

Active workplace design: current gaps and future pathways

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INTRODUCTION

Insufficient physical activity and excessive sitting time among office-based workers have been linked to various health risks and economic consequences. While health promotion interventions are important, the role of workplace design in encouraging active behaviours is increasingly recognised. However, significant gaps exist in knowledge about how workplace design influences these behaviours. This paper identifies the need to investigate the interactive effects of workplace norms and culture and the role of building layouts on workers' behaviours, as well as the need for more accurate behavioural measures. Bridging these gaps is crucial for designing workplace interventions and promoting active, healthy and productive work environments.

Workplace design: encouraging movement in workplace settings

Models such as the socioecological model demonstrate how multiple factors interact to influence physical activity and sedentary behaviour among workers in diverse contexts.¹ These frameworks emphasise the workplace environments' role in shaping these behaviours, particularly given the substantial time employees spend in these settings. Multiple studies have investigated the role of workplace physical environments on workers' physical activity and sedentary time.^{2,3} Notably, several physical environment factors

inside and outside workplaces can support workers' activity.^{2,3} However, despite the existing research, several gaps still warrant investigation in this area of science.

EXISTING GAPS AND FUTURE DIRECTIONS

Interactive effects of workplace social environments

Workplace social environments such as norms and culture can significantly influence sedentary behaviours among office-based workers⁴ and can affect how workplace design influences workers' behaviour. Most previous studies have tested the effects of workplace design on employees' active and sedentary behaviours within Western contexts,⁵ leaving a gap in how these relationships vary in other geographical settings with unique workplace norms and cultures. For instance, in a workplace where extended sitting is a cultural norm, employees may still predominantly engage in sedentary behaviour, regardless of having activity-promoting features in their workplace. Conversely, an activity-promoting environment might help mitigate norms towards sitting or even produce multiplicative positive effects in contexts where activity in the workplace is already customary. Conducting studies across varied geographical settings is necessary to identify similarities and differences in the impact of workplace norms and design on workers' active and sedentary behaviours. Cross-cultural studies can shed light on the generalisability of findings and help develop customised interventions that

address specific norms and cultural challenges. Future research can also employ mixed methods to gain a more thorough understanding of the complex interplay between workplace design, norms and culture, and employees' behaviour. Additionally, the rise of home and hybrid working arrangements indicates that office social norms could extend to home work environments. For example, a culture of regular stretch breaks in the office might encourage similar practices at home, influencing physical activity behaviours remotely. Understanding the detailed relationship between workplace design, norms and employee behaviour is critical for developing targeted contextually relevant interventions that promote active workplace environments.

Precision in tracking workplace behaviours

Accurately measuring employees' active and sitting behaviours and identifying the 'locations' where these behaviours occur is essential to understand their relationships with workplace design attributes. Global positioning systems (GPS) have been commonly used in combination with accelerometer devices to measure and spatially track people's active and sedentary behaviour in outdoor environments, such as neighbourhoods and cities.⁶ Nevertheless, GPS signals have limited accuracy or can be disrupted within indoor environments, resulting in less precise location data.

An indoor positioning system (IPS) can address the limitations of GPS in indoor environments.⁷ IPS is a wayfinding technology that uses existing low-cost WiFi and Bluetooth to provide precise locations of individuals inside buildings. The IPS can be integrated with activity-tracking wearable devices, such as accelerometers, pedometers and heart rate monitors, as well as traditional methods like behavioural mapping. This integration allows for the collection of employees'

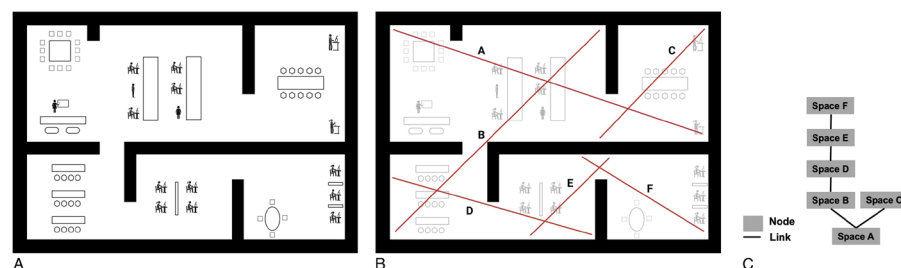


Figure 1 Space syntax examines building layouts as a whole, using the graph theory: (A) a schematic workplace layout, (B) space syntax axial lines (i.e., longest and fewest lines traversing all spaces) of the layout, and (C) the connectivity of all spaces based on the graph theory.

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Discussion

location data, movement patterns, activity intensities and other biometric data within workplaces. Additionally, the synergy between IPS and wearable devices effectively differentiates between occupational and leisure physical activities in workplaces. This distinction is key to better understanding the health paradox of the different health effects of these two types of physical activities.⁸ Furthermore, with the growth of artificial intelligence (AI), there has been a unique opportunity to employ geospatial AI (GeoAI) in workplace environments and health research. GeoAI techniques aim to integrate innovations in spatial sciences with AI, particularly deep learning.⁹ The joint application of IPS and GeoAI would enable precise location data of individuals within the workplace while using the power of spatial analysis. GeoAI can analyse workers' movement patterns derived from IPS in combination with geospatial layers such as spatial layouts, access to common places, and light conditions. For instance, a GeoAI trained by tracking data on people's movements in various indoor environments would predict people's movements and derive estimates of the amount of sedentary behaviour of employed people only from planned indoor layout. This analysis allows for identifying hotspots or areas within the workplace where active and sedentary behaviour is prevalent.

Beyond individual design elements: exploring the influence of building layout on workplace behaviour

Most previous studies have primarily examined individual design elements but fail to consider how the overall spatial layout influences movement and behaviour. Building layout encompasses the spatial arrangement of building elements such as walls, doors, windows, and access ways, and plays a fundamental role in defining the functionality of interior spaces. Once a building layout has been established, making substantial alterations to it becomes challenging or, in some cases, impossible. Therefore, designing (and, if feasible, retrofitting) building interiors to promote health is imperative, but it is still unclear which

workplace layouts are most supportive of workers' active behaviours.

The urban design theory of space syntax has the potential to partially address this gap in knowledge. Space syntax uses a set of graph-based estimators to quantify spatial layouts.¹⁰ It offers a framework to investigate the impact of building layout factors, such as workstation arrangement, common area location, and space accessibility, on workers' movement patterns and behaviours. It goes beyond isolated design elements and considers the spatial configuration as a whole (figure 1). Additionally, more research on 'how' people use and perceive their workspaces could complement the space syntax evaluations of building design.

CONCLUSIONS

Future research should investigate the interactive effects of workplace norms and culture on behaviour and conduct cross-cultural studies to identify similarities and differences. Innovative measurement methods can also be employed to accurately measure behaviours and locations where those behaviours occur within workplaces. Additionally, exploring the influence of spatial layout, and using the urban design theory of space syntax, can offer valuable insights into the design of work environments that facilitate workers' engagement in active behaviours.

Contributors MJK conceived the idea and wrote the initial draft of the manuscript. All authors contributed to the writing and assisted with the analysis and interpretation. All authors have read and approved the final manuscript and agree with the order of the presentation of authors.

Funding MJK is supported by the JSPS KAKENHI (grant 23K09701). KO is supported by the JSPS Grants-in-Aid for Scientific Research program (grant 20H04113).

Competing interests None declared. In particular, none of the authors has a financial interest in the Space Syntax Limited company.

Patient consent for publication Not applicable.

Ethics approval Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.



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To cite Koohsari MJ, Kaczynski AT, Yasunaga A, *et al.* *Br J Sports Med* 2024;**58**:1157–1158.

Accepted 22 April 2024

Published Online First 17 May 2024

Br J Sports Med 2024;**58**:1157–1158.

doi:10.1136/bjsports-2024-108146

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