



Review Article

Simultaneous evaluation of physical and social environmental correlates of physical activity in adults: A systematic review



Alexia Sawyer^{a,*}, Marcella Ucci^b, Russell Jones^c, Lee Smith^d, Abi Fisher^a

^a Health Behaviour Research Centre, Department of Epidemiology and Public Health, University College London, Gower Street, London WC1E 6BT, UK

^b UCL Institute for Environmental Design and Engineering, The Bartlett Faculty of the Built Environment, Central House, University College London, 14 Upper Woburn Place, London WC1H 0NN, UK

^c Glasgow Centre for Population Health, The Olympia Building, University of Glasgow, Glasgow G12 8QQ, UK

^d The Cambridge Centre for Sport and Exercise Sciences, Dept. of Life Sciences, Anglia Ruskin University, UK

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ABSTRACT

Background: Ecological models of physical activity posit that social and physical environmental features exert independent and interactive influences on physical activity, but previous research has focussed on independent influences. This systematic review aimed to synthesise the literature investigating how features of neighbourhood physical and social environments are associated with physical activity when both levels of influence are simultaneously considered, and to assess progress in the exploration of interactive effects of social and physical environmental correlates on physical activity.

Methods: A systematic literature search was conducted in February 2016. Articles were included if they used an adult (≥ 15 years) sample, simultaneously considered at least one physical and one social environmental characteristic in a single statistical model, used self-reported or objectively-measured physical activity as a primary outcome, reported findings from quantitative, observational analyses and were published in a peer-reviewed journal. Combined measures including social and physical environment items were excluded as they didn't permit investigation of independent and interactive social and physical effects. Forty-six studies were identified.

Results: An inconsistent evidence base for independent environmental correlates of physical activity was revealed, with some support for specific physical and social environment correlates. Most studies found significant associations between physical activity and both physical and social environmental variables. There was preliminary evidence that physical and social environmental variables had interactive effects on activity, although only 4 studies examined interactive effects.

Conclusions: Inconsistent evidence of independent associations between environmental variables and physical activity could be partly due to unmeasured effect modification (e.g. interactive effects) creating unaccounted variance in relationships between the environment and activity. Results supported multiple levels of environmental influence on physical activity. It is recommended that further research uses simultaneous or interaction analyses to gain insight into complex relationships between neighbourhood social and physical environments and physical activity, as there is currently limited research in this area.

1. Introduction

Despite several health benefits of regular participation in physical activity (Ekelund et al., 2015; Reiner, Niermann, Jekauc, & Woll, 2013), most individuals living in industrialised nations lead insufficiently active lifestyles (Hallal et al., 2012). Interventions that target individuals have had limited success (Hillsdon, Foster, & Thorogood, 2005), perhaps partly because individual-level correlates are estimated to explain

only 20–40% of reported variance in physical activity (Spence & Lee, 2003). Research and policy has therefore increasingly adopted a broader, ecological approach to activity which considers a combination of individual, social, physical, cultural and political correlates.

Systematic reviews of the literature have identified some consistent physical environment correlates of physical activity, including land use mix, connectivity and residential density which all have positive associations with activity (McCormack & Shiell, 2011; Saelens & Handy,

* Corresponding author.

E-mail addresses: alexia.sawyer@ucl.ac.uk (A. Sawyer), m.ucci@ucl.ac.uk (M. Ucci), Russell.Jones.2@glasgow.ac.uk (R. Jones), Lee.Smith@anglia.ac.uk (L. Smith), abigail.fisher@ucl.ac.uk (A. Fisher).

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2008). Access to green space may also be important: a study including over 200,000 adults reported cross-sectional associations between green space access and increased self-reported walking and moderate-to-vigorous physical activity (MVPA) (Astell-Burt, Feng, & Kolt, 2014).

The social environment has also been examined in relation to physical activity. In particular, cognitive and structural social capital constructs have been explored, encompassing aspects of perceived or objective social cohesion, trust, social support, safety, social participation and social resources (e.g. collective efficacy to enforce normative behaviours and reciprocity in sharing personal resources) (Moore & Kawachi, 2017). In a recent systematic review of 38 studies, Samuel, Commodore-Mensah, & Himmelfarb (2014) identified several characteristics of the social environment associated with overall physical activity, walking and sports participation, with higher quality social environments (i.e. increased sense of community, trustworthiness, reciprocity, social cohesion and social control) indicating higher levels of activity. There is also some evidence for a negative association between physical activity and crime and a positive relationship between physical activity and perceived safety, although findings are inconsistent. Several reasons could contribute to inconsistent results: i) inadequate measurement of crime resulting in measurement error, ii) use of physical activity outcomes that are not neighbourhood-based and therefore may have weaker relationships with the neighbourhood environment and iii) lack of consideration of features of the physical and social environment that may mediate or moderate the effects under investigation (Foster & Giles-Corti, 2008).

A core tenet of ecological models of physical activity is that correlates are embedded in a complex system whereby multiple environmental and individual characteristics are interrelated and exert independent and interactive effects (Sallis et al., 2006). While a growing literature examines independent effects of environmental correlates, there has been very little focus on their interactive or synergistic effects on physical activity despite empirical and theoretical evidence of interplay between social and physical environments (e.g. social interaction is related to structural elements including provision of communal space (Yancey, 1971), physical disorder is associated with collective efficacy (Sampson & Raudenbush, 1999) and bidirectional reciprocal associations existing between social and physical disorder as purported by broken windows theory (Keizer, Lindenberg & Steg, 2008)). The scientific value of examining social and physical effects simultaneously (rather than only controlling for other environmental correlates) is to explore the concurrent influences of social and physical environmental features on physical activity, as hypothesised in ecological models.

Conceptualising concurrent influences could elucidate counter-intuitive relationships between the environment and physical activity. For example, although there is an established relationship between area deprivation and poorer health outcomes and behaviours, including physical activity (Ecob & Macintyre, 2000), a study in two Scottish neighbourhoods found that the deprived neighbourhood had more recreation centres, sport centres and street cleaning than the affluent neighbourhood, undermining the assumption that more deprived areas would be physically less supportive of activity (Macintyre, Maciver & Sooman, 1993). Various studies in Europe, USA and Australia also report that physical activity resources are not fewer in more deprived areas (Cradock et al., 2005; Giles-Corti & Donovan, 2002; Van

Lenthe, Brug & MacKenbach, 2005). In Canada and USA, lower levels of physical activity were self-reported in areas that are objectively-classified as highly walkable (according to physical metrics like connectivity) than in less walkable areas (Jack & McCormack, 2014; King, 2008). In such instances, features of the social environment or micro-scale features of the physical environment may modify the impact of physical walkability metrics.

Broader understanding of pathways of influence could also inform intervention development. A walking intervention involving the installation of walking route signage and leadership for local walking groups in two low-income neighbourhoods in Ireland had only a marginal effect on physical activity (Burgoyne, Coleman, & Perry, 2007). Reasons behind the null effect were examined in a qualitative study (n=53), finding that social barriers such as anti-social behaviour persisted following the intervention (Burgoyne et al., 2007). This highlights the necessity of simultaneous observation of social and physical environmental correlates of activity to develop effective interventions.

To our knowledge, there is no existing review of research which simultaneously examines social and physical environmental correlates of physical activity. As such, the purpose of this systematic review was to ask how physical and social environmental features are associated with physical activity when both levels of influence are simultaneously considered in statistical models, and to assess the extent to which these influences have been considered simultaneously and interactively in the literature. Simultaneous consideration of physical and social environments in statistical models could have taken different forms, for example variables could have been included in a mediation analysis or simultaneously included in a single multivariate regression model. In every instance, results for social and physical environmental variables had to have been reported and treated as target exposures (not confounders for which associations with activity were not tested or presented).

2. Material and methods

The review was designed in accordance with PRISMA guidelines. The quality of the studies included in the review was assessed using the quality appraisal tool considering the study's research question, theoretical perspective, study design, context, sampling, data collection, data analysis, reflexivity concerning limitations, generalisability and ethics (Croucher, Myers, Jones, Ellaway & Beck, 2013). This tool has been used for related literature reviews (Croucher, Quilgars, Wallace, Baldwin & Mather, 2003). Studies were not included unless they met the 'essential' quality criteria.

2.1. Literature search

A systematic search of the literature was conducted on literature published until the end of February, 2016, using the scientific databases Embase, Ovid MEDLINE, PsycINFO and Social Policy and Practice. A reference search of relevant articles was also conducted to obtain any missing literature and original articles were identified from conference proceedings.

Search terms in Table 1 were used to access literature assessing related physical and social environment constructs and all physical

Table 1
Search terms and syntax.

Construct	Search terms
Physical environment	(Built environment or physical environment or connectivity or walkab* or neighbourhood or neighbourhood or green space or greenspace or office or workplace or housing or gym or school or community centre or care home or nursing home or park or recreation* facility* or recreation* space) in abstract OR title
Social environment	(Social capital or social control or social* cohesi* or social network or trust or safety or crime or social environment or social interaction or socio-cultural) in abstract OR title.
Physical activity	(Physical activity or walk or sedentary or exercise* or sit* or active travel* or active transport*) in abstract or title

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