

Outdoor Environment is Associated With Physical Activity of Children After 24 Months of a Whole-Systems Trial: A Network Analysis of the JU:MP Programme

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Purpose: Promoting physical activity (PA) through whole-system approaches has been identified as effective and sustainable. However, most studies use analytical methods that assume isolated and linear effects to understand how correlates of behaviours evolve over time and whether differences emerge within a controlled trial design. There is a growing need for tools that apply a complex systems lens. This study used network analysis to examine associations between moderate-to-vigorous physical activity (MVPA) and demographic, behavioural, and environmental variables in children, 24 months after the implementation of a whole-system PA intervention (JU:MP).

Methods: This study is part of a whole-system community-based physical activity programme, JU:MP, delivered at scale in Bradford, United Kingdom. This controlled trial with two-arms included 1,123 children aged 7–11 years from 33 primary schools. PA was measured via accelerometry. Demographic information, socioemotional difficulties, physical activity in school, out-of-school, home settings, environmental spaces such as parks and green spaces, and screen time were collected through questionnaires. Network models were estimated separately for intervention ($n = 766$) and control groups ($n = 687$) at baseline (B) and 24-month follow-up (F1). Network parameters included node centrality and edge weights. The extended Bayesian information criterion EBIC LASSO was used to regularise networks ($\gamma = 0.25$).

Results: At baseline, MVPA was strongly associated with lunchtime PA (0.333, 0.385) and participation in organised sport (0.401, 0.419) for both intervention and control groups, respectively. At F1, network density increased for both groups, and MVPA became strongly associated to green space (0.260, 0.297) and street PA (0.316, 0.287). However, MVPA was identified as more embedded in structured clusters of environmental and behavioural variables (such as screentime) in the intervention group. Additionally, PA before school emerged as a key central node (expected influence = 1.950).

Conclusion: After 24 months, the intervention strengthened connections between MVPA and green space use, street activity, and before-school PA. These results highlight the potential for policies that prioritise green space access and urban walkability to enhance PA in children. Network analysis offers a useful tool to assess systemic shifts and offer insights for whole-system approaches in understanding behaviour change.

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