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Doctoral Dissertation

An expert-informed audit tool for activity-friendly parks in dense urban areas

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Abstract

The global prevalence of physical inactivity and sedentary behaviour has become a pressing public health concern, contributing significantly to the burden of non-communicable diseases such as cardiovascular disease, type 2 diabetes, obesity, and certain types of cancer. Public open spaces are recognised as an essential component of the built environment that supports physical activity, promotes active lifestyles, and reduces risk factors for non-communicable diseases. However, rapid urbanisation in Asia has led to increasingly dense urban environments characterised by limited open space, spatial fragmentation, and intense competition for land use. Existing auditing tools have primarily been developed in low-density urban settings in the West, resulting in considerable gaps in their applicability to dense urban contexts, their cultural adaptability to Asian cities, and their usability across diverse user groups. These limitations restrict both the application and scientific evaluation of urban environments in different global contexts. This thesis addresses these challenges by developing and testing a park audit tool tailored specifically for high-density urban areas in Asia.

This research presents the development, validation, and remote adaptation of the dense urban park audit tool, with a focus on supporting park-related physical activity in dense urban settings. This study was conducted in Tokyo, Japan, a representative dense Asian city with constrained Public open space. Employing a multi-phase, mixed-methods design, the study involved: (1) the development of the dense urban park audit tool through systematic literature review and expert consensus; (2) field validation in selected urban parks; and (3) remote adaptation using publicly accessible virtual imagery.

Dense urban park audit tool was constructed through a systematic review of existing park audit tools and the construction of park environmental attributes that influence physical activity. Expert opinions were gathered through a fuzzy Delphi consultation involving interdisciplinary experts and researchers to identify and prioritise key park attributes. Dense urban park audit tool comprises six sections—park base information, park surroundings and accessibility, activity areas, facilities and amenities, aesthetics, and safety—measured via a series of quantifiable and clearly defined items. Pilot testing and iterative revisions ensured item clarity and feasibility. Field validation in 25 Tokyo parks assessed inter-rater reliability using Cohen's kappa and percent agreement, and construct validity against a gold standard (trainer ratings). Results showed that 91.1% of items achieved kappa values above 0.4, indicating at least moderate agreement, while 95.9% surpassed 70% agreement. Overall dimension-level validity was confirmed with 87.5% agreement, supporting audit tool's reliability and appropriateness for dense urban contexts.

Recognising the growing need for low-cost, scalable environmental assessment methods, particularly when logistical constraints limit on-site auditing across large or dispersed samples, this study introduced a remote version of dense urban park audit tool. Using Google Earth Pro as the primary data source, remote version of dense urban park audit tool was tested across 53 parks in Tokyo, with a subset ($n = 25$) also assessed on-site for comparative validation. Remote version of dense urban park audit tool demonstrated high inter-rater reliability, with 89% of items showing moderate to almost perfect agreement. Convergent validity, measured via intraclass correlation coefficient (ICC), indicated a strong correlation between remote and on-site assessments ($ICC = 0.73$). While virtual audits cannot evaluate transient or sensory attributes such as litter or graffiti, they offer significant advantages in replicability, time efficiency, and cost savings.

This thesis demonstrates a rigorous, scientifically sound and replicable research pathway for developing a park audit tool that addresses the specific challenges of dense urban environments. By bridging gaps in existing literature—inadequate applicability in dense urban contexts, insufficient adaptability to Asian cultures, and limited diversity of intended users—this research advances the scientific understanding of the link between built environment attributes and physical activity. Both on-site and remote version of dense urban park audit tool offer practical, scalable solutions for urban planners, public health professionals, and researchers aiming to enhance park environments to promote active living. In doing so, this study contributes meaningfully to the fields of urban health, built environment research, and methodological innovation.

Keywords: science-based urban design; observational audit; virtual assessment; public open space; neighbourhood design; physical activity; healthy cities