesity is associated with activities that have to do with the outdoors such as commuting for work and access to food stores, restaurants, sports facilities, health facilities and parks, all within the circulation buffer zone in the neighbourhood (Adlakha et al., 2016; Aizawa, 2019; Loo et al., 2017; Matozinhos et al., 2015; McKay, 2015; Yu et al., 2017). Nevertheless, the role of health and disease prevention even in low- and middle-income countries has a concordant relationship with physical activity despite built environment characteristics such as land slope, greenness, built-up and intersection density (Valson et al., 2019). Other authors (Arundhana, 2018; Dahly, 2013; Le Gouais et al., 2020; Matozinhos et al., 2015; Sarkar et al., 2018; Valson et al., 2019) have advised against a 'one-size-fits-all' method to mitigate the rising incidences of NCDs, thus calling for prioritisation of physical activity intervention based on local spatial heterogeneity.

The downstream interventions (i.e. reducing the use of air conditioning, wearing clothing appropriate for warm tropical weather, and controlling the air pollution level) mainly reflect people's likelihood of participating in physical activity when exposed to pro-environmental conditions while at home and work (Dahlan & Gital, 2016; Dahlan & Kurmanbekova, 2019; Tan et al., 2020). In terms of environmental quality, physical activity is associated with practices that comply with sustainable development goals (SDGs) through a reduction in traffic congestion and the level of air pollution (Rother, 2020; Wan Omar et al., 2013). Some authors second the notion that the walkable neighbourhood also contributes as a stress relief mechanism and extended exposure to features may reduce common health ailments such as hypertension (de Keijzer, 2019; Sarkar et al., 2018; Wan Omar et al., 2013).

3.3 Facilitating Behavioural Changes

Temporary urban characteristics defined by activities and structural and sensory interventions at shopping streets in Sri Lanka are strongly relevant to the human scale, walkability and mass, density and scale of the place, as documented by (Wijesundara & Wijekoon, 2017). Inhabitants of busy tropical cities such as Kuala Lumpur and Singapore also indicated that a variety of activities and facilities in public spaces is crucial for encouraging physical activity (Karuppannan & Sivam, 2013). The creation of mixed land-use developments and a continuous pedestrian network has promoted more utilitarian physical activity, albeit facilitating place-making processes, as reported in Bahrain (Pinelo Silva & Akleh, 2018), Malaysia (Hashim et al., 2017) and Singapore (Richards et al., 2020). The organization of street interventions fuels pedestrians' excitement and attempts to pursue pleasure and thus also serves as a stress release mechanism after a hard day's work (Alba & Williams, 2013). These issues are indicators of work-life balance, namely, adjustments to long working hours, ample leisure and personal care time, and a short commute time (Economist, 2017; OECD, 2011).

Reports on upstream interventions in many cities in both developed and developing countries, including Ghent, Hamburg, Helsinki, Madrid, Bogota, Brussels, Chengdu, Hyderabad, Salaya, Putrajaya, and Milan, urge the public to reduce their private car and motorcycle trip through policies set by the health ministry, transportation ministry and local governments. This can be done by engaging in any of the active travel modes (i.e., walking, cycling and public transportation) to increase health benefits, reduce traffic fatalities and air pollution exposure to provide a seamless and accessible

(i.e., affordable and universally designed) travel experience (Fraszczyk et al., 2019; Hashim et al., 2017; Thondoo et al., 2020). Despite resistance and a slow response from the public, the outbreak of COVID-19 has shown that an extreme reduction in motorization can become a reality (Thondoo et al., 2020).

4 The Implication

The authors acknowledge the influence of built environment variables such as travel time, safety (i.e., crime rate and traffic congestion), and health via environmental quality (i.e., air quality, heat stress and noise pollution) with the three types of physical activity behaviours commonly practised during daily city trips, namely, commuting to work, running errands and participating in leisure activities. Shortcomings or difficulties related to any of these variables have been reported to influence people to drive their motor vehicles. The workplace neighbourhood is a good example of a built environment that possesses all three built environment variables. The main attributes of workplace neighbourhoods, such as the ability to commute to work by walking and bicycling and the degree to which designated parking areas are available to workers, have been observed in planned cities, specifically Putrajaya in Malaysia (Hashim et al., 2017) and Singapore (Karuppannan & Sivam, 2013). Moreover, organic workplace-built environments can be seen in Chennai (Adlakha et al., 2016) and Kerala in India (Valson et al., 2019), mid to western regions of Indonesia (Arundhana, 2018), Cebu Province of the Philippines (Dahly, 2013) and Brazilian cities (Matozinhos et al., 2015).

The intervention reviewed in this theme mainly aims to understand the changes in people's response to dynamic environmental factors that can lead to healthy physical activity behaviour. Assessment of the reciprocal and dynamic relationships between people and places has been done using qualitative and quantitative methods, thus leading to a variety of physical activity intervention types suitable for each measured population. People's judgement and interpretations of the environment that lead to changes in physical activity patterns may take time. Currently, individual psycho-physical investigations show more objective and specific responses to micro-climatic and built environment characteristics. Moreover, an assessment of the individual's interpretation of his environment (i.e. workplace, home and neighbourhood) can be translated into spatial mapping to identify the effectiveness of physical activity design intervention at the street level. Both the interpretation and psycho-physical responses of the people should be considered for physical activity participation, thus warranting a built environment design that is responsive to the micro-climate and socioeconomic status of the population.

Sedentary office-working adults in the hot climate countries have shown similar health risk factors as their temperate-country counterparts. Uniform neutral operative temperatures in the workplace and a high-calorie diet contribute to low metabolism, thus leading to imbalances in energy expenditure. The authors emphasise that the spatial heterogeneity in high- and low-income communities causes a lack of localised influences on environmental determinants that are obesogenic and disparate in health information.

Consideration of providing flexible working hours by having intermittent break periods, coupled with a low-temperature difference between the indoors and outdoors will reduce workers' sedentary behaviour while indoors. There are many reviews on people's behaviour towards their built environment (Angkurawaranon, Jiraporncharoen, Chenthanakij, Doyle & Nitsch, 2014; Malambo, Kengne, De Villiers, Lambert & Puoane, 2016; Brian E Saelens & Handy, 2008; Tucker & Gilliland, 2007), but little has been said about changing work flexibility in hot-climate countries, where it can

be challenging to workers who are acclimatised to the air-conditioned indoor spaces of their workplace.

More creative and critical strategies in terms of self-reported status on health awareness and micro-environment adaptability data collections are needed to educate the public on the health benefits of physical activity. Mechanisms to promote physical activity behaviours should be designed based on downstream-level data gathered through a mixture of climate-cultural monitoring and ethnographic interviews. Discrepancies in the inhabitants' feedback between built environments in tropical and temperature are anticipated and should be adopted in future built environment health determinant policies.

The whole population intervention approach for physical activity in the tropical built environment can be summarised as shown in Figure 1. The two-way flows (i.e., up-mid and mid-down streams) show the occurrences of evidence-based information dissemination, which is commonly collected from the lower streams and used as a decision-making support for upstream-level intervention designs. However, appropriate methodologies are required through adaptation and refinement of the traditional research methods with a focus on the multifaceted factors discussed. The authors acknowledged the sentiment of local inhabitants in response to their microenvironment climate and physical conditions, and culture when deducing their behaviour towards physical activity. Emphasis on place-level prioritisation and individual adaptability to the environment suggests the importance of recognising spatial heterogeneity as physical activity triggers especially at the midstream and downstream levels.

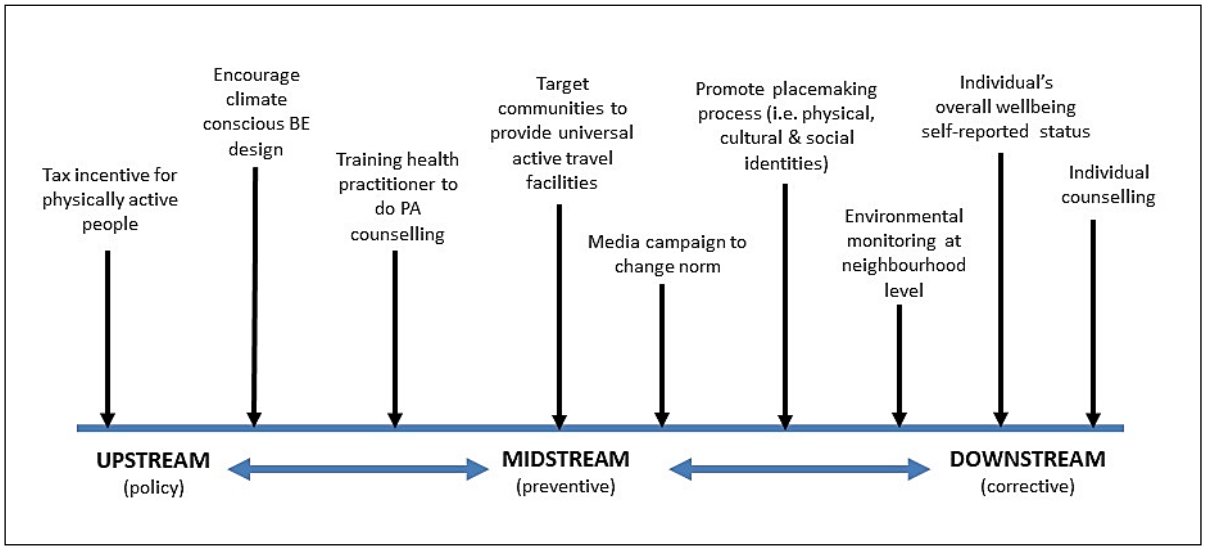

Fig. 1: Whole population physical activity intervention.
(BE: built environment; PA: physical activity)

5 Conclusion

This study aims to discuss the current literature regarding the participation in physical activities in response to their micro-climate conscious design, obesogenic environment and facilitating behavioural changes in the post-COVID-19 hot climate regions built environment. Like others, we noted that few evaluative studies that articulate environmental changes, particularly built environments act to promote physical activity or call for greater consideration for place-level prioritisation, which we found to be a more promising intervention strategy than its 'one-size-fits-all' counterpart. In addition, we deduced that 'place-level prioritisation' through multifaceted factors

encourages traits unique to the daily lives of the majority of people in hot climate built environments. Our findings suggest that downstream and midstream delivery levels of intervention will most likely empower the public to participate in physical activity in their daily lives.

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Cite as: Abd Manan M.S & Dahlan N.D., "Cultural-climate Conscious Design Approach to the Post Covid-19 Built Environment", *The 2nd International Conference on Civil Infrastructure and Construction (CIC 2023)*, Doha, Qatar, 5-8 February 2023, DOI: https://doi.org/10.29117/cic.2023.0139