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Valuing the health and wellbeing benefits of NHS Scotland's outdoor estate:

How are NHS Scotland open spaces used and what is their value to the Scottish population

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Cite as

Loria-Rebolledo, L.E., Boyers, D., Watson, V., Antunes, M., & Chalmers, N. (2025). ***Valuing the health and wellbeing value of NHS Scotland's outdoor estate: How are NHS Scotland open spaces used and what is their value to the Scottish population.*** SEFARI Gateway Research Report.
https://doi.org/10.57064/2164/25103

Keywords

Health and wellbeing benefits, NHS, open spaces, natural capital, contingent valuation, exposure, Scotland

Hillswick Health Centre

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Executive Summary

The health and wellbeing benefits of open space (e.g., outdoor) exposure are well known. NHS Scotland has substantial land holdings, with half of its estate comprising of open space that is accessible to the public and staff. These spaces are assets and provide ecosystem services that are likely to contribute to the health and wellbeing of patients, staff and wider communities. Despite the substantial potential of NHS Scotland sites to provide these benefits, little is known about how these spaces are used and their value.

To address this gap and in response to the NHS Scotland Climate Emergency and Sustainability Strategy, which requires all health boards to assess the value of the benefits provided by the natural capital of spaces within their outdoor estates, this study aims to characterise the use of NHS Scotland's green, blue, or open spaces (from here onwards referred to as NHS open spaces) and provide an economic value to them.

There are very few studies that have attempted to place a monetary value on the benefits of open space surrounding health centres and facilities. Additionally, the existing studies have focused on the value of improvements to green space, rather than the existing stock. To our knowledge, this is the first study to assess the value of the existing natural capital within a health service.

This study uses a nationally representative cross-sectional survey of Scottish adults (aged 18 and over) to collect data on visits to NHS Scotland sites (and its open spaces) over the past year. We first examine the use of NHS Scotland open spaces before employing bespoke non-market valuation methods, following guidance from the Office for National Statistics (ONS) and HM Treasury's ***The Green Book***. These methods consider the wide variety of NHS Scotland open space typologies, allowing us to assess the benefits derived from their use.

Specifically, we use the ONS ***exposure-based*** method to assess the health benefits of outdoor exposure in NHS Scotland open spaces. This assumes individuals who spend at least 120 minutes a week in the outdoors receive a set amount of health benefits, with an assigned monetary value based on the NHS resources needed to achieve this health gain, expressed as additional quality-adjusted years of life. We replicate the method by analysing visits to NHS Scotland's open spaces in the previous twelve months, while adapting to account for additional exposure from visits to other open areas.

This approach, however, may underestimate the value of NHS Scotland's open spaces, as their usage patterns differ significantly from those of more common public open spaces (for which the method was originally developed and is still applied). For instance, many use NHS Scotland open spaces as part of a visit to access NHS services, rather than treating the space as a primary destination for leisure and recreation. As a result, the time spent and the activities undertaken may differ from those typically observed in other open spaces. Additionally, this method may not capture the full range of benefits that come from the existence of these spaces.

To address this limitation, we use a contingent valuation study to elicit willingness to pay (WTP), interpreted as the annual value, for open spaces at local NHS Scotland sites with usable open spaces. The contingent valuation study uses single-bounded dichotomous choice questions and asks respondents about monthly charges (similar to the Water and Sewage Service charge in the Council Tax bill) to prevent the removal of NHS Scotland open spaces in their local Primary Care Sites (GP Surgeries and Health Centres) and Hospital Sites.

We conducted a representative cross-sectional survey of Scottish adults to collect data. This survey shares key features with ***Scotland's People and Nature Survey***, which the ONS uses for natural capital accounting in Scotland. To ensure reliability, the survey was designed and pre-tested through ''Think Aloud'' interviews with Scottish adults.

Data were collected from 2,449 Scottish adults between 21st September and 3rd November 2024. Our findings suggest that around half of the adult population has visited an NHS Scotland open space in the past year.

Overall, people who visit NHS Scotland sites are more likely to visit its open spaces. Visits to Primary Care Sites were more likely to result in visits to their open space. Of those who had visited their local Primary Care Site (and this had open space) in the past twelve months, 54.8% had visited its open space. Of those who had visited their local Hospital Site, 34.7% had visited its open space. As a result, most visits happen at Primary Care Sites.

Visit data also revealed inequalities in the sociodemographic factors associated with people who use NHS Scotland's open spaces. Older individuals and those with lower incomes are less likely to visit NHS Scotland open spaces, which is consistent with trends in general outdoor visits in Scotland. Females are also less likely to visit NHS Scotland's open spaces.

Visits to NHS Scotland open spaces typically last for less than 30 minutes, with half occurring with someone accompanying the respondent. Most visits are primarily made to visit NHS Scotland sites for other reasons, such as receiving healthcare. These open spaces are generally regarded as good or very good quality. Visits typically involve relaxing, low-impact activities, suggesting that, as expected, most of the health and wellbeing benefits are likely linked to mental wellbeing.

Based on visit data, an estimated 122 million visits are made annually to NHS Scotland open spaces, averaging around 10 million visits per month or 330,000 per day. However, visits are not evenly distributed across the population. A small group of frequent visitors accounts for the vast majority, while most people visit only occasionally.

Using the ***exposure-based*** method, we estimate that the direct annual health benefits from time spent in NHS Scotland's open spaces (not accounting for other visits to the general outdoors) are valued at £81.9 million, equivalent to £18 per adult, with a range of £50.8 million to £97.6 million (in 2023 prices).

Most of these health benefits come from visits to Primary Care sites. Additionally, we estimate that NHS Scotland-owned or leased sites account for between 60% and 99% of the total benefits.

Considering other forms of exposure from visits to outdoor spaces across Scotland, we estimate that NHS Scotland open spaces provide health benefits to approximately 205,000 adults each year, with an annual value of £73.0 million. In comparison, the total annual health benefits from recreation across Scotland's entire natural capital are valued at £870 million, while those within urban areas are valued at £350 million in 2023.

The contingent valuation study results indicate a mean WTP per month for open space of £21.48 for local Hospital Sites (95% confidence interval: £18.08 - £26.55), and £29.33 (95% confidence interval: £25.95 - £48.51) for local Primary Care Sites.

Based on these estimates, the total annual willingness to pay (WTP) for NHS Scotland open spaces at local hospital sites is £653.5 million, or £146 per adult. For local primary care sites, the total annual WTP is estimated at £560.4 million, or £125 per adult. Although Primary Care Sites have a higher WTP individually, their overall value is lower than that of hospital sites because not all local Primary Care Sites in Scotland have open spaces.

After controlling for site size and type, we find that local sites (e.g., community hospitals versus general hospitals) and those with a higher proportion of open space area (regardless of total area size) are associated with a higher WTP. We also find that rural Hospital Sites are valued marginally higher than urban ones.

Among the health boards for which we could estimate total values, NHS Grampian has the highest mean WTP for Hospital Sites, followed by NHS Tayside and NHS Lothian. In contrast, NHS Dumfries and Galloway and NHS Lanarkshire had the lowest average values.

We find that experience with the site and its open space results in higher WTP values. At the same time, more frequent and lengthier visits to any NHS Scotland open spaces are more likely to result in higher WTP for NHS Scotland open spaces regardless of the site. This suggests individuals elicit a value for NHS Scotland open spaces that contain components beyond direct use, such as the benefits these spaces can provide to them or others in the future.

Whilst our data are representative in terms of sex and age of the Scottish population, we cannot guarantee representativeness in terms of other sociodemographic characteristics and general NHS Scotland visit rates. However, when benchmarked to general outdoor statistics in Scotland and similar studies, our findings strongly suggest that the health and wellbeing benefits from exposure to NHS Scotland open spaces are substantial and at least on par with those from other public open spaces. Furthermore, as evidenced by the contingent valuation study results, it is likely these spaces provide other benefits that extend beyond direct health and wellbeing to the individual.

This study highlights the current and potential social and economic value generated by investments in NHS Scotland open spaces, both at the health board and national levels. The findings contribute to building an evidence base that supports the promotion of health and wellbeing through spending time in open spaces in healthcare settings across Scotland and beyond.

Future research could build on this work by conducting a serial survey to identify and track usage patterns of NHS Scotland open spaces and their value over time. Future research could derive a direct measure of health gain from exposure to NHS-based open spaces using NHS Scotland's cost of resources.

Royal Victoria Building, Western General Hospital
(courtesy Ian MacKenzie – NHS Lothian)

Introduction

The NHS Scotland Climate Emergency and Sustainability Strategy requires that all health boards assess the value of the benefits that arise from NHS natural capital resources such as the green and blue spaces and biodiversity found within their outdoor estate. Scottish Environment, Food and Agriculture Research Institute (SEFARI) Gateway, jointly with Public Health Scotland (PHS) awarded a Fellowship to the named authors of this study to obtain reference health and wellbeing Natural Capital Accounting (NCA) economic values of the NHS Scotland outdoor estate. The research derived from this Fellowship builds on previous research commissioned by NatureScot and PHS (Holt *et al.*, 2023).

This study aims to characterise how NHS Scotland's green, blue, or open spaces (e.g., NHS Scotland open spaces) are used and calculate the economic values derived from leisure and recreation in different outdoor spaces and across different users. The results in this Report provide a better understanding of the flow of economic benefits across the NHS and the economy and provide evidence to inform the value of social and economic benefits that arise from investment in NHS open spaces. The methods described in this Report are applicable not only to the NHS estate but can be transferred to value similar public and private open (e.g., outdoor) spaces.

Background

The UK Natural Capital is made up of stocks of elements of nature (e.g., the NHS's natural capital), including both the living and non-living aspects of ecosystems, that have a value to society (HM Treasury, 2023). These stocks provide flows of ecosystem services that, together with other forms of capital, produce a wide range of benefits. Natural Capital Accounting is the process of calculating the flow of these ecosystem services (Office for National Statistics (ONS), 2022a, 2023b).

In 2022, the total annual value of ecosystem services in Scotland was approximately £39 billion, according to the most recent UK Natural Capital Accounts. The largest contribution comes from provisioning services—resources extracted, harvested, or derived from nature, such as food, water, minerals, and energy.

Notably, around £33 billion of this total is attributed to fossil fuel extraction, including crude oil and gas production (Office for National Statistics, 2024).

Non-material benefits, such as those derived from recreation, tourism, and health-related leisure activities (categorised as cultural services), are valued at approximately £2 billion. Of this, £1 billion comes from tourism and recreation expenditures, while £500 million is attributed to the impact on house prices.

Exposure to natural habitats in open spaces provides numerous health and wellbeing benefits. In Scotland, recreation in green, blue, and other open spaces (e.g., natural capital) contributes £870 million in health-related value (Office for National Statistics, 2024).

In Scotland, most visits to natural habitats happen in urban areas, with local parks and open spaces being the most frequently visited destinations (Stewart and Eccleston, 2020). Furthermore, individuals living in the 15% most deprived areas, those from low-income households, people with long-term illness or disability, or people from minority ethnic backgrounds are more likely to visit local parks for outdoor activities.

NHS Scotland's estate also contains significant natural capital, including green, blue, and open spaces (e.g., NHS Scotland outdoor areas). With an estimated 825 hectares of open space (roughly 52% of its estate), these areas are valuable assets that provide ecosystem services likely to contribute to the health and wellbeing of patients, staff, and wider communities (Public Health Scotland, 2024). However, the value of these services to society remains unknown.[1] There is currently no established method to value the health and wellbeing benefits of NHS estates in the UK and Scotland.

Estimating the value of these benefits presents several methodological challenges. Existing methods were designed for open spaces with user patterns that likely differ from those of NHS-based open spaces.[2] For example, many visits to NHS Scotland open spaces are typically driven by a visit to NHS services, rather than the primary purpose of visiting the space itself. As a result, the time spent and activities engaged in at these sites may differ from those in other public spaces, such as parks or woodlands.

This study aims to address this methodological gap by proposing and applying methods to estimate the value of the health and wellbeing benefits derived from the natural capital of NHS Scotland's open spaces. To the authors' knowledge, this is the first attempt to derive the monetary value of the health and wellbeing benefits from the existing natural assets within a health system.

The results of this study will also describe the use of NHS open spaces and explore the barriers to their use. These findings will complement existing workstreams within the NHS Scotland Climate Emergency and Sustainability Strategy, contribute to up-to-date environmental accounting for NHS Scotland, and provide evidence to optimise the use of these spaces to maximise their health and wellbeing benefits.

1. A study by Walker et al. (2023) used benefit transfer methods to value different (non-cultural) ecosystem services provided by trees and woodland on NHS estates. As part of a pilot study, they calculated carbon storage, carbon sequestration, air pollution removal, flood and temperature regulation and noise mitigation values for four NHS England sites. These do not include services in the form of health and wellbeing benefits.

2. Other methods to value cultural services rely on travel and expenditure (e.g., travel and access fee costs). However, these do not elicit health and wellbeing benefits and, as discussed above, might not be appropriate when using the NHS open spaces for recreation is not the primary purpose and destination of the trip.

Deriving economic values of NHS Scotland open spaces

This study is concerned with the use and value of NHS Scotland's green, blue, or open space [3] within its estates which are accessible to staff, patients, and/or members of the public. From here onwards, these spaces will be referred to as NHS open spaces.

An open space is defined as a space within and on the edge of settlements comprising green space or civic areas such as squares, marketplaces, and other paved or hard landscaped areas with a civic function. Open (green) spaces can provide a recreational function, an amenity function, or aesthetic value to the public such as areas of grass, trees, other vegetation, and water, but not including agricultural or horticultural land (Scottish Government, 2021). Green spaces are areas such as parks, woodlands, fields, and green walls and roofs. Blue spaces prominently feature water such as streams, burns, ponds, and other water bodies.

The derivation of values and the creation of natural capital accounts follow the methodology set by the Office for National Statistics (ONS) and the United Nations' System of Environmental-Economic Accounting – Ecosystem Accounting (UN SEEA-EA) to estimate values in the UK. Additionally, this process aligns with HM Treasury's The Green Book, which provides guidance on appraising policies, programmes, and projects (HM Treasury, 2023; Office for National Statistics, 2023c).

There is no established framework for accurately assessing the health and wellbeing benefits of open spaces within NHS or healthcare settings. However, general methods have been used to derive the health benefits of recreation and leisure in public open spaces more broadly.

These methods posit that the natural environment provides an area for recreational activities which creates satisfaction, pleasure, and enjoyment (Office for National Statistics, 2023b). This assumes a causal link between health and physical activity or exposure to nature, which, while it has been empirically shown in the literature, remains difficult to infer at a national scale (Lee and Maheswaran, 2011). For that reason, the current methods used by the ONS to produce UK accounts of health-related benefits are currently classed as official statistics in development, meaning they are being tested and developed (Office for National Statistics, 2023c, 2023a).

The ONS uses two approaches to derive the value of health and wellbeing benefits from recreational and leisure of (general) outdoor areas: ***exercise-based*** and ***exposure-based*** (Office for National Statistics, 2022). The ***exercise-based*** approach assumes that 30 minutes of moderate-intense physical activity in an outdoor space five times per week provides individuals with a health gain. The ***exposure-based*** approach assumes individuals who spend 120 minutes per week in nature have "***higher levels of health and wellbeing***" (White ***et al.***, 2019).

3. Also commonly referred to as green and blue spaces in the literature. The Scottish Household Survey found these terms can be interchangeable, so we refer to them as green, blue, or open spaces.

The magnitude of these health gains is estimated using data from several large datasets that measure health and exposure to nature, and the estimation controls for a rich set of exogenous variables (Office for National Statistics, 2023e). The gains are expressed as average marginal improvements in Quality Adjusted Life Years (QALYs). The QALY is a generic measure used to value health in economic evaluations of healthcare that combines both the quantity and quality of life (NICE Glossary, 2024). The monetary value of these QALY gains is calculated based on the annual cost to the NHS of adding one QALY to the life of an NHS patient – based on estimates in Claxton et al. (2015).

Given that NHS Scotland open spaces are unlikely to support moderate to intense physical activity, the exposure-based approach may be better suited to evaluating their recreational health benefits. However, this method may not capture all aspects of these benefits.

Typically, this method has been applied to open spaces that people specifically visit for recreation and leisure. NHS Scotland open spaces, however, have distinct reasons and patterns of use. It is uncommon for individuals to visit these spaces solely for recreation; most visits are tied to appointments or visits to NHS services, whether as patients or visitors. Similarly, the health gains derived from these spaces may differ from those associated with other traditional open spaces.

Stated preference methods, as proposed by HM Treasury's ***The Green Book*** and the Department for Environment, Food & Rural Affairs' (DEFRA) guidance, offer an alternative method to estimate economic values obtained from non-market goods and services, such as ecosystem services (HM Treasury, 2023; DEFRA, 2023).

Stated preference methods employ questionnaire-based tools to directly assess individuals' valuation of a good or service based on their willingness to pay (WTP)—the maximum amount they would forgo from a defined budget to obtain its benefits. One such method, the Contingent Valuation Method (CVM), asks individuals directly how much they would be willing to pay for a good or service.

A CVM study constructs and presents respondents with a hypothetical market, enabling the elicitation of their monetary value. This hypothetical market describes the good, how it will be provided and the transaction with which the individual will forego money (from their disposable income) in exchange for the ecosystem service benefits of the good or service (e.g., how and who to pay and how frequently).

Survey responses are analysed to compute the average monetary value across survey respondents. These monetary values can then be included in accounting and cost-benefit analysis.[4] The collection of sociodemographic and attitudinal data alongside responses to the CVM enables the identification of key drivers behind valuations and supports the estimation of values across different population groups.

4. The most cited example of the use of CVM in a cost-benefit analysis is following the Exxon Valdez oil spill (Arrow et al., 1993). More recently, a CVM was used in the UK National Ecosystem Assessment to estimate the value of potential marine protected areas in the UK, specifically for divers and sea anglers (Kenter et al., 2013).

Review of the literature

Open space and health and wellbeing

There is a large body of evidence that has shown that open space exposure has a positive effect on health and wellbeing. For example, a review of studies on greenspace exposure and health outcomes by Twohig-Bennet and Jones (2018), found greenspace exposure is associated with wide-ranging health benefits, including reduced blood pressure and heart rate, decreased incidence of diabetes, and decreased all-cause and cardiovascular mortality.

A health impact assessment study by Barboza et al. (2021) found that many premature deaths in European cities across 31 countries could be prevented by increasing exposure to green space. Similarly, Takano et al. (2003) found a positive relationship between greenspace exposure and longevity among senior citizens. De Vries et al. (2003) found living in a green environment was associated with positive scores in three self-reported health indicators.

A review collating systematic reviews of epidemiological studies, by Yang et al. (2021), found green space was positively associated with several health-related outcomes, such as reduced all-cause and stroke-specific mortality, cardiovascular diseases, mental health, physical activity, and sleep quality.

Bowler et al. (2010) found activities undertaken in natural environments (e.g., gardens, parks, woodlands) were associated with more positive effects on self-reported measures of emotions compared to similar activities in synthetic environments (e.g., outdoor built environments or indoor environments). A study by Shanahan et al. (2016) found that people who made visits of 30 minutes or more to green spaces had lower rates of depression and high blood pressure.

Studies have also found a reduction in anxiety and stress (Lackey et al., 2021), while others highlight the benefits of urban green spaces on mental health, including improved mood (Kondo et al., 2018). Additionally, nature-based activities, such as gardening and outdoor exercise, are linked to reduced depression and better mood (Li et al., 2021). A review by Bragg and Atkins (2016) found nature-based interventions have mental health benefits including increased general mental wellbeing and reduced depression, anxiety, and stress-related symptoms.

Focusing on Great Britain, a review by Public Health England found exposure to green space is associated with positive physical and mental health outcomes (Public Health England, 2020). The findings show greenspace can improve health and wellbeing by promoting physical activity, recreational activities, connections with nature, community and social cohesion, and the development of children's skills and capabilities. It also highlights numerous studies showing provision and access to greenspace are associated with reduced costs for local areas and health authorities.

Similarly, another review explored the effects of exposure to the natural environment on health and well-being in the United Kingdom and found a correlation between access to green spaces and improved health outcomes, although variability in both exposures and outcomes affects confidence in these findings (Lamont and Hinson, 2024).

In Scotland, a study about an intervention involving patients with mental health problems to undertake activities in outdoor community settings was found to be cost-effective and comparable to other programmes aimed at social recovery (Willis et al., 2015).

The GreenHealth study (see Ward Thompson et al., 2012; 2014), found the amount of green space in the residential environment contributed to health and wellbeing and that more greenspace in the home environment was associated with lower stress levels.

Health centre open spaces and health and wellbeing

There is a small but growing body of literature highlighting the potential benefits of access to and exposure to greenspace around health centres. Ulrich (1984) found hospital patients recovering from surgery who had a window with a view of trees compared to those with a view to a brick wall, used fewer painkillers and had better emotional wellbeing and shorter post-operative stays. Marcus and Barnes (1995) found users of hospital gardens in California reported health benefits such as recovery from stress.

Similarly, Whitehouse et al. (2001) found exposure to a healing garden in a paediatric hospital was associated with positive changes in mood (e.g., more relaxed, less stressed) among family groups and staff. Sherman et al. (2005) found that people who use healing gardens in a paediatric cancer centre have lower emotional distress and pain compared to those who are inside the hospital.

A study of nurses' views on the design of an outdoor healing garden found features that enabled contact with nature were positively associated with stress relief (Naderi and Shin, 2008). Chang and Chien (2017) found that increased tree coverage, shelters, and availability of bench seats promoted visits to hospital outdoor spaces among patients.

In the UK, a year-long study named Space to Breathe, in three NHS England sites found staff wanted to spend more time in the gardens and green spaces, and staff who used green spaces reported benefits in physical and mental wellbeing (Newson et al., 2020). Furthermore, between 44% and 52% of staff across the three sites stated that the quality and availability of gardens and green spaces were important to them when considering where to work.

Responding to this growing evidence, it is evident that health services are increasingly prioritising the design and use of these spaces, guided by emerging practice recommendations. For example, Shukor et al. (2012) recommend that outdoor areas should be supportive, visible, and enable physical contact.

Other examples in Scotland are the Green Exercise Partnership's 2021 NHS Greenspace: Good design of the outdoor estate guidance (2021) and the Forestry Commission's 2012 Greenspace design for health and well-being guidance, which states that outdoor spaces offer a healing environment and advocate for a holistic design approach that follows patient centred care (Shackell and Walter, 2012).

Acknowledging the importance of access to green space in their sites to promote health benefits, multiple government agencies and the NHS have included this as part of their policy. For instance, the NHS Scotland Climate Emergency and Sustainability Strategy sets as an objective to realise the full potential of its greenspace (i.e., open space) to improve public health and reduce health inequalities (NHS Scotland, 2022). Other examples are the ***Our Natural Health Service*** programme, which uses Green Health Partnerships to contribute to the management of NHS open spaces (NatureScot, 2024) and the Centre for Sustainable Healthcare's NHS Forest, which is a network of sites working to promote the use of its open spaces (NHS Forest, 2024).

Valuing health centre open spaces

Studies have attempted to put an economic value to other types of open space (not based at health centres) in Scotland. For instance, Logan et al. (2021) found community woodlands across Edinburgh were highly valued by users for providing a range of benefits relating to physical and mental health. A study by Saraev et al. (2021) estimated the annual mental health benefits associated with visits to woodlands to be £26 million in Scotland based on avoided costs (e.g., NHS cost savings, employment-related costs due to lost working days).

Despite the growing literature that suggests there are important health and wellbeing benefits from exposure and use of NHS open spaces, there is little evidence that can help quantify their economic value. Few studies have attempted to place a monetary value on the benefits of green space surrounding health centres and facilities. These studies have estimated the value of improvements to green space and not the existing stock.[5]

Holt et al. (2023) highlighted the need to quantify and value the health and wellbeing benefits of NHS Scotland outdoor estate use and conducted an opportunistic survey of users. Holt et al. found most respondents were only somewhat or not familiar with the health and wellbeing benefits associated with NHS Scotland outdoor estate use. The survey also found walking was the most common use of NHS Scotland outdoor estates across all types of users (patients, staff, volunteers, visitors, and the local community). Moreover, the survey found most respondents did not know whether the different functional units of the NHS Scotland use its outdoor space for therapeutic or medical services.

5. Although not focused on outdoor green space, Lan & Liu (2023) found respondents of an online survey in China were willing to pay between CYN 25.68 and CYN 36.21 (approximately £2.89 and £4.09 at the time of their study) for varying degrees of biophilic indoor environments in hospital rooms.

Pérez-Urrestarazu et al. (2017) estimated the economic value of living walls and plants in a hospital in Seville, Spain. They used a CVM survey and asked people how much the hospital should invest in living walls and plants. The study found that 40.1% of respondents stated the hospital should spend between €100 and €1,000 annually, and 41.4% stated the hospital should spend more than €1,000. The study also found a positive correlation between the amount respondents thought the hospital should spend and how much respondents were willing to spend themselves to increase/improve green areas close to their residences.

Zachariou and Longo (2024) estimated WTP for improvements to green infrastructure in Musgrave Park Hospital in Northern Ireland. They conducted a CVM study among staff, visitors, and patients at the NHS site, and asked how much respondents would be willing to pay, in the form of a voluntary contribution, for varying levels of green infrastructure improvement. The study found landscape improvements were the most valued by staff and visitors, with a WTP of £12.87 and £27.70, respectively. The most valued improvement by patients was improvements that facilitated walking with a WTP of £13.13. Additionally, the study revealed that improvements to green space would lead to increased time spent outdoors among all user groups.

Methodology

General approach

We use a nationally representative cross-sectional survey to elicit the health and wellbeing value of the recreational use of NHS Scotland open spaces among the general population in Scotland. NHS Scotland open spaces are defined as ***outdoor areas that feature green (with vegetation or greenery) or blue (with a water feature) spaces within and/or in the general surroundings of any NHS premises.*** This could be within GP Practices, Health Centres or Hospitals (See Technical Appendix for details).

The survey gathered information about the respondents' visits to and use of NHS Scotland sites and open spaces for recreation. NHS Scotland sites are defined as estates that are used to deliver services provided by the NHS. These are sites owned or leased by NHS Scotland and can include private properties that host NHS services or staff, such as independent general practitioners (GPs).

A visit to an NHS Scotland site was defined as any type of visit either ***to use NHS services, to visit or accompany a relative or friends, or just to enjoy the things within the site***. The survey also included questions on the respondents' socio-demographic characteristics, health, and general use of outdoor sites.

A recreation and leisure visit to (e.g., use of) an NHS Scotland open space is defined as ***visits that could have been to sit, relax and unwind, have a picnic, meet friends or family, do physical activity like walking through the grounds, running or yoga, or as meeting place for organised gatherings. This includes walking through paths that have greenery because you wanted to enjoy the surroundings. But this does not include visits where it was the only path to access an NHS Scotland building (e.g., walking from a local car park or bus stop).***

The survey included two methods to value the open spaces: an adaptation of the ONS exposure-based approach and a bespoke CVM study. Given the uncertainty around the suitability of the exposure-based approach due to the different types of users and their usage patterns of NHS Scotland estates, we added the CVM study to produce a range of values for all users and usage patterns. The survey also included questions on the respondents' socio-demographic characteristics, health, and general use of outdoor sites.

We fielded the survey among a representative sample of the general public (adult residents) in Scotland. This sample frame aims to capture both current and potential future users of NHS Scotland open spaces in all fourteen territorial health boards (see Technical Appendix), such that we can explore differences in values across users, usage patterns and intensity, and potential benefit profiles across the population.

This study received research ethics approval from the University of Aberdeen's School of Medicine, Medical Sciences and Nutrition Ethical Review Board (SERB Reference 2223105) and Social Science Research Approval from the Scottish Government's Rural and Environment Science and Analytical Services (RESAS) Division.

Sampling

We used non-probabilistic sampling using recruitment targets on age and sex set by the research team based on the population estimates for mid-2023. Results from this Report should be interpreted as the values among the adult Scottish population (estimated to be 4,476,570 by the ONS' mid-2023 estimates of the population).

The sample was recruited using an online managed access panel (Qualtrics). This approach allows comparison to population-level statistics and assumes that the resulting values are representative of adult residents in Scotland. The panel provider managed recruitment, inviting potential respondents and paying honoraria to respondents.

Survey instrument

The survey was implemented as an online self-completed questionnaire and programmed using the Qualtrics platform. The survey was optimised to be easy to complete using devices with small screens given the increasing use of mobile phones or tablets (Wardropper et al., 2021). The survey consisted of five sections.

Section 1: described the study to respondents and explored respondents' current use of NHS Scotland sites. Respondents were asked to select their geographic locality, and this information was used to identify and ask about their local NHS Scotland board and sites. Respondents selected their local primary care health care site (e.g., GP Surgery or Health Centre) and local secondary/tertiary health care site (e.g., Hospital) from an exhaustive list of all sites in their area. The local Primary Care Site was defined as the site where their GP was based. The local Hospital Site (e.g., secondary/tertiary health care site) was defined as the hospital site they visited the most or, if they never visited one, was the site they would be most likely to visit (see Technical Appendix).

Section 2: were asked about their most recent visit to an NHS Scotland open space. The aim was to help characterise the visit — for example, to determine whether it was part of a visit to an NHS Scotland site for health or care reasons, or an exclusive visit to the open space. Additional questions covered the visit's duration, who the respondent was with, what activities they undertook, and the perceived benefits. Visit frequency and duration were then used to estimate health benefits using the ONS's ***exposure-based*** method.

Section 3: presented the CVM scenario and associated tasks. In this section, respondents' willingness to pay (WTP) for open space at their local site(s) was elicited through CVM questions. These questions were primarily designed to capture the use value of open space. However, it is possible that they also reflect other components of value. To better understand the underlying motivations behind respondents' valuations, follow-up questions were included.

Section 4: collected self-reported health measures, including self-assessed health (SAH) and long-term health conditions questions based on the Scotland's Census questions.

Section 4 also included two validated health measure instruments to explore whether it is possible to derive natural capital accounting values of the health benefits directly. For this, respondents were randomised using a simple 1:1 randomisation to either the EQ-5D or the SF-6D (Devlin & Brooks, 2017; Brazier et al., 2022). We explore two instruments because it is unclear which will be most sensitive to capture the marginal health benefits from exposure to and use of NHS-based open spaces.

Section 5: asked respondents a series of sociodemographic questions that were used as covariates in data analysis. Variables of interest were based on existing research and included household composition, current access to nature, and income. Where possible, questions were adapted from the Scotland's People and Nature Survey (SPANS), the 2021 Scotland's Census, and the 2019 Monitor of Engagement with the Natural Environment (MENE) survey to ensure comparability and benchmark results against existing data.

The survey was pretested using online "Think Aloud" interviews with individuals from the target population. Ten interviews were conducted between June and July 2024 with individuals from across Scotland who were recruited using targeted social media advertisements. These interviews resulted in changes to survey questions and wording that ensured the survey was easy to understand and encouraged accurate responses (e.g., truth-telling). More information can be found in the Technical Appendix.

A pilot study was conducted with a sample of 50 respondents between the 10th and 11th September 2024. Data from the pilot study were used to assess the questionnaire under survey conditions (more information can be found in the Technical Appendix). The main survey was fielded between 21st September and 3rd November 2024 in three stages. We conducted interim data analysis between each stage to gain feedback and adapt the CVM tasks (see Technical Appendix).

Exposure-based approach

The exposure-based method relies on respondents' self-reported past visitation data. This approach is applicable only to respondents who stated that they had visited an NHS Scotland open space in the previous twelve months (e.g., NHS Scotland open space users). Visit duration and number of annual visits data are used to estimate the average duration of exposure to NHS Scotland open spaces. If this amount exceeds the 120-minute per week annual threshold, the respondent is assumed to derive the health benefits of open space exposure from visits to NHS Scotland open spaces.

Using the ONS approach, this health benefit is equal to 0.01995 QALYs. It is estimated to cost the NHS £12,936 to provide an additional QALY to NHS patients (in 2008 prices). Therefore, the value of the 0.01995 QALYs derived from exposure to open space is £356 per person – at 2023 prices (originally calculated at £260 in 2008 prices) who attains the exposure threshold (Office for National Statistics, 2023a; 2022b).

This monetary value is then aggregated to an adult population value from the use of NHS Scotland open spaces alone using frequency of use data collected in our survey. For example, the ONS estimates, based on SPANS, that 2.3 million Scottish adults received health benefits from time spent in nature (e.g. spending more than 120 minutes a week) in 2022. By multiplying this figure by the estimated cost of NHS resources, the annual value of exposure to nature is calculated to be £870 million (Office for National Statistics, 2024).

Contingent Valuation Method

The CVM elicits a broader measure of value, beyond health and wellbeing benefits, of the NHS Scotland open spaces. The CVM questions are based on the following scenario:

Imagine that the NHS is no longer able to keep and maintain the green, blue or open spaces in your local community. This includes [your GP Practice or Health Centre and] the hospitals in your area.

Because of this, a decision has been made to get rid of all greenery, vegetation and trees, and fence around these spaces. This means that neither you, the public, patients or NHS staff would have access to use or enjoy these spaces.

In most cases, respondents were asked to value two sites (as identified in Section 1): their secondary/tertiary health care site (e.g., Hospital Site) *and* their local primary care health care site (e.g., Primary Care Site). If the respondent's Primary Care Site did not have open space, they were asked to value their secondary/tertiary site only. Further details on how local sites were defined can be found in the Technical Appendix.

Respondents were reminded of their local site(s) and told that to prevent the open space from being removed, money would be raised for the site's continued maintenance from a charge (e.g., levy) that would be paid together with their council tax bill from now on. Respondents were told this money would only be used to maintain NHS Scotland green, blue, or open spaces and keep them accessible to public, patient, and staff use.

This charge (known as a payment vehicle in the CVM literature) provided a plausible, binding, and non-avoidable means to fund the upkeep and maintenance of these spaces for public and personal use within the context of the constructed market, providing a salient transactional mechanism that can identify the flow of the ecosystem service. Due to its similarity to the Water and Sewage Service Charge in Scotland, this approach should minimise payment vehicle bias (e.g., it would be considered plausible and appropriate). The charge was also linked to financing of the service, given the localised nature of the ecosystem service and the existing funding structure of NHS services through Health and Social Partnerships.[6]

The CVM tasks were single-bounded dichotomous choice questions with adaptive bid amounts with possible answers: ***yes*** or ***no***.

6. Roberts et al (2022) used a similar council tax-based payment vehicle when eliciting willingness to pay for urban greenspace improvement in Scotland. Davies et al (2023) also used an earmarked council tax payment (e.g., City Tree Fund) for a stated preference study looking at a local tree planting programme to address air pollution and flooding in Southampton.

Respondents were instructed that they would be shown an amount (e.g., bid) and be asked if they would be willing to pay this amount each month to keep and maintain the open spaces for their own use.

The bid amount was randomly selected from an adaptive set of bids ranging from £2 to £40 per month. There was little existing evidence to guide the choice of bid amounts, so these were initially informed by existing literature and survey pretesting. The bid amounts were further refined during data collection based on the proportion of respondents responding '*yes*' to the different bid amounts – see Technical Appendix.

If two tasks were asked to value two sites, different bids were used for each site drawn from the bid set described above. The order in which the sites were valued was randomised. Respondents were reminded in the second valuation task about the amount they had agreed to pay in the first task.

Following the CVM tasks, respondents were asked debrief questions. If the participant answered '*yes*' to a valuation task, they were asked questions to capture potential social desirability in their responses and to differentiate between sources of value. If the respondent answered 'no' to a valuation task, they were asked questions to identify potential protest responses (e.g., respondents who state they are not willing to pay despite valuing the open space at the site or are unwilling to give an answer). All respondents were also asked questions related to the perceived consequentiality of their responses.

Data analysis

We use descriptive statistics to describe how NHS Scotland sites and their open spaces are being visited and used. We establish the visitation patterns of sites and the use of NHS Scotland open spaces. We describe the number of NHS Scotland open space users (e.g., individuals who have visited an NHS open space in the twelve months before the survey). For NHS Scotland open space users, we characterise the most recent visit to an NHS Scotland open space. We describe the visit, the motivations for visiting, and the perceived benefits. We use these statistics to estimate the adult Scottish population's use of NHS Scotland sites and their different open spaces.

For the exposure-based method, following SPANS, we ask about the last visit length using a multiple-choice question described by a range of values (e.g., we do not ask for the exact length of time) – see Technical Appendix. This question is used to infer the exposure throughout the year assuming the last visit is representative of all visits.

Given the cross-sectional nature of the survey and the fact it was fielded in the warmer months of the year, this assumption could result in biased results. For example, respondents will likely spend more time outdoors on their last visit than they would on a visit during the colder months. To account for this, we use a seasonally-adjusted estimate of annual visits based on stated visitation patterns during colder months (see Technical Appendix for details and non-seasonally adjusted estimates).

We use the seasonally-adjusted estimates to work out the proportion of Scottish adults who are assumed to receive health benefits from time spent in NHS Scotland open spaces. We multiply this by the cost of NHS resources to estimate the annual value.

We estimate the ***direct*** health benefits from NHS Scotland open spaces which do not consider exposure to other types of open or outdoor spaces. That is, the benefits for individuals who have spent at least 120 minutes a week in NHS Scotland open spaces throughout the previous year regardless of any other visits to open spaces.

We also estimate, based on the number and types of sites visited in the past year, how much of the value comes from exposure to open spaces in Primary Care Sites, Hospital Sites, and a combination of both.

However, health benefits from exposure to outdoor areas can be obtained from exposure to a combination of spaces, both NHS-based and other public areas. To account for this, we combine NHS Scotland open spaces and general outdoors visit data to work out the ***attributable*** health benefits from exposure to NHS open spaces. That is, the benefits that occurred solely because of visits to NHS Scotland open spaces.

To do this, we calculate the percentage of individuals whose visits to NHS Scotland open spaces helped them meet the 120-minute exposure threshold. This could happen in two ways: either the NHS Scotland open spaces visits alone were enough to meet the threshold while visits to the general outdoors were not, or the combination of visits to NHS Scotland open spaces and other outdoor areas enabled them to reach the 120-minute target when neither alone was sufficient.

For the CVM method, responses to the tasks are used to estimate the WTP for different types of sites (see Technical Appendix). Annual values are estimated using the mean WTP, based on National Records of Scotland's 2023 Household and Dwellings in Scotland Report which provides estimates of the number of households.

Hospital Site values are computed for the entire adult population as it is assumed all individuals are or potentially are users of open space at these sites (e.g., they have or will visit). For Primary Care Sites, some individuals are assumed to never visit a site that has open space (e.g., their own site does not have open space). Thus, Primary Care Site values are computed based on the estimated number of adults who would visit these sites.

Using regression techniques, we explore which socio-demographic characteristics act as drivers of value (e.g., WTP estimates). We also estimate WTP values for subgroups of interest, including the type of site, health board, and rurality – see Technical Appendix.

We use descriptive statistics to explore why non-users of NHS Scotland open spaces have not visited an NHS-based open space. For these individuals, we explore the next best alternative for open space using the relative distance to other urban habitats. We use multivariate regression analysis to determine the sociodemographic characteristics that drive the likelihood of an individual being an NHS Scotland open space user.

Methodological considerations

Disentangling use and non-use value

The exposure method will derive use values, given it relies on past visits to NHS Scotland open spaces. However, given our definition of what constitutes a visit (e.g., use) of an NHS Scotland open space, it is likely that we are not considering the benefits that come from incidental exposure through functional visits to NHS Scotland sites.

For example, this method would not consider exposure from walking along a path with greenery when this is the only choice to access a building. If individuals derive benefits from this incidental exposure, our estimates may underestimate the total values.

Stated preference methods elicit the total economic value, which includes use and non-use value. We note that for an NCA framework, only the use values are of relevance (e.g., individuals who currently use or visit NHS open spaces).

We attempt to capture the use value by asking respondents if they are willing to pay to maintain the open space for ***their own use***. Typically, we would define direct use values as the value from individuals that have visited an NHS Scotland open space in the past twelve months. However, users (e.g., people who have visited) may hold both use and non-use values. For example, NHS Scotland open spaces can serve both use (e.g., current visits) and non-use (e.g., preserve for others or oneself in future) values. As a result, all values will likely still include both use and non-use values.

We explore different use and non-use values based on the respondents past visits to (use of) NHS Scotland sites, familiarity with NHS Scotland open spaces, and debrief questions (see Technical Appendix).

For example, we define non-use values such as those from individuals who have not visited an NHS Scotland open space but are deemed likely to visit in future (e.g., option value). Other non-use values could be from individuals who have not visited an NHS Scotland open space but have visited NHS Scotland sites, who may have altruistic values, such as preserving the space without them experiencing it (e.g., existence value) and/or preserving for others (e.g., bequest value).

Open space typologies

This study is concerned with the current stock of NHS Scotland-based open spaces and specifically the respondents' local site(s). Results should be interpreted as the value based on the NHS Scotland open spaces visited (for the exposure-based method) and for their local NHS open space(s) (for the CVM).

When using the CVM, we do not elicit economic values for Primary Care Sites from individuals whose local Health Centre or GP Surgery does not have open space as we cannot assign a value to something that does not exist.

Given that respondents were not made aware if their local Primary Care Site was owned by NHS Scotland, some may be eliciting values based on their experience on non-NHS Scotland owned or leased sites.

This may include private properties that host NHS Scotland services or staff, such as independent GP and dental practices or, to a lesser extent, local pharmacies. For the exposure method, we also report the values excluding respondents who only visited non-NHS Scotland owned Primary Care Sites. For the CVM, we explore the effect on WTP of the Primary Care Site being owned or leased by NHS Scotland.

Given the diversity in sites and limitations in available data, it was not possible to fully characterise open spaces at each site. As a result, defining common typologies based on their features was not feasible. However, it is important to note that NHS Scotland spaces serve a wide range of unique and diverse needs and are not necessarily suited for grouping based on typical public open space typologies.

Instead, we allow respondents to define their own site's open space, giving them greater agency. We then aggregate the values using the most relevant information available in the context of NHS Scotland. This includes categorisation by site characteristics such as type, size, and greenspace area, as well as rurality and, where data permits, by health board.

For example, we aggregate values based on the type of NHS services offered at a Hospital Site (e.g., type of hospital). Community hospitals are defined as small hospitals for your local community that provide a range of services from maternity, minor injuries units, rehabilitation and end of life care. General hospitals are defined as facilities which are larger and provide a range of specialist services, such as specialist consultations, emergency treatment, routine, complex and life-saving surgery and specialist diagnostic procedures. Sites are grouped according to the specific services they offer.

This heterogeneity of sites also complicates the good being valued using the CVM. While respondents were asked to provide the value for the site's entire open space, it is possible that respondents who value the same site (or type of site) are basing their answers on different areas within the site. That means their values are derived from the experience, and/or familiarity, of different spaces contained within the site.

For instance, one individual might have visited a garden in one area of the site , and another individual might have used a path with greenery in another area. To address this, we include questions to characterise the space used in the last visit (e.g., size and the perceived quality of the space). However, we can only ask this for respondents who have used a site in the past.

Finally, this study does not consider the accessibility of the space and/or adjacent spaces to NHS Scotland sites which can influence valuations. For instance, the existence of a substitute space (e.g., a park) next to a site might influence the benefits and value derived from the use of NHS Scotland open spaces. However, this may be less of a concern for respondents who are more familiar with the site and its open space.

Exposure-based method

The ***exposure-based*** approach provides a straightforward method to elicit a monetary value from visits to the outdoors. This method however relies on stated behaviour related to past visits. This might raise recall bias among individuals who do not visit frequently or whose last visit happened months before.

This approach also raises methodological and empirical issues. First, it assumes a binary effect of exposure, based on the 120-minute threshold -- no health benefit is obtained if the exposure threshold is not met, and no additional benefit is obtained beyond. Second, for visits that occur as a result of accessing NHS services (e.g., hospitals), the approach does not account for the overall impact on health from the visit to the open space.

Third, it connects exposure to outdoor space to Self-Assessed Health (SAH), which is measured on a 5-point Likert scale. SAH is converted to QALYs using the assumption that excellent=1, very good=0.8, good=0.6, fair=0.4 and poor=0.2. This assumption, while convenient, is potentially problematic because the impact of SAH on QALYs is unlikely to be this simplistic.

Results validity

We use benchmark questions about general outdoor use to verify and compare our results to those obtained by SPANS and the ONS (see Technical Appendix).

We assess the external validity of the values derived using the exposure and CVM method. For instance, we examine if our exposure-based values are, as expected, below the ONS estimate of the annual value of the health benefits from Scottish habitats. Additionally, we assess if the exposure-based estimates are, as expected, lower than the CVM estimates as the latter likely include other components of use value beyond health and wellbeing benefits.

We also assess the external validity of the WTP estimates by examining whether our results align with existing data. The studies in the overview of the literature serve as a benchmark for comparing our values.[7] However, there is very limited evidence of estimates for ecosystem services from healthcare sites.

CVM data can be prone to hypothetical bias. We report how we addressed this in the Technical Appendix. We incorporate and report the results of other validity tests for the CVM estimates (see Technical Appendix).

For instance, we examine the construct (or theoretical) validity of the estimates by incorporating different expected drivers of value in different model specifications. For example, whether income or frequency of use has the expected positive effect on WTP.

7. In addition to those described in the overview of the literature section, other comparable studies include Roberts et al. (2022), Davies et al. (2023) and Longo et al. (2012).

Assessing construct validity beyond these key characteristics is difficult because we had no other expectations for the different values. For example, it is not clear whether and how local primary care sites or local hospitals would be valued differently. Similarly, sites with more open space may not necessarily be valued more highly if individuals only use a small area of the space.

We examined content validity during the pretesting stage, and we found the survey was well understood, deemed realistic and policy relevant. We also explored the comment section of the survey to gauge general perceptions from respondents.

Like other CVM studies, the valuation scenario and tasks can generate protest responses from individuals who are unwilling to pay the proposed bid because they object to providing a value.

We conduct robustness checks separating individuals who likely provided a protest response from those who rejected the proposed bid for valid reasons (e.g., individuals who are willing to pay a lower amount than the one proposed or genuinely not willing to pay anything for the good) – see Technical Appendix.

We identify protest responses using the valuation task debrief questions. Reasons to determine a protest response include objecting to a monthly charge and not wanting to measure the value of these sites in monetary terms.

The recruitment of respondents using an incentivised survey can, however. result in low-quality responses (e.g., individuals who are not engaged with the survey and/or provide untruthful responses). We explain how we addressed this in the Technical Appendix.

Sample representativeness

We use recruitment targets to obtain national representativeness in terms of age and sex. We then weighted the survey data using iterative proportional fitting (e.g., raking) applying a weighting criterion in terms of age and sex. This approach does not guarantee representativeness in terms of other covariates. Where relevant, we report 95% confidence intervals (C.I.). The margin of error of pooled sample level statistics is +/- 2%, which includes the potential design effect of weighting.

Results

Sociodemographic characteristics

The sample consists of 2,449 respondents. Table 1 shows the weighted descriptive statistics of the study population.

Table 1. Sociodemographic characteristics

Characteristic		Percentage
Sex	Female	50.9%
	Male	49.1%
Age	18-24	10.5%
	25-34	15.7%
	35-44	15.7%
	45-54	15.6%
	55+	42.5%
University education	No	66.6%
	Yes	33.4%
Working	No	37.8%
	Yes	62.2%
Married/living as married	No	43.3%
	Yes	56.7%
Adults in household	1	27.8%
	2	48.2%
	3	13.0%
	More than 3	10.9%
Under 18s in household	0	64.6%
	1	17.3%
	2	13.4%
	More than 2	4.6%
Personal annual income	Less than £12,571	17.7%
	£12,751 - £26,571	30.1%
	£26,571 - £43,662	27.2%
	£43,662 - £75,000	15.6%
	More than £75,000	9.5%

Use and familiarity of NHS Scotland sites

Local Primary Care Sites

Of the total sample, 85.6% of respondents reported that they had visited their local Primary Care Site in the previous twelve months (see Table 2). 24.2% had visited at least once every month (e.g., frequent visitors). Of those who had visited at least once, roughly half visited only once or twice a year.

Table 2. Frequency of visits to local Primary Care Site

Frequency of Visit	Total
At least once a day	3.2%
Several times a week	3.9%
Once a week	4.0%
Once or twice a month	13.1%
Once every 2-3 months	20.5%
Once or twice in last 12 months	40.9%
Not visited	14.4%

46.1% of respondents were found to have a local Primary Care Site which was owned by the NHS and known to have open space. However, not all individuals with an NHS Scotland-owned Primary Care Site were aware of the open space availability: 69.2% reported being aware of it.

Additionally, among respondents with a non-NHS Scotland-owned Primary Care Site, 31.0% reported it had open space. Thus, 62.8% of the respondents' local Primary Care Sites had open space.

Individuals with Primary Care Sites that had open space were more likely to have visited in the past year—88.6% compared to 80.4% of those with no open space at their site. However, this difference should not be solely attributed to the presence of open space at the site.

Among respondents with a Primary Care Site with open space, most were not very familiar with the open space. Only 28.8% of respondents said they were at least moderately familiar with the open space, with 14.6% saying they were not at all familiar.

Table 3. Familiarity with local Primary Care Site's open space

Familiarity with open space	Total
Not at all familiar	14.6%
Slightly familiar	33.0%
Somewhat familiar	23.6%
Moderately familiar	15.7%
Extremely familiar	13.1%

Hospital sites

Of the total sample, 89.9% of respondents reported they had visited at least one hospital in Scotland in the past five years. Additionally, 86.7% of respondents had visited their ***local*** hospital in the past five years, Of these, 38.9% had visited multiple hospital sites within their Health Board.

As shown in Table 4, 76.0% of respondents had visited their local Hospital Site in the previous twelve months. Of those who visited, most did so once or twice in the previous twelve months, and 21.7% had visited at least once a month (e.g., frequent visitors).

Table 4. Frequency of visits to local Hospital Site

Frequency of Visit	Total
At least once a day	2.6%
Several times a week	5.5%
Once a week	3.4%
Once or twice a month	10.1%
Once every 2-3 months	14.7%
Once or twice in last 12 months	39.6%
Not visited	24.0%

Notably, roughly one-third of the sample was not aware their local hospital had open space they could use: 66.8% were aware of it. Frequent visitors were more likely to be aware of their local hospital site's open space: 82.5% of frequent visitors were aware compared to 62.5% of infrequent visitors.

As shown in Table 5, most respondents are not very familiar with the open space, with a higher percentage of unfamiliarity compared to Primary Care Sites. For instance, 23.6% of respondents reported being at least moderately familiar with the open space at the Hospital Site, while 27.6% indicated they were not at all familiar with it.

Table 5. Familiarity with local hospital site open space

Familiarity with open space	Total
Not at all familiar	27.6%
Slightly familiar	27.1%
Somewhat familiar	21.7%
Moderately familiar	14.1%
Extremely familiar	9.5%

Of the local Hospital Sites (as defined by the respondents), 36.7% were community hospitals and 63.4% were general hospitals. Most respondents (65.2%) lived within 10 miles of their local hospital site. 17.8% lived within 2 miles.

Use of NHS Scotland open spaces

Roughly half of respondents had visited an NHS Scotland open space in the previous twelve months to the survey: 53.0% are considered users of NHS Scotland open spaces.[8] This percentage drops slightly to 50.2% when considering only visits to NHS Scotland-owned or leased sites.

As shown in Table 6, the most common frequency of visits is once or twice in the past year, reported by 40.3% of users (e.g., those who had visited). Additionally, 24.1% of users visit at least once a week. There is notable variation in visit frequency across different age groups, with older respondents being less likely to visit and, when they do, tending to visit less frequently.

Visits to NHS Scotland open spaces are more likely to have been in local sites: 83.8% of users visited their local site. 43.2% of users visited their local Primary Care Site and 57.7% of users visited their local Hospital Site.

In addition, frequent visitors to NHS Scotland sites were more likely to use NHS Scotland open spaces. Most users (79.3%) visited the open space of only one site (e.g., either Primary Care Site or Hospital Site). Notably, Primary Care Sites tend to have higher overall visitation rates, meaning these open spaces are used more frequently.

Table 6. Frequency of visits to NHS Scotland open spaces by age group

Frequency of visits	18-24	25-34	35-44	45-54	55+	Total
At least once a day	3.1%	6.1%	6.7%	1.4%	1.1%	3.0%
Several times a week	7.9%	9.2%	9.3%	2.2%	1.9%	4.9%
Once a week	7.6%	9.4%	7.1%	6.0%	1.3%	4.8%
Once or twice a month	16.5%	18.6%	12.4%	5.0%	4.4%	9.3%
Once every 2-3 months	16.8%	15.5%	10.4%	9.4%	5.4%	9.6%
Once or twice in last 12 months	21.6%	21.1%	20.6%	22.3%	21.4%	21.4%
Not visited	26.5%	20.0%	33.5%	53.7%	64.5%	47.0%
Have visited	*73.5%*	*80.0%*	*66.5%*	*46.3%*	*35.5%*	*53.0%*

8. These individuals have visited an open space at an NHS Scotland site, which includes locations not necessarily owned or leased by NHS Scotland.

Table 7. Most recent NHS Scotland open space visit by types of sites visited

Number of types of sites visited	Types of NHS Scotland sites			
	Local Primary Care Site	Local Hospital Site	Non-local Primary Care Site	Non-local Hospital Site
1 Type	26.7%	36.9%	10.7%	5.1%
2 Types	8.5%	7.4%	1.1%	1.1%
3 Types	1.1%	1.0%	0.2%	0.1%
4 Types	0.1%	0.1%	0.1%	0.0%
Total	36.4%	45.4%	12.0%	6.3%

Characterising the last visit to an NHS Scotland open space

As shown in Table 7 and in line with overall visit rates, 81.8% of the most recent visits to NHS Scotland open spaces were to respondents' local sites.

When exploring by type of site, 36.4% of visits were to local Primary Care Sites, 45.4% were to the local Hospital Sites, 12.0% were to other Primary Care Sites and 6.3% were to other Hospital Sites. Overall, we see that the place of most recent visit is roughly split in half between types of site: 51.7% were to open spaces in Hospital Sites and 48.3% were to Primary Care Sites.

However, those whose most recent visit was to a Primary Care Site had used NHS Scotland open spaces more frequently over the past twelve months. On average, 50.9% visited at least once a month, compared to 26.4% of those whose last visit was to a Hospital Site.

As shown in Table 8, most of NHS Scotland's open spaces used were described as grassy areas with places to sit (47.9% of users) and paths with greenery (41.5%). Other mentioned typologies were gardens with flower or wildlife beds (24.0%) and courtyards or walled gardens (20.1%).

Table 8. Open space typology description

Typology	%
Grassy area with places to sit	47.9%
Paths with greenery	41.5%
Garden with flower or wildlife beds	24.0%
Courtyard or walled garden	20.1%
Allotment or grow-your-own area	5.3%
Woodland	9.9%
Blue spaces	5.0%
Rooftop garden	9.9%
Other	0.9%

Note: Values may add up to more than 100% because some respondents selected more than one option.

Only 5.0% of respondents described the space as a blue space (e.g., areas around a burn, river, or loch). Furthermore, 38.2% of respondents described the space as a combination of typologies. When identified as more than one typology, the most common combination was grassy areas with places to sit and paths with greenery.

Most respondents rated the NHS Scotland open space as good or very good quality for doing the things they wanted to do (see Table 9): 84.1% of users described it as good or very good, 14.6% as acceptable, and only 1.3% as poor or very poor.

Most users (65.9%) visited the NHS Scotland open space because they were already at the NHS Scotland site for another reason, such as accessing NHS services, visiting someone, or for work-related purposes. The remaining 34.1% visited the open space solely for leisure or recreation.

As shown in Table 10, among those who were at the site for another reason, 35.5% were there for an outpatient appointment (e.g., not requiring an overnight stay at the NHS site), 35.2% were visiting relatives or friends, and 12.0% were there for in-patient care (e.g., requiring an overnight stay at the NHS site).

Table 9. Perceived quality of the NHS Scotland open space

Quality of the open space	%
Very poor	0.3%
Poor	1.0%
Acceptable	14.6%
Good	45.8%
Very good	38.3%

Table 11 shows the reasons for visiting the NHS Scotland open space, distinguishing between those already at the site and those just visiting the open space. Overall, the most common reason for visiting the NHS Scotland open space was because they like the space (34.6% of users). The reasons for visiting were mostly similar across those already at the site and those visiting exclusively. However, those visiting exclusively were more likely to cite liking the space and feeling safe as their reasons for visiting the NHS Scotland open space.

Table 10. Reasons for being at the NHS Scotland site (not recreation visit)

Reason for being at NHS site	%
Routine procedure or appointment (e.g., Outpatient)	35.5%
Admitted to hospital (e.g. Inpatient)	12.0%
Visiting or accompanying relatives or friends	35.2%
Work as NHS staff	7.8%
Work not as NHS staff	3.6%
Volunteer as part of NHS Scotland	1.7%
Volunteer as part of another organisation	2.0%
Other	2.2%

Table 11. Reasons for visiting the NHS Scotland open space

Reason	Already at NHS Site	Exclusively NHS open space	All users
Nearest open space	29.1%	27.1%	28.4%
Like the open space	46.5%	63.4%	34.6%
Use it to commute	12.9%	14.2%	9.1%
Where I can meet relatives and friends	15.4%	20.9%	11.3%
Activity I enjoy offered there	6.1%	10.4%	4.2%
Feel safe	17.3%	26.2%	14.3%
Other	6.5%	3.6%	4.8%

Note: Values may add up to more than 100% because some respondents selected more than one option.

Roughly half of NHS Scotland open space users visited the NHS open space accompanied by someone (46.0% of users). Among those who visited with others, the most common relationship was family (37.2% users) and friends (16.7%). Of those who visited with family, most did so with their spouse (37.8% of those who visited with family) and children (33.9%).

Table 12 shows the length of time for the visit to the NHS open space. The most common length of visit was 10 to 30 minutes. Roughly half of visits (49.7% of visits) were less than 30 minutes long, with most taking less than one hour (78.0%). There are no significant differences when separating those visiting when already at the site and those exclusively visiting the open space.

Table 12. Length of visit to the NHS Scotland open space

Length	Already at NHS Site	Visit exclusively NHS open space	All users
Less than 5 mins	3.5%	2.6%	3.2%
Between 5 and 10 mins	13.9%	11.6%	13.1%
Between 10 and 30 mins	33.5%	33.4%	33.4%
Between 30 mins and 1 hr	27.0%	30.7%	28.3%
1 up to 2 hrs	14.1%	15.8%	14.7%
2 up to 3 hrs	4.3%	4.7%	4.4%
3 up to 4 hrs	1.5%	0.7%	1.2%
4 hrs or more	2.2%	0.6%	1.7%

We do not find significant differences in the length of visit between types of sites (e.g., local, Primary Care Site/Hospital Site, or Community/General Hospital).

However, those who were at the site and were admitted to hospital (e.g., receiving inpatient care) are more likely to spend more than 30 minutes in the open space – see Table 13.

Similarly, those who visit with other people are more likely to spend more than 30 minutes in the open space – see Table 14.

Table 13. Length of visit to the NHS Scotland open space separating by those admitted to hospital.

Length	Admitted to hospital (inpatient care)	All other users
Less than 5 mins	6.3%	2.9%
Between 5 and 10 mins	12.1%	13.2%
Between 10 and 30 mins	24.9%	34.2%
Between 30 mins and 1 hr	30.3%	28.1%
1 up to 2 hrs	13.1%	14.8%
2 up to 3 hrs	6.3%	4.3%
3 up to 4 hrs	0.8%	1.3%
4 hrs or more	6.2%	1.3%

Table 14. Length of visit to the NHS Scotland open space separating by whether they visited alone or with others

Length	Visiting alone	Visiting with others
Less than 5 mins	5.2%	1.5%
Between 5 and 10 mins	14.4%	11.9%
Between 10 and 30 mins	37.4%	30.1%
Between 30 mins and 1 hr	27.8%	28.7%
1 up to 2 hrs	12.2%	16.8%
2 up to 3 hrs	2.1%	6.4%
3 up to 4 hrs	0.1%	2.2%
4 hrs or more	0.9%	2.4%

The activities done during the last visit to an NHS Scotland open space are described in Table 15. The most common activities were walking (55.9%) and relaxing (56.5%). Most users reported doing one activity (53.7% of users). However, among those who reported multiple activities, walking and relaxing were frequently mentioned together.

Other less frequently mentioned activities included the use of picnic space (12.2%), travelling to other destinations (10.3%) and informal social gatherings (8.6%).

Table 15. Activities done in visit to NHS Scotland open space

Activities done	%
Relaxing	55.9%
Walking	56.5%
Use of picnic space	12.2%
Travel to or from destination	10.3%
Informal social gathering	8.6%
Gardening	7.8%
Cycling	7.6%
Running	6.4%
Therapeutic activity	6.3%
Organised event	4.4%
Organised fitness or exercise	2.8%
Other	2.0%

Note: Values may add up to more than 100% because some respondents selected more than one option.

As shown in Table 16, most users stated having more than one motivation to visit the NHS Scotland open space. The most common were for peace and quiet (43.2% of users), for fresh air or to enjoy pleasant weather (39.1%), and to relax and unwind (38.3%). These three motivations were also often chosen together.

Other less common reasons were to enjoy scenery or wildlife (20.2%), to spend time with family and friends (17.7%) and for my own health and exercise (16.8%).

Table 16. Motivations to visit the NHS Scotland open space

Motivations to visit	%
For peace and quiet	43.2%
Fresh air or to enjoy pleasant weather	39.1%
To relax and unwind	38.3%
To be somewhere I like	21.9%
To enjoy scenery or wildlife	20.2%
To spend time with family/friends	17.7%
For own health and exercise	16.8%
To exercise a dog	6.4%
To entertain a child	5.4%
To spend time with coworkers	5.2%
To learn something about the outdoors	4.7%
To challenge myself	4.4%
To volunteer	2.9%
To take part in hobby	2.5%
Other	2.1%

Note: Values may add up to more than 100% because some respondents selected more than one option.

Most agreed that they experienced benefits from visiting the open space (see Table 17). The most agreed-upon statement was related to mental wellbeing health benefits: it helped me destress, relax and unwind (74.7% of users). This was followed by *I felt closer to nature* (69.4%) and *It made me feel energised and revitalised* (68.1%), *It improved my physical health* (61.6%), and *It was a good social experience* (59.0%).

Table 17. Agreement to different benefits from visit to NHS Scotland open space

Benefit	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
It helped me de-stress, relax and unwind	3.9%	6.1%	15.3%	40.4%	34.3%
I felt closer to nature	4.8%	6.4%	19.4%	40.8%	28.6%
It made me feel energised and revitalised	4.5%	6.9%	20.5%	43.6%	24.5%
It improved my physical health (through exercise and physical activity)	5.5%	8.7%	24.2%	37.4%	24.2%
It was a good social experience (through spending time with other people)	5.2%	9.3%	26.5%	37.1%	21.9%

NHS Scotland open space use

General population use

We estimate there is a total annual volume of **122 million** visits taken to NHS Scotland open spaces based on visits in the twelve months before the survey among Scottish adults. This is equivalent to roughly 10 million visits per month or 330,000 visits per day. See Technical Appendix for the uncertainty around this estimate.

However, these visits are not evenly distributed across the population. A significant majority of these visits (96 million) come from just 16.6% of users who visit at least twice a week, whereas half of adults (53.1%) visit only once every three months or less, accounting for just 2.9% of the total visits (4 million).

As shown in Figure 1, most visits (58.0%) last less than 30 minutes, with 26.6% lasting under 15 minutes. In contrast, only 15.6% extend beyond one hour. The median visit length is 26 minutes, and the average is 38 minutes.

From these visits and after adjusting for seasonality, we estimate users spend **87 million hours** in NHS Scotland open spaces every year. See the Technical Appendix for details on seasonality adjustment and non-seasonal estimates

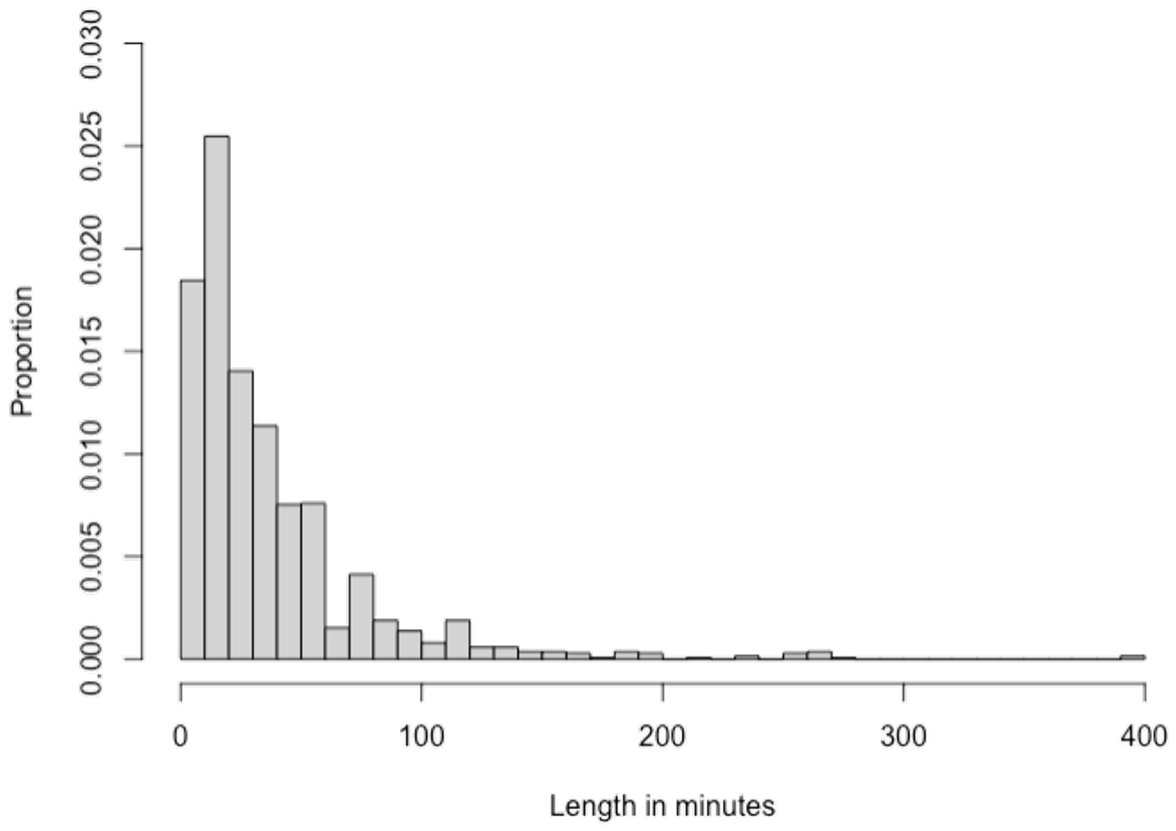

Figure 1. Estimated length of visits to NHS Scotland open spaces

NHS Scotland sites visited

We estimate that of the 122 million total visits, approximately **83 million** visits were to open spaces located in Primary Care Sites and **39 million** were to open spaces in Hospital Sites.

As shown in Table 18, there were roughly 73 million and 29 million confirmed visits to open spaces in Primary Care Sites and Hospital Sites respectively from people who only visited one type of site.

Among those who visited multiple sites, we don't know how many visits were to each type of site. But, based on aggregate visitation patterns, we estimate a further 10.5 million visits were to Primary Care Sites and 9.2 million to Hospital Sites.

Notably, regardless of the type of site, most visits were to local sites. We estimate 92 million (75% of the 122 million) visits were made to either local Primary Care Sites or local Hospital Sites.

Table 18. Estimated visits by site type (in millions)

Visits	Primary Care Sites	Hospital Sites
Confirmed	73.0	29.4
Attributable	10.5	9.2
Combined	**83.4**	**38.6**

The distribution between Primary Care Sites and Hospital Sites differs from the visitation estimates for the most recent visit, which showed a more even split between site types (see Table 7). This discrepancy arises because Primary Care Sites are generally visited more frequently. As shown in Table 19, respondents whose last visit was to a Primary Care Site were more likely to have used NHS Scotland open spaces more frequently over the past twelve months.

Table 19. Frequency of visits by site type

Frequency of visits	Primary Care Site	Hospital Site
At least once a day	9.5%	2.2%
Several times a week	11.9%	6.8%
Once a week	12.8%	5.7%
Once or twice a month	19.6%	15.5%
Once every 2-3 months	19.8%	16.5%
Once or twice in last 12 months	26.4%	53.3%

Monetary value of NHS Scotland open spaces

Exposure-based method

Direct benefits

We find that **5.1% of the sample** (equivalent to 9.7% of NHS Scotland open space users) meets the 120-minute exposure threshold at which they are considered to derive QALY gains from their visits to NHS Scotland open spaces alone. Non-seasonal adjusted estimates are reported in the Technical Appendix.

When estimating for the Scottish population, 230,318 adults are assumed to derive health and wellbeing benefits from exposure to NHS Scotland open spaces.

Using White et al.'s estimate of marginal QALY gains from this exposure, we calculate that visits to NHS Scotland open spaces lead to an additional **4,595 QALYs** per year across the Scottish population.

Based on Claxton et al.'s NHS cost values, we estimate that the health benefits of direct exposure to NHS Scotland open spaces have an average annual value of **£81,993,068** or £18.32 per adult in Scotland (in 2023 prices).

When accounting for the way the number of visits was recorded in the survey, we estimate between 3.2% and 6.1% of the sample meets the threshold. These proportions would be equivalent to between 142,578 and 274,188 adults meeting the 120-minute threshold. This suggests the health benefits value ranges between **£50,757,613** or £11.34 per adult in Scotland and **£97,610,795** or £21.80 per adult.

Breakdown by type of site

Of those who met the 120-minute threshold and are assumed to receive benefits, 65.1% estimated at 149,889 individuals, only visited primary care centre sites and 23.8%, estimated at 54,838 individuals, only visited hospital sites. A remaining 11.1%, estimated at 25,591 individuals, visited both types of sites.

As shown in Table 20, the proportion of the annual value from exposure to Primary Care Sites is estimated to be £53.4 million or £11.92 per adult. The proportion of the annual value from exposure to Hospital Sites is £19.5 million or £4.36 per adult.

The proportion of the annual value from exposure to a combination of both types of sites is £9.1 million or £2.04 per adult. For this value we cannot determine the exact contribution of each type of site as we do not know the exact number of visits to each site.

Table 20. Value by type of site

Site type	Value
Primary Care Site	£53,360,568
Hospital Site	£19,522,159
Combination	£9,110,340
Total	**£81,993,068**

Benefits from NHS Scotland-owned or leased sites

Given respondents were not aware if the sites visited were NHS Scotland owned or not, our estimates include visits that may have happened at sites not owned or leased by NHS Scotland but used to deliver NHS services such as privately owned GP Surgeries and, to a lesser extent, local pharmacies.

Out of the 122 million visits to NHS Scotland open spaces, we estimate that ***at least* 76 million** were to NHS Scotland-owned or leased sites. This estimate is based on data from respondents who, with certainty, visited only NHS Scotland-owned sites in the past twelve months.

Based on those who visited a combination of sites, which included at least one NHS Scotland-owned or leased site, the total number of visits to NHS Scotland-owned sites could be as high as **119 million**.

Based on these visits, we estimate that the annual health benefits from exposure to NHS Scotland-owned or leased sites can range from at least £49.5 million to up to £81.3 million. This means that exposure to NHS Scotland-owned or leased sites contributes between 60.3% and 99.2% of the total annual health benefits from all NHS Scotland-based sites.

Attributable benefits

Visits to the general outdoors are more frequent and significantly longer than those to NHS Scotland sites (see Technical Appendix). As a result, some users who met the 120-minute threshold for health benefits from NHS Scotland open space visits may have reached the criteria based solely on time spent outdoors. This suggests their NHS Scotland visits might not have provided additional health benefits.

When considering total exposure to all types of open spaces, we find that 2.6% of the sample (approximately 111,270 individuals) met the 120-minute threshold solely based on their NHS Scotland site visits, while their time spent in the general outdoors alone would not have reached the threshold.

A further 2.2% of the sample (approximately 93,884 individuals) met the 120-minute threshold because of the sum of time spent in the general outdoors and NHS Scotland open spaces combined, while the time spent in each individually would have not been enough.

When combining the above, **4.8% of the sample** (estimated to be 205,155 individuals) derive health benefits from exposure to open space that is attributable to visits to NHS Scotland sites. This is equivalent to an annual value **£73,035,291** or £17.15 per adult in Scotland – see Table 21.

Table 21. Breakdown of attributable benefits

Reason	Value
NHS open spaces, not otherwise	£39,612,361
Combination of NHS open space and general outdoors	£33,422,930
Total	**£73,035,291**

Contingent valuation method

Population values

40.5% of respondents were willing to pay the proposed bid to keep and maintain spaces for their own use at their local Hospital Site – see Table 22.

Table 22. Acceptance rate per bid for Hospital Sites

Bid (£)	Yes	No	Sample Size
2	58.6%	41.4%	468
5	49.1%	50.9%	470
10	35.9%	64.1%	474
15	32.3%	67.7%	368
20	29.6%	70.4%	457
40	29.1%	70.9%	211
Total	40.5%	59.5%	2449

Of those who were also asked to value their local Primary Care Site (e.g., out of 1538 individuals who saw this task because their Primary Care Site has open space), 49.7% of respondents were willing to pay the proposed bid for that site – see Table 23.

Table 23. Acceptance rate per bid for Primary Care Sites

Bid (£)	Yes	No	Sample Size
2	72.0%	28.0%	254
5	49.5%	50.5%	261
10	39.0%	61.0%	277
15	54.2%	45.8%	377
20	39.8%	60.2%	255
40	33.9%	66.1%	115
Total	49.7%	50.3%	1538

Both acceptance rates are in line with the literature. As expected, the acceptance of the proposed monthly bid (e.g., willingness to pay) generally decreases as the bid increases. See Technical Appendix for unweighted frequencies.

Table 24 shows the value (e.g., willingness to pay) estimates for both types of sites in Scotland. The mean WTP for the open space in local Primary Care Sites is **£29.33 per month**. The mean WTP for the open space in local Hospital Sites is **£21.48 per month**. See Technical Appendix for model specification, regression results and robustness analysis.

Table 24. Local NHS Scotland open space values (in £ per month)

Estimate	Hospital Sites	Primary Care Sites
Median	4.32	16.00
Mean	21.48	29.33
Confidence interval (95%)	18.08 - 26.55	25.95 - 48.51

Figures 2 and 3 show the relationship between acceptance and bid price (e.g., the implied demand curve) for Hospital Sites and Primary Care Sites, showing the mean and median estimates.

Using these WTP values, we estimate the total annual value of open space at local Hospital Sites to be £653,501,506 and at local Primary Care Sites to be £560,388,322 across the Scottish population. This translates to an annual per-adult value of £145.98 for Hospital Sites and £125.18 for Primary Care Sites.

Although Primary Care Sites are individually valued more highly, their overall aggregate value is lower because not all sites have open space available.

Determinants of value (site characteristics and size)

WTP is greater at sites that offer more primary care services. Specifically, WTP is highest for Primary Care Sites, followed by Community Hospitals, with General Hospitals having the lowest WTP.

For instance, after controlling for site area and open space size, the mean WTP for the open space of a community hospital is £24.48 per month and for a general hospital is £15.34 per month – see Table 25.

Table 25. Local NHS Scotland Hospital Sites open space values by type (in £)

	Community Hospital	General Hospital
Median	14.68	0.00[a]
Mean	24.48	15.34
Confidence interval (95%)	20.80 - 29.95	14.02 - 18.99

Note: [a] This estimate suggests a significant rejection of the proposed bid. Since the median is unbounded, it leads to a negative estimate (see Technical Appendix).

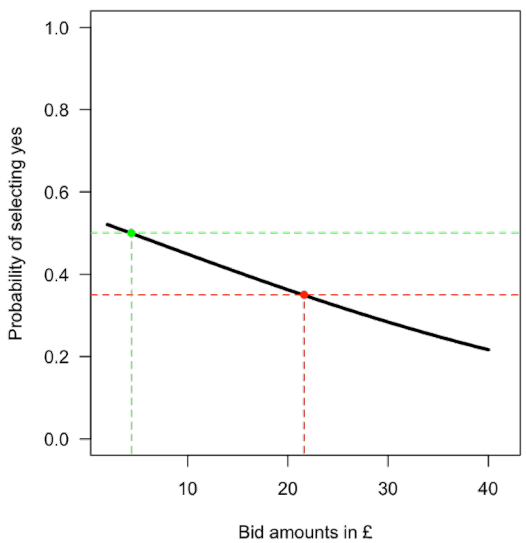

Figure 2. Implied demand curve for local Hospital Sites open space (mean intercept in red and median intercept in green).

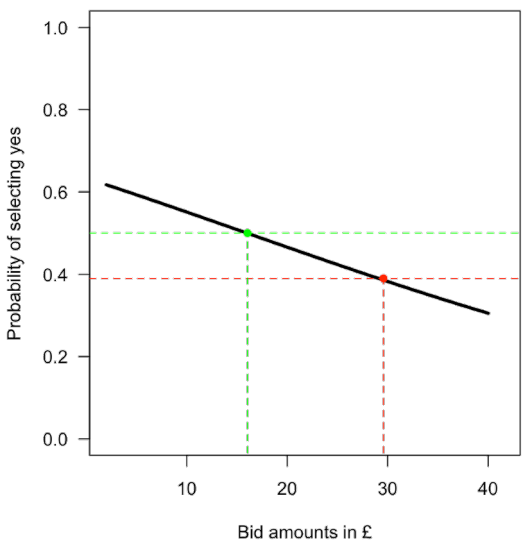

Figure 3. Implied demand curve for local Primary Care Sites open space (mean intercept in red and median intercept in green).

The hospital site's total and open space area size also have an impact on WTP. After controlling for hospital type, we find the area of open space as a percentage of total site footprint has a positive effect on WTP. We also find that a larger total site area size is associated with lower WTP. See the Technical Appendix for model specification and regression estimates.

For instance, we estimate a hospital of 10 hectares in size of which 20% is open space has a mean WTP of £12.69 per month (95% C.I.: £10.71 - £15.44). In contrast, a smaller hospital of 3 hectares in size of which 70% is open space has a mean WTP of £19.82 per month (95% C.I.: £15.88 - £26.99) – Table 26.

Table 26. Comparison of two hypothetical sites by size and open space area

	Hospital 1	Hospital 2
Size (in hectares)	10	3
% open space	20%	70%
WTP	**£12.69**	**£19.82**

For Primary Care Sites (and NHS Scotland-owned since we only have area size for these), we do not find a statistically significant effect of the amount of open space after controlling for area size. However, we do find a significant effect when using 90% confidence intervals in which more open space as a proportion of total site area is positively associated with WTP. This could be because of the perceived homogeneity of total and open space area size within these sites.

After controlling for past visits[9], we also find that having an NHS Scotland-owned local Primary Care Site is associated with higher WTP for the open space in this site: the mean WTP among those whose Primary Care Site is NHS owned is £26.14 (95% C.I.: £23.57 – £35.27) per month. In contrast, the WTP among respondents whose Primary Care Site is not owned or leased by NHS Scotland is £12.75 (95% C.I.: £8.00 – £16.41). This difference could be because NHS Scotland-owned sites have more and/or better perceived open space than privately owned ones. It was not possible to control for open space typology and size of Primary Care Sites because we had no data on open space for non-NHS owned or leased ones.

Determinants of value (sociodemographic characteristics)

Table 27 shows the individual characteristics associated as drivers of value for NHS Scotland open spaces. See Technical Appendix for specification details (e.g., Model 7).

For both types of sites, we find being in higher age bands is associated with lower WTP. Notably, easy access to alternative open spaces has a negative impact on WTP: both living within one mile of an open space (e.g., park, playing field, loch, public garden, riverside park, etc.) and having access to a private garden at home.

Higher income and having under 18s living at home are associated with higher WTP.

9. We control for past visits because we find individuals whose local Primary Care Site is owned or leased by the NHS are more likely to visit their site more frequently. More information in the Technical Appendix (Model 6).

For Hospital Sites, marital status (married or living as married) and living within five miles are associated with higher WTP. For both sites, more visits to the general outdoors are associated with higher WTP.

Other factors, including university education, number of adults living in the household (expressed as more than 2 adults), paid employment (e.g., working), marital status (for Primary Care Sites), and self-reported health and mental health are not statistically significant to be considered drivers of value in any site.

Table 27. Regression coefficients when controlling for sociodemographic characteristics

Regressors	Hospital Sites	Primary Care Sites
Bid	-0.048**	-0.046**
Sex (female)	-0.167	-0.220
Age	-0.235**	-0.198**
Income	0.433**	0.295*
University education	0.019	-0.048
Working	0.075	0.043
Married/living as married	0.241*	0.142
More than 2 adults in home	0.000	0.112
Under 18s in home	0.548**	0.720**
Very good or good health	0.144	0.102
Very good or good mental health	-0.107	0.117
Open space within 1 mile of home	-1.182**	-1.083**
Access private garden	-0.305**	-0.315**
Lives within 5 miles of hospital	0.176	0.083
Annual visits to general outdoors	0.001**	0.001*
Constant	1.215**	1.246**
Observations	2449	1609
AIC	2798.159	1897.763

Note: Regression coefficients should be interpreted as non-negative for positive association with WTP and negative for negative association with WTP. ** significance at 1%, * significance at 5%. AIC: Akaike Information Criterion.

Determinants of value (regionality)

Using the Scottish Government Urban Rural Classification (e.g., 2-fold classification), we find sites in rural areas have slightly higher WTP for local Hospital Sites. For instance, the open space of a Community Hospital in rural Scotland has a mean WTP of £23.84 (95% C.I.: £15.09 – £27.14) and the open space of one in the rest of Scotland has a WTP of £20.48 (95% C.I.: £14.67 – £24.33). This effect is only significant at the 10% level when accounting for hospital type and size. We find no effect for local Primary Care Sites.

When examining by health boards, we find users in NHS Grampian have the highest WTP for Hospital Sites with £45.03 (95% C.I.: £21.87 – £258.74), followed by NHS Tayside with £29.91 (95% C.I.: £15.59 – £143.26), NHS Lothian with £20.96 (95% C.I.: £15.02 – £34.11), NHS Greater Glasgow & Clyde with £19.68 (95% C.I.: £14.27 – £31.02), NHS Borders with £18.08 (95% C.I.: £11.37 – £36.69), NHS Dumfries & Galloway with £11.65 (95% C.I.: £11.37 – £36.69) and NHS Lanarkshire with £10.65 (95% C.I.: £7.60 – £17.66). We did not obtain statistically significant results for the remaining health boards, likely because of sample size limitations.

Disentangling use and non-use values

Expectedly, users of NHS Scotland open spaces (e.g., people who have visited in the previous twelve months) are willing to pay more for keeping these spaces open for use. As shown in Table 28, users of both Hospital Sites and Primary Care Sites are willing to pay more than non-users.

On average, those who have visited an NHS Scotland open space in the previous twelve months (e.g., NHS open space users) place a value of £43.33 per month for Hospital Sites and £55.16 per month for Primary Care Sites. In contrast, an individual who has not visited any NHS Scotland open space has a mean WTP of £4.62 for Hospital Sites and £5.41 for Primary Care Sites.

Table 28. Willingness to pay between users and non-users of NHS sites

	Hospital Sites		Primary Care Sites	
	User	**Non-user**	**User**	**Non-user**
Median	30.24	0.00	40.34	0.76
Mean	43.33	4.62	55.16	5.41
Confidence interval	33.71 - 62.05	4.00 - 5.34	38.15 - 107.55	4.41 - 7.09

In fact, when accounting for past visits, we find that individuals who visit more frequently and for longer periods any NHS Scotland open space are likely to have higher WTP for NHS Scotland open spaces. For instance, we estimate that an individual who has visited NHS Scotland open spaces on average twice a week and whose last visit lasted between 30 minutes and 1 hour has a mean WTP of £33.84 per month (95% C.I.: £29.30 - £39.89) for their local Hospital Site. See regression results in the Technical Appendix.

An individual who has visited an NHS Scotland open space once a month for 10 to 30 minutes has a WTP of £23.37 (95% C.I.: £20.61 – £26.76). An individual who has visited twice in the previous twelve months, each visit lasting less than five minutes, has a mean WTP of £11.73 (95% C.I.: £10.17 - £13.68). Compared to an individual who has not visited any NHS Scotland open space in the previous twelve months, who has a mean WTP of £8.86 (95% C.I.: £7.60 - £10.51).

Our findings indicate that a significant proportion of value is likely derived from the direct use of the NHS Scotland open space being valued. For instance, the mean WTP among those who have visited their local hospital, and its open space, is £24.87 (95% C.I.: £18.56 - £36.48). When including those who have also visited other NHS Scotland open spaces, this increases to £34.93 per month (95% CI: £25.62 - £54.42). This suggests having additional experience of other sites' open spaces can also act as a driver of value.

At the same time, our WTP estimates may contain different components of value besides direct use. For instance, the mean WTP among those who have not visited the site but have visited other open spaces is £10.08 (95% C.I.: £5.09 - £20.86). This positive value is indicative of components other than direct use, such as option value (e.g., the potential use of the hospital's open space if they visit the site in the future).

We also see evidence of other non-use components of value. For example, the mean WTP among those who have visited the hospital site, but have not visited any NHS Scotland open space, is £4.58 per month (95% CI: £3.85 - £5.36). As likely non-users of the NHS Scotland open space at their Hospital Site, much of this value is probably driven by a desire to preserve the space for others to use (e.g., bequest or altruistic value) and/or an endowment effect associated with the site (e.g., a sense of ownership or attachment).

Reasons for WTP

Table 29 shows the level of agreement with different statements from those who accepted at least one of the bids. The statements with the most agreement suggest respondents were more likely to pay to maintain NHS Scotland open spaces for others to use rather than for their own personal use. For instance, the most agreed-upon statement was ***I want to preserve the natural environment*** (79.5% of respondents agreed). Similarly, ***I want to maintain the quality of NHS open spaces for other people to use and enjoy*** was agreed with by 78.8% of respondents and ***It is important future generations have access to these types of spaces*** was agreed with by 77.8% of respondents.

In contrast, statements referring to personal use were less agreed with (but still received a plurality of agreement). For instance, ***I want to maintain the quality of NHS open spaces for myself*** was agreed with by 62.7% of respondents and ***NHS open spaces are useful to me*** was agreed with by 62.8% of respondents.

Table 29. Reasons for accepting to pay bid

Reason	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I want to preserve the natural environment	3.0%	4.0%	13.4%	37.3%	42.2%
I want to individually contribute to the space's preservation	3.5%	7.9%	22.8%	37.8%	27.9%
NHS open spaces are useful to me	4.3%	7.7%	25.2%	32.6%	30.2%
I want to maintain the quality of NHS open spaces for myself	4.6%	7.6%	25.1%	33.7%	29.0%
I can afford it	5.1%	10.6%	23.0%	33.8%	27.6%
It is important future generations have access to these types of spaces	3.3%	4.7%	14.3%	36.7%	41.0%
I want to maintain the quality of NHS open spaces for other people to use and enjoy	3.1%	3.6%	14.4%	39.6%	39.3%
I want to contribute to a good cause	3.5%	3.8%	15.6%	38.6%	38.5%

Table 30. Reasons for rejecting to pay bid

Reason	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I am willing to pay something but not this amount	22.5%	14.8%	23.0%	26.7%	13.0%
It is unfair for me to pay for NHS open spaces	2.2%	6.7%	26.4%	34.5%	30.0%
Taxpayers should pay for NHS open spaces	16.7%	16.3%	33.9%	22.8%	10.3%
The closure of NHS open spaces is not important to me	9.5%	21.2%	31.1%	23.3%	14.9%
Maintaining NHS open spaces should be funded from existing budgets	2.5%	8.8%	28.3%	32.4%	28.0%
I don't want to measure the value of maintaining NHS open spaces in money terms	2.3%	4.1%	21.6%	40.5%	31.5%
A charge should not be used to pay for NHS open spaces	2.7%	6.9%	39.3%	33.2%	18.0%
I don't use and I don't visit NHS open spaces	3.0%	5.3%	22.4%	32.1%	37.1%
I need more information to decide whether to support NHS open spaces or not	3.0%	5.3%	22.4%	32.1%	37.1%
The money collected won't make a difference to NHS open spaces	11.7%	11.0%	27.5%	34.4%	15.5%
I cannot afford to pay this amount for NHS open spaces	3.2%	11.6%	37.4%	30.1%	17.8%
I don't have faith in the local council	5.8%	7.3%	23.1%	27.4%	36.4%
There are other similar open spaces not in the NHS that I would rather use	2.7%	4.9%	30.5%	32.1%	29.9%

Table 30 shows the agreement to different statements among those who did not agree to pay at least one of the monetary bids. Among these, the most agreed upon reasons for not being willing to pay were not visiting the spaces (e.g., *I don't use and I don't visit NHS open spaces* with 69.3%) and a perception of better alternatives (e.g., *There are other similar open spaces not in the NHS that I would rather use* with 62.0%). There was also recognition that these spaces are important (e.g., only 38.2% agreed that *The closure of NHS open spaces is not important to me*).

However, there was an agreement that these spaces should be funded from somewhere else: 60.4% agreed that *Maintaining NHS open spaces should be funded from existing budgets*, and 51.2% agreed that *A charge should not be used to pay for NHS open spaces*. Only 33.1% agreed with the statement: *Taxpayers should pay for NHS open spaces*.

Roughly half stated affordability as a reason for not accepting the proposed charge: 47.9% agreed to *I cannot afford to pay this amount for NHS open spaces*. Notably, there was significant hesitancy to the idea of putting monetary values on NHS open spaces (e.g., *I don't want to measure the value of maintaining NHS open spaces in money terms* with 72.0% of respondents) and a sense of unfairness in having to pay (e.g., *It is unfair for me to pay for NHS open spaces* was agreed by 64.6%).

There is also the perception among some that funds might not prevent open spaces from being removed because of a lack of faith in the institution that could be seen as in charge of collecting the payment (e.g., *I don't have faith in the local council* with 63.8%) and, to lesser extent, a sense that they won't make a difference (e.g., *The money collected won't make a difference to NHS open spaces* with 49.9%). Sensitivity analyses considering possible protest responses for the CVM are described and reported in the Technical Appendix.

When asked about the perceived consequentiality of the survey, there was a general perception among respondents that their responses would impact how NHS Scotland open spaces are provided. Only 23.3% disagreed to the statement *I believe that my answers will have an impact on how NHS open spaces are provided in the future*. Similarly, only 30.4% disagreed to the statement *I believe the money collected will only be used to keep and maintain NHS open spaces and nothing else*, which suggests there is majority institutional trust in how funds are used and allocated.

Barriers to use NHS Scotland open spaces

Those who had not visited an NHS Scotland open space in the previous twelve months stated more than one reason for not visiting. As shown in Table 31, the most stated reasons were not seeing the need to visit (50.8%), not being aware that they could use NHS Scotland open spaces (34.2%) and that there were other open spaces they would rather visit (25.3%).

Females were slightly more likely to mention not knowing the location of the nearest NHS Scotland open spaces or not having any nearby. However, only 1 in 10 cited these as reasons. Older individuals were slightly more likely to mention poor health and not having NHS Scotland open spaces nearby. But only 1 in 10 cited any of these as reasons.

Table 31. Reasons for not visiting any NHS Scotland open space in past twelve months

Reason	%
I have not seen the need to use	50.8%
I was not aware you could use NHS open spaces	34.2%
There are other open spaces I rather visit	25.3%
No particular reason	18.1%
I do not know where nearby NHS open spaces are	14.4%
My current health does not allow me	8.9%
There are no NHS open spaces nearby to go	8.6%
I am too busy	7.2%
Bad or poor weather	6.7%
Other	5.2%
The open space is not suited to do the activities I enjoy doing	4.5%
I have no access to car or transport	3.0%
I am worried about my safety	1.4%
My age does not allow me	0.4%

Table 32 shows the results from a multivariate regression to identify the characteristics that make it less likely to be an NHS Scotland open space user. As previously established, the frequency of visits to different NHS Scotland sites makes it more likely for an individual to have visited an NHS Scotland open space in the previous twelve months. See the variable description in the Technical Appendix.

We find that being female, in an older age band, having access to a private garden, and living within a mile of an open space make it less likely for an individual to have visited an NHS Scotland open space in the previous twelve months. Conversely, having a higher income and living with under-18s makes it more likely to use NHS Scotland open spaces.

Notably, living with a physical disability (e.g., a condition that substantially limits one or more basic physical activities) and with a mental condition (e.g., a condition that affects the emotional, physical, and mental wellbeing) also make it more likely to have visited an NHS Scotland open space.

However, living with a long-term illness (e.g., a condition that may be managed with treatment and medication) makes it less likely to have visited an NHS Scotland open space. Self-reported health and self-reported mental health were found to be statistically insignificant and, therefore, do not influence whether an individual visits NHS Scotland open spaces.

Table 32. Regression results of characteristics of individuals ***not*** using NHS Scotland open spaces

Variable	Estimate
Sex (female)	0.458**
Age	0.267**
Income	-0.393**
More than 2 adults in home	-0.142
Under 18s living at home	-0.446**
University education	-0.142
Access to private garden	0.257*
Live within 1 mile of outdoor area	1.323**
NHS Hospital is closer than nearest outdoor area	-0.445
Visits to general outdoors	-0.001**
Visits to GP	-0.007**
Visits to Hospital	-0.007**
Very good or good health	-0.048
Very good or good mental health	-0.060
Living physical disability	-0.302*
Living mental health condition	-0.343*
Living long-term illness or condition	0.330*
Constant	-1.519**
Observations	1152
AIC	2565.6

Note: Coefficients should be interpreted as the effect on the likelihood of ***not*** being an NHS open space user. **significance at 1%, *significance at 5%. AIC: Akaike Information Criterion.

When exploring whether local Hospital Sites can be a suitable alternative to traditional open spaces, we find that in 95.1% of cases, there is an outdoor space (e.g., park, playing field, public garden, etc.) that is nearer to their home than the local hospital. This means visits to NHS Scotland open spaces in Hospital Sites will require additional travel to the site.

It is likely most visits to NHS Scotland open spaces will happen because the individual visited the site to use NHS services. However, not all NHS Scotland site visitors will use its open space. We estimate that 84.7% of the population are potential users of NHS Scotland open spaces (because they visited their local Primary Care Site which has an open space and/or their local Hospital Site in the previous twelve months). In other words, they have visited an NHS Scotland site which has open space. However, of those, 40.7% did not use any of its open spaces.

Conclusions

This study has provided insights into the social and economic value of NHS Scotland open spaces at both health board and national levels. As part of actions outlined by the NHS Scotland Climate Emergency and Sustainability Strategy, this study has aimed to characterise the use and elicit a monetary value for the health and wellbeing benefits of NHS Scotland open spaces. This study provides evidence to guide and support investment in NHS Scotland open spaces, promoting health and wellbeing through improved access to these spaces at health centres across Scotland and beyond.

To the authors' knowledge, this is the first study to assign a monetary value to the health and wellbeing benefits of natural assets within a health service. Our approach captures a wide range of open space typologies, accounting for diverse usage patterns and benefit profiles distinct from traditional open spaces. The methods align with guidance from the ONS and HM Treasury's Green Book, adapting existing frameworks to quantify health benefits from exposure to NHS Scotland open spaces. Additionally, we employ a CVM method that assesses a broader measure of value derived from both use and access.

We estimate that half of the Scottish adult population has visited an NHS Scotland open space in the previous twelve months. An estimated 122 million visits are made annually to NHS Scotland open spaces, but usage is uneven. A small group of frequent visitors accounts for most visits, while most people visit only occasionally.

Most visits are to local sites, with open spaces located at Primary Care Sites receiving the highest number of visits. This is likely because individuals regularly visit Primary Care Sites more often. Most visits to NHS Scotland open spaces last less than 30 minutes, with approximately half occurring with others. Most users consider these spaces to be of good or very good quality.

Visits typically involve relaxing, low-impact activities, which together with stated benefits by respondents, suggests that most of the health and wellbeing benefits of these spaces are likely related to mental health. This confirms that using the ***exposure-based*** method is more appropriate than the exercised-based one, which assumes individuals undertake moderate-intense physical activities activities. However, future research could improve on the ***exposure-based*** approach and/or directly explore the health and wellbeing benefits from NHS-based open spaces using health measurement instruments.

Our findings suggest that the value of the health and wellbeing benefits from NHS Scotland open spaces is significant. Visits to NHS Scotland open spaces result in a total of 87 million hours of exposure to open spaces. Using the ONS ***exposure-based*** approach, the direct health benefits from exposure to NHS Scotland open spaces are £82 million per year, mainly from visits to Primary Care Sites. Additionally, most visits happen at NHS Scotland-owned or leased sites.

We also find that some individuals who are assumed to enjoy health benefits from NHS Scotland open spaces would have likely received these from visiting general outdoor spaces. When combined with other exposure from visits to other non-NHS Scotland open spaces, we find that roughly 205,000 adults receive health benefits that can be attributable to NHS Scotland open spaces, resulting in an annual value of £73.0 million. For comparison, the total annual health benefits from recreation across Scotland's entire natural capital were most recently valued at £870 million (based on 2023 prices).

The CVM findings suggest that NHS Scotland's open spaces may hold greater value to the Scottish population, encompassing other benefits beyond health and wellbeing benefits. The estimated annual values are £125 per adult for local Primary Care Sites and £146 per adult for local Hospital Sites.

Both the exposure-based and CVM approaches show that past user experience significantly influences the value attributed to NHS Scotland open spaces and people generally place higher value on sites that deliver primary and community health and care services. Additionally, the CVM approach shows that the value of open spaces on hospital grounds is determined by the proportion of the total area they cover, rather than their actual size.

We note, however, that the results from the exposure-based approach and the CVM may not be directly comparable. For instance, the CVM estimates could be subject to hypothetical bias, though they align with similar studies of other open spaces.

Our findings also show that most visits occur as part of overall visits to NHS Scotland sites, and not all NHS Scotland site users make use of the open spaces. This suggests that NHS Scotland open spaces have the potential for greater use and could offer even more value if fully utilised, particularly for therapeutic purposes. Further research could improve on the exposure-based approach by directly establishing the health gains from exposure to NHS-based sites and deriving a Scotland-based NHS cost of resources.

Our findings also reveal inequalities in the factors that influence whether an individual uses NHS Scotland open spaces. Older individuals and those with lower incomes are less likely to visit NHS Scotland open spaces, which aligns with trends in general outdoor visit activity in Scotland. These individuals were also more likely to elicit a lower value for these spaces. Females are also less likely to visit NHS Scotland open spaces. It's important to note that while females are less likely to visit, they do not necessarily elicit a lower value for these spaces.

Notably, those who regularly visit the general outdoors are more likely to visit NHS Scotland open spaces. However, easy access to alternative public open spaces reduces the likelihood of individuals using NHS Scotland open spaces. At the same time, living with a disability or mental health condition are associated with greater use of NHS Scotland open spaces. Improving access and raising awareness of the existence and benefits of these spaces could increase their exposure and value for a broader population.

While our sample is representative of the Scottish adult population by age and sex, its representativeness regarding visits to NHS Scotland sites remains uncertain, making our results exploratory. However, comparisons with general outdoor statistics in Scotland and similar studies strongly suggest that the health and wellbeing benefits of NHS Scotland open spaces are significant and at least comparable to those of other public open spaces.

Given the substantial benefits of NHS Scotland's open spaces, investing in them is likely to generate a net gain for society. Future research could further quantify this by comparing the monetary value of these benefits with current maintenance expenses and potential future investment costs.

Future studies could replicate this research as a longitudinal survey to identify patterns in NHS Scotland open space use and gain a deeper understanding of the monetary value over time. Further research is needed to explore the barriers preventing different potential user groups from using and spending more time in NHS Scotland open spaces, to better understand the perceived benefits of exposure to them, and to focus on strategies for encouraging more users—particularly addressing the inequalities described above—to visit these spaces.

Ninewells Hospital

Technical Appendix

NHS Scotland territorial boards

This study is concerned with the 14 NHS Territorial (Regional) Health Boards in Scotland (see Figure TA1). These Boards are responsible for the protection and improvement of their population's health, and the delivery of frontline healthcare services (NHS Scotland, 2024).

There are an additional 8 Special Boards, tasked with supporting the regional boards by providing a range of important specialist and national services, which were not considered in this study. Future research might explore the values elicited by users of these Boards' sites.

Table TA1 presents the distribution of survey respondents by Board alongside the assumed populations for each based on mid-2023 statistics from the National Records of Scotland.

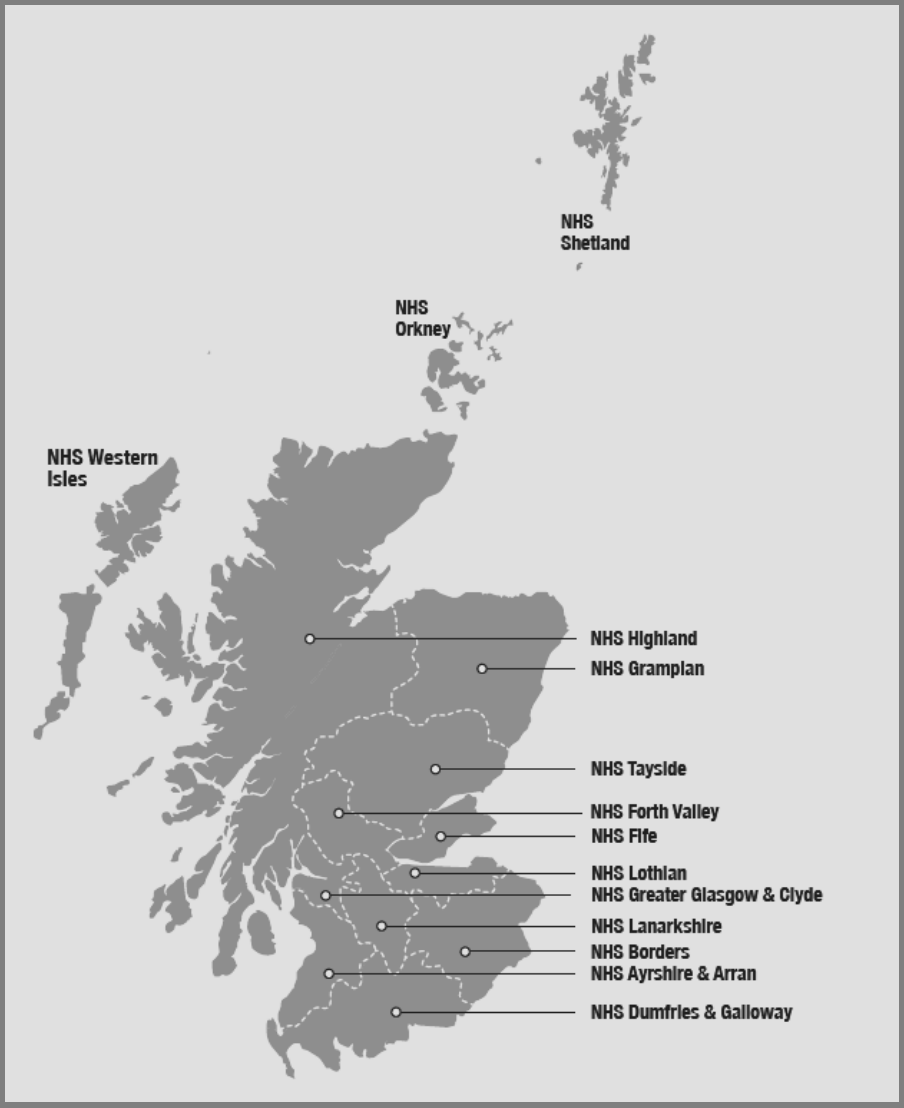

Figure TA1. NHS Scotland territorial Health Boards map

Table TA1. Respondent distribution and assumed adult populations

Board	%	Assumed Population
NHS Ayrshire & Arran	6.9%	307,725
NHS Borders	3.1%	137,613
NHS Dumfries & Galloway	2.5%	112,257
NHS Fife	5.0%	225,051
NHS Forth Valley	5.2%	234,258
NHS Grampian	13.5%	602,875
NHS Greater Glasgow & Clyde	20.9%	935,268
NHS Highland	4.8%	214,603
NHS Lanarkshire	9.5%	423,794
NHS Lothian	18.7%	838,311
NHS Orkney	0.5%	21,643
NHS Shetland	0.5%	21,478
NHS Tayside	7.9%	354,913
NHS Western Isles	1.0%	46,782
Total	**100%**	**4,476,570**

Defining local sites

Respondents were asked to select the council area and locality of their residence. Geographical information was based on the National Records for Scotland Locality Geographies guidelines. Localities are defined as: "Localities correspond to the more recognisable towns and cities of Scotland, which can be found within settlements. They also have a minimum rounded population of 500 people or more".

This information was used to match the respondent to their Health Board. Respondents were asked to confirm this and were given the option to select an alternative Board (in case they had lived in an area near a geographical boundary for locality/board). Respondents were presented with local sites within their health boards.

Sites were defined and described based on data provided by Public Health Scotland, National Records Scotland, and complemented with public information on the Health Boards' websites. We used area and open space size based on data provided by Public Health Scotland and available as an interim report (see Public Health Scotland, 2024). We considered active sites which were used to deliver primary care services (Health Centres, Clinics, and GP Surgeries) and secondary and tertiary services (Hospitals). We did not consider other NHS Scotland sites such as care home facilities, administrative buildings, or vacant plots.

Respondents first selected their Primary Care Site from an initial selection of NHS Scotland-owned or leased sites, with the option to select from a wider list of non-NHS Scotland-owned sites (based on the latest GP Practice list) if their GP Surgery or Health Centre was not listed. This list does not include dental practices or private pharmacies. Respondents were not made aware if their Health Centre or GP Practice was NHS Scotland-owned. For non-NHS Scotland-owned sites, given not all have open spaces for use and there is no existing data to determine this, respondents were asked if their local Primary Care Site had open space.

When multiple sites were located within a common boundary, such as hospital complexes, they were considered and described as a single site. For example, the site containing Aberdeen Royal Infirmary, Aberdeen Maternity Hospital, and Royal Aberdeen Children's Hospital was described as Foresterhill Health Campus (NHS Grampian). Another example was the Queen Elizabeth University Hospital Site which described the site of Queen Elizabeth University Hospital, Royal Hospital for Children, and Queen Elizabeth Maternity Unit (NHS Greater Glasgow and Clyde).

Prior to the CVM tasks, respondents were reminded of their local sites based on the answers provided. If known, respondents were also presented with the approximate size of the open space, expressed in hectares and in the equivalent number of cars that could be parked in that area.

If they had not visited any hospital, the Health Board's main general hospital was described to them as their local hospital (given it was the one they were most likely to use in the future). For NHS Lothian, this was randomised to either the Royal Infirmary of Edinburgh or Western General. For NHS Greater Glasgow and Clyde, this was randomised to Glasgow Royal Infirmary or Queen Elizabeth University Hospital Site.

Survey pretesting

We tested the survey using "Think Aloud" interviews or cognitive interviews. These are sessions during which respondents are asked to think aloud (or verbalise their thoughts) while completing the survey together with researchers (Willis, 2005; Ryan et al., 2009).

A combination of concurrent and retrospective think-aloud approaches was used to ensure an exploration of the thought processes with minimum interruption and bias introduction.

Participants from the general population survey were recruited using a targeted Facebook advertisement campaign carried out in July 2024. Study advertisements were shown to adult residents living in Scotland. Interested participants were invited to a Microsoft Teams interview with at least two members of the research team.

Informed consent was sought prior to the interview. Participants received a £20 shopping voucher as an honorarium to compensate them for their time. Participant feedback was used to make iterative changes to the survey after each interview session. We also used the interview to gauge the content validity of the survey instrument. Interviews were held until saturation was reached (e.g., two or more interviews where no new information or issues emerged).

No major issues with the survey were found in the pretest interviews. The interviews found the survey encouraged individuals to reveal their preferences truthfully, was well understood, and easy to complete (e.g., thus minimising hypothetical bias). The survey length was deemed adequate and manageable.

Following the think aloud, small wording changes were made to improve comprehension and readability. These included changing the term *levy* to *charge* when defining the payment vehicle of the CVM task and simplifying the definition of open space.

Respondent Quality

We used the pilot study results to calculate the survey's estimated completion time. We use this as a benchmark to define the minimum completion time at which respondents are thought to be engaged with the survey. Based on a median completion time of 12.5 minutes, we assume respondents who completed the main study in less than 6.25 minutes were not engaged with the survey and were removed from the data by the survey provider.

The panel provider, Qualtrics, undertook additional screening and steps controls to ensure good response quality (Qualtrics, 2024). For example, preventing multiple completions, assessing 24-hour completion rates, and bot screening. We did not include any validation questions as we were concerned this could impact the incentive compatibility of the valuation tasks.

Uncertainty around estimates

Margin of error

The unweighted margin of error for a hypothetical result of 50% at the 95% confidence levels is ±1.98%. Considering a design effect from the demographic weighing of 1.05, the adjusted margin of error for pooled statistics is ±2.03%.

Total volume of visits

The total volume of visits is estimated by aggregating the frequency of visitation from each NHS Scotland open space user. Given the cross-sectional nature of the survey, we have to estimate this volume from the question:

How often, on average, have you taken visits to any NHS open space (this includes within any Health Centre, GP Practice, or Hospital in Scotland) for leisure and recreation in the last 12 months?

Since the options described ranges of visitation frequencies (e.g., several times a week, once or twice a month, etc.), we had to assume an annual frequency of visitation for each. We defined these by using the central of an optimistic and conservative value as shown in Table TA2. We then extrapolate the number of visits to the Scottish adult population following the steps described in Table TA3.

Table TA2. Assumed number of annual visits

Frequency	Conservative	Optimistic	Central
More than once a day	365	548	456
Every day	365	365	365
Several times a week	104	260	182
Once a week	52	104	78
Once or twice a month	12	24	18
Once every 2-3 months	4	6	5
Once or twice in the last 12 months	1	3	2

Table TA3. Annual total visit estimation

Code	Description	Source	Estimate
A	% of sample that is NHS open space user	From Survey	53.0%
B	Average annual visits per user	From Survey	51.46
C	Scottish adult population	NRS	4,476,570
D	Assumed % of population	A x C	2,371,573
E	Assumed total visits	B x D	122.05 million

Note: NRS = National Records of Scotland

Replicating the above analysis using conservative and optimistic assumptions for annual visits results in an estimated range of 91 to 153 million visits per year.

It is important to acknowledge that assuming from the most recent visit to estimate all visits may overstate exposure for individuals who visit NHS Scotland sites infrequently (e.g., those who visit only once or twice might have an unusually long visit). However, our findings indicate that most individuals receiving health benefits—assumed to spend more than 120 minutes per week—are frequent visitors, meaning their most recent visit is likely to be a reliable reflection of their typical visit patterns.

Seasonal adjustment of exposure

The estimate of length of visit (e.g., exposure) to NHS Scotland open spaces assumes the last visit is representative of all the visits made during the past twelve months. This is because it was impractical to ask about the length of every single visit in the past year. However, given the cross-sectional nature of the survey and the fact it was fielded during the warmer months of the year, using the last visit could overestimate site use. For example, visits might be shorter during colder weather.

To account for this, we adjusted for seasonality using the information we collected on expected visitation patterns when the weather was uncomfortable. We did this as follows:

We assume there are two periods in a year: six base weather months and six uncomfortable months. Based on how many visits have occurred in the past four weeks, we estimate the exposure during the base months. We estimate the expected exposure during uncomfortable weather months using similar information we collected about frequency and length of visits during a four-week period if the weather was uncomfortable.

We use a ratio based on the respondent's visitation frequency during both periods to estimate the average exposure. For example, if a respondent stated they had ten visits in the past four weeks (e.g., the base weather months) and on the uncomfortable weather months they stated they had five visits, we assume two-thirds of the total visits follow the former months exposure and one-third follow the latter months exposure. We use this ratio to estimate expected visitation based on total visits.

Non-seasonal adjusted exposure

Using the responses on the last visit without adjusting for seasonality (e.g., when assuming this is representative of all annual visits) results in an estimate of 95 million hours (compared to 87 million when seasonally adjusted).

This is derived from an average visit length of 45 minutes (compared to 38 minutes when seasonally adjusted) and a median of 35 minutes (compared to 26 minutes). The average visit length, like the seasonally adjusted estimate, is inflated by roughly 9.8% of users who spend more than 90 minutes per visit.

When calculating the health benefits using the *exposure-based* method, it is estimated 5.1% of the population or 228,490 adults (compared to 230,318 adults when seasonally adjusted), derived health benefits, with an annual value of £81,342,329 (compared to £81,993,068 when seasonally adjusted).

This indicates that while the total exposure volume rises by approximately 9% with non-seasonally adjusted estimates, the increase is primarily driven by frequent visitors. However, since this does not translate into additional health benefits, the overall annual value remains largely unchanged.

Further research could replicate this study as a monthly or quarterly wave survey with a recurrent 12-month collection period with a question that asks about visitation in the past four weeks, like SPANS, to minimise seasonality issues.

NHS Scotland open space visits compared to outdoor visits

Visits to the general outdoors are more frequent than those to NHS Scotland open spaces – see Table TA4 and TA5. This suggests that individuals are more likely to meet the 120-minute threshold from visits to the general outdoors than NHS Scotland open spaces.

Table TA4. Frequency of visits to different types of open space

Frequency	NHS Scotland Open Spaces	General Outdoors
At least once a day	3.0%	19.0%
Several times a week	4.9%	27.6%
Once a week	4.8%	16.4%
Once or twice a month	9.3%	15.8%
Once every 2-3 months	9.6%	8.2%
Once or twice in last 12 months	21.4%	8.0%
Not visited	47.0%	5.0%

Table TA5. Length of last visit to different types of open space

	NHS Scotland Open Spaces	General Outdoors
Less than 5 mins	3.2%	5.2%
Between 5 and 10 mins	13.1%	9.7%
Between 10 and 30 mins	33.4%	22.6%
Between 30 mins and 1 hr	28.3%	28.4%
1 up to 2 hrs	14.7%	21.9%
2 up to 3 hrs	4.4%	7.1%
3 up to 4 hrs	1.2%	2.6%
4 hrs or more	1.7%	2.4%

Estimating willingness to pay using the CVM

Theoretical framework

The elicitation and estimation of values using the Contingent Valuation and Contingent Travel Behaviour method followed current practice as originally described by the Report of the NOAA Panel on Contingent Valuation (Arrow et al., 1993) and Carson (2000). Additional resources that have updated these guidelines were also used to design this study (Johnston et al., 2017; Carson and Hanemann, 2005).

There is no consensus on which elicitation format is best, but contemporary guidance and usage in the literature suggest a single binary dichotomous choice task is the best suited to elicit incentive compatible WTP estimates (Carson et al., 2014; Carson & Groves, 2007).

In a single-bounded dichotomous choice question, respondents are presented with a question asking them whether they would be willing to pay a specific amount (the bid), with two possible answers: yes or no.

If they answer yes, we assume their maximum WTP lies between the bid amount shown and their income. If they answer no, we assume the respondents' maximum WTP lies between zero and the bid amount. This information is used to derive the probability of observing different maximum WTP amounts across the study population.

We used a coercive payment vehicle in the form of a charge (e.g., levy), which, like Waste and Water Charges in Scotland, would be payable by households every month together with council tax. Furthermore, this payment would be permanent. This mechanism has been used in UK contexts before and was deemed to be realistic and simple to understand.

Monetary bids ranged from £2 to £40. An initial set of bids – £2, £5, £10, £15, and £20 – was based on existing, though limited, literature and tested during the "Think Aloud" interviews. Bids were adapted based on the proportion of individuals accepting each bid amount from interim data analysis done at each collection stage. The £40 bid was introduced from stage 2.

We estimate the implied demand curves using the acceptance rates for each bid amount. The derivation of willing to pay (WTP) estimates follows the utility function:

$$U = f(y, X) + \varepsilon_j$$

s Where *y* is a dichotomous which takes the value of 1 if the respondent agrees to the bid (*B*) amount and 0 if they refuse, and *X* denotes relevant sociodemographic characteristics of the individual. The ε is an assumed independent and identical random error term. The corresponding logit model takes the form of:

$$y = \beta_0 + \beta_1 X + \beta_2 B + \varepsilon_j$$

Where β describe coefficients for parameters of observed determinants of willingness to pay. We estimate this using multivariate logistic regressions. These parameters are used to compute average willingness to pay values using the formulae (with no covariate data):

Mean WTP: $\ln \frac{1+\exp(\beta_0)}{\beta_1}$

Median WTP: $\frac{\beta_0}{\beta_1}$

Where β_1 is the parameter for the bid amount and β_0 the intercept (e.g., deterministic factor). The mean reports the average amount people are willing to pay. The median reports the amount where 50% of the population would be willing to pay. We use the mean to aggregate to population level statistics. We aggregate using household statistics as the proposed payment vehicle was similar to that of a council tax. Confidence intervals of the mean estimate are computed using bootstrap methods, which rely on the distribution of the parameters based on estimations from random draws of the sample.

Model specification

We estimate a model (***Model 1***) with only the bid amount as a predictor of acceptance. We then expand (***Model 2***) to control for the sociodemographic characteristics that we used to assess the representativeness of the sample: sex and age.

Given the use of quotas to ensure sample-level representativeness in terms of age and sex, we do not find significant differences between *Models 1* and *2* when using the pooled sample. However, we use *Model 2* as our base specification to compare values among subgroups of interest for which we cannot guarantee representativeness in terms of these variables.

As robustness tests, we expand to explore the effect of annual income on value (*Model 3*). We further explore adding other payment related factors: whether someone else in the household contributes to household expenses and whether they receive some council tax reduction (*Model 4*). To explore the effect of site and open space area, we include as regressors the site area, the percentage of area that is open space, and (for the Hospital Sites) the type of hospital (*Model 5*). To explore the effect of the Primary Care Site being owned or leased by NHS Scotland, we include as regressors whether the site is NHS Scotland-owned and past visits to the site (*Model 6*). To explore sociodemographic drivers of value, we expand the model (*Model 7*) to include relevant individual characteristics of interest (see Table TA6).

Table TA6. Characteristics used to explore drivers of WTP

Variable	Type	Description
Bid	Continuous	Monetary bid amount
Sex	Dummy	Female = 1
Age	Ordered	Five levels (18-24, 25-34, 35-44, 45-54, 55+)
Income higher tax rate	Dummy	Annual personal income over £43,662 = 1
University education	Dummy	Qualifications include university education = 1
Private garden	Dummy	Access to private garden in home = 1
Married/Living as married	Dummy	Marital status is married or living as married = 1
More than 2 adults	Dummy	3 or more adults living in home = 1
Under 18s	Dummy	At least one under 18 usually living in home = 1
Health	Dummy	Self-reported health is very good or good
Mental health	Dummy	Self-reported mental health is very good or good
Open space within 1 mile	Dummy	Lives within one mile of open space = 1
Lives within 5 miles of hospital	Dummy	Lives within five miles of local hospital site = 1
Annual visits to general outdoors	Continuous	Visits to the general outdoors in previous twelve months
Working	Dummy	Working as employee, self-employed or any kind of paid work = 1

To explore the impact of past visits to NHS open spaces, we add the number of visits to any NHS open space and the length of each visit in minutes as regressors (*Model 8*). For all specifications, we report the Akaike Information Criterion as measure of model fit.

Model robustness and additional results

Tables TA7 and TA8 show the unweighted bid acceptances.

Table TA7. Unweighted bid acceptance rates for Hospital Sites

Bid (£)	Yes	No	Sample Size
2	60.1%	39.9%	464
5	51.5%	48.5%	468
10	38.9%	61.1%	475
15	36.0%	64.0%	372
20	33.1%	66.9%	453
40	32.7%	67.3%	217
Total	40.5%	59.5%	2449

Table TA8. Unweighted bid acceptance rates for Primary Care Sites

Bid (£)	Yes	No	Sample Size
2	73.0%	27.0%	256
5	52.6%	47.4%	270
10	42.0%	58.0%	274
15	56.7%	43.3%	425
20	43.0%	57.0%	265
40	37.0%	63.0%	119
Total	49.7%	50.3%	1609

Table TA9 and TA10 show the regression coefficients from the specifications described in the previous section (e.g., robustness) for Hospital Sites and Primary Care Sites.

Expectedly, for all sites, we find that higher personal income is associated with higher WTP for both sites and in all specifications. We also find that extra household income is associated with higher WTP.

Interestingly, having a Council Tax Reduction is associated with higher WTP. This could be because respondents who pay less in Council Tax may be more willing to accept an additional charge compared to those who pay more. However, we are unable to determine the exact extent of the Council Tax Reduction.

Table TA11 shows the regression results from the specification exploring the open space area and hospital type for Hospital Sites and Primary Care Sites (*Model 5*).

Table TA12 shows the regression results from the specification exploring the impact of the Primary Care Site being owned or leased by NHS Scotland (*Model 6*). This shows that NHS Scotland ownership of the site and more past visits are associated with higher WTP.

Table TA13 shows the specification exploring the impact of past visits to NHS Scotland open spaces (*Model 8*). We find annual visits and length of visits to NHS Scotland open spaces are positively associated with higher WTP values for both types of sites.

Table TA9. Regression results for robustness analysis (Models 1-4) for Hospital Sites

	Model 1	Model 2	Model 3	Model 4
Bid	-0.063**	-0.063**	-0.064**	-0.039**
Sex (female)		-0.146	-0.079	-0.319**
Age		-0.360**	-0.350**	-0.447**
Income			0.222**	0.309**
Extra income				0.231*
Council tax reduction				0.577**
Constant	0.153*	1.521**	0.861**	0.699**
Observations	2439	2439	2439	2439
AIC	3274.459	3047.819	2978.019	2945.981

Note: ** significance at 1%, * significance at 5%. AIC: Akaike Information Criterion.

Table TA10. Regression results for robustness analysis (Models 1-4) for Primary Care Sites

	Model 1	Model 2	Model 3	Model 4
Bid	-0.031**	-0.034**	-0.037**	-0.039**
Sex (female)		-0.446**	-0.306**	-0.368**
Age		-0.421**	-0.391**	-0.421**
Income			0.267**	0.284**
Extra income				0.175
Council tax reduction				0.771**
Constant	0.495**	2.053**	1.154**	0.906**
Observations	1609	1609	1609	1609
AIC	2196.674	2068.911	2026.477	1987.161

Note: ** significance at 1%, * significance at 5%. AIC: Akaike Information Criterion.

Table TA11. Regression results exploring site and open space typology

	Hospital Sites	Primary Care Sites
Bid	-0.043**	-0.035**
Sex (female)	-0.273**	-0.418**
Age band	-0.369**	-0.371**
Site size (in hectares)	-0.026**	-0.096
Open space size (as percentage of site area)	0.873*	0.673
Hospital Type (General Hospital)	-0.639**	-
Constant	1.952**	1.900**
Observations	2313	1103
AIC	2769.802	1404.950

Note: ** significance at 1%, * significance at 5%. AIC: Akaike Information Criterion.

Table TA12. Regression results exploring Primary Care Site ownership and past visits

	Primary Care Sites
Bid	-0.446**
Sex (female)	-0.247*
Age band	-0.291**
NHS Scotland owned or leased	1.048**
Length of visit (mins)	0.007**
Constant	0.624**
Observations	1605
AIC	1882.482

Note: ** significance at 1%, * significance at 5%. AIC: Akaike Information Criterion.

Table TA13. Regression results exploring past visits to NHS Scotland open spaces

	Hospital Sites	Primary Care Sites
Bid	-0.049**	-0.048**
Sex (female)	-0.149	-0.203
Age band	-0.274**	-0.263**
Length of last visit (mins)	0.342**	0.317**
Annual visits to NHS open space	0.007**	0.007**
Constant	0.409*	0.519*
Observations	2489	1605
AIC	2669.893	1816.738

Note: ** significance at 1%, * significance at 5%. AIC: Akaike Information Criterion.

Protest behaviour

Table TA14 shows the estimates from the base Model 2 that excludes possible protest responses. We assume protest responses as those who rejected all bids shown and agreed or strongly agreed to the statements, *I don't want to measure the value of maintaining NHS open spaces in money terms* and *A charge should not be used to pay for NHS open spaces.*

Table TA14. WTP estimates excluding possible protest responses

	All Sample		Excluding Protests	
	Hospital Sites	Primary Care Sites	Hospital Sites	Primary Care Sites
Median	4.32	16.00	18.84	39.03
Mean	21.48	29.33	29.97	37.54
Confidence interval (95%)	18.08 - 26.55	25.95 - 48.51	25.09 - 37.21	30.39 - 50.92
Sample Size	2449	1609	1915	1323

Barriers to use

In Table TA15, we describe the variables used to explore the sociodemographic characteristics that influence whether an individual is a user of NHS Scotland open spaces (e.g., dependent variable is that the individual has not visited one in the previous twelve months).

Table TA15. Sociodemographic characteristics to explore whether an individual is not an NHS Scotland open space user

Variable	Type	Description
Bid	Continuous	Monetary bid amount
Sex	Dummy	Female = 1
Age	Ordered	Five levels (18-24, 25-34, 35-44, 45-54, 55+)
Income higher tax rate	Dummy	Annual personal income over £43,662 = 1
University education	Dummy	Qualifications include university education = 1
Private garden	Dummy	Access to private garden in home = 1
NHS Hospital closer than nearest outdoor area	Dummy	Local Hospital Site is closer to home than nearest outdoor area = 1
More than 2 adults	Dummy	3 or more adults living in home = 1
Under 18s	Dummy	At least one under 18 usually living in home = 1
Health	Dummy	Self-reported health is very good or good
Mental health	Dummy	Self-reported mental health is very good or good
Open space within 1 mile	Dummy	Lives within one mile of open space = 1
Visits to GP	Continuous	Visits to local Primary Care Site in previous twelve months
Visits to Hospital	Continuous	Visits to local Hospital Site in previous twelve months
Visits to general outdoors	Continuous	Visits to the general outdoors in previous twelve months
Living physical disability	Dummy	Living with physical disability (a condition that substantially limits one or more basic physical activities such as walking, climbing stairs, lifting or carrying) = 1
Living mental health condition	Dummy	Living with mental health condition (a condition that affects your emotional, physical and mental wellbeing) = 1
Living long-term illness or condition	Dummy	Living with long-term illness, disease or condition (a condition that you may have for life which may be managed with treatment or medication) = 1

Validity Testing

Benchmarking visits to general outdoors

When comparing general outdoor visit data with the latest 2023/2024 SPANS survey, we find similar visit frequency patterns, as shown in Table TA16. Our data shows that 63% of the population visits the outdoors at least once a week, closely aligning with SPANS' estimate of 61%. The 2023 Scottish Household Survey (SHS) provides a slightly higher estimate of 68%. However, the SHS also reveals a downward trend, falling from a peak of 70% in 2022 back to the pre-COVID pandemic average of 56–59% (Scottish Government, 2023).

Table TA16. Visit frequency to general outdoors comparison

	Our data	2023/2024 SPANS
At least once a day	19%	17%
Several times a week	28%	28%
Once a week	16%	15%
Once or twice a month	16%	18%
Once every 2-3 months	8%	8%
Once or twice in last 12 months	8%	8%
Not visited	5%	5%

Note: Rounded to the nearest whole number as this is how it is reported in SPANS.

When further comparing health benefits from exposure to the general outdoors, we estimate from our data that 1.8 million adults in Scotland gain health benefits, with an annual value of £637 million. The ONS estimates 2.3 million people receive health benefits, resulting in an annual value of £870 million.

Although our estimate is lower than that of the ONS, it is based on more recent data and aligns with recent trends indicating a decline in outdoor visits and associated health benefits since 2020 (Office for National Statistics, 2023a). Future research could use the latest Scottish data for comparison.

Benchmarking benefits from NHS Scotland open spaces

Using the exposure method, we estimate the annual health benefits from recreation from NHS Scotland open spaces to be approximately £82 million (see Results). For context, this value is around 9% of the £870 million that the ONS estimates as the annual value of ecosystem services related to health benefits from recreation across all habitats in Scotland (2021 prices).

The health benefits provided by NHS open spaces are likely higher in proportion, compared to those from similar functional urban green spaces. NHS Scotland manages 829 hectares of open space—comprising 825 hectares of green space and 4 hectares of blue space—which accounts for about 6% of the total 14,663 hectares of functional green space and 9% of the total 9,407 hectares of publicly accessible green space in urban areas across Scotland (Office for National Statistics, 2019).

Our findings indicate that NHS Scotland-owned or leased open spaces generate between 14% and 23% of the associated health benefits attributed to exposure to urban habitats, estimated by the ONS to be £350 million. This higher relative proportion may be due to factors such as higher visit rates, distinct user demographics, and differences in quality and accessibility of these spaces. Future research might explore this in more detail.

We also find the value from the exposure method is smaller than that of the CVM. This is expected, given the values from the CVM method likely contain other components, both use and non-use, of value (e.g., total economic value) beyond health benefits. We note that the values from the CVM are for local sites only, which are the ones most likely to be visited more frequently. Further research can explore whether this amount would be different if asked to value all NHS open spaces.

When comparing to other studies, our average contingent valuation WTP estimates (£21.48 per month or £257.76 per year for Hospital Sites and £29.33 per month or £351.96 per year for Primary Care Sites) are in line with expectations based on similar studies of traditional open spaces.

Specifically, Roberts et al. (2022) found Scottish urban residents were willing to pay at least £113 per household per year as a council tax increase for maintaining urban greenspaces in general. They also found residents were willing to pay additional amounts for improvements for recreation, in wildlife, and tree coverage and accessibility. Davies et al. (2023) found taxpayers in Southampton were willing to pay between £13.10 and £17.80 per month in the form of an earmarked council tax charge for a tree planting scheme that reduced air pollution and flooding.

Similarly, Zachariou and Longo (2024) found NHS staff and visitors were willing to pay a lump sum of £12.87 and £27.70, respectively, for landscape improvements in a hospital in Belfast. Longo et al. (2012) found taxpayers in the Basque Country, Spain were willing to pay between approximately €173 and €280 in annual taxes (approx. £199 and £327 in 2024 prices) for climate change mitigation programmes with ancillary health benefits.

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Acknowledgements

The research was commissioned as part of a Scottish Environment, Food and Agriculture Research Institute (SEFARI) Gateway with Public Health Scotland Fellowship. Funding was provided by the Scottish Government as part of the NHS Climate Emergency and Sustainability Strategy. Additional funding was provided by the University of Aberdeen.

The authors would like to acknowledge and thank Jodi Dean (Public Health Scotland), Peter Rawcliffe (NatureScot), Ivan Clark (NatureScot), Michelle Wilson (SEFARI Gateway), and Charles Bestwick (SEFARI Gateway) for their contributions throughout the research study and to this report. The authors would also like to thank Andrew Gasiorowski (Public Health Scotland) for helping with the sites' spatial data.

The authors thank reviewers for their valuable feedback and constructive suggestions. The authors would like to thank all members of the public who took part in the Think Aloud interviews to help design and test the survey used in this study.

The authors confirm that this research was conducted independently and was not influenced by any funding sources. The findings, interpretations, and conclusions are solely those of the authors and do not necessarily reflect the views of any affiliated institutions or funding bodies.

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