Abstract

There is increasing appreciation of the benefits associated with exposure to natural environments. However, most of the evidence relates to green space with much less on blue space. Drawing on data from a British survey of adults, we describe the characteristics of visits to blue space and investigate whether the benefits reported in studies of green space - physical activity, social interaction, and psychological benefits – are evident with respect to blue space. We also examine the importance of nature to people's visits to blue space and investigate the sociodemographic predictors of visit frequency and location, the benefits received, and the importance of nature to the visit. Social interaction and psychological benefits were the most important benefits obtained from visiting blue space. Socioeconomic status was a predictor of both frequency and location of visits and was also associated with identifying social interaction as the most important benefit. Respondents who reported psychological benefits as the most important benefit were more likely to find nature very important to their visit. The importance of nature in underpinning these benefits was relatively greater for older people compared with younger people. These findings highlight the social and psychological benefits obtained from visits to blue space, and provide new evidence on the importance of the natural environment in underpinning these benefits and enriching people's lives.

1. Introduction

Exposure to the natural environment can have a range of social and psychological benefits and contribute to physical and mental health (Gascon et al., 2016; van den Berg et al., 2015). This paper will investigate the benefits associated with visiting a specific environment type, freshwater blue space. Research has concentrated on green space, with studies tending to focus on the quantity of green space in people's living environment (van den Berg et al.,

2015). A range of health benefits have been associated with living in a greener neighbourhood, including better perceived general health (de Vries, van Dillen, Groenewegen, & Spreeuwenberg, 2013), mental health (Richardson, Pearce, Mitchell, & Kingham, 2013), happiness (van Herzele & de Vries, 2011), lower rates of cardiovascular disease (Richardson et al., 2013), and lower death rates (van den Berg et al., 2015; Villeneuve et al., 2012).

1.1 Mechanisms by which the environment affects health and associated benefits

A number of mechanisms have been proposed to explain the association between green space and health (Kuo, 2015). Many relate to environmental conditions, for example improvements in air quality and microclimate regulation, resulting from the presence of green spaces in the living environment (Kuo, 2015). In terms of people's visits to green spaces, three main mechanisms have been suggested which link activities in these areas to specific health-related benefits (de Vries et al., 2013; Hartig, Mitchell, de Vries, & Frumkin, 2014).

(i) Green spaces give people an area in which to be physically active, and people may also be more likely to exercise in these environments as they are aesthetically pleasing (de Vries et al., 2013; Maas, Verheij, Spreeuwenberg, & Groenewegen, 2008; Richardson et al., 2013). This provides a health benefit of physical activity.

(ii) Green spaces provide people with a space in which they can socialise with family and friends (de Vries et al., 2013). This provides a health benefit through social interaction.

(iii) Green spaces facilitate relaxation, mental restoration and stress reduction (de Vries et al., 2013; van Herzele & de Vries, 2011). They therefore provide psychological benefits for health.

Of the three mechanisms and associated benefits, a review of the literature suggests the role of green space in facilitating relaxation and stress reduction (psychological benefits) appears to be most important in explaining the green space-health relationship (Hartig et al., 2014). Visiting green space more frequently has been associated with achieving the recommended amount of physical activity (Flowers, Freeman, & Gladwell, 2016), but physical activity does not appear to mediate the association between green space and health (Hartig et al., 2014). There is some evidence that socialising (social interaction benefits) may also be a mediator; for example, de Vries et al., (2013) found that perceived social cohesion and stress reduction mediated the relationship between streetscape greenery and health, but there are a limited number of studies which have investigated this (Hartig et al., 2014).

Whilst research has concentrated on the provision of green space and its proximity to the dwelling, recent studies have investigated the importance of the quality of this green space in providing benefits (Dallimer et al., 2012; van den Berg et al., 2015). Quality can refer to both the amenity value of green space, such as the maintenance and the provision of paths and other facilities including benches and play areas, or its biological attributes, for example the presence of wildlife or the biodiversity of the space (Lovell, Wheeler, Higgins, Irvine, & Depledge, 2014; van den Berg et al., 2015).

With respect to amenity value, studies suggest that residents in neighbourhoods in which green spaces have more amenities have better mental health (de Vries et al., 2013; Francis, Wood, Knuiman, & Giles-Corti, 2012). Regarding the biological quality of the space, evidence indicates that, although the general public are fairly poor at accurately gauging the biodiversity of green space, the biodiversity they perceive is associated with their mental well-being (Dallimer et al., 2012). Studies have also found a link between objective measures of biodiversity, particularly plant and bird communities, and better mental well-being (Fuller, Irvine, Devine-Wright, Warren, & Gaston, 2007; Luck, Davidson, Boxall, & Smallbone,

2011). The majority of studies have focused on the psychological benefits of experiencing biodiversity but there is some evidence of increased physical activity in more biodiverse environments (Lovell et al., 2014).

The benefits obtained from natural environments may also depend on the type of natural environment (Hartig et al., 2014; Wheeler et al., 2015). Freshwater blue spaces - areas of standing or running water, such as rivers, lakes, and canals – are one type of environment which has been identified as needing further research (Foley & Kistemann, 2015; White et al., 2010). Our study aims to address this need by investigating the benefits of visiting freshwater environments.

1.2 Blue space, health and well-being

Qualitative studies have highlighted the value that people place on both freshwater and coastal blue spaces: water is associated with psychological benefits as well as having aesthetic value, providing a place for recreation and physical activity (Foley & Kistemann, 2015; Völker & Kistemann, 2011). However, a recent scoping review found that quantitative studies of the relationship between freshwater blue space and health are scarce (Gascon, Triguero-Mas, Martínez, & Dadvand, 2015).

Studies from the UK and the Netherlands have shown that freshwater blue space availability is associated with better psychological and general health (de Vries, Verheij, Groenewegen, & Spreeuwenberg, 2003; Wheeler et al., 2015), and, using a validated mental health scale, lower prevalence of mood and anxiety disorders (de Vries et al., 2016). There is some evidence that the distance of blue space from the home may affect this association, with water more than 1km from the home having a positive health effect but water less than 1km having a negative effect (de Vries et al., 2003).

One problem that studies of freshwater blue space have encountered is that of scale. Compared to green space, blue space is small in area and forms less than 2% of land cover in the UK (Gascon et al., 2015; White, Alcock, Wheeler, & Depledge, 2013). In comparison, Richardson & Mitchell, (2010) found the average area covered by green space in urban areas in the UK is 46.2%. This makes it difficult to determine any effect blue spaces may have on health and well-being in large-scale studies and has often led to the inclusion of freshwater blue space with green space in analyses (Gidlow, Randall, Gillman, Smith, & Jones, 2016; Triguero-Mas et al., 2015).

The coastal environment covers a much larger area and, as a result, there is a greater range of evidence relating to health benefits of coastal blue space. Living near the coast has been found to be positively associated with both general and mental health in studies using cross-sectional and longitudinal survey data (Wheeler, White, Stahl-Timmins, & Depledge, 2012; White, Alcock, et al., 2013), and higher proportions of visible coastal blue space have been linked with lower rates of psychological distress (Nutsford, Pearson, Kingham, & Reitsma, 2016).

Studies in England investigating coastal blue space and health have used data from the Monitor for Engagement with the Natural Environment (MENE) survey. Running since 2009, the MENE survey collects data on visits to the natural environment, asking participants to concentrate specifically on their last visit and their activities, motivations, and attitudes to visiting natural spaces (Natural England, 2015a).

Evidence from the survey indicates that visits to the coast are perceived to be more restorative than visits to other natural spaces, such as urban parks and playing fields, and that people living nearer the coast are more likely to meet physical activity guidelines (White, Pahl, Ashbullby, Herbert, & Depledge, 2013; White, Wheeler, Herbert, Alcock, & Depledge,

120 2014). However, the questions asked in the MENE survey limit the scope of the analyses
121 which can be undertaken. The survey does not have a question which includes all three
122 benefits - physical activity, social interaction, and psychological benefits – as outcomes of the
123 visit.

124 We found only one study which has explored whether the mechanisms affecting green space
125 and health also apply to blue space. Triguero-Mas et al. (2015) found no relationship between
126 freshwater or coastal blue space and health but did find that access to these blue spaces was
127 associated with increased social interaction.

128 Existing studies of both freshwater and coastal blue space and health have considered the
129 contribution of social factors, including age, gender, socioeconomic status, household
130 composition, and urbanity (de Vries et al., 2016; Triguero-Mas et al., 2015). The green space
131 literature also indicates that factors such as socioeconomic status (Mitchell & Popham, 2008),
132 age and gender (Astell-Burt, Mitchell, & Hartig, 2014; Richardson & Mitchell, 2010),
133 influence the relationship between the natural environment and health.

134 Our study investigates whether the benefits associated with the mechanisms thought to
135 mediate the green space-health relationship are evident in people's visits to freshwater blue
136 space. The pathways between time spent in blue space and these benefits are represented in
137 Figure 1. We considered sociodemographic factors known to influence the relationship
138 between the natural environment and health and their effect on the characteristics of visits to
139 blue space, the benefits people received from their visit, and the value people placed on
140 nature when visiting blue space (Fig. 1).

141 *1.3 Study objectives*

142 We had three objectives: (i) to describe the characteristics – frequency and location - of visits
143 to freshwater blue space; (ii) to investigate which benefits identified in studies of green space

144 are evident for blue space; and (iii) to examine the importance of nature in enhancing the
145 benefits derived from visits to blue space.

146 **2. Methods**

147 *2.1 Sample*

148 Our cross-sectional study was based on the Office for National Statistics (ONS) Opinions and
149 Lifestyle survey, a British survey containing standard socio-demographic questions, together
150 with modules commissioned by government organisations, academic institutions, and
151 charities. Modules are designed with the Opinions and Lifestyle survey team to meet ONS
152 quality standards. Data access is governed by the ONS Code of Practice, Protocol on Data
153 Access and Confidentiality and Microdata Release Procedure (UK Statistics Authority,
154 2009).

155 The survey covers Great Britain, excluding the Isles of Scilly and the Scottish Highlands and
156 Islands and is based on a random probability sample of private households stratified by
157 region and socio-demographic profile (ONS, 2014). Each month, 2010 addresses are selected
158 and one person over 16 in each household is designated as a respondent for the address
159 (ONS, n.d.). Trained interviewers conduct face-to-face interviews, interviewing only the
160 selected respondent at the address, and returning at least 8 times to each address at different
161 times of the day and week to achieve as many responses as possible. Response rates are
162 typically between 50% and 60% (ONS, n.d.). The survey runs for eight months of the year;
163 we commissioned a module in the May 2015 survey for which the response rate was 56%,
164 resulting in a sample of 1043.

165 The sampling structure of the survey, selecting first households and then one individual
166 within a household, means that the likelihood of an individual being chosen for the survey
167 differs depending on household size (individuals living alone in a household are certain to be

selected if their household is selected; individuals in a family of four in a household only have a 25% chance of selection if their household is selected). As household size may vary based on other demographics, this has the potential to bias results. In addition, some groups are less likely to agree to respond to the survey than others. These factors mean that weighting is required to make the gathered sample representative of the general population. The ONS provides an individual analysis weight for each case which accounts likelihood of selection and non-response bias. In calculating percentages of individuals choosing each option to a question, raw response numbers were multiplied by the weighting to make them nationally representative (ONS, n.d.).

2.2 Survey questions

To address our three objectives, our module asked four questions relating to people's visits to freshwater blue spaces. These were defined for study participants as 'areas such as rivers, canals and lakes and their immediate surroundings, including river paths, canal paths and lakeside walks' and therefore excluded coastal blue spaces such as beaches.

We based our questions on those asked by the MENE survey to enable us to compare our data on visits to blue spaces to information from the MENE survey on visits to other natural environments. The MENE survey asks respondents to think about their last visit to a natural environment. We used the same format as we considered respondents would give clearer answers than if asked about visits to blue spaces in general. We also adapted some of the MENE questions to provide data on the mechanisms affecting the blue space-health relationship and the importance of nature to visits to blue space.

The first question asked the respondent how often they visit blue spaces, with possible answers being: *every day; once a week; once a month; once every few months; two or three times a year; once a year or less; never visit*. Respondents who answered '*never visit*' were

asked no further questions from our module. Respondents who had visited blue space were then asked to think about their last visit to a blue space and report the location of this visit (either *countryside* or *built up area*).

To investigate mechanisms, we asked respondents to indicate the single most important benefit they experienced during their last visit to a blue space, the options being: *exercise or keeping fit; spending time with friends or family; relaxation or stress reduction.* Respondents were also given the option of answering '*other'* in which case they were asked to describe the benefit.

The final question asked respondents to assess the importance of nature in enhancing their visit, with options being: *very important; quite important; not important; not at all important*.

2.3 Variables

Sociodemographic and health information was collected as part of the ONS survey. We used data on factors that other studies have found to be related to green and blue space use as predictor variables in our analyses. These factors were: age; gender; household composition (cohabiting status, number of dependent children); socioeconomic status (highest educational qualification); car ownership; health status (limiting long-standing illness); and urbanity of the respondent's dwelling, with 'urban' being defined as more than more than 10,000 people in the settlement and 'not urban' as less than 10,000 (Table 1).

2.4 Statistical analyses

For some questions, numbers for certain responses were small, requiring response categories to be merged to allow robust statistical analysis (Table 2). For frequency of visits, responses were combined to form three categories: frequently (≥ once a month), infrequently (< once a month), and never visit. For the importance of nature to the visit, the majority of respondents answered 'very important' so this was considered the appropriate category for comparison

and ‘quite important’, ‘not important’, and ‘not at all important’ were merged into one group ‘less important’.

A logistic regression model was run to examine the sociodemographic and health factors predicting whether respondents visited blue space frequently or not frequently (infrequently or never). Pearson Chi-squared tests were used to determine if there were differences in the sociodemographic and health profiles of those who visited blue space (frequently or infrequently) and those who never visited.

Users who had never visited a blue space (n=158) were then excluded from further analyses. Logistic regression models were used to investigate the association between the sociodemographic and health factors and each outcome: visit location; visit benefits; and the importance of nature to the visit.

A logistic regression model was run to predict the sociodemographic and health factors associated with the location of the respondents’ last visit to a blue space (built-up area or countryside).

A multinomial logistic regression model was run for visit benefits, to investigate the sociodemographic and health predictors of selecting ‘exercise or keeping fit’, ‘spending time with family or friends’, or ‘other’ rather than ‘relaxation and stress reduction’.

The sociodemographic and health predictors of the importance of nature in enhancing the respondent’s last visit to a blue space were investigated; reporting that nature was very important rather than less important was modelled.

Finally, a second multinomial logistic regression model was run to identify sociodemographic and health factors associated with choosing ‘exercise or keeping fit’, ‘spending time with family or friends’, or ‘other’ rather than ‘relaxation and stress reduction’. The importance of

nature was added as a predictor to determine whether the likelihood of choosing a particular benefit was associated with the importance placed on nature during the visit.

Statistical analyses were carried out in SPSS Version 22. Nagelkerke's R^2 is displayed to indicate the goodness of fit of the model. Results are presented as adjusted odds ratios (OR) (OR calculated taking into account the effects of all the other variables in the model) with 95% confidence intervals (CI) (these are Wald CI and relate to the adjusted odds-ratios estimated by SPSS in the logistic regressions). Only variables which were significant predictors in the multivariable models are displayed in the paper, the full models are available in the supplementary information.

3. Results

Table 1 describes our study sample.

3.1 Frequency of visits and location of last visit to freshwater blue space

Half (50%) of respondents visited blue space frequently (≥ once a month) although 15% had never visited a blue space (Table 2). Those who had never visited blue space were significantly different to those who had in age, cohabiting status, number of dependent children, car ownership, level of higher education, and long-term limiting illness (Table 3). Table 3 describes the social profile of people who never visited blue space; 37% were 65 and over and 42% had no educational qualifications.

Of those who had visited blue space, a larger proportion (54%) had visited a built-up area on their last visit to a blue space than had been to the countryside (46%).

Both the frequency of visits and the location of a respondents' last visit were predicted by their personal and social circumstances. Compared to people with a degree, people with below degree level qualifications were less likely to visit a blue space frequently (OR 0.71,

CI 0.51-0.98). People were more likely to visit blue spaces frequently if they lived in a rural area than a built up area (OR 3.01, CI 1.91-4.76) (Table 4).

People with a degree were more likely to have visited a blue space in an urban area on their last visit to blue space than those with other (OR 0.53, CI 0.32-0.88) or no qualifications (OR 0.52, CI 0.32-0.86; Table 5). Those who did not own a car were also more likely to have visited a blue space in an urban area on their last trip to a blue space than those who owned a car (OR 1.73, CI 1.16-2.57), as were respondents who lived in an urban area rather than a rural area (Table 5).

3.2 Perceived benefits received from visits to freshwater blue space

Most people reported that spending time with friends or family (33%) or psychological benefits (40%) was the single most important benefit they received most from their visit, 17% identified exercise or keeping fit whilst 10% responded 'other' (Table 2). Respondents who choose 'other' referred mostly to using blue space for a specific activity such as walking with friends, fishing, dog walking, or as a route to another activity such as work. Other benefits discussed included enjoying the fresh air and seeing wildlife. There were no sociodemographic or health factors which predicted selecting other as the most important visit benefit (Table 3 in the supplement).

Health status was a predictor of choosing physical activity as a visit benefit. Respondents who did not have a limiting long term illness were more likely to report physical activity than psychological benefits as the most important benefit received from their last visit to blue space (OR 2.49, CI 1.36-4.54) (Table 6).

Socioeconomic circumstances were a predictor of choosing social interaction as a visit benefit. Compared to respondents with a degree, those with no qualifications were nearly

285 twice as likely to identify spending time with family or friends than psychological benefits
286 (OR 1.97, CI 1.09-3.57) as the key benefit of their visit to blue space (Table 6).

287 Household composition was also a predictor. Compared to respondents with children, those
288 without children were less likely to report social interaction than psychological benefits (OR
289 0.40, CI 0.27-0.59) as the most important benefit of their visit to blue space (Table 6).

290 Finally, those aged 65 and over were less likely to report socialising as the single most
291 important benefit of their visit compared to young adults (OR 0.34, CI 0.14-0.80, Table 6).

292 *3.3 Importance of nature on visits to freshwater blue space*

293 The majority (57%) of respondents considered nature very important to their most recent visit
294 to a blue space (Table 2).

295 Table 7 describes the social patterning of those who found nature very important. Women
296 were more likely than men to value nature (OR 1.28, CI 1.05-1.82). The likelihood of finding
297 nature important increased with age; compared to those aged 16-24, those aged 45-64 were
298 over twice as likely (OR 2.43, CI 1.31-4.51) and those aged 65 and older were over three
299 times as likely (OR 3.48, CI 1.70-7.11) to find nature very important. Socioeconomic status
300 was also a predictor. Compared to people with a degree or equivalent, those with no
301 qualifications were less likely to find nature important (OR 0.55, CI 0.34-0.90).

302 The likelihood of selecting different visit benefits differed depending on how important the
303 respondent found nature to their visit (Table 8). Respondents who found nature less important
304 were more likely to select exercise (OR 2.80, CI 1.83-4.28) or spending time with family and
305 friends (OR 1.69, CI 1.21-2.37) than psychological benefits as the most important benefit of
306 their visit in comparison to those who found nature very important.

When the importance of nature was included in the model, both gender and cohabiting status became predictors of identifying physical activity as the most important benefit of the visit. Women were more likely to select physical activity than psychological benefits as the single most important benefit of their visit compared to men (OR 1.51, CI 1.01 – 2.26). Single respondents were less likely to report exercise than psychological benefits as the most important benefit of their visit compared to those who were married (OR 0.48, CI 0.24 – 0.98).

4. Discussion

4.1 Frequency and location of visits to freshwater blue space

While the majority of respondents visited a blue space at least monthly, access to blue space was socially patterned. Socioeconomic status and living in an urban area were predictors of both the frequency and location of visits to blue space whilst car ownership was also a predictor of visit location.

Evidence on the importance of accessibility to natural spaces is varied. Most visits to green spaces are to those closest to the home but, whilst White et al. (2013) found that people living nearer the coast are more likely to visit than people who live further away, frequency of visits to specific landscape features such as forests, beaches, or lakes appears to be less affected by distance (Schipperijn et al., 2010). Our results suggest area of residence is a predictor of visit frequency and location. Users from urban areas were more likely to visit blue space in a built-up area while respondents from rural areas, with perhaps more access to blue space, visited more frequently. As those without a car were less likely to go to rural blue spaces, the individual's ability to access the space also appears to be a factor affecting visit frequency and location.

331 *4.2 Perceived benefits received from visits to freshwater blue space*

332 The main benefits people identified as receiving from their visits to blue space were social
333 interaction and psychological benefits (Table 2). Social disadvantage was associated with
334 increased odds of identifying social interaction as the most important benefit as was
335 household composition. Age was an additional predictor: older respondents were less likely
336 to identify spending time with family or friends as the most important benefit of their visit
337 than younger respondents. Health status was a predictor of reporting physical activity as the
338 most important visit benefit.

339 We asked our respondents to identify the most important benefit they felt they received from
340 visiting blue space. Our results are similar to findings from green space studies, where social
341 interaction and psychological benefits have been identified as particularly important (de Vries
342 et al., 2013; Hartig et al., 2014).

343 These results differed from the MENE survey which, in 2014-15, found that almost half of
344 people visited the natural environment for health and exercise whilst 29% reported their
345 motivation for visiting was 'to relax and unwind' (Natural England, 2015b). This may be
346 because MENE asks respondents about their reasons for visiting rather than the benefits
347 resulting from their visit; people's intentions before visiting may not be the same as the
348 outcome of the visit (Natural England, 2015a). MENE also asks about a range of natural
349 environments, not just blue and green space, so it may be indicative of differences in the use
350 and benefits received from these spaces.

351 People may access different benefits from natural environments simultaneously (Hartig et al.,
352 2014). For example, some respondents who answered 'other' identified 'walking with a
353 friend' as a benefit, which could provide physical activity and social interaction benefits. It
354 should also be noted that many answers in the 'other' category were recreational pursuits,

355 which can provide benefits in themselves (Völker & Kistemann, 2013). Although people
356 identified these activities as the most important benefit of their visit, most could be placed in
357 one of the three categories provided, for example, dog walking as physical activity.

358 An individual's socio-demographic characteristics affected the benefits they felt they
359 received from visiting the space. We found that respondents who were older and who had a
360 limiting long-term illness were more likely to report psychological benefits as the single most
361 important benefit they received from visiting blue space. Both are user groups who may have
362 problems with mobility and accessing blue space, so provision of these spaces with
363 appropriate amenities, such as paths and benches to allow ease of access and use, is essential
364 to enable them to derive these benefits (Finlay, Franke, McKay, & Sims-Gould, 2015;
365 Schipperijn, Stigsdotter, Randrup, & Troelsen, 2010).

366 Socioeconomic status was a predictor of identifying social interaction as the single most
367 important benefit received from visiting blue space. Studies of green and blue space have
368 suggested that these areas may moderate some of the effects of socioeconomic inequality on
369 health (Mitchell & Popham, 2008; Wheeler et al., 2012). This may be because people from
370 different socioeconomic groups are using these spaces in different ways and therefore gaining
371 different benefits from them. This is supported by research on relational encounters which
372 suggests that the benefits people receive from natural spaces are a result of interaction
373 between individuals and the wider socio-environmental setting (Conradson, 2005).

374 For some people, or in some situations, visiting a natural space may not be beneficial due to
375 the interaction or relationship of the individual with the environment (Plane & Klodawsky,
376 2013). We found that one in six people never visited blue space; many of these respondents
377 were elderly or in poor socioeconomic circumstances. They may not access these spaces
378 because they are physically unable or due to time or financial limitations, but in some cases,

379 it may be because blue spaces are perceived negatively as unhealthy places for them (Finlay
380 et al., 2015; Plane & Klodawsky, 2013). More deprived neighbourhoods often have less
381 access to natural spaces, and those that are present are more likely to be of poor quality
382 (Mitchell & Popham, 2008; Rigolon, 2016), so these groups may have both fewer
383 opportunities and little incentive to visit these spaces. As these respondents do not visit blue
384 space, they are unable to access any benefits from spending time there.

385 *4.3 Importance of nature on visits to freshwater blue space*

386 The majority of our respondents found nature to be very important to their visit. Current
387 evidence regarding the impact of water quality on recreational visits to blue space is mixed.
388 Some research has found that people are more likely to choose to visit blue spaces with good
389 water quality (Doi, Atano, Egishi, & Anada, 2013), however, work by Ziv et al. (2016)
390 suggests that water quality does not affect whether people use blue spaces for recreation.
391 These differences may reflect variation in people's perceptions of what is natural, as nature is
392 regarded differently by different people, and is even situation-dependent, with people
393 expecting spaces to be more or less managed depending on whether they are rural or urban
394 (Cooper, Crase, & Maybery, 2017).

395 There is some research indicating that people prefer the natural environment to have a degree
396 of naturalness rather than being excessively managed, a view that seems to be stronger in
397 women than men (Lindemann-Matthies & Bose, 2007; Southon, Jorgensen, Dunnett, Hoyle,
398 & Evans, 2017; Strumse, 1994). This preference for nature may be a factor in why people in
399 rural areas were more likely to visit blue space frequently; more extensively modified by
400 human activity, blue spaces in urban areas are less likely to 'look natural' (Wild, Bernet,
401 Westling, & Lerner, 2011).

Valuing nature showed social patterning: respondents who were female, older and socially advantaged were more likely to regard nature as very important to their last visit to blue space. This is in line with studies of pro-environmental behaviours which found that people engaging in these behaviours tend to be older and female although a recent meta-analysis of nature connectedness found no effects of age or gender (Capaldi, Dopko, & Zelenski, 2014).

Our results suggest that finding nature important when visiting blue space increases the likelihood of identifying psychological benefits as the main benefit of the visit. This may be indicative of the respondents' own biases – those who value nature highly may be more likely to gain psychological benefits from their visit. However, research on visits to green space indicates that there is a link between biodiversity and the psychological benefits of the space (Fuller et al., 2007), and that spaces with higher actual and perceived biodiversity are more restorative than those with less biodiversity (Carrus et al., 2015; Hoyle, Hitchmough, & Jorgensen, 2017). A review of the health benefits of blue spaces also highlights the significance of features related to quality such as the movement, colour, and clarity of water to users (Völker & Kistemann, 2011), so the nature present in blue space may be important in providing psychological benefits.

4.4 Limitations and further work

Because our study formed part of a wider national survey, we were able to include a wide range of sociodemographic factors in our analysis, and use established measures of socioeconomic position (based on education), health status and household composition. However, some limitations of our study should be noted. The low pseudo-R^2 values indicate that there is a large amount of variation not explained by the models, probably due to unmeasured factors, and the cross-sectional nature of the study meant that conclusions could not be drawn about causality. We were therefore unable to investigate whether the perceived

benefits of visits to blue space mediated potential health effects of exposure to blue space. In addition, like other studies of the benefits of exposure to natural environments, our study relied on self-reported measures. Thus, although freshwater blue space was defined, there may be differences in people's perception and recall of visits to areas such as rivers, canals and their surroundings. However, to explain the social differences we found in frequency, location and benefits of visits to blue space, such perceptual and memory differences would need to be socially patterned. We consider this unlikely.

Our study adds to evidence in an area where research is limited and is one of the first to examine whether the perceived benefits of spending time in green space were also evident for blue space (Triguero-Mas et al., 2015). Our findings suggest visits to freshwater blue space are important for users; their potential contribution to mental health and well-being requires further investigation and comparison with the benefits provided by coastal blue spaces to determine whether different types of blue space provide similar benefits.

4.5 Relevance for policy and planning

There is increasing policy recognition of the societal benefits of the natural environment, from the acknowledgment of the need for a biodiverse natural environment to meet social needs in the Welsh Well-being of Future Generations Act (2015) to the promotion of green spaces for exercise by Natural England (Natural England, 2009; Natural Resources Wales, 2015).

Our study indicates the importance of the natural environment beyond green space, showing that different groups of people experience a range of benefits from freshwater blue space. For example, we found that younger and older people derive different benefits, as do those in urban and rural areas. Evidence on such patterns can help inform local and national strategies to promote the use of public blue space; encouraging the use of freshwater blue spaces could

450 both prevent overuse of coastal environments and allow people who do not live on or near the
451 coast access to the benefits of blue environments.

452 Importantly, we found that one in six adults does not visit blue space. The social patterning of
453 visiting blue space infrequently or not at all suggests inequalities in access to blue space –
454 and therefore to the benefits that exposure to these spaces may provide.

455 Our findings also indicate the importance of protecting and improving blue space,
456 particularly in urban areas. Whilst many are heavily modified or culverted, urban blue spaces
457 often exist within urban green spaces or are present where green space has been erased
458 through urbanisation (Völker, Matros, & Claßen, 2016; Wild et al., 2011). There are an
459 increasing number of projects which aim to restore urban rivers including success stories
460 such as that of the river Quaggy in London where restoration has improved the local
461 environment and increased use by residents (Chartered Institution of Water and
462 Environmental Management, 2012; The River Restoration Centre, 2009).

463 Blue spaces deserve consideration in urban planning as areas which can benefit people and
464 support nature. To ensure the provision of good quality blue spaces for use by urban
465 populations, the catchments upstream of settlements need management to ensure the quality
466 of the water downstream (Neale & Moffett, 2016). Urban planners should also ensure that
467 local communities are engaged with restoration projects, particularly in the planning stages,
468 so that spaces are designed with their support and to meet their needs (Smith et al., 2016).

469 **5. Conclusions**

470 In our study, the majority of people had visited a freshwater blue space in the last year; these
471 visits were split almost equally between urban and rural areas. The frequency and location of
472 an individual's visits to blue space were socially patterned, and determined by people's
473 circumstances and access to the space, whether due to car ownership or their urban location.

Freshwater blue spaces were perceived as important primarily as areas for social interaction and psychological benefits. This is consistent with evidence from the green space-health literature which has identified social interaction and psychological benefits as key mechanisms through which green space benefits health. Those who were most socially disadvantaged (as proxied by having no educational qualifications) were more likely to report social interaction as the primary benefit, pointing to the role that blue space could play in supporting social engagement and improving wellbeing among those at greatest risk of poor health. However, as noted above, we found marked social inequalities in use of blue space; the most socially disadvantaged groups were least likely to report visiting a blue space frequently.

The majority of people considered nature very important to their visit, with women and those aged 45 and over attaching greater importance to nature than men and younger adults. People who considered nature very important to their visit were more likely to identify psychological benefits as the most important benefit of their visit. This suggests that the quality of the blue space may be integral to the benefits that people derive and points to potential synergies between protecting natural habitats and promoting public health.

The findings of our study are relevant to the design of natural spaces for use by local populations as well as more broadly for social and environmental policies. The factors related to people's use of these spaces, particularly socioeconomic and health status, need to be addressed to ensure that access to blue spaces benefits everyone and does not contribute to widening socioeconomic inequalities.

References

Astell-Burt, T., Mitchell, R., & Hartig, T. (2014) The association between green space and mental health varies across the lifecourse: A longitudinal study. *Journal of Epidemiology and Community Health*, 68(6), 578–83. http://doi.org/10.1136/jech-2013-203767

Capaldi, C. A., Dopko, R. L., & Zelenski, J. M. (2014) The relationship between nature connectedness and happiness: a meta-analysis. *Frontiers in Psychology*, 5, 1–15. http://doi.org/10.3389/fpsyg.2014.00976

Carrus, G., Scopellitib, M., Lafortezzac, R., Colangeloc, G., Ferrinid, F., Salbitanoe, F., Agrimif, M., Portoghesif, L., Semenzatog, P., & Sanesic, G. (2015) Go greener, feel better? The positive effects of biodiversity on the well-being of individuals visiting urban and peri-urban green areas. *Landscape and Urban Planning*, 134, 221–228. https://doi.org/10.1016/j.landurbplan.2014.10.022

Chartered Institution of Water and Environmental Management. (2012) *De-culverting of Watercourses*. Retrieved from - http://www.ciwem.org/policy-and-international/policy-position-statements/de-culverting-of-watercourses.aspx

Conradson, D. (2005) Landscape, care and the relational self: Therapeutic encounters in rural England. *Health & Place*, 11(4), 337–348. https://doi.org/10.1016/j.healthplace.2005.02.004

Cooper, B., Crase, L., & Maybery, D. (2017) Incorporating amenity and ecological values of urban water into planning frameworks: evidence from Melbourne, Australia. *Australasian Journal of Environmental Management*, 24(1), 64–80. http://dx.doi.org/10.1080/14486563.2016.1277559

Dadvand, P., Bartoll, X., Basagaña, X., Dalmau-Bueno, A., Martinez, D., Ambros, A., Cirach, M., Triguero-Mas, M., Gascon, M., Borrell, C., & Nieuwenhuijsen, M. J. (2016) Green spaces and general health: Roles of mental health status, social support, and physical activity. *Environment International*, 91, 161–167. http://doi.org/10.1016/j.envint.2016.02.029

Dallimer, M., Irvine, K. N., Skinner, A. M. J., Davies, Z. G., Rouquette, J. R., Maltby, L. L., Warren, P. H., Armsworth, P. R., & Gaston, K. J. (2012) Biodiversity and the Feel-Good factor: Understanding associations between self-reported human well-being and species richness. *BioScience*, 62(1), 47–55. http://doi.org/10.1525/bio.2012.62.1.9

de Vries, S., Verheij, R. A, Groenewegen, P. P., & Spreeuwenberg, P. (2003) Natural environments -- healthy environments? An exploratory analysis of the relationship between greenspace and health. *Environment and Planning A*, 35(10), 1717–1731. http://doi.org/10.1068/a35111

de Vries, S., van Dillen, S. M. E., Groenewegen, P. P., & Spreeuwenberg, P. (2013) Streetscape greenery and health: Stress, social cohesion and physical activity as mediators. *Social Science & Medicine*, 94, 26–33. http://doi.org/10.1016/j.socscimed.2013.06.030

de Vries, S., Have, M., van Dorsselaer, S., van Wezep, M., Hermans, T., & de Graaf, R. (2016) Local availability of green and blue space and prevalence of common mental disorders in the Netherlands. *BJPsych Open*, 2, 366–372. http://doi.org/10.1192/bjpo.bp.115.002469

Doi, H., Katano, I., Negishi, J., Anada, S., & Kayaba, Y. (2013) Effects of biodiversity, habitat structure , and water quality on recreational use of rivers. *Ecosphere*, 4(8), 1–11.

Finlay, J., Franke, T., McKay, H., & Sims-Gould, J. (2015) Therapeutic landscapes and wellbeing in later life: Impacts of blue and green spaces for older adults. *Health and Place,* 34, 97–106. http://doi.org/10.1016/j.healthplace.2015.05.001

Flowers, E. P., Freeman, P., & Gladwell, V. F. (2016) A cross-sectional study examining predictors of visit frequency to local green space and the impact this has on physical activity levels. *BMC Public Health*, 16(1), 420. http://doi.org/10.1186/s12889-016-3050-9

Foley, R., & Kistemann, T. (2015) Blue space geographies: Enabling health in place. *Health & Place*, 35, 1–9. http://doi.org/10.1016/j.healthplace.2015.07.003

Francis, J., Wood, L. J., Knuiman, M., & Giles-Corti, B. (2012) Quality or quantity? Exploring the relationship between Public Open Space attributes and mental health in Perth, Western Australia. *Social Science & Medicine*, 74(10), 1570–1577. http://doi.org/10.1016/j.socscimed.2012.01.032

Fuller, R. A, Irvine, K. N., Devine-Wright, P., Warren, P. H., & Gaston, K. J. (2007) Psychological benefits of greenspace increase with biodiversity. *Biology Letters,* 3(4), 390–4. http://doi.org/10.1098/rsbl.2007.0149

Gascon, M., Triguero-Mas, M., Martínez, D., & Dadvand, P. (2015) Mental health benefits of long-term exposure to residential green and blue spaces: A systematic review. *International Journal of Environmental Research and Public Health*, 4354–4379. http://doi.org/10.3390/ijerph120404354

Gascon, M., Triguero-Mas, M., Martínez, D., Dadvand, P., Rojas-Rueda, D., Plasència, A., & Nieuwenhuijsen, M. J. (2016) Residential green spaces and mortality: A systematic review. *Environment International*, 86, 60–67. http://doi.org/10.1016/j.envint.2015.10.013

Gidlow, C. J., Randall, J., Gillman, J., Smith, G. R., & Jones, M. V. (2016) Natural environments and chronic stress measured by hair cortisol. *Landscape and Urban Planning*, 148, 61–67. http://doi.org/10.1016/j.landurbplan.2015.12.009

Hartig, T., Mitchell, R., de Vries, S., & Frumkin, H. (2014) Nature and health. *Annual Review of Public Health,* 35, 207–28. http://doi.org/10.1146/annurev-publhealth-032013-182443

Hoyle, H., Hitchmough, J., & Jorgensen, A. (2017) All about the "wow factor"? The relationships between aesthetics, restorative effect and perceived biodiversity in designed urban planting. *Landscape and Urban Planning*, 164, 109–123. https://doi.org/10.1016/j.landurbplan.2017.03.011

Lindemann-Matthies, P., & Bose, E. (2007). Species richness, structural diversity and species composition in meadows created by visitors of a botanical garden in Switzerland. *Landscape and Urban Planning*, 79(3–4), 298–307. http://doi.org/10.1016/j.landurbplan.2006.03.007

Lovell, R., Wheeler, B. W., Higgins, S. L., Irvine, K. N., & Depledge, M. H. (2014) A systematic review of the health and well-being benefits of biodiverse environments. *Journal of Toxicology and Environmental Health, Part B: Critical Reviews*, 17(1), 1–20.

http://doi.org/10.1080/10937404.2013.856361

Luck, G. W., Davidson, P., Boxall, D., & Smallbone, L. (2011) Relations between urban bird and plant communities and human well-being and connection to nature. *Conservation Biology*, 25(4), 816–26. http://doi.org/10.1111/j.1523-1739.2011.01685.x

Kuo, M. (2015) How might contact with nature promote human health? Promising mechanisms and a possible central pathway. *Frontiers in Psychology*, 6(1093), 1-8. http://doi: 10.3389/fpsyg.2015.01093

Maas, J., Verheij, R. a, Spreeuwenberg, P., & Groenewegen, P. P. (2008) Physical activity as a possible mechanism behind the relationship between green space and health: A multilevel analysis. *BMC Public Health*, 8, 206. http://doi.org/10.1186/1471-2458-8-206

Marselle, M. R., Irvine, K. N., Lorenzo-Arribas, A., & Warber, S. L. (2015) Moving beyond green: Exploring the relationship of environment type and indicators of perceived environmental quality on emotional well-being following group walks. *International Journal of Environmental Research and Public Health*, 12(1), 106–130. http://doi.org/10.3390/ijerph120100106

Mitchell, R., & Popham, F. (2008) Effect of exposure to natural environment on health inequalities: An observational population study. *Lancet*, 372, 1655–60. http://doi.org/10.1016/S0140-6736(08)61689-X

Natural England. (2009) *Our Natural Health Service*. Sheffield: Natural England.

Natural England. (2015a) *Monitor of Engagement with the Natural Environment: Technical Report from year 6 of the survey March 2014 to February 2015*. Retrieved from - https://www.gov.uk/government/statistics/monitor-of-engagement-with-the-natural-environment-2014-to-2015

Natural England. (2015b) *Monitor of Engagement with the Natural Environment Headline Report from the 2014-15 survey*. Retrieved from - https://www.gov.uk/government/statistics/monitor-of-engagement-with-the-natural-environment-2014-to-2015

Natural Resources Wales. (2015) *Well-being of Future Generations (Wales) Act 2015: the Essentials*. Retrieved from - http://gov.wales/topics/people-and-communities/people/future-generations-act/?lang=en

Neale, M. W., & Moffett, E. R. (2016) Re-engineering buried urban streams: Daylighting results in rapid changes in stream invertebrate communities. *Ecological Engineering*, 87, 175–184. http://doi.org/10.1016/j.ecoleng.2015.11.043

Nutsford, D., Pearson, A. L., Kingham, S., & Reitsma, F. (2016) Residential exposure to visible blue space (but not green space) associated with lower psychological distress in a capital city. *Health & Place*, 39, 70–78. http://doi.org/10.1016/j.healthplace.2016.03.002

ONS. (2014) *Opinions and Lifestyle (Opinions) Survey Information Guide 2013-14*. Retrieved from - http://www.ons.gov.uk/ons/about-ons/products-and-services/opn/index.html

ONS. (n.d.) *Opinions and Lifestyle Omnibus Service Methodology*. Retrieved from - https://www.ons.gov.uk/aboutus/whatwedo/paidservices/opinions

Plane, J. & Klodawsky, F. (2013) Neighbourhood amenities and health: Examining the

significance of a local park. *Social Science & Medicine*, 99, 1–8. https://doi.org/10.1016/j.socscimed.2013.10.008

Richardson, E., & Mitchell, R. (2010) Gender differences in relationships between urban green space and health in the United Kingdom. *Social Science & Medicine*, 71(3), 568–75. http://doi.org/10.1016/j.socscimed.2010.04.015

Richardson, E., Pearce, J., Mitchell, R., & Kingham, S. (2013) Role of physical activity in the relationship between urban green space and health. *Public Health*, 127(4), 318–24. http://doi.org/10.1016/j.puhe.2013.01.004

Rigolon, A. (2016). A complex landscape of inequity in access to urban parks: A literature review. *Landscape and Urban Planning*, 153, 160–169. http://doi.org/10.1016/j.landurbplan.2016.05.017

Schipperijn, J., Ekholm, O., Stigsdotter, U. K., Toftager, M., Bentsen, P., Kamper-Jorgensen, F., & Randrup, T. B. (2010) Factors influencing the use of green space: Results from a Danish national representative survey. *Landscape and Urban Planning*, 95(3), 130–137. http://doi.org/10.1016/j.landurbplan.2009.12.010

Schipperijn, J., Stigsdotter, U. K., Randrup, T. B., & Troelsen, J. (2010) Influences on the use of urban green space - A case study in Odense, Denmark. *Urban Forestry and Urban Greening*, 9(1), 25–32. http://doi.org/10.1016/j.ufug.2009.09.002

Smith, R. F., Hawley, R. J., Neale, M. W., Vietz, G. J., Diaz-Pascacio, E., Hermann, J., Lovell, A. C., Prescott, C., Rios-Touma, B., Smith, B., & Utz, R. M. (2016) Urban stream renovation: incorporating societal objectives to achieve ecological improvements. *Freshwater Science*, 35(1), 364–379. http://doi.org/10.1086/685096.

Southon, G. E., Jorgensen, A., Dunnett, N., Hoyle, H., & Evans, K. L. (2017). Biodiverse perennial meadows have aesthetic value and increase residents' perceptions of site quality in urban green-space. *Landscape and Urban Planning*, 158, 105–118. http://doi.org/10.1016/j.landurbplan.2016.08.003

Strumse, E. (1994). Perceptual dimensions in the visual preferences for agrarian landscapes in western Norway. *Journal of Environmental Psychology*, 14(4), 281–292. http://doi.org/10.1016/S0272-4944(05)80219-1

The River Restoration Centre. (2009) *The London Rivers Action Plan*. Retrieved from - www.therrc.co.uk

Triguero-Mas, M., Dadvand, P., Cirach, M., Martínez, D., Medina, A., Mompart, A., Basagana, X., Grazuleviciene, R. & Nieuwenhuijsen, M. J. (2015) Natural outdoor environments and mental and physical health: Relationships and mechanisms. *Environment International*, 77, 35–41. http://doi.org/10.1016/j.envint.2015.01.012

UK Statistics Authority. (2009) *Code of Practice for Official Statistics.* Retrieved from - https://www.statisticsauthority.gov.uk/publication/code-of-practice/

van den Berg, M., Wendel-Vos, W., Van Poppel, M., Kemper, H., Van Mechelen, W., & Maas, J. (2015) Health benefits of green spaces in the living environment: A systematic review of epidemiological studies. *Urban Forestry & Urban Greening*, 14(4), 806–816. http://doi.org/10.1016/j.ufug.2015.07.008

van Herzele, A., & de Vries, S. (2011) Linking green space to health: a comparative study of two urban neighbourhoods in Ghent, Belgium. *Population and Environment*, 34(2),

171–193. http://doi.org/10.1007/s11111-011-0153-1

Villeneuve, P. J., Jerrett, M., Su, J. G., Burnett, R. T., Chen, H., Wheeler, A. J., & Goldberg, M. S. (2012) A cohort study relating urban green space with mortality in Ontario, Canada. *Environmental Research*, 115, 51–8. http://doi.org/10.1016/j.envres.2012.03.003

Völker, S., & Kistemann, T. (2011) The impact of blue space on human health and well-being - Salutogenetic health effects of inland surface waters: A review. *International Journal of Hygiene and Environmental Health*, 214(6), 449–460. http://doi.org/10.1016/j.ijheh.2011.05.001

Völker, S., Matros, J., & Claßen, T. (2016) Determining urban open spaces for health-related appropriations: a qualitative analysis on the significance of blue space. *Environmental Earth Sciences*, 75(13), 1067. http://doi.org/10.1007/s12665-016-5839-3

Wheeler, B. W., Lovell, R., Higgins, S. L., White, M. P., Alcock, I., Osborne, N. J., Husk, K., Sabel, C. E., & Depledge, M. H. (2015) Beyond greenspace: an ecological study of population general health and indicators of natural environment type and quality. *International Journal of Health Geographics,* 14(1). http://doi.org/10.1186/s12942-015-0009-5

Wheeler, B. W., White, M., Stahl-Timmins, W., & Depledge, M. H. (2012) Does living by the coast improve health and wellbeing? *Health & Place*, 18(5), 1198–201. http://doi.org/10.1016/j.healthplace.2012.06.015

White, M., Alcock, I., Wheeler, B. W., & Depledge, M. H. (2013) Coastal proximity, health and well-being: results from a longitudinal panel survey. *Health & Place*, 23, 97–103. http://doi.org/10.1016/j.healthplace.2013.05.006

White, M., Pahl, S., Ashbullby, K., Herbert, S., & Depledge, M. H. (2013) Feelings of restoration from recent nature visits. *Journal of Environmental Psychology*, 35, 40–51. http://doi.org/10.1016/j.jenvp.2013.04.002

White, M., Smith, A., Humphryes, K., Pahl, S., Snelling, D., & Depledge, M. (2010) Blue space: the importance of water for preference, affect, and restorativeness ratings of natural and built scenes. *Journal of Environmental Psychology*, 30(4), 482–493. http://doi.org/10.1016/j.jenvp.2010.04.004

White, M., Wheeler, B. W., Herbert, S., Alcock, I., & Depledge, M. H. (2014) Coastal proximity and physical activity: Is the coast an under-appreciated public health resource? *Preventive Medicine*, 69, 135–140. http://doi.org/10.1016/j.ypmed.2014.09.016

Wild, T. C., Bernet, J. F., Westling, E. L., & Lerner, D. N. (2011) Deculverting: reviewing the evidence on the “daylighting” and restoration of culverted rivers. *Water and Environment Journal*, 25(3), 412–421. http://doi.org/10.1111/j.1747-6593.2010.00236.x

Ziv, G., Mullin, K., Boeuf, B., Fincham, W., Taylor, N., Villalobos-Jiménez, G., von Vittorelli, L., Wolf, C., Fritsch, O., Strauch, M., Seppelt, R., Volk, M., & Beckmann, M. (2016) Water quality is a poor predictor of recreational hotspots in England. *PLoS One*, 11(11), e0166950. http://doi.org/10.1371/journal.pone.0166950

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Table 1 Social profile of the sample (n = 1043)

	N	Weighted %
Gender		
Male	468	44.9
Female	575	55.1
Age		
16 to 24	116	11.1
25 to 44	338	32.4
45 to 64	349	33.5
65 and over	239	23.0
Cohabiting status		
Married/cohabiting	636	61.0
Single	238	22.8
Widowed	63	6.0
Divorced/separated	106	10.2
Dependent children		
Yes	386	37.0
No	657	63.0
Car ownership		
Yes	835	80.1
No	208	19.9
Level of higher education		
Degree or equivalent	298	28.6
Below degree level	439	42.1
Other qualifications	122	11.7
None	184	17.6
Limiting long-term illness		
Yes	211	56.2
No	188	43.8
Urbanity		
Urban	894	85.7
Not urban	149	14.3

Table 2 Visits to blue space (n=1040)

	N	Weighted %
Frequency of visits		
Frequently (≥once a month)	520	50.0
Infrequently (<once a month)	362	34.8
Never	158	15.2
Missing	3	
Location of visits		
Built-up area	402	45.6
Countryside	479	54.4
Missing[1]	161	
Visit benefits		
Exercise or keeping fit	151	17.1
Spending time with family or friends	292	33.2
Psychological benefits	349	39.6
Other	89	10.1
Missing[1]	161	
Importance of nature		
Very important	500	56.7
Less important	382	43.3
Missing[1]	161	

[1]includes respondents who have never visited a blue space

Table 3 Social profile of respondents who never visited a blue space (n=158), who had visited a blue space (n=885), and differences in sociodemographic and health factors between these two groups (* marks variables for which the difference is significant)

	Never visited		Visited			
	N	Weighted %	N	Weighted %	X^2	p-value[1]
Gender						
Male	64	40.5	404	45.6	2.59	0.108
Female	94	59.5	481	54.4		
*Age**						
16 to 24	18	11.5	98	11.1	33.46	<0.01
25 to 44	37	23.6	301	34.0		
45 to 64	44	28.0	305	34.5		
65 and over	58	36.9	181	20.5		
*Cohabiting status**						
Married/cohabiting	71	44.9	565	63.8	31.62	<0.01
Single	45	28.5	193	21.8		
Widowed	21	13.3	42	4.7		
Divorced/separated	21	13.3	85	9.6		
*Dependent children**						
Yes	53	33.5	333	37.6	5.14	0.023
No	105	66.5	552	62.4		
*Car ownership**						
Yes	97	61.8	738	83.3	65.13	<0.01
No	60	38.2	148	16.7		
*Level of higher education**						
Degree or equivalent	19	12.1	279	31.5	96.67	<0.01
Below degree level	49	31.2	390	44.0		
Other qualifications	23	14.6	99	11.2		
None	66	42.0	118	13.3		
*Limiting long term illness**						
Yes	62	39.2	149	61.8	47.74	<0.01
No	96	60.8	92	38.2		
Urbanity						
Yes	142	89.9	752	85.0	3.80	0.051
No	16	10.1	133	15.0		

[1]p-values based on Pearson Chi-squared tests

Table 4 Logistic regression analysis estimates for visiting a blue space frequently (≥once a month) rather than infrequently or never (pseudo-R^2 = 0.05)

	Frequency	
	Adjusted OR[1]	95% CI
Level of higher education		
Degree or equivalent	1	
Below degree level	0.71	0.51-0.98
Other qualifications	0.91	0.56-1.46
None	0.66	0.43-1.02
Urbanity		
Urban	1	
Not urban	3.01	1.91-4.76

[1] adjusted for gender, age, cohabiting status, number of dependent children, and car ownership

Table 5 Logistic regression analysis estimates for visiting a blue space in a built-up area rather than the countryside, excluding respondents who have never visited a blue space (pseudo-R^2 = 0.10)

	Adjusted OR[1]	95% CI
Level of higher education		
Degree or equivalent	1	
Below degree level	0.73	0.52-1.02
Other qualifications	0.53	0.32-0.88
None	0.52	0.32-0.86
Car ownership		
Yes	1	
No	1.73	1.16-2.57
Urbanity		
Urban	1	
Not urban	0.23	0.14-0.37

[1]adjusted for gender, age, cohabiting status, number of dependent children, and long-term limiting illness

Table 6 Multinomial logistic regression analysis estimates for the most important benefit received on the respondents' last visit to blue space (compared with psychological benefits), excluding respondents who have never visited a blue space (pseudo-R^2 = 0.17)

	Exercise or physical activity		Spending time with family or friends	
	Adjusted OR[1]	95% CI	Adjusted OR[2]	95% CI
Age				
16 to 24			1	
25 to 44			0.86	0.44-1.67
45 to 64			0.48	0.23-1.00
65 and over			0.34	0.14-0.80
Dependent children				
Yes			1	
No			0.40	0.27-0.59
Level of higher education				
Degree or equivalent			1	
Below degree level			1.35	0.91-2.02
Other qualifications			0.76	0.41-1.43
None			1.97	1.09-3.57
Limiting long term illness				
Yes	1			
No	2.49	1.36-4.54		

1 adjusted for gender, age, cohabiting status, number of dependent children, car ownership, level of higher education, urbanity

2 adjusted for gender, cohabiting status, car ownership, limiting long-term illness, urbanity

Table 7 Logistic regression analysis estimates for whether people found nature to be very important when visiting a blue space, excluding respondents who have never visited a blue space (pseudo-R^2 = 0.06)

	Adjusted OR[1]	95% CI
Gender		
Male	1	
Female	1.38	1.05-1.82
Age		
16 to 24	1	
25 to 44	1.54	0.87-2.71
45 to 64	2.43	1.31-4.51
65 and over	3.48	1.70-7.11
Level of higher education		
Degree or equivalent	1	
Below degree level	0.79	0.57-1.10
Other qualifications	1.07	0.65-1.76
None	0.55	0.34-0.90

[1] adjusted for cohabiting status, number of dependent children, car ownership, limiting long-term illness, urbanity

Table 8 Multinomial logistic regression analysis estimates for the most important benefit received on the respondents' last visit to blue space (compared with psychological benefits), excluding respondents who have never visited a blue space (pseudo-R^2 = 0.20)

	Exercise or physical activity		Spending time with family or friends	
	Adjusted OR[1]	95% CI	Adjusted OR[2]	95% CI
Gender				
Male	1			
Female	1.51	1.01-2.26		
Age				
16 to 24			1	
25 to 44			0.82	0.42-1.61
45 to 64			0.44	0.21-0.92
65 and over			0.30	0.12-0.71
Cohabiting status				
Married/cohabiting	1			
Single	0.48	0.24-0.98		
Widowed	1.57	0.65-3.79		
Divorced/separated	0.75	0.38-1.48		
Dependent children				
Yes			1	
No			0.41	0.28-0.61
Level of higher education				
Degree or equivalent			1	
Below degree level			1.39	0.93-2.08
Other qualifications			0.78	0.41-1.47
None			2.10	1.16-3.82
Limiting long term illness				
No	1			
Yes	2.66	1.45-4.89		
Importance of nature				
Very important	1		1	
Less important	2.80	1.83-4.28	1.69	1.21-2.37

1 adjusted for age, number of dependent children, level of higher education, car ownership, urbanity

2 adjusted for gender, cohabiting status, car ownership, limiting long-term illness, urbanity

List of figures

Figure 1 Conceptual model showing the benefits obtained from visiting blue space and possible influences on the relationship, adapted from Hartig et al. (2014).

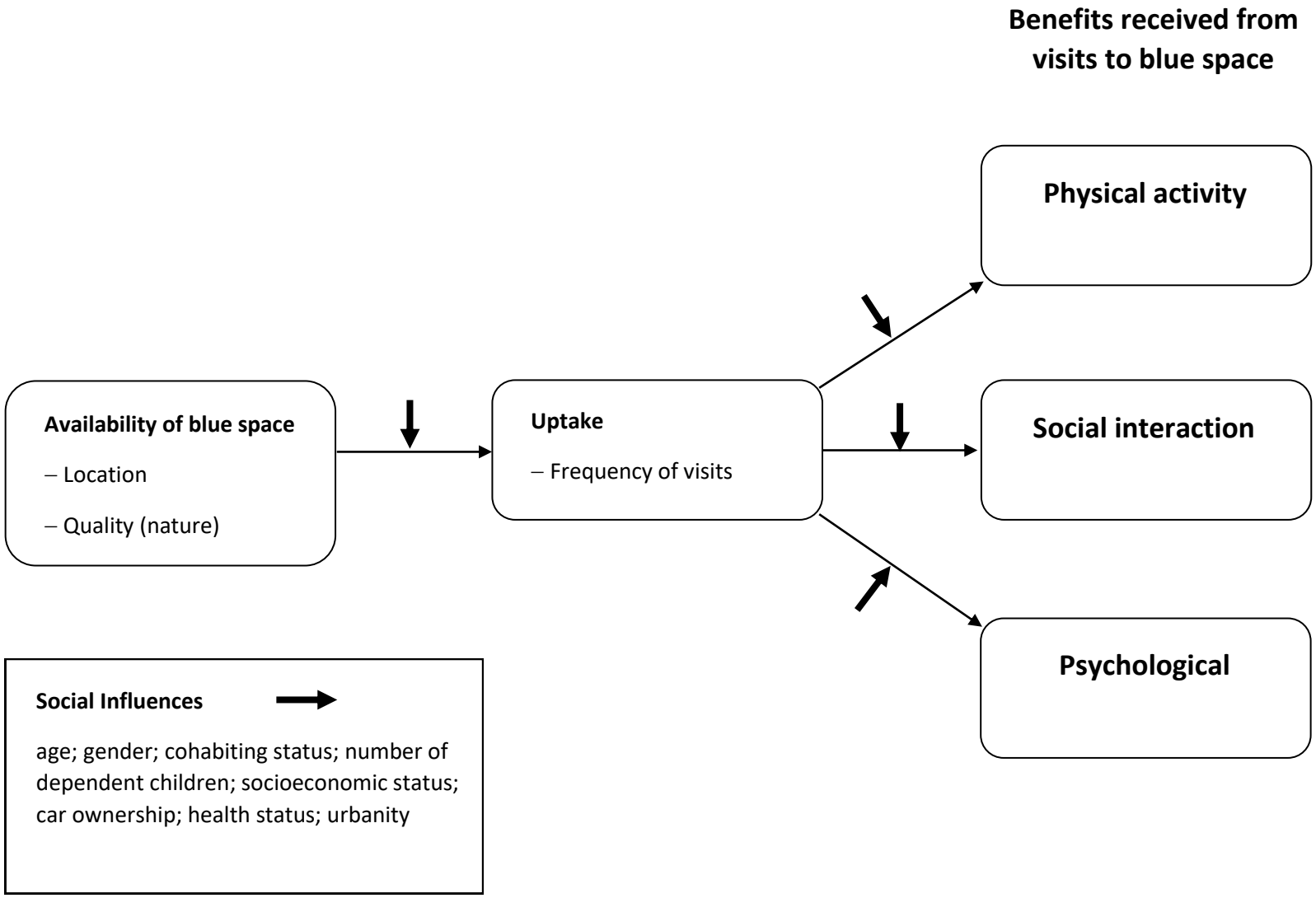

Figure 1 Conceptual model showing the benefits obtained from visiting blue space and possible influences on the relationship, adapted from Hartig et al. (2014).