Links between natural environments and physiological health: evidence briefing

Purpose of briefing

This briefing note is one of a series that summarises evidence of the relationships between the natural environment and a range of outcomes. This briefing focuses on links between the natural environment and physiological health[1]. The notes are aimed at: policy makers, practitioners, practice enablers (including Natural England, Natural Resources Wales etc.), local decision makers, and the wider research community. They highlight some of the implications for future policy, service delivery and research. It is intended they will inform practitioner planning, targeting and rationales, but not the identification of solutions or design of interventions. Barriers to access or use are not considered in these notes. The other briefings in the series published so far cover physical activity, obesity, mental health, connection with nature, and learning. The notes consider evidence of relevance to the UK and outcomes for both adults and children. Please see EIN016 for methodology, glossary and evaluation resources.

Extent of the issue

- Although UK premature death rates, particularly from causes such as respiratory and circulatory disease, have significantly reduced over the past 50 years we still face considerable challenges.
- Rates of non-communicable diseases (NCDs) have been described to be at epidemic levels and are set to rise in the coming years.
- The **Kings Fund** provides information on rates of mortality and NCDs: Around 835,000 people in the UK have been diagnosed with chronic obstructive pulmonary disease, and 5.4 million people in the UK are currently receiving treatment for asthma; the number of people with arthritis in the UK is expected to rise from 8.5 million to 17 million by 2030; coronary heart disease and stroke are the biggest causes of death in the UK; the number of people diagnosed with diabetes rose from 1.4 million in 1996 to 3.1 million in 2010, and by 2025 it is estimated that it will rise to more than 4 million, a 29 percent rise[2].
- Diabetes alone currently costs the NHS approximately £1.5million an hour and takes up about 10 percent of the total budget per annum[3].

Summary statement

Evidence tends to show that, at a population level, higher levels of exposure to natural environments are associated with lower all-cause mortality, rates of diabetes type 2, cardiovascular and respiratory disease, and more positive maternal and pregnancy outcomes. Less is known about relationships with cancer, musculoskeletal health, allergies, or of the impact of different types of environment or of the

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consistency of variation in any of the outcomes between different socio-demographic groups. The evidence base is occasionally contradictory and varies according to the nature of exposure assumed and population in which it is assessed. The evidence for most of the outcomes included in this briefing is *indicative* of a relationship; the types of studies used to investigate the relationships are not suitable to help us understand causal linkages, instead we find indicative *associations*. Pathways between an exposure (e.g. living near natural environments) and outcome (e.g. respiratory disease) are complex and likely to be affected by many factors (including lifestyle), without more robust studies it is difficult to identify exactly what role natural environments have in causing better outcomes.

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Review of the evidence

All-cause mortality

There is 'strong' and generally consistent evidence that greater amounts of natural environments around the home are associated with lower rates of all-cause mortality (death for any reason) [1, 2]. However, the evidence is not entirely consistent and in some places (for instance, urban USA) the opposite has been found with higher levels of mortality in greener environments [3].

- Analysis of death records from across England showed higher rates of mortality in the groups exposed to the least amount of greenspace around the home [4].

The internal biome, immunological system and allergies

A small but robust body of evidence suggests that natural environments provide exposure to the microbial diversity necessary for immuno-regulation [5]. It is thought that exposure to microbial diversity (including that from the natural environment) affects the human micro-biome which is linked to most of the health states included in this briefing [6]. Whilst pollen is a common allergen and there appears to be a synergistic effect between the pollen of certain tree species and pollution on exacerbating symptoms, the broader link between allergies and the type and quality of neighbourhood environments is not clear; findings from the small number of studies to have investigated relationships are inconsistent and some show a negative effect [8, 9].

- Living in an environment with higher levels of biodiversity has been shown to be associated with a higher diversity of bacteria on the skin (an indicator of exposure to microbial diversity). A Finnish study found that adolescents with 'allergic disposition' tended to live in areas with lower biodiversity and to have lower microbial diversity on their skin [7].
- A German study of two sets of children found a reduced risk of allergies was associated with the amount of greenspace around the home in one of the groups but a raised risk in the other group [8].

Maternal health and pregnancy outcomes

There is relatively consistent evidence from a small number of studies to suggest that exposure to greenspace during pregnancy is associated with better maternal health and pregnancy outcomes, such as healthy birth

weight, head circumference and lower infant mortality risk [10].

- An American study found that a 10% increase in tree-canopy cover within 50m of a house was associated with a reduction in the number of small for gestational age births [11].

Musculoskeletal health

There is currently very little evidence which has investigated any association between musculoskeletal health and natural environments [12].

Cardiovascular disease and mortality

There is some evidence to suggest that rates of cardiovascular disease are lower amongst those who live in greener environments.

- A study from New Zealand showed that after controlling for all confounders the amount of neighbourhood greenspace was postively related to better cardiovascular health status [13].

Respiratory disease and mortality

There are relatively few studies which have considered linkages between greenspace and respiratory disease (such as Chronic Obstructive Pulmonary Disease). Existing evidence suggests that growing up in a rural area is protective of respiratory health but the link with natural environments (over other factors) is not certain.

- A Canadian study using found that greater amounts of residential greenspace was protective against all forms of mortality but especially so for deaths from respiratory disease [14].

Cancer

As of yet it appears there has been no systematic examination of a relationship between different cancers and exposure to and use of natural environments. Lung cancer has been used as a 'counterfactual' to demonstrate a lack of association where one is not expected [15].

- A Canadian study found women living in the greenest areas had lower rates of all-cause non-accidental mortality than those in the least green areas, the associations were strongest for respiratory and cancer mortality [16].
- A positive association has been indicated (i.e. higher rates) with skin cancer in Australia [17].

Type 2 Diabetes

Positive associations between exposure to greenspaces and lower levels of Type 2 diabetes have been found in a small number of studies [18, 19].

- Studies from the UK and Australia have found that after controlling for other relevant factors the risk of Type 2 Diabetes is significantly lower in neighbourhoods with greater amounts of greenspaces [18, 19]. The Australian study showed the risk was considerably less for those living in neighbourhoods with relatively high levels of greenspace (41- 60% coverage) [19].

What is the impact of the type or quality of natural environment on markers of physiological health?

Currently there is little evidence of the influence of the type or quality of environment on the health outcomes included in this briefing (other immune-regulation) [1]. Typically studies have focused on the amount or proximity of generic natural environments around the home without seeking to differentiate between different environment types. What does exist suggests that high quality (both in terms of ecological quality and maintenance) greenspaces are associated with better outcomes.

- A UK study found that people who lived in areas with greater amounts of 'brownfield'

sites were significantly more likely to suffer from poorer physiological health than those living in areas with less [20].

Do the impacts of natural environments on physiological health vary between different groups of people?

The impacts of natural environments do appear to differ according to various socio-economic and demographic factors, these patterns appear to vary and are inconsistent between studies and according to the health condition considered [1].

- Analysis of data from across the UK showed that whilst rates of mortality from cardiovascular disease and respiratory disease decreased with increasing greenspace for men, no significant associations were found for women [15].

Do natural environments have an impact on physiological health inequalities?

There is a growing body of evidence which typically shows that higher levels of natural environments around the home is associated with reduced levels of socio-economic inequalities in multiple health outcomes, however there has been no systematic examination of the consistency of this according to exposure or outcome.

- Analysis of death records from England found that income related health inequalities in all-cause mortality and mortality from circulatory diseases were lowest amongst those people living in the greenest areas [4]. A study based in post-industrial North-East England concluded that the natural environment was one of a number of factors which contributed to deprived communities' better-than-expected health [21]. The natural environment was thought to ameliorate the detrimental health effects of long term deprivation.
- Inequalities in birth outcomes have also been shown to be lowest in populations who have the greatest exposure to greenspaces, with the strongest associations for parents with the lowest rates of educational attainment and socio-economic status [22].

What are the outcomes and cost-effectiveness of health interventions using or taking place in natural environments?

It appears that impacts to physiological health are rarely assessed as outcomes of natural environment interventions (whether changes to environments, such as increased availability or access, or the use of natural environments for health promotion or prevention) [23].

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Implications for policy, service delivery and research

Policy and service delivery

- The weight of evidence suggests that future policy and decision making should take account of the potential for good quality natural spaces around the home to promote better physiological health.
- Planners and developers should consider the role of natural environments on physiological health outcomes, however it should not be assumed that all greenspaces will result in improved health gain unless they are

appropriately sited, sensitively designed, and well maintained.

- The limited evidence of variation between social groups suggests the differential in impacts should be considered in the design of future policy and interventions.
- Although there is very little evidence as to the effectiveness of environmental interventions targeting physiological health outcomes, it appears there may be value exploring how the design or use of natural environments can help tackle some of the key health issues we face. Modification of the environment may facilitate and contribute to health interventions which address other physiological health risk factors, such a health behaviours.

Research

- There is a need for further research into the relationships between natural environments and with cancer, musculoskeletal health, and allergies, and to systematically address the variation in physiological outcomes associated with exposure to natural environments between social and demographic groups [1].
- To inform decisions relating to the design and use of natural environment interventions to address physiological health there is a need to better understand causality and mechanisms, cost-effectiveness, variation in any outcomes, and potential to ameliorate or exacerbate health inequalities.
- As many interventions are essentially complex and often part of wider programmes of activity, researchers should consider application of the principles of the Medical Research Council's *'Complex Intervention Guidance'* to better define interventions and understand process and outcomes [23, 24]. There is potential to make links with the new **Centre for the Evaluation of Complexity Across the Nexus**.
- Good quality evaluations, using robust methodologies with rigorous reporting, should be integrated into future greenspace interventions. Evaluation methodologies which help clarify 'what works, when and for whom' would be of particular value [25].

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[1] Physiological health refers to physical health status and function, as opposed to mental health, quality of life etc.
[2] **Kings Fund data on trends in disease and disability**
[3] **Diabetes.co.uk** data on diabetes trends