

BMJ Open

BMJ Open is committed to open peer review. As part of this commitment we make the peer review history of every article we publish publicly available.

When an article is published we post the peer reviewers' comments and the authors' responses online. We also post the versions of the paper that were used during peer review. These are the versions that the peer review comments apply to.

The versions of the paper that follow are the versions that were submitted during the peer review process. They are not the versions of record or the final published versions. They should not be cited or distributed as the published version of this manuscript.

BMJ Open is an open access journal and the full, final, typeset and author-corrected version of record of the manuscript is available on our site with no access controls, subscription charges or pay-per-view fees (<http://bmjopen.bmj.com>).

If you have any questions on BMJ Open's open peer review process please email info.bmjopen@bmj.com

BMJ Open

Changes in the frequency and experiences of visits to green space following restrictions on movement during the COVID-19 pandemic: A nationally representative cross-sectional study of UK adults.

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2020-044067
Article Type:	Original research
Date Submitted by the Author:	21-Aug-2020
Complete List of Authors:	Burnett, Hannah; University of Glasgow, MRC/CSO Social and Public Health Sciences Unit Olsen, Jonathan; University of Glasgow, MRC/CSO Social and Public Health Sciences Unit Nicholls, Natalie; University of Glasgow, MRC/CSO Social and Public Health Sciences Unit Mitchell, Richard; University of Glasgow, MRC/CSO Social and Public Health Sciences Unit
Keywords:	MENTAL HEALTH, COVID-19, PUBLIC HEALTH

SCHOLARONE™
Manuscripts



I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

1
2
3 **Changes in the frequency and experiences of visits to green space following**
4 **restrictions on movement during the COVID-19 pandemic: A nationally**
5 **representative cross-sectional study of UK adults.**
6
7

8 **Hannah Burnett¹, Jonathan R Olsen¹, Natalie Nicholls¹, Richard Mitchell¹**
9 **¹MRC/CSO Social and Public Health Sciences Unit, University of Glasgow, Berkeley**
10 **Square, 99 Berkeley Street, Glasgow, G3 7HR, United Kingdom.**
11
12

13 **Correspondence:**
14 **Hannah Burnett**
15 **MRC/CSO Social and Public Health Sciences Unit,**
16 **University of Glasgow,**
17 **Berkeley Square,**
18 **99 Berkeley Street,**
19 **Glasgow,**
20 **G3 7HR.**
21 **Email: h.burnett.1@research.gla.ac.uk**
22
23

24 **Key words: mental health; COVID-19; public health.**
25
26

27 **Word Count: 3,054**
28 **Tables : 3**
29 **Figures : 1**
30 **Supplementary tables : 3**
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

ABSTRACT

Objectives Green space has previously been found to positively influence health and well-being, however inequalities in green space visitation are prevalent. Restrictions on movement enforced due to the COVID-19 pandemic could have exacerbated the existing inequalities regarding who visits green space. Therefore, this study aimed to explore how restrictions on movement have changed the frequency and experiences of visits to green space in the United Kingdom (UK) and how these differed by individual-level demographic and socio-economic characteristics.

Design and outcome measures A nationally representative cross-sectional survey administered through YouGov between 30th April – 1st May 2020. Data were collected on the frequency of visits and experiences within green space, including missing social interaction, increased physical activity, and feeling greater mental health benefits in green space. Demographic information was collected on sex, age, ethnicity, social grade and dog ownership. Associations between specific outcome variables and predictors were assessed using logistic regression.

Setting United Kingdom, with population weights applied.

Participants 2,252 adults aged 18 years and over.

Results Overall, 63% of respondents reported a decrease in green space visits following restrictions on movement. Lower social grade respondents were less likely to visit green space before *and* after restrictions were enforced (OR: 0.35 (95% CI: 0.24-0.51); OR: 0.68 (95% CI: 0.56-0.83)). Older (65+) (OR: 1.30 (95% CI: 1.04-1.64)) and female (OR: 1.26 (95% CI: 1.04-1.54)) respondents were more likely than middle age (25 to 64 years) and male respondents to report decreased visits and to agree that green space benefitted their mental health more following restrictions on movement.

Conclusions Inequalities in green space use were sustained, and possibly exacerbated, during restrictions on movement. Further investigation is required to determine how these patterns change through the different stages of the COVID-19 pandemic in the UK.

(Word Count: 289)

Strengths and Limitations of this study

- Our data are currently the only existing data covering change in the frequency and experiences of green space for the UK population following the restrictions on movement enforced due to the COVID-19 pandemic.
- The sample is nationally representative of UK adults.
- The data collected for this study were from a cross-sectional survey, therefore it is not possible to demonstrate causality between change in green space use and experiences and the demographic data.
- Certain variable response categories were recategorised for analysis, which meant that some distinctiveness across groups were lost, particularly for the ethnicity and age variables.

INTRODUCTION

Evidence suggests that exposure to green space has a positive influence on health and well-being.[1,2] Green space has been found to increase levels of social interaction and physical activity, and decrease levels of all-cause mortality, loneliness and stress.[3–5] Additionally, there is evidence that contact with green space may disproportionately benefit disadvantaged populations, reducing health inequalities and therefore weakening the effects of poverty – known as the ‘equigenic’ effect.[6,7]

The health impacts of contact with green spaces are quite well studied by both observational and experimental designs. There is rather less literature on the levels, motivations and barriers of visiting green spaces in the first place. Recent surveys by Natural England and Scottish Natural Heritage have found that 74% of the English population and 70% of the Scottish population visit green space ‘frequently’ (once a month or more often). In both countries, the top three reasons stated for frequent green space use were health and exercise, walking the dog, and to relax/unwind.[8,9] Further research exploring the motivations and reasons for visiting green space found that visitation frequency is affected by an individual’s feelings of nature connectedness, as well as their childhood exposure to nature.[10–12]. It is important to note that substantial inequalities in green space use have also been reported, with existing studies stating that females, older people and those from less advantaged socioeconomic positions (SEP) are more likely to be infrequent users than their male, younger and higher SEP counterparts.[9,13–15]

In 2020, the United Kingdom (UK) experienced major disruption to everyday life due to the novel coronavirus disease 2019 (COVID-19) pandemic. COVID-19 is an infectious disease first identified in the city of Wuhan, China in December 2019.[16] As a result of the COVID-19 outbreak, the UK announced a series of restrictions on movement from 23rd March 2020. These included rules around social distancing, meaning that people could only leave their households to make ‘essential trips’ for food, medication and exercise.[17] The aim of this research was to explore changes in the frequency and experience of visits to green space among the UK population following restrictions on movement. The sociodemographic characteristics focused on were those identified by the literature as being most consistent markers of inequality in use. The research questions were:

- 1) How did frequency of green space use change following restrictions on movement, compared with before, and for whom?
- 2) How did experiences of visits to green space change following the restrictions, and did any change vary by sex, social grade, age, ethnicity and dog ownership?
Specifically,
 - a) Did respondents feel that green space benefitted their mental health more since restrictions than before?
 - b) Did respondents miss social interaction in green space more following restrictions on movement?
 - c) Had physical activity increased following restrictions on movement?

METHODS

Survey design and sample

An online cross-sectional survey was administered by YouGov between 30th April and 1st May 2020.[18] Questions were answered by a sample of 2,252 adults from the UK (aged 18 and over). The sample was drawn from a panel of over 800,000 individuals who specifically opted in to participate in online research activities. Sample members were selected at random from the panel and sent an email providing a survey link. Table 1 shows the themes and specific survey instruments analysed in this paper. Demographic information about participants was also collected (including sex, age and social grade, which was classified by occupation).[19,20] Although the sample was reasonably large, small numbers in variable response categories necessitated some category mergers (Table 1 and Supplementary Table 1).

The survey covered adults from across the UK, with respondents from England (N=1,875), Scotland (N=209), Wales (N=107), Northern Ireland (N=61) and weightings were applied to render the sample representative of UK adults (detailed below). When the survey was distributed, the same restrictions on movement were implemented across the UK. Since then, the individual parliaments/assemblies representing these countries have imposed different COVID-19 policies.

Table 1: Survey themes and specific items analysed, including variables recategorised.

Themes	Question/statement	Potential responses	Recategorised
Visit frequency and change	<i>"Did you EVER visit a green space in the year before the movement restrictions were enforced in the UK?"</i>	Yes, I did No, I didn't Don't know/ can't recall	-
	<i>"Please think about your behaviour since the UK enforced a 'lock down' to restrict movement, as a result of the current Coronavirus (COVID-19) outbreak (i.e. since 23rd March 2020). Have you visited a green space since the movement restrictions have been enforced in the UK?"</i>	Yes, I have No, I haven't Don't know/ can't recall	-
	<i>"How much, if at all, has the amount of time that you have spent visiting green spaces changed since the 'lock down' movement restrictions began (i.e. 23rd March 2020) compared to before?"</i>	Increased a lot Increased a little No difference Decreased a little Decreased a lot Don't know	'Increased' (increased a lot and increased a little vs. no difference, decreased a little and decreased a lot) 'Decreased' (decreased a lot and decreased a little vs. no difference, increased a little and increased a lot)
Experience change (If respondent had visited a green space since the movement	<i>"I feel that being in green spaces benefits my mental health <u>more now</u>, than before the movement restrictions were in place"</i>	Strongly agree Slightly agree Neither agree nor disagree Slightly disagree Strongly disagree Don't know/ can't recall	'Agree' (strongly agree and slightly agree vs. neither agree nor disagree, slightly disagree, and strongly disagree) 'Disagree' (slightly disagree and strongly disagree vs. neither agree nor disagree, slightly agree, and strongly agree)

restrictions were enforced)	<i>"I have missed seeing and/ or talking with people in green spaces since the movement restrictions were introduced"</i>	Strongly agree Slightly agree Neither agree nor disagree Slightly disagree Strongly disagree Don't know/ can't recall	'Agree' (strongly agree and slightly agree vs. neither agree nor disagree, slightly disagree, and strongly disagree) 'Disagree' (slightly disagree and strongly disagree vs. neither agree nor disagree, slightly agree, and strongly agree)
	<i>"I do more physical activity in green spaces now, than I did before the movement restrictions were introduced"</i>	Strongly agree Slightly agree Neither agree nor disagree Slightly disagree Strongly disagree Don't know/ can't recall	'Agree' (strongly agree and slightly agree vs. neither agree nor disagree, slightly disagree, and strongly disagree) 'Disagree' (slightly disagree and strongly disagree vs. neither agree nor disagree, slightly agree, and strongly agree)

Demographic variables

Individual level demographic and socio-economic characteristics were captured from the survey, as follows: sex (male, female); age group (18-24 years, 25-64 years, 65+ years); ethnicity (White, Black, Asian and minority ethnic (BAME)); dog ownership (Yes, No); and social grade (ABC1, C2DE), derived by YouGov from combined occupational social grade categories. ABC1 was the higher social grade, and included non-manual workers, for example, senior managers and owners of small establishments. C2DE was the lower social grade, and included all manual workers, for example, shop assistants and labourers.[21] Hereafter, social grade will be described as higher and lower social grade.

Patient and Public Involvement

There was no direct patient or public involvement in this study.

Analyses

Descriptive statistics

The count and proportion of respondents who had: visited green space before and after restrictions on movement were enforced; increased or decreased visitation; and agreed or disagreed with the three change in experience statements (Table 1) are presented. These were also explored by sex, age, ethnicity, dog ownership and social grade.

Statistical analysis

Multiple binary logistic regression analyses were conducted to assess the association between the individual predictor variables and each of the following outcomes:

1. having visited green space in the year before restrictions on movement were enforced;
2. having visited green space since restrictions on movement were enforced;

3. having increased green space visitation following restrictions on movement;
4. having decreased green space visitation following restrictions on movement;
5. agreeing that green space benefits their mental health more now (since restrictions on movement were enforced compared to before);
6. agreeing that they miss seeing/talking to people in green space now (since restrictions on movement were enforced compared to before); and
7. agreeing that they do more physical activity in green space now (since restrictions on movement were enforced compared to before).

Associations were expressed as odds ratios (OR) with 95% confidence intervals (CIs). Univariate models for each predictor were conducted first, followed by a fully adjusted model containing all predictors for each outcome. Weightings were calculated by YouGov and applied during analyses to render the sample representative of UK adults.[20] All analyses were conducted in R v3.5.1,[22] a full R script is available on GitHub.[23]

Interactions

Given existing literature,[9,13,24,25] we expected some interactions between predictor variables, which included sex, age, social grade, ethnicity and dog ownership, in their relationships with change in frequency and experiences within green spaces following restrictions on movement. We therefore explored interactions, adding interaction terms to the models, assessing their significance via Wald tests, and then producing predicted probabilities to aid interpretation of the significant interactions.

RESULTS

Descriptive statistics

93% of all respondents had visited green space in the year before restrictions on movement were enforced (Supplementary Table 2). In contrast, 49% of respondents reported visiting green space following restrictions on movement. 63% of respondents reported that the amount of time they spent in green space had decreased since restrictions on movement compared to before, with 15% reporting an increase, and 22% reporting no difference in visitation frequency.

A greater proportion of respondents agreed (65%) than disagreed (35%) that green space benefited their mental health more following restrictions on movement compared to before (Supplementary Table 3). More respondents agreed (54%) that they missed social interaction in green space more since restrictions on movement, than disagreed (46%). 71% of respondents disagreed that they had increased physical activity in green space since restrictions on movement, compared to 29% who agreed.

Visit frequency and change

Visiting green space before restrictions on movement

In the adjusted logistic regression model for visiting green space in the year before restrictions on movement were enforced (Table 2), only two variables had significant associations ($p < 0.05$). Lower social grade respondents (OR: 0.35 (95%CI: 0.24-0.51)) and

1
2
3 BAME (OR: 0.43 (95%CI: 0.23-0.80)) respondents both had lower odds of visiting green
4 space before restrictions on movement were enforced, compared to higher social grade and
5 white respondents.
6
7

8 Visiting green space following restrictions on movement 9

10 Respondents in the lower social grade group were less likely to have visited green space than
11 respondents in the higher social grade group (OR: 0.68 (95%CI: 0.56-0.83)) (Table 2).
12 Respondents who owned a dog/s were more likely than respondents who did not to have
13 visited green space after restrictions on movement were enforced (OR: 1.44 (95%CI: 1.16-
14 1.79)).
15
16
17
18

19 Change in frequency of green space visitation 20

21 Lower social grade respondents were less likely than higher social grade respondents to
22 report increased visits following restrictions on movement (OR: 0.52 (95%CI: 0.38-0.70))
23 (Table 2). Older respondents (aged 65+) were less likely to report increased green space
24 visitations than respondents aged between 25-64 years (OR: 0.59 (95%CI: 0.41-0.84)). Sex
25 and older age were significantly associated with *decreased* visits. Females were more likely
26 to report decreased green space visits compared to males (OR: 1.26 (95%CI:1.04-1.54)), and
27 older respondents were more likely to report a decrease in green space visits than respondents
28 aged 25-64 years (OR: 1.30 (95%CI: 1.04-1.64)) (Table 2).
29
30
31

32 Interaction effects 33

34 Three interactions were significant ($p < 0.05$); one between social grade and ethnicity in their
35 association with visiting green space before restrictions on movement, and two between age
36 and ethnicity, in their association with visiting green spaces since restrictions on movement
37 and with *increased* visits since restrictions on movement.
38
39

40 Higher social grade white respondents had the highest probability of visiting green space
41 before lockdown, but lower social grade BAME respondents were more likely to have visited
42 green space before lockdown than the higher social grade BAME respondents (Figure 1).
43 Young BAME respondents had a higher probability of visiting green space and reporting
44 increased visits since lockdown compared to white and older BAME respondents. However,
45 the number of BAME respondents, especially young and older BAME respondents, in this
46 sample was small and these results should be interpreted with caution.
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Table 2: Adjusted binary logistic regression models predicting change in frequency of green space visitation. OR = odds ratio; CI = confidence intervals; $p < 0.05$.

	Visited green space in the year before restrictions ('yes')		Visited green space after restrictions ('yes')		Green space visitation change since lockdown ('increased')		Green space visitation change since lockdown ('decreased')	
	Adjusted		Adjusted		Adjusted		Adjusted	
	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value
Sex								
Male (ref)	-	-	-	-	-	-	-	-
Female	1.35 (0.94-1.95)	0.109	0.92 (0.76-1.11)	0.361	0.96 (0.72-1.27)	0.755	1.26 (1.04-1.54)	0.020
Social grade								
ABC1 (ref)	-	-	-	-	-	-	-	-
C2DE	0.35 (0.24-0.51)	<0.001	0.68 (0.56-0.83)	<0.001	0.52 (0.38-0.70)	<0.001	0.96 (0.79-1.17)	0.704
Age								
18-24	2.92 (1.00-8.57)	0.051	0.93 (0.63-1.36)	0.692	1.60 (0.97-2.63)	0.064	0.77 (0.52-1.15)	0.201
25-64 (ref)	-	-	-	-	-	-	-	-
65+	1.22 (0.80-1.85)	0.353	0.81 (0.65-1.01)	0.058	0.59 (0.41-0.84)	0.004	1.30 (1.04-1.64)	0.023
Ethnicity								
White (ref)	-	-	-	-	-	-	-	-
BAME	0.43 (0.23-0.80)	0.007	0.91 (0.59-1.39)	0.651	1.15 (0.63-2.08)	0.650	0.67 (0.43-1.03)	0.068
Dog ownership								
Don't own a dog/s (ref)	-	-	-	-	-	-	-	-
Own a dog/s	1.29 (0.83-2.00)	0.260	1.44 (1.16-1.79)	0.001	0.74 (0.53-1.03)	0.070	0.83 (0.67-1.04)	0.109

Change in visit experience

Mental health benefits

Agreeing that green space benefits mental health more since restrictions on movement compared to before was associated with sex, social grade, age (only 65+) and dog ownership (Table 3). Females were more likely to agree than males that being in green space benefitted their mental health more following restrictions on movement than before (OR: 1.60 (95% CI: 1.19-2.15)). Whilst lower social grade (OR: 0.69 (95% CI: 0.51-0.93)), older respondents (OR: 0.58 (95% CI: 0.42-0.82)), and dog owners (OR: 0.72 (95% CI: 0.52-0.98)) were less likely to agree.

Missed social interaction

Female respondents were more likely to agree that they missed seeing and talking with other people in green space since restrictions on movement compared to before than male respondents (OR: 1.72 (95% CI: 1.30-2.28)) (Table 3).

Increased physical activity

Younger respondents were more likely (OR: 1.93 (95% CI: 1.06-3.54)) than the middle age group respondents to agree that they had done more physical activity since restrictions on movement were enforced whilst older respondents were less likely to agree (OR: 0.53 (95% CI: 0.35-0.79)) (Table 3). Respondents who owned a dog/s were less likely than respondents without a dog/s to agree (OR: 0.45 (95% CI: 0.31-0.65)).

DISCUSSION

There was a general polarisation of use following restrictions on movement; for example, older respondents reported decreased visits to green space, whilst younger respondents reported increased physical activity levels in green spaces following restrictions on movement. Our findings suggest that inequalities in use of green space between demographic groups were sustained following restrictions on movement, with lower social grade individuals less likely than higher social grade individuals to have visited green space before and since restrictions on movement. These inequalities were possibly exacerbated in the month after restrictions on movement were enforced, as females and older respondents were more likely to report a decrease in visits following restrictions on movement.

The proportion of respondents who visited green space before and following restrictions on movement decreased, from 93% to 49%. This was consistent with Natural England's findings from April 2020 where 49% of English adults reported green space visits in the previous two weeks.[26] Natural England conducted an online panel survey in April 2020 (N=2,083), the survey covered only the English population, collecting information on the frequency of time in green and natural spaces in the 12 months, and then 2 weeks, prior to the survey.[27] The survey did not directly ask respondents about whether they felt their experiences within green space had changed following restrictions on movement.

Table 3: Adjusted binary logistic regression models predicting change in experience of green space since restrictions. OR = odds ratio; CI = confidence intervals; $p < 0.05$.

	Using green spaces benefits my mental health more now ('agree')		Miss social interaction in green spaces now ('agree')		Do more physical activity in green spaces now ('agree')	
	Adjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Sex						
Male (ref)	-	-	-	-	-	-
Female	1.60 (1.19-2.15)	0.002	1.72 (1.30-2.28)	<0.001	1.22 (0.88-1.68)	0.232
Social grade						
ABC1 (ref)	-	-	-	-	-	-
C2DE	0.69 (0.51-0.93)	0.014	0.79 (0.59-1.06)	0.118	0.81 (0.58-1.14)	0.227
Age						
18-24	0.59 (0.32-1.11)	0.102	1.40 (0.77-2.57)	0.270	1.93 (1.06-3.54)	0.033
25-64 (ref)	-	-	-	-	-	-
65+	0.58 (0.42-0.82)	0.002	1.08 (0.78-1.50)	0.643	0.53 (0.35-0.79)	0.002
Ethnicity						
White (ref)	-	-	-	-	-	-
BAME	1.72 (0.80-3.69)	0.162	1.03 (0.53-2.01)	0.923	1.47 (0.73-2.96)	0.278
Dog ownership						
Don't own a dog/s (ref)	-	-	-	-	-	-
Own a dog/s	0.72 (0.52-0.98)	0.038	1.25 (0.92-1.70)	0.154	0.45 (0.30-0.65)	<0.001

1
2
3 Females and older individuals were more likely to have reported decreased visits to green
4 space following restrictions on movement. These findings corroborate with existing data
5 collected before restrictions on movement.[9,13,14] Boyd *et al.* analysed the Natural England
6 ‘Monitor of Engagement with the Natural Environment’ survey (N=63,890) with a focus on
7 infrequent use. They found that females and older adults in England were more likely to be
8 infrequent visitors.[9] Cohen *et al.* explored physical activity levels in Los Angeles’ parks
9 (N=1,318). They reported that age and sex were predictors of park use, with <5% of park
10 users over 60 years old, and males using parks more often than females (62% vs. 38%).[13]
11
12

13
14 Our findings suggested that existing patterns of inequality in use by females were sustained
15 and potentially exacerbated due to fears arising from the COVID-19 pandemic. For example,
16 an Ipsos MORI survey was conducted in April 2020, collecting data on gender differences in
17 British attitudes towards COVID-19. They found that women were more likely to report
18 following government rules to avoid leaving their home (78%) than men (68%) and felt more
19 uncomfortable about returning to “normal” (N=1,000).[28,29]
20
21

22 Previous studies have found that females feel more vulnerable than males in green spaces,
23 especially without company.[14,15,24,30–32] There are few quantitative studies focusing on
24 sex and the importance of social interaction as a motivation behind green space use. We
25 found that females were more likely to agree that they missed seeing/talking with others in
26 green space than males. This could be explained by the nature of the restrictions on
27 movement at this time, particularly the inability to socially interact with individuals outside
28 your household in green space.
29
30

31 Given older age is probably the most important risk factor for an adverse outcome from
32 COVID-19,[33,34] it was not surprising that older individuals were more likely to report a
33 decrease in green space visits and to disagree that they were doing more physical activity
34 following restrictions on movement. These findings corroborate with the majority of research
35 exploring older age and green space use before the restrictions on movement.[9,13,35] The
36 significant decrease in green space visits following restrictions on movement for older
37 respondents could be explained by the government advice for over 70s and those with an
38 underlying health condition to shield, minimise interaction and stay at home, for around 12
39 weeks from 21st March 2020.[36]
40
41

42 Lower social grade respondents reported little or no change in visitation to green space, with
43 visit frequency remaining low both before and after restrictions on movement. This is
44 supported by previous studies exploring the association between socio-economic position
45 (SEP) and green space use.[9,15,35] One possible explanation is a lack of interest in visiting
46 green space reported by lower SEP individuals.[9] Additionally, the social grade variable was
47 categorised by occupation, and it was likely that individuals categorised as lower social grade
48 were working in manual or service occupations.[21] They may have continued at their usual
49 workplace/working hours during the COVID-19 pandemic. Findings from the Office for
50 National Statistics support this explanation, with 30.5% of employees in the bottom three
51 income deciles (monthly earnings of up to £1,450) considered as key workers in March/April
52 2020, compared to 26.4% in the top three income deciles (monthly earnings of up to
53 £3,250).[37]
54
55
56

57 Younger BAME respondents had a higher probability of visiting green space following
58 restrictions on movement and reporting increased visits since restrictions on movement,
59 compared to white and older BAME respondents. A survey on park use and ethnic integration
60

1
2
3 in Reading, UK (N=294) reported similar findings, with Black and Asian youths accounting
4 for a higher proportion of parks users than white youths.[38] Further exploration is required
5 to enable interpretation of these interaction results because of our small BAME sample.
6
7

8 **Strengths and limitations**

9

10 Our study has several strengths; to our knowledge, currently this is the only data covering
11 UK population change in use and experiences within green space at the start of the
12 restrictions on movement from 23rd March 2020. This means that the data could provide
13 timely information to local and national governments across the UK. The rapid collection of
14 data, just over a month after the restrictions on movement were introduced, reduces risk of
15 recall bias. The sample is nationally representative of UK adults, with weightings calculated
16 by YouGov and applied to all analyses, reducing risk of selection bias.
17
18

19 A further strength of our study is providing quantitative data on the importance of social
20 interaction as a driver for using green space, which is under-reported in the literature. We
21 analysed social grade at an individual level, which provides greater detail and accuracy of the
22 respondent's SEP than at neighbourhood level.
23
24

25 There are some caveats. The survey design was cross-sectional, and we are unable to
26 demonstrate causality between change in green space use and experiences and the
27 demographic data. Additionally, the data on use and experiences are self-reported and
28 therefore subjective. Certain variable response categories had to be recategorised in order to
29 analyse them. This is particularly evident in the ethnicity and age variables, where some
30 distinctiveness across groups was lost.
31
32

33 We encourage future research to further investigate the interactions between ethnicity, age
34 and social grade in relation to green space use to enable more substantial interpretation of the
35 results and to explore whether the patterns are consistent over time and in different contexts.
36 Moreover, further research is required to explore the reasons *why* many patterns and changes
37 in use of green space since restrictions on movement have emerged.
38
39

40 **CONCLUSION**

41

42 During the COVID-19 pandemic, our study provides timely and novel evidence to suggest
43 that green space use and experiences were affected during the first month of restrictions on
44 movement in the UK. Our findings suggested that inequalities in use were sustained, with
45 lower social grade individuals less likely to visit green space than higher social grade
46 individuals before and following restrictions on movement were enforced. It is possible that
47 these inequalities were exacerbated, as females and older individuals were the groups most
48 likely to report decreased visits following restrictions on movement. Further investigation is
49 required to support these findings and how they may change through the stages of the
50 COVID-19 pandemic and the relaxing, and potential re-introduction, of restrictions on
51 movement.
52
53
54

55 **COMPETING INTERESTS**

56 None declared.
57

58 **DATA SHARING STATEMENT**

59
60

We have made our research dataset publicly available (Datacite DOI: 10.5525/gla.researchdata.1038 - embargoed until 31/10/2023).

CONTRIBUTORS

HB, JRO and RM designed the study and survey; HB conducted data analysis which was reviewed by NN; HB wrote the first draft of the paper; all authors contributed to interpreting the results and revising the draft. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

FUNDING STATEMENT

The authors (HB, JRO, NN & RM) are part of the Places and Health Programme at the MRC/CSO Social and Public Health Sciences Unit (SPHSU), University of Glasgow, supported by the Medical Research Council (MC_UU_12017/10) and the Chief Scientist Office (SPHSU10).

References:

- 1 Barton J, Pretty J. What is the Best Dose of Nature and Green Exercise for Improving Mental Health? A Multi-Study Analysis. *Environ Sci Technol* 2010;**44**:3947–55. doi:10.1021/es903183r
- 2 Douglas O, Lennon M, Scott M. Green space benefits for health and well-being: A life-course approach for urban planning, design and management. *CITIES* 2017;**66**:53–62. doi:10.1016/j.cities.2017.03.011
- 3 Twohig-Bennett C, Jones A. The health benefits of the great outdoors: A systematic review and meta-analysis of greenspace exposure and health outcomes. *Environ Res* 2018;**166**:628–37. doi:10.1016/j.envres.2018.06.030
- 4 Maas J, Van Dillen SME, Verheij RA, *et al.* Social contacts as a possible mechanism behind the relation between green space and health. *Health Place* 2009;**15**:586–95. doi:10.1016/j.healthplace.2008.09.006
- 5 Wells N, Evans G. NEARBY NATURE A Buffer of Life Stress Among Rural Children. *Environ Behav* 2003;**35**:311–30. doi:10.1177/0013916503251445
- 6 Frumkin H, Bratman GN, Breslow SJ, *et al.* Nature Contact and Human Health: A Research Agenda. *Environ Health Perspect* 2017;**125**. doi:10.1289/EHP1663
- 7 Mitchell RJ, Richardson EA, Shortt NK, *et al.* Neighborhood Environments and Socioeconomic Inequalities in Mental Well-Being. *Am J Prev Med* 2015;**49**:80–4. doi:10.1016/j.amepre.2015.01.017
- 8 Wilson V, Seddon B. Scotland's People and Nature Survey 2017/18 – outdoor recreation and health modules. (Scottish Natural Heritage Research Report No. 1062). Inverness: 2018.
- 9 Boyd F, White MP, Bell SL, *et al.* Who doesn't visit natural environments for recreation and why: A population representative analysis of spatial, individual and temporal factors among adults in England. *Landsc Urban Plan* 2018;**175**:102–13. doi:10.1016/j.landurbplan.2018.03.016
- 10 Bell SL, Phoenix C, Lovell R, *et al.* Green space, health and wellbeing: making space for individual agency. *Health Place* 2014;**30**:287–92. doi:10.1016/j.healthplace.2014.10.005
- 11 Lin BB, Fuller RA, Bush R, *et al.* Opportunity or Orientation ? Who Uses Urban Parks and Why. 2014;**9**:1–7. doi:10.1371/journal.pone.0087422
- 12 Ward Thompson C, Aspinall P, Montarzino A. The Childhood Factor Adult Visits to Green Places and the Significance of Childhood Experience. *Environ Behav*

- 2008;**40**:111–43. doi:10.1177/0013916507300119
- 13 Cohen DA, McKenzie TL, Sehgal A, *et al.* Contribution of Public Parks to Physical Activity. *Am J Public Health* 2007;**97**:509–14. doi:10.2105/AJPH.2005.072447
- 14 Lee ACK, Maheswaran R. The health benefits of urban green spaces: A review of the evidence. *J Public Health (Bangkok)* 2011;**33**:212–22. doi:10.1093/pubmed/fdq068
- 15 Morris J, O'Brien E, Ambrose-Oji B, *et al.* Access for all? Barriers to accessing woodlands and forests in Britain. *Local Environ Int J Justice Sustain* 2011;**16**:375–96. doi:10.1080/13549839.2011.576662
- 16 Wynants L, Van Calster B, Bonten MMJ, *et al.* Prediction models for diagnosis and prognosis of covid-19 infection: systematic review and critical appraisal . *BMJ* 2020;**369**. doi:10.1136/bmj.m1328
- 17 Johnson B. Prime Minister's statement on coronavirus (COVID-19): 23 March 2020. GOV.UK. 2020.<https://www.gov.uk/government/speeches/pm-address-to-the-nation-on-coronavirus-23-march-2020> (accessed 7 Jul 2020).
- 18 YouGov. About YouGov Company. <https://yougov.co.uk/about/> (accessed 8 Jun 2020).
- 19 YouGov and ESOMAR (World Association for Social Opinion and Market Research). ESOMAR 28: 28 Questions to help Online Research Buyers. The Netherlands: 2012. http://cdn.yougov.com/cumulus_uploads/document/t3r5k565j5/ESOMAR_28.pdf (accessed 8 Jun 2020).
- 20 YouGov. Panel Methodology. <https://yougov.co.uk/about/panel-methodology/> (accessed 8 Jun 2020).
- 21 The Market Research Society (MRS). Definitions employed in Social Grading. MRS. [https://www.mrs.org.uk/pdf/Definitions used in Social Grading based on OG7.pdf](https://www.mrs.org.uk/pdf/Definitions%20used%20in%20Social%20Grading%20based%20on%20OG7.pdf) (accessed 2 Jul 2020).
- 22 R Core Team. R: A Language and Environment for Statistical Computing. 2018.<https://www.r-project.org/>
- 23 Burnett H. Change in green space use and experiences following UK restrictions on movement. GitHub. 2020.https://github.com/hannahburnett/greenspace-covid_code (accessed 21 Jul 2020).
- 24 Richardson EA, Mitchell R. Gender differences in relationships between urban green space and health in the United Kingdom. *Soc Sci Med* 2010;**71**:568–75. doi:10.1016/J.SOCSCIMED.2010.04.015
- 25 Astell-Burt T, Mitchell R, Hartig T, *et al.* The association between green space and mental health varies across the lifecourse. A longitudinal study. *J Epidemiol Community Heal* 2014;**68**:578–83. doi:10.1136/jech-2013-203767
- 26 Natural England. The People and Nature Survey for England: Monthly interim indicators for April 2020 (Experimental Statistics) . Nat. Engl. 2020.<https://www.gov.uk/government/publications/the-people-and-nature-survey-for-england-monthly-interim-indicators-for-april-2020-experimental-statistics/the-people-and-nature-survey-for-england-monthly-interim-indicators-for-april-2020-experimental-statistics> (accessed 25 Jun 2020).
- 27 Natural England. The People and Nature Survey For England. 2020. <http://publications.naturalengland.org.uk/publication/6382837173583872>
- 28 Ipsos MORI. Gender differences in attitudes towards Coronavirus. 2020. https://www.ipsos.com/sites/default/files/ct/news/documents/2020-05/fawcett_society_presentation.pdf (accessed 10 Jul 2020).
- 29 Ipsos MORI, The Fawcett Society. 6 in 10 women finding it harder to stay positive day-to-day due to Coronavirus: Women more likely to bearing the emotional and impact of the pandemic . Fawcett Soc.

- 2020.<https://www.fawcettsociety.org.uk/Handlers/Download.ashx?IDMF=f173fde3-4edb-4c51-8453-7244e867ed90> (accessed 10 Jul 2020).
- 30 Thompson CW, Aspinall P, Bell S, *et al.* “It Gets You Away From Everyday Life”: Local Woodlands and Community Use—What Makes a Difference? *Landsc Res* 2007;**30**:109–46. doi:10.1080/0142639042000324794
- 31 Burgess J. Focusing on Fear: The Use of Focus Groups in a Project for the Community Forest Unit, Countryside Commission. 1996.
- 32 O’Brien L, Morris J. Well-being for all? The social distribution of benefits gained from woodlands and forests in Britain. *Local Environ Int J Justice Sustain* 2014;**19**:356–83. doi:10.1080/13549839.2013.790354
- 33 Public Health England. Disparities in the risk and outcomes from COVID-19. London: 2020. www.facebook.com/PublicHealthEngland (accessed 26 Jul 2020).
- 34 Office for National Statistics. Deaths registered weekly in England and Wales, provisional: week ending 10 July 2020. ONS. 2020.<https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/deathsregisteredweeklyinenglandandwalesprovisional/latest#deaths-registered-by-age-group> (accessed 26 Jul 2020).
- 35 TNS. Scotland’s People and Nature Survey 2013/14. (Scottish Natural Heritage Commissioned Report No. 679). 2014.
- 36 Johnson B. Prime Minister’s statement on coronavirus (COVID-19): 16 March 2020. GOV.UK. 2020.<https://www.gov.uk/government/speeches/pm-statement-on-coronavirus-16-march-2020> (accessed 26 Jun 2020).
- 37 Office for National Statistics. Coronavirus and how people spent their time under lockdown. ONS. 2020.<https://www.ons.gov.uk/economy/nationalaccounts/satelliteaccounts/bulletins/coronavirusandhowpeoplespenttheirtimeunderrestrictions/28marchto26april2020> (accessed 16 Jul 2020).
- 38 Ravenscroft N, Markwell S. Ethnicity and the integration and exclusion of young people through urban park and recreation provision. *Manag Leis* 2000;**5**:135–50. doi:10.1080/13606710050084838

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

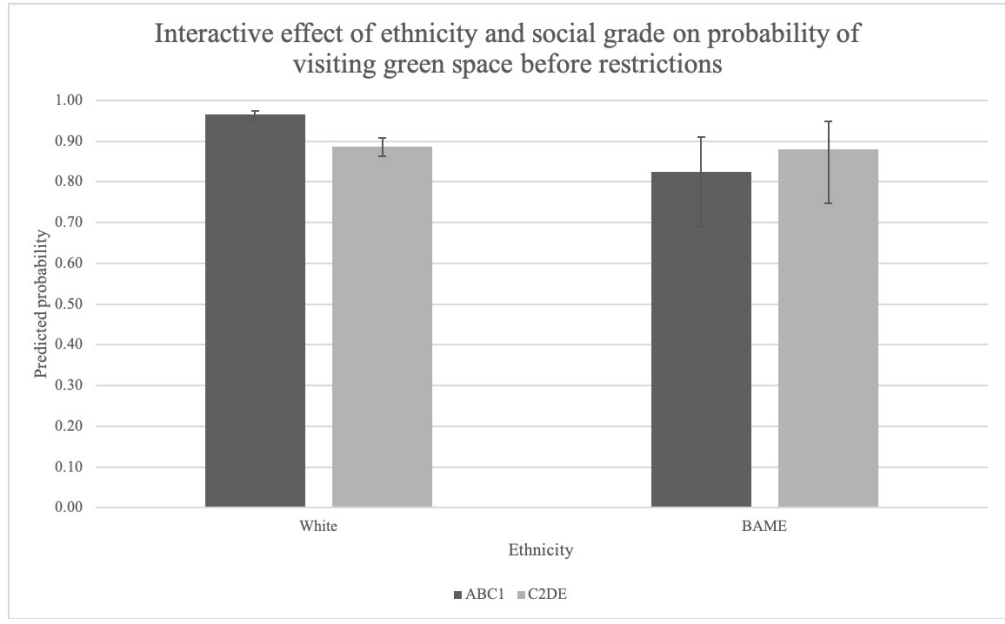


Figure 1: The significant interaction between social grade and ethnicity in their association with visiting green space before restrictions on movement, with 95% confidence interval bars.

202x124mm (144 x 144 DPI)

Supplementary Materials

Supplementary Table 1: Category mergers of the response categories (ethnicity, age, social grade, sex and dog ownership).

	Original categories (Unweighted N)	New categories (Unweighted N)
Ethnicity	White British (1659)	White (1747)
	Any other white background (86)	
	White and Black Caribbean (6)	BAME (87)
	White and Black African (4)	
	White and Asian (8)	
	Any other mixed background (8)	
	Indian (17)	
	Pakistani (5)	
	Bangladeshi (4)	
	Any other Asian background (3)	
	Black Caribbean (4)	
	Black African (3)	
	Any other black background (3)	
	Chinese (10)	
	Other ethnic group (12)	
	Prefer not to say (19)	Missing (418)
	Not answered (399)	
	Age	18-24 (165)
25-34 (316)		25-64 (1497)
35-44 (396)		
45-54 (398)		
55-64 (387)		
65+ (590)		65+ (590)
Social grade	ABC1 (1419)	
	C2DE (833)	
Sex	Male (1018)	
	Female (1234)	
Dog ownership	Yes (616)	
	No (1636)	

Supplementary Table 2: Change in green space visit frequency since restrictions by individual demographic and socio-economic characteristics (weighted).

	Visited green space in the year before restrictions		Visited green space after restrictions		Green space visitation change since lockdown		
	Yes (N=2014; 93%)	No (N=158; 7%)	Yes (N=1086; 49%)	No (N=1123; 51%)	Increased (N=324; 15%)	Decreased (N=1375; 63%)	No difference (N=480; 22%)
	% (N)	% (N)	% (N)	% (N)	% (N)	% (N)	% (N)
Sex							
Male	92% (963)	8% (88)	50% (529)	50% (538)	15% (156)	61% (636)	24% (252)
Female	94% (1050)	6% (70)	49% (557)	51% (585)	15% (167)	65% (739)	20% (228)
Social grade							
ABC1	95% (1186)	5% (59)	53% (667)	47% (590)	18% (228)	63% (775)	19% (236)
C2DE	89% (828)	11% (99)	44% (419)	56% (533)	10% (95)	64% (600)	26% (244)
Age							
18-24	91% (203)	9% (21)	50% (115)	50% (117)	19% (43)	57% (126)	24% (54)
25-64	93% (1335)	7% (103)	51% (746)	49% (712)	16% (232)	62% (895)	22% (314)
65+	93% (477)	7% (35)	43% (225)	57% (294)	9% (48)	69% (354)	22% (112)
Ethnicity							
White	93% (1521)	7% (115)	47% (790)	53% (877)	13% (212)	64% (1057)	23% (378)
BAME	85% (80)	15% (14)	44% (41)	56% (52)	17% (15)	53% (47)	30% (27)
Dog ownership							
Don't own a dog/s	92% (1443)	8% (119)	47% (749)	53% (840)	16% (250)	64% (1003)	20% (314)
Own a dog/s	94% (571)	7% (40)	55% (338)	46% (282)	12% (74)	61% (372)	27% (166)

Supplementary Table 3: Change in green space experience since restrictions by individual demographic and socio-economic characteristics (weighted).

	Using green spaces benefits my mental health more now		Miss social interaction in green spaces now		Do more physical activity in green spaces now	
	Agree (N=689; 65%)	Disagree/neither agree nor disagree (N=368; 35%)	Agree (N=566; 54%)	Disagree/neither agree nor disagree (N=490; 46%)	Agree (N=309; 29%)	Disagree/neither agree nor disagree (N=746; 71%)
	% (N)	% (N)	% (N)	% (N)	% (N)	% (N)
Sex						
Male	59% (301)	41% (211)	46% (238)	54% (278)	27% (138)	73% (375)
Female	71% (387)	29% (157)	61% (328)	39% (211)	32% (171)	69% (371)
Social grade						
ABC1	69% (452)	31% (206)	56% (365)	44% (292)	32% (208)	68% (447)
C2DE	59% (237)	41% (162)	51% (201)	50% (197)	25% (101)	75% (299)
Age						
18-24	60% (64)	40% (42)	61% (66)	39% (42)	46% (50)	55% (60)
25-64	69% (500)	31% (229)	53% (383)	47% (342)	30% (216)	70% (508)
65+	56% (125)	44% (97)	52% (116)	48% (106)	20% (43)	81% (178)
Ethnicity						
White	63% (481)	37% (286)	51% (390)	49% (374)	26% (202)	74% (566)
BAME	73% (29)	28% (11)	51% (21)	49% (20)	44% (17)	56% (22)
Dog ownership						
Don't own a dog/s	68% (498)	32% (232)	52% (379)	48% (351)	34% (248)	66% (479)
Own a dog/s	58% (190)	42% (136)	57% (186)	43% (139)	19% (61)	81% (267)

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	P1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	P2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	P3
Objectives	3	State specific objectives, including any prespecified hypotheses	P3
Methods			
Study design	4	Present key elements of study design early in the paper	P4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	P4
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	P4
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	P4/5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	P4
Bias	9	Describe any efforts to address potential sources of bias	P4, 6
Study size	10	Explain how the study size was arrived at	P4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	P5/6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	P5/6
		(b) Describe any methods used to examine subgroups and interactions	P6
		(c) Explain how missing data were addressed	P4, 6
		(d) If applicable, describe analytical methods taking account of sampling strategy	P4, 6
		(e) Describe any sensitivity analyses	-
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Supplementary Tables 1-3
		(b) Give reasons for non-participation at each stage	-
		(c) Consider use of a flow diagram	-

Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	P5/6, Supplementary Table 1
		(b) Indicate number of participants with missing data for each variable of interest	Supplementary Table 1
Outcome data	15*	Report numbers of outcome events or summary measures	Tables 2 and 3 + Supplementary Tables 2 and 3
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	P6-9
		(b) Report category boundaries when continuous variables were categorized	-
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	P7
Discussion			
Key results	18	Summarise key results with reference to study objectives	P9
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	P12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	P9, 11, 12
Generalisability	21	Discuss the generalisability (external validity) of the study results	P12
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	P13

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Change in time spent visiting and experiences of green space following restrictions on movement during the COVID-19 pandemic: A nationally representative cross-sectional study of UK adults.

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2020-044067.R1
Article Type:	Original research
Date Submitted by the Author:	02-Nov-2020
Complete List of Authors:	Burnett, Hannah; University of Glasgow, MRC/CSO Social and Public Health Sciences Unit Olsen, Jonathan; University of Glasgow, MRC/CSO Social and Public Health Sciences Unit Nicholls, Natalie; University of Glasgow, MRC/CSO Social and Public Health Sciences Unit Mitchell, Richard; University of Glasgow, MRC/CSO Social and Public Health Sciences Unit
Primary Subject Heading:	Public health
Secondary Subject Heading:	Mental health
Keywords:	MENTAL HEALTH, COVID-19, PUBLIC HEALTH

SCHOLARONE™
Manuscripts



I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1 **Change in time spent visiting and experiences of green space following**
2 **restrictions on movement during the COVID-19 pandemic: A nationally**
3 **representative cross-sectional study of UK adults.**

4
5 **Hannah Burnett¹, Jonathan R Olsen¹, Natalie Nicholls¹, Richard Mitchell¹**
6 **¹MRC/CSO Social and Public Health Sciences Unit, University of Glasgow, Berkeley**
7 **Square, 99 Berkeley Street, Glasgow, G3 7HR, United Kingdom.**

8
9 **Correspondence:**

10 **Hannah Burnett**

11 **MRC/CSO Social and Public Health Sciences Unit,**

12 **University of Glasgow,**

13 **Berkeley Square,**

14 **99 Berkeley Street,**

15 **Glasgow,**

16 **G3 7HR.**

17 **Email: h.burnett.1@research.gla.ac.uk**

18
19 **Key words: mental health; COVID-19; public health.**

20
21 **Word Count: 4,000**

22 **Tables : 4**

23 **Figures : 1**

24 **Supplementary tables: 5**

25 ABSTRACT

26
27 **Objectives** Green space positively influences health and well-being, however inequalities
28 in use of green space are prevalent. Movement restrictions enforced due to the COVID-19
29 pandemic could have exacerbated existing inequalities regarding who visits green space.
30 Therefore, this study aimed to explore how movement restrictions have changed the time
31 spent visiting green space and experience of green space in the United Kingdom (UK) and
32 how these differed by individual-level demographic characteristics.

33
34 **Design and outcome measures** A nationally representative cross-sectional survey
35 administered through YouGov between 30th April–1st May 2020. Data were collected on the
36 time spent visiting green space and change in the experience of green space, including
37 missing social interaction, increased physical activity, and feeling greater mental health
38 benefits in green space. Demographic information was collected on sex, age, ethnicity, social
39 grade and dog ownership. Associations between specific outcome variables and predictors
40 were assessed using logistic regression.

41
42 **Setting** United Kingdom, with population weights applied.

43
44 **Participants** 2,252 adults aged 18 years and over.

45 **Results** Overall, 63% of respondents reported a decrease in time spent visiting green space
46 following movement restrictions. Lower social grade respondents were less likely to visit
47 green space before *and* after restrictions were enforced (OR:0.35 (95% CI:0.24-0.51);
48 OR:0.77 (95% CI:0.63-0.95)). Female respondents were more likely than male respondents to
49 agree that green space benefitted their mental health more following restrictions (PP:0.70 vs.
50 0.59). Older (65+) respondents were less likely than middle age (25-64 years) respondents to
51 have visited green space following the restrictions (OR:0.79 (95% CI:0.63-0.98)).

52 **Conclusions** Inequalities in green space use were sustained, and possibly exacerbated,
53 during movement restrictions. Our findings emphasise the importance of green spaces
54 remaining open globally in any future ‘lockdowns’/pandemics. Further investigation is
55 required to determine how visit patterns and experiences change through the different stages
56 of the COVID-19 pandemic in the UK.

57 **(Word Count: 300)**

58 **Strengths and Limitations of this study**

- 59 • Our data are currently the only existing data covering change in the time spent visiting
60 green space and experiences of green space for the UK population following the
61 movement restrictions enforced due to the COVID-19 pandemic.
- 62 • The sample is nationally representative of UK adults.
- 63 • Collecting data on *both* time spent visiting green space and change in experience of green
64 space during the movement restrictions is a strength of this study, compared to other
65 surveys exploring change in green space use during the COVID-19 pandemic, including
66 the Google COVID-19 Community Mobility Reports and Natural England’s People and
67 Nature Survey.
- 68

- 1
2
3
4 69 • The data collected for this study were from a cross-sectional survey, therefore it is not
5 70 possible to demonstrate causality between change in green space use and experiences and
6 71 the demographic data.
7 72 • Certain variable response categories were necessarily recategorised for analysis, which
8 73 meant that some distinctiveness across groups were lost, particularly for the ethnicity and
9 74 age variables.
10 75

11 76 INTRODUCTION

12 77
13 78 Evidence suggests that exposure to green space has a positive influence on health and well-
14 79 being.[1,2] Green space use is associated with increased levels of social interaction and
15 80 physical activity, and decreased levels of all-cause mortality, loneliness and stress.[3–5]
16 81 Additionally, there is evidence that contact with green space may disproportionately benefit
17 82 disadvantaged populations, reducing health inequalities and therefore weakening the effects
18 83 of poverty – known as the ‘equigenic’ effect.[6,7]
19 84

20 85 The health impacts of contact with green spaces are quite well studied by both observational
21 86 and experimental designs. There is rather less literature on the levels of, motivations for, and
22 87 barriers to visiting green spaces in the first place. Recent surveys by Natural England and
23 88 Scottish Natural Heritage have found that 74% of the English population and 70% of the
24 89 Scottish population visit green space ‘frequently’ (once a month or more often). In both
25 90 countries, the top three reasons stated for frequent green space use were health/exercise, dog
26 91 walking, and to relax/unwind.[8,9] Further research exploring the motivations and reasons for
27 92 visiting green space found that visitation frequency is affected by an individual’s feelings of
28 93 nature connectedness, as well as their childhood exposure to nature.[10–12]. It is important to
29 94 note that substantial inequalities in green space use have also been reported, with studies
30 95 finding that females, older people and those from less advantaged socioeconomic positions
31 96 (SEP) are more likely to be infrequent users than their male, younger and higher SEP
32 97 counterparts.[9,13–15]
33 98

34 99 In 2020, the United Kingdom (UK) experienced major disruption to everyday life due to the
35 100 novel coronavirus disease 2019 (COVID-19) pandemic. COVID-19 is an infectious disease
36 101 first identified in the city of Wuhan, China in December 2019.[16] As a response to the
37 102 COVID-19 outbreak, the UK announced a series of movement restrictions from 23rd March
38 103 2020. These included rules designed to increase social distancing, meaning that people could
39 104 only leave their households to make ‘essential trips’ for food, medication and exercise.[17]
40 105 Recent studies have highlighted the negative effects of COVID-19 on the UK population’s
41 106 mental health and wellbeing, which are likely to be profound and long-lasting.[18] Research
42 107 exploring the wider health effects of COVID-19 suggest that the negative indirect effects are
43 108 being borne disproportionately by people who have fewer resources and poorer health.[19] If
44 109 natural environments usually act to mitigate the connections between adversity and poor
45 110 health,[6,7] it is important to assess the extent to which lockdown affected both use and
46 111 experience of such environments. Future lockdowns and movement restrictions are highly
47 112 likely as second, third and perhaps fourth waves of the pandemic take place around the world.
48 113

49 114 The aim of this research was to explore changes in the time spent visiting green space and
50 115 experience of visits to green space among the UK population following movement
51 116 restrictions. The sociodemographic characteristics focused on were those identified by the
52 117 literature as being most consistent markers of inequality in use. The research questions were:

118

119

120

121

122

123

124

125

126

127

128

129

130

131

132

133

134

135

136

137

138

139

140

141

142

143

144

145

146

147

148

149

150

151

152

153

154

155

- 1) How did time spent visiting green space change following movement restrictions, compared with before, and for whom?
- 2) How did experiences of visits to green space change following the restrictions, and did any change vary by sex, social grade, age, ethnicity and dog ownership? Specifically,
 - a) Did respondents feel that green space benefitted their mental health more since restrictions than before?
 - b) Did respondents miss social interaction in green space more following movement restrictions?
 - c) Had physical activity increased following movement restrictions?

METHODS

Survey design and sample

An online cross-sectional survey was administered by YouGov between 30th April and 1st May 2020.[20] Questions were answered by a sample of 2,252 adults from the UK (aged 18 and over). The sample was drawn from a panel of over 800,000 individuals who specifically opted in to participate in online research activities. Sample members were randomly selected at random from the panel and sent an email providing a survey link. Table 1 shows the themes and specific survey instruments analysed in this paper. Only the respondents that visited green space following movement restrictions were asked the questions regarding change in experience of green space. Demographic information about participants was also collected (including sex, age and social grade, which was classified by occupation).[21,22] Although the sample was reasonably large, small numbers in variable response categories necessitated some category mergers (Table 1 and Supplementary Table 1).

The survey covered adults from across the UK, with respondents from England (N=1,875), Scotland (N=209), Wales (N=107), and Northern Ireland (N=61). Weightings were applied to render the sample representative of UK adults (detailed below). When the survey was distributed, the same movement restrictions were implemented across the UK. These included only leaving home for limited purposes, such as medical needs, shopping for basic necessities (food and medicine), and exercising once a day alone/with members of your household.[23] Since then, the individual parliaments/assemblies representing these countries have imposed different COVID-19 policies.

Table 1: Survey themes and specific items analysed, including variables recategorised.

Themes	Question/statement	Potential responses	Recategorised
Change in the amount of time spent visiting green space	<i>"Did you EVER visit a green space in the year before the movement restrictions were enforced in the UK?"</i>	Yes, I did No, I didn't Don't know/ can't recall	- <i>Don't know/can't recall excluded (N=80, 3.5%)</i>
	<i>"Please think about your behaviour since the UK enforced a 'lock down' to restrict movement, as a result of the current Coronavirus (COVID-19) outbreak (i.e. since 23rd March 2020). Have you visited a green space since the movement</i>	Yes, I have No, I haven't Don't know/ can't recall	-

	<i>restrictions have been enforced in the UK?"</i>		<i>Don't know/can't recall excluded (N=43, 1.9%)</i>
	<i>"How much, if at all, has the amount of time that you have spent visiting green spaces changed since the 'lock down' movement restrictions began (i.e. 23rd March 2020) compared to before?"</i>	Increased a lot Increased a little No difference Decreased a little Decreased a lot Don't know	'Increased' (increased a lot and increased a little) 'Same' (no difference) 'Decreased' (decreased a lot and decreased a little) <i>Don't know excluded (N=74, 3.3%)</i>
Experience change (If respondent had visited a green space since the movement restrictions were enforced)	<i>"I feel that being in green spaces benefits my mental health <u>more now</u>, than before the movement restrictions were in place"</i>	Strongly agree Slightly agree Neither agree nor disagree Slightly disagree Strongly disagree Don't know/ can't recall	'Agree' (strongly agree and slightly agree) 'Neither' (neither agree nor disagree) 'Disagree' (slightly disagree and strongly disagree) <i>Don't know/can't recall excluded (N=7, 0.6%)</i>
	<i>"I have missed seeing and/ or talking with people in green spaces <u>since</u> the movement restrictions were introduced"</i>	Strongly agree Slightly agree Neither agree nor disagree Slightly disagree Strongly disagree Don't know/ can't recall	'Agree' (strongly agree and slightly agree) 'Neither' (Neither agree nor disagree) 'Disagree' (slightly disagree and strongly disagree) <i>Don't know/can't recall excluded (N=8, 0.8%)</i>
	<i>"I do more physical activity in green spaces <u>now</u>, than I did before the movement restrictions were introduced"</i>	Strongly agree Slightly agree Neither agree nor disagree Slightly disagree Strongly disagree Don't know/ can't recall	'Agree' (strongly agree and slightly agree) 'Neither' (Neither agree nor disagree) 'Disagree' (slightly disagree and strongly disagree) <i>Don't know/can't recall excluded (N=9, 0.8%)</i>

Don't know/ can't recall responses were all excluded from analysis (weighted counts and proportions reported above).

Demographic variables

Individual level demographic and socio-economic characteristics were captured from the survey, as follows: sex (male, female); age group (18-24 years, 25-64 years, 65+ years); ethnicity (White, Black, Asian and minority ethnic (BAME)); dog ownership (Yes, No); and social grade (ABC1, C2DE), derived by YouGov from combined occupational social grade categories. ABC1 was the higher social grade, and included non-manual workers, for example, senior managers and owners of small establishments. C2DE was the lower social grade, and included all manual workers, for example, shop assistants and labourers.[24] Hereafter, social grade will be described as higher and lower social grade.

Patient and Public Involvement

There was no direct patient or public involvement in this study.

173 **Analyses**

174 175 **Descriptive statistics**

176
177 The count and proportion of respondents who had: visited green space before and after
178 movement restrictions were enforced; increased or decreased visitation; and agreed or
179 disagreed with the three change in experience statements (Table 1) are presented. These were
180 also explored by sex, age, ethnicity, dog ownership and social grade.

182 **Statistical analysis**

183
184 Binary logistic regression analyses were conducted to assess the association between the
185 individual predictor variables and the following two outcomes:

- 187 1. having visited green space in the year before movement restrictions were enforced;
- 188 2. having visited green space since movement restrictions were enforced, with this
189 analysis being restricted to those who had reported visiting green space before
190 movement restrictions.

191
192 The associations between the individual predictor variables and each of the following
193 outcomes were also assessed using multinomial logistic regression or, if appropriate, ordinal
194 logistic regression, with results presented as predicted probabilities (PP):

- 196 1. Change in green space visitation following movement restrictions;
- 197 2. Levels of agreement that green space benefits their mental health more now (since
198 movement restrictions compared to before);
- 199 3. Levels of agreement that they miss seeing/talking to people in green space now (since
200 movement restrictions compared to before); and
- 201 4. Levels of agreement that they do more physical activity in green space now (since
202 movement restrictions compared to before).

203
204 The results of the binary logistic regression analyses were expressed as odds ratios (OR) with
205 95% confidence intervals (CIs). Other results are presented as predicted outcome group
206 probabilities for each variable. Univariate models for each predictor were conducted first,
207 followed by a fully adjusted model containing all predictors for each outcome. Weightings
208 were calculated by YouGov, with the final data weighted to match the national profile of all
209 adults aged 18 and over and applied during analyses to render the sample representative of
210 UK adults.[22] All analyses were conducted in R v3.5.1,[25], and the *brant* package,[26],
211 was used to check that the proportionality of odds assumption for ordinal logistic regression
212 was not violated.[27] A full R script is available on GitHub.[28]

214 **Interactions**

215
216 Given existing literature,[9,13,29,30] we expected some interactions between the
217 demographic variables sex, age, social grade, and ethnicity, in their relationships with change
218 in visit time and experience of green space following movement restrictions. We therefore
219 explored interactions between each of these demographic variables for every model,
220 assessing their significance via Wald tests, and then producing predicted probabilities to aid
221 interpretation of the significant interactions.

RESULTS

Descriptive statistics

93% of all respondents had visited green space in the year before movement restrictions were enforced. In contrast, 53% of respondents reported visiting green space following movement restrictions. 63% of respondents reported that the amount of time they spent in green space had decreased since movement restrictions compared to before, with 15% reporting an increase, and 22% reporting no difference in the time spent visiting green space (Supplementary Table 2).

A greater proportion of respondents agreed (65%) than disagreed (10%) or neither agreed nor disagreed (25%) that green space benefited their mental health more following movement restrictions compared to before. More respondents agreed (54%) that they missed social interaction in green space more since movement restrictions, than disagreed (19%) or neither agreed nor disagreed (27%). 39% of respondents disagreed that they had increased physical activity in green space since movement restrictions, compared to 29% who agreed and 32% that neither agreed nor disagreed (Supplementary Table 3).

Change in visitation time

Visiting green space before movement restrictions

In the adjusted logistic regression model for visiting green space in the year before movement restrictions were enforced (Table 2), only two variables had significant associations ($p < 0.05$). Lower social grade respondents (OR:0.35 (95%CI:0.24-0.51)) and BAME (OR:0.43 (95%CI:0.23-0.80)) respondents had lower odds of visiting green space before movement restrictions, compared to higher social grade and white respondents.

Visiting green space following movement restrictions

Respondents in the lower social grade group were less likely to have visited green space than respondents in the higher social grade group (OR:0.77 (95%CI:0.63-0.95)) (Table 2). Older respondents (65+) were also less likely than middle age respondents (25-64) to have visited green space following the movement restrictions (OR:0.79 (95% CI:0.63-0.98)). Respondents who owned a dog/s were more likely than respondents who did not to have visited green space after movement restrictions were enforced (OR:1.42 (95%CI:1.14-1.78)).

Change in time spent visiting green space

Lower social grade respondents were less likely (had a lower predicted probability) than higher social grade respondents to report increased visits following movement restrictions (PP:0.09 vs. 0.16)(Table 3). Older respondents (aged 65+) were the least likely to report increased green space visitations (PP:0.09(65+) vs. 0.14(25-64) and 0.21(18-24)). Sex was significantly associated with *decreased* visits. Females were more likely (had a higher predicted probability) to report decreased green space visits compared to males (PP:0.67 vs. 0.62)(Table 3). Respondents without a dog/s were more likely to report decreased visitations to green space compared to dog owners (PP:0.66 vs. 0.62).

271

272 Interaction effects

273

274 Six interactions were significant ($p < 0.05$); one between social grade and ethnicity in their
275 association with visiting green space before movement restrictions. Two between age and
276 ethnicity, in their association with visiting green spaces since movement restrictions and with
277 *increased* visits since movement restrictions. The three experience outcomes (mental health
278 benefits, miss social interaction and increased physical activity) had significant interactions
279 between social grade and age.

280

281 Higher social grade white respondents had the highest probability of visiting green space
282 before restrictions, but lower social grade BAME respondents were more likely to have
283 visited green space before restrictions than the higher social grade BAME respondents
284 (Supplementary Table 4). Young BAME respondents had a higher probability of visiting
285 green space and reporting increased visits following restrictions compared to white and older
286 BAME respondents (Figure 1). Older BAME and white respondents had a higher probability
287 of reporting decreased visits following movement restrictions than their corresponding
288 middle age respondents. However, the number of BAME respondents, especially young and
289 older BAME respondents, in this sample was small and these results should be interpreted
290 with caution.

291

292 For the interactions associated with the experience outcomes, younger respondents from the
293 higher social grade group had the highest probability of agreeing both that green space
294 benefitted their mental health more, and that they missed social interaction in green space,
295 following the movement restrictions. In contrast, younger respondents in the lower social
296 grade group had the highest probability of disagreeing that mental health benefitted their
297 mental health more. Older respondents in the lower social grade group had a higher
298 probability of agreeing that they missed social interaction in green space than younger
299 respondents. Finally, younger respondents had the highest probability of agreeing that they
300 had increased physical activity following the movement restrictions compared to the older
301 respondents in both social grade groups (Supplementary Table 5).

302

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46

303 **Table 2:** Adjusted binary logistic regression models predicting green space visit before and after the movement restrictions were enforced. OR =
304 odds ratio; CI = confidence intervals; $p < 0.05$.
305

	Visited green space in the year before restrictions (yes)		Visited green space after restrictions (yes & visited green space before restrictions)	
	Adjusted		Adjusted	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Sex				
Male (ref)				
Female	1.35 (0.94-1.95)	0.109	0.88 (0.72-1.07)	0.205
Social grade				
ABC1 (ref)				
C2DE	0.35 (0.24-0.51)	<0.001	0.77 (0.63-0.95)	0.013
Age				
18-24	2.92 (1.00-8.57)	0.051	0.81 (0.54-1.21)	0.297
25-64 (ref)				
65+	1.22 (0.80-1.85)	0.353	0.79 (0.63-0.98)	0.035
Ethnicity				
White (ref)				
BAME	0.43 (0.23-0.80)	0.007	1.06 (0.67-1.68)	0.799
Dog ownership				
No (ref)				
Yes	1.29 (0.83-2.00)	0.260	1.42 (1.14-1.78)	0.002

307

308

309

Table 3: Multinomial logistic regression models predicting change in time visiting green space and levels of agreement that green space benefits their mental health more now (since movement restrictions were enforced compared to before). **Significant predicted probabilities; $p < 0.05$.**

		Change in time spent visiting green space				Using green spaces benefits my mental health more now			
		Decreased	Same	Increased	p-value	Agree	Neither	Disagree	p-value
<i>Sex</i>	Male	0.62	0.25	0.13	<i>0.041</i>	0.59	0.31	0.10	<i>0.004</i>
	Female	0.67	0.20	0.12		0.70	0.22	0.09	
<i>Social grade</i>	ABC1	0.65	0.19	0.16	<i><0.001</i>	0.68	0.24	0.09	<i>0.048</i>
	C2DE	0.64	0.27	0.09		0.59	0.31	0.10	
<i>Age</i>	18-24	0.57	0.22	0.21	<i>0.004</i>	0.55	0.20	0.25	<i><0.001</i>
	25-64	0.63	0.22	0.14		0.68	0.22	0.10	
	65+	0.69	0.22	0.09		0.55	0.38	0.06	
<i>Ethnicity</i>	White	0.22	0.65	0.12	0.167	0.64	0.26	0.10	0.063
	BAME	0.30	0.56	0.14		0.73	0.25	0.02	
<i>Dog ownership</i>	No	0.66	0.21	0.13	<i>0.003</i>	0.67	0.24	0.09	0.117
	Yes	0.62	0.28	0.10		0.59	0.30	0.11	

310 **Table 4:** Multinomial logistic regression models predicting levels of agreement that respondents missed seeing/talking to people in green space
 311 more since movement restrictions were enforced compared to before, and levels of agreement that respondents do more physical activity in
 312 green space following the movement restrictions. **Significant predicted probabilities; $p < 0.05$.**

		Miss social interaction in green spaces now				Do more physical activity in green spaces now			
		Agree	Neither	Disagree	p-value	Agree	Neither	Disagree	p-value
<i>Sex</i>	Male	0.45	0.30	0.25	<0.001	0.24	0.37	0.40	0.096
	Female	0.58	0.26	0.16		0.27	0.29	0.43	
<i>Social grade</i>	ABC1	0.53	0.27	0.20	0.256	0.27	0.31	0.42	0.307
	C2DE	0.48	0.31	0.21		0.23	0.36	0.41	
<i>Age</i>	18-24	0.59	0.23	0.18	0.672	0.44	0.23	0.33	0.002
	25-64	0.51	0.28	0.21		0.29	0.31	0.40	
	65+	0.53	0.30	0.18		0.18	0.38	0.45	
<i>Ethnicity</i>	White	0.52	0.28	0.20	0.802	0.25	0.32	0.42	0.063
	BAME	0.52	0.31	0.16		0.33	0.44	0.22	
<i>Dog Ownership</i>	No	0.50	0.30	0.20	0.295	0.31	0.30	0.39	<0.001
	Yes	0.55	0.25	0.20		0.17	0.38	0.46	

1
2
3 3134 314 **Change in visit experience**

5 315

6 316 **Mental health benefits**

7 317

8 318 Females were more likely to agree than males that being in green space benefitted their
9 319 mental health more following movement restrictions than before (PP:0.70 vs. 0.59). Higher
10 320 social grade respondents were more likely to agree than lower social grade respondents
11 321 (PP:0.68 vs. 0.59). Younger respondents were more likely to disagree that being in green
12 322 space benefitted their mental health more following movement restrictions than before, whilst
13 323 older respondents were less likely to disagree (PP:0.25(18-24) vs. 0.06(65+) and 0.10(25-
14 324 64))(Table 3).

15 325

16 326 **Missed social interaction**

17 327

18 328 Female respondents were more likely to agree that they missed seeing and talking with other
19 329 people in green space since movement restrictions compared to before than male respondents
20 330 (PP:0.58 vs. 0.45)(Table 4).

21 331

22 332 **Increased physical activity**

23 333

24 334 Older respondents were less likely to agree that they had increased physical activity
25 335 following movement restrictions (PP:0.18(65+) vs. 0.20(25-64) and 0.44(18-24)).
26 336 Respondents who owned a dog/s were less likely than respondents without a dog/s to agree
27 337 (PP:0.17 vs. 0.31)(Table 4).

28 338

29 339 **DISCUSSION**

30 340

31 341 Our findings suggest that inequalities in use of green space between demographic groups
32 342 were sustained following movement restrictions, with lower social grade individuals less
33 343 likely than higher social grade individuals to have visited green space before and since
34 344 movement restrictions. Other existing inequalities in use were possibly exacerbated in the
35 345 month after movement restrictions were enforced, with females being more likely to report a
36 346 decrease in visits following movement restrictions.

37 347

38 348 The proportion of respondents who visited green space before and following movement
39 349 restrictions decreased, from 93% to 53%. This was consistent with Natural England's
40 350 findings from April 2020 where 49% of English adults reported green space visits in the
41 351 previous two weeks.[31] Natural England conducted an online panel survey in April 2020
42 352 (N=2,083), the survey covered only the English population, collecting information on the
43 353 frequency of time in green and natural spaces in the 12 months, and then 2 weeks, prior to the
44 354 survey.[32] The survey did not directly ask respondents about whether they felt their
45 355 experiences within green space had changed following movement restrictions. A similar
46 356 study focused on change in time spent visiting parks using the Google COVID-19
47 357 Community Mobility Reports covering 620 counties across the United States(USA). They
48 358 found a lower percentage decrease in park visits compared to our findings, reporting a 17-
49 359 35% decrease in visits between 15th March-9th May 2020.[33] This difference may be
50 360 explained by the focus on parks alone rather than different types of green space. However,
51 361 additional research exploring the Google COVID-19 Community Mobility Reports found that

1
2
3 362 from 16th February-29th March 2020 park use decreased by 90% in Catalonia, 7% in Oslo,
4 363 and 79% in New York County. In Stockholm, park use increased by 24% in the same
5 364 timeframe.[34] This could be explained by Sweden having a less stringent approach to
6 365 movement restrictions and instead relying on 'self-responsibility' to prevent the population
7 366 having to restrict movement and stay at home.[35] The Swedish population may also be more
8 367 culturally attuned to seeking time in nature to combat stress.

9 368

11 369 Females and older individuals were more likely to have reported decreased visits to green
12 370 space following movement restrictions. These findings corroborate with existing data
13 371 collected before movement restrictions.[9,13,14] Boyd *et al.* analysed the Natural England
14 372 'Monitor of Engagement with the Natural Environment' survey (N=63,890) with a focus on
15 373 infrequent use. They found that females and older adults in England were more likely to be
16 374 infrequent visitors.[9] Cohen *et al.* explored physical activity levels in Los Angeles' parks
17 375 (N=1,318). They reported that age and sex were predictors of park use, with <5% of park
18 376 users over 60 years old, and males using parks more often than females (62% vs. 38%).[13]

19 377

21 378 Our findings suggested that existing patterns of gender inequality in use were sustained and
22 379 potentially exacerbated due to fears arising from the COVID-19 pandemic. For example, an
23 380 Ipsos MORI survey was conducted in April 2020, collecting data on gender differences in
24 381 British attitudes towards COVID-19. They found that women were more likely to report
25 382 following government rules to avoid leaving their home (78%) than men (68%) and felt more
26 383 uncomfortable about returning to "normal"(N=1,000).[36,37]

27 384

29 385 Previous studies have found that females feel more vulnerable than males in green spaces,
30 386 especially without company.[14,15,29,38–40] There are few quantitative studies focusing on
31 387 sex and the importance of social interaction as a motivation behind green space use. We
32 388 found that females were more likely to agree that they missed seeing/talking with others in
33 389 green space than males. This could be explained by the nature of the movement restrictions at
34 390 this time, particularly the inability to socially interact with individuals outside your household
35 391 in green space.

36 392

38 393 Given older age is probably the most important risk factor for an adverse outcome from
39 394 COVID-19,[41,42] it was not surprising that older individuals were less likely to report an
40 395 increase in green space visits and to agree that they were doing more physical activity
41 396 following movement restrictions. These findings corroborate with the majority of research
42 397 exploring older age and green space use before the movement restrictions.[9,13,43] Older
43 398 people in the UK have been found to be at particular risk of social isolation during social
44 399 distancing, being less likely to use online communications and more likely to live alone than
45 400 younger individuals.[19] Our findings also show that older people are less likely to have used
46 401 green space during lockdown, further emphasising this point. The significant decrease in
47 402 green space visits following movement restrictions for older respondents could be explained
48 403 by the government advice for over 70s and those with an underlying health condition to
49 404 shield, minimise interaction and stay at home, for around 12 weeks from 21st March
50 405 2020.[44]

51 406

53 407 Lower social grade respondents reported little or no change in visitation to green space, with
54 408 time spent visiting green space remaining low both before and after movement restrictions.
55 409 This is supported by previous studies exploring the association between socio-economic
56 410 position (SEP) and green space use.[9,15,43] One possible explanation is a lack of interest in
57 411 visiting green space reported by lower SEP individuals.[9] Additionally, the social grade

1
2
3 412 variable was categorised by occupation, and it was likely that individuals categorised as
4 413 lower social grade were working in manual or service occupations.[24] They may have
5 414 continued at their usual workplace/working hours during the COVID-19 pandemic. Findings
6 415 from the Office for National Statistics support this explanation, with 30.5% of employees in
7 416 the bottom three income deciles (monthly earnings of up to £1,450) considered as key
8 417 workers in March/April 2020, compared to 26.4% in the top three income deciles (monthly
9 418 earnings of up to £3,250).[45] Similarly, existing international research on public space use
10 419 during COVID-19 restrictions worldwide state that skilled workers in the knowledge
11 420 economy have shifted easily into online work from home, and can therefore make more use
12 421 of green spaces during the movement restrictions.[46]
13 422

14 423 Younger BAME respondents had a higher probability of visiting green space following
15 424 movement restrictions and reporting increased visits since movement restrictions, compared
16 425 to white and older BAME respondents. A survey on park use and ethnic integration in
17 426 Reading, UK (N=294) reported similar findings, with Black and Asian youths accounting for
18 427 a higher proportion of parks users than white youths.[47] Further exploration is required to
19 428 enable interpretation of these interaction results because of our small BAME sample.
20 429

21 430 The results for dog owners suggest that the movement restrictions have had an overall
22 431 negative impact on their experiences within green space. Although dog owners were more
23 432 likely to have visited green space following the movement restrictions than those that did not
24 433 own a dog, they were less likely to agree that they had increased physical activity and more
25 434 likely to have decreased visitations following the restrictions. These results differ from
26 435 research undertaken in Canada that reported findings that dog ownership was associated with
27 436 more outdoor play and less indoor play in Canadian youth at the start of the pandemic.[48]
28 437 However, the focus on youth rather than adults may explain this difference in findings.
29 438 Instead, the difference found in visits after restrictions were enforced may be due to dog
30 439 owners having to walk their dog/s in green spaces *despite* the pandemic restrictions. In
31 440 comparison between our results and those of other studies, we are mindful of the difference
32 441 between number of visits and time spent in green spaces as measures of 'use'. It would be
33 442 entirely possible to increase one at the expense of the other and our data were not well suited
34 443 to unpacking the relationship between them.
35 444

36 445 **Strengths and limitations**

37 446

38 447 Our study has several strengths; to our knowledge, currently this is the only data covering
39 448 UK population change in use and experiences within green space at the start of the movement
40 449 restrictions from 23rd March 2020. This means that the data could provide timely information
41 450 to local and national governments across the UK. It is important to understand the effects of
42 451 the initial movement restrictions to generate policy recommendations for any future
43 452 movement restrictions. The rapid collection of data, just over a month after the movement
44 453 restrictions were introduced, reduces risk of recall bias. The sample is nationally
45 454 representative of UK adults, with weightings calculated by YouGov and applied to all
46 455 analyses, reducing risk of selection bias.[22]
47 456

48 457 A further strength of our study is providing quantitative data on the importance of social
49 458 interaction as a driver for using green space, which is under-reported in the literature. We
50 459 analysed social grade at an individual level, which provides greater detail and accuracy of the
51 460 respondent's SEP than at neighbourhood level.
52 461

1
2
3 462 There are some caveats. The survey design was cross-sectional, and we are unable to
4 463 demonstrate causality between change in green space use and experiences and the
5 464 demographic data. Additionally, the data on use and experiences are self-reported and
6 465 therefore subjective. Certain variable response categories had to be recategorised in order to
7 466 analyse them. This is particularly evident in the ethnicity and age variables, where some
8 467 distinctiveness across groups was lost. The variable best capturing change in behaviour
9 468 measured time spent in green space, but this made it difficult to understand whether
10 469 respondents traded off time and numbers of visits.
11
12 470

13
14 471 We encourage future research to further investigate the interactions between ethnicity, age
15 472 and social grade in relation to green space use to enable more substantial interpretation of the
16 473 results and to explore whether the patterns are consistent over time and in different contexts.
17 474 Moreover, further research is required to explore the reasons *why* many patterns and changes
18 475 in use of green space since movement restrictions have emerged. It would also be interesting
19 476 to explore the change in patterns of use before and following movement restrictions for those
20 477 that did not visit before the movement restrictions but did visit green space following
21 478 restrictions.
22

23 479

24 480 **CONCLUSION**

25 481
26 482 During the COVID-19 pandemic, our study provides novel evidence to suggest that green
27 483 space use and experiences were affected during the first month of movement restrictions in
28 484 the UK. Our findings suggested that inequalities in use were sustained, with lower social
29 485 grade individuals less likely to visit green space than higher social grade individuals before
30 486 and following movement restrictions. It is possible that these inequalities were exacerbated,
31 487 as females and older individuals were the groups most likely to have decreased visits
32 488 following movement restrictions. Although these findings reflect the UK population's
33 489 experience during the movement restrictions, they could be compared with countries such as
34 490 Norway, USA, and Spain where green space visits also decreased. We believe that these
35 491 findings emphasise the need for green spaces to remain open in any future 'lockdowns' and
36 492 for governments to actively encourage individuals to utilise these spaces to support their
37 493 mental and physical health during subsequent waves of the pandemic. Further investigation
38 494 is required to support these findings and how they may change through the stages of the
39 495 COVID-19 pandemic and the relaxing, and potential re-introduction, of movement
40 496 restrictions.
41
42
43
44 497

45 498 **COMPETING INTERESTS**

46 499 None declared.

47 500

48 501 **DATA SHARING STATEMENT**

49 502 We have made our research dataset publicly available (Datacite DOI:
50 503 10.5525/gla.researchdata.1038 - embargoed until 31/10/2023).
51 504

52 505

53 506 **CONTRIBUTORS**

54 506 HB, JRO and RM designed the study and survey; HB conducted data analysis which was
55 507 reviewed by NN; HB wrote the first draft of the paper; all authors contributed to interpreting
56 508 the results and revising the draft. The corresponding author attests that all listed authors meet
57 509 authorship criteria and that no others meeting the criteria have been omitted.
58 510

59 511

60 512 **FUNDING STATEMENT**

1
2
3 512 The authors (HB, JRO, NN & RM) are part of the Places and Health Programme at the
4 513 MRC/CSO Social and Public Health Sciences Unit (SPHSU), University of Glasgow,
5 514 supported by the Medical Research Council (MC_UU_12017/10) and the Chief Scientist
6 515 Office (SPHSU10).
7
8

9 **References:**

- 10
11 516 1 Barton J, Pretty J. What is the Best Dose of Nature and Green Exercise for Improving
12 517 Mental Health? A Multi-Study Analysis. *Environ Sci Technol* 2010;**44**:3947–55.
13 518 doi:10.1021/es903183r
14
15 519 2 Douglas O, Lennon M, Scott M. Green space benefits for health and well-being: A
16 520 life-course approach for urban planning, design and management. *CITIES* 2017;**66**:53–
17 521 62. doi:10.1016/j.cities.2017.03.011
18 522 3 Twohig-Bennett C, Jones A. The health benefits of the great outdoors: A systematic
19 523 review and meta-analysis of greenspace exposure and health outcomes. *Environ Res*
20 524 2018;**166**:628–37. doi:10.1016/j.envres.2018.06.030
21
22 525 4 Maas J, Van Dillen SME, Verheij RA, *et al.* Social contacts as a possible mechanism
23 526 behind the relation between green space and health. *Health Place* 2009;**15**:586–95.
24 527 doi:10.1016/j.healthplace.2008.09.006
25 528 5 Wells N, Evans G. NEARBY NATURE A Buffer of Life Stress Among Rural
26 529 Children. *Environ Behav* 2003;**35**:311–30. doi:10.1177/0013916503251445
27
28 530 6 Frumkin H, Bratman GN, Breslow SJ, *et al.* Nature Contact and Human Health: A
29 531 Research Agenda. *Environ Health Perspect* 2017;**125**. doi:10.1289/EHP1663
30 532 7 Mitchell RJ, Richardson EA, Shortt NK, *et al.* Neighborhood Environments and
31 533 Socioeconomic Inequalities in Mental Well-Being. *Am J Prev Med* 2015;**49**:80–4.
32 534 doi:10.1016/j.amepre.2015.01.017
33 535 8 Wilson V, Seddon B. Scotland’s People and Nature Survey 2017/18 – outdoor
34 536 recreation and health modules. (Scottish Natural Heritage Research Report No. 1062).
35 537 Inverness: 2018.
36
37 538 9 Boyd F, White MP, Bell SL, *et al.* Who doesn’t visit natural environments for
38 539 recreation and why: A population representative analysis of spatial, individual and
39 540 temporal factors among adults in England. *Landsc Urban Plan* 2018;**175**:102–13.
40 541 doi:10.1016/j.landurbplan.2018.03.016
41 542 10 Bell SL, Phoenix C, Lovell R, *et al.* Green space, health and wellbeing: making space
42 543 for individual agency. *Health Place* 2014;**30**:287–92.
43 544 doi:10.1016/j.healthplace.2014.10.005
44
45 545 11 Lin BB, Fuller RA, Bush R, *et al.* Opportunity or Orientation ? Who Uses Urban Parks
46 546 and Why. 2014;**9**:1–7. doi:10.1371/journal.pone.0087422
47 547 12 Ward Thompson C, Aspinall P, Montarzino A. The Childhood Factor Adult Visits to
48 548 Green Places and the Significance of Childhood Experience. *Environ Behav*
49 549 2008;**40**:111–43. doi:10.1177/0013916507300119
50
51 550 13 Cohen DA, McKenzie TL, Sehgal A, *et al.* Contribution of Public Parks to Physical
52 551 Activity. *Am J Public Health* 2007;**97**:509–14. doi:10.2105/AJPH.2005.072447
53 552 14 Lee ACK, Maheswaran R. The health benefits of urban green spaces: A review of the
54 553 evidence. *J Public Health (Bangkok)* 2011;**33**:212–22. doi:10.1093/pubmed/fdq068
55 554 15 Morris J, O’Brien E, Ambrose-Oji B, *et al.* Access for all? Barriers to accessing
56 555 woodlands and forests in Britain. *Local Environ Int J Justice Sustain* 2011;**16**:375–96.
57 556 doi:10.1080/13549839.2011.576662
58
59 557 16 Wynants L, Van Calster B, Bonten MMJ, *et al.* Prediction models for diagnosis and
60 558 prognosis of covid-19 infection: systematic review and critical appraisal . *BMJ*

- 2020;**369**. doi:10.1136/bmj.m1328
- 559
560 17 Johnson B. Prime Minister’s statement on coronavirus (COVID-19): 23 March 2020.
561 GOV.UK. 2020.[https://www.gov.uk/government/speeches/pm-address-to-the-nation-](https://www.gov.uk/government/speeches/pm-address-to-the-nation-on-coronavirus-23-march-2020)
562 [on-coronavirus-23-march-2020](https://www.gov.uk/government/speeches/pm-address-to-the-nation-on-coronavirus-23-march-2020) (accessed 7 Jul 2020).
- 563 18 O’Connor RC, Wetherall K, Cleare S, *et al*. Mental health and wellbeing during the
564 COVID-19 pandemic: longitudinal analyses of adults in the UK COVID-19 Mental
565 Health & Wellbeing study. *Br J Psychiatry* 2020;:1–17. doi:10.1192/bjp.2020.212
- 566 19 Douglas M, Katikireddi SV, Taulbut M, *et al*. Mitigating the wider health effects of
567 covid-19 pandemic response. *BMJ* 2020;**369**. doi:10.1136/bmj.m1557
- 568 20 YouGov. About YouGov Company. <https://yougov.co.uk/about/> (accessed 8 Jun
569 2020).
- 570 21 YouGov and ESOMAR (World Association for Social Opinion and Market Research).
571 ESOMAR 28: 28 Questions to help Online Research Buyers. The Netherlands: 2012.
572 http://cdn.yougov.com/cumulus_uploads/document/t3r5k565j5/ESOMAR_28.pdf
573 (accessed 8 Jun 2020).
- 574 22 YouGov. Panel Methodology. <https://yougov.co.uk/about/panel-methodology/>
575 (accessed 8 Jun 2020).
- 576 23 Cabinet Office. Staying at home and away from others (social distancing). London:
577 2020. [https://www.gov.uk/government/publications/full-guidance-on-staying-at-home-](https://www.gov.uk/government/publications/full-guidance-on-staying-at-home-and-away-from-others)
578 [and-away-from-others](https://www.gov.uk/government/publications/full-guidance-on-staying-at-home-and-away-from-others) (accessed 8 Oct 2020).
- 579 24 The Market Research Society (MRS). Definitions employed in Social Grading. MRS.
580 [https://www.mrs.org.uk/pdf/Definitions employed in Social Grading. MRS.](https://www.mrs.org.uk/pdf/Definitions%20used%20in%20Social%20Grading%20based%20on%20OG7.pdf)
581 <https://www.mrs.org.uk/pdf/Definitions used in Social Grading based on OG7.pdf>
(accessed 2 Jul 2020).
- 582 25 R Core Team. R: A Language and Environment for Statistical Computing.
583 2018.<https://www.r-project.org/>
- 584 26 Schlegel BE. Package brant. <https://benjaminschlegel.ch/en/r/brant/> (accessed 29 Oct
585 2020).
- 586 27 Brant R. Assessing proportionality in the proportional odds model for ordinal logistic
587 regression. *Biometrics* 1990;**46**:1171–8.
- 588 28 Burnett H. Change in green space use and experiences following UK restrictions on
589 movement. GitHub. 2020.https://github.com/hannahburnett/greenspace-covid_code
590 (accessed 21 Jul 2020).
- 591 29 Richardson EA, Mitchell R. Gender differences in relationships between urban green
592 space and health in the United Kingdom. *Soc Sci Med* 2010;**71**:568–75.
593 doi:10.1016/J.SOCSCIMED.2010.04.015
- 594 30 Astell-Burt T, Mitchell R, Hartig T, *et al*. The association between green space and
595 mental health varies across the lifecourse. A longitudinal study. *J Epidemiol*
596 *Community Heal* 2014;**68**:578–83. doi:10.1136/jech-2013-203767
- 597 31 Natural England. The People and Nature Survey for England: Monthly interim
598 indicators for April 2020 (Experimental Statistics) . Nat. Engl.
599 2020.[https://www.gov.uk/government/publications/the-people-and-nature-survey-for-](https://www.gov.uk/government/publications/the-people-and-nature-survey-for-england-monthly-interim-indicators-for-april-2020-experimental-statistics/the-people-and-nature-survey-for-england-monthly-interim-indicators-for-april-2020-experimental-statistics)
600 [england-monthly-interim-indicators-for-april-2020-experimental-statistics/the-people-](https://www.gov.uk/government/publications/the-people-and-nature-survey-for-england-monthly-interim-indicators-for-april-2020-experimental-statistics/the-people-and-nature-survey-for-england-monthly-interim-indicators-for-april-2020-experimental-statistics)
601 [and-nature-survey-for-england-monthly-interim-indicators-for-april-2020-](https://www.gov.uk/government/publications/the-people-and-nature-survey-for-england-monthly-interim-indicators-for-april-2020-experimental-statistics/the-people-and-nature-survey-for-england-monthly-interim-indicators-for-april-2020-experimental-statistics)
602 [experimental-statistics](https://www.gov.uk/government/publications/the-people-and-nature-survey-for-england-monthly-interim-indicators-for-april-2020-experimental-statistics/the-people-and-nature-survey-for-england-monthly-interim-indicators-for-april-2020-experimental-statistics) (accessed 25 Jun 2020).
- 603 32 Natural England. The People and Nature Survey For England. 2020.
604 <http://publications.naturalengland.org.uk/publication/6382837173583872>
- 605 33 Curtis DS, Rigolon A, Schmalz DL, *et al*. Getting out while staying in: Park use
606 decreased during the COVID-19 pandemic, especially where park availability was
607 low. *Cent Open Sci OSF Prepr* Published Online First: 2020.
608 doi:10.31235/osf.io/9xzgf

- 1
2
3 609 34 Barton D, Haase D, Mascarenhas A, *et al.* Enabling Access to Greenspace During the
4 610 Covid-19 Pandemic-Perspectives from Five Cities. *Nat. Cities*.
5 611 2020.[https://www.thenatureofcities.com/2020/05/04/enabling-access-to-greenspace-](https://www.thenatureofcities.com/2020/05/04/enabling-access-to-greenspace-during-the-covid-19-pandemic-perspectives-from-five-cities/)
6 612 [during-the-covid-19-pandemic-perspectives-from-five-cities/](https://www.thenatureofcities.com/2020/05/04/enabling-access-to-greenspace-during-the-covid-19-pandemic-perspectives-from-five-cities/) (accessed 23 Oct 2020).
7 613 35 Savage M. Lockdown, what lockdown? Sweden’s unusual response to coronavirus.
8 614 BBC News. 2020.
9 615 36 Ipsos MORI. Gender differences in attitudes towards Coronavirus. 2020.
10 616 [https://www.ipsos.com/sites/default/files/ct/news/documents/2020-](https://www.ipsos.com/sites/default/files/ct/news/documents/2020-05/fawcett_society_presentation.pdf)
11 617 [05/fawcett_society_presentation.pdf](https://www.ipsos.com/sites/default/files/ct/news/documents/2020-05/fawcett_society_presentation.pdf) (accessed 10 Jul 2020).
12 618 37 Ipsos MORI, The Fawcett Society. 6 in 10 women finding it harder to stay positive
13 619 day-to-day due to Coronavirus: Women more likely to bearing the emotional and
14 620 impact of the pandemic . Fawcett Soc.
15 621 2020.[https://www.fawcettsociety.org.uk/Handlers/Download.ashx?IDMF=f173fde3-](https://www.fawcettsociety.org.uk/Handlers/Download.ashx?IDMF=f173fde3-4edb-4c51-8453-7244e867ed90)
16 622 [4edb-4c51-8453-7244e867ed90](https://www.fawcettsociety.org.uk/Handlers/Download.ashx?IDMF=f173fde3-4edb-4c51-8453-7244e867ed90) (accessed 10 Jul 2020).
17 623 38 Thompson CW, Aspinall P, Bell S, *et al.* “It Gets You Away From Everyday Life”:
18 624 Local Woodlands and Community Use—What Makes a Difference? *Landsc Res*
19 625 2007;**30**:109–46. doi:10.1080/0142639042000324794
20 626 39 Burgess J. Focusing on Fear: The Use of Focus Groups in a Project for the Community
21 627 Forest Unit, Countryside Commission. 1996.
22 628 40 O’Brien L, Morris J. Well-being for all? The social distribution of benefits gained
23 629 from woodlands and forests in Britain. *Local Environ Int J Justice Sustain*
24 630 2014;**19**:356–83. doi:10.1080/13549839.2013.790354
25 631 41 Public Health England. Disparities in the risk and outcomes from COVID-19. London:
26 632 2020. www.facebook.com/PublicHealthEngland (accessed 26 Jul 2020).
27 633 42 Office for National Statistics. Deaths registered weekly in England and Wales,
28 634 provisional: week ending 10 July 2020. ONS.
29 635 2020.[https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriag-](https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/deathsregisteredweeklyinenglandandwalesprovisional/latest#deaths-registered-by-age-group)
30 636 [es/deaths/bulletins/deathsregisteredweeklyinenglandandwalesprovisional/latest#deaths](https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/deathsregisteredweeklyinenglandandwalesprovisional/latest#deaths-registered-by-age-group)
31 637 [-registered-by-age-group](https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/deathsregisteredweeklyinenglandandwalesprovisional/latest#deaths-registered-by-age-group) (accessed 26 Jul 2020).
32 638 43 TNS. Scotland’s People and Nature Survey 2013/14. (Scottish Natural Heritage
33 639 Commissioned Report No. 679). 2014.
34 640 44 Johnson B. Prime Minister’s statement on coronavirus (COVID-19): 16 March 2020.
35 641 GOV.UK. 2020.[https://www.gov.uk/government/speeches/pm-statement-on-](https://www.gov.uk/government/speeches/pm-statement-on-coronavirus-16-march-2020)
36 642 [coronavirus-16-march-2020](https://www.gov.uk/government/speeches/pm-statement-on-coronavirus-16-march-2020) (accessed 26 Jun 2020).
37 643 45 Office for National Statistics. Coronavirus and how people spent their time under
38 644 lockdown. ONS.
39 645 2020.[https://www.ons.gov.uk/economy/nationalaccounts/satelliteaccounts/bulletins/co-](https://www.ons.gov.uk/economy/nationalaccounts/satelliteaccounts/bulletins/coronavirusandhowpeoplespenttheirtimeunderrestrictions/28marchto26april2020)
40 646 [ronavirusandhowpeoplespenttheirtimeunderrestrictions/28marchto26april2020](https://www.ons.gov.uk/economy/nationalaccounts/satelliteaccounts/bulletins/coronavirusandhowpeoplespenttheirtimeunderrestrictions/28marchto26april2020)
41 647 (accessed 16 Jul 2020).
42 648 46 Honey-Rosés J, Anguelovski I, Chireh VK, *et al.* The impact of COVID-19 on public
43 649 space: an early review of the emerging questions – design, perceptions and inequities.
44 650 *Cities Heal* 2020;**1**–17. doi:10.1080/23748834.2020.1780074
45 651 47 Ravenscroft N, Markwell S. Ethnicity and the integration and exclusion of young
46 652 people through urban park and recreation provision. *Manag Leis* 2000;**5**:135–50.
47 653 doi:10.1080/13606710050084838
48 654 48 Moore SA, Faulkner G, Rhodes RE, *et al.* Impact of the COVID-19 virus outbreak on
49 655 movement and play behaviours of Canadian children and youth: a national survey. *Int*
50 656 *J Behav Nutr Phys Act* 2020;**17**. doi:10.1186/s12966-020-00987-8
51 657
52 658

1
2
3 **659 Figure legends:**
4

5 **660**

6 **661** Figure 1: Interaction between age and ethnicity for change in time spent visiting green space

7 **662** since movement restrictions were enforced.
8

9 **663**
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

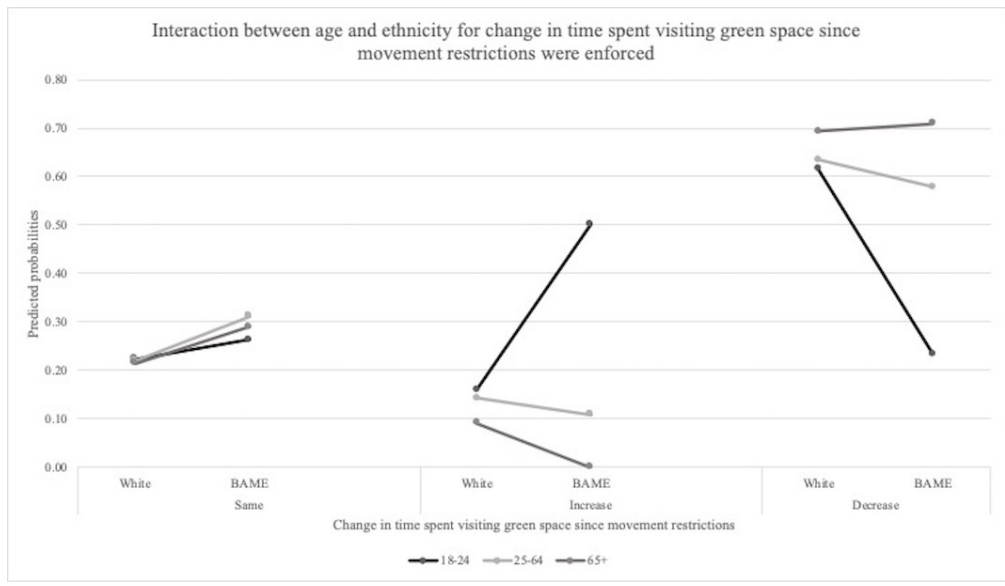


Figure 1: Interaction between age and ethnicity for change in time spent visiting green space since movement restrictions were enforced.

90x51mm (300 x 300 DPI)

Supplementary Materials

Supplementary Table 1: Category mergers of the response categories (ethnicity, age, social grade, sex and dog ownership).

	Original categories (Unweighted N)	New categories (Unweighted N)
Ethnicity	White British (1659)	White (1745)
	Any other white background (86)	
	White and Black Caribbean (6)	BAME (87)
	White and Black African (4)	
	White and Asian (8)	
	Any other mixed background (8)	
	Indian (17)	
	Pakistani (5)	
	Bangladeshi (4)	
	Any other Asian background (3)	
	Black Caribbean (4)	
	Black African (3)	
	Any other black background (3)	
	Chinese (10)	
	Other ethnic group (12)	
	Prefer not to say (19)	Missing (420)
	Not answered (401)	
	Age	18-24 (165)
25-34 (316)		25-64 (1497)
35-44 (396)		
45-54 (398)		
55-64 (387)		
65+ (590)		65+ (590)
Social grade	ABC1 (1419)	
	C2DE (833)	
Sex	Male (1018)	
	Female (1234)	
Dog ownership	Yes (616)	
	No (1636)	

Supplementary Table 2: Change in green space visit frequency since restrictions by individual demographic and socio-economic characteristics (unweighted).

	Visited green space in the year before restrictions		Visited green space after restrictions (only those who visited green space before restrictions)		Green space visitation change since lockdown		
	Yes (N=2045, 93.5%)	No (N=142, 6.4%)	Yes (N=1099, 53.8%)	No (N=943, 46.2%)	Decreased (N=1392, 63.3%)	Same (N=473, 21.5%)	Increased (N=333, 15.2%)
	% (N)	% (N)	% (N)	% (N)	% (N)	% (N)	% (N)
Sex							
Male (ref)	92.6% (919)	7.4% (73)	55.2% (507)	44.8% (411)	61.6% (609)	23.5% (232)	15% (148)
Female	94.2% (1126)	5.8% (69)	52.7% (592)	47.3% (532)	64.8% (783)	19.9% (241)	15.3% (185)
Social grade							
ABC1 (ref)	95.8% (1328)	4.2% (58)	56.7% (753)	43.3% (574)	62.9% (871)	18.8% (260)	18.3% (254)
C2DE	89.5% (717)	10.5% (84)	48.4% (346)	51.6% (369)	64.1% (521)	26.2% (213)	9.7% (79)
Age							
18-24	93.3% (139)	6.7% (10)	56.9% (78)	43.1% (59)	58.4% (87)	20.8% (31)	20.8% (31)
25-64 (ref)	93.6% (1364)	6.4% (94)	56.1% (765)	43.9% (598)	61.8% (906)	21.5% (315)	16.7% (245)
65+	93.4% (542)	6.6% (38)	47.2% (256)	52.8% (286)	68.4% (399)	21.8% (127)	9.8% (57)
Ethnicity							
White (ref)	93.6% (1592)	6.4% (109)	52.1% (828)	47.9% (762)	64.1% (1098)	22.5% (385)	13.4% (229)
BAME	84.1% (69)	15.9% (13)	47.8% (33)	52.2% (36)	57% (45)	30.4% (24)	12.7% (10)
Dog ownership							
Don't own a dog/s (ref)	93.1% (1476)	6.9% (109)	51.4% (757)	48.6% (717)	64.4% (1027)	19.5% (311)	16.1% (256)
Own a dog/s	94.5% (569)	5.5% (33)	60.2% (342)	39.8% (226)	60.4% (365)	26.8% (162)	12.7% (77)

Don't know/ can't recall responses were all excluded from analysis.

Supplementary Table 3: Change in green space experience since restrictions by individual demographic and socio-economic characteristics (unweighted).

	Using green spaces benefits my mental health more now			Miss social interaction in green spaces now			Do more physical activity in green spaces now		
	Agree (N=721, 65.8%)	Neither (N=272, 24.8%)	Disagree (N=102, 9.3%)	Agree (N=590, 54.1%)	Neither (N=288, 26.4%)	Disagree (N=213, 19.5%)	Agree (N=322, 29.5%)	Neither (N=337, 30.9%)	Disagree (N=431, 39.5%)
	% (N)			% (N)			% (N)		
<i>Sex</i>									
Male (ref)	59.6% (300)	30.8% (155)	9.5% (48)	45.8% (231)	30% (151)	24.2% (122)	27.4% (137)	35.4% (177)	37.2% (186)
Female	71.1% (421)	19.8% (117)	9.1% (54)	61.2% (359)	23.3% (137)	15.5% (91)	31.4% (185)	27.1% (160)	41.5% (245)
<i>Social grade</i>									
ABC1 (ref)	68% (511)	22.9% (172)	9.1% (68)	54.9% (412)	25.3% (190)	19.7% (148)	31.6% (236)	28.9% (216)	39.6% (296)
C2DE	61% (210)	29.1% (100)	9.9% (34)	52.2% (178)	28.7% (98)	19.1% (65)	25.1% (86)	35.4% (121)	39.5% (135)
<i>Age</i>									
18-24	67.5% (52)	19.5% (15)	13% (10)	64.9% (50)	22.1% (17)	13% (10)	48.7% (38)	16.7% (13)	34.6% (27)
25-64 (ref)	69% (526)	21% (160)	10% (76)	53.7% (407)	25.9% (196)	20.4% (155)	30.8% (233)	30.1% (228)	39.1% (296)
65+	55.9% (143)	37.9% (97)	6.2% (16)	52% (133)	29.3% (75)	18.8% (48)	20% (51)	37.6% (96)	42.4% (108)
<i>Ethnicity</i>									
White (ref)	62.8% (518)	27.3% (225)	9.9% (82)	51.6% (423)	28% (230)	20.4% (167)	26.5% (218)	32.3% (266)	41.2% (339)
BAME	75% (24)	21.9% (7)	3.1% (1)	51.5% (17)	30.3% (10)	18.2% (6)	38.7% (12)	38.7% (12)	22.6% (7)
<i>Dog ownership</i>									
Don't own a dog/s (ref)	68.2% (514)	23.9% (180)	8% (60)	52.5% (395)	27.1% (204)	20.5% (154)	34.5% (259)	28.7% (215)	36.8% (276)
Own a dog/s	60.7% (207)	27% (92)	12.3% (42)	57.7% (195)	24.9% (84)	17.5% (59)	18.5% (63)	35.9% (122)	45.6% (155)

Don't know/ can't recall responses were all excluded from analysis.

Supplementary Table 4: Significant interactions as predicted probabilities for visiting green space before restrictions on movement (ethnicity and social grade) and after the restrictions on movement were enforced (ethnicity and age).

	Before restrictions on movement:			After restrictions on movement:			
	ABC1 (Higher social grade)	C2DE (Lower social grade)	p-value	18-24	25-64	65+	p-value
White	0.96	0.89	0.007	0.42	0.53	0.48	0.005
BAME	0.82	0.88		0.82	0.49	0.32	

For peer review only

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46

Supplementary Table 5: Significant interactions as predicted probabilities for change in green space visits following restrictions on movement (ethnicity and age) and the three experience outcomes (social grade and age).

Change in green space visits		18-24	25-64	65+	p-value
White	Increase	0.16	0.14	0.09	0.015
	Neither	0.22	0.22	0.22	
	Decrease	0.62	0.64	0.69	
BAME	Increase	0.50	0.11	0.00	
	Neither	0.26	0.31	0.29	
	Decrease	0.23	0.58	0.71	
Mental Health					
ABC1	Agree	0.79	0.70	0.56	0.023
	Neither	0.10	0.20	0.38	
	Disagree	0.11	0.10	0.06	
C2DE	Agree	0.26	0.64	0.53	
	Neither	0.33	0.27	0.41	
	Disagree	0.41	0.10	0.06	
Social Interaction					
ABC1	Agree	0.70	0.54	0.49	0.008
	Neither	0.08	0.27	0.28	
	Disagree	0.22	0.19	0.22	
C2DE	Agree	0.45	0.45	0.55	
	Neither	0.43	0.29	0.32	
	Disagree	0.13	0.26	0.13	
Physical Activity					

ABC1	Agree	0.41	0.31	0.18	0.047
	Neither	0.29	0.27	0.43	
	Disagree	0.30	0.42	0.39	
C2DE	Agree	0.45	0.25	0.16	
	Neither	0.18	0.39	0.33	
	Disagree	0.36	0.36	0.51	

For peer review only

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	P1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	P2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	P3/4
Objectives	3	State specific objectives, including any prespecified hypotheses	P3/4
Methods			
Study design	4	Present key elements of study design early in the paper	P5/6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	P5/6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	P5/6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	P5-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	P4/5
Bias	9	Describe any efforts to address potential sources of bias	P4, 7
Study size	10	Explain how the study size was arrived at	P4/5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	P6-8
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	P7/8
		(b) Describe any methods used to examine subgroups and interactions	P8
		(c) Explain how missing data were addressed	P4-6
		(d) If applicable, describe analytical methods taking account of sampling strategy	P6-8
		(e) Describe any sensitivity analyses	-
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Supplementary Tables 1-3
		(b) Give reasons for non-participation at each stage	-
		(c) Consider use of a flow diagram	-

1 2 3 4 5 6 7 8 9	Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest	P4-6, Supplementary Table 1 Table 1 + Supplementary Table 1
10 11 12	Outcome data	15*	Report numbers of outcome events or summary measures	Tables 2-4+ Supplementary Tables 2-5
13 14 15 16 17 18 19 20 21 22 23	Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	P8-14 - -
24 25	Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	P9/10
26	Discussion			
27 28	Key results	18	Summarise key results with reference to study objectives	P14/15
29 30 31 32	Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	P17
33 34 35 36	Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	P14-17
37 38	Generalisability	21	Discuss the generalisability (external validity) of the study results	P14, 17, 18
39	Other information			
40 41 42 43 44	Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	P18

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Change in time spent visiting and experiences of green space following restrictions on movement during the COVID-19 pandemic: A nationally representative cross-sectional study of UK adults.

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2020-044067.R2
Article Type:	Original research
Date Submitted by the Author:	20-Jan-2021
Complete List of Authors:	Burnett, Hannah; University of Glasgow, MRC/CSO Social and Public Health Sciences Unit Olsen, Jonathan; University of Glasgow, MRC/CSO Social and Public Health Sciences Unit Nicholls, Natalie; University of Glasgow, MRC/CSO Social and Public Health Sciences Unit Mitchell, Richard; University of Glasgow, MRC/CSO Social and Public Health Sciences Unit
Primary Subject Heading:	Public health
Secondary Subject Heading:	Mental health
Keywords:	MENTAL HEALTH, COVID-19, PUBLIC HEALTH

SCHOLARONE™
Manuscripts



I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1 **Change in time spent visiting and experiences of green space following**
2 **restrictions on movement during the COVID-19 pandemic: A nationally**
3 **representative cross-sectional study of UK adults.**

4
5 **Hannah Burnett¹, Jonathan R Olsen¹, Natalie Nicholls¹, Richard Mitchell¹**
6 **¹MRC/CSO Social and Public Health Sciences Unit, University of Glasgow, Berkeley**
7 **Square, 99 Berkeley Street, Glasgow, G3 7HR, United Kingdom.**

8
9 **Correspondence:**

10 **Hannah Burnett**

11 **MRC/CSO Social and Public Health Sciences Unit,**

12 **University of Glasgow,**

13 **Berkeley Square,**

14 **99 Berkeley Street,**

15 **Glasgow,**

16 **G3 7HR.**

17 **Email: h.burnett.1@research.gla.ac.uk**

18
19 **Key words: mental health; COVID-19; public health.**

20
21 **Word Count: 3,721**

22 **Tables: 4**

23 **Supplementary tables: 7**

24 ABSTRACT

26 **Objectives** Green space positively influences health and well-being, however inequalities
27 in use of green space are prevalent. Movement restrictions enforced due to the COVID-19
28 pandemic could have exacerbated existing inequalities regarding who visits green space.
29 Therefore, this study aimed to explore how movement restrictions have changed the time
30 spent visiting green space and experience of green space in the United Kingdom (UK) and
31 how these differed by individual-level demographic characteristics.

33 **Design and outcome measures** A nationally representative cross-sectional survey
34 administered through YouGov between 30th April–1st May 2020. Data were collected on the
35 time spent visiting green space and change in the experience of green space, including
36 missing social interaction, increased physical activity, and feeling greater mental health
37 benefits in green space. Demographic information was collected on sex, age, ethnicity, social
38 grade and dog ownership. Associations between specific outcome variables and predictors
39 were assessed using logistic regression.

41 **Setting** United Kingdom, with population weights applied.

43 **Participants** 2,252 adults aged 18 years and over.

44 **Results** Overall, 63% of respondents reported a decrease in time spent visiting green space
45 following movement restrictions. Lower social grade respondents were less likely to visit
46 green space before *and* after restrictions were enforced (OR:0.35 (95% CI:0.24-0.51);
47 OR:0.77 (95% CI:0.63-0.95)). Female respondents were more likely than male respondents to
48 agree that green space benefitted their mental health more following restrictions (PP:0.70 vs.
49 0.59). Older (65+) respondents were less likely than middle age (25-64 years) respondents to
50 have visited green space following the restrictions (OR:0.79 (95% CI:0.63-0.98)).

51 **Conclusions** Inequalities in green space use were sustained, and possibly exacerbated,
52 during movement restrictions. Our findings emphasise the importance of green spaces
53 remaining open globally in any future ‘lockdowns’/pandemics. Further investigation is
54 required to determine how visit patterns and experiences change through the different stages
55 of the COVID-19 pandemic in the UK.

56 **(Word Count: 300)**

58 **Strengths and Limitations of this study**

- 59 • Our data are currently the only existing data covering change in the time spent visiting
60 green space and experiences of green space for the UK population following the
61 movement restrictions enforced due to the COVID-19 pandemic.
- 62 • The sample is nationally representative of UK adults.
- 63 • Collecting data on *both* time spent visiting green space and change in experience of green
64 space during the movement restrictions is a strength of this study, compared to other
65 surveys exploring change in green space use during the COVID-19 pandemic, including
66 the Google COVID-19 Community Mobility Reports and Natural England’s People and
67 Nature Survey.

- 1
2
3
4 68 • The data collected for this study were from a cross-sectional survey, therefore it is not
5 69 possible to demonstrate causality between change in green space use and experiences and
6 70 the demographic data.
7 71 • Certain variable response categories were necessarily recategorised for analysis, which
8 72 meant that some distinctiveness across groups were lost, particularly for the ethnicity and
9 73 age variables.
10 74

11 74 12 75 **INTRODUCTION**

13 76
14 77 Evidence suggests that exposure to green space has a positive influence on health and well-
15 78 being.[1,2] Green space use is associated with increased levels of social interaction and
16 79 physical activity, and decreased levels of all-cause mortality, loneliness and stress.[3–5]
17 80 Additionally, there is evidence that contact with green space may disproportionately benefit
18 81 disadvantaged populations, reducing health inequalities and therefore weakening the effects
19 82 of poverty – known as the ‘equigenic’ effect.[6,7]
20 83

21 84 The health impacts of contact with green spaces are quite well studied by both observational
22 85 and experimental designs. There is rather less literature on the levels of, motivations for, and
23 86 barriers to visiting green spaces in the first place. Recent surveys by Natural England and
24 87 Scottish Natural Heritage have found that 74% of the English population and 70% of the
25 88 Scottish population visit green space ‘frequently’ (once a month or more often). In both
26 89 countries, the top three reasons stated for frequent green space use were health/exercise, dog
27 90 walking, and to relax/unwind.[8,9] Further research exploring the motivations and reasons for
28 91 visiting green space found that visitation frequency is affected by an individual’s feelings of
29 92 nature connectedness, as well as their childhood exposure to nature.[10–12]. It is important to
30 93 note that substantial inequalities in green space use have also been reported, with studies
31 94 finding that females, older people and those from less advantaged socioeconomic positions
32 95 (SEP) are more likely to be infrequent users than their male, younger and higher SEP
33 96 counterparts.[9,13–15]
34 97

35 98 In 2020, the United Kingdom (UK) experienced major disruption to everyday life due to the
36 99 novel coronavirus disease 2019 (COVID-19) pandemic. COVID-19 is an infectious disease
40 100 first identified in the city of Wuhan, China in December 2019.[16] As a response to the
41 101 COVID-19 outbreak, the UK announced a series of movement restrictions from 23rd March
42 102 2020. These included rules designed to increase social distancing, meaning that people could
43 103 only leave their households to make ‘essential trips’ for food, medication and exercise.[17]
44 104 Recent studies have highlighted the negative effects of COVID-19 on the UK population’s
45 105 mental health and wellbeing, which are likely to be profound and long-lasting.[18] Research
46 106 exploring the wider health effects of COVID-19 suggest that the negative indirect effects are
47 107 being borne disproportionately by people who have fewer resources and poorer health.[19] If
48 108 natural environments usually act to mitigate the connections between adversity and poor
49 109 health,[6,7] it is important to assess the extent to which lockdown affected both use and
50 110 experience of such environments. Future lockdowns and movement restrictions are highly
51 111 likely as second, third and perhaps fourth waves of the pandemic take place around the world.
52 112

53 113 The aim of this research was to explore changes in the time spent visiting green space and
54 114 experience of visits to green space among the UK population following movement
55 115 restrictions. The sociodemographic characteristics focused on were those identified by the
56 116 literature as being most consistent markers of inequality in use. The research questions were:

- 1
2
3 117
4 118 1) How did time spent visiting green space change following movement restrictions,
5 119 compared with before, and for whom?
6 120 2) How did experiences of visits to green space change following the restrictions, and
7 121 did any change vary by sex, social grade, age, ethnicity and dog ownership?
8 122 Specifically,
9 123 a) Did respondents feel that green space benefitted their mental health more since
10 124 restrictions than before?
11 125 b) Did respondents miss social interaction in green space more following movement
12 126 restrictions?
13 127 c) Had physical activity increased following movement restrictions?
14 128

17 129 METHODS

20 131 Survey design and sample

22 133 An online cross-sectional survey was administered by YouGov between 30th April and 1st
23 134 May 2020.[20] Questions were answered by a sample of 2,252 adults from the UK (aged 18
24 135 and over). The sample was drawn from a panel of over 800,000 individuals who specifically
25 136 opted in to participate in online research activities. Sample members were randomly selected
26 137 from the panel and sent an email providing a survey link. Table 1 shows the themes and
27 138 specific survey instruments analysed in this paper. Only the respondents that visited green
28 139 space following movement restrictions were asked the questions regarding change in
29 140 experience of green space. Demographic information about participants was also collected
30 141 (including sex, age and social grade, which was classified by occupation).[21,22] Although
31 142 the sample was reasonably large, small numbers in variable response categories necessitated
32 143 some category mergers (Table 1 and Supplementary Table 1).
33 144

36 145 The survey covered adults from across the UK, with respondents from England (N=1,875),
37 146 Scotland (N=209), Wales (N=107), and Northern Ireland (N=61). Weightings were applied to
38 147 render the sample representative of UK adults (detailed below). When the survey was
39 148 distributed, the same movement restrictions were implemented across the UK. These
40 149 included only leaving home for limited purposes, such as medical needs, shopping for basic
41 150 necessities (food and medicine), and exercising once a day alone/with members of your
42 151 household.[23] Since then, the individual parliaments/assemblies representing these
43 152 countries have imposed different COVID-19 policies.
44 153

45 153
46 154 **Table 1:** Survey themes and specific items analysed, including variables recategorised.

Themes	Question/statement	Potential responses	Recategorised
Change in the amount of time spent visiting green space	<i>"Did you EVER visit a green space in the year before the movement restrictions were enforced in the UK?"</i>	Yes, I did No, I didn't Don't know/ can't recall	- <i>Don't know/can't recall excluded (N=80, 3.5%)</i>
	<i>"Please think about your behaviour since the UK enforced a 'lock down' to restrict movement, as a result of the current Coronavirus (COVID-19) outbreak (i.e. since 23rd March 2020). Have you visited a green space since the movement</i>	Yes, I have No, I haven't Don't know/ can't recall	-

	<i>restrictions have been enforced in the UK?"</i>		<i>Don't know/can't recall excluded (N=43, 1.9%)</i>
	<i>"How much, if at all, has the amount of time that you have spent visiting green spaces changed since the 'lock down' movement restrictions began (i.e. 23rd March 2020) compared to before?"</i>	Increased a lot Increased a little No difference Decreased a little Decreased a lot Don't know	'Increased' (increased a lot and increased a little) 'Same' (no difference) 'Decreased' (decreased a lot and decreased a little) <i>Don't know excluded (N=74, 3.3%)</i>
Experience change (If respondent had visited a green space since the movement restrictions were enforced)	<i>"I feel that being in green spaces benefits my mental health <u>more now</u>, than before the movement restrictions were in place"</i>	Strongly agree Slightly agree Neither agree nor disagree Slightly disagree Strongly disagree Don't know/can't recall	'Agree' (strongly agree and slightly agree) 'Neither' (neither agree nor disagree) 'Disagree' (slightly disagree and strongly disagree) <i>Don't know/can't recall excluded (N=7, 0.6%)</i>
	<i>"I have missed seeing and/or talking with people in green spaces <u>since</u> the movement restrictions were introduced"</i>	Strongly agree Slightly agree Neither agree nor disagree Slightly disagree Strongly disagree Don't know/can't recall	'Agree' (strongly agree and slightly agree) 'Neither' (Neither agree nor disagree) 'Disagree' (slightly disagree and strongly disagree) <i>Don't know/can't recall excluded (N=8, 0.8%)</i>
	<i>"I do more physical activity in green spaces <u>now</u>, than I did before the movement restrictions were introduced"</i>	Strongly agree Slightly agree Neither agree nor disagree Slightly disagree Strongly disagree Don't know/can't recall	'Agree' (strongly agree and slightly agree) 'Neither' (Neither agree nor disagree) 'Disagree' (slightly disagree and strongly disagree) <i>Don't know/can't recall excluded (N=9, 0.8%)</i>

Don't know/ can't recall responses were all excluded from analysis (weighted counts and proportions reported above).

Demographic variables

Individual level demographic and socio-economic characteristics were captured from the survey, as follows: sex (male, female); age group (18-24 years, 25-64 years, 65+ years); ethnicity (White, Black, Asian and minority ethnic (BAME)); dog ownership (Yes, No); and social grade (ABC1, C2DE), derived by YouGov from combined occupational social grade categories. ABC1 was the higher social grade, and included non-manual workers, for example, senior managers and owners of small establishments. C2DE was the lower social grade, and included all manual workers, for example, shop assistants and labourers.[24] Hereafter, social grade will be described as higher and lower social grade.

Patient and Public Involvement

There was no direct patient or public involvement in this study.

172 **Analyses**

173 174 **Descriptive statistics**

175
176 The count and proportion of respondents who had: visited green space before and after
177 movement restrictions were enforced; increased or decreased visitation; and agreed or
178 disagreed with the three change in experience statements (Table 1) are presented. These were
179 also explored by sex, age, ethnicity, dog ownership and social grade.

181 **Statistical analysis**

182
183 Binary logistic regression analyses were conducted to assess the association between the
184 individual predictor variables and the following two outcomes:

- 186 1. having visited green space in the year before movement restrictions were enforced;
- 187 2. having visited green space since movement restrictions were enforced, with this
188 analysis being restricted to those who had reported visiting green space before
189 movement restrictions.

190
191 The associations between the individual predictor variables and each of the following
192 outcomes were also assessed using multinomial logistic regression or, if appropriate, ordinal
193 logistic regression, with results presented as predicted probabilities (PP):

- 195 1. Change in green space visitation following movement restrictions;
- 196 2. Levels of agreement that green space benefits their mental health more now (since
197 movement restrictions compared to before);
- 198 3. Levels of agreement that they miss seeing/talking to people in green space now (since
199 movement restrictions compared to before); and
- 200 4. Levels of agreement that they do more physical activity in green space now (since
201 movement restrictions compared to before).

202
203 The results of the binary logistic regression analyses were expressed as odds ratios (OR) with
204 95% confidence intervals (CIs). Other results are presented as predicted outcome group
205 probabilities for each variable. Predicted probabilities (PP) can be interpreted as a an
206 indicator of likelihood, so that the closer the value is to 1.0, the greater the likelihood. We
207 opted to present these results as predicted probabilities as they better illustrate not only the
208 size of the association between the predictor variable and response category, but also the
209 difference in this *between* variables. For example, the likelihood of men either decreasing,
210 maintaining or increasing their time in green space can be more easily compared to the
211 likelihood of those in the higher social grade category decreasing, maintaining or increasing
212 their time in green space using predicted probability than with an OR or risk ratio (RR). This
213 is because an OR or RR is expressed relative to the reference category. For those who prefer
214 a RR, these are provided in the supplementary material (Supplementary Tables 2-5).

215
216 Univariate models for each predictor were conducted first, followed by a fully adjusted
217 model containing all predictors for each outcome. Weightings were calculated by YouGov,
218 with the final data weighted to match the national profile of all adults aged 18 and over and
219 applied during analyses to render the sample representative of UK adults.[22] All analyses
220 were conducted in R v3.5.1,[25], and the *brant* package,[26], was used to check that the

221 proportionality of odds assumption for ordinal logistic regression was not violated.[27] A full
222 R script is available on GitHub.[28]

223

224 RESULTS

225

226 Descriptive statistics

227

228 93% of all respondents had visited green space in the year before movement restrictions were
229 enforced. In contrast, 53% of respondents reported visiting green space following movement
230 restrictions. 63% of respondents reported that the amount of time they spent in green space
231 had decreased since movement restrictions compared to before, with 15% reporting an
232 increase, and 22% reporting no difference in the time spent visiting green space
233 (Supplementary Table 6).

234

235 A greater proportion of respondents agreed (65%) than disagreed (10%) or neither agreed nor
236 disagreed (25%) that green space benefited their mental health more following movement
237 restrictions compared to before. More respondents agreed (54%) that they missed social
238 interaction in green space more since movement restrictions, than disagreed (19%) or neither
239 agreed nor disagreed (27%). 39% of respondents disagreed that they had increased physical
240 activity in green space since movement restrictions, compared to 29% who agreed and 32%
241 that neither agreed nor disagreed (Supplementary Table 7).

242

243 Change in visitation time

244

245 Visiting green space before movement restrictions

246

247 In the adjusted logistic regression model for visiting green space in the year before movement
248 restrictions were enforced (Table 2), only two variables had significant associations ($p < 0.05$).
249 Lower social grade respondents (OR:0.35 (95%CI:0.24-0.51)) and BAME (OR:0.43
250 (95%CI:0.23-0.80)) respondents had lower odds of visiting green space before movement
251 restrictions, compared to higher social grade and white respondents.

252

253 Visiting green space following movement restrictions

254

255 Respondents in the lower social grade group were less likely to have visited green space than
256 respondents in the higher social grade group (OR:0.77 (95%CI:0.63-0.95)) (Table 2). Older
257 respondents (65+) were also less likely than middle age respondents (25-64) to have visited
258 green space following the movement restrictions (OR:0.79 (95% CI:0.63-0.98)). Respondents
259 who owned a dog/s were more likely than respondents who did not to have visited green
260 space after movement restrictions were enforced (OR:1.42 (95%CI:1.14-1.78)).

261

262 Change in time spent visiting green space

263

264 Following lockdown, changes in the time spent visiting green space was found to differ by
265 demographic group. The likelihood of spending more time in greenspace was found to differ
266 by social grade. Lower social grade respondents were less likely to report spending more time
267 in green space following movement restrictions than higher social grade respondents
268 (PP:0.09 vs. 0.16) (Table 3). Age was also found to be associated with change in time spent
269 in green space. Older respondents (aged 65+) were the least likely to report increased green

1
2
3 270 space visits (PP:0.09(65+) compared to younger groups (PP: 0.14(25-64) and 0.21(18-24)).
4 271 Females were more likely to report decreased green space visits compared to males (PP:0.67
5 272 vs. 0.62), as well as being less likely to report no change in visit time (PP:0.20 vs.
6 273 0.25)(Table 3). Finally, respondents without a dog/s were slightly more likely to report
7 274 decreased green space visitations compared to dog owners(PP:0.66 vs. 0.62), and less likely
8 275 to sustain their frequency of visitation (PP:0.21 vs. 0.28).
9 276
10 277
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

278

279 **Table 2:** Adjusted binary logistic regression models predicting green space visit before and after the movement restrictions were enforced. OR =
 280 odds ratio; CI = confidence intervals.

	Visited green space in the year before restrictions (yes)		Visited green space after restrictions (yes & visited green space before restrictions)	
	Adjusted		Adjusted	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Sex				
Male (ref)				
Female	1.35 (0.94-1.95)	0.109	0.88 (0.72-1.07)	0.205
Social grade				
ABC1 (ref)				
C2DE	0.35 (0.24-0.51)	<0.001	0.77 (0.63-0.95)	0.013
Age				
18-24	2.92 (1.00-8.57)	0.051	0.81 (0.54-1.21)	0.297
25-64 (ref)				
65+	1.22 (0.80-1.85)	0.353	0.79 (0.63-0.98)	0.035
Ethnicity				
White (ref)				
BAME	0.43 (0.23-0.80)	0.007	1.06 (0.67-1.68)	0.799
Dog ownership				
No (ref)				
Yes	1.29 (0.83-2.00)	0.260	1.42 (1.14-1.78)	0.002

281

282

283

284

285

Table 3: Multinomial logistic regression models: Predicted probabilities (likelihoods) of being in each outcome group for change in time visiting green space and levels of agreement that green space benefits their mental health more now (since movement restrictions were enforced compared to before). The p-values presented reflect the significance of each factor in the model.

		Change in time spent visiting green space				Using green spaces benefits my mental health more now			
		Decreased	Same	Increased	p-value	Agree	Neither	Disagree	p-value
Sex	Male	0.62	0.25	0.13	<i>0.041</i>	0.59	0.31	0.10	<i>0.004</i>
	Female	0.67	0.20	0.12		0.70	0.22	0.09	
Social grade	ABC1	0.65	0.19	0.16	<i><0.001</i>	0.68	0.24	0.09	<i>0.048</i>
	C2DE	0.64	0.27	0.09		0.59	0.31	0.10	
Age	18-24	0.57	0.22	0.21	<i>0.004</i>	0.55	0.20	0.25	<i><0.001</i>
	25-64	0.63	0.22	0.14		0.68	0.22	0.10	
	65+	0.69	0.22	0.09		0.55	0.38	0.06	
Ethnicity	White	0.22	0.65	0.12	0.167	0.64	0.26	0.10	0.063
	BAME	0.30	0.56	0.14		0.73	0.25	0.02	
Dog ownership	No	0.66	0.21	0.13	<i>0.003</i>	0.67	0.24	0.09	0.117
	Yes	0.62	0.28	0.10		0.59	0.30	0.11	

286 **Table 4: Multinomial logistic regression models:** Predicted probabilities (likelihoods) of each levels of agreement that respondents missed
 287 seeing/talking to people in green space more since movement restrictions were enforced compared to before, and levels of agreement that
 288 respondents do more physical activity in green space following the movement restrictions. The p-values presented reflect the significance of
 289 each factor in the model.

		Miss social interaction in green spaces now				Do more physical activity in green spaces now			
		Agree	Neither	Disagree	p-value	Agree	Neither	Disagree	p-value
<i>Sex</i>	Male	0.45	0.30	0.25	<0.001	0.24	0.37	0.40	0.096
	Female	0.58	0.26	0.16		0.27	0.29	0.43	
<i>Social grade</i>	ABC1	0.53	0.27	0.20	0.256	0.27	0.31	0.42	0.307
	C2DE	0.48	0.31	0.21		0.23	0.36	0.41	
<i>Age</i>	18-24	0.59	0.23	0.18	0.672	0.44	0.23	0.33	0.002
	25-64	0.51	0.28	0.21		0.29	0.31	0.40	
	65+	0.53	0.30	0.18		0.18	0.38	0.45	
<i>Ethnicity</i>	White	0.52	0.28	0.20	0.802	0.25	0.32	0.42	0.063
	BAME	0.52	0.31	0.16		0.33	0.44	0.22	
<i>Dog Ownership</i>	No	0.50	0.30	0.20	0.295	0.31	0.30	0.39	<0.001
	Yes	0.55	0.25	0.20		0.17	0.38	0.46	

290

291 **Change in visit experience**

292

293 **Mental health benefits**

294

295 Females were more likely to agree than males that being in green space benefitted their
296 mental health more following movement restrictions than before (PP:0.70 vs. 0.59). Higher
297 social grade respondents were more likely to agree than lower social grade respondents
298 (PP:0.68 vs. 0.59). Younger respondents were more likely to disagree that being in green
299 space benefitted their mental health more following movement restrictions than before, whilst
300 older respondents were less likely to disagree (PP:0.25(18-24) vs. 0.06(65+) and 0.10(25-
301 64))(Table 3).

302

303 **Missed social interaction**

304

305 Female respondents were more likely to agree that they missed seeing and talking with other
306 people in green space since movement restrictions compared to before than male respondents
307 (PP:0.58 vs. 0.45)(Table 4).

308

309 **Increased physical activity**

310

311 Older respondents were less likely to agree that they had increased physical activity
312 following movement restrictions (PP:0.18(65+) vs. 0.20(25-64) and 0.44(18-24)).
313 Respondents who owned a dog/s were less likely than respondents without a dog/s to agree
314 (PP:0.17 vs. 0.31)(Table 4).

315

316 **DISCUSSION**

317

318 Our findings suggest that inequalities in use of green space between demographic groups
319 were sustained following movement restrictions, with lower social grade individuals less
320 likely than higher social grade individuals to have visited green space before and since
321 movement restrictions. Other existing inequalities in use were possibly exacerbated in the
322 month after movement restrictions were enforced, with females being more likely to report a
323 decrease in visits following movement restrictions.

324

325 The proportion of respondents who visited green space before and following movement
326 restrictions decreased, from 93% to 53%. This was consistent with Natural England's
327 findings from April 2020 where 49% of English adults reported green space visits in the
328 previous two weeks.[29] Natural England conducted an online panel survey in April 2020
329 (N=2,083), the survey covered only the English population, collecting information on the
330 frequency of time in green and natural spaces in the 12 months, and then 2 weeks, prior to the
331 survey.[30] The survey did not directly ask respondents about whether they felt their
332 experiences within green space had changed following movement restrictions. A similar
333 study focused on change in time spent visiting parks using the Google COVID-19
334 Community Mobility Reports covering 620 counties across the United States(USA). They
335 found a lower percentage decrease in park visits compared to our findings, reporting a 17-
336 35% decrease in visits between 15th March-9th May 2020.[31] This difference may be
337 explained by the focus on parks alone rather than different types of green space. However,
338 additional research exploring the Google COVID-19 Community Mobility Reports found that

1
2
3 339 from 16th February-29th March 2020 park use decreased by 90% in Catalonia, 7% in Oslo,
4 340 and 79% in New York County. In Stockholm, park use increased by 24% in the same
5 341 timeframe.[32] This could be explained by Sweden having a less stringent approach to
6 342 movement restrictions and instead relying on 'self-responsibility' to prevent the population
7 343 having to restrict movement and stay at home.[33] The Swedish population may also be more
8 344 culturally attuned to seeking time in nature to combat stress.

9 345
10 346 Females and older individuals were more likely to have reported decreased visits to green
11 347 space following movement restrictions. These findings corroborate with existing data
12 348 collected before movement restrictions.[9,13,14] Boyd *et al.* analysed the Natural England
13 349 'Monitor of Engagement with the Natural Environment' survey (N=63,890) with a focus on
14 350 infrequent use. They found that females and older adults in England were more likely to be
15 351 infrequent visitors.[9] Cohen *et al.* explored physical activity levels in Los Angeles' parks
16 352 (N=1,318). They reported that age and sex were predictors of park use, with <5% of park
17 353 users over 60 years old, and males using parks more often than females (62% vs. 38%).[13]

18 354
19 355 Our findings suggested that existing patterns of gender inequality in use were sustained and
20 356 potentially exacerbated due to fears arising from the COVID-19 pandemic. For example, an
21 357 Ipsos MORI survey was conducted in April 2020, collecting data on gender differences in
22 358 British attitudes towards COVID-19. They found that women were more likely to report
23 359 following government rules to avoid leaving their home (78%) than men (68%) and felt more
24 360 uncomfortable about returning to "normal"(N=1,000).[34,35]

25 361
26 362 Previous studies have found that females feel more vulnerable than males in green spaces,
27 363 especially without company.[14,15,36–39] There are few quantitative studies focusing on sex
28 364 and the importance of social interaction as a motivation behind green space use. We found
29 365 that females were more likely to agree that they missed seeing/talking with others in green
30 366 space than males. This could be explained by the nature of the movement restrictions at this
31 367 time, particularly the inability to socially interact with individuals outside your household in
32 368 green space.

33 369
34 370 Given older age is probably the most important risk factor for an adverse outcome from
35 371 COVID-19,[40,41] it was not surprising that older individuals were less likely to report an
36 372 increase in green space visits and to agree that they were doing more physical activity
37 373 following movement restrictions. These findings corroborate with the majority of research
38 374 exploring older age and green space use before the movement restrictions.[9,13,42] Older
39 375 people in the UK have been found to be at particular risk of social isolation during social
40 376 distancing, being less likely to use online communications and more likely to live alone than
41 377 younger individuals.[19] Our findings also show that older people are less likely to have used
42 378 green space during lockdown, further emphasising this point. The significant decrease in
43 379 green space visits following movement restrictions for older respondents could be explained
44 380 by the government advice for over 70s and those with an underlying health condition to
45 381 shield, minimise interaction and stay at home, for around 12 weeks from 21st March
46 382 2020.[43]

47 383
48 384 Lower social grade respondents reported little or no change in visitation to green space, with
49 385 time spent visiting green space remaining low both before and after movement restrictions.
50 386 This is supported by previous studies exploring the association between socio-economic
51 387 position (SEP) and green space use.[9,15,42] One possible explanation is a lack of interest in
52 388 visiting green space reported by lower SEP individuals.[9] Additionally, the social grade

1
2
3 389 variable was categorised by occupation, and it was likely that individuals categorised as
4 390 lower social grade were working in manual or service occupations.[24] They may have
5 391 continued at their usual workplace/working hours during the COVID-19 pandemic. Findings
6 392 from the Office for National Statistics support this explanation, with 30.5% of employees in
7 393 the bottom three income deciles (monthly earnings of up to £1,450) considered as key
8 394 workers in March/April 2020, compared to 26.4% in the top three income deciles (monthly
9 395 earnings of up to £3,250).[44] Similarly, existing international research on public space use
10 396 during COVID-19 restrictions worldwide state that skilled workers in the knowledge
11 397 economy have shifted easily into online work from home, and can therefore make more use
12 398 of green spaces during the movement restrictions.[45]
13 399

14 400 The results for dog owners suggest that the movement restrictions have had an overall
15 401 negative impact on their experiences within green space. Although dog owners were more
16 402 likely to have visited green space following the movement restrictions than those that did not
17 403 own a dog, they were less likely to agree that they had increased physical activity and more
18 404 likely to have decreased visitations following the restrictions. These results differ from
19 405 research undertaken in Canada that reported findings that dog ownership was associated with
20 406 more outdoor play and less indoor play in Canadian youth at the start of the pandemic.[46]
21 407 However, the focus on youth rather than adults may explain this difference in findings.
22 408 Instead, the difference found in visits after restrictions were enforced may be due to dog
23 409 owners having to walk their dog/s in green spaces *despite* the pandemic restrictions. In
24 410 comparison between our results and those of other studies, we are mindful of the difference
25 411 between number of visits and time spent in green spaces as measures of ‘use’. It would be
26 412 entirely possible to increase one at the expense of the other and our data were not well suited
27 413 to unpacking the relationship between them.
28 414

29 415 **Strengths and limitations**

30 416

31 417 Our study has several strengths; to our knowledge, currently this is the only data covering
32 418 UK population change in use and experiences within green space at the start of the movement
33 419 restrictions from 23rd March 2020. This means that the data could provide timely information
34 420 to local and national governments across the UK. It is important to understand the effects of
35 421 the initial movement restrictions to generate policy recommendations for any future
36 422 movement restrictions. The rapid collection of data, just over a month after the movement
37 423 restrictions were introduced, reduces risk of recall bias. The sample is nationally
38 424 representative of UK adults, with weightings calculated by YouGov and applied to all
39 425 analyses, reducing risk of selection bias.[22]
40 426

41 427 A further strength of our study is providing quantitative data on the importance of social
42 428 interaction as a driver for using green space, which is under-reported in the literature. We
43 429 analysed social grade at an individual level, which provides greater detail and accuracy of the
44 430 respondent’s SEP than at neighbourhood level.
45 431

46 432 There are some caveats. The survey design was cross-sectional, and we are unable to
47 433 demonstrate causality between change in green space use and experiences and the
48 434 demographic data. Additionally, the data on use and experiences are self-reported and
49 435 therefore subjective. Certain variable response categories had to be recategorised in order to
50 436 analyse them. This is particularly evident in the ethnicity and age variables, where some
51 437 distinctiveness across groups was lost. The variable best capturing change in behaviour
52

1
2
3 438 measured time spent in green space, but this made it difficult to understand whether
4 439 respondents traded off time and numbers of visits.

5 440
6 441 We encourage future research to explore the reasons *why* many patterns and changes in use of
7 442 green space since movement restrictions have emerged. It would also be interesting to
8 443 explore the change in patterns of use before and following movement restrictions for those
9 444 that did not visit before the movement restrictions but did visit green space following
10 445 restrictions.
11 446

12 447 **CONCLUSION**

13 448
14 449 Our study provides novel evidence to suggest that green space use and experiences were
15 450 profoundly affected during the first month of movement restrictions in the UK which were
16 451 part of the response to COVID-19. Our findings suggested that inequalities in use were
17 452 sustained, with lower social grade individuals less likely to visit green space than higher
18 453 social grade individuals before and following movement restrictions. It is possible that these
19 454 inequalities were exacerbated, as females and older individuals were the groups most likely
20 455 to have decreased visits following movement restrictions. Although these findings reflect the
21 456 UK population's experience during the movement restrictions, they could be compared with
22 457 countries such as Norway, USA, and Spain where green space visits also decreased. We
23 458 believe that these findings emphasise the need for green spaces to remain open in any future
24 459 'lockdowns' and for governments to actively encourage individuals to utilise these spaces to
25 460 support their mental and physical health during subsequent waves of the pandemic. Further
26 461 investigation is required to support these findings and how they may change through the
27 462 stages of the COVID-19 pandemic and the relaxing, and potential re-introduction, of
28 463 movement restrictions.
29 464

30 465 **COMPETING INTERESTS**

31 466 None declared.

32 467 **DATA SHARING STATEMENT**

33 468
34 469 We have made our research dataset publicly available (Datacite DOI:
35 470 10.5525/gla.researchdata.1038 - embargoed until 31/10/2023).

36 471 **CONTRIBUTORS**

37 472
38 473 HB, JRO and RM designed the study and survey; HB conducted data analysis which was
39 474 reviewed by NN; HB wrote the first draft of the paper; all authors contributed to interpreting
40 475 the results and revising the draft. The corresponding author attests that all listed authors meet
41 476 authorship criteria and that no others meeting the criteria have been omitted.
42 477

43 478 **FUNDING STATEMENT**

44 479 The authors (HB, JRO, NN & RM) are part of the Places and Health Programme at the
45 480 MRC/CSO Social and Public Health Sciences Unit (SPHSU), University of Glasgow,
46 481 supported by the Medical Research Council (MC_UU_12017/10) and the Chief Scientist
47 482 Office (SPHSU10).
48 483

49 484 **References:**

- 50
51
52
53
54
55
56
57
58
59 483 1 Barton J, Pretty J. What is the Best Dose of Nature and Green Exercise for Improving
60 484 Mental Health? A Multi-Study Analysis. *Environ Sci Technol* 2010;**44**:3947–55.

- 1
2
3 485 doi:10.1021/es903183r
4 486 2 Douglas O, Lennon M, Scott M. Green space benefits for health and well-being: A
5 487 life-course approach for urban planning, design and management. *CITIES* 2017;**66**:53–
6 488 62. doi:10.1016/j.cities.2017.03.011
7
8 489 3 Twohig-Bennett C, Jones A. The health benefits of the great outdoors: A systematic
9 490 review and meta-analysis of greenspace exposure and health outcomes. *Environ Res*
10 491 2018;**166**:628–37. doi:10.1016/j.envres.2018.06.030
11 492 4 Maas J, Van Dillen SME, Verheij RA, *et al.* Social contacts as a possible mechanism
12 493 behind the relation between green space and health. *Health Place* 2009;**15**:586–95.
13 494 doi:10.1016/j.healthplace.2008.09.006
14
15 495 5 Wells N, Evans G. NEARBY NATURE A Buffer of Life Stress Among Rural
16 496 Children. *Environ Behav* 2003;**35**:311–30. doi:10.1177/0013916503251445
17 497 6 Frumkin H, Bratman GN, Breslow SJ, *et al.* Nature Contact and Human Health: A
18 498 Research Agenda. *Environ Health Perspect* 2017;**125**. doi:10.1289/EHP1663
19 499 7 Mitchell RJ, Richardson EA, Shortt NK, *et al.* Neighborhood Environments and
20 500 Socioeconomic Inequalities in Mental Well-Being. *Am J Prev Med* 2015;**49**:80–4.
21 501 doi:10.1016/j.amepre.2015.01.017
22
23 502 8 Wilson V, Seddon B. Scotland’s People and Nature Survey 2017/18 – outdoor
24 503 recreation and health modules. (Scottish Natural Heritage Research Report No. 1062).
25 504 Inverness: 2018.
26 505 9 Boyd F, White MP, Bell SL, *et al.* Who doesn’t visit natural environments for
27 506 recreation and why: A population representative analysis of spatial, individual and
28 507 temporal factors among adults in England. *Landsc Urban Plan* 2018;**175**:102–13.
29 508 doi:10.1016/j.landurbplan.2018.03.016
30
31 509 10 Bell SL, Phoenix C, Lovell R, *et al.* Green space, health and wellbeing: making space
32 510 for individual agency. *Health Place* 2014;**30**:287–92.
33 511 doi:10.1016/j.healthplace.2014.10.005
34 512 11 Lin BB, Fuller RA, Bush R, *et al.* Opportunity or Orientation ? Who Uses Urban Parks
35 513 and Why. 2014;**9**:1–7. doi:10.1371/journal.pone.0087422
36
37 514 12 Ward Thompson C, Aspinall P, Montarzino A. The Childhood Factor Adult Visits to
38 515 Green Places and the Significance of Childhood Experience. *Environ Behav*
39 516 2008;**40**:111–43. doi:10.1177/0013916507300119
40 517 13 Cohen DA, McKenzie TL, Sehgal A, *et al.* Contribution of Public Parks to Physical
41 518 Activity. *Am J Public Health* 2007;**97**:509–14. doi:10.2105/AJPH.2005.072447
42 519 14 Lee ACK, Maheswaran R. The health benefits of urban green spaces: A review of the
43 520 evidence. *J Public Health (Bangkok)* 2011;**33**:212–22. doi:10.1093/pubmed/fdq068
44 521 15 Morris J, O’Brien E, Ambrose-Oji B, *et al.* Access for all? Barriers to accessing
45 522 woodlands and forests in Britain. *Local Environ Int J Justice Sustain* 2011;**16**:375–96.
46 523 doi:10.1080/13549839.2011.576662
47
48 524 16 Wynants L, Van Calster B, Bonten MMJ, *et al.* Prediction models for diagnosis and
49 525 prognosis of covid-19 infection: systematic review and critical appraisal . *BMJ*
50 526 2020;**369**. doi:10.1136/bmj.m1328
51 527 17 Johnson B. Prime Minister’s statement on coronavirus (COVID-19): 23 March 2020.
52 528 GOV.UK. 2020.<https://www.gov.uk/government/speeches/pm-address-to-the-nation-on-coronavirus-23-march-2020> (accessed 7 Jul 2020).
53 529
54 530 18 O’Connor RC, Wetherall K, Cleare S, *et al.* Mental health and wellbeing during the
55 531 COVID-19 pandemic: longitudinal analyses of adults in the UK COVID-19 Mental
56 532 Health & Wellbeing study. *Br J Psychiatry* 2020;:1–17. doi:10.1192/bjp.2020.212
57 533 19 Douglas M, Katikireddi SV, Taulbut M, *et al.* Mitigating the wider health effects of
58 534 covid-19 pandemic response. *BMJ* 2020;**369**. doi:10.1136/bmj.m1557

- 1
2
3 535 20 YouGov. About YouGov Company. <https://yougov.co.uk/about/> (accessed 8 Jun
4 536 2020).
- 5 537 21 YouGov and ESOMAR (World Association for Social Opinion and Market Research).
6 538 ESOMAR 28: 28 Questions to help Online Research Buyers. The Netherlands: 2012.
7 539 http://cdn.yougov.com/cumulus_uploads/document/t3r5k565j5/ESOMAR_28.pdf
8 540 (accessed 8 Jun 2020).
- 9 541 22 YouGov. Panel Methodology. <https://yougov.co.uk/about/panel-methodology/>
10 542 (accessed 8 Jun 2020).
- 11 543 23 Cabinet Office. Staying at home and away from others (social distancing). London:
12 544 2020. [https://www.gov.uk/government/publications/full-guidance-on-staying-at-home-](https://www.gov.uk/government/publications/full-guidance-on-staying-at-home-and-away-from-others)
13 545 [and-away-from-others](https://www.gov.uk/government/publications/full-guidance-on-staying-at-home-and-away-from-others) (accessed 8 Oct 2020).
- 14 546 24 The Market Research Society (MRS). Definitions employed in Social Grading. MRS.
15 547 [https://www.mrs.org.uk/pdf/Definitions used in Social Grading based on OG7.pdf](https://www.mrs.org.uk/pdf/Definitions%20used%20in%20Social%20Grading%20based%20on%20OG7.pdf)
16 548 (accessed 2 Jul 2020).
- 17 549 25 R Core Team. R: A Language and Environment for Statistical Computing.
18 550 2018.<https://www.r-project.org/>
- 19 551 26 Schlegel BE. Package brant. <https://benjaminschlegel.ch/en/r/brant/> (accessed 29 Oct
20 552 2020).
- 21 553 27 Brant R. Assessing proportionality in the proportional odds model for ordinal logistic
22 554 regression. *Biometrics* 1990;**46**:1171–8.
- 23 555 28 Burnett H. Change in green space use and experiences following UK restrictions on
24 556 movement. GitHub. 2020.https://github.com/hannahburnett/greenspace-covid_code
25 557 (accessed 21 Jul 2020).
- 26 558 29 Natural England. The People and Nature Survey for England: Monthly interim
27 559 indicators for April 2020 (Experimental Statistics) . Nat. Engl.
28 560 2020.[https://www.gov.uk/government/publications/the-people-and-nature-survey-for-](https://www.gov.uk/government/publications/the-people-and-nature-survey-for-england-monthly-interim-indicators-for-april-2020-experimental-statistics/the-people-and-nature-survey-for-england-monthly-interim-indicators-for-april-2020-experimental-statistics)
29 561 [england-monthly-interim-indicators-for-april-2020-experimental-statistics/the-people-](https://www.gov.uk/government/publications/the-people-and-nature-survey-for-england-monthly-interim-indicators-for-april-2020-experimental-statistics/the-people-and-nature-survey-for-england-monthly-interim-indicators-for-april-2020-experimental-statistics)
30 562 [and-nature-survey-for-england-monthly-interim-indicators-for-april-2020-](https://www.gov.uk/government/publications/the-people-and-nature-survey-for-england-monthly-interim-indicators-for-april-2020-experimental-statistics/the-people-and-nature-survey-for-england-monthly-interim-indicators-for-april-2020-experimental-statistics)
31 563 [experimental-statistics](https://www.gov.uk/government/publications/the-people-and-nature-survey-for-england-monthly-interim-indicators-for-april-2020-experimental-statistics/the-people-and-nature-survey-for-england-monthly-interim-indicators-for-april-2020-experimental-statistics) (accessed 25 Jun 2020).
- 32 564 30 Natural England. The People and Nature Survey For England. 2020.
33 565 <http://publications.naturalengland.org.uk/publication/6382837173583872>
- 34 566 31 Curtis DS, Rigolon A, Schmalz DL, *et al.* Getting out while staying in: Park use
35 567 decreased during the COVID-19 pandemic, especially where park availability was
36 568 low. *Cent Open Sci OSF Prepr* Published Online First: 2020.
37 569 doi:10.31235/osf.io/9xzgf
- 38 570 32 Barton D, Haase D, Mascarenhas A, *et al.* Enabling Access to Greenspace During the
39 571 Covid-19 Pandemic-Perspectives from Five Cities. *Nat. Cities*.
40 572 2020.[https://www.thenatureofcities.com/2020/05/04/enabling-access-to-greenspace-](https://www.thenatureofcities.com/2020/05/04/enabling-access-to-greenspace-during-the-covid-19-pandemic-perspectives-from-five-cities/)
41 573 [during-the-covid-19-pandemic-perspectives-from-five-cities/](https://www.thenatureofcities.com/2020/05/04/enabling-access-to-greenspace-during-the-covid-19-pandemic-perspectives-from-five-cities/) (accessed 23 Oct 2020).
- 42 574 33 Savage M. Lockdown, what lockdown? Sweden’s unusual response to coronavirus.
43 575 BBC News. 2020.
- 44 576 34 Ipsos MORI. Gender differences in attitudes towards Coronavirus. 2020.
45 577 [https://www.ipsos.com/sites/default/files/ct/news/documents/2020-](https://www.ipsos.com/sites/default/files/ct/news/documents/2020-05/fawcett_society_presentation.pdf)
46 578 [05/fawcett_society_presentation.pdf](https://www.ipsos.com/sites/default/files/ct/news/documents/2020-05/fawcett_society_presentation.pdf) (accessed 10 Jul 2020).
- 47 579 35 Ipsos MORI, The Fawcett Society. 6 in 10 women finding it harder to stay positive
48 580 day-to-day due to Coronavirus: Women more likely to bearing the emotional and
49 581 impact of the pandemic . Fawcett Soc.
50 582 2020.[https://www.fawcettsociety.org.uk/Handlers/Download.ashx?IDMF=f173fde3-](https://www.fawcettsociety.org.uk/Handlers/Download.ashx?IDMF=f173fde3-4edb-4c51-8453-7244e867ed90)
51 583 [4edb-4c51-8453-7244e867ed90](https://www.fawcettsociety.org.uk/Handlers/Download.ashx?IDMF=f173fde3-4edb-4c51-8453-7244e867ed90) (accessed 10 Jul 2020).
- 52 584 36 Thompson CW, Aspinall P, Bell S, *et al.* “It Gets You Away From Everyday Life”:

- 1
2
3 585 Local Woodlands and Community Use—What Makes a Difference? *Landsc Res*
4 586 2007;**30**:109–46. doi:10.1080/0142639042000324794
5 587 37 Burgess J. Focusing on Fear: The Use of Focus Groups in a Project for the Community
6 588 Forest Unit, Countryside Commission. 1996.
7 589 38 Richardson EA, Mitchell R. Gender differences in relationships between urban green
8 590 space and health in the United Kingdom. *Soc Sci Med* 2010;**71**:568–75.
9 591 doi:10.1016/J.SOCSCIMED.2010.04.015
10 592 39 O’Brien L, Morris J. Well-being for all? The social distribution of benefits gained
11 593 from woodlands and forests in Britain. *Local Environ Int J Justice Sustain*
12 594 2014;**19**:356–83. doi:10.1080/13549839.2013.790354
13 595 40 Public Health England. Disparities in the risk and outcomes from COVID-19. London:
14 596 2020. www.facebook.com/PublicHealthEngland (accessed 26 Jul 2020).
15 597 41 Office for National Statistics. Deaths registered weekly in England and Wales,
16 598 provisional: week ending 10 July 2020. ONS.
17 599 2020.<https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/deathsregisteredweeklyinenglandandwalesprovisional/latest#deaths-registered-by-age-group> (accessed 26 Jul 2020).
18 600
19 601
20 602 42 TNS. Scotland’s People and Nature Survey 2013/14. (Scottish Natural Heritage
21 603 Commissioned Report No. 679). 2014.
22 604 43 Johnson B. Prime Minister’s statement on coronavirus (COVID-19): 16 March 2020.
23 605 GOV.UK. 2020.<https://www.gov.uk/government/speeches/pm-statement-on-coronavirus-16-march-2020> (accessed 26 Jun 2020).
24 606
25 607 44 Office for National Statistics. Coronavirus and how people spent their time under
26 608 lockdown. ONS.
27 609 2020.<https://www.ons.gov.uk/economy/nationalaccounts/satelliteaccounts/bulletins/coronavirusandhowpeoplespenttheirtimeunderrestrictions/28marchto26april2020>
28 610 (accessed 16 Jul 2020).
29 611
30 612 45 Honey-Rosés J, Anguelovski I, Chireh VK, *et al*. The impact of COVID-19 on public
31 613 space: an early review of the emerging questions – design, perceptions and inequities.
32 614 *Cities Heal* 2020;**1**–17. doi:10.1080/23748834.2020.1780074
33 615 46 Moore SA, Faulkner G, Rhodes RE, *et al*. Impact of the COVID-19 virus outbreak on
34 616 movement and play behaviours of Canadian children and youth: a national survey. *Int*
35 617 *J Behav Nutr Phys Act* 2020;**17**. doi:10.1186/s12966-020-00987-8
36 618
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Supplementary Materials

Supplementary Table 1: Category mergers of the response categories (ethnicity, age, social grade, sex and dog ownership).

	Original categories (Unweighted N)	New categories (Unweighted N)
Ethnicity	White British (1659)	White (1745)
	Any other white background (86)	
	White and Black Caribbean (6)	BAME (87)
	White and Black African (4)	
	White and Asian (8)	
	Any other mixed background (8)	
	Indian (17)	
	Pakistani (5)	
	Bangladeshi (4)	
	Any other Asian background (3)	
	Black Caribbean (4)	
	Black African (3)	
	Any other black background (3)	
	Chinese (10)	
	Other ethnic group (12)	
	Prefer not to say (19)	Missing (420)
	Not answered (401)	
	Age	18-24 (165)
25-34 (316)		25-64 (1497)
35-44 (396)		
45-54 (398)		
55-64 (387)		
65+ (590)		65+ (590)
Social grade	ABC1 (1419)	
	C2DE (833)	
Sex	Male (1018)	
	Female (1234)	
Dog ownership	Yes (616)	
	No (1636)	

Supplementary Table 2: Multinomial logistic regression models of being in each outcome group for change in time visiting green space (increase or decrease in visits to green space since movement restrictions were enforced compared to before), results are reported as Risk Ratios (RR) with 95% Lower Confidence Limits (LCL) and Upper Confidence Limits (UCL); **p<0.05**.

		RR of Decreased visits to "Same" and 95% CIs			RR of Increased to "Same" and 95% CIs		
		RR	LCL	UCL	RR	LCL	UCL
	Intercept	3.11	2.48	3.90	0.96	0.71	1.30
<i>Sex</i>	Female (Ref=Male)	1.34	1.07	1.69	1.19	0.85	1.66
<i>Social Grade</i>	C2DE (Ref=ABC1)	0.70	0.56	0.88	0.40	0.28	0.56
<i>Age group</i>	18-24 (Ref=25-64)	0.91	0.56	1.47	1.50	0.82	2.73
	65+ (Ref=25-64)	1.13	0.87	1.46	0.64	0.43	0.97
<i>Ethnicity</i>	BAME (Ref=White)	0.62	0.38	1.02	0.83	0.42	1.62
<i>Dog Ownership</i>	Yes (Ref=No)	0.69	0.53	0.88	0.56	0.38	0.82

Supplementary Table 3: Multinomial logistic regression models of being in each outcome group for levels of agreement that green space benefits their mental health more now (since movement restrictions were enforced compared to before), results are reported as Risk Ratios (RR) with 95% Lower Confidence Limits (LCL) and Upper Confidence Limits (UCL); **p<0.05**.

		RR of Agree to "Neither agree or disagree" and 95% CIs			RR of Disagree to "Neither agree or disagree" and 95% CIs		
		RR	LCL	UCL	RR	LCL	UCL
	Intercept	2.94	2.17	3.99	0.43	0.27	0.70
<i>Sex</i>	Female (Ref=Male)	1.72	1.24	2.39	1.29	0.76	2.18
<i>Social Grade</i>	C2DE (Ref=ABC1)	0.67	0.48	0.93	0.88	0.52	1.49
<i>Age group</i>	18-24 (Ref=25-64)	0.87	0.40	1.89	2.71	1.03	7.12
	65+ (Ref=25-64)	0.47	0.33	0.67	0.37	0.19	0.73
<i>Ethnicity</i>	BAME (Ref=White)	1.20	0.54	2.69	0.21	0.03	1.43
<i>Dog Ownership</i>	Yes (Ref=No)	0.72	0.51	1.02	1.02	0.59	1.76

Supplementary Table 4: Multinomial logistic regression models of being in each outcome group for levels of agreement that respondents missed seeing/talking to people in green space more since movement restrictions were enforced compared to before, results are reported as Risk Ratios (RR) with 95% Lower Confidence Limits (LCL) and Upper Confidence Limits (UCL); **p<0.05**.

		RR of Agree to "Neither agree or disagree" and 95% CIs			RR of Disagree to "Neither agree or disagree" and 95% CIs		
		RR	LCL	UCL	RR	LCL	UCL
	Intercept	1.47	1.08	1.99	0.89	0.62	1.27
<i>Sex</i>	Female (Ref=Male)	1.53	1.11	2.13	0.76	0.50	1.14
<i>Social Grade</i>	C2DE (Ref=ABC1)	0.76	0.54	1.06	0.90	0.60	1.36
<i>Age group</i>	18-24 (Ref=25-64)	1.40	0.69	2.86	1.00	0.40	2.49
	65+ (Ref=25-64)	0.98	0.67	1.43	0.78	0.49	1.26
<i>Ethnicity</i>	BAME (Ref=White)	0.91	0.43	1.93	0.72	0.27	1.91
<i>Dog Ownership</i>	Yes (Ref=No)	1.33	0.92	1.91	1.15	0.74	1.80

Supplementary Table 5: Multinomial logistic regression models of being in each outcome group for levels of agreement that respondents do more physical activity in green space following the movement restrictions, results are reported as Risk Ratios (RR) with 95% Lower Confidence Limits (LCL) and Upper Confidence Limits (UCL); **p<0.05**.

		RR of Agree to "Neither agree or disagree" and 95% CIs			RR of Disagree to "Neither agree or disagree" and 95% CIs		
		RR	LCL	UCL	RR	LCL	UCL
	Intercept	1.09	0.78	1.51	1.22	0.89	1.66
<i>Sex</i>	Female (Ref=Male)	1.44	0.99	2.08	1.35	0.97	1.88
<i>Social Grade</i>	C2DE (Ref=ABC1)	0.75	0.51	1.09	0.85	0.61	1.19
<i>Age group</i>	18-24 (Ref=25-64)	2.07	0.99	4.36	1.13	0.52	2.49
	65+ (Ref=25-64)	0.51	0.32	0.80	0.93	0.64	1.34
<i>Ethnicity</i>	BAME (Ref=White)	0.95	0.44	2.08	0.38	0.15	0.97
<i>Dog Ownership</i>	Yes (Ref=No)	0.43	0.28	0.66	0.95	0.68	1.35

Supplementary Table 6: Change in green space visit frequency since restrictions by individual demographic and socio-economic characteristics (unweighted).

	Visited green space in the year before restrictions		Visited green space after restrictions (only those who visited green space before restrictions)		Green space visitation change since lockdown		
	Yes (N=2045, 93.5%)	No (N=142, 6.4%)	Yes (N=1099, 53.8%)	No (N=943, 46.2%)	Decreased (N=1392, 63.3%)	Same (N=473, 21.5%)	Increased (N=333, 15.2%)
	% (N)	% (N)	% (N)	% (N)	% (N)	% (N)	% (N)
<i>Sex</i>							
Male (ref)	92.6% (919)	7.4% (73)	55.2% (507)	44.8% (411)	61.6% (609)	23.5% (232)	15% (148)
Female	94.2% (1126)	5.8% (69)	52.7% (592)	47.3% (532)	64.8% (783)	19.9% (241)	15.3% (185)
<i>Social grade</i>							
ABC1 (ref)	95.8% (1328)	4.2% (58)	56.7% (753)	43.3% (574)	62.9% (871)	18.8% (260)	18.3% (254)
C2DE	89.5% (717)	10.5% (84)	48.4% (346)	51.6% (369)	64.1% (521)	26.2% (213)	9.7% (79)
<i>Age</i>							
18-24	93.3% (139)	6.7% (10)	56.9% (78)	43.1% (59)	58.4% (87)	20.8% (31)	20.8% (31)
25-64 (ref)	93.6% (1364)	6.4% (94)	56.1% (765)	43.9% (598)	61.8% (906)	21.5% (315)	16.7% (245)
65+	93.4% (542)	6.6% (38)	47.2% (256)	52.8% (286)	68.4% (399)	21.8% (127)	9.8% (57)
<i>Ethnicity</i>							
White (ref)	93.6% (1592)	6.4% (109)	52.1% (828)	47.9% (762)	64.1% (1098)	22.5% (385)	13.4% (229)
BAME	84.1% (69)	15.9% (13)	47.8% (33)	52.2% (36)	57% (45)	30.4% (24)	12.7% (10)
<i>Dog ownership</i>							
Don't own a dog/s (ref)	93.1% (1476)	6.9% (109)	51.4% (757)	48.6% (717)	64.4% (1027)	19.5% (311)	16.1% (256)
Own a dog/s	94.5% (569)	5.5% (33)	60.2% (342)	39.8% (226)	60.4% (365)	26.8% (162)	12.7% (77)

Don't know/ can't recall responses were all excluded from analysis.

Supplementary Table 7: Change in green space experience since restrictions by individual demographic and socio-economic characteristics (unweighted).

	Using green spaces benefits my mental health more now			Miss social interaction in green spaces now			Do more physical activity in green spaces now		
	Agree (N=721, 65.8%)	Neither (N=272, 24.8%)	Disagree (N=102, 9.3%)	Agree (N=590, 54.1%)	Neither (N=288, 26.4%)	Disagree (N=213, 19.5%)	Agree (N=322, 29.5%)	Neither (N=337, 30.9%)	Disagree (N=431, 39.5%)
	% (N)			% (N)			% (N)		
<i>Sex</i>									
Male (ref)	59.6% (300)	30.8% (155)	9.5% (48)	45.8% (231)	30% (151)	24.2% (122)	27.4% (137)	35.4% (177)	37.2% (186)
Female	71.1% (421)	19.8% (117)	9.1% (54)	61.2% (359)	23.3% (137)	15.5% (91)	31.4% (185)	27.1% (160)	41.5% (245)
<i>Social grade</i>									
ABC1 (ref)	68% (511)	22.9% (172)	9.1% (68)	54.9% (412)	25.3% (190)	19.7% (148)	31.6% (236)	28.9% (216)	39.6% (296)
C2DE	61% (210)	29.1% (100)	9.9% (34)	52.2% (178)	28.7% (98)	19.1% (65)	25.1% (86)	35.4% (121)	39.5% (135)
<i>Age</i>									
18-24	67.5% (52)	19.5% (15)	13% (10)	64.9% (50)	22.1% (17)	13% (10)	48.7% (38)	16.7% (13)	34.6% (27)
25-64 (ref)	69% (526)	21% (160)	10% (76)	53.7% (407)	25.9% (196)	20.4% (155)	30.8% (233)	30.1% (228)	39.1% (296)
65+	55.9% (143)	37.9% (97)	6.2% (16)	52% (133)	29.3% (75)	18.8% (48)	20% (51)	37.6% (96)	42.4% (108)
<i>Ethnicity</i>									
White (ref)	62.8% (518)	27.3% (225)	9.9% (82)	51.6% (423)	28% (230)	20.4% (167)	26.5% (218)	32.3% (266)	41.2% (339)
BAME	75% (24)	21.9% (7)	3.1% (1)	51.5% (17)	30.3% (10)	18.2% (6)	38.7% (12)	38.7% (12)	22.6% (7)
<i>Dog ownership</i>									
Don't own a dog/s (ref)	68.2% (514)	23.9% (180)	8% (60)	52.5% (395)	27.1% (204)	20.5% (154)	34.5% (259)	28.7% (215)	36.8% (276)
Own a dog/s	60.7% (207)	27% (92)	12.3% (42)	57.7% (195)	24.9% (84)	17.5% (59)	18.5% (63)	35.9% (122)	45.6% (155)

Don't know/ can't recall responses were all excluded from analysis.

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	P1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	P2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	P3/4
Objectives	3	State specific objectives, including any prespecified hypotheses	P3/4
Methods			
Study design	4	Present key elements of study design early in the paper	P4/5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	P4/5
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	P4/5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	P4-6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	P4-6
Bias	9	Describe any efforts to address potential sources of bias	P4, 6
Study size	10	Explain how the study size was arrived at	P4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	P5-7
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	P6/7
		(b) Describe any methods used to examine subgroups and interactions	-
		(c) Explain how missing data were addressed	P4-7
		(d) If applicable, describe analytical methods taking account of sampling strategy	P4-6
		(e) Describe any sensitivity analyses	-
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Supplementary Tables 1, 6 and 7
		(b) Give reasons for non-participation at each stage	-
		(c) Consider use of a flow diagram	-

Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	P4/5, Supplementary Table 1
		(b) Indicate number of participants with missing data for each variable of interest	Table 1 + Supplementary Table 1
Outcome data	15*	Report numbers of outcome events or summary measures	Tables 2-4+ Supplementary Tables 2-7
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	P7-13
		(b) Report category boundaries when continuous variables were categorized	-
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	P13/14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	P15/16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	P13-15
Generalisability	21	Discuss the generalisability (external validity) of the study results	P13, 15/16
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	P17

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.