PUBLIC PERCEPTIONS OF THE HEALTH IMPACTS OF CLIMATE CHANGE AND PRIORITIES FOR ACTION

FINAL REPORT

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Ethics

Ethical approval for the study was received from the Health Sciences Research Governance Committee, University of York on 11 September 2020 (ref: HSRGC/2020/409/C).

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Front cover photos

Car pollution (milehightraveler)
York floods (Matt Cornock)
Heatwave (rawpixel.com)

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At a glance

What we found out… about public perceptions of the health impacts of climate change

Most people are concerned about climate change. Concern did not decline during the COVID-19 pandemic and the associated restrictions on everyday life.

In UK-wide surveys, the majority (61%) perceived climate change to be already having an impact on people's health in the UK. However, in the qualitative study, participants were less certain whether climate change had health impacts.

Those with experience of floods and air pollution, personally and/or in their local area, were more likely to be concerned about climate change and to perceive it as already affecting the health of people in the UK.

Public concern about climate change was little affected by the increased UK media coverage of climate change associated with the 26th Conference of Parties (COP26) to the UN Framework Convention on Climate Change held in Glasgow in November 2021.

….and the public's priorities for action and their willingness to pay

Air pollution and flooding were consistently identified as the major priorities for national and local government to address in order to protect people's health from climate change. Again, experience mattered: those with experience of these exposures were more likely to select them as their top priorities for government action.

The UK-wide surveys also explored people's willingness to pay (WTP) to reduce the health impacts and fatality risks from heatwave and floods. The evidence suggests that the public values reducing these risks. Personal exposure to heatwave and floods, respectively, increased WTP to reduce their associated health impacts. Although the values are currently not robust enough to recommend for immediate policy application, they are nevertheless indicative that people would value interventions to reduce the health impacts from both heatwave and flood.

Why we did this study

Climate change is placing people's health at increasing risk. Urgent action is required by national and local government to address the risks and secure a healthy future for the UK population. In democratic societies, action needs to be aligned with public concerns and priorities. However, little is known about these concerns and priorities. Our study begins to fill this gap.

What we did

We conducted UK-wide quantitative surveys of adults aged ≥18 years, and a qualitative study of those aged ≥15 years living in England. The project timeline (April 2020-March 2022) coincided with the COVID-19 pandemic and the associated restrictions on people's lives, requiring adjustments to the project design. The project timeline enabled the surveys to take account of the UK's hosting of the global forum on climate change, with surveys conducted in the months prior to and after COP26.

What are the implications?

Our findings point to a UK public that is aware climate change is affecting people's health, have clear priorities for government action and are willing to pay to reduce impacts to their own health. Our study lends support to a 'health framing' of climate change in public health and climate policies, particularly one that engages directly with people's experiences of climate-related exposures.

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Executive summary

Background

Climate change is negatively affecting people's health in the UK, and its impacts are set to accelerate and intensify. In democratic societies, the mandate for government action comes from the public – however, little is known about their perceptions of health and climate change or about their priorities for government action. Taking account of public perspectives is recognised to facilitate ethical and effective policy making.

Aims

Focusing on adults in the UK, the project aims to provide evidence on:

- people's perceptions of the health impacts of climate change
- their priorities for action by government to address the health impacts of climate change
- their willingness to pay (WTP) to reduce the health impacts of climate change

The areas represent new fields of research where UK evidence is sparse. Our project is therefore exploratory, providing an initial set of findings on which to build.

The project's timeline (April 2020-March 2022) coincided with the COVID-19 pandemic. It also included the meeting of the 26th Conference of Parties (COP26) to the UN Framework Convention on Climate Change in November 2021 in Glasgow. As an additional aim, we examined the stability of climate change concern and the importance of climate change relative to other potential issues of public concern (i.e. its issue salience) across 2021.

Methods

The project is informed by UK-wide quantitative surveys of adults aged ≥18 years and a qualitative study of those aged ≥15 years living in England. Note: both components were completed prior to heatwaves in June-August 2022.

Conducted across 2021 and early 2022, the quantitative surveys addressed all three of the project aims: perceptions of the health impacts of climate change, priorities for action, and willingness to pay. Surveys were conducted via an online survey platform that provides access to a UK-wide panel of adults; quota-controlled recruitment was used to match the national UK population for gender, age group, ethnic group, educational attainment and location (UK country/England region).

Conducted in 2021, the qualitative study focused on perceptions of the health impacts of climate change and priorities for action. Participants were recruited via community organisations. Based on IMD (Indicators of Multiple Deprivation), a measure of relative deprivation at small local area level, a higher proportion of the sample lived in both the least and most deprived deciles.

Findings

Perceptions of the health impacts of climate change

- The majority (86%) of survey participants were 'fairly' or 'very' concerned about climate change. In the qualitative study, participants' responses suggested that climate change was perceived more as a phenomenon happening elsewhere than one affecting people in the UK.
- In the surveys, the majority (61%) considered that climate change was already having an impact on people's health in the UK; a further third (32%) noted that, while not yet having a health impact, it would in the future. In the qualitative study, while some participants spoke about the impacts of flooding and air pollution, others

struggled to connect climate change and health. As one participant observed, 'I don't really associate climate change with actual like people's health'.

- When asked in surveys whether, overall, climate change would be good or bad for people's health, the majority (71%) considered that it would be bad: as either 'more bad than good than bad' (46%) or 'entirely bad' (25%). However, 17% leaned towards a more neutral view ('equally good and bad') or considered that climate change would be positive overall for people's health in the UK (11%).
- In the surveys, awareness of climate-related exposures in the local area, together with personal experiences and those of family and close friends, were associated with heightened concern about climate change and its health impacts. The reporting of floods and air pollution in the local area significantly increased the odds of perceiving the impacts as 'more bad than good' or 'entirely bad'.

COP26 and public concern about climate change

- UK media coverage of climate change increased from January 2021, with a major spike around COP26 (October-November 2021). However, there was little change in public concern about climate change across the year or around the COP26 period.
- Across 2021, climate change remained one of the top three issues of public concern. COVID-19 was identified as 'the single most important issue facing the UK today' across the year. In January 2021, 6% selected climate change as their most important concern. In subsequent months, this proportion increased – but we found no evidence that COP26 and the associated spike in media coverage of climate change produced an increase in its issue salience.

Priorities for action on the health impacts of climate change by local and national government

- Our survey questions on priorities for government action were developed in a pilot survey where participants were randomly assigned to either a fixed-response or an open-ended question about concerns they may have about the health impacts of climate change in the UK. The aggregated list of concerns was used in the main surveys.
- Excluding those having no concerns about impacts on health, follow-up questions asked separately about priorities for action by the UK government and by their local government to address their concerns. The top two priorities at both levels were air pollution (national: 46%; local: 52%) and floods (39%; 41%).
- Awareness of local air pollution and floods in their local area in the previous 12 months doubled the odds of participants selecting it as a top priority.
- In the qualitative study, air pollution and floods were again identified as the priorities for action. In explaining why, participants spoke about their serious impacts, the scale of impact and the potential for remedy by government.

Willingness to pay (WTP) to reduce the health impacts of climate change

- Focusing on floods and heatwave and WTP to reduce impacts on one's own health, we found a similar WTP to reduce the health impacts of these extreme weather events, and to pay more for avoiding a greater health impact. Higher income and personal experience of heatwave/floods were

significantly associated with greater WTP.

- We also explored WTP to reduce the personal risk of dying from the impact of climate change through extreme weather events like floods and heatwave. Again, participants were willing to pay to reduce the risk and to pay more for a greater risk reduction.
- The findings are preliminary at this stage. However, they suggest that the UK public would value reducing the health impacts of climate change and point to the potential for incorporating climate-related health and mortality risk reductions into policy appraisal.

Study limitations

Our project provides UK evidence on public perceptions of the health impacts of climate change, priorities for government action and willingness to pay (WTP) to reduce the health impacts. However, as an exploratory study undertaken against the backdrop of the COVID-19 pandemic, limitations should be noted.

Firstly, repeated waves of COVID-19 infections and government restrictions across 2020/21 meant it was not possible to progress the public participation panel, co-developed with an inner-city community benefit organisation.

Secondly, the pandemic and the imposition of a national lockdown in March 2020 required a switch to online recruitment and data collection. While most UK adults (95%) have internet access, the excluded minority are disproportionally drawn from households on low incomes and/or with long-term health conditions.

Thirdly, our evidence comes from cross-sectional studies. We cannot therefore track stability and change in perceptions and WTP at an individual level. However, by spacing our quantitative surveys across 2021 and early 2022, we were able to explore stability and change at population level. Additionally, the quantitative surveys were large (in total, we surveyed over 10,000 adults) and were based on quotas representative of the UK adult population.

Finally, our project relied on primary studies. Alternative methods are available to provide insight into public perceptions and priorities, including citizens' juries and community consultations. While offering more direct opportunities for community engagement and dialogue, individuals have differential capacity to participate, with the attendant risk that the perspectives do not reflect those of the wider community. Survey research is therefore likely to remain an essential source of insight into public sentiment for the policy community.

Implications of the findings

Climate change is an increasingly important determinant of population health – and therefore of public health policy. Our findings provide up-to-date evidence on public perspectives and priorities in the UK, a critical resource for policy-making and communication.

We found widespread public concern about the impacts of climate change on people's health in the UK and a WTP to reduce these risks. We found that personal experience matters. Exposure to floods and air pollution increased people's concern about climate change's health impacts as well as the likelihood that these exposures were identified as priorities for action by local government. Similarly, exposure to floods and heatwaves increased WTP to reduce the impacts on their own health.

Taken together, our findings point to the potential for a health framing of climate change in policy development and public consensus-building, particularly with respect to people's experiences of climate-related exposures.

Introduction

Climate change and health

Climate change is placing people's health at risk within the UK (1-5) and globally (6, 7). Driven by increasing greenhouse gas (GHG) emissions, rising global temperatures are increasing the frequency, duration and severity of extreme weather events in the UK, including flooding and heat waves (1, 8). GHG emissions are also the major source of poor air quality, both with respect to fine particulate matter ($PM_{2.5}$) and other health-damaging air pollutants released during the combustion of fossil fuels for power generation, residential and commercial energy use and transport (9, 10).

The health risks of the UK's changing climate are spelled out in government reports. The 2022 UK Climate Risk Assessment identified high temperatures as 'a very high risk' to 'health and wellbeing', and river and surface flooding as 'a very high risk' to 'people and communities' (11). The National Risk Register highlights these climate-related exposures and places their human health impacts at the top of its list of adverse consequences. In addition, it identifies air pollution as 'the largest environmental risk to public health in the UK' (12). The lifetime risk of health-damaging exposures will increase across cohorts: for children and for future generations compared with today's adults, particularly if the upward trend in global temperatures is not halted (13).

Action on climate change and health

The global framework for action is the UN Framework Convention on Climate Change (UNFCCC), which seeks to prevent 'dangerous anthropogenic interference with the climate system' (14). The landmark 2015 Paris Agreement instituted a 'bottom-up' governance regime, through which national governments develop their own plans to tackle climate change (15, 16). This flexible structure enables stakeholder perspectives, including public views, to inform climate action (17). Taking account of public perspectives is recognised to be an essential enabler of action (18, 19).

In democratic societies, policies need to be informed by and aligned with public concerns and priorities. In the UK, climate policies are placing particular emphasis on local action (20-22) to address the health impacts of climate change, an emphasis that requires an understanding of people's priorities for their local government.

Public perceptions, priorities for action and willingness to pay

While a critical resource for policy, little is known about public perceptions of the health impacts of climate change, their priorities for action and their willingness to pay.

Studies of individuals and communities affected by climate-related exposures like flooding point to a heightened appreciation of health impacts (23-26). But there are few studies of the wider public. A review of studies of public perceptions of the health impacts of climate change included studies published up to 2017 (27). It located 10 in English-speaking countries, but only one in the UK (28). Using a similar search strategy to this earlier review, we searched for studies published up December 2021. We located a further two UK studies (29, 30). Neither covered public priorities for action to address the health impacts of climate change.

Previous willingness to pay studies relating to the health impacts of climate change have been designed to look in detail at describing and valuing the health impacts caused, for example, by either flooding or heat (31, 32). However, due to differences in samples, methods and health impacts descriptions, it is not possible to compare directly values across the different studies and to assess whether respondents are more concerned with health impacts from flooding or heatwave, when everything else is kept constant.

Our project begins to address these evidence gaps. The project timeline (April 2020-March 2022) meant it did so in the context of the COVID-19 pandemic and the associated restrictions on people's lives (33). In March 2020, a national lockdown was imposed, with 'stay at home' measures involving the closure of schools, workplaces and public amenities and restrictions on personal movement and social interaction outside the home. Restrictions continued through 2020, with further national lockdowns imposed in 2021.

The project's timeframe also included the meeting of the 26th Conference of Parties (COP26) to the UN Framework Convention on Climate Change (UNFCCC) in November 2021 in Glasgow (34, 35). This major global forum was linked to a marked increase in coverage in the UK national press (our analyses) and on social media (36) – and greater media coverage of climate change has been linked to greater public concern (37). The timing of COP26 provided an opportunity to examine whether, in the context of COVID-19, increased climate change coverage was associated with increased public concern.

Aims

The project's aims are to provide evidence on:

- people's perceptions of the health impacts of climate change
- their priorities for action by government to address the health impacts of climate change
- their willingness to pay (WTP) to reduce the health impacts of climate change

WTP expresses in monetary terms the maximum that an individual would be willing to pay to obtain a specified health benefit e.g. avoiding a climate-related health impact. Individual responses are aggregated to provide an overall value (e.g. mean or median WTP). As an aggregated measure, WTP therefore incorporates individual differences in ability to pay.

Our project provides preliminary evidence on the public's WTP for policies to address health impacts related to climate change. Specifically, we investigate people's WTP with respect to the health impacts of floods and heatwave. We also explore people's WTP to reduce their risk of dying from climate-related exposures.

The three foci of our project – perceptions of the health impacts of climate change, priorities for action to address these health impacts and willingness to pay among UK adults - represent new fields of research and ones where UK evidence is sparse. Our project should therefore be considered exploratory: extending the reach of UK public health research to include public perspectives on what has been identified as the single biggest health threat of the 21st century (38).

As noted in the Introduction, an understanding of public perceptions is a critical resource for policy-making in democratic societies where the mandate for government action comes from the public.

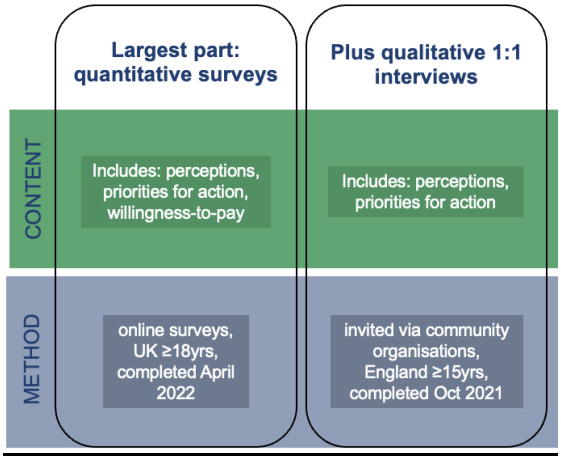
Methods

Introduction: the impact of COVID-19

The project is based on a series of quantitative surveys and a qualitative study (Figure 1). Separate quantitative surveys explored (i) perceptions of the health impacts of climate change and priorities for action and (ii) willingness to pay. The qualitative study focused on perceptions of the health impacts of climate change and priorities for action.

The COVID-19 pandemic and associated restrictions required adjustments to both elements. It required moving to online data collection. The switch impacted particularly on the WTP component of the project, where face-to-face methods had been built into the project design, both to develop initial WTP measures and to enable triangulation with data collected in the qualitative study. Plans for a public involvement component, co-developed with an inner-city community benefit organisation, also faced numerous hurdles and was not able to progress[i].

Figure 1: study design



Quantitative surveys. We switched from the planned modules of questions in the Office for National Statistics (ONS) Opinions and Lifestyle Survey (39); this survey was closed to external researchers in March 2020 to enable ONS to prioritise COVID-related surveys. Instead, we used Qualtrics, an online survey platform (40) widely used by UK health researchers (41-43). It provides access to a UK-wide panel of people aged ≥18 years who have agreed to be contacted about participation in surveys and enables quotas to be set for gender, age group and other key social factors to match the UK population.

For our surveys, Qualtrics managed participant recruitment and data collection. The project team undertook the survey design and analysis.

Qualitative study. We switched from in-person focus groups to individual interviews, with the option of online or telephone interviews. Our original plan of recruitment via community organisations remained in place. However, COVID-19 and the associated restrictions meant many community groups were either suspended or limited their services to core support for members.

This impacted on the qualitative study in a number of ways. It delayed recruitment with the result that the qualitative study took place alongside (rather than prior to) the surveys. It also restricted the range of participating community groups and therefore the social profile of the sample. Additionally, because willingness to pay proved difficult to explore in online interviews, the qualitative study focused on perceptions and priorities.

The project team undertook all stages of the study, including design, participant

[i] See Appendix A for details

recruitment (in partnership with community groups), data collection and analysis.

Data collection and analysis: quantitative surveys

Questions were piloted and refined prior to the main surveys. Table 1 summarises the survey timeline.

Table 1: Study participants

Surveys	Perceptions/ priorities	Willingness to pay
Pilot surveys	*Jan-Feb 2021* (n=1014) *July 2021* (n=1018)	*Mar-May 2021* (n=1324) *Aug 2021* (n=443)
Main surveys	*Oct 2021* (n=2040) *Dec 2021* (n=2010)	*Nov-Dec 2021* (n=1186) *Mar-Apr 2022* (n=2283)

Via the Qualtrics platform, we used quota-controlled recruitment to match the national UK population for gender, age group, ethnic group (44), educational attainment (International Standard Classification of Education—ISCED) (45) and location (UK country/England region) (46). The participant profile is summarised in Appendix B.

Potential survey participants received the following invitation:

You are invited to take part in a UK survey about your views on climate change. Findings from the survey will help policymakers understand the concerns and priorities of the public.

Prior to being asked to consent, invitees were given information on data privacy, data management and anonymity. 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 survey related to climate change in the previous year. Box 1 summarises key topics in the surveys.

Box 1: topics included in the surveys

- *socio-demographic position* (e.g. gender, age group, ethnic group, educational attainment), and location (type of area, UK country/English region)
- *climate change concern and its UK impacts*, including its health impacts,
- *specific climate change concerns with respect to people's health*. These were developed via open-ended questions in pilot surveys,
- *priorities for government action*. The question built on participants' responses to the question on climate change concerns with respect to people's health. The concerns that participants selected were presented to them and they were asked to identify the ones they considered most important for government to address,
- *willingness to pay to reduce the health impacts of flooding and heatwave*. In the WTP survey, participants were randomised into two survey arms and asked to indicate the maximum (in £s) that they would be willing to pay to avoid a (described) health impact caused by either flooding (arm 1) or heatwave (arm 2). The same health impacts were used in both arms (differing only with respect to whether the health impact was caused by flooding or heatwave).
- *willingness to pay to reduce the risk of dying* from the impacts of extreme weather events, using the example of floods and heatwave. In this survey, participants were asked two WTP questions: one with a mortality risk reduction of 1 in 100,000 and one with a risk reduction of 4 in 100,000.
- *experiences of environmental hazards*, including flooding, air pollution/poor air quality, severe storms and heatwaves in the previous 12 months. Separate questions asked participants 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.

Logistic regression was used for the analyses, with initial models informed by what is known about potentially important factors (for example, reported recent exposure to climate-related weather events), together with standard socio-demographic measures (e.g. age group, gender, ethnic group, education). Further details of the analysis methods are given in

the Findings sections of the report and in the associated papers in the Appendix.

As the surveys were anonymous, it was not possible to provide participants with a summary of findings. However, a link to further information on the project, including contact details, was included as part of the invitation and consent process.

Data collection and analysis: qualitative study

Using networking and online searches, we identified a range of community groups based in England, including major cities, smaller towns and rural areas. However, with recurrent peaks in the COVID-19 pandemic and the associated periods of lockdowns, many community groups were either suspended or only offering core services for members. Of the 140+ groups we contacted, agreement to circulate details of the study to group members was secured from nineteen. Members expressing an interest were sent further details, which noted that:

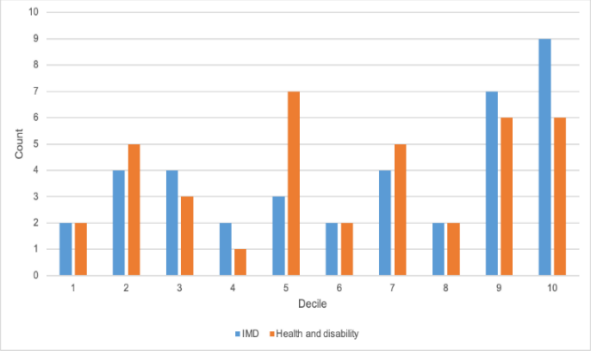
We are wanting to speak to people across England about their thoughts on climate change and whether they think climate change has an impact on their health. We are wanting to speak with people who have different experiences and views of climate change.

Prior to being asked to consent, invitees were given information on data privacy, data management and anonymity. Consent (assent and parental consent for participants aged 15 years) was obtained.

We sought participants from different social backgrounds and living in both urban and rural locations. However, we relied more heavily than planned on networks in Yorkshire and the north-east of England and on community groups serving an older male population[ii]. Over half of the sample was aged 60 and older (compared with 23% in the wider population) and over 60% were male. Further details of the study participants and the community groups is available in Appendix C.

Figure 2 describes the sample profile, based on (i) IMD (Indicators of Multiple Deprivation) (47), a measure of relative deprivation at small local area level, and (ii) the health and disability domain of IMD (48). As it indicates, the sample was skewed, with 29% (12 participants) living in areas in the highest decile and 44% (47) in the three most deprived deciles. With respect to its health profile, the sample was more evenly distributed across deciles (Figure 2).

Figure 2: IMD and health profile of qualitative study (n=41)



Interviews began with open-ended questions about perceptions of climate change and people's health. Photographs from the UK of 'climate-related events that are likely to become more common with climate change' were then introduced as prompts. Interviews were conducted by a single member of the project team, digitally recorded, transcribed and anonymised. Data were analysed using NVivo (49) and thematic analysis, a widely-used qualitative methodology (50, 51). Themes were iteratively refined in discussion with the

[ii] Yorkshire-based participants told us they liked to support locally-led activities, including those led by the University of York.

project team. A summary of findings was made available to the study participants.

Findings: Perceptions of the health impacts of climate change

Note: the empirical elements of the project were completed before the heatwaves and drought of summer 2022.

Introduction

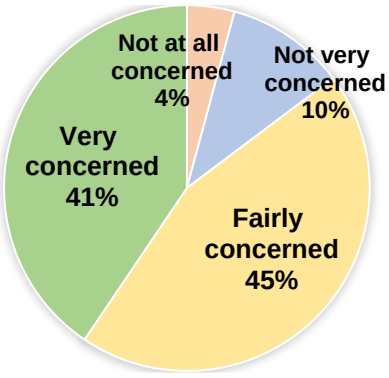
This section presents evidence on public concerns about climate change and public perceptions of its health impacts.

In November 2021, the UK hosted the 26th meeting of the Conference of Parties (COP26) to the UN Framework Convention on Climate Change (UNFCCC), a widely-anticipated follow-up to the Paris Agreement designed to ratchet up climate action. With high-level leadership from the UK and extensive media coverage, COP26 provided a further focus for analysis. In the final part of this section, we consider whether it had an intervention-like effect on public perceptions of climate change and its importance as an issue for the UK.

Public concern about climate change

In line with other studies (52-54), the majority of survey participants were 'fairly' or 'very' concerned about climate change (Figure 3).

Figure 3: How concerned, if at all, are you about climate change? (Oct & Dec 2021, n=2050)



In the qualitative study, most participants also expressed concern about climate change. Their answers suggested that it was primarily seen as a phenomenon happening elsewhere: participants described the extreme impacts of climate change beyond the UK as well as in the future (Box 2).

Box 2: When you think about climate change, what do you think of? (n=41)

We can't point a finger to it (climate change), you know, we can't, and certainly in England, because I think in England, I think we have a long way to go before climate change (male, aged 40-49).

It is a worry obviously. I've got children and grandchildren of my own and I'm thinking 'what's the future of the planet?' (male, aged 60-69).

In Britain, we're not so affected really... not really victims of climate change, you know (female, aged 30-39).

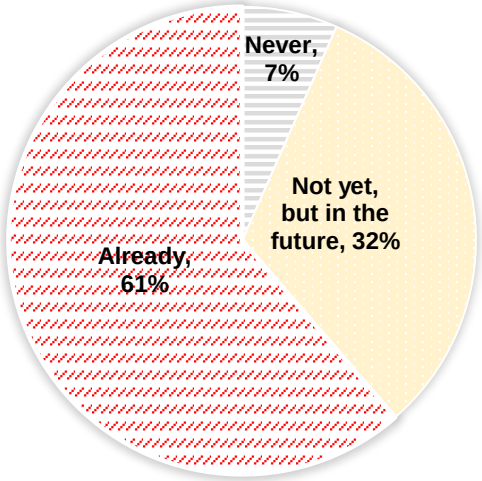
Public perceptions of the health impacts of climate change

Evidence from the quantitative surveys points to a widespread perception that climate change is already having an impact on people's health in the UK (Figure 4).

In analyses that combined 'not yet having' and 'will never have' an impact into a single group, we found that women were significantly more likely than men to perceive climate change as already having a health impact in the UK, as were those with higher levels of educational

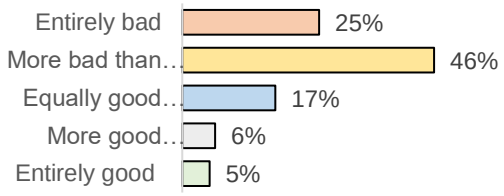
attainment. Participants aged ≥55 years were less likely to hold this view[iii].

Figure 4: 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? (Oct & Dec 2021; n=4050)



Using the July 2021 survey, Figure 5 examines public perceptions of health impacts in more detail. Excluding those who considered that *'climate change will never have an impact on people's health in the UK'*, a follow-up question asked *'Overall, do you think climate change will be good or bad for the health of people in the UK?*' Participants were given a 5-option response: entirely good, more good than bad, equally good and bad, more bad than good, and entirely bad. As Figure 5 indicates, the majority (71%) saw the health impacts as negative.

Figure 5: Overall, do you think climate change will be good or bad for the health of people in the UK? (July 2021, n=964*)



**data excludes 60 participants (6% of sample) who considered CC climate change would never have an impact on people's health in the UK*

Again using the July 2021 survey, we investigated whether experiences of flooding and air pollution/poor air quality, the two most frequently reported exposures, were associated with perceptions of the health impacts of climate change[iv].

We found that awareness of climate-related exposures in the local area, together with personal exposures and those of significant others (family and close friends), were associated with heightened concern about climate change and its health impacts[v]. The reporting of floods and air pollution in the local area significantly increased the odds of perceiving the 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). For further details, see Appendix D.

In the qualitative study, some participants noted the health impacts of climate change, and here again experience (both direct and via the media) was important. For example, a participant described how older people in their neighbourhood were anxious when the local area was exposed to flooding; others mentioned the death of Ella Adoo-

[iii] Our analyses took account of gender, age group, ethnic group and socio-economic position (education).

[iv] 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 (Floodlist, Met Office). UK annual monitoring data (DEFRA) indicated that 28% of local areas fail to meet the 2005 WHO guidelines on air quality.

[v] Our analyses took account of socio-demographic factors (including gender, age group, ethnic group, and education), location (UK country/English region) and health status.

Kissi-Debrah where the coroner's report listed air pollution as a contributory factor (55). However, a number of participants struggled to connect climate change and health (Box 3). As noted in the Methods section, the sample was older and more male than the general population; in the quantitative surveys, we found that men and those aged ≥55 years were less likely to perceive climate change as already having an impact on people's health in the UK (see above).

Box 3: Thoughts about the impacts of climate change on people's health

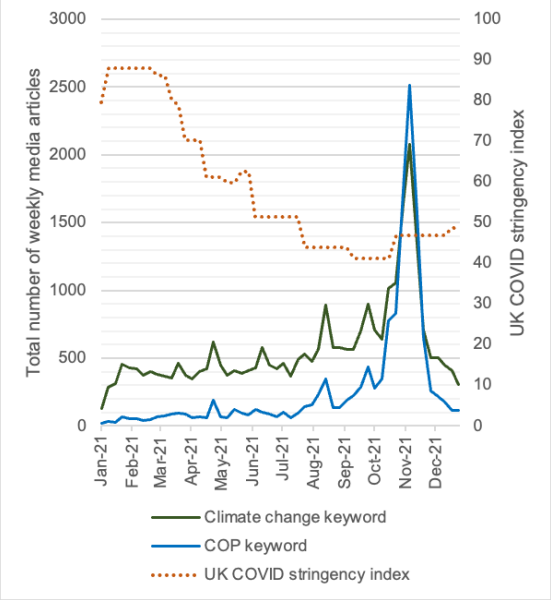
> *Until you mentioned this interview thing, I never thought of it in terms of the consequence for human life because other life took precedence in my mind (male, aged 60-69).*
>
> *I don't really associate climate change with actual like people's health (female, aged 15-19).*
>
> *Despite the fact that I've had notice of this conversation for quite some time, people's health isn't very high up what I think about (male, aged 60-69).*

Analysis of the interview data suggests that participants' perceptions of the health impacts of climate change were framed by their wider perceptions of climate change: as an extreme phenomenon happening elsewhere and manifested in life-threatening events (extensive flooding, wildfires, intense heatwaves). Understood in this way, participants noted that they *'didn't see much of a connection'* between climate change and people's health in the UK, where *'the British weather'* was seen as inherently variable, and where *'it's ups and downs'* and '*tricks'* did not constitute clear evidence of climate change. For further details of the qualitative analysis, see Appendix E.

Did COP26 heighten public concern about climate change?

The timing of the quantitative surveys (Table 1) enabled us to investigate public perceptions of climate change across 2021 in the context of a major climate change event, COP26, as well as the ongoing COVID-19 pandemic. We tracked media coverage of climate change in the most-read UK news sources (using the Lexis Nexis database) across 2021 (Figure 6). The Figure also plots changes in the COVID-19 restrictions on everyday life, using the Oxford COVID-19 Government Response Tracker index (OxCGRT) (33).

Figure 6: UK newspaper coverage of climate change

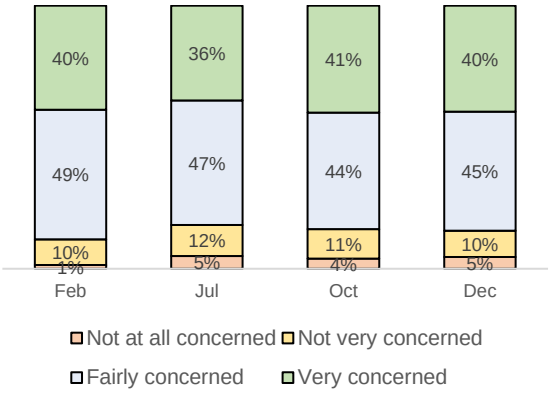


We investigated whether the increase in media coverage was associated with increased climate change concern and in heightened salience of climate change as an important issue facing the UK.

Climate change concern. As Figure 7 indicates, climate change concern was at its highest in Jan-Feb 2021, months when there was little media coverage of climate change and government restrictions were at their most stringent. There was no

evidence of a 'COP26 effect' on public concern about climate change.

Figure 7: Climate change concern in 2021 Surveys in January, July, October and December 2021 (n=6082)



Climate change as an important issue facing the UK. Using a question adapted from YouGov surveys (56), we examined whether COVID-19 and COP26 were associated with changes in the public salience of climate change.

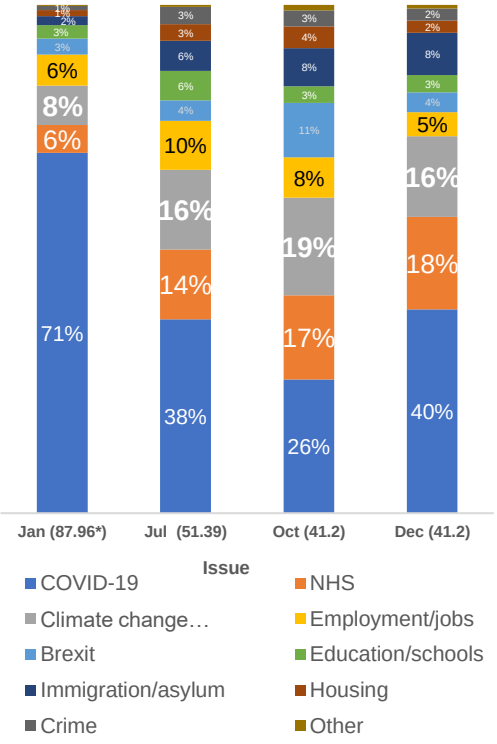
Participants were asked *'In your view, what are the most important issues facing the UK today?'* and invited to select up to three randomly-ordered options from a list that included the coronavirus (COVID-19) pandemic, NHS (National Health Service), Britain leaving the EU (Brexit), climate change and environmental issues.

Across 2021, COVID-19, the NHS, and climate change and environmental issues were consistently the three 'most important issues facing the UK today'.

However, when asked to identify the single most important issue, COVID-19 was the dominant concern (Figure 8). It was selected by 71% of UK adults in Jan 2021 when the public health impact of COVID-19 was at its height and the restrictions were most extensive. At that point, 6% identified climate change as their priority concern. In subsequent months, this proportion increased – but we found no evidence that COP26 and the associated spike in media coverage of climate change produced an increase in its issue salience[vi]. As other studies have found, while global meetings can turn the spotlight on climate change, the effects on the general public appear to be limited (57).

Further details of the analysis of COP26, climate change concern and issue salience are available at Appendix G.

Figure 8: What do you see as the single most important facing the UK today? Surveys in January, July, October and December 2021 (n=6082)



*UK Covid Stringency Index score at time of survey

[vi] Our analysis also took account of the impact of COVID-19 on changing climate change salience.

Findings: Priorities for action on the health impacts of climate change by local and national government

Note: the empirical elements of the project were completed before the heatwaves of summer 2022.

Introduction

Protecting people's health from 'dangerous anthropogenic interference with the climate system' (14) requires policies to address climate-related exposures like flooding, air pollution and heatwaves. An understanding of public priorities is an important part of the evidence base for policies at both national and local level.

In the current UK policy landscape, action by local government is seen as particularly important (20-22). We therefore focus on people's priorities for local government action.

Priorities for government action on the health impacts of climate change

In the surveys, our question on priorities for action built on an earlier question about climate-related exposures of concern. Participants were asked *'Thinking now about the harmful impacts that climate change may have on people's health in the UK, what kind of impacts - if any - concern you?'*

In the first pilot survey[vii] in Jan/Feb 2021, participants were randomly assigned to answer this question either by selecting concerns from a list, with a 'none of these concern me' option, or by completing a response in their own words. In the self-completion arm, only a small minority (1%) gave answers that suggested they considered that climate change had no harmful health impacts (noting, for example, *'No direct impact on health', 'Nothing'*), a pattern matched in the fixed-response arm. In the self-completion arm, the majority of participants described climate exposures of concern that were listed in the fixed-response arm of the survey, including air pollution, wildfires, storms, drought, sea level rise and coastal erosion. Additionally, some noted increasing temperatures, an exposure not listed in the fixed-response arm.

For subsequent surveys, the self-completion arm was removed. All participants were given the same set of responses, which included increasing temperatures (Box 4).

Excluding participants who noted that *'none of these concern me'*, follow-up questions asked about priorities for action by government. Participants were asked:

Thinking about these problems and the harmful impacts they may have on people's health, what are your top priorities for [national] [your local] government to address?

[vii] A fuller summary of the question development process is available here. See *Public Perceptions of Health and Climate Change in the UK: An Overview of Findings from Two Pilot Surveys*, section 5.

Box 4: Thinking now about the harmful impacts that climate change may have on people's health in the UK, what kind of impacts - if any - concern you? You can select more than one.

Response options*
- Air pollution (poor air quality)
- Severe storms
- Drought (a prolonged period without rain)
- Severe floods
- Heat waves
- Coastal erosion (where the sea wears away the land)
- Increasing temperatures
- Sea level rises
- Wildfires
- Other – please describe
- None of these concern me

*the order of the first nine response options was randomised

The main surveys were conducted in October and December 2021, prior to and after COP26[viii]. For both national and local government, air pollution and floods were identified as the top priorities for government action (Figures 9 and 10).

Figure 9: Stacked bar chart of the proportion of participants selecting each exposure as their 'Top Two' priorities for the UK government to address (Oct and Dec 2021; n=3861)

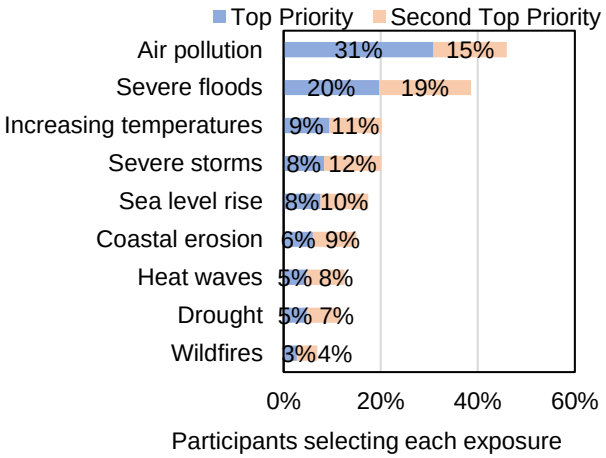
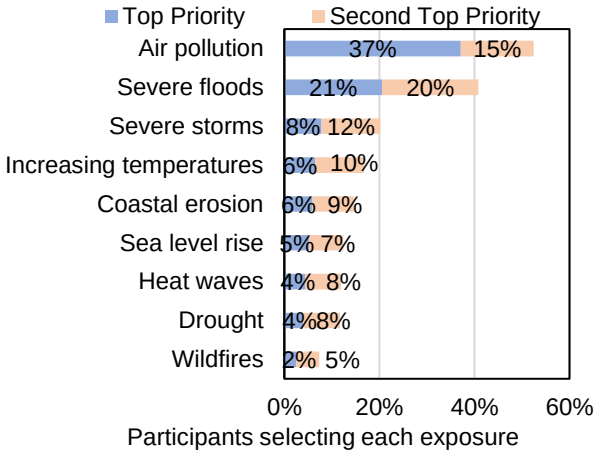


Figure 10: Stacked bar chart of the proportion of participants selecting each exposure as their 'Top Two' priorities for local government to address (Oct and Dec 2021; n=3861)



Focusing on the top two priorities for action by local government, we investigated factors predicting their selection[ix]. Awareness of local-area air pollution in the previous 12 months doubled the odds of selecting it as a top priority (OR 2.01, 95%CI 1.71, 2.36). Similarly, awareness of local-area flooding doubled the odds of severe floods being a top priority (OR 2.16, 95%CI 1.88, 2.48). In neither model was survey month significant, pointing to a stability in people's priorities across a period of heightened media engagement in climate change.

In the qualitative study, priorities for action to address the health impacts of climate change were framed around action by national government. Prompted by photographs of climate-related exposures in the UK, including air pollution, storms, drought and floods, participants were asked what they considered most important for the government to tackle.

As in the surveys, air pollution and floods were most frequently identified. Participant accounts point to three factors guiding their prioritisation: an appreciation of serious

[viii] Across the two surveys, 5% (n=189) selected 'none of these concern me'.

[ix] The models took account of socio-demographic factors (gender, age group, ethnic group,

health impacts, the scale of impact and the potential for remedy (Box 5).

Box 5: In terms of health impacts in the UK, which climate change events do you think are most important for government to tackle?

I say air pollution is my number one because I think there's, there's stuff that could be done that could be helped by the government. Number, my number two would probably be floods; like once again also cos I think there is stuff that could be done and also the sort of, the scale of the issue is very devastating for the people involved (female, aged 15-19).

I think air pollution because the whole range of actions that they can take, that they can carry out and that especially in towns and cities (male, aged 60-69).

Those (air pollution and floods) are the main ones, partly because of the impact on us and the fact that air and floods, I think we could more easily do something about them than some of the others (male, aged 20-29).

educational attainment, tenure, health status), health status and type of area (urban/outskirts of town or city/small village/rural), together with reported air pollution/flooding in the participant's local area and by the participant personally in the previous 12 months.

Findings: Willingness to pay to reduce the health impacts of climate change

Note: the empirical elements of the project were completed before the heatwaves and drought of summer 2022.

Introduction

Willingness to pay (WTP), a measure of the maximum a person is prepared to pay for a defined benefit, is widely used to assess public support for government policies. Measured at the individual level and aggregated up to population level, WTP captures in monetary terms the value that the population as whole places on an outcome (for example, reduced health risks from climate change). For benefits like health with a non-market value, contingent valuation methods are used to estimate the value in monetary terms (58, 59).

The UK government incorporates monetary (WTP) values for fatality risk reductions into regulatory analysis, for example through the Value of Preventing a Fatality (VPF) (60). This measure represents the aggregate WTP-based value of small individual mortality risk reductions which, taken over the affected population, can be expected to prevent one statistical fatality/save one statistical life (not the value of saving an identified life) (see 61).

In two WTP surveys conducted in Nov/Dec 2021 and Mar/April 2022, we provide preliminary evidence on the willingness of UK adults to pay to reduce the health impacts of climate change. We focus on floods and heatwave, the two most common extreme weather events in the UK with known effects on health (8, 11, 62). We investigate WTP to reduce their impacts on health and, as a supplementary analysis, on fatality risk[x].

The findings from our exploratory surveys are summarised in the two sections below.

Willingness to pay to reduce the health impacts of heatwave and floods

In the WTP surveys, participants were randomised into two survey arms, one in which they were asked to imagine that the health impacts had been caused by a heatwave and, in the other, by a flood. They were asked to give their WTP for a treatment that would return them to normal health within 3-4 days, rather than suffer the longer-term effects of the health impact (Box 6). These longer-term effects were presented in a less severe (A) and more severe (B) form, enabling us to test for internal consistency in the responses (i.e. that participants were willing to pay more to avoid a more severe health impact). To control for possible order effects, 50% of the surveys asked about A then B, while the other 50% asked about B then A.

To help participants think about and formulate their WTP, we used a payment card on which a range of possible monetary values were listed. They were given the option of choosing a value from the card or stating their own amount.

On average, participants indicated similar preferences for avoiding health impacts from floods and heatwave. As Table 2 indicates, mean and median WTP were similar for both exposures.

[x] There is a notable imbalance in fatalities – the large majority are caused by heatwaves. However, with floods increasing, we present one overall, combined climate fatality risk.

Box 6: WTP to avoid the health impacts from exposure to heatwave and flood

Health Impact A

In Hospital

- One night in hospital

After Hospital

- Slight to moderate pain for 2-7 days followed by some pain/discomfort for several weeks
- Some restrictions to work and/or leisure activities for several weeks/months
- After 1-2 months, return to normal health with no permanent disability

Health Impact B

In Hospital

- 2-7 days in hospital
- Slight to moderate pain

After Hospital

- Some pain/discomfort for several weeks
- Some restrictions to work and/or leisure for several weeks/months
- After 3-4 months, return to normal health with no permanent disability

With the two surveys conducted in autumn 2021 and spring 2022, the evidence predates the heatwaves of summer 2022. The preferences are therefore not a result of 'recency effects'[xi] (63) but are likely to reflect concerns that predate these weather extremes.

In separate regression analyses for heatwave and floods, we investigated socio-demographic differences in WTP[xii]. These analyses also took account of the survey data and of personal and local exposure to flooding/heatwave within the last 12 months.

For both floods and heatwave, higher income and personal experience of heatwave/floods were significantly associated with greater WTP. For both exposures, participants were willing to pay more for avoiding a more severe health impact (i.e. to pay more to avoid B than A). Survey date was not significant for either heatwave or floods, indicating stability in public preferences. For further details of the analysis, see Appendix H.

Table 2: Mean and median WTP to reduce the health impacts of heatwave and floods

		Mean WTP in £ (std. dev)	Median WTP in £	n
Heatwave	Smaller health impact (A)	230 (365)	100	1133
	Larger health impact (B)	395 (575)	200	1133
Flooding	Smaller health impact (A)	231 (307)	125	934
	Larger health impact (B)	402 (565)	200	934

Willingness to pay to reduce the risk of dying from climate change

The number of climate-related fatalities has to date been very small in the UK[xiii].

[xi] The recency effect is the tendency to remember the most recent experiences and the most recent information. It is therefore a form of cognitive bias.

[xii] Gender, age group, ethnic group, education, income (income is defined as household or individual income depending on the respondent's answer to a follow-up question). We also took account of climate change concern.

[xiii] Estimated 50 deaths per 100,000 people per decade from extreme weather events in the United Kingdom (1, 54); this is likely to be an upper bound given the likelihood that at least some of these extreme weather events would have occurred in the absence of significant climate change.

However, with projections pointing to the increasing risk of extreme weather events in the UK, the policy community needs to anticipate an increase in fatalities.

In the WTP surveys, participants were asked two questions framed around fatality risks: one with a risk reduction of 1 in 100,000 and one with a risk reduction of 4 in 100,000. Box 6 summarises the question.

Box 7: WTP to reduce the fatality risks from the impact of climate change

> In this question we ask you to focus on your own risk of dying from the impact of climate change through more extreme weather like floods and heatwaves. Remember that the risk of dying from climate change is only one form of risk you face in life.
>
> If this policy were to be put in place, we are interested in the maximum increase in the cost of living you would be willing to pay to reduce this risk. Remember the money you spend on this wouldn't be available to be spent on other things.
>
> ---
>
> Assume your risk of dying from climate change could be reduced each year for the next decade. Imagine that this risk reduction was 1[4] in 100,000 each year. This means your risk of dying each year would reduce from 5 in 100,000 to 4[1] in 100,000.
>
> What is the maximum you would be willing to pay each year for the next decade for this risk reduction?
>
> When answering the following question, think about how big an impact the payment would have on your budget and keep in mind that the money you spend on reducing your risk of dying could be spent on other things.

As with the WTP question on health impacts, we used a payment card on which a range of possible monetary values were listed – or participants had the option of stating their own amount.

Our analysis focused on a sub-sample of responses that met the economic consistency check of an internal scope test (individuals should be WTP more for the 4 in 100,000 risk reduction compared to the 1 in 100,000 risk reduction). Table 3 summarises the mean and median WTP for a 1 in 100,000 and 4 in 100,000 reduction in the risk of dying.

From these responses, we can estimate the mean and median VPF (Value of Preventing a Fatality). Mean VPF is £5.5 million and £8.5 for the 1 in 100,000 and 4 in 100,000 risk reductions, respectively[xiv] (60). However, we would emphasise that these are preliminary observations regarding peoples' preferences with respect to climate fatalities in the UK. Whilst we can infer from the findings that the UK public would value reducing such risks, the values are not currently robust enough to recommend for policy as they stand.

Nonetheless, together with our exploration of WTP to reduce the health impacts of climate change, they indicate the potential for incorporating climate-related health risks into population surveys of WTP.

For further details of the fatality risk analysis, see Appendix J.

Table 3: Mean and median WTP to reduce the risk of dying from the impact of climate change

	Mean in £ (std. dev)	Median in £	n
Mortality (risk reduction of 1 in 100,000)	55 (93)	20	539
Mortality (risk reduction of 4 in 100,000)	85 (122)	27.5	539

[xiv] VPF is the recommended measure for safety policy appraisal in HM Treasury Green Book 2022 (60)

Study limitations

Our project provides UK-based evidence on public perceptions of the health impacts of climate change, their priorities for government action and their willingness to pay (WTP) to reduce the health impacts.

Given this focus, the project does not provide evidence on people's perspectives on, or priorities for, specific policies. For example, we did not investigate people's views and preferences with respect to policies to mitigate and adapt to climate change. However, evidence from the study point to the priority that people attach to government action to address the health impacts of air pollution (requiring mitigative measures) as well as floods (adaptation measures). Building on this evidence, the next steps would be to explore how people's priorities for action translate into their policy preferences at national and local level.

As an exploratory study undertaken against the backdrop of the COVID-19 pandemic, some limitations should be noted.

Firstly, the COVID-19 pandemic and the imposition of a national lockdown in March 2020 required adjustments to the project design. We had planned to include bespoke modules in the Office for National Statistics (ONS) Opinions and Lifestyle Survey, a continuous cross-sectional survey of people in Britain with rich socio-economic data including IMD. In March 2020, ONS closed this option to produce weekly bulletins on the social impacts of COVID-19. We therefore switched the surveys to an online survey platform which does not collect postcode data; the option of IMD analysis was therefore not available. IMD could however be derived for the qualitative study.

Both the quantitative and qualitative components of the project switched to online recruitment and data collection (the method also used by the ONS Opinions and Lifestyle Survey). While most UK adults (95%) have internet access, the excluded minority are disproportionally drawn from households on low incomes and/or long-term health conditions. We sought to address this challenge by working with a community organisation serving a disadvantaged inner-city neighbourhood to establish a face-to-face public participation panel. However, a wave of COVID-19 infections and restrictions in summer 2021 meant this component was not able to progress[xv].

Secondly, like the ONS Opinions and Lifestyle Survey, our evidence comes from cross-sectional studies. We cannot therefore track stability and change in perceptions at an individual level. However, by spacing our quantitative surveys across 2021 and early 2022, we were able to explore stability and change at population level. Additionally, the quantitative surveys were large (in total, we surveyed over 10,000 adults) and were based on quotas representative of the UK adult population.

Because the final surveys were completed in late 2021 and early 2022, we were not able to capture the potential effects of the severe heatwaves and drought in summer 2022 on public perceptions and priorities.

With increasing global temperatures linked to greater frequency, magnitude and intensity of heatwaves and drought, both in the UK and globally (64-67), we consider it imperative that studies such as ours are repeated to enable the policy community in to monitor stability and change in public perspectives on health and climate change

[xv] See Appendix A.

over time. As climate change reaches critical tipping points (68, 69), public perceptions, priorities and willingness to pay may do too.

Thirdly, there is scope for additional analyses that we have not been able to undertake within the timeframe of the project. This includes investigating the perceptions and priorities of UK adults who report being unconcerned about climate change and its health impacts. It includes, too, exploring how political orientation (for example, voting intentions), moral values and trust in government are related to perceptions and priorities; questions on these issues were included in the quantitative surveys. They have been found to be related to perceptions of climate change (70-72); however, to our knowledge, these factors have not been investigated as potential predictors of perceptions of the health impacts of climate change and priorities for action.

Finally, it should be noted that our project relied on primary studies. We recognise that there are alternative methods of generating insight into public perceptions and priorities, including citizens' juries, community workshops, public meetings and consultation exercises. While offering more direct opportunities for community engagement and dialogue, individuals have differential capacity to participate, with the attendant risk that the perspectives and priorities do not reflect those of the wider community (73, 74). For the policy community, survey research is therefore likely to remain an essential source of insight into public sentiment.

Conclusions

Climate change is an increasingly important determinant of population health – and therefore of public health policy. Our findings provide up-to-date evidence on public perspectives and priorities in the UK, a critical resource for policy-making and communication.

We found widespread public concern about the impacts of climate change on people's health in the UK and a WTP to reduce these risks. We found that experience matters. Both the experience of floods and air pollution and being aware of these exposures in the local area increased concern about the health impacts of climate change. These direct and indirect experiences also increased the likelihood that floods and air pollution were identified as priorities for action by national and local government. Similarly, exposure to floods and heatwaves increased WTP to reduce the risks to their own health.

Taken together, our findings indicate that there is a broad platform of public support for action by government to address the health impacts of climate change. They also point to the potential for a health framing of climate change in the development and implementation of policies across DHSC, Department of Business, Energy and Industrial Strategy (BEIS) and other government departments (including the Department for Levelling Up, Housing and Communities and the Department for Environment, Food and Rural Affairs).

Our project suggests that people's experiences of climate-related exposures like air pollution and floods are a key factor in their perceptions of climate change and health. As climate change accelerates and population exposure to its effects increases and intensifies, a health framing of climate change has an essential role to play in public engagement and policy development at both national and local level.

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Appendices

A. Overview of public involvement component

B. Participant profile: quantitative surveys

Appx B.docx

C. Community organisations and participant profile: qualitative study

Appx C.docx

D. Public perceptions of climate change and its health impacts: taking account of people's exposure to floods and air pollution

- https://www.mdpi.com/1660-4601/19/4/2246

E. 'I don't really associate climate change with actual like people's health': a qualitative study in England of perceptions of climate change and its impacts on health

F. Public priorities for local action to reduce the health impacts of climate change: evidence from a UK survey

https://doi.org/10.1016/j.puhip.2022.100346

G. Did increased media coverage of climate change and the COVID-19 pandemic affect climate change concern and issue salience in the UK in 2021?

H. Willingness to pay to avoid the health impacts of climate change

Appx H.docx

J. Note on the valuation of reduced mortality risk in the context of climate change

Appx J.docx

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