Article

Public Perceptions of Climate Change and Its Health Impacts: Taking Account of People’s Exposure to Floods and Air Pollution

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**Abstract:** Climate change-related exposures like flooding and ambient air pollution place people’s health at risk. A representative UK survey of adults investigated associations between reported flooding and air pollution (in the participants’ local area, by the participant personally and/or by family and close friends) and climate change concerns (CCC) and perceptions of its health impacts (PIH). In multinomial regression analyses controlling for socio-demographic factors and health status, exposure was associated with greater CCC and more negative PIH. Compared to those with low CCC, participants who reported local-area exposure were significantly more likely to be fairly (OR 2.07, 95%CI 1.26, 3.40) or very concerned (OR 3.40, 95%CI 2.02, 5.71). Odds of greater CCC were higher for those reporting personal and/or family exposure (‘fairly concerned’: OR 2.83, 95%CI 1.20, 6.66; ‘very concerned’: OR 4.11, 95%CI 1.69, 10.05) and for those reporting both local and personal/family exposure (‘fairly concerned’: OR 3.35, 95%CI 1.99, 5.63; ‘very concerned’: OR 6.17, 95%CI 3.61, 10.55). For PIH, local exposure significantly increased the odds of perceiving impacts as ‘more bad than good’ (1.86, 95%CI 1.22, 2.82) or ‘entirely bad’ (OR 1.88; 95%CI 1.13, 3.13). Our study suggests that public awareness of climate-related exposures in their local area, together with personal exposures and those of significant others, are associated with heightened concern about climate change and its health impacts.

**Keywords****:** climate change; public perceptions; climate-related exposures; flood; air pollution

1. Introduction

The world is warming very quickly, driven by the upward trend in greenhouse gas (GHG) emissions [1-3]. Rising global temperatures are increasing the incidence and severity of extreme weather events, with greater population exposure to flooding across western and central Europe [4,5]. GHG emissions are also the major source of poor air quality, both with respect to fine particulate matter (PM₂.₅) and other air pollutants released during the combustion of fossil fuels for power generation, residential and commercial energy use and transport. Flooding [6,7] and air pollution [8-11] are placing human health at risk. In the UK, the 12 months up to July 2021 included storms and resultant severe flooding in August, November and December 2020 as well as flash floods in January, June and July 2021 [12,13]. UK annual monitoring data [14] indicate that 28% of local areas fail to meet the 2005 WHO guidelines on air quality [9]; the more stringent thresholds in the WHO’s updated guidelines are likely to increase this proportion [15].

Studies of populations exposed to flooding and air pollution have reported participants’ concerns about climate change and its adverse impacts [16-18]. However, little is known about whether exposure is a predictor of climate change concern (CCC) and perceptions of its health impacts (PIH) in the general population. A 2018 review of studies of public perceptions of the health impacts of climate change did not report on the studies’ inclusion of measures of exposure [19]. A more recent review [20] found two studies that included UK populations [21,22], neither of which investigated exposures as potential factors predicting climate change concern and perceptions of health impacts.

 To address this gap, we investigate whether reported exposure to floods and air pollution is associated with greater concern about climate change and more negative perceptions of its health impacts. We follow Strobe guidelines for reporting observational studies [23].

2. Materials and Methods

***Data and sample profile:***The study is based on an online cross-sectional survey of 1024 adults aged ≥18 conducted via the Qualtrics survey platform [24] in July 2021. It was approved by the Health Sciences Research Governance Committee, University of York (ref: HSRGC/2020/409/C) and informed consent was secured from study participants. The survey used quota-controlled recruitment to match the national UK population for gender, age group, ethnic group [25], educational attainment (International Standard Classification of Education - ISCED[26] and location (UK country/England region [27]). Where numbers were small, response categories were combined (age group, ethnic group, country/region). To avoid potential priming effects that participation in previous climate change research may have had on responses, participants were excluded if they had taken part in a climate-change related survey in the previous year.

***Outcome measures:***Climate change concern (CCC) was measured by the question ‘How concerned, if at all, are you about climate change?’ [28], with a 4-option response (not at all concerned, not very concerned, fairly concerned, very concerned). All participants were asked this question (n=1024). Perceptions of health impacts (PIH) were measured by the question ‘Overall, do you think climate change will be good or bad for the health of people in the UK?’ with a 5-option response (entirely good, more good than bad, equally good and bad, more bad than good and entirely bad). An earlier question asked ‘Thinking about people’s health, which of these statements best describes your views about the impacts of climate change on people’s health in the UK?’. Participants who answered ‘Climate change will never have an impact on people’s health in the UK’ were not asked the PIH question (n=60; 5.9%).

***Exposure measure:***At the end of the survey, participants were asked about exposure to ‘flooding’ and ‘air pollution (poor air quality)’ in the past 12 months. The question avoided terms that may elicit a strong association with climate change, for example ‘extreme weather events’ [29]. Participants were asked separately if they were aware of these exposures ‘in your local area’, if they personally experienced them and if a family member or a close friend had experienced them. The latter two responses (personal experience and family/friend experience) were combined into a single ‘personal exposure’ category because of small numbers.

Responses for flooding and air pollution were combined due to some correlation of exposures and small numbers in the separate levels of exposure (local/personal). This produced four categories: 1-Not exposed to either flooding or air pollution at local or personal level; 2 – Local exposure to one/both of flooding and air pollution; 3 – Personal exposure to one/both; 4 – Local and personal exposure to one/both.

***Analysis:***Bivariate analyses investigated associations between reported exposure and CCC and between reported exposure and PIH. Bivariate associations between exposure and socio-demographic factors (gender, age group, ethnic group, education, housing tenure, UK country/English region) and health status were also examined (response categories for these factors are summarized in Table 1).

In two regression models, multinomial regression was used to assess associations between exposures and CCC and PIH, using SPSS version 26 [30]. The reference groups were, respectively, not being concerned about climate change (combining those not at all and not very concerned) and not perceiving the health impacts of climate change as bad (combining those perceiving the impacts as entirely good, more good than bad and equally good and bad).

The models were built hierarchically with socio-demographic factors and health status added before the exposure measures. The backwards stepwise approach was used; the threshold for retention was a cut-off of p<0.1 for inclusion in the final model. Model testing was performed with goodness of fit, r2 estimates and log likelihood presented for each model along with the percentage correctly predicted.

3. Results

3.1. Sample profile (Table 1)

The majority of participants were concerned about climate change (fairly: 47%; very: 36%) and perceived its impacts on health in the UK to be negative (more bad than good: 46%; entirely bad: 25%). With respect to exposures, flooding in their local area and/or personally (by the individual, family, close friend) was reported by 36% of participants. For air pollution, the proportion was 43%.

**Table 1.** Participant profile (n=1024).

|  |  |
| --- | --- |
|   | % (number) |
| **Age** | **18-34** | 30.1 (308) |
| **35-54** | 38.6 (395) |
| **55+** | 31.3 (321) |
| **Gender\*** | **Male** | 49.1 (503) |
| **Female** | 50.2 (514) |
| **Education (ISCED)** | **Level 1 (none to GCSE grade D-G)** | 21.6 (221) |
| **Level 2 (GCSE grade A-C to higher education qualification)** | 41.2 (422) |
| **Level 3 Degree and above** | 37.2 (381) |
| **Ethnic group\*\*** | **White** | 88.2 (903) |
| **Black & minority ethnic groups** | 11.8 (121) |
| **Housing tenure** | **Own home** | 51.2 (524) |
| **Rent or Other** | 48.8 (500) |
| **Health status** | **Good to Very Good** | 89.9 (921) |
| **Fair to Very Bad** | 10.1 (103) |
| **Region** | **Greater London & Southern England** | 36.3 (372) |
| **Mid England (West Midlands, East Midlands & East of England)** | 23.4 (240) |
| **Northern England (North West, North East, Yorkshire & the Humber)** | 24.2 (248) |
| **Scotland, N. Ireland & Wales** | 16.0 (164) |
| **Climate change concern** | **Not at all concerned** | 4.9 (50) |
| **Not very concerned** | 11.8 (150) |
| **Fairly concerned** | 47.3 (484) |
| **Very concerned** | 36.0 (369) |
|  | **Entirely good**  | 4.5 (46) |
|  | **More good than bad** | 5.6 (57) |
| **Impact of climate change on the health of people in the UK\*\*\***  | **Equally good and bad** | 17.1 (175) |
| **More bad than good** | 46.1 (444) |
| **Entirely bad** | 25.1 (242) |
| **Reported exposure to flooding**  | **Local** | 26.9 (275) |
| **Personal** | 6.0 (61) |
| **Family/Friend** | 11.2 (115) |
| **Any** | 336 (344) |
| **Reported exposure to air pollution**  | **Local** | 33.9 (347) |
| **Personal** | 22.9 (234) |
| **Family/Friend** | 19.4 (199) |
| **Any** | * 1. (441)
 |
| *\*Response options included ‘prefer to self-define’ (with space provided to do so) and ‘prefer not to share this information’; 7 particpants selected one of these options**\*\* response options included: White - includes any White background; Mixed or multiple ethnic groups - includes White and Black Caribbean, White and Black African, White and Asian or any other Mixed ethnic group; Asian or Asian British - includes Indian, Pakistani, Bangladeshi, Chinese or any other Asian background; Black, African, Caribbean or Black British - includes African, Caribbean or any other Black background; Other - for example Arab or any other.* *\*\*\* n=60 (5.9%) participants were not this asked this question. When asked a filter question 'Thinking now about people’s health, which of these statements best describes your views about the impacts of climate change on people’s health in the UK?', they selected the response 'Climate change will never have an impact on people’s health in the UK'.*  |

3.2. Bivariate associations between reported exposure (floods and air pollution) and climate change concern and perceived health impacts of climate change

As Table 2 indicates, reported exposure to flooding and air pollution was associated with both CCC and PIH (p<0.001). Among those not concerned about climate change, 66% reported no exposure to air pollution and/or flooding in their local area, personally or among family and friends. Among those fairly and very concerned about climate change, the proportions were 43% and 31% respectively. A similar association is evident with respect to PIH (p<0.001). Nearly half (49%) of those who did not perceive the health impacts as bad (as entirely good, more good than bad, equally good and bad) reported no exposure to flooding or air pollution compared with 41% and 29% in the ‘more bad than good’ and ‘entirely bad’ groups.

In the bivariate analyses (supplementary Table S1), education was significantly associated with CCC (p<0.001) and PIH (p<0.001), with a higher proportion of those in the highest educational group (Level 3) being very concerned about climate change and perceiving its health effects to be entirely bad. Other socio-demographic factors were significantly associated with CCC: being female (p<0.01), being older (p<0.001) and living in London/southern England Region (p<0.001) and with PIH (housing tenure, p<0.01). Health status was not significantly associated with either outcome (>0.05).

**Table 2.** Climate change concern and perceived health impacts of climate change by reported exposure to floods and air pollution.

|  |  |  |  |
| --- | --- | --- | --- |
|   | Total | Exposure to floods and/or air pollution |   |
| **None** | **Local** | **Personal** | **Both local and personal** | **Chi2 test** |
| **Count** | **Column %** | **Row %** | **Row %** | **Row %** | **Row %** | **Sig** |
| **Climate change concern** | Not concerned | 171 | 16.7% | 66.1% | 16.4% | 4.1% | 13.5% | <0.001 |
| Fairly concerned | 484 | 47.3% | 42.6% | 20.7% | 8.7% | 28.1% |
| Very concerned | 369 | 36.0% | 30.9% | 24.4% | 7.9% | 36.9% |
| **Impact of climate change on health**  | Entirely good, more good than bad, equally good and bad | 278 | 28.8% | 48.9% | 16.5% | 9.4% | 25.2% | <0.001 |
| More bad than good | 444 | 46.1% | 41.2% | 26.8% | 4.5% | 27.5% |
| Entirely bad | 242 | 25.1% | 29.3% | 19.4% | 11.2% | 40.1% |

3.3. Regression Analysis

***Climate change concern.*** The regression model assessed the strength of association between reported exposure and CCC. It estimated the odds of being fairly concerned or very concerned about climate change compared to not being concerned (not at all concerned/not very concerned), taking account of socio-demographic factors, health status and exposure. The effects of exposure are presented in Table 3 (in full in Supplement Table S2).

**Table 3.** Multinomial logistic regression model of reported exposure to floods and air pollution against climate concern.

|  |  |  |  |
| --- | --- | --- | --- |
| Climate change concern (reference category: not at all/not very concerned) | Sig. | Adjusted OR\* | 95% CI |
| **Lower** | **Upper** |
| **Fairly concerned** |   |   |  |  |
| **ExposureReference (no exposure)** | **Local exposure** |  0.004 | 2.070 | 1.260 | 3.401 |
| **Personal exposure** |  0.017 | 2.827 | 1.201 | 6.655 |
| **Both local and personal exposure**  | <0.001 | 3.349 | 1.993 | 5.629 |
| **Very concerned** |   |   |  |  |
| **ExposureReference (no exposure)** | **Local exposure** | <0.001 | 3.398 | 2.021 | 5.713 |
| **Personal exposure** |  0.002 | 4.114 | 1.685 | 10.045 |
| **Both local and personal exposure** | <0.001 | 6.173 | 3.614 | 10.545 |
| *\*Adjusted OR; model adjusted for age, gender, education, health status, country/region of residence. Ethnic group and tenure were inputted into the model but were removed in backwards stepwise approach.*  |
| Model Fitting - Obs - 1017, Log Likelihood 1495.464, Nagelkerke R2 - 0.183, Goodness-of-fit sig. 0.741, Correctly Predicted 53% |

As Table 3 indicates, exposure was significantly associated with greater CCC, with exposure at local, personal or both levels always having a positive association with concern. Compared to not being concerned about climate change, reported exposures in the local area or at a personal level (personally/among family and friends) doubled the odds of being fairly concerned (local: 2.07; 95%CI 1.26, 3.40; personal: 2.83; 95%CI 1.20, 6.66). Reporting both local and personal exposure increased the odds to 3.35 (95%CI 1.99, 5.63). Being female and younger were also associated with a greater likelihood of being fairly concerned; living outside London/Southern England reduced the odds (Table S2).

With respect to being very concerned, personal exposure was associated with higher odds (OR 4.11; 95%CI 1.69, 10.05) than local exposure (OR 3.40; 95%CI 2.02, 5.71). The largest odds were associated with reporting both local and personal exposure (OR 6.17; 95%CI 3.61, 10.55). Being female, younger and achieving the highest level of education (Level 3) increased the odds of being very concerned; living outside London/Southern England reduced the odds (Table S2).

The model was a good fit with 53% of all cases correctly predicted, significant (>0.05) for the goodness of fit test and r2 indicating that 18% of all variance in the level of climate concern was accounted for in this model.

Perceived impact on health

The regression model estimated the contribution of exposure to the odds of perceiving the health impacts of climate change to be negative (more bad than good or entirely bad). The reference category included all other responses (entirely good, more good than bad, equally good and bad). As above, the analysis took account of socio-demographic factors, health status and exposure. The effects of exposure are presented in Table 4 (in full in supplementary Table S3).

**Table 4.** Multinomial logistic regression of reported exposure to floods and air pollution against perceived impact of climate change on health.

|  |  |  |  |
| --- | --- | --- | --- |
| Perceptions of health impacts of climate change (reference category: entirely good, more good than bad, equally bad and good) | Sig. | Adjusted OR\* | 95% CI |
| **Lower** | **Upper** |
| **Climate change is more bad than good for people’s health**  |  |  |  |  |
| **ExposureReference (no exposure)** | **Local exposure** | 0.004 | 1.857 | 1.224 | 2.816 |
| **Personal exposure** | 0.072 | 0.559 | 0.297 | 1.053 |
| **Both local and personal exposure** | 0.191 | 1.286 | 0.882 | 1.876 |
| **Climate change is entirely bad than good for people’s health** |  |  |  |  |
| **ExposureReference (no exposure)** | **Local exposure** | 0.015 | 1.882 | 1.130 | 3.134 |
| **Personal exposure** | 0.032 | 1.973 | 1.060 | 3.672 |
| **Both local and personal exposure** | <0.001 | 2.526 | 1.641 | 3.888 |
| *\*Adjusted OR; model adjusted for respondents age group, gender, health status, education, region of residence. Age, ethnic group and health status were inputted into the model but were removed in backwards stepwise approach* |
| Model Fitting - Obs - 957, Log Likelihood 1604.191, Nagelkerke R2 - 0.098, Goodness-of-fit sig. 0.091, Correctly Predicted 49.3% |

As Table 4 indicates, local exposure is a significant predictor of perceiving the health impacts of climate change as being more bad than good (OR 1.86, 95%CI 1.22, 2.82, p<0.01). Being female and having a higher level of educational attainment were also associated with a greater likelihood of perceiving the health impacts of climate change as being more bad than good (Table S3).

Exposure was more strongly associated with perceiving the health impacts as entirely bad. Compared with those reporting no exposure, participants reporting local exposure had an 88% higher likelihood of perceiving climate to be entirely bad for people’s health (OR 1.88; 95%CI 1.13, 3.13). For those reporting personal exposure, the odds were higher (OR 1.97; 95%CI 1.06, 3.67) and were further elevated for participants reporting both local and personal exposure (OR 2.53, 95%CI 1.64, 3.89). Being female and having a higher level of education was associated with a greater likelihood of perceiving the health impacts of climate change as being more bad than good or entirely bad (Table S3).

The model was a good fit with 49.3% correctly predicted, significant (>0.05) for the goodness of fit test and r2 indicating 9.8% of all variance in PIH was accounted for in this model.

4. Discussion

The study is based on a survey representative of the UK population. Like other social surveys, it relies on participant-reported data and therefore captures participants’ perspectives on climate change and health, together with their reported exposures to flooding and air pollution over the previous 12 months. The proportion of participants reporting flooding to their home in the previous year (6%) is in line with a large national probability survey [29]. While air pollution can be difficult to detect, perceived exposure is associated with measured exposure. In line with this finding, population-weighted estimates suggest that 28% of local authorities in the UK had PM₂.₅ levels above WHO guidelines (annual mean of 10 μgm-3) in 2019, the latest year for which data are available [14]. In our survey, 34% of participants reported air pollution/poor air quality in their local area.

Some limitations of our survey design should be noted. Firstly, because potential participants were recruited through an online survey agency, the study excluded those without access to the internet (either via a smartphone or through a connection in their homes). This means that the views and concerns of some of the UK’s most vulnerable populations are likely to be under-represented. The large majority of those without internet access face other forms of social disadvantage [31] [32]. However, the COVID pandemic has restricted alternative methods of data collection and prompted a rapid shift towards online data collection [33].

Secondly, causality cannot be inferred from cross-sectional surveys. It is therefore possible that heightened CCC and PIH resulted in increased awareness of floods and air pollution. However, as noted above, national exposure data are consistent with participant-reported exposure. To increase robustness, we also investigated associations between exposure and CCC and PIH using multinomial regression models that were hierarchical in the design and employed a backwards stepwise approach. This enabled inclusion of a wide range of potential predictors and the removal of non-significant factors in the final model. Interactions were not investigated; surveys with larger sample sizes may add to the findings presented here.

Thirdly, while the sample size (n=1024) was similar to or larger than other UK studies [21,22], it prevented more detailed analyses of the patterns and impacts of exposure. For example, pooling smaller ethnic groups into two heterogeneous groups (white; black and minority ethnic groups) may have masked important differences in both exposures and outcomes [34]. A larger sample size would also have enabled separate investigation of floods and air pollution as predictors.

Fourthly, public perceptions of climate change are known to be influenced by events beyond the individual’s immediate experience, including their exposure to media reporting of climate change events. Climate change coverage in both the mainstream and social media is episodic, peaking at times of scientific and political engagement with climate change [35,36], for example, when major global reports on climate change are published [37,38] and when major global events occur [39]. Our survey was conducted in a month (July 2021) of limited engagement in climate change in the mainstream and social media. We recognize that it is important to repeat the survey at times of heightened media coverage.

5. Conclusions

Understanding how the public perceives climate change and its health impacts is essential for climate mitigation and adaptation policies. While studies of populations exposed to extreme weather events and to air pollution have pointed to the importance of direct experience in shaping perceptions of climate change and its health impacts, little is known about the association between exposure and perceptions in the general population. A recent global review [20] located over 50 studies of perceptions of health in the context of climate change in the general population but less than 10% investigated associations with exposure; of these, none were based in the UK or Europe.

In a representative UK survey of adults, we investigated whether reported exposures were related to public concerns and perceptions. We examined whether people’s awareness of climate change-related exposures in their local area and their experience of these exposures, either personally or among their family and close friends, were associated with climate change concern and perceptions of the health impacts of climate change. In the multivariate analyses, reported exposure to floods and air pollution was associated with heightened CCC and with more negative PIH after controlling for other factors.

Our findings suggest that policies seeking to increase public awareness of climate concern and its health impacts should pay attention to people’s experiences of climate-related exposures. An appreciation of peoples’ experiences and concerns is increasingly recognized to be essential to securing public support for national and local policies to address climate change and its health impacts [40-42]. Our study provides evidence to support this people-centered approach to policy-making.

**Supplementary Materials:** The following are available online at [www.mdpi.com/xxx/s1](http://www.mdpi.com/xxx/s1). Table S1 – Participant demographics including gender, age group and ethnic group along with reported exposure to floods and air pollution plotted against level of climate change concern and also perceived impact of climate change on health. Table S2 – Multinomial logistic regression model of reported exposure to floods and air pollution against climate concern. Table S3 – Multinomial logistic regression model of reported exposure to floods and air pollution against perceived impact of climate change on health.

**Author Contributions:** conceptualization: HG, AH, PL; methodology: HG, AH; analysis: AH; data curation: AH; writing – original draft preparation: HG, AH; writing – review and editing: HG, AH, PL; supervision: HG; project administration: Helen Haynes, Department of Health Sciences, University of York, UK; funding acquisition: HG (Principal Investigator) on behalf of the project team (HG, Susan Chilton, Jytte Nielsen, Mark Petticrew). All authors have read and agreed to the published version of the manuscript.

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**Institutional Review Board Statement:** Ethical approval was secured from the Health Sciences Research Governance Committee, University of York on 11 September 2020 (ref: HSRGC/2020/409/C). Data from the study cannot be released.

**Informed Consent Statement:** Informed consent was obtained from all participants involved in the study. All participants are anonymous and cannot be identified.

**Data Availability Statement:** under the Privacy Notice accompanying the consent form, participants were advised that only the project team have access to the data and it will not be shared.

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**Conflicts of Interest:** The authors declare no conflict of interest. The funders had no role in the design of the survey, in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

References

1. World Meteorological Organization (WMO). The state of the global climate 2020. Available online: <https://public.wmo.int/en/our-mandate/climate/wmo-statement-state-of-global-climate> (accessed on

2. World Meteorological Organization. WMO Global Annual to Decadal Climate Update. Available online: <https://hadleyserver.metoffice.gov.uk/wmolc/> (accessed on

3. World Meteorological Organization (WMO). United in Science: A multi-organization high-level compilation of the latest climate science information. Available online: <https://public.wmo.int/en/resources/united_in_science> (accessed on

4. Blöschl, G.; Kiss, A.; Viglione, A.; Barriendos, M.; Böhm, O.; Brázdil, R.; Coeur, D.; Demarée, G.; Llasat, M.C.; Macdonald, N.J.N. Current European flood-rich period exceptional compared with past 500 years. **2020**, *583*, 560-566, doi:10.1038/s41586-020-2478-3.

5. Environment Agency. *Living better with a changing climate*; Environment Agency: Bristol, 2021.

6. Graham, H.; White, P.; Cotton, J.; McManus, S. Flood-and weather-damaged homes and mental health: An analysis using England’s Mental Health Survey. *International journal of environmental research and public health* **2019**, *16*, 3256.

7. Mulchandani, R.; Armstrong, B.; Beck, C.R.; Waite, T.D.; Amlôt, R.; Kovats, S.; Leonardi, G.; Rubin, G.J.; Oliver, I. The English National Cohort Study of Flooding & Health: psychological morbidity at three years of follow up. *BMC public health* **2020**, *20*, 1-7, doi:<https://doi.org/10.1186/s12889-020-8424-3>.

8. Landrigan, P.J.; Fuller, R.; Acosta, N.J.; Adeyi, O.; Arnold, R.; Baldé, A.B.; Bertollini, R.; Bose-O'Reilly, S.; Boufford, J.I.; Breysse, P.N. The Lancet Commission on pollution and health. *The lancet* **2018**, *391*, 462-512.

9. World Health Organisation (WHO). WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfor dioxide. . Available online: <https://www.who.int/phe/health_topics/outdoorair/outdoorair_aqg/en/> (accessed on

10. Sass, V.; Kravitz-Wirtz, N.; Karceski, S.M.; Hajat, A.; Crowder, K.; Takeuchi, D. The effects of air pollution on individual psychological distress. *Health & place* **2017**, *48*, 72-79.

11. Newbury, J.B.; Stewart, R.; Fisher, H.L.; Beevers, S.; Dajnak, D.; Broadbent, M.; Pritchard, M.; Shiode, N.; Heslin, M.; Hammoud, R. Association between air pollution exposure and mental health service use among individuals with first presentations of psychotic and mood disorders: retrospective cohort study. *The British Journal of Psychiatry* **2021**, 1-8.

12. Floodlist. Available online: <https://floodlist.com/europe/united-kingdom/> (accessed on 27/7/21).

13. Met Office. Storm Christophe 18 to 20 January 2021. Available online: <https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/interesting/2021/2021_01_storm_christoph.pdf> (accessed on

14. Department of Environment, F.a.R.A. Modelled background pollution data. Available online: <https://uk-air.defra.gov.uk/data/pcm-data> (accessed on 22nd March 2021).

15. World Health Organisation (WHO). *WHO global air quality guidelines: particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide*; 2021.

16. Chakraborty, J.; Collins, T.W.; Grineski, S.E.; Maldonado, A.J.I.j.o.e.r.; health, p. Racial differences in perceptions of air pollution health risk: Does environmental exposure matter? **2017**, *14*, 116, doi:10.3390/ijerph14020116.

17. Fernandez, A.; Black, J.; Jones, M.; Wilson, L.; Salvador-Carulla, L.; Astell-Burt, T.; Black, D. Flooding and mental health: a systematic mapping review. *PloS one* **2015**, *10*, e0119929.

18. Walker-Springett, K.; Butler, C.; Adger, W.N. Wellbeing in the aftermath of floods. *Health & place* **2017**, *43*, 66-74.

19. Hathaway, J.; Maibach, E.W. Health implications of climate change: a review of the literature about the perception of the public and health professionals. *Current environmental health reports* **2018**, *5*, 197-204.

20. Lampard, P.; Graham, H. Public perceptions of the health impacts of climate change: a rapid review of studies, under review. **2021**.

21. Graham, H.; de Bell, S.; Hanley, N.; Jarvis, S.; White, P.C.L.J.p.h. Willingness to pay for policies to reduce future deaths from climate change: evidence from a British survey. **2019**, *174*, 110-117, doi:10.1016/j.puhe.2019.06.001. PMID: 31326760.

22. van Wijk, M.; Naing, S.; Diaz Franchy, S.; Heslop, R.T.; Novoa Lozano, I.; Vila, J.; Ballesté-Delpierre, C.J.P.o. Perception and knowledge of the effect of climate change on infectious diseases within the general public: A multinational cross-sectional survey-based study. **2020**, *15*, e0241579, doi:10.1371/journal.pone.0241579.

23. Von Elm, E.; Altman, D.G.; Egger, M.; Pocock, S.J.; Gøtzsche, P.C.; Vandenbroucke, J.P.; Initiative, S. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies. *J Clin Epidemiol* **2008**, *61*, 344-349, doi:10.1016/j.jclinepi.2007.11.008.

24. Qualtrics. Research services. Available online: <https://www.qualtrics.com/uk/research-services/> (accessed on

25. UK Government. List of ethnic groups. Available online: <https://www.ethnicity-facts-figures.service.gov.uk/style-guide/ethnic-groups> (accessed on

26. International Standard Classification of Education (ISCED). Available online: <http://uis.unesco.org/en/topic/international-standard-classification-education-isced> (accessed on

27. DEFRA. Map of the United Kingdom detailing the Government Office Regions (GOR) of England. Available online: <https://secure.fera.defra.gov.uk/pusstats/surveys/documents/uk_map.pdf> (accessed on

28. Department of Business, E.a.I.S. BEIS Public Attitudes Tracker (December 2020, Wave 36, UK). Available online: <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/959601/BEIS_PAT_W36_-_Key_Findings.pdf> (accessed on

29. Roxburgh, N.; Guan, D.; Shin, K.J.; Rand, W.; Managi, S.; Lovelace, R.; Meng, J. Characterising climate change discourse on social media during extreme weather events. *Global environmental change* **2019**, *54*, 50-60.

30. SPSS Inc. *IBM SPSS Statistics for Windows. Version 26.0*; IBM Corp: Armonk, NY, 2019.

31. Serafino, P. Exploring the UK’s digital divide. *Office for National Statistics* **2019**.

32. Burgess, G. The Digital Divide: what does the research tell us? Available online: <https://www.cchpr.landecon.cam.ac.uk/Research/Start-Year/2017/building_better_opportunities_new_horizons/digital_divide_research> (accessed on

33. Hlatshwako, T.G.; Shah, S.J.; Kosana, P.; Adebayo, E.; Hendriks, J.; Larsson, E.C.; Hensel, D.J.; Erausquin, J.T.; Marks, M.; Michielsen, K. Online health survey research during COVID-19. *The Lancet Digital Health* **2021**, *3*, e76-e77.

34. Aspinall, P.J. Ethnic/racial terminology as a form of representation: a critical review of the lexicon of collective and specific terms in use in Britain. *Genealogy* **2020**, *4*, 87.

35. Schäfer, M.S.; Ivanova, A.; Schmidt, A. What drives media attention for climate change? Explaining issue attention in Australian, German and Indian print media from 1996 to 2010. *International Communication Gazette* **2014**, *76*, 152-176, doi:10.1177/1748048513504169.

36. Saunders, C.; Grasso, M.T.; Hedges, C. Attention to climate change in British newspapers in three attention cycles (1997–2017). *Geoforum* **2018**, *94*, 94-102, doi:10.1016/j.geofo rum.2018.05.024.

37. Boykoff, M.; Pearman, O. Now or never: How media coverage of the IPCC special report on 1.5 C shaped climate-action deadlines. *J One Earth* **2019**, *1*, 285-288, doi:j.oneear.2019.10.026.

38. Romanello, M.; McGushin, A.; Di Napoli, C.; Drummond, P.; Hughes, N.; Jamart, L.; Kennard, H.; Lampard, P.; Rodriguez, B.S.; Arnell, N. The 2021 report of the Lancet Countdown on health and climate change: code red for a healthy future. *The Lancet* **2021**, *398*, 1619-1662, doi:10.1016/S0140-6736(21)01787-6.

39. Media Measurement. Available online: <https://www.mediameasurement.com/climate-conversation-barometer> (accessed on

40. Van der Linden, S.; Maibach, E.; Leiserowitz, A. Improving public engagement with climate change: Five “best practice” insights from psychological science. *Perspectives on psychological science* **2015**, *10*, 758-763.

41. Ogunbode, C.A.; Demski, C.; Capstick, S.B.; Sposato, R.G. Attribution matters: Revisiting the link between extreme weather experience and climate change mitigation responses. *Global Environmental Change* **2019**, *54*, 31-39.

42. Myers, T.A.; Maibach, E.W.; Roser-Renouf, C.; Akerlof, K.; Leiserowitz, A.A. The relationship between personal experience and belief in the reality of global warming. *Nature climate change* **2013**, *3*, 343-347.