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Keeping warm at home during winter in Wales

Differences in heating behaviours, coping strategies,
and well-being from 2022 to 2023

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Executive summary

To explore the impact of rising costs of living on people's ability to keep warm and well at home in winter, a national household survey of 2,290 residents in Wales aged 18 years and over was undertaken between January to March 2022. Sampling included a boost of 500 individuals aged 65 years and over because of the evidence linking older adults to increased vulnerability in cold homes. The survey was repeated in January to March 2023 to explore changes in household heating behaviours and well-being. Findings used a sample of 507 participants who completed both survey waves.

Key findings

- The mean room thermostat temperature was lower in 2023 (19.3°C) compared to 2022 (19.9°C; $p<0.001$).
- There was a reduction in the number of people who reported their first response to feeling cold was to turn their heating temperature up (17.2% in 2022 vs 10.2% in 2023; $p<0.001$).
- The proportion reporting thermal comfort (feeling comfortably warm) in their main living area in winter was lower in 2023 (94.0% in 2022 vs 89.5% in 2023; $p=0.004$). However, nine in 10 respondents reported that they were able to achieve thermal comfort in their main living area across both survey waves.
- The proportion reporting stress or anxiety in the last three months over the costs of heating their home increased (57.2% in 2022 vs 66.5% in 2023; $p<0.001$).

These findings support our understanding of household heating behaviours and coping strategies to stay warm, as they identify a change towards lower heating temperatures in home environments and the reduction in duration of heating being used. However, the full extent of the current cost of living crisis on heating behaviours is still being identified. There is a recognised need for further research to explore appropriate temperature thresholds for overall health and well-being in different population groups, particularly vulnerable groups.

This report is part of a series of publications exploring housing warmth and health and well-being in Wales. Other outputs are available online on our [Repository](#) (link opens in new window).

Introduction

In 2021 the UK entered a cost of living crisis, characterised by a fall in real disposable income (the amount of money that a household has left after deduction of taxes and adjustment for inflation) [1–3]. In October 2022, the inflation rate in the UK reached its highest level in 41 years, drastically reducing the purchasing power of households [2]. Compared to other goods, the cost of energy rose disproportionately [4]. In winter 2022 average domestic gas bills were nearly double that of the preceding winter, while domestic electric bills increased by 50% [5,6]. In 2023, energy prices rose further [5,6]. Higher energy prices, coupled with food inflation, claim a greater proportion of households' disposable income, and can increase rates of fuel poverty (see Box 1).

Box 1: Fuel poverty

Varying definitions of fuel poverty exist. In general, fuel poverty relates to the affordability of adequate heating [7]. The Welsh Government define fuel poverty as households which need to spend more than 10% of their income to maintain warmth [8]. Certain demographic groups (e.g. low-income, single adult and private rented households) are at higher likelihood of living in fuel poverty [9,10].

In 2021, it was estimated that 14% (approximately 196,000) of households in Wales were living in fuel poverty with an additional 11% at risk of fuel poverty [11]. In 2022 these figures were estimated to increase to 45% (approximately 614,000) and up to 15% respectively [11]. Furthermore, in 2022, 98% of low-income households in Wales were classified as living in fuel poverty, with over four in 10 estimated to be in severe fuel poverty [12].

The increased cost of living may lead to some individuals needing to make trade-offs between heating their home or paying for food - often described as a 'heat or eat' dilemma. Such compromises can lead to cold exposure or poor nutrition and therefore negatively impact health and well-being [13].



The Welsh Government 'satisfactory heating regime' currently specifies minimum indoor temperatures for older adults and those with disabilities and other households; (see Box 2; [9]). The satisfactory heating regime is similar to indoor temperature recommendations of the World Health Organization and UK Health and Security Agency, which stipulate that a minimum threshold of 18°C might be appropriate [8,14,15].

Box 2: Welsh Government 'satisfactory heating regime'

The Welsh Government satisfactory heating regime specifies:

- 23.0°C in the living room and 18.0°C in other rooms achieved for 16 hours in a 24-hour period in households with older or disabled people.
- 21.0°C in the living room and 18.0°C in other rooms for nine hours in every 24-hour period on weekdays, and 16 hours in a 24-hour period on weekends for other households.

There are many factors that can influence a household's vulnerability to living in a cold home, including societal factors (e.g. the rising cost of living), property factors (e.g. energy efficiency) and personal factors (e.g. age) [16]. Living in a cold home can pose a significant risk to occupants' health and well-being. Cold homes can cause or worsen health conditions such as heart attacks, strokes, bronchitis, and asthma [10,17,18]. In England and Wales in 2022, cold homes caused 4,020 excess winter deaths [19]. Residing in a cold home can also harm mental well-being, especially for those with pre-existing mental health concerns or in those who have moved from an adequately warm home to a cold home [9].

The health impacts of cold homes can also impact an individuals' ability to work, increase the risk of fuel poverty and negatively affect the regional economy [10,20]. Cold homes also can have broader negative implications for communities and society including increased spending and resource usage within the healthcare system [10,21].

About this report

This report presents findings from the Housing Warmth Survey (Wales), a longitudinal household survey undertaken in two winter periods: January to March 2022 and January to March 2023. The report provides insight into household heating behaviours and health and well-being in a sample of residents in Wales.

Findings use a sub-sample of 507 residents in Wales aged 18 years and older who completed both survey waves. As research evidence identifies older age as a risk factor for experiencing the health impacts of cold homes, the survey included a sample boost of older adults (aged 65 years and above). As a result, findings are not representative of the Welsh population.

Methods

The Housing Warmth (Wales) Survey was conducted in two waves during the winter periods (January to March) in 2022 (wave one) and 2023 (wave two). The survey was designed to understand the heating regimes implemented in homes across Wales during winter and to explore relationships with thermal comfort, safety, health and well-being. Participants were invited to take part by computer assisted telephone interviewing or online. A professional market research company was commissioned to undertake data collection. Full study methodology is provided in Appendix 1.

In total, 2,290 adults participated in wave one. In recognition of the evidence on the increased vulnerability of older adults and cold homes [14, 15], this sample was inclusive of a deliberate boost of 500 adults aged 65 years and over. Of 979 respondents who gave consent in wave one to be contacted for follow-up, 516 (53%) completed the wave two survey. Nine individuals who had moved home since wave one were excluded due to the influence that dwelling features have upon the thermal environment of the home, resulting in a final sample for analysis of 507 (507 telephone, 2022; 375 telephone, 132 online, 2023).

The survey questionnaires were repeated across survey waves to enable comparison across timepoints. Survey questions used in this report are shown in Appendix Table A2. All questions were self-reported.

Data analysis used SPSS version 29. Descriptive statistics were used to calculate sample characteristics (age, gender, income, and survey mode [telephone or online]; Appendix Table A1). Sample sizes varied by question (Appendix Tables A3 – A9). Analyses of statistical differences between survey waves used paired-sample t-tests or McNemar's test. Presented results are unweighted and therefore not representative of the Welsh population. The demographics for the sample used in analysis are shown in Box 3.

Ethical approval was granted by Bangor University Healthcare and Medical Sciences Academic Ethics Committee (references: 2021-17050 [wave one] and 2022-17239 [wave two]).

Box 3: Overview of sample demographics used in this report

Over half of the sample (51.6%) reported their gender as female. At wave one (2022) the majority were aged 60 years or over (80.5%) with around a third (31.0%) categorised as low income (reporting a household income of less than £20,000 a year). Nearly six in 10 (59.2%) resided in an urban location, with over half of the sample (52.0%) living in the least two deprived deprivation quintiles (see Appendix Table A1).

Findings

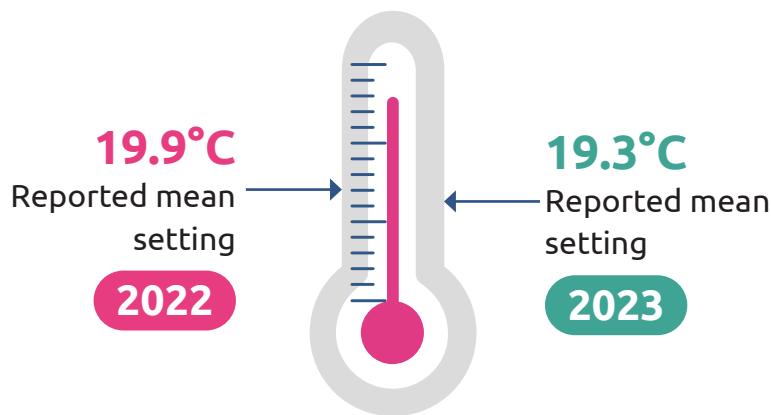
Room thermostat temperature settings (n=357)

Participants were asked what temperature their room thermostat was typically set to heat their home in winter. Temperatures in Fahrenheit were converted to Celsius

Mean room thermostat settings reduced from 19.9°C to 19.3°C

The mean reported thermostat settings decreased significantly from 19.9°C (Standard Deviation [SD] 2.17) in 2022 to 19.3°C (SD 2.03) in 2023 ($p < 0.001$; Figure 1; Appendix Table A3).

Figure 1: Mean room thermostat temperature settings in 2022 and 2023



Weekday (n=461) and weekend (n=456) heating hours

Participants were asked on a typical weekday/weekend in winter what times of day they/their household had their heating on

There was a non-significant reduction in mean daily heating hours from 2022 to 2023 across weekdays (10.2 hours to 9.8 hours respectively) and weekends (10.6 hours to 10.2 hours respectively; Appendix Table A3).

Heating the whole home (n=504)

Participants were asked if during winter they or their household heat their whole home

There was a non-significant reduction in the proportion of participants who reported heating the whole home across survey waves from 71.2% in 2022 to 68.8% in 2023 (Appendix Table A4).

Heating only selected rooms in the home (n=90)

Participants who responded that they didn't heat their whole home were asked which rooms of their home they heat

Of individuals that did not heat their entire home there was no significant change in the rooms heated at home across waves (Appendix Table A4).

Initial behavioural responses when feeling cold at home (n=499)

Participants were asked which warming behaviour they usually do first when they feel cold in their home

Across both survey waves the most popular first response to feeling cold was to put on extra clothes, the proportion of which increased from 43.7% in 2022 to 48.3% in 2023. However, this was non-significant (Figure 2; Appendix Table A5).

There was a significant reduction in the proportion reporting that their first response to feeling cold was to turn their heating temperature up across study waves (17.2% vs 10.2%; $p < 0.001$; Figure 2; Appendix Table A5). Despite an increase in those reporting that their first response to feeling cold was to turn on the heating (10.6% vs 12.6%; $p = 0.326$), this change was non-significant.

There were no other significant changes in the first response to feeling cold across study waves (see Appendix Table A5).

The proportion reporting that they turned up their heating temperature when cold increased

Figure 2: Proportion of respondents reporting this action as the first they take when feeling cold at home across study waves.

Put on extra clothes



43.7% 2022
48.3% 2023

Use a blanket



16.8% 2022
17.8% 2023

Turn on heating



10.6% 2022
12.6% 2023

Hot water bottle



2.4% 2022
2.8% 2023

Turn the heating temperature up



17.2% 2022
10.2% 2023

Thermal comfort in the main living area (n=504)

Participants were asked if in winter they were able to keep comfortably warm in their main living area

Most respondents were able to achieve thermal comfort (e.g. satisfaction with the current environment [23]) in the main living area. However, levels of thermal comfort significantly decreased across study waves from 94.0% in 2022 to 89.5% in 2023 ($p = 0.004$, Appendix Table A5).

The proportion reporting they were comfortably warm at home reduced

Minimum temperatures for comfort and safety in generally healthy (n=382) and vulnerable people (n=378)

Participants were asked what minimum temperature they thought homes should be heated to in winter to keep generally healthy people and more vulnerable people (e.g. older people or people with long-term health conditions) comfortable and safe at home. Temperatures in Fahrenheit were converted to Celsius

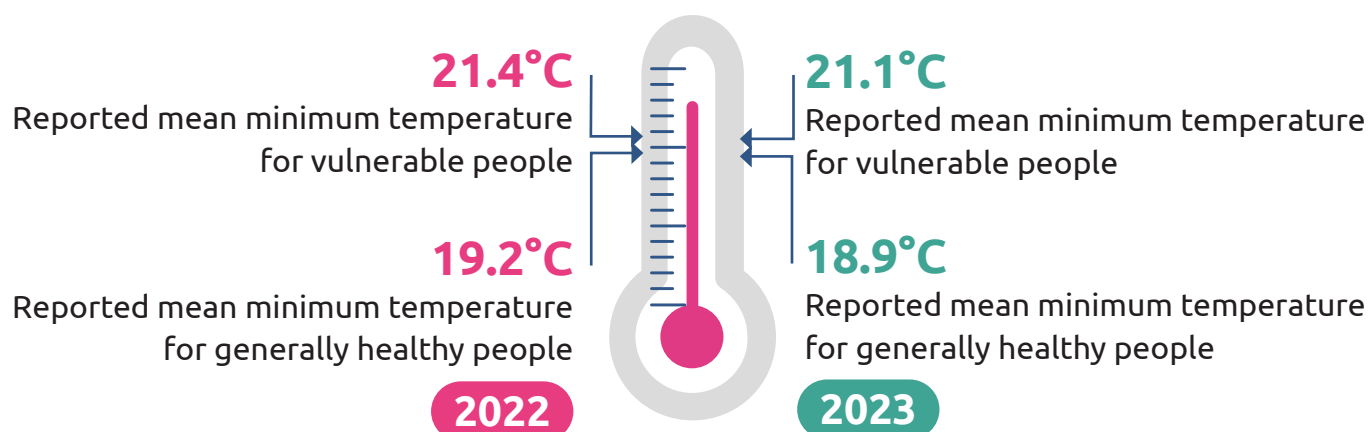
The mean temperature that respondents thought homes should be heated to for vulnerable people was higher than the temperature for generally healthy people across both survey waves (Figure 3; Appendix Table A6).

The mean minimum temperature that respondents felt would keep generally healthy adults comfortable and safe at home significantly reduced from 19.2°C (SD 2.18°C) in 2022 to 18.9°C (SD 2.02°C) in 2023 ($p=0.006$; Figure 3; Appendix Table A6).

The mean minimum temperature respondents to keep vulnerable people comfortable and safe at home also significantly reduced from 21.4°C (SD 2.54°C) in 2022 to 21.1°C (SD 2.46°C) in 2023 ($p=0.009$; Figure 3; Appendix Table A6).

The mean minimum temperatures that respondents thought would keep individuals comfortable and safe at home reduced

Figure 3: The reported mean minimum temperature for comfort and safety for general populations or those vulnerable, across 2022 and 2023.



Stress or anxiety about the costs of heating the home (n=502)

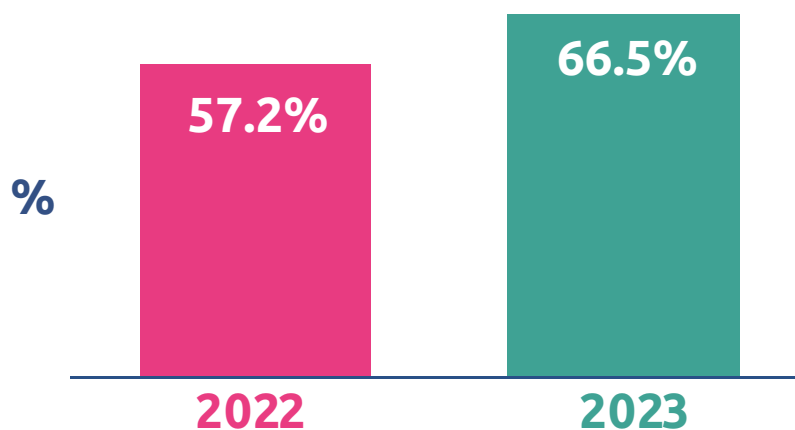
Participants were asked about their feelings of stress or anxiety over the cost of heating their home in the past three months. Those who responded that they any frequency of anxiety were categorised as having stress or anxiety. Those reporting stress or anxiety were then asked if they were a little or very stressed or anxious, or somewhere in-between

The proportion reporting stress or anxiety about the costs of heating their home increased

There was a significant increase in the proportion reporting that in the last three months they were stressed or anxious about the cost of heating their home; 57.2% (n=287) in 2022 and 66.5% (n=334) in 2023 ($p < 0.001$; Figure 4; Appendix Table A7).

Of those reporting stress or anxiety over the cost of heating their home, only the proportion reporting that they were 'a little' stressed or anxious increased from 2022 to 2023. There was no increase in those reporting they were 'very' stressed or anxious or 'somewhere in between' (Appendix Table A8).

Figure 4: Proportion of respondents reporting that they felt stressed or anxious about heating costs in the last three months



Mental well-being (SWEMWBS; n=457)

Participants were asked about their mental well-being using the 7-item Short Warwick-Edinburgh Mental Wellbeing Scale (SWEMWBS; see Box 4)

There was a non-significant decrease in mean scores for mental well-being across study waves from 24.7 (SD 4.38) in 2022 to 24.4 (SD 4.62) in 2023 ($p=0.189$; Appendix Table A9).

Box 4: Scoring SWEMWBS

SWEMWBS comprises of 7-items, of which responses to each item are scored from 1 (none of the time) to 5 (all the time; see Appendix Table A2). These scores are then summed to provide an overall raw score, which is then transformed according to established guidelines [24]. Scores can range from 7 to 35 with lower scores indicating lower mental well-being. Here, scores have not been categorised into a measure of low mental well-being, instead the mean SWEMWBS scores across study waves have been reported.

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Cutting or reducing meals due to the cost of heating the home (n=504)

Participants were asked if in the last three months, they had ever cut the size of their meals or skipped meals because of the cost of heating their home

There was a non-significant increase in the proportion of respondents cutting the size of their meal or skipping meals in the last three months due to heating costs, with 9.1% reporting such behaviour in 2022 and 11.3% in 2023 ($p=0.161$; Appendix Table A7).



Discussion

This report explores changes in heating behaviours, coping strategies, and well-being from winter 2022 to winter 2023 in a non-representative sample of residents in Wales. Our results indicate changes in behaviour relating to heating the home, thermal comfort and stress and anxiety around the costs of heating the home. These findings add to a growing body of evidence exploring the change in household heating behaviours since the start of the cost of living crisis. The findings are important for understanding household heating behaviours and coping strategies, as they identify a change towards reduced heating levels (i.e. lower temperatures) and durations (i.e. fewer hours) of heating use.

Despite average colder outdoor temperatures in winter in Wales (1st December to 28th February) in 2023 compared to 2022 (4.7°C vs 5.9°C respectively; [24]), households in this sample self-reported their mean room thermostat temperature was significantly lower in winter 2023 (compared to 2022). However, the mean temperature across both time points remained above the current Welsh Government recommended minimum temperature for a satisfactory heating regime in general populations for rooms in the house other than the living room (see Box 2; [8]).

Other research in Great Britain has identified a widespread reduction in room thermostat settings, with one study finding thermostat settings were approximately 1°C lower during the cost of living crisis [25]. Other research in the UK has identified an increase in the proportion of households reporting their thermostat is set to more than 18°C from winter 2020/21 to 2022/23 [26]. However, the clear reduction in indoor thermostat settings across studies cannot always be directly attributed to the cost of living crisis.



In general, British households consumed 8.4% less electricity and 10.8% less gas between October 2022 and March 2023 compared to the previous winter period [27]. Energy consumption was not directly measured in the present study, but there was a significant reduction across study waves in the proportion reporting that their first response to feeling cold was to turn the heating temperature up. Applying lower temperature settings is a cost saving behaviour [5,6].

In winter 2022/23, British householders reported putting more effort into saving energy than they had prior to the rising cost of living [25]. Other energy-saving actions can include keeping curtains closed, wearing more clothes, and using an electric blanket [25]. However, these behaviours are not new. Research in Wales prior to the cost of living crisis found that individuals used a range of coping strategies to stay warm including strategies to heat the person and not the home (e.g. using a hot water bottle/blankets) or an avoidance of turning up heating settings [28]. Although respondents in this sample reported such common coping strategies, there was no significant change in the proportion reporting their use of these as a first action in response to feeling cold across study waves.

There was a small but non-significant reduction found in heating hours (midweek, weekend). Heating hours can be linked to occupancy (e.g. young children [29] and disability [30]) and dwelling type/structure [30]. However, due to our sample being unrepresentative of the Welsh population, with the majority over 60 years of age, we did not analyse the change in heating hours by participant demographics. Furthermore, we found a non-significant reduction across study waves in the proportion reporting they heat their whole home. In Great Britain, 52.1% of householders reported that during winter 2022/23 they did not usually heat the whole home, compared to 35.5% before the rising cost of living [25]. Variations in temperature across rooms in the home has been found to have a direct impact on the use of household space, with cold rooms the least likely to be used during cold weather [28].

A non-significant increase in the proportion reporting they cut the size of or skipped meals because of the cost of heating their home was identified. The 'heat or eat' dilemma is a potential budgetary trade-off between food consumption and heating a home [31,32]. In October 2023, almost six million low-income UK households reduced, skipped or went without meals in the previous 30 days [33]. Poor nutrition from an unbalanced diet can lead to impaired physical abilities or development, or poor cognitive function [34]. Residing in a cold home is also linked to poor physical health outcomes [35]. Further research is therefore needed to examine the impact of the cost of living crisis on the heat or eat dilemma. Research should also seek to understand other cold coping strategies which are defined as 'risky' (e.g. energy rationing or self-disconnection) due to their potential negative impacts on health and well-being.

Here, there was a reduction in the proportion reporting thermal comfort (satisfaction with the thermal environment [22]), measured here as the ability to keep comfortably warm in the main living area. Thermal comfort is a highly subjective measure [36], influenced by individual (e.g. age, health status) and physical (e.g. air temperature) factors [37]. This finding is particularly interesting given the significant reduction across study waves in the mean temperature room thermostats were set to heat the home [27].

A lack of thermal comfort is linked to poorer well-being [25], and residing in a cold home has been shown to be detrimental to mental and physical health particularly in those with pre-existing health conditions [38]. Despite a reduction in thermal comfort, we did not identify a significant change in mean mental well-being (SWEMWBS) scores across survey waves. Instead, we found an increase in the proportion reporting stress or anxiety about the costs of heating their home.



Unaffordable energy has been linked to increased risk of anxiety or depression [39], and a greater frequency of financial difficulty (stress relating to fuel payments) has been linked to worsening mental health [40]. Persistent worry about debt and the affordability of heating are mental health stressors [41].

The full extent of the current cost of living crisis on mental well-being is still being identified. To further explore and understand the complexity between household heating and well-being during the cost of living, in-depth qualitative insights would be beneficial [42]. Further research is also required into the impact that living in cold homes has on mental health and well-being [35]. Such understanding is important given the demand on healthcare services that lower mental well-being presents [43], and its wider economic and social costs [9] including unstable employment [44]. As such, further research is needed to explore the complex relationship between home heating and well-being, using larger and representative samples.

There was a significant reduction across study waves in the mean temperature that respondents thought homes should be heated to in winter to keep people comfortable and safe. Mean temperatures for vulnerable people (e.g. older people or people with long-term health conditions) across both survey waves were both below the Welsh Government satisfactory heating regime for vulnerable individuals (21.4°C in 2022 and 21.1°C in 2023 vs a threshold of 23.0°C in the living room), whilst the mean temperature for generally healthy populations only dropped below the recommended threshold in 2023 (19.2°C in 2022, 18.9°C in 2023 vs a threshold of 18.0°C; see Box 2). There is a recognised need for further research to explore appropriate temperature thresholds for overall health and well-being in a range of population groups [35]. Such an understanding will be of use to a wide audience including policy makers, researchers, and those with a broader commitment to housing and health.



Strengths and limitations

This study used a longitudinal design with repeated measures. The findings add to the evidence base on heating regimes in homes in Wales during a time of increased energy and living costs [16]. Knowledge of these issues can help to inform sustainable and equitable responses to rising costs of living and future financial shocks and can inform policy to protect those who are most vulnerable to living in cold homes.

Only 49% of those who took part in wave one gave permission to be re-contacted, of whom 47% declined to participate in wave two (a response rate of 53%). As such, the sample used for analysis corresponds to 22.1% of the original wave one sample ($n=507/2,290$; see methods and Appendix Table A1). We were unable to record reasons for declining to participate in wave 2 and self-selection to participate may have resulted in study bias. Furthermore, some individuals had a change in study method (telephone or online) between waves, as individuals completed wave two using their preferred study method.

The study population used for analysis is not representative of the Welsh population, with eight in ten respondents aged 60 years and over. However, the findings provide insight into home heating behaviours among a particularly vulnerable population during a time of rising energy and living costs. Furthermore, four in ten (40.8%) respondents resided in rural communities. Many homes in rural areas use oil, liquid gas or coal as their primary heating source, which did not benefit from the original Ofgem price cap protections offered like residential mains gas and electricity.

All survey measures were self-reported and therefore subject to recall and reporting bias. Not all respondents had a room thermostat or digital temperature controller in their home and thus were unable to report thermostat settings, resulting in a smaller sample size for measures of change in these outcomes. The location of room thermostats can also vary across homes and respondents were not asked to report which room their thermostat was located in.

SWEMWBS was used to assess changes in mental well-being between survey waves. However, the scale has been shown to have a ceiling effect in general population samples, thus possibly limiting the identification of changes amongst people experiencing better well-being [45]. However, to mitigate survey fatigue and ensure an appropriate length of survey, there was value in administering the SWEMWBS over the longer version of the scale.

Energy conservation messaging can have a measurable effect on people's energy use [46–48]. It is possible that energy saving tips at the time of rising energy costs, such as turning down a thermostat, might have influenced the behaviours reported by the survey respondents. As such, we are unable to directly attribute change in outcomes studied directly to the cost of living crisis.

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Appendix 1: Full methodology

Sampling, recruitment and data collection

All participants (residents in Wales, aged 18 years or older and able to consent to participation) in the wave one Housing Warmth Survey (Wales, winter 2022) were asked to consent to be recontacted for follow up research. All participants who provided permission to be recontacted (n=979) were contacted by either telephone (n=552) or by email (n=427), as per their recorded preference. Potential telephone participants were sent a text message prior to a call to inform them that they would be contacted. Participants were contacted in Welsh where this was stated as their language preference.

Data collection was conducted by a professional market research company (MRC; M.E.L Research) between 26th January and 10th March 2023. While telephone interviews were sought wherever possible, an online survey method was offered to those who expressed a preference for email contact. Both telephone and online surveys were available in Welsh or English language. Calls were made all days of the week within reasonable hours, with up to five call attempts made. If the survey was not completed after five call or three email attempts, the participant was then contacted using the alternative survey method (online, telephone) where they had provided contact details.

On contact, all participants were informed of information of the study including its aims and objectives, voluntary nature and contact details for the MRC, the research team and an independent contact for complaints. It was made clear to all participants that were able to withdraw their personal contact information and consent to being contacted at any time. All participants were provided with information on appropriate national support services.

Study questionnaire

To enable comparison across timepoints, the wave 2 follow-up questionnaire repeated most measures from the wave one survey. Three new questions were added to confirm the respondents had not moved residence, to determine the energy performance certificate of the dwelling, and reflect the expanded winter payment programmes available in 2023. Table A2 presents the questions used across survey waves for analysis in this report.

Data analysis

Data from waves one and two for participants were linked using a personal identifier code. Personal contact data (name, email, telephone) was held separately to survey data. Due to small numbers, age and income categories were collapsed. Table A2 presents the qualifying response used for each outcome studied and where applicable indicates any data coding.

Demographics

Table A1 Sample demographics at baseline in the Housing Warmth Survey (Wales, winter 2022)

		n	%
Gender (n=506)	Male	245	48.4
	Female	261	51.6
Age group (years; n=507)	18 to 39	13	2.6
	40 to 49	25	4.9
	50 to 59	61	12.0
	60 to 69	155	30.6
	70 or older	253	49.9
Gross annual Income (n=377)	Less than £9,999	26	6.9
	£10,000 to 19,999	91	24.1
	£20,000 to 29,999	83	22.0
	£30,000 to 39,999	51	13.5
	£40,000 to 49,999	43	11.4
	More than £50,000	83	22.0
Rurality (n=507)	Urban	300	59.2
	Rural	207	40.8
Deprivation quintile (n=507)	1 (most deprived)	54	10.7
	2	85	16.8
	3	104	20.5
	4	132	26.0
	5 (least deprived)	132	26.0

Table A2 Survey questions used for outcomes of interest with qualifying responses

Item	Question asked (response options)	Qualifying response/ data coding
Room thermostat temperature settings	In winter, what temperature is your room thermostat or digital temperature controller typically set to heat your home to? (°C or °F; I don't know)	Temperatures in Fahrenheit converted to Celsius and rounded to two decimal places
Weekday heating hours	On a typical weekday (Monday to Friday) in winter, what times of day do you and your household have your heating on? (select all the times that apply: 12am to 11pm; Heating is on all the time; I don't know)	Total hours summed
Weekend heating hours	On a typical weekend (Saturday to Sunday) in winter what times of day do you and your household have your heating on (select all the times that apply: 12am to 11pm; Heating is on all the time; I don't know)	Total hours summed
Heating the whole home	Do you and your household heat your whole home in winter? (Yes; No)	Yes
Heating selected rooms (Participants who reported they did not heat the whole home)	Which rooms do you heat in winter? select all that apply (Living room; Kitchen; Dining room; All bedrooms; Selected bedrooms; Bathroom(s); Hallway/landing; Other)	
Behavioural responses to feeling cold at home	When you feel cold in your home, which of the following do you usually do first? (Turn on the heating; Turn the heating temperature up; Put on extra clothes e.g. extra jumper; Put on outdoor clothing e.g. coat, gloves, hat; Use a hot water bottle; Use a blanket; I rarely or never feel cold at home; Other {please specify}; I don't know)	
Thermal comfort at home	In winter, are you able to keep comfortably warm in your main living area (the room in which you spend the most time)? (Yes; No; I don't know)	Yes

Item	Question asked <i>(response options)</i>	Qualifying response/ data coding
Minimum temperatures for comfort and safety	<p>What minimum temperature do you think homes should be heated to in winter, to keep the following groups comfortable and safe?</p> <ul style="list-style-type: none"> • Generally healthy people • More vulnerable people, for example, some older people or people with long-term health conditions <p><i>(°C or °F; I don't know)</i></p>	<p>Temperatures in Fahrenheit converted to Celsius and rounded to two decimal places</p>
Stress or anxiety about the costs of heating the home	<p>In the last 3 months, how often have you felt stressed or anxious about the cost of heating your home?</p> <p><i>(Not at all; Not often; Quite often; Very often)</i></p>	<p>Not often, quite often, or very often</p>
Severity of stress or anxiety about the costs of heating the home	<p>Those reporting stress or anxiety (see above) were then asked:</p> <ul style="list-style-type: none"> • Thinking about the most recent time you felt stressed or anxious about the cost of heating your home, how would you describe the level of these feelings? <p><i>(A little stressed or anxious; Very stressed or anxious; Somewhere in between)</i></p>	
Mental well-being (SWEMWBS)	<p>The following are statements about feelings and thoughts. Please tell me which best describes your experience of each over the last 2 weeks.</p> <ul style="list-style-type: none"> • I've been feeling optimistic about the future. • I've been feeling useful. • I've been feeling relaxed. • I've been dealing with problems well. • I've been thinking clearly. • I've been feeling close to other people. • I've been able to make up my own mind about things. <p><i>(None of the time; Rarely; Some of the time; Often; All of the time)</i></p>	<p>Items scored and scores converted from raw to metric in line with guidance [24]</p>
Cutting or reducing meals due to the cost of heating the home	<p>In the last 3 months, have you ever cut the size of your meals or skipped meals because of the cost of heating your home?</p> <p><i>(Never; Only occasionally; Quite often; Very often)</i></p>	<p>Only occasionally, quite often, or very often</p>

Appendix 2: Results tables

Table A3 Changes in mean self-reported room thermostat temperatures and heating hours across waves, analysed using paired sample t-test

	N	2022 Mean (\pm SD)	2023 Mean (\pm SD)	P
Mean room thermostat temperature ($^{\circ}$ C)	357	19.9 (\pm 2.17)	19.3 (\pm 2.03)	<0.001
Mean weekday heating hours (Monday to Friday)	461	10.2 \pm 6.77	9.8 \pm 7.00	0.196
Mean weekend heating hours (Saturday to Sunday)	456	10.6 \pm 6.82	10.2 \pm 7.01	0.217

Note: SD = Standard deviation.

Table A4 Changes in the proportion reporting heating the whole home or selected rooms across waves, analysed using McNemar's test

	2022			2023		χ^2	P
	N	n	%	n	%		
Heat whole home	504	359	71.2	347	68.8	1.01	0.315
Living room	90	86	95.6	85	94.4	0.00	1.000
Kitchen	90	64	71.1	64	71.1	0.00	1.000
Bathroom(s)	90	59	65.6	62	68.9	0.00	0.648
Some bedrooms	90	54	60.0	59	65.6	0.59	0.441
Hallway/Landing	90	46	51.1	44	48.9	0.00	0.832
Dining	90	40	44.4	40	44.4	0.00	1.000

Note: Responses to options 'all bedrooms' and 'other' are not presented here due to small numbers.

Table A5 Changes in the proportion reporting thermal comfort and the initial behavioural response when cold across waves, analysed using McNemar's test

	2022			2023		X ²	P
	N	n	%	n	%		
Thermal comfort	504	474	94.0	451	89.5	8.49	0.004
Put on extra clothes e.g. extra jumper	499	218	43.7	241	48.3	2.70	0.100
Use a blanket	499	84	16.8	89	17.8	0.18	0.675
Turn on the heating	499	53	10.6	63	12.6	0.96	0.326
Turn the heating temperature up	499	86	17.2	51	10.2	12.99	<0.001
I rarely or never feel cold at home	499	23	4.6	11	2.2	3.56	0.059
Use a hot water bottle	499	12	2.4	14	2.8	0.00	0.791
Other	499	19	3.8	22	4.4	0.13	0.719

Note: Responses to the option 'put on outdoor clothing e.g. coat, gloves, hat' are not presented here due to small numbers.

Table A6 Changes in the perceived mean minimum indoor temperature (°C) for health and comfort in general and vulnerable populations across waves, analysed using paired sample t-test

	N	2022 Mean (± SD)	2023 Mean (± SD)	P
Generally healthy people	382	19.2 (±2.18)	18.9 (±2.02)	0.006
Vulnerable people	378	21.4 (± 2.54)	21.1 (± 2.46)	0.009

Note: SD = Standard deviation.

Table A7 Changes in the proportion reporting any stress or anxiety about home heating costs in the last three months and cutting or skipping meals across waves, analysed using McNemar’s test

	N	2022		2023		X ²	P
		n	%	n	%		
Any stress or anxiety regarding home heating costs	502	287	57.2	334	66.5	18.08	<0.001
Cutting or skipping meals due to the cost of heating	504	46	9.1	57	11.3	1.96	0.161

Table A8 The severity of stress or anxiety about heating costs across waves

	2022						2023							
	A little		Somewhere in between		Very		A little		Somewhere in between		Very			
	N	n	%	n	%	n	%	N	n	%	n	%		
	284	121	42.9	102	35.9	61	21.5	332	173	52.1	104	31.3	55	16.6

Table A9 Changes in mean mental well-being (SWEMWBS) score across waves, analysed using paired sample t-test

	N	2022 Mean (± SD)	2023 Mean (± SD)	P
Mental well-being score	457	24.7 (±4.38)	24.4 (±4.62)	0.189

Note: SD = Standard deviation.



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