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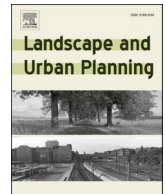
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Research Paper

Environmental qualities in green and natural spaces: Fresh air / peace and tranquillity and feeling closer to nature as pathways to perceived visit-related health benefits

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HIGHLIGHTS

- Environmental qualities showed distinct links with visit experiences.
- Biodiversity was most strongly associated with feeling closer to nature.
- Safety was most strongly associated with peace and tranquillity.
- Cleanliness problems were negatively associated with peace and tranquillity.
- Both visit experiences were linked to perceived visit-related health benefits.

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ABSTRACT

Rising levels of stress and mental ill-health have intensified interest in nature-based public health approaches, including green social prescribing and nature as medicine. However, it remains unclear whether different environmental qualities are associated with different aspects of visit experience, and how these experiences relate to perceived visit-related health benefits. This study examined direct associations of biodiversity, safety, accessibility and cleanliness problems with perceived visit-related health benefits, and indirect associations involving fresh air / peace and tranquillity and feeling closer to nature. Cross-sectional data from 19,814 adults in England who reported a recent visit to a green or natural space in the People and Nature Survey (PaNS) were analysed using partial least squares structural equation modelling (PLS-SEM). In the direct-effects model, biodiversity, safety and accessibility were positively associated with perceived visit-related health benefits, whereas cleanliness problems showed a negative association. Most of these direct associations were substantially attenuated when the two visit experiences were included, and both experiences were positively associated with perceived benefits. The pathway model also revealed differentiated associations across experiences, with safety most closely associated with fresh air / peace and tranquillity, biodiversity with feeling closer to nature, and cleanliness problems showing a negative indirect association through fresh air / peace and tranquillity. By considering qualities of the setting alongside experiences during the visit, the findings highlight the value of a quality-experience-benefit perspective in which different environmental qualities may show different patterns of association with perceived visit-related health benefits through particular visit experiences. This perspective may help inform the selection and management of natural settings used in nature-based public-health approaches, particularly where specific visit experiences are intended to be supported.

1. Introduction

Green and natural spaces are increasingly recognised as potentially valuable resources for supporting health and well-being (Markevych

et al., 2017, Twohig-Bennett and Jones, 2018, Shanahan et al., 2019). Understanding why visits to green and natural spaces may be perceived as more or less beneficial requires attention not only to whether people visit these settings, but also to how they perceive their qualities and

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what they experience during the visit (Hadavi et al., 2015, Wyles et al., 2019, Markevych et al., 2017). This issue is particularly relevant in England, where stress and mental ill health constitute substantial public-health challenges among adults (van den Bosch and Jarvis, 2025, Morris et al., 2025). The total economic and social cost of mental ill health in England was estimated at £300 billion, equivalent to approximately twice the NHS budget for that year (Cardoso and McHayle, 2024). Mental ill health is also associated with increased risks of cardiovascular disease, obesity, diabetes and other chronic physical conditions (Prince et al., 2007). These burdens have strengthened interest in nature-based approaches to supporting health and well-being through engagement with green and natural environments.

Reflecting this growing interest, UK policy has increasingly recognised the potential contribution of nature and green spaces to health and well-being (GOV.UK, 2018). This includes interest in complementary, non-pharmaceutical approaches involving engagement with nature (Pretty, 2004, Haywood et al., 2024), sometimes framed as a “dose of nature” (Cox et al., 2017, Stonebridge et al., 2025) or “nature as medicine” (Victorson et al., 2020). Green social prescribing has also been promoted as a means of connecting people with nature-based activities to improve health and well-being (Haywood et al., 2024, Burale et al., 2025). For example, a £5.77 million cross-government green social prescribing initiative supported 8,339 people with mental health needs in accessing nature-based activities. Its evaluation estimated a social return on investment of £1.88–£2.42 for every £1 invested (Haywood et al., 2024). This level of investment in nature-based approaches reinforces the importance of understanding the role that visits to green and natural spaces may play in supporting health and well-being.

A substantial evidence base links contact with green and natural environments with psychological restoration, reduced stress and improved well-being (Shanahan et al., 2019, Shanahan et al., 2015, Markevych et al., 2017, Dzhambov et al., 2020, Cleary et al., 2019, Bengtsson et al., 2025, Douglas et al., 2017, Hamejs et al., 2026). Experimental research further indicates that experiences in natural environments can support emotional and physiological recovery following stress (Ulrich et al., 1991). These associations extend beyond psychological outcomes, with green-space exposure also linked to physical health outcomes, including lower blood pressure and heart rate and reduced risks of type II diabetes and cardiovascular mortality (Twhig-Bennett and Jones, 2018). However, this broad evidence of health and well-being associations does not imply that all green and natural settings are perceived or experienced as equally beneficial (Wyles et al., 2019, Nguyen et al., 2021).

Accordingly, research has increasingly examined whether specific perceived qualities of green and natural settings are associated with restorative and well-being outcomes. Perceived biodiversity and naturalness, for example, have been associated with perceived restorativeness and emotional well-being (Marselle et al., 2016), while greenness and level of vegetation have also been examined as aspects of perceived green-space quality (Hipp et al., 2016). A broader multidimensional perspective is provided by the Perceived Sensory Dimensions (PSD) framework, which identifies eight perceived dimensions of green-space environments, including nature, social, space, rich in species, serene, culture, refuge and prospect, some of which have been associated with stress restoration (Grahn and Stigsdotter, 2010). Consistent with this broader perspective, research indicates that associations between green spaces and health and well-being may vary according to qualities such as biodiversity, naturalness, safety, maintenance and cleanliness (Fisher et al., 2021, Nguyen et al., 2021, Ríos-Rodríguez et al., 2021). These studies highlight perceived environmental quality as an important consideration in understanding variation in the relationships between green and natural spaces and health and well-being.

From a person-environment perspective, associations between perceived environmental qualities and health and well-being may also depend on the opportunities and experiences those qualities afford visitors (Hadavi et al., 2015). How environmental qualities are perceived

and experienced may vary according to people’s needs, intentions and capacities. Similar settings may consequently be experienced differently by different visitors. In this context, the present study considers fresh air / peace and tranquillity and feeling closer to nature as two aspects of visit experience (White et al., 2013, Wyles et al., 2019, Samus et al., 2022). Considering both experiences within the same model allows their associations with the same perceived environmental qualities and perceived visit-related health benefits to be examined.

The relevance of experiences during visits can also be situated within broader pathway accounts of green space and health. Markevych et al. (2017) organise the proposed links between green space and health into three broad domains: reducing harm, restoring capacities, and building capacities. Hartig (2021) further argues that restoration should not be reduced to stress recovery and attention restoration but should instead be understood as a broader adaptive process through which environments support the renewal of psychological, emotional, and social resources. In research specifically concerned with green space and loneliness, Astell-Burt et al. (2022) similarly emphasise that relevant pathways may operate through personal, relational and collective processes and may depend on wider contextual circumstances. These perspectives emphasise that characteristics of settings and experiences during visits may both be relevant to health and well-being.

Empirical pathway research has examined perceived restorativeness and nature connectedness as intermediate variables in associations between environmental characteristics and health and well-being related outcomes. Perceived restorativeness, for example, has been examined as an intermediate link between perceived biodiversity or naturalness and emotional well-being (Marselle et al., 2016). Other studies have linked perceived sensory dimensions with perceived restorativeness and psychological restoration experiences (Malekinezhad et al., 2020). Nature connectedness has been examined as an intermediate response linking perceived wildness with positive affect (Samus et al., 2022). Longitudinal research has further examined associations between residential environmental quality and restorative perceptions over time (Wu et al., 2024).

More specifically, PaNS-based research has examined time spent in nature, recent nature visits, nature connectedness, noticing nature, environmental qualities and health and well-being among adults in England. Richardson and Hamlin (2021) found that longer-term time in nature and nature connectedness, and shorter-term recent visits and noticing nature, showed different associations with well-being. Alcock et al. (2025) further examined nature-visit frequency and nature connectedness in relation to well-being and environmentalism while accounting for perceived neighbourhood nature quality. More recent PaNS studies have also shown that characteristics and experiences of recent nature visits are associated with perceived health and well-being benefits (Douglas et al., 2026, Hamejs et al., 2026).

Although previous studies have established associations among environmental quality, visit experiences and health and well-being, it remains unclear whether particular perceived environmental qualities show different associations with fresh air / peace and tranquillity and feeling closer to nature when both experiences are considered simultaneously. It is also unclear whether indirect associations between perceived environmental qualities and perceived visit-related health benefits are evident through each experience. The present study addresses these questions within a single pathway model. Considering these as distinct aspects of visit experience within the same model allows examination of whether particular perceived environmental qualities show different associations with fresh air / peace and tranquillity and feeling closer to nature, and how each experience is associated with perceived visit-related health benefits.

Supplementary analyses assessed the consistency of the main associations across nature-visit frequency groups and destination types, for perceived physical and mental health benefits separately, and across levels of door-to-door visit duration. Reduced models were also compared to assess the additional explanatory value of considering both

visit experiences together. By highlighting the environmental qualities associated with particular visit experiences and how those experiences relate to perceived visit-related health benefits, this study may help inform the selection, design and management of green and natural spaces used in nature-based public-health approaches, particularly where programmes seek to support particular experiences (Haywood et al., 2024, Ridgley et al., 2020).

The remainder of the paper is structured as follows. Section 2 presents the conceptual model and study objectives; Section 3 describes the methods; Section 4 reports the results; Section 5 discusses the findings, implications, and limitations; and Section 6 presents the conclusion.

2. Conceptual framework and study objectives

In the present study, these relationships are considered within a quality-experience-benefit framework that distinguishes three components of a visit to a green or natural space: perceived qualities of the setting, experiences during the visit, and perceived visit-related health benefits. Perceived environmental qualities refer to characteristics or conditions that visitors attribute to the setting, such as biodiversity, safety, accessibility, maintenance and cleanliness problems. Visit experiences refer to what respondents experienced during the particular visit; the present study focuses specifically on fresh air / peace and tranquillity and feeling closer to nature. Perceived visit-related health benefits refer to respondents' evaluations of whether that visit was good for their physical and mental health. Distinguishing these components allows the analysis to examine how different perceived environmental qualities are associated with the two visit experiences and how those experiences are associated with perceived visit-related health benefits.

Visitors may perceive multiple environmental qualities during a visit to a green or natural space, with some potentially associated with more positive experiences and others with less positive experiences. Perceiving a variety of plants and wildlife may be associated with greater attention to natural features of the setting, perceived restorativeness and well-being (Wyles et al., 2019, Marselle et al., 2016). Feeling safe and perceiving a space as well maintained may be associated with greater comfort and restorative quality (Fisher et al., 2021), while perceived accessibility has been associated with health and well-being in research on recent nature visits (Hampejs et al., 2026). By contrast, litter, dog mess and graffiti may reduce enjoyment, disturb tranquillity or create an impression of neglect. Such environmental incivilities have been associated with poorer mental health, and litter may reduce the perceived restorative quality of natural settings (Ellaway et al., 2009, Wyles et al., 2016). Taken together, this evidence suggests that different perceived environmental qualities may show different associations with experiences during visits and with perceived visit-related health benefits (Wyles et al., 2016, Gidlow et al., 2012, Nguyen et al., 2021, Hampejs et al., 2026).

The experience of fresh air / peace and tranquillity reflects the extent to which the visit was experienced as peaceful, tranquil and conducive to calm and respite. Research on nature visits and favourite places has associated experiences of calmness, relaxation and respite with psychological restoration (Korpela et al., 2008, White et al., 2013, Pasanen et al., 2018), while perceived tranquillity in urban green spaces has been associated with feeling more relaxed following a visit (Watts et al., 2013). These findings can be situated within broader theories of psychological restoration. Stress Recovery Theory proposes that natural environments can facilitate emotional and physiological recovery from stress (Ulrich et al., 1991), whereas Attention Restoration Theory emphasises the restoration of depleted attentional resources through opportunities to experience being away from everyday demands (Kaplan and Kaplan, 1989). Empirical pathway research has also linked perceived environmental qualities with well-being-related outcomes through perceived restorativeness (Marselle et al., 2016, Fisher et al., 2021).

Feeling closer to nature reflects a subjective sense of closeness to the

natural environment during the visit. This is narrower than the broader construct of nature connectedness, which is commonly assessed using multi-item measures. Nevertheless, research on recent and momentary nature experiences indicates that feelings of connection to nature can vary during particular encounters with natural environments (Wyles et al., 2019, Samus et al., 2022). Experimental research has also shown that experiences in nearby nature can foster a subjective sense of connection with nature (Nisbet and Zelenski, 2011). Attention to natural features of the setting, including plants and wildlife, may also be associated with stronger feelings of connection to nature (Pocock et al., 2023, Richardson et al., 2021). Feeling closer to nature during a visit may also be associated with greater perceived visit-related health benefits, consistent with broader evidence linking nature connectedness with health and well-being (Martin et al., 2020, Richardson and Hamlin, 2021, Hampejs et al., 2026).

Fresh air / peace and tranquillity and feeling closer to nature may occur during the same visit but need not occur to the same degree. Natural environments may offer different opportunities for experience, with particular qualities being more relevant to some experiential responses than to others (Hadavi et al., 2015). A setting perceived as safe, accessible and well maintained may be associated with greater fresh air / peace and tranquillity, whereas a setting perceived as rich in plants and wildlife may show a larger association with feeling closer to nature. Conversely, litter, dog mess or graffiti may be more closely associated with lower fresh air / peace and tranquillity than with feelings of closeness to nature. Considering the two experiences simultaneously therefore allows the analysis to examine whether different perceived environmental qualities show different patterns of association with the two experiences.

Accordingly, within the quality-experience-benefit framework, the study examines direct associations between perceived environmental qualities and perceived visit-related health benefits, alongside indirect associations through fresh air / peace and tranquillity and feeling closer to nature. These indirect associations are interpreted as statistical pathways of association rather than evidence of causal mediation. Fig. 1 summarises the hypothesised relationships, including direct paths from each perceived environmental quality to perceived visit-related health benefits and indirect associations through the two visit experiences. The study therefore has two objectives:

Objective 1: To examine the direct associations of perceived biodiversity, safety, accessibility and cleanliness problems with perceived visit-related health benefits.

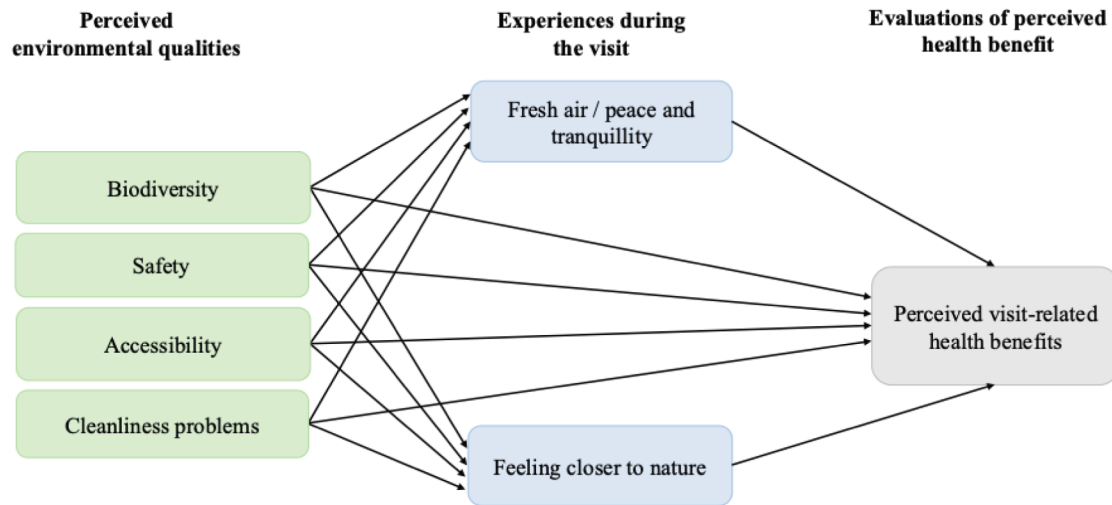
Objective 2: To examine the indirect associations between perceived environmental qualities and perceived visit-related health benefits through fresh air / peace and tranquillity and feeling closer to nature.

3. Methods

3.1. Data source and sample selection

Data were drawn from the People and Nature Survey (PaNS), a national survey administered by Natural England to monitor how adults in England engage with, experience and benefit from the natural environment (England, 2025).¹ PaNS is a continuous online panel survey of adults aged 16 years and over in England, with approximately 2,000 respondents surveyed each month. It collects information on visits to green and natural spaces, perceived benefits and environmental quality, pro-environmental behaviours, and patterns of access and use. The survey produces accredited official statistics and provides a nationally relevant data source for research on nature engagement, environmental quality and well-being (Richardson and Hamlin, 2021). Its coverage of

¹ Natural England. People and Nature Survey for England: Technical Documentation. Available at: <https://www.gov.uk/government/collections/people-and-nature-survey-for-england>.



Note. Arrows represent the hypothesised structural paths examined in the pathway model.

Fig. 1. Conceptual model of hypothesised associations among perceived environmental qualities, visit experiences and perceived visit-related health benefits. Note. Arrows represent the hypothesised structural paths examined in the pathway model.

recent visits to green and natural spaces, perceived environmental qualities and perceived benefits makes it particularly suitable for the aims of the present study.

The full dataset comprises 112,412 responses collected across England (England, 2025) and was used as the starting sample for the present analysis. Only survey modules relevant to respondent characteristics and the conceptual framework were used, specifically Modules M1, M2, M2A, and M2A-SUB, although not all items within these modules were included.

To define the eligible sample, respondents were required to have reported at least one visit to a green or natural space within the previous 14 days (Module M2). Participants were instructed to include visits of any duration, such as brief trips to local parks or dog walks, but to exclude time spent in private gardens, outdoor activities conducted as part of paid work, or visits outside the UK. Respondents reporting at least one qualifying visit were routed to Module M2A, which collected detailed information about their most recent qualifying visit. Modules M2A and M2A-SUB included items on visit characteristics, perceived environmental qualities, fresh air / peace and tranquillity, feeling closer to nature, and perceived health benefits, corresponding to the variables in the proposed conceptual model. Of the 68,278 respondents reporting a qualifying recent visit, not all were administered every item required for the structural model because of survey routing, and some respondents had item-level missing data. Complete-case selection across all model variables therefore resulted in a final analytic sample of 19,814 respondents.

3.2. Measures

3.2.1. Respondents and visit characteristics

Respondent characteristics included region of residence, age, gender identity, highest educational qualification, marital status, employment status, annual household income, and ethnic group or background. The categories and distributions of these characteristics are presented in Table 1.

Nature-visit frequency was reported in response to the question: “In the last 12 months, how often, on average have you spent free time outside in green and natural spaces?”. Response options were “every day”, “more than twice a week”, “twice a week”, “once a week”, “once or twice a month”, “once every 2–3 months” and “less often”.

Respondents reported the main destination of their most recent visit using the following categories: urban green space, such as a park, field or playground; grounds of a historic property or country park; allotment or community garden; woodland or forest; river, lake or canal; hill, mountain or moorland; beach, other coastline or sea; nature or wildlife reserve; and fields, farmland or countryside; or other green and natural spaces.

Door-to-door visit duration was reported in response to the question: “How long did this visit last altogether (from the time you left home or wherever you started from to when you returned)?”. Response options were “Up to 30 min”, “Over 30 min and up to an hour”, “Over 1 h and up to 2 h”, “Over 2 h and up to 3 h”, “Over 3 h and up to 5 h” and “Over 5 h”.

Additional characteristics of the visit included the approximate distance travelled to the destination, the main activity undertaken, the main form of transport used, whether the visit was made alone, with other people or with a dog, the reasons for making the visit, and whether the physical effort involved was sufficient to raise the respondent’s breathing rate. Full response categories and descriptive distributions for these questions are presented in [supplementary A](#).

3.2.2. Measures and indicators

For the present analysis, four PaNS items were used to represent perceived environmental qualities of the green or natural space visited: “There was a variety of plants and wildlife to see”; “The place felt welcoming / safe”; “The place was accessible and well maintained (including good paths)”, and “There was lots of litter / dog mess / graffiti”. These items were used as indicators of biodiversity, safety, accessibility and cleanliness problems, respectively, consistent with previous PaNS-based research (Hampejs et al., 2026). The fourth item is negatively framed in terms of litter, dog mess and graffiti; higher scores

Table 1
Demographic characteristics of included and excluded respondents.

Characteristic	Category	Included analytic sample (n = 19,814)		Not included in analytic sample (n = 92,598)	
		N	Percent	N	Percent
Place of Residence	North East	1,021	5.2%	4,710	5.1%
	North West	2,571	13.0%	11,772	12.7%
	Yorkshire and the Humber	1,849	9.3%	8,871	9.6%
	East Midlands	1,836	9.3%	8,949	9.7%
	West Midlands	2,078	10.5%	10,328	11.2%
	East	2,305	11.6%	10,702	11.6%
	London	2,973	15.0%	13,871	15.0%
	South East	3,196	16.1%	14,666	15.8%
	South West	1,985	10.0%	8,729	9.4%
Age last birthday	16–24	2,421	12.2%	11,716	12.7%
	25–39	5,084	25.7%	22,394	24.2%
	40–54	4,877	24.6%	22,669	24.5%
	55–64	3,104	15.7%	14,216	15.4%
	65+	4,328	21.8%	21,603	23.3%
Gender Identity	Male	9,841	49.7%	44,444	48.0%
	Female	9,940	50.2%	47,971	51.8%
	In another way	33	0.2%	183	0.2%
Highest level of qualification	No qualifications	760	3.8%	5,640	6.1%
	Any other qualifications	12,449	62.8%	59,649	64.4%
	A university degree (or above)	6,605	33.3%	27,309	29.5%
Marital status	Single	5,188	26.2%	26,478	28.6%
	Married or in a civil partnership	10,303	52.0%	44,479	48.1%
	Other Relationship Status (co-habiting, separated, divorced, widow)*	4,320	21.8%	21,605	23.4%
Employment Status	Employed (full-time, part-time or self-employed)*	11,980	60.5%	51,622	55.7%
	Unemployed (less than 12 months or long term) *	762	3.8%	4,608	5.0%
	Not working*	6,138	31.0%	31,783	34.3%
	Student*	934	4.7%	4,576	5.0%
Annual household income before tax	£0–14,999	2,493	12.6%	15,458	16.8%
	£15,000–19,999	1,992	10.1%	10,840	11.8%
	£20,000–29,999	3,965	20.1%	18,677	20.3%
	£30,000–39,999	3,288	16.6%	14,703	16.0%
	£40,000–49,999	2,541	12.9%	10,576	11.5%
	£50,000 +	5,470	27.7%	21,912	23.8%
Ethnic group or background	White	17,091	87.5%	77,885	86.1%
	Mixed	417	2.1%	2,045	2.3%
	Asian or Asian British	1,165	6.0%	6,134	6.8%
	Black or Black British	712	3.6%	3,671	4.1%
	Any other ethnic group or background	157	0.8%	760	0.8%

Percentages are based on available responses; totals may vary because of missing data.

*Some categories were merged for reporting purposes to enhance interpretability. For detailed information, see (England, 2025).

therefore indicate greater perceived cleanliness problems. Higher scores on the first three indicators indicate more positive perceptions.

The PaNS item “It was a good place to get fresh air / peace and tranquillity” was used as an indicator of fresh air / peace and tranquillity, consistent with previous PaNS-based research (Hampejs et al., 2026). Because this item combines fresh air with peace and tranquillity, it should be interpreted as a compound PaNS indicator rather than as a pure measure of peace and tranquillity. This item does not constitute a comprehensive measure of psychological restoration but reflects the extent to which respondents experienced the visit as peaceful, tranquil and conducive to calm and respite.

The item “I felt closer to nature” was used as the indicator of feeling closer to nature, reflecting how close respondents reported feeling to nature during that particular visit. This approach is consistent with previous visit-based research using closely related wording to assess recalled connectedness to nature (Wyles et al., 2019). Because this is a single, visit-specific indicator, while PaNS separately includes a multi-item measure of broader nature connectedness, the term feeling closer to nature is used rather than nature connectedness.

Perceived visit-related health benefits were operationalised using two PaNS items: “It was good for my physical health” and “It was good for my mental health”. In the present analysis, these items were specified as reflective indicators of perceived visit-related health benefits. Previous PaNS-based research has similarly considered these items in relation to visit-related biological and psychological health and well-being (Hampejs et al., 2026).

All items described in this subsection were rated on a five-point scale ranging from 1 = strongly disagree to 5 = strongly agree.

3.3. Data analysis Strategy

3.3.1. Model specification

Partial Least Squares Structural Equation Modelling (PLS-SEM) was conducted using SmartPLS 4 (version 4.1.1.8). PLS-SEM is a variance-based approach suited to complex structural models, with an emphasis on explaining variance in endogenous constructs (Hair et al., 2016). It was appropriate for the present study because the analysis focused on examining associations among perceived environmental qualities, visit experiences and perceived visit-related health benefits within a specified pathway model. The analysis relied on existing PaNS survey items, several of which were represented by single-item indicators. PLS-SEM can accommodate single-item measures, allowing these survey indicators to be incorporated directly into the structural model (Hair et al., 2019, Hair et al., 2016).

Measurement-model evaluation was undertaken for the two-item perceived visit-related health-benefits construct. Indicator reliability was assessed using outer loadings, internal consistency using Cronbach’s alpha and composite reliability, and convergent validity using average variance extracted (AVE). Given that the construct comprised only two indicators, Cronbach’s alpha was interpreted alongside the inter-item correlation and composite reliability.

Pearson correlations were examined descriptively to assess the magnitude of bivariate associations among the model variables, including the association between fresh air / peace and tranquillity and feeling closer to nature. Inner variance inflation factor (VIF) values were examined to assess collinearity among the predictors of each endogenous construct.

Two structural models were estimated. The first was a direct-effects model in which biodiversity, safety, accessibility and cleanliness problems were associated directly with perceived visit-related health benefits. The second was a pathway model that included fresh air / peace and tranquillity and feeling closer to nature as visit experiences while retaining the direct associations between the four perceived environmental qualities and perceived visit-related health benefits. This enabled estimation of both the retained direct associations and the specific indirect associations through each visit experience. The structural models focused on the associations specified in the conceptual framework and did not include additional sociodemographic or visit-level covariates.

Structural-model evaluation included standardised path coefficients (β), explained variance (R^2), effect sizes (f^2), and predictive performance using PLSpredict (Q^2 predict). Statistical significance was assessed using bootstrapping with 5,000 resamples, two-tailed tests and 95% confidence intervals. Given the large sample size, effect sizes were considered alongside statistical significance.

Harman’s single-factor test was conducted as an exploratory screening diagnostic of potential common-method variance. All model indicators were entered into an unrotated principal component analysis,

and the proportion of variance explained by the first component was examined (Podsakoff et al., 2003; Fuller et al., 2016). The first component accounted for 40.93% of the total variance, suggesting that no single component dominated the variance among the model indicators.

3.3.2. Sensitivity and supplementary analyses

Five sensitivity and supplementary analyses were conducted to assess the consistency of the main findings and explore variation in the estimated associations.

First, the pathway model was re-estimated separately for higher-frequency and lower/moderate-frequency visitors. Respondents were grouped as higher-frequency visitors if they reported visiting green and natural spaces “every day” or “more than twice a week”, and as lower/moderate-frequency visitors if they reported visiting “twice a week”, “once a week”, “once or twice a month”, “once every 2–3 months” or “less often”. Previous research has similarly grouped responses to this nature-visit frequency item using binary (Martin et al., 2020) or four-category groupings (Alcock et al., 2025). The two-group classification was used to examine whether the main pattern of associations was similar across respondents with different nature-visit frequencies.

Second, the pathway model was estimated by destination type, with visits grouped as green-space or blue-space destinations, to examine whether the main pattern of associations was broadly similar across the two groups. Destinations were classified according to their dominant environmental feature. Green-space destinations included urban green spaces; grounds of historic properties or country parks; allotments or community gardens; woodlands or forests; hills, mountains or moorlands; nature or wildlife reserves; and fields, farmland or countryside. Blue-space destinations included rivers, lakes or canals, and beaches, other coastal areas or the sea.

Third, the pathway model was re-estimated using perceived physical health benefit and perceived mental health benefit as single-item outcomes. These analyses examined whether modelling the two items together as a combined perceived visit-related health-benefits construct masked differences in their patterns of association with perceived environmental qualities and the two visit experiences.

Fourth, an exploratory moderation analysis examined whether door-to-door visit duration moderated the associations between perceived environmental qualities, the two visit experiences and perceived visit-related health benefits. Door-to-door visit duration was specified as a moderator of each structural relationship in the pathway model using the SmartPLS moderation procedure.

Finally, two reduced pathway models were estimated to compare the variance in perceived visit-related health benefits explained when both visit experiences were included with that explained when each experience was included alone. One reduced model included fresh air / peace and tranquillity as the only visit experience, while the other included feeling closer to nature as the only visit experience.

The results of these sensitivity and supplementary analyses are presented in Section 4.4.3 and Supplementary Tables C–H.

4. Results

4.1. Participant characteristics

Table 1 summarises the demographic characteristics of respondents included in the analytic sample ($n = 19,814$) and compares them with respondents who were not included because they either did not report a qualifying visit within the previous 14 days or had incomplete data for one or more model variables ($n = 92,598$). The included sample was broadly distributed across English regions and showed a near-even gender balance. Most respondents were aged 25 years or above, and the majority were employed. Compared with respondents not included in the analytic sample, those included had slightly higher proportions of respondents with university education, employment and higher household income.

4.2. Visit-related characteristics

Most visits were to urban green spaces (34.4%), followed by fields, farmland or countryside (14.3%), woodland or forest (12.0%), rivers, lakes or canals (11.4%), and the beach, other coastline or sea (9.7%). The majority of visits lasted between 30 min and 2 h, with 31.6% lasting over 30 min and up to 1 h, and 30.8% lasting over 1 h and up to 2 h. The most frequently reported reasons for visiting were to get fresh air (61.5%), physical health and exercise (50.8%), and mental health and well-being (38.2%).

4.3. Measurement model evaluation

The two indicators of perceived visit-related health benefits were moderately and positively correlated ($r = 0.563$, $p < 0.001$; $N = 19,814$), indicating that they captured related aspects of the construct. As shown in Table 2, both indicators loaded significantly on the construct, with outer loadings above 0.70. The construct demonstrated acceptable internal consistency, with Cronbach's alpha of 0.720 and composite reliability of 0.721, and acceptable convergent validity, with an AVE of 0.563 (Hair et al., 2016).

Pearson correlations among the model variables ranged from -0.155 to 0.563 . The largest correlation was between perceived physical and mental health benefits ($r = 0.563$). Among the remaining variables, correlations were generally low to moderate, with the largest association observed between safety and fresh air / peace and tranquillity ($r = 0.526$). Fresh air / peace and tranquillity and feeling closer to nature were moderately positively correlated ($r = 0.401$), indicating that the two visit experiences were related but not strongly overlapping. Cleanliness problems showed weak negative correlations with most variables and were not significantly correlated with feeling closer to nature ($r = -0.012$) (Table 3).

4.4. Structural model evaluation

For the pathway model, inner VIF values ranged from 1.032 to 1.620, indicating no problematic collinearity among the predictors of the endogenous constructs (Table 4).

4.4.1. Direct-effects model

The direct-effects model showed that all four perceived environmental qualities were significantly associated with perceived visit-related health benefits (Table 5). Safety showed the largest positive direct association, followed by biodiversity and accessibility. Cleanliness problems showed a significant negative association. The direct-effects model explained 26.1% of the variance in perceived visit-related health benefits.

Table 2

Indicator reliability, internal consistency and convergent validity of perceived visit-related health benefits.

Constructs/ Indicators	Outer loading	t statistic	P value	Cronbach's α	CR	AVE
Perceived visit-related health benefits	—	—	—	0.720	0.721	0.563
Perceived physical health benefit	0.734	106.789	0.001	—	—	—
Perceived mental health benefit	0.767	117.398	0.001	—	—	—

Note: CR = composite reliability; AVE = average variance extracted.

Table 3
Pearson correlations among model variables.

Variable	Perceived physical health benefit	Perceived mental health benefit	Feeling closer to nature	Biodiversity	Accessibility	Cleanliness problems	Safety	Fresh air / peace and tranquillity
Perceived physical health benefit	—							
Perceived mental health benefit	0.563**	—						
Feeling closer to nature	0.481**	0.508**	—					
Biodiversity	0.267**	0.268**	0.405**	—				
Accessibility	0.269**	0.273**	0.281**	0.289**	—			
Cleanliness problems	−0.050**	−0.047**	−0.012	0.081**	−0.095**	—		
Safety	0.315**	0.337**	0.343**	0.331**	0.479**	−0.105**	—	
Fresh air / peace and tranquillity	0.399**	0.407**	0.401**	0.330**	0.395**	−0.155**	0.526**	—

Note. ** $p < 0.01$.

Table 4
Inner-model variance inflation factors for the pathway model.

Structural path	VIF
Biodiversity → Perceived visit-related health benefits	1.317
Biodiversity → Fresh air / peace and tranquillity	1.173
Biodiversity → Feeling closer to nature	1.173
Safety → Perceived visit-related health benefits	1.620
Safety → Fresh air / peace and tranquillity	1.382
Safety → Feeling closer to nature	1.382
Accessibility → Perceived visit-related health benefits	1.377
Accessibility → Fresh air / peace and tranquillity	1.338
Accessibility → Feeling closer to nature	1.338
Cleanliness problems → Perceived visit-related health benefits	1.052
Cleanliness problems → Fresh air / peace and tranquillity	1.032
Cleanliness problems → Feeling closer to nature	1.032
Fresh air / peace and tranquillity → Perceived visit-related health benefits	1.581
Feeling closer to nature → Perceived visit-related health benefits	1.346

4.4.2. Pathway model and indirect associations

To examine the indirect associations, the two visit experiences were included in the pathway model while retaining the direct associations between perceived environmental qualities and perceived visit-related health benefits (Fig. 2). Biodiversity decreased from $\beta = 0.220$ in the direct-effects model to $\beta = 0.021$ in the pathway model. Accessibility decreased from $\beta = 0.159$ to $\beta = 0.072$, and safety decreased from $\beta = 0.281$ to $\beta = 0.088$. The direct association between cleanliness problems and perceived visit-related health benefits became non-significant. Full structural-model estimates, including f^2 values for all paths, are reported in Supplementary Table B.

In the pathway model, feeling closer to nature had the largest direct association with perceived visit-related health benefits ($\beta = 0.498$, $p < 0.001$), while fresh air / peace and tranquillity was also positively associated with perceived benefits ($\beta = 0.255$, $p < 0.001$). The corresponding effect size was larger for feeling closer to nature ($f^2 = 0.398$) than for fresh air / peace and tranquillity ($f^2 = 0.089$). Safety showed the largest association with fresh air / peace and tranquillity ($\beta = 0.386$, $p < 0.001$), whereas biodiversity showed the largest association with feeling closer to nature ($\beta = 0.314$, $p < 0.001$).

The associations of safety and accessibility with both fresh air /

peace and tranquillity and feeling closer to nature were also significant. Among the associations between perceived environmental qualities and the two visit experiences, the largest effect sizes were observed for safety with fresh air / peace and tranquillity ($f^2 = 0.163$) and biodiversity with feeling closer to nature ($f^2 = 0.108$). Cleanliness problems were negatively associated with fresh air / peace and tranquillity ($\beta = -0.113$, $p < 0.001$) but were not significantly associated with feeling closer to nature ($\beta = -0.008$, $p = 0.205$).

The pathway model explained 53.7% of the variance in perceived visit-related health benefits, 33.6% of the variance in fresh air / peace and tranquillity, and 22.0% of the variance in feeling closer to nature. These values are broadly within the range reported in related PLS-SEM studies of green-space experience and well-being, although direct comparison is limited by differences in constructs, predictors and study populations (Tae et al., 2022, Malekinezhad et al., 2020). All reported Q^2 predict values were above zero, indicating lower prediction error than the naïve mean benchmark.

The indirect associations showed that biodiversity, safety and accessibility were associated with perceived visit-related health benefits through fresh air / peace and tranquillity and feeling closer to nature (Table 6). The largest indirect association was from biodiversity through feeling closer to nature to perceived visit-related health benefits (0.157, $p < 0.001$). Safety and accessibility also showed significant indirect associations with perceived visit-related health benefits through both visit experiences. Among these three environmental qualities, indirect associations through fresh air / peace and tranquillity ranged from 0.038 to 0.098, while indirect associations through feeling closer to nature ranged from 0.049 to 0.157. Cleanliness problems showed a significant negative indirect association with perceived visit-related health benefits through fresh air / peace and tranquillity (-0.029 , $p < 0.001$), whereas the indirect association through feeling closer to nature was not statistically significant (-0.004 , $p = 0.206$). Thus, the indirect association involving cleanliness problems was evident through lower scores on the fresh air / peace and tranquillity rather than through feeling closer to nature.

4.4.3. Sensitivity and supplementary results

The models estimated separately for the two nature-visit frequency

Table 5
Direct-effects model linking perceived environmental qualities to perceived visit-related health benefits.

Structural path	R ²	Q ² predict	f ²	Path coefficient (β)	Confidence intervals (2.5%, 97.5%)	t statistic	P value
Biodiversity → Perceived visit-related health benefits	—	—	0.056	0.220	0.203, 0.238	24.227	0.001
Safety → Perceived visit-related health benefits	—	—	0.078	0.281	0.261, 0.302	26.710	0.001
Accessibility → Perceived visit-related health benefits	—	—	0.026	0.159	0.139, 0.180	15.400	0.001
Cleanliness problems → Perceived visit-related health benefits	—	—	0.002	−0.038	−0.053, −0.023	4.876	0.001
Perceived visit-related health benefits	0.261	0.188	—	—	—	—	—

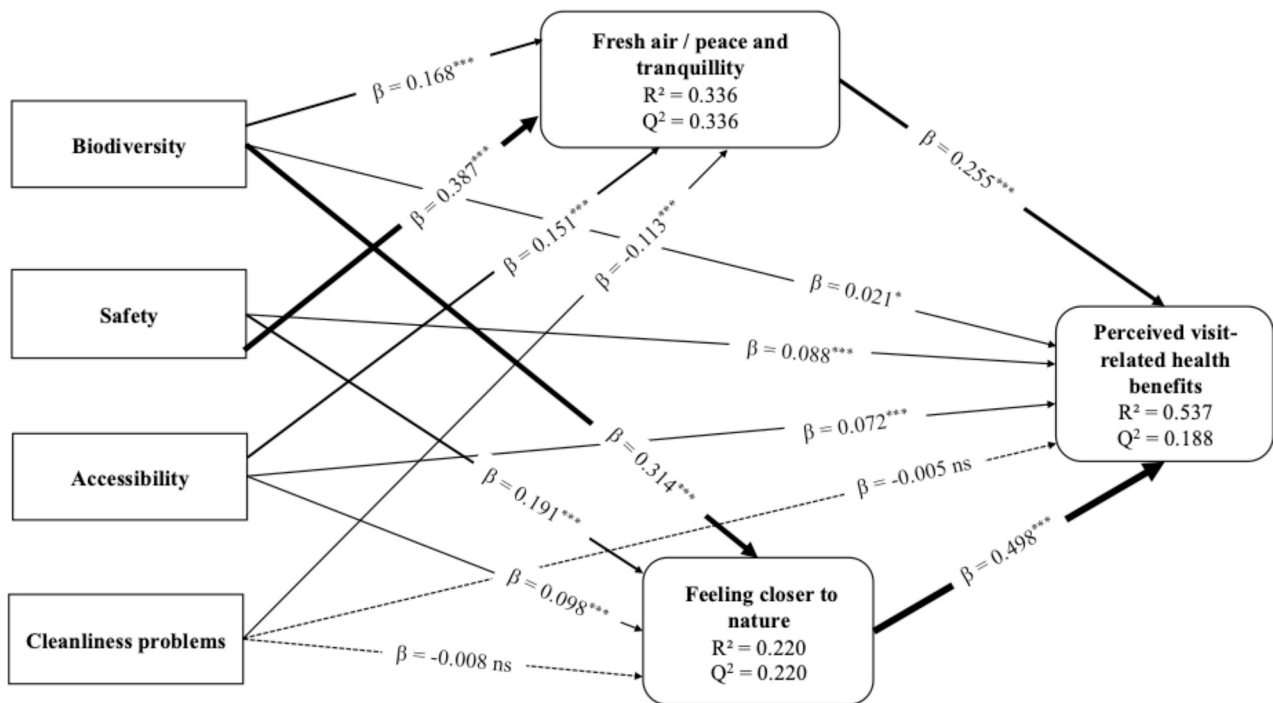


Fig. 2. Pathway model of perceived environmental qualities, visit experiences and perceived visit-related health benefits. Note. Values on arrows represent standardised path coefficients (β), and values within endogenous constructs represent R^2 and Q^2 predict values. Solid arrows indicate statistically significant paths; dashed arrows indicate non-significant paths (ns). Arrow thickness reflects the relative magnitude of the standardised coefficients. * $p < 0.05$; *** $p \leq 0.001$.

Table 6

Indirect associations in the pathway model.

Specific indirect association	Estimate	95% CI	t statistic	P value
Biodiversity $\rightarrow$ Feeling closer to nature $\rightarrow$ Perceived visit-related health benefits	0.157	0.147, 0.166	31.994	0.001
Biodiversity $\rightarrow$ Fresh air / peace and tranquillity $\rightarrow$ Perceived visit-related health benefits	0.043	0.038, 0.048	16.927	0.001
Safety $\rightarrow$ Feeling closer to nature $\rightarrow$ Perceived visit-related health benefits	0.095	0.086, 0.105	19.374	0.001
Safety $\rightarrow$ Fresh air / peace and tranquillity $\rightarrow$ Perceived visit-related health benefits	0.098	0.089, 0.107	21.498	0.001
Accessibility $\rightarrow$ Feeling closer to nature $\rightarrow$ Perceived visit-related health benefits	0.049	0.040, 0.057	11.007	0.001
Accessibility $\rightarrow$ Fresh air / peace and tranquillity $\rightarrow$ Perceived visit-related health benefits	0.038	0.033, 0.044	14.088	0.001
Cleanliness problems $\rightarrow$ Feeling closer to nature $\rightarrow$ Perceived visit-related health benefits	-0.004	-0.010, 0.002	1.265	0.206
Cleanliness problems $\rightarrow$ Fresh air / peace and tranquillity $\rightarrow$ Perceived visit-related health benefits	-0.029	-0.033, -0.025	14.913	0.001

groups showed broadly similar patterns to the main analysis (Supplementary Table C). In both the higher-frequency and lower/moderate-frequency groups, feeling closer to nature remained the largest direct association with perceived visit-related health benefits. Safety remained the largest association with fresh air / peace and tranquillity, while cleanliness problems were negatively associated with fresh air / peace and tranquillity in both groups. The green-space and blue-space models also showed broadly similar patterns of association

(Supplementary Table D), with feeling closer to nature and fresh air / peace and tranquillity remaining more strongly associated with perceived benefits than most direct associations involving perceived environmental qualities.

When perceived physical and mental health benefits were examined separately, the principal pattern of associations was similar across the two outcomes, although some small differences were evident (Supplementary Table E). Feeling closer to nature remained the largest direct association with both perceived physical health benefit ($\beta = 0.359$, $p < 0.001$) and perceived mental health benefit ($\beta = 0.389$, $p < 0.001$), while fresh air / peace and tranquillity was also positively associated with both outcomes (physical: $\beta = 0.196$, $p < 0.001$; mental: $\beta = 0.187$, $p < 0.001$). One difference concerned the residual direct association of biodiversity, which was small but statistically significant for perceived physical health benefit ($\beta = 0.023$, $p < 0.001$) but was not statistically significant for perceived mental health benefit ($\beta = 0.009$). The models explained 28.9% of the variance in perceived physical health benefit and 31.6% of the variance in perceived mental health benefit. Overall, the principal associations involving the two visit experiences were therefore evident for both outcomes, while the separate models also identified some outcome-specific variation.

None of the interaction terms involving door-to-door visit duration was statistically significant ($\beta = -0.007$ to 0.011 ; $p = 0.102$ to 0.946), providing no evidence that door-to-door visit duration moderated the associations in the pathway model (Supplementary Table F). Correlations between door-to-door visit duration and the model variables were also small, ranging from -0.097 to 0.105 (Supplementary Table G).

In the reduced pathway models, the model containing fresh air / peace and tranquillity alone explained 35.3% of the variance in perceived visit-related health benefits, whereas the model containing feeling closer to nature alone explained 49.6%. The full pathway model containing both visit experiences explained 53.7%. In the feeling closer to nature only model, the direct association between biodiversity and perceived benefits was substantially reduced, whereas cleanliness problems retained a negative direct association. In the model containing only fresh air / peace and tranquillity, the direct association between

cleanliness problems and perceived visit-related health benefits was not statistically significant, while a negative indirect association was observed through fresh air / peace and tranquillity. Full results are presented in [Supplementary Table H](#).

5. Discussion

Using a pathway model, this study examined associations between perceived qualities of visited green and natural spaces and perceived visit-related health benefits, both directly and through two visit experiences: fresh air / peace and tranquillity and feeling closer to nature. In the direct-effects model, perceived benefits were positively associated with biodiversity, safety and accessibility and negatively associated with cleanliness problems. When fresh air / peace and tranquillity and feeling closer to nature were included in the pathway model, most of these direct associations were substantially reduced. Environmental qualities showed different patterns of association with the visit experiences. These findings suggest that different qualities of green and natural settings may be associated with different experiences during visits and with how beneficial those visits are perceived to be, with potential implications for nature-based public-health approaches.

The findings are consistent with research suggesting that environmental quality and experiences during visits to green and natural spaces are relevant to health and well-being ([Markevych et al., 2017](#), [Wyles et al., 2019](#), [Nguyen et al., 2021](#)). Previous PaNS research has examined time spent in nature, recent nature visits, nature connectedness and perceived environmental qualities in relation to health and well-being. [Richardson and Hamlin \(2021\)](#) and [Alcock et al. \(2025\)](#) highlighted the relevance of nature connectedness, while [Douglas et al. \(2026\)](#) and [Hamejs et al. \(2026\)](#) showed that characteristics and perceived qualities of visits and settings are also associated with perceived health benefits and well-being. The present study extends this PaNS-based evidence by modelling perceived environmental qualities alongside two visit-specific experiences simultaneously, allowing comparison of whether the same environmental qualities are differentially associated with fresh air / peace and tranquillity and feeling closer to nature, and whether these experiences show different statistical pathways to perceived visit-related health benefits.

The attenuation of the direct associations after the two visit experiences were included is comparable with findings from previous empirical pathway studies, although the constructs examined are not equivalent. For example, [Marselle et al. \(2016\)](#) found that perceived restorativeness statistically accounted for associations between perceived environmental qualities, including perceived biodiversity and naturalness, and emotional well-being following group walks in nature. In the present study, the direct association between perceived biodiversity and perceived visit-related health benefits similarly decreased substantially, from $\beta = 0.220$ in the direct-effects model to $\beta = 0.021$ in the pathway model, while the largest biodiversity-related indirect association was through feeling closer to nature ($\beta = 0.157$). This suggests a broadly similar pattern in which associations between perceived environmental qualities and well-being-related outcomes are substantially reduced when visit experiences are considered, although the present study identifies a visit-specific feeling of closeness to nature, rather than perceived restorativeness, as the more prominent pathway for perceived biodiversity. [Samus et al. \(2022\)](#) likewise found that state nature connectedness was an intermediate response linking perceived wildness with positive affect. The present findings parallel this pattern in showing a relatively strong association between perceived biodiversity and feeling closer to nature, but differ in examining a narrower, visit-specific indicator of feeling closer to nature and perceived physical and mental health benefits rather than state nature connectedness and positive affect. Together with other empirical pathway studies linking environmental qualities to restoration-related experiences and well-being outcomes ([Malekinezhad et al., 2020](#), [Chen et al., 2022](#)), these comparisons suggest that experiential responses may be important in

understanding associations between perceived environmental qualities and perceived benefits, while also indicating that the particular experience involved may depend on the environmental quality and outcome examined. As the present data are cross-sectional, these patterns are interpreted as statistical pathways of association rather than evidence of causal mediation.

Importantly, although the two visit experiences were positively associated with perceived visit-related health benefits, their associations with individual environmental qualities differed. Fresh air / peace and tranquillity and feeling closer to nature were moderately related, while their associations with environmental qualities suggest that they reflect related but not fully overlapping aspects of visit experience. This is consistent with previous research showing that restoration and connectedness can co-occur during nature visits and both vary according to characteristics of the visited environment ([Wyles et al., 2019](#)). Related studies also indicate that connectedness and restoration overlap without necessarily showing identical relationships with environmental characteristics or well-being-related outcomes ([Spano et al., 2023](#), [Arnberger et al., 2024](#)). A setting may therefore support calm and respite without necessarily being experienced as strongly connecting the visitor with nature, while another may foster closeness to nature without being especially tranquil. The larger association of feeling closer to nature with perceived visit-related health benefits further suggests that the two experiences may differ in how closely they are related to visitors' evaluations of the benefits of the visit.

The association between biodiversity and feeling closer to nature suggests that perceiving variety in plants and wildlife may be especially relevant to feelings of closeness to nature during a visit. Previous research has linked perceived species richness and biodiversity with psychological well-being, restorative responses and emotional well-being ([Carrus et al., 2015](#), [Marselle et al., 2016](#), [Nghiem et al., 2021](#), [Dallimer et al., 2012](#)). In the present study, the association of biodiversity was larger with feeling closer to nature than with fresh air / peace and tranquillity, suggesting that perceived biodiversity may be particularly relevant to feelings of closeness to nature. This pattern aligns with recent experimental evidence showing that perceived biodiversity was associated with greater state nature connectedness ([Orth et al., 2025](#)). The indirect association between biodiversity and perceived visit-related health benefits through feeling closer to nature is also consistent with evidence linking perceived qualities of natural settings, state nature connectedness and well-being-related outcomes ([Samus et al., 2022](#)). Whereas these previous studies have generally examined biodiversity or naturalness in relation to restoration, connectedness or affective outcomes, the present analysis shows that the association of perceived biodiversity was substantially larger with the visit-specific experience of feeling closer to nature ($\beta = 0.314$) than with fresh air / peace and tranquillity ($\beta = 0.168$), providing evidence of differentiation between two experiences assessed within the same model.

A different pattern emerged for safety and accessibility, which showed larger associations with fresh air / peace and tranquillity than with feeling closer to nature. The larger associations of safety and accessibility with fresh air / peace and tranquillity align with evidence showing that perceived safety and the design, maintenance and care of public spaces are associated with restorative quality and restoration-related experiences ([Fisher et al., 2021](#), [Ríos-Rodríguez et al., 2021](#), [Jiang and Marzbali, 2026](#)). The present results refine this evidence by showing that, when fresh air / peace and tranquillity and feeling closer to nature were modelled simultaneously, perceived safety was more strongly associated with fresh air / peace and tranquillity ($\beta = 0.386$) than with feeling closer to nature ($\beta = 0.191$), with a similar though smaller difference for accessibility ($\beta = 0.151$ and $\beta = 0.098$, respectively). Thus, qualities relating to safety, accessibility and maintenance appear more closely associated with the calm and respite-related aspect of the visit than with the visit-specific feeling of closeness to nature. Conversely, cleanliness problems were negatively associated with fresh

air / peace and tranquillity but were not significantly associated with feeling closer to nature. Their direct association with perceived visit-related health benefits was also no longer statistically significant once the visit experiences were included. The negative association for cleanliness problems similarly accords with experimental evidence showing that litter can reduce the restorative quality and psychological benefits of natural environments (Wyles et al., 2016). The present model further differentiates this association: cleanliness problems were negatively associated with fresh air / peace and tranquillity ($\beta = -0.113$) but showed essentially no association with feeling closer to nature ($\beta = -0.008$, $p = 0.205$), suggesting that perceived litter, dog mess and graffiti may be more relevant to the calm or tranquillity of a visit than to feelings of closeness to nature. These findings suggest that different perceived environmental qualities may be relevant to different aspects of visit experience rather than showing the same pattern of association across experiences.

The supplementary analyses indicated that the principal pathway relationships were generally similar across visit-frequency groups, green- and blue-space destinations, and the separate perceived physical and mental health outcomes. For the latter analyses, feeling closer to nature and fresh air / peace and tranquillity remained positively associated with both perceived physical and mental health benefits, although the small residual direct association of biodiversity was evident for perceived physical health benefit but not for perceived mental health benefit. Previous research has likewise shown associations of both patterns of nature visitation and characteristics of green and natural settings with health and well-being outcomes (White et al., 2019, Nguyen et al., 2021).

The reduced-model comparisons provide additional evidence that considering both aspects of visit experience together accounts for more variance in perceived visit-related health benefits than considering either experience alone. The model containing fresh air / peace and tranquillity alone explained 35.3% of the variance in perceived visit-related health benefits, compared with 49.6% for feeling closer to nature alone and 53.7% when both were included (Supplementary Table H). Although feeling closer to nature explained more variance when considered alone, the increase in explained variance when both experiences were included suggests that each contributed information not wholly captured by the other. This further suggests that the two experiences represent related but not fully overlapping aspects of visit experience, consistent with previous evidence that restoration and connectedness are related but may show different relationships with environmental characteristics and well-being-related outcomes (Wyles et al., 2019, Arnberger et al., 2024).

The supplementary moderation analysis provided no evidence that door-to-door visit duration altered the pattern of associations in the pathway model. Previous research, including PaNS analyses, has linked measures of time spent in or visiting green and natural spaces with health-related outcomes (White et al., 2019, Douglas et al., 2026, Hampejs et al., 2026). In the present study, these relationships were relatively consistent across shorter and longer door-to-door visit durations. However, because the duration measure included travel time, the analysis cannot determine whether time spent specifically within the green or natural setting is associated with differences in these relationships.

In sum, the findings extend pathway-based research on visits to green and natural spaces and health by showing that perceived environmental qualities may be associated differently with different aspects of visit experience. The reduction in most direct associations after the visit experiences were included suggests that associations between environmental quality and perceived benefits are closely related to how the visit is experienced. At the same time, the different associations of environmental qualities with fresh air / peace and tranquillity and feeling closer to nature suggest that treating visit experience as a single general response may overlook variation in how environmental qualities relate to different aspects of visit experience. Together, these findings suggest

that understanding associations between perceived environmental quality and perceived visit-related health benefits requires attention to the different visit experiences associated with different setting qualities.

Conceptual contribution and practical implications

At a conceptual level, the present study distinguishes three components of a visit to a green or natural space: perceived qualities of the setting, experiences reported during the visit, and evaluations of perceived visit-related health benefits. The resulting quality-experience-benefit framework should be interpreted in relation to the specific PaNS indicators available rather than as a direct test of broader multidimensional constructs or theories. In particular, the fresh air / peace and tranquillity item does not provide a comprehensive measure of psychological restoration, and the visit-specific item assessing feeling closer to nature is narrower than established multidimensional measures of nature connectedness. Accordingly, Attention Restoration Theory, Stress Recovery Theory and research on nature connectedness provide broader interpretive context for the observed associations rather than constructs directly tested in the present analysis. Within these measurement boundaries, the finding that fresh air / peace and tranquillity and feeling closer to nature showed different patterns of association with perceived environmental qualities suggests value in distinguishing different aspects of reported visit experience rather than treating experience as a single undifferentiated component.

At a practical level, the findings may have implications for the planning, design and management of green and natural spaces used by people who already visit such settings. Among these recent visitors, opportunities to notice a variety of plants and wildlife were particularly associated with feeling closer to nature, whereas settings perceived as safe, welcoming, accessible and well maintained were more closely associated with fresh air / peace and tranquillity. Minimising litter, dog mess and graffiti may likewise be relevant where calm and tranquillity are intended to be supported. For nature-based public-health programmes, including green social prescribing, these associations may help inform consideration of which setting qualities are associated with particular experiences among programme participants who are able and willing to engage with such settings. However, the present findings do not address barriers to visitation, participation or access among non-visitors and should not be interpreted as evidence concerning the equitable accessibility of green or natural spaces or nature-based programmes.

5.1. Limitations and future research

Several limitations should be acknowledged. First, the cross-sectional design limits causal inference. Accordingly, the indirect associations identified in the pathway model should not be interpreted as evidence that fresh air / peace and tranquillity or feeling closer to nature causally mediate associations between perceived environmental qualities and perceived visit-related health benefits (Maxwell and Cole, 2007). Because all key variables were reported by the same respondents in relation to the same visit, common-method bias cannot be ruled out entirely, although the diagnostic test suggested that no single component dominated the variance. Future longitudinal, repeated-measures and experimental studies should examine whether changes in perceived environmental qualities are followed by changes in visit experiences and subsequent health and well-being outcomes, using both self-reported and independently assessed health indicators where possible. Such studies should also examine whether these associations remain after accounting for additional sociodemographic and visit-level factors. Such designs could also be incorporated into evaluations of nature-based public-health interventions to examine whether changes in setting quality and visit experience are associated with subsequent changes in health and well-being (Haywood et al., 2024).

Second, several key concepts were represented by single survey

items, which provide brief indicators rather than comprehensive measures of multidimensional constructs (Fuchs and Diamantopoulos, 2009). These indicators should therefore not be interpreted as equivalent to validated measures of psychological restoration, nature connectedness or multidimensional health and well-being. The associations reported here pertain specifically to respondents' answers to these visit-specific survey items, and theoretical interpretation should remain correspondingly cautious. Previous studies using similar visit-specific measures have likewise acknowledged the limitations of single-item indicators for nature connectedness and visit-related health and well-being (Hampejs et al., 2026, Wyles et al., 2019, Douglas et al., 2026). In addition, some items combined related but distinct concepts, including safety and welcome, accessibility and maintenance, and fresh air / peace and tranquillity. The cleanliness item also combined litter, dog mess and graffiti, which may not be perceived in the same way. For example, graffiti may be interpreted either as a sign of neglect or as a form of artistic expression (Ives et al., 2017, Vanderveen and Van Eijk, 2016). Future research should address these measurement limitations by using validated multi-item measures for multidimensional constructs and separate items for concepts and environmental conditions currently combined within single items (Boateng et al., 2018). It could also examine how specific contextual cues, including graffiti, perceived safety and dog mess, are associated with peace, tranquillity and other visit experiences.

Third, the analytic sample was restricted to respondents who had visited a green or natural space within the previous 14 days and provided complete data for all model variables. The findings therefore apply to recent visitors with complete data and should not be generalised to non-visitors, people facing barriers to visiting green and natural spaces, or the wider population in relation to green-space access or equity. Consequently, the analysis cannot determine whether the environmental qualities or visit experiences identified here are relevant to people who do not visit such spaces, including those whose non-visitation reflects structural, health-related, financial or perceived-safety barriers. The analytic sample also included somewhat higher proportions of respondents with university education, employment and higher household income than those not included. Future studies should examine whether similar patterns are observed among groups facing health, mobility, financial, safety or accessibility barriers, particularly those who may have fewer opportunities to visit green and natural spaces.

Fourth, visit motivations were not incorporated into the pathway model and may have been associated with both how respondents experienced the visit and how they evaluated perceived health benefits. Visitors seeking exercise, relaxation or mental-health benefits may differ in their expectations and experiences of the same setting. Future research should therefore examine whether the associations between environmental qualities, visit experiences and perceived health benefits vary according to visit motivation.

Fifth, the PaNS measure of visit duration captured total door-to-door visit duration, including travel time, rather than time spent specifically within the green or natural setting. Future research should use more precise measures of time spent in the natural setting to examine more directly whether time spent within the setting modifies the associations identified here.

6. Conclusion

This study contributes to empirical pathway-based research on visits to green and natural spaces by examining how specific PaNS indicators of perceived environmental quality, visit experience and perceived visit-related health benefits are associated. The findings indicate that the two visit-specific experiences examined here – fresh air / peace and tranquillity and feeling closer to nature – showed different patterns of association with perceived setting qualities. Together, these findings highlight the value of a quality-experience-benefit perspective that

distinguishes perceived environmental qualities, experiences during visits and perceived visit-related health benefits as conceptually different but interrelated components of visits to green and natural spaces. This perspective provides a more specific basis for considering why different green and natural settings may not be experienced as equally beneficial and which aspects of the setting may be relevant to particular experiences during a visit.

For nature-based public-health approaches involving people who visit green and natural settings, the findings suggest value in considering not only opportunities for visitation but also which perceived setting qualities are associated with particular reported visit experiences. These associations may help inform the selection and management of settings used for nature-based activities and the evaluation of participants' experiences. However, because the analytic sample comprised recent visitors, the findings do not address barriers to access or participation among non-visitors and should not be extrapolated to questions of population-level green-space equity.

CRediT authorship contribution statement

Fahimeh Malekinezhad: Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Paul Courtney:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization.

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Declaration on the use of Generative AI

Generative AI was used only to assist with language editing and improving clarity of expression. The authors take full responsibility for the content, interpretation, and final wording of the manuscript.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.landurbplan.2026.105812>.

Data availability

The authors are unable or have chosen not to specify which data has been used.

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