Health impacts of environmental and social interventions designed to increase deprived communities' access to urban woodlands: a mixed-methods study

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researcher (2006–11) on commissioned research funded by FCS to undertake an evaluation of some of its Woods In and Around Towns programme. Richard Mitchell is a non-remunerated director of a charity (Paths For All), which delivers, and advocates for, walking for health.

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Scientific summary

Increasing deprived communities' access to urban woodlands

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Scientific summary

Background

High prevalence of poor mental health is a major public health problem in the economically developed world. Approximately 27% (83 million people) of the adult population in the European Union experienced at least one mental health disorder in the past year. The economic cost of poor mental health is high. In Scotland, where this project was based, this cost has been estimated at £10.7B.

Environmental influences on health, including mental health, are of particular interest because of their potential to affect large numbers of people. Observational and experimental studies have found associations between access to natural environments and a range of physical and mental health benefits. However, there is also evidence that, within certain distance parameters, quality may be more important than proximity. There is varying evidence on whether the health effects of proximity to natural environments are stronger in men or women.

The present evidence base on the population-level health effects of exposure to natural environments is largely observational and tells us little about how changes in access to natural environments improve health, or how those changes should best be achieved. For instance, it is unclear whether the provision of natural environments or the promotion of opportunities to access these environments matters most. This evidence gap provided the rationale for this study.

The research took advantage of a rare opportunity for a prospective study. Through its Woods In and Around Towns (WIAT) programme, Forestry Commission Scotland (FCS) planned a set of physical and social interventions in deprived communities to enhance public access to natural environments. The study treated these interventions as a quasi-experiment and investigated their impact on mental health at a community level over time.

Objectives

The study's main objective was to evaluate the health impacts of interventions that sought to increase community use of local woodlands. Our research questions were:

- What is the impact of the WIAT programme of interventions on mental health (particularly levels of stress) in the community?
- Is any impact on mental health associated with changes in engagement with woodland or other natural environments after implementation of the WIAT interventions?
- Are changes to the physical woodland environment sufficient to have an impact on mental health and/or woodland awareness and use by the community, or are organised activities and other promotional initiatives also required?
- What is the impact of the intervention on other health and well-being outcomes [i.e. physical activity (PA) levels, connectedness to nature and community cohesion]?
- What is the impact of the intervention on length and frequency of visits to natural areas and local woods, experience of local woods, awareness of them, activities undertaken there and visual contact with woodland?
- Are there gender differences in the impacts of the interventions?
- Are there differences in patterns of woodland use, and in impacts of the interventions, in accordance with distance of woodlands from participants' homes; is there any distance threshold for impacts?
- What are the cost consequences of each stage of the intervention in relation to the study outcomes?

Methods

The study was a controlled, programme-level evaluation of the WIAT intervention. The research design was quasi-experimental and included three intervention and three matched control sites as part of a longitudinal, mixed-methods study. Repeat cross-sectional surveys were undertaken of individuals resident in intervention and control communities, with three waves of data collection to assess health impacts. A longitudinal cohort of participants (seen at two or three waves) was nested within the cross-sectional surveys, the size of which was determined by the extent to which we obtained repeat responses. The study also tracked the quality and cost of environmental changes and promotional activities in the woodlands, the local communities' perceptions of these interventions and their impact on primary and secondary health outcomes.

The study contained six main components:

1. A preliminary survey of all potentially WIAT-eligible woodlands and their associated communities, using FCS maps and site visits, to identify sites appropriate for intervention starting in 2012/13 and for which comparable control woodlands and communities could be identified.
2. A record of the environmental and social interventions planned and implemented by FCS under their WIAT programme, including the costs involved at all stages.
3. A core survey of the local community in each site, undertaken before and after each of the two phases of WIAT intervention, to record the intervention's impact on health and well-being outcomes, perceptions and use of local woods and green space.
4. Audits of the woodlands and associated neighbourhood environment, by expert auditors and by community members, in both winter and summer, before and after each phase of the intervention, to evaluate any physical change at each site.
5. A qualitative study of a subsample of core survey and woodland audit participants from each local community to elicit an understanding of the experience of the intervention and perceptions of its effectiveness.
6. An economic evaluation of the intervention and any associated health outcomes identified.

The interventions

Phase 1 (physical interventions) took place over 8 months and included (1) clearing shrubs, (2) installing fences and gates, (3) creating boardwalks and paths and (4) adding signage.

Phase 2 (social interventions) started 4 months after the physical interventions were completed and took place over 9 months. Examples include led walk programmes, family fun days, sculpture, sport activities and special event days, targeting a range of different age groups.

Measures used in the core survey

The primary outcome was a measure of stress, assessed using the Perceived Stress Scale (PSS).

The main secondary outcome measures used were:

- mental well-being [as measured by the Short Warwick–Edinburgh Mental Well-being Scale (SWEMWBS)]
- self-reported PA levels [as measured by the International Physical Activity Questionnaire – Short Form (IPAQ-SF)]
- self-reported visits to the local woodland site
- self-reported visits to other local green spaces
- perceptions and experiences of the local woodlands

- emotional connection to the natural world [as measured by the Inclusion of Nature in Self (INS) scale]
- perceived restorativeness of the woodland environment
- self-reported health-related quality of life (HRQoL) [as measured by the EuroQol-5 Dimensions (EQ-5D)]
- perceptions of the local neighbourhood and social cohesion
- a range of sociodemographic variables.

Study participants recruited and analytical methods

The core community survey recruited individuals aged ≥ 16 years living in the intervention and control communities within 1.5 km of the relevant woodland site. Selection used a random sampling approach, stratified in accordance with distance from the WIAT-eligible woodlands. After data cleaning and checking, the survey produced a cross-sectional sample of 5460 participants (wave 1, $n = 2117$; wave 2, $n = 1672$; wave 3, $n = 1671$), labelled panel A. The survey contained a nested longitudinal cohort of 609 participants (wave 1, $n = 609$; wave 2, $n = 350$; wave 3, $n = 402$), labelled panel B. Panel B was less representative than panel A but had the virtue of reflecting change in the same individuals at baseline and after the interventions. Approaches to quantitative analysis included an overall effect estimate based on intention to treat (ITT) and, subsequently, a closer inspection of the intervention effect on our primary outcome (perceived stress). This considered the differential impact of the WIAT programme as a function of three main factors: (1) engagement with the woods (physical and visual), (2) gender and (3) distance to the woods.

Community members were also recruited to undertake 6-monthly environmental audits at all sites, each winter and summer between 2013 and 2015. Participants at each site contributed 256 community-led audits in total, alongside expert audits by landscape professionals.

Community members in the three intervention sites were also recruited to participate in post-intervention focus groups or interviews in 2015 or 2017 ($n = 34$). Thematic analysis of the transcripts informed interpretation of findings.

Economic analysis considered the costs of the interventions against HRQoL outcomes. Cost–consequences and cost–utility analyses were undertaken, along with a sensitivity analysis, and the results of all simulations were combined to give incremental cost-effectiveness ratio (ICER) results.

Results

Our findings for the primary outcome measure showed that stress (as measured by the PSS) increased significantly in the intervention group and marginally decreased in the control group. Multilevel regression models showed a differential impact between intervention and control at survey wave 3 in panel A [B (unstandardised coefficient) 3.58, 95% confidence interval (CI) 2.85 to 4.31; $p < 0.001$] and in panel B (B 3.03, 95% CI 1.54 to 4.52; $p < 0.001$). Mental well-being results showed a similar differential impact, with a decline in SWEMWBS score by wave 3 for panel A (B –0.57, 95% CI –1.10 to –0.03; $p < 0.05$) and panel B (B –1.65, 95% CI –2.73 to –0.57; $p < 0.01$). Using the same analytical approach, we found no significant change in HRQoL (EQ-5D) associated with the intervention.

The differential in stress between intervention and control was lower or non-significant in those who visited woodlands and other natural environments in the previous year (panel A, B 1.9, 95% CI 0.8 to 3; $p < 0.001$; panel B, B 0.64, 95% CI –1.6 to 2.88; $p = 0.57$), whereas for SWEMWBS there was a positive differential for this group in panel A by wave 3 (B 0.91, 95% CI 0.13 to 1.68; $p < 0.05$). The increase in PSS scores and decrease in SWEMWBS scores associated with the intervention was strongly evident in those who had not made such nature visits, suggesting that factors other than the WIAT intervention lie behind the mental health patterns observed.

Measures of PA (as measured by the IPAQ-SF) showed positive association with the intervention for moderate levels of PA (panel A, *B* 249.2, 95% CI 58.25 to 440.1; $p = 0.01$; panel B, *B* 559.3, 95% CI 211.3 to 907.2; $p = 0.002$) and overall PA (panel B, *B* 861.5, 95% CI 106.5 to 1616.4; $p = 0.025$). This compared favourably with the control group, in which levels of PA declined over time.

The intervention was also associated with increased INS score (panel A, *B* 0.39, 95% CI 0.2 to 0.57; $p < 0.001$) and social cohesion (panel A, *B* 0.5, 95% CI 0.29 to 0.70; $p < 0.001$) by wave 3 but these findings were significant for panel A only.

The intervention did not show a significant association with length and frequency of visits to the specified local woods. However, there was a significant association with undertaking nature visits more generally, compared with control sites, in both panels [panel A, odds ratio (OR) 2.69, 95% CI 1.9 to 3.81; $p < 0.001$; panel B, OR 2.77, 95% CI 1.45 to 5.29; $p < 0.001$]. This translated into a predicted increase of 6% in intervention site participants visiting natural environments, compared with a drop of 11% in the control site.

Awareness of the local woods also increased significantly for the intervention group (panel B, OR 3.39, 95% CI 1.72 to 6.67; $p < 0.001$). For those who visited their local woods (a minority of participants), there was a significant increase in going for a walk in the woods by wave 3 (panel A, OR 3.3, 95% CI 1.73 to 6.29; $p < 0.001$) and for walking with family and/or friends by wave 2 (panel A, OR 3.42, 95% CI 1.37 to 8.56; $p < 0.01$). For measures of experience of the woods associated with attention restoration theory, we found a significant association between the intervention and 'being away' and 'fascination' by wave 3 for both panels ['being away', panel B, *B* 2.72, 95% CI 1.95 to 3.49; $p < 0.001$].

Although our results showed that, on average, women were consistently associated with higher levels of stress than men, there was no significant difference in stress levels by gender.

Differences in stress between the intervention and control groups were largest in those living furthest from the woods (501–750 m and 751–1500 m), with significantly higher stress in both panel A and panel B for participants in these categories. In panel B, increases in stress levels were not significantly different between control and intervention site participants living within 500 m of their local woodlands.

The environmental audit results showed a significant difference between intervention and control site scores at each time point, both for community ($p < 0.001$) and for expert audits ($p < 0.001$). The interventions were perceived as significantly enhancing the quality of the intervention woodlands compared with baseline, and this was true regardless of seasonality. By summer 2015, after both phases of the intervention were completed, the intervention sites were considered to be of significantly higher quality than the control sites. However, for the community auditors (but not the expert auditors), this had also been true at baseline.

The qualitative analysis of focus groups and interviews suggests that the positive changes in intervention sites noted by community-led audits were highly appreciated by community members, although these were often participants who already visited the woods regularly. Positive responses to the intervention included walking, appreciation of wildlife and nature (especially for children) and enjoyment of peace and quiet. There was also evidence of positive social engagement and community benefits. Negative comments largely focused on vandalism, litter and dog faeces, overgrown vegetation and deterioration of footpaths that reflected a lack of maintenance after the interventions were completed. Overall, there was considerable consistency between comments made by community site auditors and the focus groups/interviews.

The total cost of the WIAT interventions was £241,667 across the estimated eligible population on whom the programme had an impact ($n = 20{,}472$). This resulted in an average cost of £7.68 (95% CI £7.67 to £7.69) for the physical intervention (wave 2) and £11.80 (95% CI £11.79 to £11.82) for both physical and social interventions (wave 3). Because no significant associations between the intervention and improvements in EQ-5D score were found, WIAT's cost-effectiveness cannot be demonstrated. The cost–utility analysis in panel A reveals an ICER of £935 (95% CI £399 per QALY to dominated, thus higher cost and lower QALY

than the control) in wave 2 for the physical intervention and an ICER of £662 (95% CI £206 per QALY to dominated) in wave 3 for both social and physical interventions. This illustrates that, given the modest cost of the interventions based on the average per person in the eligible population, WIAT interventions would need to have only a small impact on HRQoL to show cost-effectiveness.

Contributions of the study

To our knowledge, this study is the first of its kind: a prospective study in which planned interventions to enhance urban populations' access to natural environments provided a 'natural experiment' and health impacts of the interventions were evaluated at a community level over time. Our evaluation was enhanced by several factors, including primary data collection, the embedded longitudinal component and a mixed-methods approach.

The study is underpinned by a clear theoretical model and the findings offer some support for certain pathways indicated in the model between interventions in the natural environment and health outcomes.

Conclusions

- The significant increase in stress outcomes associated with intervention sites cannot be adequately explained by data from our mixed-methods approach and may be attributable to external influences beyond this study.
- Our evidence suggests that other, significantly positive outcomes may be at least in part attributable to the interventions, although we cannot exclude external influences.
- The economic evaluation illustrated the requirements for WIAT to show cost-effectiveness in relation to HRQoL. Longer-term interventions and post-intervention evaluation might be needed before any such outcome is likely.
- We recommend increasing the number of sites included in such a study – that is, in which natural experiments do not allow for random allocation of participants to different treatments and the cost of primary data collection is high. Such an approach might, for example, use routinely collected data to undertake a whole-programme evaluation of WIAT.

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