Exploring the association between health, local area characteristics and climate action plans in the UK: cross-sectional analysis using administrative data from 2018 and a citizen science ranking of climate action plans from 2021

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Abstract: Local government has an important role to play in mitigation and adaption to climate change. In the UK, 82% of all emissions fall within the scope of local government. However, in UK climate legislation there is no statutory requirement for local government to address climate change. Eighty percent of local authorities have declared a climate emergency and developed climate action plans. The aim of this study is to explore the association between social vulnerability (poor health, financial resources, deprivation, house prices) and the quality of climate action plans as measured by a scorecard system created by Climate Emergency UK. We hypothesis that areas with lower levels of social vulnerability will have higher quality climate plans. We utilised a citizen science created dataset ranking local government's climate action plans and administrative data on local area characteristics related to social vulnerability at the local authority level. Descriptive analysis and multivariate regression were employed. We found a very small but significant association between total weighted score, central government funding and average house prices. For the individual dimensions of the quality of climate action plans, higher male life expectancy and house prices were associated with better commitment and integration and having a greater percentage of the population over the age of 65 was associated with a lower score in this dimension. More urban areas and less deprived areas had higher scores for planning climate education, skills and training. We suggest that greater national guidance is needed including sharing good practice on how to build community support and additional funding for climate change mitigation/adaption in particular for education, skills, and training in more deprived areas may help to prevent variations in climate action plans increasing inequalities.

Key words: *Climate Change; local government; climate action plans; UK; inequalities; net-zero*

Introduction:

Climate change is one of the greatest challenges to humanity in the 21st century [1]. To mitigate human made climate change, a global effort is required [2]. In the UK, average surface temperatures have already risen by 1.2C [3]. Because of its geography, the UK is at particular risk of droughts, flooding, and extreme flooding events increasing risk to food production, water, and infrastructure [3]. Extreme weather events can cause injury, trauma, exacerbate existing health conditions, and even loss of life. These types of events are expected to increase in frequency and severity; resulting in more resources being spent on climate related emergencies and mitigation measures which could have been spent on improving health and well-being. Droughts increase the risk of food insecurity

leading to rising food and fuel prices, increased supply chain disruptions, and greater pressure on health and social care services [4]. The Climate Change Act 2008 [5] enshrines in UK law its global commitment to address climate change. The law requires that the UK reduces its emissions of greenhouse gases by 100% of 1990 levels (e.g. net zero) by 2050. In addition, the Act requires the UK Government to assess the risk and opportunities from climate change and to adapt to them. To achieve these aims the Act established the Committee on Climate Change which is tasked with ensuring that emission targets are evidence based and independently assessed as well as advising on risks from climate change and assessing progress towards tackling them [6].

This national level policy did not create any statutory requirements for local government, which are called local authorities in the UK. However, of all UK emissions 82% are within scope of influence of local authorities [7]. But it is not a legal requirement for local authorities to develop climate change plans and deliver reductions in emissions in line with carbon budgets, nor were local authorities given carbon budgets [8]. Although, the need for national government to introduce a statutory duty to take account of the UK's net-zero targets and to create a clear role for local authorities has recently been highlighted by the Mission-Zero independent review [9]. Despite the lack of clarity or statutory duties, many local authorities (currently approximately 80%) have declared a climate emergency [10]. Declaring a climate emergency is an indication that the local authority recognises that humanity is facing a climate crisis and that urgent action is required to address the potentially irreversible effects of climate change. Climate emergency declarations started in Australia in 2016 with the first one in the UK being declared by Bristol City Council in November 2018 [11]. The declaration of a climate emergency leads to the development of a climate action plan to create a strategy on how to reduce emissions and mitigate/adapt to climate change.

The lack of a clearly defined role for local authorities in reaching the UK's national emission targets and delivering climate risk mitigation/adaption means that whilst the majority of local authorities have developed climate action plans, moving from aspiration to action is a challenge. Research by

the Environmental Law Foundation [12] identified a lack of connectivity between local authority plans and actions. A lack of national coordination and guidance means that some local authorities may have poorly developed or no clear plans. Different geographies also have different risks for climate change e.g. flooding, drought, heat which may increase regional inequalities if plans do not reflect local risks because of lack of capacity to collate and act upon local data [13,14]. The government has previously stated that no national leadership is needed because of the 'diversity of barriers and opportunities local places experience' [7].

In addition, local authorities have been working in an environment of decreasing funding from 2010 (austerity). Between 2010 and 2020, local government had a reduction in core funding from the central government of £16 billion [15]. More deprived areas with higher demand for statutory services faced the largest cuts [16].

In combination, this lack of national leadership in a constrained funding environment has the potential to exacerbate the deeply entrenched regional inequalities present across the UK [17], negatively impacting on the Government's ''Levelling Up' agenda to ensure equality of opportunities across the UK [16].

The aim of this paper is to explore the relationship between social vulnerability defined by population health, local government financial resources, thesocial determinants of health (the conditions in which people are born, work, live and age and the wider set of systems and forces such as social norms, economic conditions, policies that shape daily life [18]) and the quality of climate action plans (based upon implementation criteria of the plan [19]) at the local authority level. We hypothesise that areas with better health, more resources, areas with higher house prices, less deprived areas, and urban areas compared to predominately rural areas will have more highly ranked climate action plans. Areas with more resources including better health and lower levels of deprivation are predicted to have more capacity to focus on climate change. Areas with higher house prices may have greater buy in for climate mitigation/adaption strategies to protect their

assets [20,21]. Predominately rural areas have unique challenges particularly around transport which may impact on the creation and implementation of climate action plans [22]. We also hypothesise that the age composition of the population may impact on the quality of the climate action plan. Findings from the Office of National Statistics (ONS) suggest that on average older age groups (those over 70) were less likely to report that they were very worried about climate change compared to younger age groups [23].

Understanding how local area characteristics may influence the quality of a local authority's climate plan, and therefore their ability to reduce emissions and mitigate/adapt to climate change, is essential for developing both local and national climate change policies and ensuring that existing inequalities are not made worse or future inequalities arise.

Methods:

Data Sources:

To assess the quality of local authority's climate action plan we use data collated by Climate Emergency UK [19]. To create the database, 120 volunteers trained and supervised by the Climate Emergency UK assessed UK council's climate action plans that were published online before 20 September 2021. Quality was assessed by examining the six areas : 1) are the climate actions costed; 2) do the actions have a clear goal; 3) are local residents engaged with climate action; 4) are there actions to decarbonise waste, planning, housing, and other services that councils have a statutory requirement to manage; 5) does the plan include working with other stakeholders who help provide council services to decarbonise their services; 6) are there actions to re-skill the workforce, provide climate education, governance and funding for climate action across the following 9 dimensions of each climate plan : 1) government, development, and funding; 2) mitigation and adaption; 3) commitment and integration; 4) community engagement and communication; 5) measuring and setting emission targets; 6) co-benefits; 7) diversity and social inclusion; 8) education, skills and training; and 9) ecological emergency. These dimensions were

chosen based upon consultation with 200 councillors, council officers, climate action campaigners and organisations [25]. A total score was developed based upon summing the scores across the nine dimensions. These scores were weighted based upon the number of questions in each dimension. To reflect that each area was equally important [25].

We restrict our analysis to local authorities in England and have data on 261 local authorities out of a total of 317 local authorities [24]. Figure 1 shows the climate action plans for England with darker shaded areas having a higher ranked plan.

To control for social vulnerability, we use regional level data for the 9 regions in England[1]. This data comes from the place based longitudinal data resource [26].

Outcome Variable:

We use a number of different ways of ranking of local authorities climate action plans. First, we use the total weighted score of each climate action plan (where a higher score means an action plan that delivers on the six different areas across nine dimensions as described above) [19]. Next, we create a binary variable that equals one if the local authorities climate action plan is in the top quartile of ranked climate action plans and is equal to zero otherwise. Finally, we analyse separately the nine dimensions which make up the total weighted score for each climate action plan.

Explanatory Variables

We include local area variables related to social vulnerability using data from the Place Based Longitudinal Data Resource [26] from 2018. This year is chosen as for the majority of local authorities this would be the year before they declared a climate emergency so it should be a good indication of what local conditions were like when the initial plan was drafted. The variables we include are healthy life expectancy at birth for males and females, average house price, total funding

[1] These regions include: 1) London; 2)North East ; 3) North West ; 4) Yorkshire; 5) East Midland; 6) West Midlands, 7) South East; 8) East of England; and South West

from central government, % of the population over age 65, % of the population between 16-64, some models with a continuous variable for index of multiple deprivation from 2015 and some models with a dummy variable that equals one if the area is in the top three deciles of deprivation and is equal to zero otherwise, and a dummy variable that equals one if the local authority is predominately urban area and is equal to zero otherwise.

Analysis

First, to describe the data, we estimate the means and standard deviations of the variables related to social vulnerability for those areas in the top and bottom quartile of total weighted scores for their climate action plan. T-tests are calculated to determine if there are any statistically significant differences in social vulnerability between the highest and lowest scoring quartiles. Next, we start by estimating the relationship between total weighted score as a continuous variable and variables related to social vulnerability employing a multivariate regression approach. This allows us to assess the relationship between total score and social vulnerability. Then, we look specifically at the association between having the highest ranked scores (top quartile of total weighted scores) compared to a lower ranked score and social vulnerability by estimated a multivariate logistic regression. Finally, to assess the association between different dimensions of the climate emergency plans and social vulnerability we estimate 9 different multivariate regressions for each dimension. All models are clustered by region.

Metadata for the creation of the dataset used for analysis and the equations estimated can be found here: https://github.com/hwb1030/Climate-Change-Meta-Data.

Results:

Descriptive Analysis

Descriptive statistics for the areas in the lowest scoring quartile for total score and highest scoring quartile for total score are shown in Table 1. Male healthy life expectancy is approximately 58 years

old and female healthy life expectancy is 59 years old. Approximately 61% of people in the sample are between 16-64 years old. We can see that the highest and lowest scoring areas are relatively similar. None of the variables are statistically significantly different. This would suggest that social vulnerability does not influence the quality of the climate action plan at the extremes of quality (e.g. highest and lowest quartile scores). However, we will explore this in greater detail in the multivariate regression analysis.

Total Climate Score and Social Vulnerability

In Table 2, in column 1 where we used total weighted climate action plan score as a continuous variable there is a significant association (though very small) between central government funding and having a higher score. There is a very small and marginally significant positive association between average house price and having a higher total weighted climate action plan score. None of the other variables are statistically significant. When specifically looking at areas with the highest quartile of score compared to areas with lower scores using a binary variable none of the explanatory variables are statistically significantly. This is consistent with what was found in the descriptive statistics in Table 1.

Dimensions of Climate Action Plan and Social Vulnerability

Next, in Table 3, we estimate nine ordinary least squares models for each dimension of the climate action plan scores. For the government, development, and funding and mitigation and adaption dimensions (columns 1 and 2) none of the variables related to social vulnerability are statistically significantly associated. For the commitment and integration dimension (column 3) higher male health life expectancy and higher average house price are positively associated with having a higher score. The percent of the population over the age of 65 is negatively and significantly associated with having a lower score. For the community engagement and communications, measuring and setting emission targets, and co-benefits dimensions (columns 4, 5, and 6) none of the social vulnerability variables are significantly associated with these dimensions. In column 7, for the

diversity and social inclusion dimensions, being in an urban area compared to a rural is statistically significantly associated with having a higher score. In column 8, for education, skills and training dimension, being in an urban area compared to a rural is statistically significantly associated with having a higher score and being in an area of high deprivation compared to less deprived areas is statistically significantly associated with having a lower score. Finally, in column 9, for declaring an ecological emergency none of the explanatory variables are statistically significant.

Discussion

In this study, we explored the association between the quality of local authorities in England climate action plan and social vulnerability. We hypothesised that areas with higher levels of social vulnerability would have lower quality plans. The mechanisms explaining this association include 1) areas with higher social vulnerability being more stretched and needing to focus on their statutory duties rather than 'extras' such as climate plans which are not a legal requirement [28]; 2) more affluent areas with higher home ownership rates and house prices are more likely to support local action to mitigate and adapt to climate change to protect their assets [20]; and 3) skills mix and training opportunities for the population may limit ambitions to support a transition to 'green' jobs which is more likely to be an issue in more deprived areas [27].

We found that there was a very small but significant association between total weighted score, central government funding and average house prices. When looking at the different dimensions of the climate action plan we found that higher male life expectancy and house prices were associated with better commitment and integration and having a greater percentage of the population over the age of 65 was associated with a lower score in this dimension. This is consistent with our hypotheses that healthier more affluent populations were more likely to 'buy into' the climate agenda [20] and areas with older populations may have less of an appetite for change [23]. Urban areas compared to rural areas were associated with a higher score on diversity and social inclusion and education, skills and training. More deprived areas compared to less deprived area was

associated with having a lower score on education, skills, and training. This is consistent with our hypothesis that higher levels of social vulnerability will affect local authority's ability to address climate change.

These findings highlight gaps in power, funding, capacity which limit local authorities ability to achieve their climate change ambitions [28]. Without additional resources from central government against a back drop of constrained resources and rising demand for statutory services [15-17] more deprived local authorities risk being 'left behind' exacerbating already existing inequalities in economic productivity [28]. Funding from central government should be allocated in particular to skills training and education to support economic development and environmental sustainability. Transitioning to a green economy is essential for rural areas; thus, it is important that they are supported to develop a workforce that can meet the challenges and demands of a net zero economy [22].

It is widely acknowledged that climate change is a public health emergency [29]. In England, local authorities have a responsibility to improve the health of their local population and provision of public health services [30]. However, there is no legal responsibility for local authorities to contribute to the UK's responsibilities to addressing climate change [6]. This creates the possibility for heterogeneity in the quality of response to climate change by local authorities potentially contributing to health inequalities. This heterogeneity in quality is demonstrated in the data by being able to rank different local authorities climate plans. The UK Health Security Agency has responsibility at the national level for research and surveillance of the health impacts of climate change [31]. In this role, the organisation has been working with local authorities to understand barriers and facilitators to taking local action. However, until there is greater national guidance and potentially legislation it is likely that there will continue to be this heterogeneity in quality of climate action at the local level. Particular areas of concern include diversity, inclusion, education, skills and training. As the impacts of climate change accelerate it is likely that this heterogeneity in the quality

of plans and hence implementation of mitigation and adaption measures may contribute to increasing inequalities.

Strengths and Limitations:

This research was co-designed with a strategy and climate team lead from a local authority in England. We utilised a unique dataset to better understand important gaps in the UK's response to climate change and what that may mean for health inequalities and in particular regional health inequalities going forward. A weakness of the research is that the dataset we used has not been externally validated in terms of assessing the quality of climate action plans. Climate action plans are also living documents. Thus, the quality of plans may have changed since the snapshot in 2021 which we used, which may have implications for our findings.

Conclusions:

We found some evidence to suggest that for the dimensions of commitment and integration and diversity, inclusion, education, skills and training were associated with, social vulnerability of a local authority. Differences in the quality of climate action plans could potentially contribute to increasing regional inequalities. Our policy recommendations include national coordination and guidance to ensure that capacity does not constrain local authority climate plans which could include sharing good practice on how to build community support. Additional funding for climate change mitigation/adaption is needed as part of local authorities budgets. In particular, support for developing education, skills, and training in more deprived areas may help to prevent regional inequalities and support economic development. Future research is needed on the implementation of climate action plans and if and how local area characteristics are associated with implementation.

Declarations:

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Data Availability: All data used in this study is publicly available. The climate action plan ranking data can be found here: https://www.councilclimatescorecards.uk/. The data on local characteristics can be accessed from: https://pldr.org/. Metadata for the creation of the dataset used for analysis and the equations estimated can be found here: https://github.com/hwb1030/Climate-Change-Meta-Data.

Author Contributions: All authors developed the project idea. HB undertook the analysis with assistance from SD. HB drafted the manuscript. All authors commented on the manuscript.

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Table 1: *Descriptive Statistics*

	Lowest scoring quartile	Highest scoring quartile	Difference (p-value)
	N=79	N=72	
Male Healthy Life Expectancy	58.58 (0.71)	58.73 (0.54)	p=0.1490
Female Healthy Life Expectancy	59.29 (0.60)	59.36 (0.48)	p=0.4327
Average House Price 2018	127889.90 (19791.29)	128042.30 (30504.63)	p=0.9707
Central_Gov_Funding_Total 2018	232864.10 (49425.57)	241131.00 (43220.35)	p=0.2777
Pop. % over 65	18.32 (2.21)	17.82 (2.45)	p=0.1894
Pop % between 16-64	61.72 (0.98)	61.89 (0.81)	p=0.2498
IMD decile	3.09 (1.38)	3.12 (1.33)	p=0.8922

Notes: Standard deviations in parenthesis

Table 2: *Total Weighted Score Using a Continuous and Binary Outcome variable*

Total Weighted Score	(Continuous) Coef	(Binary) odds ratio
Male healthy life expectancy	4.956	1.180
	(3.112)	(0.388)
Female healthy life expectancy	-1.609	0.981
	(3.800)	(0.389)
Average House Price 2018	0.001*	1.000
	(0.000)	(0.000)
Central_Gov_Funding_Total2018	0.000**	1.000
	(0.000)	(0.000)
Pop. % over 65	-10.400	1.057
	(7.339)	(0.150)
Pop % between 16-64	-31.214	1.173
	(20.373)	(0.420)
IMD score	0.690	0.841
	(1.007)	(0.234)
urban	-0.476	1.613
	(3.472)	(0.628)
Constant	1,765.953	0.000
	(1,318.176)	(0.000)
Observations	298	298
R-squared	0.145	

Notes: Continous variable is for total weighted score. Binary variable is equal to one for those local authorities with highest quartile for score and is equal to zero otherwise. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

	(1) Govt, dev. & funding	(2) Mitigation & Adaption	(3) Commitment & Integration	(4) Community engagement & communication	(5) Measuring & setting emission targets	(6) Co-benefits	(7) Diversity & Social Inclusion	(8) Education, skills & training	(9) Ecological Emergency
Male healthy life expectancy	1.986	1.598	**7.376***	2.532	3.854	4.762	3.758	6.661	2.368
	(3.629)	(4.404)	**(4.436)**	(4.268)	(4.612)	(5.302)	(2.615)	(4.101)	(4.700)
Female healthy life expectancy	-0.042	1.197	-3.824	-3.339	-2.046	-4.626	-1.743	-7.459	-3.204
	(4.384)	(5.320)	(5.358)	(5.155)	(5.571)	(6.404)	(3.158)	(4.954)	(5.677)
Average house price 2018	0.000	0.000	**0.000***	0.000	-0.000	0.000	0.000	-0.000	0.000
	(0.000)	(0.000)	**(0.000)**	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Central_Gov_Funding_Total2018	-0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Pop. % over 65	-1.494	-2.801	**-3.570***	-0.490	1.161	-1.287	0.779	2.405	-0.509
	(1.570)	(1.905)	**(1.919)**	(1.846)	(1.995)	(2.294)	(1.131)	(1.774)	(2.033)
Pop % between 16-64	-0.910	-4.714	-7.398	0.748	2.433	0.696	-0.324	6.156	0.129
	(3.970)	(4.818)	(4.852)	(4.668)	(5.045)	(5.800)	(2.860)	(4.486)	(5.141)
High deprivation	-3.186	-3.489	-3.084	0.933	-1.976	-2.955	-1.873	**-7.206****	-0.974
	(3.083)	(3.741)	(3.768)	(3.625)	(3.918)	(4.504)	(2.221)	**(3.484)**	(3.992)
Urban	-4.124	0.069	-0.312	0.254	2.536	-2.120	**5.547***	**8.011***	-3.466
	(3.922)	(4.759)	(4.793)	(4.611)	(4.983)	(5.729)	**(2.825)**	**(4.431)**	(5.078)
Constant	7.231	206.140	329.762	49.062	-243.073	6.189	-119.593	-339.029	88.485
	(307.467)	(373.107)	(375.775)	(361.525)	(390.728)	(449.172)	(221.513)	(347.432)	(398.148)
Observations	298	298	298	298	298	298	298	298	298
R-squared	0.017	0.023	0.034	0.008	0.011	0.021	0.039	0.041	0.005

Notes: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1