The Scottish Executive
Central Heating Programme:
Assessing Impacts on Health
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Several Local Authorities and Housing Associations assisted in the identification of tenants included in the Central Heating Programme, who were potential candidates for the recruitment into the evaluation. The corresponding function was provided for private sector households by Eaga Group. We express our thanks to staff in all these organisations.
EXECUTIVE SUMMARY

This Report presents the findings from an evaluation of the health impacts of the Scottish Executive Central Heating Programme (CHP). The evaluation was based on data collected between November 2002 and March 2006, and contrasted the experiences of a group of 1,281 households which received central heating under the CHP (‘recipients’) with those of a comparison group of 1,084 households not enrolled in the CHP.

The key message from the evaluation is that the CHP significantly reduced condensation, dampness and cold in recipients’ homes, long-term exposure to which is associated with poor health. However, there was little evidence of a clear and systematic direct impact of the Programme on health outcomes and use of health services. While receipt of heating under the programme was associated with a reduced probability of receiving a first diagnosis of heart disease and of high blood pressure, this finding must be treated with caution: it was based on self-reported data, rather than clinical records, and was not accompanied by any reduction in the use of medical services or medication which might be expected as a consequence.

The main findings of the evaluation are as set out below.

- Two years after installation, the Programme had no clear impact on respondents’ current health or their use of health services or medication.

- The prevalence of poor environmental conditions – specifically, the presence of condensation, dampness and / or mould (long term exposure to which is associated with poor health) – in individual rooms within the home was significantly lower for those who received heating under the CHP than for the comparison group. Recipients were also less likely than comparison respondents to avoid the use of rooms due to difficulty in heating them, or to problems of damp or condensation.

- Receipt of central heating under the CHP was associated with a reduced probability of receiving a first diagnosis of heart disease, or of high blood pressure, during the period examined by the evaluation. (However for reasons discussed below this finding must be treated with caution.)

  - The CHP did not show any significant relationship with respondents’ usage of primary or secondary health services.

  - Heating recipients were more likely than the comparison group to report receiving a first diagnosis of a nasal allergy (such as hayfever) during the evaluation period.

  - A further fourteen outcome measures representing specific symptoms and health conditions exhibited no significant associations with the receipt of heating under the Programme.
Receipt of heating via the Programme was associated with better outcomes on two dimensions of the SF-36 Health Survey questionnaire\(^1\): physical functioning (i.e. fitness and mobility) and general health. However, the estimated size of the difference between recipients and non-recipients of heating was small in both cases.

The Programme was not associated with any significant effect on respondents’ experience of long-standing illness or disability.

Heating recipients were found not to be significantly different from the comparison group in their use of medications, either prescribed or ‘over the counter’.

No significant effect of the Programme was found on respondents’ behaviour in respect of cigarette smoking or alcohol consumption.

Those acquiring heating via the Programme were less likely to report any degree of inability to manage financially.

Receipt of heating under the CHP was associated with apparently contradictory effects on respondents’ overall satisfaction with their homes. Recipients were less likely to perceive home as a place ‘to get away from’ but were more likely to express a desire to move home if able to do so.

CHP recipients perceived their homes to be warmer in winter, indicated that their heating was less likely to be a serious problem and reported that they were more satisfied with their heating overall, relative to those who were not part of the CHP.

Those who received central heating under the CHP reported that in general a greater proportion of the home was heated, and for longer, than was the case for the comparison group. The only exception to this pattern was that recipients were found to heat the dwelling’s main living room in cold weather for a shorter time than comparison households.

Those receiving heating under the Programme were less likely than the comparison group to dissuade friends or relatives from staying overnight, or from visiting, due to poor housing conditions such as dampness or cold.

There is no evidence to suggest that the CHP had different effects on specific subgroups, e.g. owner occupiers versus tenants or different age groups, among those who received heating.

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\(^1\) The SF-36 is a 36 item self-administered questionnaire which measures health-related quality of life in the general population. Eight health profiles are derived from the summarised scores: physical functioning, social functioning, role limitations due to physical problems, role limitations due to emotional problems, mental health, energy/vitality, pain and general health perception. There is a separate measure of health change over the past year.
Overall, the results indicate that receipt of heating under the Central Heating
Programme had considerable impacts on the home environment, including on
conditions such as cold, dampness and mould. However, there was no evidence of a
clear and systematic direct effect on health. The findings indicating a reduced
likelihood of diagnosis with high blood pressure or heart disease, while noteworthy,
must be treated with caution. Although the recipient group were subsequently less
likely to be diagnosed with heart disease and high blood pressure than the comparison
group, this difference was not accompanied by a difference in the use of health
services. This suggests that the apparent difference in incidence of diagnosis may not
be reliable.
SECTION 1  SUMMARY OF FINDINGS

This report sets out the findings obtained from an evaluation of the health impacts of the Scottish Executive Central Heating Programme (CHP). The CHP is an initiative funded by the Scottish Executive which, during the period studied (November 2002 to March 2006), provided free central heating and associated thermal efficiency measures (such as loft insulation) to:

- homes in the public rented sector which lacked central heating; and
- homes in the private sector which lacked central heating (or had a central heating system which was broken beyond repair), and where the householder (or her / his partner) was aged 60 or over.

The evaluation compared the experiences of a group of 1,281 households which received heating under the Programme with those of a ‘comparison’ group of 1,084 households not included in the CHP. A total of 67 individual outcome measures, classified into 11 discrete conceptual areas, was considered. The conceptual areas are listed, and the outcomes within each area defined, in Sections B.2 to B.12 in Appendix B. The outcomes included both direct indicators of health (e.g. the experience of specific conditions such as high blood pressure) and a range of other indicators plausibly linked with human health (e.g. the presence of mould or dampness in the home).

The key message from the evaluation is that the CHP significantly reduced condensation, damp and cold in recipients’ homes. Recipients heated more rooms in their homes, and for longer. The Programme significantly reduced important risk factors for cardio-respiratory disease. However, there was little evidence of a clear and systematic direct impact of the Programme on health outcomes and use of health services.

The main findings of the study are summarised below.

Perceptions of warmth in the home: Three measures reflecting the ability of the dwelling’s heating to provide sufficient warmth were examined; all three showed a significant effect of the CHP. It was found that, relative to households not enrolled in the CHP (‘comparison’ households), recipients of heating under the Programme were (i) more likely to report always being kept adequately warm in cold weather (odds ratio: 3.50 [95% confidence interval: 2.85 to 4.29]); (ii) less likely to experience a serious problem relating to inadequate heating (odds ratio: 0.48 [95% confidence interval: 0.29 to 0.81]); and (iii) more likely to be ‘very satisfied’ or ‘fairly satisfied’ with their heating (odds ratio: 4.96 [95% confidence interval: 3.87 to 6.37]).

The odds ratio is a measure of the probability of an event being experienced in one group, relative to the corresponding probability in a second group. In the context of this Report, an odds ratio greater than 1 indicates that heating recipients are more likely to report the outcome condition (e.g. being kept adequately warm) than comparison group households. Conversely, an odds ratio less than 1 shows that recipients are less likely to report the condition. A fuller explanation is given in the Glossary of Statistical Terms.

A confidence interval defines the lower and upper limits within which the unknown ‘true’ value of an estimated quantity (here, an odds ratio) is expected to fall – see the Glossary of Statistical Terms.
Patterns of heating in the home: Ten measures relating to the extent and duration of heating use were assessed. All of these exhibited significant associations with the CHP. Recipients of heating under the Programme were found to be (i) less likely to keep more than half of the rooms in the home unheated during cold weather (odds ratio: 0.22 [95% confidence interval: 0.16 to 0.29]); (ii) less likely to heat more than half of the dwelling’s rooms for nine hours per day or less (odds ratio: 0.79 [95% confidence interval: 0.68 to 0.91]); and (iii) more likely to heat more than half of the home’s rooms continually i.e. 24 hours per day (odds ratio: 1.28 [95% confidence interval: 1.04 to 1.58]). It was also found that in recipient dwellings the kitchen, bathroom, hall, main bedroom and second bedroom were heated for longer in cold weather than in non-recipient homes (five individual outcomes). The estimated difference in heating duration for these five room types ranged from 1.11 hours per day (for the kitchen [95% confidence interval: 0.51 hours to 1.71 hours]) to 2.37 hours per day (for the bathroom [95% confidence interval: 1.74 hours to 3.00 hours]). The average duration of heating (across all rooms in the home) was also greater for CHP recipients, the estimated difference being 1.12 hours per day ([95% confidence interval: 0.60 hours to 1.64 hours]). While all of these findings indicate a greater extent or duration of heating use, it was also found that recipients heated the main living room for a shorter period of time (estimated at 1.15 hours per day ([95% confidence interval: 0.60 hours to 1.70 hours]) than households in the comparison group.

The home environment: Nine individual outcome measures were considered in this area, all of which were found to exhibit statistically significant effects associated with receiving heating under the Programme. Recipients were found to be less likely to report the presence of environmental problems (mould, condensation and / or dampness) in any of six general room types considered (kitchen, bathroom, main living room, hall, main bedroom, second bedroom – six individual outcomes). Odds ratios for the presence of problems in these six room types ranged from 0.44 (for the second bedroom [95% confidence interval: 0.34 to 0.57]) to 0.59 (for the main living room [95% confidence interval: 0.46 to 0.75]). Those receiving heating under the Programme also reported a reduced likelihood of (i) avoiding the use of any rooms in the home due to difficulty in heating them (odds ratio: 0.43 [95% confidence interval: 0.31 to 0.59]); (ii) experiencing serious difficulty in daily life related to environmental problems (odds ratio: 0.52 [95% confidence interval: 0.31 to 0.86]); and (iii) being unable to use one or more rooms due to problems of damp or condensation (odds ratio: 0.39 [95% confidence interval: 0.15 to 1.00]).

The evaluation found limited evidence of direct impacts on health in two areas:

Specific symptoms and health conditions, and use of primary and secondary health services: A total of 21 individual outcomes was investigated in this area. Of these, 17 related to the respondent’s experience of specific symptoms and health conditions. Analysis of these 17 outcomes indicated that heating recipients were less likely to report having received a first diagnosis of (i) heart disease (odds ratio: 0.69 [95% confidence interval: 0.52 to 0.91]), and (ii) high blood pressure (odds ratio: 0.77 [95% confidence interval: 0.61 to 0.97]) during the two-year period between the initial and
final interviews\textsuperscript{4}. However, those receiving heating also reported an increased likelihood of receiving a first diagnosis of nasal allergy during the same period (odds ratio: 1.52 [95% confidence interval: 1.05 to 2.20]). The remaining 14 symptom- and health-related measures (which in the main represented cardiovascular and respiratory conditions, including asthma) showed no significant effect associated with the CHP. A further four measures in this conceptual area related to respondents’ use of health services. None of these exhibited a significant association with the receipt of heating under the CHP.

Self-reported health-related quality of life: This area included nine outcomes (physical functioning, social functioning, role limitations due to physical problems, role limitations due to emotional problems, mental health, energy/vitality, pain, general health perception and health change over the past year) derived from the SF-36 Health Survey, a 36 item self-administered questionnaire which measures health-related quality of life in the general population. Those who received heating under the Programme reported higher (better) scores on two of the measures examined, namely the physical functioning scale (which assesses fitness and mobility), and the general health scale (which evaluates an individual’s general perception of her / his state of health). However, although values of these two measures indicated a positive effect of the CHP on health, the estimated size of the difference between recipients and non-recipients of heating was small in both cases (2.51 scale units for Physical Functioning [95% confidence interval: 0.62 units to 4.40 units], 2.57 units for General Health [95% confidence interval: 0.87 units to 4.27 units]; both scales range from zero [‘least good’] to 100 [‘best’]). No significant effect of the Programme was found for the remaining seven measures in this area.

The evaluation also considered two further areas directly related to health:

- Long-standing illness or disability (consisting of a single outcome measure)
- Use of medications (two outcome measures)

None of the measures in these areas was found to exhibit a significant association with receipt of heating under the CHP.

In addition to the areas reported above, the evaluation also considered the effect of the CHP on four other areas which might plausibly be expected either to reflect or to influence human health:

Overall satisfaction with the home: Heating recipients were found to be more likely to disagree with the perception of home as ‘A place I want to get away from’ (odds ratio: 1.19 [95% confidence interval: 1.03 to 1.37]). However, those receiving heating also indicated that they were less likely not to move home if they were able to do so (odds ratio: 0.83 [95% confidence interval: 0.69 to 0.99]). Three further outcomes in this area showed no significant associations with the Programme.

Social contacts: Recipients were less likely than comparison group respondents to report having dissuaded friends or relatives (i) from staying overnight (odds ratio:

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\textsuperscript{4} See Section 3.2 for a description of the interview scheme under which data were collected for the evaluation.
0.42 [95% confidence interval: 0.26 to 0.70]), and (ii) from visiting (odds ratio: 0.40 [95% confidence interval: 0.23 to 0.70]), due to poor housing conditions such as dampness or cold. Two further measures in this area were not significantly associated with the CHP.

**Financial strain:** Those acquiring heating via the Programme were less likely to report any degree of inability to ‘manage financially’ (odds ratio: 0.77 [95% confidence interval: 0.60 to 0.99]).

**Health behaviours:** Two measures were investigated, representing respondents’ use of alcohol and cigarettes. Neither was found to be significantly associated with the Programme.

**Subgroups:** A limited number of subgroup analyses was performed in order to assess whether the CHP operated differentially on specific subgroups of recipients. Differential effects were investigated for three key outcomes: respiratory health problem, general health and environmental problem in main rooms in the respondent’s dwelling. In investigating differential effects, attention focussed on the possible influence of housing tenure, physical house type (e.g. ‘semi-detached’), gender and age. None of the results obtained indicates that the effect of the Programme varied substantially across subgroups for the range of outcomes examined.

Overall, the results indicate that receipt of heating under the Central Heating Programme had considerable impacts on the home environment, including on conditions such as cold, damp and mould. Long-term exposure to these adverse conditions is associated with poor health and it is possible that their reduction will bring health benefits to recipients in the longer term. However, results also showed no evidence for a clear and systematic direct effect on health. The findings indicating a reduced likelihood of diagnosis with high blood pressure or heart disease, while noteworthy, must be treated with caution. Although recipients were subsequently less likely to be diagnosed with heart disease and high blood pressure than the comparison group, this difference was not accompanied by a difference in the use of health services. A diagnosis of heart disease would place an individual into a programme of monitoring and care. We would have therefore expected to see higher rates of service use in the comparison group – reflecting their greater incidence of diagnosis. The absence of differences in service use between the recipient and comparison groups suggests that the apparent difference in incidence of diagnosis may not be reliable.

The effects of environmental conditions such as damp and cold on cardio-respiratory health occur over a relatively long time period. While a respondent may feel warmer, and their walls may dry out relatively quickly following installation of heating, changes to their physiology which may delay or even prevent a diagnosis of heart disease or high blood pressure will take longer. The two year follow-up period is unlikely to have been long enough for any clear impact on cardio-respiratory health to be seen. Furthermore, housing conditions are not the only influences on health: wider economic circumstances and behaviours (e.g. diet and exercise) can also exert considerable impact. Health benefits of the Programme may be insignificant if the rest of the individual’s life and behavioural circumstances become or remain unhealthy.
We conclude that receipt of heating under the Scottish Executive’s Central Heating Programme was associated with reduction of problems with cold, damp and mould, with higher levels of heating in the home, with feeling warmer in winter, and with greater level of satisfaction with heating. It was not clearly or consistently associated with direct impacts on the cardio-respiratory health of recipients, nor with reductions in NHS service use. It is possible that these direct health impacts will become visible over a longer period of time.
SECTION 2  OUTLINE OF THE SCOTTISH EXECUTIVE CENTRAL HEATING PROGRAMME (CHP)

The Scottish Executive Central Heating Programme (CHP), which was introduced in 2001, is a scheme to provide central heating systems and a package of related measures to households in Scotland which meet certain qualifying criteria. During the period covered by the evaluation (November 2002 to March 2006), those eligible to receive heating under the CHP were:

a) tenants in the social sector (local authority or housing association) whose home lacked any form of central heating system; and

b) households in the private sector in which the head of household (or her / his partner or spouse) was aged 60 or over, and whose home either lacked any form of central heating or contained a central heating system which was broken beyond repair\(^5\).

Under the Programme, qualifying households were eligible to receive:

a) an efficient and modern central heating system (from a choice of gas, electric, oil or solid fuel)

b) insulation (where possible - cavity wall fill, lagging of boiler and pipes, loft insulation, draft exclusion measures)

c) if appropriate - safety alarms (carbon monoxide detector, a smoke alarm and a cold alarm)

d) advice on energy use and the option of receiving a benefit entitlement check.

Fuller details of the Programme are given in the *Annual Reports* published by the Scottish Executive. Two such reports are currently available, covering respectively the periods 2001-2 [1] and 2003-4 [2]

\(^5\) These were the criteria specified for private sector eligibility at the start of the evaluation period. The requirements for private sector households were relaxed in May 2004 to include households in which the householder (or partner) was aged 80 or over, and the dwelling had a partial or inefficient central heating system.
SECTION 3: OUTLINE OF THE EVALUATION

3.1 Objectives of the evaluation

In order to assess the effect of the CHP on the health of households which received heating, the Scottish Executive commissioned an evaluation focused explicitly on the health impacts of the Programme. This was carried out by a team from the Research Unit in Health, Behaviour and Change and the General Practice Section (School of Clinical Sciences and Community Health, University of Edinburgh) and The Medical Research Council Social and Public Health Sciences Unit (University of Glasgow). The evaluation had the following specific objectives:

a) To measure change in health status among Programme recipients up to two years after installation

b) To establish the reasons for these changes, clearly separating out any effects directly or indirectly attributable to the Central Heating Programme, including changes in temperature and humidity, living conditions and use of the house, and reduced fuel poverty

c) To identify the particular aspects of health (physical, mental, well-being) and the types of household and occupant (children, adults, elderly, very elderly) that are affected by the Programme

3.2 Design of the evaluation

The design of the evaluation was shaped by two main principles. Firstly, it was required to be longitudinal – that is, to collect data on respondents’ experiences at multiple points in time. Secondly, it was specified that the evaluation should be controlled: the experiences of respondents who received heating under the Programme were to be contrasted with those of a comparison group who did not receive facilities under the CHP. The longitudinal element (specifically, the collection of data both before and after the installation of heating in recipient homes) permitted the identification of changes (for example, in respondents’ health status) which took place over the period when heating was provided. The inclusion of a comparison group assisted in isolating changes which might reasonably be attributed to the CHP from those which might have occurred for other reasons.

While, as stated, the evaluation featured a comparison group, it was not a true experiment, as the allocation of individuals to the recipient and comparison groups was not carried out by the research team. The recipients in the study were an ‘opportunistic’ sample, reflecting varying degrees of willingness among public-sector landlords and tenants / householders to participate. Moreover, the comparison group (which would ideally have consisted of households which lacked central heating throughout the period of the evaluation) necessarily included a proportion of homes which possessed central heating systems, for the simple reason that it would have been impossible to find a sufficiently large body of ‘heating-less’ households which were not enrolled in the CHP. In the event, the comparison group included dwellings both with and without central heating. This being so, the comparison group was
viewed as a body of households whose status in respect of their domestic heating arrangements was expected to remain broadly static across the period of the evaluation, thus providing a fairly constant base against which any changes experienced by the recipient group could be contrasted. This expectation was not, in the event, wholly met (see Section 3.4).

To provide data for the evaluation, a sample of households eligible to receive central heating under the Programme was contacted at three different time points. First, an initial interview with the head of household (or her / his partner or spouse) was conducted in the respondent’s home shortly before heating was scheduled to be installed. This initial data collection phase gathered information on a range of topics, including (but not limited to) household heating arrangements and the health of the respondent\(^6\). One year after the initial interview, a short postal questionnaire was sent to participating households. This included a subset of the questions presented at the initial interview stage (some of them modified), together with a number of new items. Finally, one year after provision of the postal questionnaire (and thus two years after the initial interview), a final interview was conducted, again in the respondent’s home.

The interview schedule for this final data collection phase was almost identical to that used in the initial contact. The final questionnaire differed from that used at the baseline point in two respects. First, the final questionnaire included some additional items – presented to all respondents – about the receipt of central heating and related thermal efficiency measures. These additional items sought to establish whether heating had been installed since the initial interview, how long it had been in the property, and whether additional measures such as loft insulation or cavity wall fill had been fitted since the first interview. Respondents in the CHP recipient group who had not actually received heating were also asked to provide the reason(s) for non-installation. Second, a series of questions on key life events (such as bereavement, or the experience of serious illness) within the past year was included. These questions were not included in the initial questionnaire (though they were included in the interim postal questionnaire).

In parallel with the process described above, a sample of comparison households was subjected to an identical data collection regime (i.e. initial interview, interim postal questionnaire and final interview). Comparison households were, as far as possible, individually matched to recipients in terms of certain key characteristics, the matching criteria being described in the Fieldwork Report (Appendix A).

\(^6\) For reasons of space, the questionnaires used in the evaluation are not reproduced in this Report. However, definitions of all outcome measures examined – including the precise text of the questionnaire item from which each outcome was derived – are given in Appendix B, Sections B.2 to B.12.
3.3 Data collection timetable and achieved sample numbers

3.3.1 Initial interviews

The initial data collection took place between November 2002 and February 2004. A total of 3,849 households provided data. Of these, 1,977 (51.4%) were central heating recipients, the remaining 1,872 (48.6%) being comparison households.

3.3.2 Interim postal questionnaire

Postal questionnaires were sent out over the period November 2003 to March 2005, i.e. approximately one year after the initial interviews. Responses were received from 2,131 participants, representing 55.4% of the sample interviewed at the start of the evaluation.

3.3.3 Final interviews

Final interviews were conducted between December 2004 and March 2006. Successful interviews were achieved with 2,365 households, representing 61.4% of the original sample. The results presented in this Report are based on data from these households. Of the 2,365 respondents who contributed to both the initial and final interviews, 1,281 (54.2%) were heating recipients, the remaining 1,084 (45.8%) being from comparison households. The 1,281 recipients represented 64.8% of the total number of recipients interviewed at the initial point, while the 1,084 comparison respondents made up 57.9% of the comparison households which provided initial interviews.

3.4 Stability of the respondent groups

As explained earlier, the comparison group was not a ‘control’ element in the accepted sense, but rather a set of respondent households – some with central heating at the start of the evaluation, some without – whose domestic heating arrangements were expected to remain broadly unchanged across the two-year period covered by the evaluation. In the event, it was found that a substantial proportion of comparison households did experience a change in their heating status (specifically, the acquisition of central heating) in the course of the evaluation. Of the 1,084 comparison respondents who provided data both at Wave 1 and Wave 3, 279 (25.7%) appear to have acquired central heating at some point during the period examined by the evaluation. Conversely, of the 1,281 recipient households who yielded successful interviews at Waves 1 and 3, evidence from the interviews suggests that 92 (7.2%) did not actually receive heating or had a central heating installation which predated the start of the evaluation.

Despite this ‘contamination’ of the two groups, the original classification of respondents as either recipients or comparison group members was retained for the analyses reported here. This approach corresponds to the ‘intention to treat’ approach applied in clinical trials, under which subjects are retained for analysis purposes in the treatment group to which they were originally allocated, even if for some reason they
did not in the event receive the intended treatment option. In the present case, the
decision to adopt the ‘intention to treat’ approach was motivated by the following
considerations. The remit of the evaluation was not to assess the health impact of
receiving central heating in general, but rather to determine the health-related effects
of a specific initiative – the Central Heating Programme – with its own unique client
base, and financial and administrative characteristics. One feature of such a real-
world initiative is that, for a variety of reasons, some intended clients of the
Programme will not in the event actually receive heating systems. A second feature is
that households outside the Programme will, via a variety of routes, acquire central
heating independently of the initiative. Thus, to assess the specific health impacts of
the CHP – as distinct from the more general effects of ‘receiving central heating’ – in
the actual context within which it operates, it was considered appropriate to retain the
original respondent groupings (even if subject to ‘contamination’) on the grounds that
this approach faithfully reflects the experience of the CHP as actually implemented.

3.5 Comparability of recipient and comparison groups in final achieved sample

Table 3.5.1 compares the recipient and comparison groups in the final achieved
sample, in terms of a number of key characteristics: age; sex; socioeconomic group;
household composition; housing tenure (simplified representation); and physical
property type.
### Table 3.5.1 Characteristics of CHP recipients and comparison group

<table>
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<th>comparison group</th>
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<td><strong>n = 1,084</strong></td>
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<td>C2</td>
<td>18.1</td>
<td>22.0</td>
</tr>
<tr>
<td>DE</td>
<td>61.2</td>
<td>60.5</td>
</tr>
<tr>
<td>Household composition (%):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>single adult</td>
<td>8.7</td>
<td>9.5</td>
</tr>
<tr>
<td>single parent</td>
<td>8.5</td>
<td>6.7</td>
</tr>
<tr>
<td>single pensioner</td>
<td>37.3</td>
<td>35.8</td>
</tr>
<tr>
<td>couple with no children</td>
<td>11.1</td>
<td>11.1</td>
</tr>
<tr>
<td>couple with children</td>
<td>7.1</td>
<td>7.7</td>
</tr>
<tr>
<td>pensioner couple</td>
<td>22.7</td>
<td>22.4</td>
</tr>
<tr>
<td>multiple adults</td>
<td>4.6</td>
<td>6.9</td>
</tr>
<tr>
<td>Tenure (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>owner-occupier</td>
<td>42.5</td>
<td>40.7</td>
</tr>
<tr>
<td>Rented from local authority/housing association</td>
<td>51.4</td>
<td>56.4</td>
</tr>
<tr>
<td>Rented from private landlord</td>
<td>4.7</td>
<td>1.9</td>
</tr>
<tr>
<td>Other</td>
<td>1.4</td>
<td>1.0</td>
</tr>
<tr>
<td>Property type (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>detached house</td>
<td>13.7</td>
<td>14.9</td>
</tr>
<tr>
<td>semi-detached house</td>
<td>14.0</td>
<td>15.7</td>
</tr>
<tr>
<td>terraced house</td>
<td>27.7</td>
<td>23.4</td>
</tr>
<tr>
<td>tenement</td>
<td>22.5</td>
<td>19.2</td>
</tr>
<tr>
<td>four-in-a-block</td>
<td>12.3</td>
<td>15.6</td>
</tr>
<tr>
<td>flat in converted building</td>
<td>1.5</td>
<td>1.1</td>
</tr>
<tr>
<td>high-rise flat</td>
<td>2.6</td>
<td>7.6</td>
</tr>
<tr>
<td>other</td>
<td>5.7</td>
<td>2.6</td>
</tr>
</tbody>
</table>

**Notes**

(1) The characteristics shown are as measured at the initial interview point.

(2) The cell content represents the percentage of the group (column) total e.g. ‘AB’ respondents comprise 3.6% of all recipients. This form of representation is also used for the ‘household composition’ and ‘property type’ variables.
SECTION 4 THE CENTRAL HEATING PROGRAMME AND SPECIFIC OUTCOME AREAS

4.1 Introduction

This section provides results for the individual outcome measures examined by the evaluation. Measures are grouped by conceptual area (for example, Section 4.2 reports on outcomes relating to perceptions of warmth in the home). For each outcome area, the following information is provided:

1) A key message statement, providing a non-technical interpretation of the findings.

2) A summary, briefly defining the area and listing those outcome measures within it which were found to be significantly associated with the receipt of heating under the CHP.

3) For the measures listed in (2) – that is, those which exhibited a statistically significant relationship with the CHP – one or more illustrative charts demonstrating the size of the effect associated with the Programme.

4) One or more tables showing numerical results for the significant outcome measures.

5) Where appropriate, a list of the remaining outcome measures within the area reported on; that is, those measures found not to have a statistically significant association with the Programme.

The material in the following sections makes some use of a small number of technical statistical terms which may not be familiar to all readers. Two key terms (‘odds ratio’ and ‘confidence interval’) have previously been introduced in Section 1. One further statistical concept - that of the p value – is described in Section 4.2. Explanations of these, and of other statistical terms used in this Report, are featured in the Glossary of Statistical Terms.
4.2 Perceptions of warmth in the home

KEY MESSAGE: Central Heating Programme recipients perceived their homes to be warmer in winter, indicated that their heating was less likely to be a serious problem and reported that they were more satisfied with their heating overall, relative to those who were not part of the CHP.

SUMMARY: There were three measures included in this area, providing different perspectives on the adequacy of domestic heating. For all three, there was a clear impact of the CHP. The three measures were:

1) whether the respondent is kept sufficiently warm by her / his heating during the period October – March
2) whether inadequate heating in the respondent’s home presents a serious problem
3) whether the respondent is satisfied with her / his heating.

CHARTS: Chart 4.2.1 shows the differences between respondents who were part of the CHP and those who were not; results are presented in the form of odds ratios. In this chart, the black rectangles represent the estimated odds ratios for the effect of the CHP, the horizontal lines show the 95% confidence intervals for the odds ratios, and the dashed vertical line marks the odds ratio of one which indicates no difference between the groups. Although all three results are shown on a single chart, the individual estimates should not be directly compared with each other, because they represent responses to different questions. Chart 4.2.2 shows the proportions (percentages) of respondents who report the condition (e.g. being kept warm enough) at the end of the evaluation. It should be stressed that the differences between the two groups (i.e. heating recipients and the comparison group) do not necessarily match those indicated by the odds ratios shown in Chart 4.2.1 and in Table 4.2.1. This is because the absolute values shown in Chart 4.2.2 represent the 'raw' or unadjusted values of the measures for each group at the evaluation endpoint, while the odds ratio estimates are adjusted for the effect of other factors (see Appendix B; Section B.1). The estimated odds ratios, incorporating adjustment, provide a better approximation to the true effect of the CHP. This principle holds for all the results provided in this section of the Report.

---

7 Definitions for all measures are given in Appendix B (Sections B.2 to B.12).
Chart 4.2.1 Differences in perceptions of warmth in the home (odds ratios)

Chart 4.2.2 Perceptions of warmth in the home (comparison group versus recipients)
RESULTS: Table 4.2.1 gives the results numerically. The odds are for CHP recipients, relative to the comparison group. The column headed ‘95% CI’ shows the 95% confidence interval for the odds ratio estimate; that headed ‘p’ gives the associated p value; and the column headed ‘n’ shows the number of responses on which the result was based. (The p value returned by a statistical test is an indication of how likely the result is to have arisen by chance, as distinct from being due to some real effect. The smaller the p value, the greater the likelihood that a real effect has been observed – see the Glossary of Statistical Terms.) With regard to the latter, the n value for the middle row of the table is markedly lower than those for the other rows; this is because the question on which the ‘serious problem’ result is based was presented only to a small subset of respondents. This situation occurs elsewhere in these results.

<table>
<thead>
<tr>
<th>measure</th>
<th>odds ratio</th>
<th>95% CI</th>
<th>p</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whether kept warm enough during Oct.-Mar.</td>
<td>3.50</td>
<td>2.85 to 4.29</td>
<td>&lt; 0.01</td>
<td>2,289</td>
</tr>
<tr>
<td>Whether heating a serious problem</td>
<td>0.48</td>
<td>0.29 to 0.81</td>
<td>&lt; 0.01</td>
<td>228</td>
</tr>
<tr>
<td>Whether satisfied with heating</td>
<td>4.96</td>
<td>3.87 to 6.37</td>
<td>&lt; 0.01</td>
<td>2,323</td>
</tr>
</tbody>
</table>

MEASURES NOT SHOWING A SIGNIFICANT ASSOCIATION WITH THE CHP: None
4.3 Patterns of heating in the home

KEY MESSAGE: Those who received central heating under the CHP reported that in general more of the home was heated, and for longer, than was the case for the comparison group. The only exception to this pattern was that recipients reported heating the living room in cold weather for a shorter time than comparison households. This should not automatically be interpreted as a ‘negative’ or adverse finding, as it is possible to explain this result in a way which is consistent with a positive effect of the CHP. For example, it may be that recipients were more able to maintain uniformly comfortable levels of heating throughout the home, and therefore had less need to retain a concentration of heat in the dwelling’s living room.

SUMMARY: This area included 10 measures representing various aspects of the duration and extent of domestic heating use in cold weather. A clear impact of the CHP was identified for all ten measures, which were:

1) whether more than half of the rooms in the home are permanently unheated in cold weather
2) whether more than half of the rooms in the home are permanently heated (24 hours per day) in cold weather
3) whether more than half of the rooms in the home are heated for nine hours per day or less in cold weather
4) the duration (hours per day) for which the dwelling’s kitchen is heated in cold weather
5) the duration (hours per day) for which the dwelling’s bathroom is heated in cold weather
6) the duration (hours per day) for which the dwelling’s main living room is heated in cold weather
7) the duration (hours per day) for which the dwelling’s hall is heated in cold weather
8) the duration (hours per day) for which the dwelling’s main bedroom is heated in cold weather
9) the duration (hours per day) for which the dwelling’s second bedroom (where extant) is heated in cold weather
10) the average duration (hours per day) for which rooms in the dwelling are heated in cold weather

CHARTS: Chart 4.3.1 illustrates, for measures (1) to (3) above, the differences between CHP recipients and comparison group respondents. Results are presented as odds ratios, and the format of the chart is identical to that of Chart 4.2.1. Chart 4.3.2 shows the results for the remaining measures listed above. In this chart, the small black rectangles represent the estimated differences in heating duration (hours per day) between recipients and comparison households, the horizontal lines show the 95% confidence intervals for the differences, and the dashed vertical line marks the value of zero which indicates no difference between the groups.8

8 Because the results shown in Chart 4.3.2 are multiple regression parameter estimates (rather than odds ratio estimates, as in Chart 4.3.1), the line of ‘no effect’ in Chart 4.3.2 is positioned at zero.
Chart 4.3.1 Differences in patterns of heating in the home (odds ratios)

Chart 4.3.2 Differences in duration of heating in the home
Chart 4.3.3 shows, for measures (1) to (3) above, the proportions (percentages) of respondents who report each condition (e.g. maintaining more than half of the rooms in the home unheated) at the end of the evaluation. Finally, Chart 4.3.4 shows average values at the end of the evaluation for the remaining measures listed above.

**Chart 4.3.3 Patterns of heating in the home (comparison group versus recipients)**

![Chart 4.3.3 Patterns of heating in the home](chart.png)

**Chart 4.3.4 Duration of heating different rooms in the home (comparison group versus recipients)**

![Chart 4.3.4 Duration of heating different rooms in the home](chart.png)
RESULTS: Table 4.3.1 gives the results numerically. The first three rows show odds ratio estimates and associated values for measures (1) to (3) above. The format of these rows is identical to that used in Table 4.2.1. The remaining rows in Table 4.3.1 provide results for the other measures listed in the Summary above. These rows show, for each measure, the estimated average difference in heating duration (in hours per day). A value greater than zero indicates that central heating recipients maintain heating for longer than do comparison group respondents. Each estimate is followed by its 95% confidence interval, the $p$ value associated with the estimate, and the number of responses on which the result is based.

<table>
<thead>
<tr>
<th>measure</th>
<th>odds ratio</th>
<th>95% CI</th>
<th>$p$</th>
<th>$n$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whether more than half of rooms are permanently unheated in cold weather</td>
<td>0.22</td>
<td>0.16 to 0.29</td>
<td>&lt; 0.01</td>
<td>2,149</td>
</tr>
<tr>
<td>Whether more than half of rooms are permanently heated in cold weather</td>
<td>1.28</td>
<td>1.04 to 1.58</td>
<td>&lt;0.05</td>
<td>2,149</td>
</tr>
<tr>
<td>Whether more than half of rooms are heated for 9 hours per day or less in cold weather</td>
<td>0.79</td>
<td>0.68 to 0.91</td>
<td>&lt; 0.01</td>
<td>2,149</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>measure</th>
<th>estimate (hours / day)</th>
<th>95% CI</th>
<th>$p$</th>
<th>$n$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration (hours / day) of heating KITCHEN</td>
<td>1.11</td>
<td>0.51 to 1.71</td>
<td>&lt; 0.01</td>
<td>2,213</td>
</tr>
<tr>
<td>Duration (hours / day) of heating BATHROOM</td>
<td>2.37</td>
<td>1.74 to 3.00</td>
<td>&lt; 0.01</td>
<td>2,270</td>
</tr>
<tr>
<td>Duration (hours / day) of heating LIVING ROOM</td>
<td>-1.15</td>
<td>-1.70 to -0.60</td>
<td>&lt; 0.01</td>
<td>2,249</td>
</tr>
<tr>
<td>Duration (hours / day) of heating HALL</td>
<td>1.38</td>
<td>0.75 to 2.02</td>
<td>&lt; 0.01</td>
<td>2,203</td>
</tr>
<tr>
<td>Duration (hours / day) of heating MAIN BEDROOM</td>
<td>1.58</td>
<td>0.95 to 2.21</td>
<td>&lt; 0.01</td>
<td>2,249</td>
</tr>
<tr>
<td>Duration (hours / day) of heating 2nd BEDROOM</td>
<td>1.72</td>
<td>1.01 to 2.42</td>
<td>&lt; 0.01</td>
<td>1,874</td>
</tr>
<tr>
<td>Average duration (hours / day) of heating ALL</td>
<td>1.12</td>
<td>0.60 to 1.64</td>
<td>&lt; 0.01</td>
<td>2,149</td>
</tr>
</tbody>
</table>

MEASURES NOT SHOWING A SIGNIFICANT ASSOCIATION WITH THE CHP:
None
4.4 Condensation, dampness and mould

KEY MESSAGE: The prevalence of poor environmental conditions – specifically, the presence of condensation, dampness and / or mould – in individual rooms within the home was significantly lower for those who received heating under the CHP than for the comparison group. Recipients were also less likely than comparison respondents to avoid the use of rooms due to difficulty in heating them, or to problems of damp or condensation.

SUMMARY: A total of nine measures was included in this area, each representing some aspect of the extent to which the respondent’s home was affected by adverse environmental conditions (specifically, problems such as dampness, mould and condensation). Definitions of the measures are given in Appendix B (Section B.4). A statistically significant impact of the CHP was observed for all nine measures, which were as follows:

1) whether any environmental problem (condensation / damp /mould) is present in the dwelling’s kitchen
2) as above, for the bathroom
3) as above, for the main living room
4) as above, for the hall
5) as above, for the main bedroom
6) as above, for the second bedroom
7) whether use of any room(s) in the home is avoided due to difficulty in heating
8) whether environmental problems (condensation / damp / mould) cause serious difficulty
9) whether any room(s) in the home cannot be used due to problems of damp or condensation

CHARTS: Chart 4.4.1 shows the observed differences between CHP recipients and comparison households for measures (1) to (6) above. The results are presented as odds ratios with 95% confidence intervals, and the format of the chart is identical to that of Chart 4.2.1. Chart 4.4.2 shows the results for the remaining measures (7) to (9), again in the form of odds ratios. Chart 4.4.3 shows, for measures (1) to (6) above, the proportions (percentages) of respondents who report the condition (e.g. experiencing environmental problems in the kitchen) at the end of the evaluation. Finally, Chart 4.4.4 shows the same information for the remaining measures listed above.
Chart 4.4.1 Differences in poor environmental conditions (odds ratios)

- environmental problem(s) in KITCHEN
- environmental problem(s) in BATHROOM
- environmental problem(s) in MAIN LIVING ROOM
- environmental problem(s) in HALL
- environmental problems in MAIN BEDROOM
- environmental problem(s) in SECOND BEDROOM

ODDS RATIO

Chart 4.4.2 Differences in impact of poor environmental conditions (odds ratios)

- whether room(s) avoided due to difficulty heating
- whether environmental problems cause serious difficulty
- whether room(s) cannot be used due to problems of damp / condensation

ODDS RATIO
Chart 4.4.3  Poor environmental conditions (comparison group versus recipients)

Chart 4.4.4  Impacts of poor environmental conditions (comparison group versus recipients)
RESULTS: Table 4.4.1 presents the results numerically, in the form of odds ratios.

Table 4.4.1  Differences in poor environmental conditions and impact of poor environmental conditions (odds ratios)

<table>
<thead>
<tr>
<th>measure</th>
<th>odds ratio</th>
<th>95% CI</th>
<th>p</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whether any environmental problem(s) present in KITCHEN</td>
<td>0.49</td>
<td>0.39 to 0.61</td>
<td>&lt; 0.01</td>
<td>2,291</td>
</tr>
<tr>
<td>Whether any environmental problem(s) present in BATHROOM</td>
<td>0.46</td>
<td>0.37 to 0.59</td>
<td>&lt; 0.01</td>
<td>2,302</td>
</tr>
<tr>
<td>Whether any environmental problem(s) present in MAIN LIVING ROOM</td>
<td>0.59</td>
<td>0.46 to 0.75</td>
<td>&lt; 0.01</td>
<td>2,305</td>
</tr>
<tr>
<td>Whether any environmental problem(s) present in HALL</td>
<td>0.56</td>
<td>0.40 to 0.79</td>
<td>&lt; 0.01</td>
<td>2,271</td>
</tr>
<tr>
<td>Whether any environmental problem(s) present in MAIN BEDROOM</td>
<td>0.48</td>
<td>0.39 to 0.61</td>
<td>&lt; 0.01</td>
<td>2,297</td>
</tr>
<tr>
<td>Whether any environmental problem(s) present in SECOND BEDROOM</td>
<td>0.44</td>
<td>0.34 to 0.57</td>
<td>&lt; 0.01</td>
<td>1,939</td>
</tr>
<tr>
<td>Whether use of any room(s) in the home is avoided due to difficulty in heating</td>
<td>0.43</td>
<td>0.31 to 0.59</td>
<td>&lt; 0.01</td>
<td>2,330</td>
</tr>
<tr>
<td>Whether environmental problems cause serious difficulty</td>
<td>0.52</td>
<td>0.31 to 0.86</td>
<td>&lt; 0.01</td>
<td>297</td>
</tr>
<tr>
<td>Whether any rooms in the home cannot be used due to problems of damp or condensation</td>
<td>0.39</td>
<td>0.15 to 1.00</td>
<td>&lt; 0.05</td>
<td>300</td>
</tr>
</tbody>
</table>

MEASURES NOT SHOWING A SIGNIFICANT ASSOCIATION WITH THE CHP: None
4.5 Overall satisfaction with the home

KEY MESSAGE: Recipients of heating under the Programme expressed greater attachment to their homes (via strong disagreement with the concept of home as a place to “get away from”) than the comparison group. However, this result was apparently contradicted by a second finding to the effect that recipients were less likely than comparison respondents not to wish to move home. While this is clearly paradoxical, the general measures of attachment to the home which were investigated are open to influence by many factors beyond the adequacy of the dwelling’s heating (e.g. the quality of the physical environment, noisy / hostile neighbours etc). It is arguably unwise to interpret these findings purely as indications of the impact of the CHP.

SUMMARY: Five measures were included in this area, providing different perspectives on respondents’ overall levels of satisfaction and contentment with their homes. For one of these five measures – the perception of home as “a place I want to get away from” – recipients of heating reported a greater degree of attachment to the home than did those in the comparison group. For one further item, which asked whether respondents would move home if they were able to do so, recipients were significantly less likely than comparison respondents to provide a NO response. The remaining three measures did not show significant associations with the Programme.

CHARTS: Chart 4.5.1 shows results for the two measures which were significantly associated with the CHP. Results are expressed as odds ratios. The first item (“a place I want to get away from”) is represented in analysis such that an odds ratio of greater than one indicates that recipients are more likely to express strong disagreement with the statement (that is, to display greater attachment to their homes) than comparison respondents. The definition of this measure is explained in Appendix B (Section B.5.2).

Chart 4.5.1 Differences in overall satisfaction with the home (odds ratios)
Chart 4.5.2 shows, for the two measures featured in Chart 4.5.1, the respective proportions of respondents who report each condition at the end of the evaluation.

Chart 4.5.2  Overall satisfaction with the home (comparison group versus recipients)

RESULTS: Table 4.5.1 shows numeric results (odds ratios).

Table 4.5.1  Differences in overall satisfaction with the home (odds ratios)

<table>
<thead>
<tr>
<th>measure</th>
<th>odds ratio</th>
<th>95% CI</th>
<th>p</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whether respondent indicates strong disagreement with the perception of home as “A place I want to get away from”</td>
<td>1.19</td>
<td>1.03 to 1.37</td>
<td>0.02</td>
<td>2,322</td>
</tr>
<tr>
<td>Whether respondent would not move home if able to do so.</td>
<td>0.83</td>
<td>0.69 to 0.99</td>
<td>0.04</td>
<td>2,207</td>
</tr>
</tbody>
</table>

MEASURES NOT SHOWING A SIGNIFICANT ASSOCIATION WITH THE CHP:
Three measures within the area did not exhibit significant associations with the receipt of central heating under the CHP. These measures were (see Appendix B, Section B.5 for full definitions):

1) the respondent’s overall level of satisfaction with her/his home
2) the respondent’s perception of home as “A place where I feel safe”
3) the respondent’s perception of home as “A place where I feel at home”

Thus, there were no statistically significant differences between recipients and comparison group with respect to level of satisfaction with their home, or the perception of the home as place of safety and ease.
4.6 Drinking and smoking

KEY MESSAGE: Receipt of central heating under the Programme exerted no significant influence on respondents’ drinking or smoking behaviour.

SUMMARY: This area consisted of two measures, representing respondents’ recent consumption of alcohol and their current smoking status. Neither measure exhibited a significant association with the receipt of central heating under the CHP.

CHARTS: None shown, as no statistically significant results were found.

RESULTS: None shown.

MEASURES NOT SHOWING A SIGNIFICANT ASSOCIATION WITH THE CHP:

1) whether the respondent has consumed an alcoholic drink within the last seven days
2) whether the respondent currently smokes cigarettes
4.7 Nature and extent of social contacts

KEY MESSAGE: Those receiving heating under the Programme were less likely than the comparison group to dissuade friends or relatives from staying overnight, or from visiting, due to poor housing conditions such as dampness or cold.

SUMMARY: There were four measures included in this area, representing aspects of respondents’ recent contacts with friends and/or relatives. Of these measures, two were found to be associated with a significant impact of the CHP. These two measures were:

1) whether friends and/or relatives have been dissuaded from staying overnight within the past four weeks, due to poor housing conditions such as dampness or cold
2) whether friends and/or relatives have been dissuaded from visiting within the past four weeks, due to poor housing conditions such as dampness or cold.

CHARTS: Chart 4.7.1 shows results for measures (1) and (2) above, in the form of odds ratios. Chart 4.7.2 shows the respective proportions (percentages) of respondents who report each condition (e.g. dissuading friends/relatives from staying overnight) at the end of the evaluation.
RESULTS: Table 4.7.1 shows numerical results, in the form of odds ratios.

Table 4.7.1 Differences in nature and extent of social contacts (odds ratios)

<table>
<thead>
<tr>
<th>measure</th>
<th>odds ratio</th>
<th>95% CI</th>
<th>p</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whether friends / relatives dissuaded from staying overnight due to poor housing conditions</td>
<td>0.42</td>
<td>0.26 to 0.70</td>
<td>&lt; 0.01</td>
<td>2,292</td>
</tr>
<tr>
<td>Whether friends / relatives dissuaded from visiting due to poor housing conditions</td>
<td>0.40</td>
<td>0.23 to 0.70</td>
<td>&lt; 0.01</td>
<td>2,322</td>
</tr>
</tbody>
</table>

Despite the small numbers reporting these negative impacts of housing conditions, the differences between recipients and comparison group were statistically significant (see table 4.7.1).

MEASURES NOT SHOWING A SIGNIFICANT ASSOCIATION WITH THE CHP:

1) number of times the respondent has gone out to visit family or friends in the past two weeks
2) number of times the respondent has been visited at home by family or friends in the past two weeks.
4.8 Perceived financial strain

KEY MESSAGE: Those who received heating under the CHP were less likely than the comparison group to report experiencing any degree of financial difficulty.

SUMMARY: This area consisted of a single measure, representing whether the respondent reported any degree of financial difficulty. A significant effect of the CHP was observed, recipients of heating under the Programme being less likely than the comparison group to indicate that they were experiencing financial difficulty.

CHARTS: Chart 4.8.1 shows the result (odds ratio) for the measure.

Chart 4.8.1 Difference in perceived financial strain (odds ratio)

Chart 4.8.2 shows the respective proportions (percentages) of respondents who report the condition (i.e. experiencing any degree of financial difficulty) at the end of the evaluation.

Chart 4.8.2 Perceived financial strain (comparison group versus recipients)
RESULTS: Table 4.8.1 provides numerical results for the single measure featured in the area.

Table 4.8.1  Difference in perceived financial strain (odds ratio)

<table>
<thead>
<tr>
<th>measure</th>
<th>odds ratio</th>
<th>95% CI</th>
<th>p</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whether respondent reported any degree of financial difficulty</td>
<td>0.77</td>
<td>0.60 to 0.99</td>
<td>0.04</td>
<td>2,318</td>
</tr>
</tbody>
</table>
4.9 Specific symptoms and health conditions, and use of primary and secondary health services

KEY MESSAGE: Those who received heating under the CHP were less likely than the comparison group to report having received a first diagnosis of heart disease or of high blood pressure during the evaluation period, but were more likely to report a first diagnosis of nasal allergy. The finding that receipt of central heating was associated with a positive effect on two potentially serious classes of condition (i.e. heart disease and high blood pressure) is potentially of considerable interest. However, fourteen further outcome measures related to specific symptoms and health conditions showed no significant association with the CHP. This indicates that the provision of central heating appeared to exert no discernible effect on respiratory conditions such as asthma and bronchitis.

Of a second subgroup of four outcome measures representing respondents’ use of health services, none exhibited a significant association with the CHP. This is a potentially anomalous finding, in that significant between-group differences in the respective experience of heart disease and high blood pressure would be expected to co-occur with differences in the use of health services. This issue is not considered further here, but is discussed in the Summary of Findings (Section 1) and in the Conclusions to this Report (Section 5).

SUMMARY: This area consisted of 21 measures, covering two closely-related conceptual sub-areas. First, a group of 17 measures representing various aspects of the respondent’s state of health (focussing especially on respiratory and cardiovascular health) was considered. Second, four further measures relating to different aspects of the respondent’s use of health services were examined. These two sets of outcomes were treated as a single conceptual area for reporting purposes on the grounds that any significant observed effects of the CHP on specific symptoms and health conditions might reasonably be expected to generate consequent effects on the respondent’s use of health services.

Of the 17 outcomes which related to specific symptoms and health conditions, three exhibited a significant effect of the CHP, namely:

1) whether the respondent reported having received a first diagnosis of heart disease during the evaluation period
2) whether the respondent reported having received a first diagnosis of high blood pressure during the evaluation period
3) whether the respondent reported having received a first diagnosis of a nasal allergy such as hayfever during the evaluation period.

Of the four measures which represented respondents’ use of health services, none was found to be significantly associated with the receipt of central heating under the CHP.

CHARTS: Chart 4.9.1 shows results for the three measures which exhibited a significant effect of the CHP. Results are shown as odds ratios.
Chart 4.9.1 Differences in health conditions (odds ratios)

Chart 4.9.2 shows the proportions (percentages) of respondents who reported each condition (e.g. having received a first diagnosis of heart disease) at the endpoint of the evaluation.

Chart 4.9.2 Health conditions (comparison group versus recipients)

RESULTS: Table 4.9.1 provides numerical results for the three measures which showed significant associations with the receipt of heating under the CHP.
### Table 4.9.1 Differences in health conditions (odds ratios)

<table>
<thead>
<tr>
<th>Measure</th>
<th>Odds Ratio</th>
<th>95% CI</th>
<th>p</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whether respondent reported a first diagnosis of heart disease during</td>
<td>0.69</td>
<td>0.52 to 0.91</td>
<td>0.01</td>
<td>1,928</td>
</tr>
<tr>
<td>the evaluation period</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whether respondent reported a first diagnosis of high blood pressure</td>
<td>0.77</td>
<td>0.61 to 0.97</td>
<td>0.02</td>
<td>1,340</td>
</tr>
<tr>
<td>during the evaluation period</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whether respondent reported a first diagnosis of nasal allergy during</td>
<td>1.52</td>
<td>1.05 to 2.20</td>
<td>0.03</td>
<td>2,136</td>
</tr>
<tr>
<td>the evaluation period</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**MEASURES NOT SHOWING A SIGNIFICANT ASSOCIATION WITH THE CHP:**

*(first sub-area: specific symptoms and health conditions)*

1) number of reported episodes of cold / flu symptoms in the past six months  
2) whether the respondent reported a first diagnosis of asthma during the evaluation period  
3) whether the respondent reported a first diagnosis of chest problems such as chronic bronchitis or pulmonary disease during the evaluation period  
4) whether the respondent reported a first diagnosis of eczema during the evaluation period  
5) whether the respondent reported a first diagnosis of circulatory problems during the evaluation period  
6) number of reported attacks of asthma in the past 12 months  
7) whether the respondent has been woken by shortness of breath in the past 12 months  
8) whether the respondent has been woken by tightness in the chest in the past 12 months  
9) whether the respondent has experienced wheezing in the chest in the past 12 months  
10) whether the respondent has experienced coughing or phlegm on most days for a minimum of three months a year and for at least two successive years  
11) whether the respondent suffers from at least one respiratory health problem  
12) whether the respondent has ever been advised by a health professional to change diet or lifestyle to reduce blood pressure or to avoid having high blood pressure  
13) whether the respondent is currently taking any action in relation to diet or lifestyle because of concerns about blood pressure  
14) whether the respondent currently has high blood pressure  

*(second sub-area: use of primary and secondary health services)*

15) the number of times the respondent has seen or spoken to a GP or nurse, either at their practice or at home, over the past year  
16) the number of times the respondent has visited a hospital outpatient clinic or day bed unit over the past year  
17) the number of times the respondent has had an overnight stay in hospital over the past year  
18) the number of times the respondent has visited a Casualty or Accident and Emergency Department for treatment over the past year
4.10 Self-reported health-related quality of life

KEY MESSAGE: A statistically significant positive effect of the CHP was observed for two of the individual dimensions of self-reported health and well-being which are measured by the SF-36 Health Survey [3]. However, the estimated effect sizes observed in the evaluation were small (around 2.5 points on a 100-point scale in each case). This is unlikely to be a clinically significant difference.

SUMMARY: This area consisted of nine measures representing various aspects of the respondent’s self-reported health and wellbeing. All measures were drawn from the SF-36 Version 2 Health Survey, a 36 item self-administered questionnaire which measures health-related quality of life in the general population. Of the nine measures, two exhibited a significant effect of the CHP:

1) the respondent’s score on the SF-36 physical functioning scale
2) the respondent’s score on the SF-36 general health scale.

The remaining seven measures showed no statistically significant associations with the CHP.

CHARTS: Chart 4.10.1 shows results for the two measures listed above. In this chart, the small black rectangles represent the estimated differences in average values of the measures between recipients and comparison respondents. Both values are positive (i.e. greater than zero), indicating that recipients recorded higher (‘better’) scores for these scales than did the comparison group9. The horizontal lines show the 95% confidence intervals for the estimated differences, and the dashed vertical line marks the value of zero which indicates no difference between the two groups of respondents (i.e. recipients and comparison households).

**Chart 4.10.1 Differences in self-reported health-related quality of life (odds ratios)**

![Chart 4.10.1 Differences in self-reported health-related quality of life (odds ratios)](image)

9 For all SF-36 scales, a higher score denotes better health. Scales are scored on a range from 0 (‘worst’) to 100 (‘best’).
Chart 4.10.2 shows average values of the two measures at the endpoint of the evaluation.

**Chart 4.10.2 Self-reported health-related quality of life (comparison group versus recipients)**

RESULTS: Table 4.10.1 shows numerical results for the two measures which exhibited significant associations with the CHP. The column headed ‘estimate’ shows the average difference between recipients’ scores on each scale and the scores for comparison group respondents.

**Table 4.10.1 Differences in self-reported health-related quality of life (odds ratios)**

<table>
<thead>
<tr>
<th>measure</th>
<th>estimate</th>
<th>95% CI</th>
<th>p</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score on SF-36 Physical Functioning scale</td>
<td>2.51</td>
<td>0.62 to 4.40</td>
<td>&lt; 0.01</td>
<td>2,171</td>
</tr>
<tr>
<td>Score on SF-36 General Health scale</td>
<td>2.57</td>
<td>0.87 to 4.27</td>
<td>&lt; 0.01</td>
<td>2,314</td>
</tr>
</tbody>
</table>

MEASURES NOT SHOWING A SIGNIFICANT ASSOCIATION WITH THE CHP:

1) the respondent’s score on each of the following SF-36 scales: Role-Physical, Bodily Pain, Vitality, Social Functioning, Role-Emotional and Mental Health.
2) the respondent’s score on the SF-36 Health Transition item
4.11 Long-standing illness or disability

KEY MESSAGE: Receipt of central heating under the Programme did not exert a significant influence on the likelihood of the respondent suffering from a long-standing illness, disability or health problem.

SUMMARY: This area consisted of a single measure, representing whether the respondent currently suffers from any long-standing illness, health problem or disability which limits her / his daily activities or the type of work which may be undertaken. This measure was found not to be significantly associated with the receipt of central heating under the CHP.

CHARTS: None shown, as no statistically significant result was found.

RESULTS: None shown.

MEASURES NOT SHOWING A SIGNIFICANT ASSOCIATION WITH THE CHP: As outlined in Summary above.
4.12 Use of medications

KEY MESSAGE: The evaluation detected no significant association between the receipt of heating under the Programme and respondents’ use of either prescribed or ‘over the counter’ medications.

SUMMARY: This area included two measures relating to the respondent’s use of medications. Neither of these was found to be significantly associated with the receipt of central heating under the CHP.

CHARTS: None shown, as no statistically significant results were found.

RESULTS: None shown.

MEASURES NOT SHOWING A SIGNIFICANT ASSOCIATION WITH THE CHP:

1) whether the respondent is currently taking prescribed medications
2) whether the respondent is currently taking ‘over the counter’ medications
4.13 Subgroup analyses

A limited number of subgroup analyses were performed in order to assess whether the CHP operated differentially on specific subgroups of recipients. Differential effects were investigated for three key outcomes, namely: whether the respondent suffers from at least one respiratory health problem; the respondent’s score on the SF-36 general health scale; and whether any environmental problem (damp, mould etc.) is present in the main living room and the main bedroom of the respondent’s dwelling. In investigating differential effects, attention focussed on the possible influence of housing tenure, physical house type (e.g. ‘semi-detached’), gender and age. The investigation was performed in two stages.

Firstly, a revised series of statistical models was constructed in which specific subgroups of recipients (e.g. those living in semi-detached homes) were compared to the entire control group. Comparison of the effects associated with each subgroup (e.g. comparing recipients in semi-detached homes with recipients in tenements) provided an indication – though not formal statistical evidence - of whether receipt of heating operated uniformly across the specified subgroups of recipients on a particular outcome (e.g. SF-36 general health). To provide formal confirmation of these initial insights, a number of additional analyses were performed in which the interactions between receipt of central heating and the factors of interest (e.g. the age of the respondent) were estimated. This further stage was not performed for all possible combinations of outcomes and classifying factors (such as gender and tenure), but none of the results obtained can reasonably be interpreted as indicating that the effect of the Programme varied substantially across subgroups for the range of outcomes examined. Clearly, this conclusion cannot be definitive: even if all possible differential effects were formally tested, the number of individual statistical tests involved would be such as to introduce a real danger of ‘false positive’ results. However, it may be asserted with some confidence that the Programme does not appear to have exerted meaningful differential effects on specific subgroups of those who received heating.
The evaluation examined the impact of the CHP on a wide range of outcome measures. Some of these – for example, those relating to specific symptoms and health conditions, and use of health services – were direct indicators of human health, while others (e.g. those outcomes which assessed social contacts, or financial strain) bore indirect relationships with health. It is clear from the results presented in Section 4 that the set of outcomes which can reasonably be viewed as direct expressions of health provided only limited evidence of a statistically significant effect of the CHP. Of 17 measures representing specific symptoms and health conditions (Section 4.9), only two (namely, reduced likelihood of first diagnoses with heart disease and with high blood pressure) indicated a significant positive effect of the CHP (that is, an effect indicative of improved health), while a third (namely, increased likelihood of first diagnosis of nasal allergy) showed a significant association with the Programme which cannot unambiguously be characterised as positive. The two measures which exhibited significant links with a positive effect (namely, reduced likelihood of first diagnoses with heart disease and with high blood pressure) are potentially important, and are moreover to some degree consistent with current knowledge of the physiological effects of cold on human cardiovascular functioning [4] [5].

However, the finding that provision of heating under the CHP appears to be associated with a reduced likelihood of being diagnosed with heart disease and / or high blood pressure must be treated with caution, for the following reasons. First, the evaluation only examined respondents’ experiences across a relatively short time period (two years), and without further research it is impossible to say whether the observed reductions in the incidence of heart disease / high blood pressure would be sustained in the longer term. Second, it is paradoxical that the apparently reduced experience of these two classes of condition among heating recipients was not matched by corresponding reductions in the use of health services, which is what might reasonably have been expected. Rather, utilisation of health services exhibited no significant differences between recipients and comparison respondents. Third, the outcome measures representing diagnosis with heart disease and high blood pressure were based on the respondent’s self-report, rather than being drawn from objective clinical sources such as GP or hospital records. This, inevitably, means that a degree of uncertainty or imprecision attaches to the outcomes. For example, one respondent might report a recent diagnosis of angina as ‘heart disease’, while a second might not. These three factors – the limited time period examined, the apparent lack of effect on respondents’ use of health services, and the self-reported nature of the outcomes – suggest that the apparently positive effect of the CHP on cardiovascular health, while interesting and potentially important, must be viewed with some reservations. Broadly speaking, it would be prudent to regard the direct impact of the CHP on health – based on these two findings – as limited.

Additional evidence that the direct influence of the CHP on health is limited comes from two further considerations. First, one outcome measure – the likelihood of a first diagnosis with nasal allergy such as hayfever – exhibited a significant association with the CHP which cannot be characterised as positive: recipients were found to be more likely to report such a diagnosis than comparison respondents. This ‘adverse’ finding goes some way towards negating the positive impact implied by the heart disease / high blood pressure results, leading to a more neutral view of the overall
health impact of the Programme. Second, it must be borne in mind that the remaining 14 symptom- and health-related outcomes in this area (most of which related to respiratory health) failed to provide evidence of any significant influence of the CHP.

The findings relating to self-reported health-related quality of life (Section 4.10) present a similar picture, in that they suggest a limited positive effect of the Programme. Of nine measures drawn from the SF-36, two indicated a ‘positive’ effect of the CHP (that is, recipients experiencing more favourable outcomes than comparison group respondents). However, it is evident that these positive effects, while statistically significant, are modest in size, and their practical or clinical significance is unlikely to be great.

A further area directly reflecting human health is that of long-standing illness or disability (Section 4.11). The single outcome measure featured in this area exhibited no significant effect of the CHP, strengthening the impression that the impact of the Programme on health over the period examined was limited. Further support for this conclusion is provided by the findings relating to use of medications (Section 4.12). While this area is arguably not a direct expression of health, it would reasonably be expected that any appreciable impact of the CHP on recipients’ health status would be reflected in altered levels of behaviour associated with the maintenance of health, including use of medications. The findings of the evaluation suggest that no such change was observed during the period examined.

A limited number of subgroup analyses was performed in order to assess whether the CHP operated differentially on specific subgroups of recipients. Differential effects were investigated for three key outcomes: respiratory health problem, general health and environmental problem in main rooms in the respondent’s dwelling. In investigating differential effects, attention focussed on the possible influence of housing tenure, physical house type (e.g. ‘semi-detached’), gender and age. None of the results obtained indicates that the effect of the Programme varied substantially across subgroups for the range of outcomes examined.

The findings in relation to the impact on physical health are broadly consistent with previous findings. Earlier studies have suggested that energy efficiency measures may be associated with improvements in respiratory symptoms (not found in the current study). However a systematic review carried out in 2001 [6] (suggested that only one of four studies had adjusted for potential confounding variables and that high rates of attrition (sample loss) in these studies may limit the generalisability of these findings. More recent research points to limited health impacts in the short term, with an indication that improvements in mental health, and perhaps physical functioning (e.g., mobility) are also plausible health outcomes of energy efficiency measures.

For example, an unpublished evaluation of a fuel poverty programme in the Armagh and Dungannon Health Action Zone in Northern Ireland [7] found that the installation of energy efficiency measures, including central heating systems, were associated with significant reductions in the numbers of householders reporting arthritis/rheumatism and the numbers reporting the mean number of total illnesses suffered per head in each household compared to the non-intervention group. This finding is consistent with the current study, where significant increases in scores on the physical functioning scale (which assesses fitness and mobility) were recorded.
The Northern Ireland study also found no impact on symptoms of angina, but improvements in stress/mental health (compared to the no-intervention group). The number of rooms which had problems with cold, mould and damp also decreased; and though average temperatures reduced little, there was a reduction in the range of temperatures of the monitored rooms, indicating improvements in levels of heating control.

The findings of the Lambeth study which evaluated the impacts of central heating installation in older people [8] are somewhat similar; with only limited improvements in health in terms of SF-36 scores, which the authors put down to the insensitivity of the SF-36, the small sample size and the short length of follow-up (<1 year). Improvements in controllability and reductions in swings in temperature were again observed. However (contrary to the current study), half of those with central heating felt that their gas bill was ‘a bit more’ or ‘much more’ than last winter, compared to a fifth of those without central heating.

The Glasgow Warm homes study [9], which evaluated the effects of improvements to physical conditions and energy efficiency of homes among Glasgow City Council’s housing stock, further illustrates the point that significant changes in health may result from improvements in environmental conditions; here there were improvements in symptoms that tend to be associated with dampness, in particular in relation to respiratory, skin, alimentary, and musculo-skeletal symptoms. The dwellings themselves were warmer, less humid and with reduced fungal spore concentrations, and less damp and easier to heat. This improvement was achieved with no increase in energy costs (i.e., more rooms could be heated after the intervention, with no significant increase in electricity bills).

The improvements in environmental conditions associated with health (in particular mental health) have been found in other studies [10] [11] [12]. Somerville et al [13] [14] also report that installing heating improves child respiratory health.

Overall the more recent research suggests that SF-36 may be relatively insensitive to changes in health associated with non-clinical interventions, but that (based on our own experience) it may pick up changes in physical functioning, in particular mobility, that result from increases in warmth. Changes in health associated with improvements in cold, damp and mould are plausible, on the basis of previous research [15], but these may emerge over longer periods of follow-up.

In contrast with the limited effects of the Programme on direct measures of health, the effects of the CHP on what may be termed ‘thermal comfort’ are clear and substantial. Of those measures which relate to perceptions of warmth in the home (Section 4.2), to patterns of heating in the home (that is, the extent and duration of domestic heating in cold weather – Section 4.3) and to internal environmental conditions (Section 4.4), an overwhelming majority show significant effects of the Programme. Recipients of heating under the CHP feel warmer, heat more of their homes for longer, and are less likely to experience undesirable environmental manifestations such as dampness, mould and condensation.

While these effects are clearly desirable in themselves, it is reasonable to assume that, over an extended period of time, the improved residential conditions associated with
these effects (i.e. better-heated homes, with fewer problems of mould etc.) may be conducive to the development and maintenance of improved health. Under this assumption, one possible explanation for the limited direct impact of the CHP on health lies in a factor which has already been highlighted: the relatively short follow-up period (two years). The effects of the Programme on health over a more extended timescale cannot be extrapolated from the evaluation reported here, and further research would be required to determine any longer-term impacts of the CHP on the health status of central heating recipients.
GLOSSARY OF STATISTICAL TERMS

(Terms in bold type are themselves the subject of definitions in this glossary)

analysis of covariance  A type of regression analysis in which data representing two groups (here, recipients and comparison respondents) are analysed in such a way as effectively to generate separate results for each group. This method permits estimation of the average difference in the outcome of interest (for example, some measure of health) between the groups.

certainty interval  A range of values – expressed as a lower and an upper limit – within which the unknown ‘true’ value of an estimated quantity (such as an average) is expected to fall. Confidence intervals are expressed in terms of specific levels of uncertainty. For example, a 95% confidence interval indicates a 95% probability that the true value will lie within the stated lower and upper limits. Interpretation of the confidence interval depends on the nature of the analysis which generated it. For example in a regression analysis (including analysis of covariance) if the confidence interval around the estimated value of a predictor includes the value zero, the result is considered not to be statistically significant. However, in a logistic regression, the inclusion of the value one in the confidence interval around an estimated odds ratio indicates a nonsignificant result.

logistic regression  A special form of regression used when the outcome of interest is binary; that is, can only take one of two possible values (e.g. the presence or absence of some specific disease). When logistic regression is used, the parameter estimates are expressed as odds ratios.

odds ratio  A measure of the likelihood of a binary factor (such as the presence or absence of some disease) being observed in one group relative to the corresponding likelihood for a second group. An odds ratio of one indicates equal likelihood for both groups; odds ratios greater / lower than one indicate unequal likelihoods. An odds ratio may be presented with an associated confidence interval. A full understanding of odds ratios is important for the results of the evaluation to be interpreted correctly. Recognising this, a simple worked example of odds ratio calculation is given at the end of this section.

p value  The probability that the result of a statistical test is attributable to the random play of chance, rather than to the presence of an actual effect in the population of interest. All p values fall within a range bounded by zero and one. Large p values (e.g. 0.2) are interpreted as indicating that the observed result could plausibly have arisen due merely to chance, while small p values (e.g. 0.01) suggest that the result reflects an effect which is actually present in the
population from which the sample is drawn. A value of \( p = 0.05 \) is commonly regarded as an informal ‘threshold’ of statistical significance, values of 0.05 or lower being considered significant (i.e. indicative of a real effect) while values greater than 0.05 are treated as nonsignificant. While this is a useful guideline, it can be potentially misleading – it is incorrect to place a completely different interpretation on the result of a statistical test simply because the observed \( p \) value is (say) 0.06 rather than 0.05.

**parameter estimate**

The ‘result’ obtained from a statistical model (such as a regression analysis), estimating – on the basis of a sample – the unknown ‘true’ value of some quantity in the population under investigation. The parameter estimate embodies a degree of uncertainty as to how accurately it represents the true (population) value; this uncertainty may be quantified by showing a confidence interval.

**regression**

A family of statistical techniques which seek to predict the value of some quantity (e.g. a measure of health) from one or more other variables (e.g. gender, age).

**Odds ratio – worked example**

Suppose there are two groups of individuals. 150 of these are central heating recipients, of whom 32 have some condition of interest - for example, they report that their heating always keeps them sufficiently warm. The odds of the condition being present among these individuals is calculated as the number who do have the condition divided by the number who do not i.e.

\[
\frac{32}{118} = 0.271
\]

The second group consists of 144 comparison group respondents (i.e. individuals not receiving central heating), of whom 17 indicate that their heating always provides adequate warmth. The odds of the condition being present among these people is given by

\[
\frac{17}{127} = 0.134
\]

The odds ratio – that is, the odds of the condition being present among heating recipients relative to the odds of its presence among comparison group members – is given by

\[
\frac{0.271}{0.134} = 2.03
\]

The above example illustrates the calculation of a ‘raw’ or unadjusted odds ratio. In the statistical models used to generate the results of the evaluation, the odds ratios are adjusted for the effects of other factors which might plausibly be relevant – see Appendix B, Section B.13.
APPENDIX A  FIELDWORK REPORT

A.1 Introduction

As outlined in Section 3 the evaluation involved three waves of fieldwork, namely:

1) an initial wave of face-to-face interviews in respondents’ homes (referred to hereafter as ‘Wave 1’)
2) a postal survey one year after the initial interviews (‘Wave 2’)
3) a second wave of face-to-face fieldwork two years after the initial interviews (‘Wave 3’)

This Appendix details the conduct of the fieldwork for each of the three waves.

A.2 Wave 1 fieldwork - research design, procedures and achieved sample

A.2.1 Research design

The fieldwork for the first wave of the evaluation commenced in November 2002 and was completed in February 2004. The evaluation design (described in Section 3.2) was informed by a previous study into the feasibility of measuring the health impact of the Warm Deal initiative. Households where central heating was to be installed under the CHP formed the intervention group. A comparison group of matched respondents, who did not receive work under the Programme, was also interviewed.

The design for the initial wave of fieldwork involved a number of elements:

- Tenants of public sector properties which were potentially eligible for work under the CHP were contacted by Registered Social Landlords (RSLs), while householders in eligible private sector properties were invited to apply for inclusion in the Programme through EAGA.
- During the initial survey of potentially eligible properties, recipients’ permission was sought to allow their details to be passed to the evaluation contractors (TNS). This approach was used in the Warm Deal study and led to a high response rate.
- Recipients were approached to be interviewed. One respondent was chosen in each household. In households without children, the respondent was chosen randomly from the householders. In households with children, the householder who was best placed to answer questions on the children’s health was selected.
- Where a successful interview with a recipient was achieved, an interview was sought with a representative from a matched comparison household. The criteria for matching were tenure (owned, privately rented, rented from a Local Authority or Housing Association); household type (single adult, single parent, single pensioner, couple with no children, couple with children, pensioner couple); socio-economic group (AB, C1C2, DE); and locality (postcode sector).
In a small number of cases, interviewers reported considerable difficulty in finding a suitable matched comparison respondent. These interviews were either reissued to another interviewer, or alternatively one of the matching criteria was relaxed (for example, by allowing a single pensioner to be matched with a pensioner couple).

Due to difficulties in obtaining the required amount of sample, a number of changes to the fieldwork procedures were made during the course of the Wave 1 fieldwork period. Before describing the outcome of the Wave 1 fieldwork sweep, details of the receipt of sample and the resulting changes to the initial procedures are discussed.

A.2.2 Receipt of sample

Several difficulties were encountered in the receipt of sample. Initially, the larger RSLs and EAGA did not collect consent details and thus had no sample to provide, leading to a delay in the start of fieldwork by a year. Following this delay, there were continuing difficulties in obtaining the necessary amount of useable sample, primarily from RSLs. As a result, the amount of sample available was much lower than expected. Considerable effort was required both by the research team and by representatives of the Scottish Executive to increase the flow of sample from RSLs.

Additionally, the short timescales between consent being given by recipients to be interviewed (obtained at the initial survey of the respondent’s home) and the installation of central heating, coupled with the delay in receiving consent forms from RSLs, led to a high proportion of addresses being deemed either unusable on receipt or being found to have had central heating installed when visited by an interviewer. Difficulty in allocating sample in sufficient time to achieve an interview was exacerbated by the concentration of installations in a small number of RSLs – around 84% of the RSL sample were received from three RSLs. Thus, the concentration of installations in particular areas, coupled with short lead-in times to installation, led to some difficulty in allocating all useable sample to interviewers.

A.2.3 Changes to fieldwork procedures during Wave 1

In response to the challenges described above, several changes were made to the procedures for the sample collection and fieldwork during the course of 2003. First, information was obtained from RSLs on those properties they considered would be eligible to receive central heating, rather than waiting to obtain consent at the initial survey stage. This resulted in an increase in the number of addresses received, and, in the main, increased the period between receipt of sample and the date of installation of central heating. It also, however, led to a significant decrease in the proportion of addresses where an interview was obtained, for the following reasons:

- Some properties were vacant.
- There was a higher refusal rate as tenants had not ‘opted in’ to the survey, as they had done previously.
- A proportion of tenants stated that they did not want work carried out under the Central Heating Programme, and were thus ineligible for interview.
In a proportion of properties the central heating work had been carried out some time prior to the interviewer’s visit.

Second, the allocation of recipient and comparison interviews was ‘decoupled’. At the start of the fieldwork period, each interviewer was required to achieve a comparison interview for every successful recipient interview. In order to maximise the number of interviews with recipients before installation, recipient and comparison interviews were split. This allowed interviewing capacity to be concentrated on recipient sample and reduced the proportion of addresses where work had been carried out before the visit of an interviewer. Although the increase in the elapsed time between recipient and comparison interviews was not ideal, this was considered preferable to losing a significant proportion of sample.

Third, on occasion the length of time between receipt of sample and the completion of work remained short. It was decided to proceed with interviews where installation had taken place in the preceding fortnight. If installation had taken place more than two weeks earlier, interviewers were instructed not to interview.

Finally, in order to maximise the available interviewer capacity, the questionnaire was converted from a CAPI format (i.e. direct input of respondents’ data to computer) to a pen-and-paper version, permitting the allocation of sample to additional interviewers. Given the intermittent pattern of receiving sample from the three RSLs who provided the majority of the LA sample, and the considerable size of such batches of sample, this maximised the number of interviews that could be achieved before installation took place.

A.2.4 Interviews obtained in Wave 1

Table A.2.1 provides details of the numbers of interviews achieved against the targets set. A total of 1136 interviews was achieved with tenants of RSLs who were due to get work done under the initiative, and a total of 1121 comparison interviews was achieved. In total, 842 interviews were completed with householder (EAGA) recipients, and 751 comparison interviews were achieved for this group. Overall, the number of interviews with recipients marginally exceeded the target set (101%), while the number of comparison interviews fell only slightly short of the target set (95%).

<table>
<thead>
<tr>
<th></th>
<th>recipient interviews</th>
<th>comparison interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>target</td>
<td>achieved</td>
</tr>
<tr>
<td>RSL</td>
<td>1249</td>
<td>1136^10 (90%)</td>
</tr>
<tr>
<td>EAGA</td>
<td>714</td>
<td>842 (118%)</td>
</tr>
<tr>
<td>Total</td>
<td>1963</td>
<td>1978 (101%)</td>
</tr>
</tbody>
</table>

^10 One RSL recipient later requested that her Wave 1 data be deleted. In consequence, the total number of usable respondents recruited at Wave 1 reduced from 3,850 (i.e. 1,978 recipients plus 1,872 comparison respondents) to 3,849.
A.3 Wave 2 fieldwork - procedures and achieved sample

This section details the conduct of the fieldwork for the second wave, the postal survey. The objectives of the postal wave were twofold. First, it was designed as an exercise in panel management, with contact through the postal survey designed to reduce attrition between Wave 1 and Wave 3. Second, it was intended to capture data on changes to property characteristics and the health of the respondents, and on occurrences of particular life events which may affect health. The questionnaire used in Wave 2 was much shorter than that employed at Wave 1.

The sample frame comprised those who had provided an interview at Wave 1. A target response rate of at least 50% was set, based on previous postal surveys. With 3,850 interviews achieved at Wave 1, this represented a target of 1,925 interviews. Fieldwork commenced in November 2003, one year after the start of the Wave 1 fieldwork. An initial questionnaire was sent out to Wave 1 respondents a year following their initial interview. A reminder letter and a further copy of the questionnaire were sent two weeks after the initial mailout to those who had not returned a completed postal questionnaire. Fieldwork was completed in March 2005 (just over a year after the completion of Wave 1).

Table A.3.1 provides details of the achieved response rate at Wave 2. In total, 2131 Wave 2 questionnaires were returned, representing a response rate of 55%. The response rate differed between the recipient and comparison groups, and between respondents in public sector stock (RSLs) and the private sector stock (EAGA). While the response rate among recipients from LA/HAs was 45%, the corresponding response rate among EAGA recipients was 76%.

<table>
<thead>
<tr>
<th></th>
<th>recipient interviews</th>
<th>comparison interviews</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RSLs</td>
<td>EAGA</td>
<td>RSLs</td>
</tr>
<tr>
<td>Completed Wave 2 questionnaire</td>
<td>515  (45%)</td>
<td>641  (76%)</td>
<td>467  (42%)</td>
</tr>
<tr>
<td>No Wave 2 questionnaire</td>
<td>621  (55%)</td>
<td>201  (24%)</td>
<td>654  (58%)</td>
</tr>
<tr>
<td>Total</td>
<td>1136</td>
<td>842</td>
<td>1121</td>
</tr>
</tbody>
</table>

For the vast majority of non-respondents to the postal survey, no information on reasons for non-response was received. This is usual for postal surveys. For a small number of postal questionnaires (n=22), however, feedback was available. Twelve respondents asked to withdraw from the study, including one respondent who asked for her Wave 1 data to be deleted. Five Wave 1 respondents had died, an additional four were too ill to take any further part in the study and one had moved to sheltered accommodation. These 22 Wave 1 respondents were not re-contacted as part of the Wave 3 fieldwork.
A.4 Wave 3 fieldwork - procedures and achieved sample

A.4.1 Fieldwork procedures at Wave 3

In order to permit an analysis of the impact of receipt of central heating on health status, Wave 1 respondents were re-interviewed around two years after they had undertaken the initial interview (Wave 3). The sample comprised those who had undertaken an interview at Wave 1, regardless of whether they had completed a postal questionnaire (bar the 22 who were actively withdrawn during Wave 2).

Fieldwork for Wave 3 commenced in December 2004 and was completed in March 2006. To ensure that the time lag between the initial interview and the re-interview was as near to two years as possible, the sample was divided into five-week periods, with interviewer schedules set around the midpoint of these periods. It should be noted that some sample with unsuccessful outcomes was reissued to increase the total number of achieved interviews. This invariably led to a gap of more than two years between the Wave 1 and Wave 3 interviews. Reissues are discussed in greater depth below.

The Wave 3 questionnaire was almost identical to the Wave 1 questionnaire. The only revisions to the questionnaire were the addition of questions relating to work conducted under the programme and minor changes to a small number of questions with pre-defined answer categories replacing “open” responses.

The fieldwork procedures were designed to maximise the number of interviews obtained. All Wave 1 respondents were visited on at least four occasions, on different days and at different times of the day to try to obtain an interview. This is reflected in the final fieldwork outcomes: only 7% of the total sample resulted in no contact after four or more visits. Indeed, among this sample, 26% were visited on six or more occasions. A further effort to maximise the response at Wave 3 was made by reissuing sample with an unsuccessful outcome. In total, 294 addresses were reissued to interviewers. The vast majority of this sample had been away during the initially specified fieldwork batch period, were ‘soft’ refusals, or had received four or more attempted contacts. This resulted in an additional 126 interviews being achieved.

A.4.2 Fieldwork outcomes at Wave 3

In total, 2,365 interviews were achieved at Wave 3. This represents 62% of the total sample available (all interviews achieved at Wave 1 minus those who actively withdrew at Wave 2). A summary of outcomes for Wave 3 is given in Table A.4.1, with a more detailed presentation – including a breakdown of responses by source (i.e. RSL vs. EAGA) – in Table A.4.2. The proportions of interviews achieved differed between the recipient and comparison groups, and between respondents in public sector stock (RSLs) and the private sector stock (EAGA). In total, interviews were achieved with 59% of Wave 1 public sector stock recipients (n=669), 73% of private sector stock recipients (n=612), 52% of public sector comparison households (n=579), and 68% of private sector comparison households (n=505).
The total number of interviews achieved was less than the target of 70% of Wave 1 interviews. The most common unsuccessful fieldwork outcomes were sample members moving without trace (10%), refusal (9%), non-contact (7%), death (4%), hospitalisation (3%) and derelict/demolished/empty properties (2%). Survey response rates are generally calculated as the number of achieved interviews as a proportion of total sample minus ineligible sample (‘deadwood’). Excluding deadwood, the overall achieved response rate among the full sample was 76%.

Table A.4.1 Fieldwork outcomes at wave 3 (summary)

<table>
<thead>
<tr>
<th>Summary of sample</th>
<th>all</th>
<th>recipients</th>
<th>comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total sample available</td>
<td>3828</td>
<td>1968</td>
<td>1860</td>
</tr>
<tr>
<td>Total sample allocated</td>
<td>3828</td>
<td>1968%</td>
<td>1860%</td>
</tr>
</tbody>
</table>

Fieldwork outcomes

| Successful                     | 2365    | 1281       | 1084       |
| Unsuccessful                   | 1463    | 687        | 776        |

|                                | all     | recipients | comparison |
| No reply after 4 or more visits| 284     | 131        | 153        |
| Refused                        | 358     | 177        | 181        |
| Empty/Demolished/Derelict      | 79      | 26         | 53         |
| Deceased                       | 152     | 88         | 64         |
| In hospital/too ill            | 102     | 49         | 53         |
| Moved                          | 365     | 166        | 199        |
| Other unsuccessful             | 123     | 50         | 73         |
| Total Unsuccessful             | 1463    | 687        | 776        |

|                                | all     | recipients | comparison |
| Total                          | 3828    | 1968       | 1860       |

53
<table>
<thead>
<tr>
<th>Fieldwork outcomes</th>
<th>Total sample available</th>
<th>Total</th>
<th>RSL</th>
<th>EAGA comparison</th>
<th>RSL</th>
<th>EAGA comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Successful</td>
<td>3828</td>
<td>2365</td>
<td>1281</td>
<td>1968</td>
<td>1133</td>
<td>1115</td>
</tr>
<tr>
<td>Unsuccessful</td>
<td></td>
<td>1463</td>
<td>687</td>
<td>1968</td>
<td>1133</td>
<td>1115</td>
</tr>
<tr>
<td>No reply after 4 or more visits</td>
<td>284</td>
<td>131</td>
<td>177</td>
<td>1968</td>
<td>1133</td>
<td>1115</td>
</tr>
<tr>
<td>Refused</td>
<td>358</td>
<td>99</td>
<td>24</td>
<td>1968</td>
<td>1133</td>
<td>1115</td>
</tr>
<tr>
<td>Empty/Demolished/Derelict</td>
<td>79</td>
<td>26</td>
<td>1</td>
<td>1968</td>
<td>1133</td>
<td>1115</td>
</tr>
<tr>
<td>Deceased</td>
<td>152</td>
<td>79</td>
<td>1</td>
<td>1968</td>
<td>1133</td>
<td>1115</td>
</tr>
<tr>
<td>In hospital/too ill</td>
<td>102</td>
<td>166</td>
<td>33</td>
<td>1968</td>
<td>1133</td>
<td>1115</td>
</tr>
<tr>
<td>Moved</td>
<td>365</td>
<td>100</td>
<td>33</td>
<td>1968</td>
<td>1133</td>
<td>1115</td>
</tr>
<tr>
<td>Other unsuccessful</td>
<td>1463</td>
<td>100</td>
<td>33</td>
<td>1968</td>
<td>1133</td>
<td>1115</td>
</tr>
<tr>
<td>Total unsuccessful</td>
<td>1463</td>
<td>100</td>
<td>33</td>
<td>1968</td>
<td>1133</td>
<td>1115</td>
</tr>
</tbody>
</table>

Table A.4.2: Fieldwork outcomes at wave 3 (full version)
APPENDIX B  ANALYTICAL METHODS

B.1  Introduction

As outlined in the Summary of Findings (Section 1), a total of 67 individual outcome measures was investigated as part of the evaluation. Analysis of these was conducted either by analysis of covariance (for continuous outcomes measures) or by logistic regression (in the case of binary outcomes). For each measure, a statistical model was constructed in which the outcome at the endpoint of the evaluation was predicted by:-

a)  The value of the outcome at the initial point (i.e. the first interview with the respondent)
b)  A binary indicator representing whether the respondent was a member of the comparison group, or was a recipient of central heating under the Programme
c)  A set of additional covariates representing factors (such as the age and gender of the respondent) which could potentially influence any relationship between the outcome and the receipt of central heating

Of the above, item (a) was included to guard against the results being influenced by the statistical phenomenon known as ‘regression to the mean’ (simply stated, the tendency of ‘extreme’ values to become less extreme over time irrespective of specific actions or influences which may be in operation e.g. the provision of new heating systems). Item (b) is the main result of interest, for it is the values of this – obtained via the statistical models – which permit a determination of whether households which received heating under the Programme report different values of the outcomes from those of the comparison group. The additional factors (Item [c]) were included to ensure that, so far as is practically feasible, the influence of (for example) the age and gender of the respondent were adjusted for when estimating the effect of the Programme on a specific outcome measure. The precise set of such factors or predictors included in the statistical modelling process varied according to the outcome of interest. For example, an outcome representing some measure of health required adjustment for the possible influence of tobacco smoke exposure, while a measure representing heating usage did not.

All analyses were weighted – via the method of inverse propensity scores [ref. 6] – to adjust for attrition of respondents between the initial and final interviews.

The following material provides, for each outcome measure:-

a)  A brief account of how the measure was defined
b)  The type of model used (either analysis of covariance or logistic regression), and an indication of which additional predictors were featured in the model. Three standard sets of predictors were used (referred to respectively as Predictor set A, B and C). A full listing of the elements included in each set is given later in this Appendix (Section B.13). For a small number of outcomes, technical considerations meant that none of the standard predictor sets could be used satisfactorily. In such cases, the actual predictors used are explicitly specified.

Sections B.2 to B.12 give the information outlined above (i.e. items [a] to [c]) for the individual conceptual areas featured in the analysis, and thus correspond to Sections 4.2 to 4.12 in the body of the Report.
B.2 Perceptions of warmth in the home

B.2.1 Whether respondent is kept sufficiently warm by heating during the period October - March

Definition

This measure is derived from responses to the question “During the colder months (October – March), do you generally find that your heating keeps you warm enough at home or not?”. The available responses to the question are: “Yes, always”, “Only some of the time” and “No, never”. For the analysis responses were dichotomised, contrasting “Yes, always” against the two remaining (less favourable) responses.

Type of model / Additional predictors

Logistic regression / Predictor set C

B.2.2 Whether inadequate heating presents a serious problem

Definition

This measure is derived from a supplementary question to that cited above, the additional prompt to respondents taking the form “How much of a problem is this, if at all, to you?” . The supplementary item is presented only to those who give a reply of other than “Yes, always” to the preceding question, and offers the following response options: “A serious problem”, “A bit of a problem”, “Not very much of a problem” and “Not a problem”. For analysis purposes, responses were dichotomised such as to contrast “A serious problem” against the three remaining (less severe) responses.

Type of model / Additional predictors

Logistic regression / Predictor set C

B.2.3 Whether respondent is satisfied with heating

Definition

The respondent’s level of satisfaction with her / his heating is elicited via the question “Overall, how satisfied or dissatisfied are you with your heating?”. The response options provided are: “Very satisfied”, “Fairly satisfied”, “Neither satisfied nor dissatisfied”, “Fairly dissatisfied” and “Very dissatisfied”. To perform the analysis, responses were dichotomised such as to contrast “Very satisfied” OR “Fairly satisfied” against the remaining responses (which indicate lower levels of satisfaction).

Type of model / Additional predictors

Logistic regression / Predictor set C
B.3 Patterns of heating in the home

B.3.1 Whether more than half of the rooms in the home are permanently unheated in cold weather

Definition

This measure is derived from responses to a linked group of questions asking for how long each individual room in the home (e.g. kitchen, bathroom) is heated in winter. Responses are collected via a system of duration bands, the available options being “0 (no hours)”, “1-3 hours”, “4-6 hours”, “7-9 hours”, “10-12 hours”, “13-16 hours”, “17-19 hours”, “20-23 hours” and “24 hours”. To derive the measure, the number of rooms identified as being heated for zero hours is divided by the total number of rooms in the dwelling. The result of this calculation is then reduced to a binary quantity, contrasting 0.5 (half) of the total number of rooms or less against more than half of the total number of rooms. The final value thus represents whether more than half of the rooms in the home are unheated in winter.

Type of model / Additional predictors

Logistic regression / Predictor set C

B.3.2 Whether more than half of the rooms in the home are permanently heated (24 hours per day) in cold weather

Definition

This measure is derived as described in B.3.1 above, except that the numerator in the calculation is the number of rooms reported as being heated for 24 hours per day. The final value of this measure represents whether more than half of the rooms in the home are permanently heated in winter.

Type of model / Additional predictors

Logistic regression / Predictor set C

B.3.3 Whether more than half of the rooms in the home are heated for nine hours per day or less in cold weather

Definition

This measure is derived as described in B.3.1 above, except that the numerator in the calculation is the number of rooms reported as being heated for any of “0 (no hours)”, “1-3 hours”, “4-6 hours” or “7-9 hours”. The final value of this measure represents whether more than half of the rooms in the home are heated for nine hours per day or less in winter.

Type of model / Additional predictors

Logistic regression / Predictor set C
B.3.4 Duration (hours per day) for which the dwelling’s kitchen is heated in cold weather

Definition

This measure is derived from responses to the appropriate item in the set of questions used in B.3.1 – B.3.3 above. To arrive at a numeric value appropriate for use in analysis, the banded representation of heating duration (see B.3.1) is replaced by the mid-point of each band. Thus, an original response of “4-6 hours” is converted to a notional value of 5 hours; “13-16 hours” becomes 14.5 hours; and so on.

Type of model / Additional predictors

Analysis of covariance / Predictor set C

B.3.5 Duration (hours per day) for which the dwelling’s bathroom is heated in cold weather

Definition, type of model and additional predictors as B.3.4.

B.3.6 Duration (hours per day) for which the dwelling’s main living room is heated in cold weather

As B.3.4.

B.3.7 Duration (hours per day) for which the dwelling’s hall is heated in cold weather

As B.3.4.

B.3.8 Duration (hours per day) for which the dwelling’s main bedroom is heated in cold weather

As B.3.4.

B.3.9 Duration (hours per day) for which the dwelling’s second bedroom is heated in cold weather

As B.3.4.
B.3.10 Average duration (hours per day) for which rooms in the dwelling are heated

Definition

This measure is derived by summing the heating duration values reported for individual rooms (i.e. the values derived at B.3.4 to B.3.9 above), then dividing this sum by the number of rooms in the dwelling.

Type of model / Additional predictors

Analysis of covariance / Predictor set C

B.4 Condensation, dampness and mould

B.4.1 Whether use of any rooms in the home is avoided due to difficulty in heating

Definition

This measure is derived from responses to the question “Are there any rooms in your home that you avoid using because you have difficulty heating them?”. The available response options offer a simple binary choice (“Yes” and “No, none”). The analysis models the probability of a “Yes” response.

Type of model / Additional predictors

Logistic regression / Predictor set C

B.4.2 Whether any environmental problem (condensation / damp /mould) is present in the kitchen

Definition

This measure is derived from responses to a series of questions asking which of a range of environmental problems are experienced in individual rooms within the dwelling. The problems specified are “Condensation on windows or walls”, “Damp smell”, “Mould growth on carpets / curtains / furniture”, “Mould growth on walls, ceilings or floors”, “Mould or rot in window frames” and “Other problems”. The information is elicited separately for each room in the home (kitchen, bathroom etc.), and respondents are permitted to report multiple problems within a room where appropriate. The measure is derived by determining whether one or more of the specific problem types (i.e. excluding “Other problems”) is identified in the kitchen.

Type of model / Additional predictors

Logistic regression / Predictor set C
B.4.3 Whether any environmental problem (condensation / damp /mould) is present in the bathroom

*Definition, type of model and additional predictors* as B.4.2

B.4.4 Whether any environmental problem (condensation / damp /mould) is present in the main living room

As B.4.2.

B.4.5 Whether any environmental problem (condensation / damp /mould) is present in the hall

As B.4.2.

B.4.6 Whether any environmental problem (condensation / damp /mould) is present in the main bedroom

As B.4.2.

B.4.7 Whether any environmental problem (condensation / damp /mould) is present in the second bedroom

As B.4.2.

B.4.8 Whether any environmental problems (condensation / damp /mould) cause serious difficulty

*Definition*

This measure is derived only for those respondents who report the presence of any environmental problems in the home. Such respondents are presented with the question “Overall, how much do these problems cause you difficulty in daily life?”. The response options offered are “A lot of difficulty”, “A little difficulty” and “No difficulty at all”. For the analysis responses were reduced to a binary quantity, contrasting “A lot of difficulty” with the two remaining options. The resultant measure represents whether environmental problems in the home are perceived as causing serious difficulty.

*Type of model*

Logistic regression

*Additional predictors*

Technical considerations (specifically, sparseness in the data) meant that the standard predictor set C could not be used for this analysis, predictor set B being used instead.
B.4.9 Whether any rooms in the home cannot be used due to problems of damp or condensation

Definition

As with B.4.8, this measure is derived only for those respondents who report the presence of any environmental problems in the home. Such respondents are presented with the question “Are there any rooms in your home that you are unable to use because of problems of damp or condensation?”. The response options provide a simple binary choice between “Yes” and “No, none”. The analysis models the probability of a “Yes” response.

Type of model

Logistic regression

Additional predictors

Technical considerations (specifically, sparseness in the data) meant that the standard predictor set C could not be used for this analysis, additional predictors being restricted to age, gender and housing tenure.

B.5 Overall satisfaction with the home

B.5.1 Respondent’s overall satisfaction with her / his home

Definition

This measure is based on responses to a questionnaire item which asks “On the whole, how satisfied or dissatisfied are you with this house or flat?”. The response options offered are “Very satisfied”, “Fairly satisfied”, “No opinion”, “Fairly dissatisfied” and “Very dissatisfied”. The original responses were reduced to a binary quantity by contrasting “Very satisfied” against the remaining responses.

Type of model / Additional predictors

Logistic regression / Predictor set C

B.5.2 Respondent’s perception of home as “A place I want to get away from”

Definition

This measure is derived from responses to a questionnaire item which elicits the respondent’s level of agreement with the statement “My house / flat is a place I want to get away from”. The response options offered are “Strongly agree”, “Agree”, “Neither agree nor disagree”, “Disagree” and “Strongly disagree”. For the analysis, responses were dichotomised such as to contrast “Strongly disagree” (the most favourable response i.e. that indicating the greatest
degree of attachment to the home) against all other responses. This approach creates a measure which represents whether the respondent does not express a strong desire to “get away from” her/his home.

Type of model / Additional predictors

Logistic regression / Predictor set C

B.5.3 Respondent’s perception of home as “A place where I feel safe”

Definition

This measure is derived from responses to a questionnaire item which elicits the respondent’s level of agreement with the statement “My house/flat is a place where I feel safe”. The response options offered are the same as those for B.5.2 above. Responses were again dichotomised, contrasting the most favourable reply (“Strongly agree”) against the remaining responses.

Type of model / Additional predictors

Logistic regression / Predictor set C

B.5.4 Respondent’s perception of home as “A place where I feel at home”

Definition

This measure is based on responses to a question which elicits the respondent’s level of agreement with the statement “My house/flat is a place where I feel at home”. The response options offered are the same as those for B.5.2 above. As with B.5.2 and B.5.3, responses were reduced to a binary quantity by contrasting the most favourable reply (“Strongly agree”) against the remaining responses.

Type of model / Additional predictors

Logistic regression / Predictor set C

B.5.5 Whether respondent would move home if able to do so

Definition

This measure is based on responses to the question “Would you move house if you were able to?”. Only “Yes” and “No” responses are permitted. The analysis models the probability of a “No” response; that is, whether the respondent would not move house if able to do so.
B.6 Drinking and smoking

B.6.1 Whether respondent has consumed an alcoholic drink in the last seven days

Definition

This measure is based on responses to the question “Have you had an alcoholic drink in the last 7 days?”. Only “Yes” and “No” responses are permitted. The analysis models the probability of a “Yes” response.

Type of model / Additional predictors

Logistic regression / Predictor set C

B.6.2 Whether respondent currently smokes cigarettes

Definition

This measure is derived from responses to a questionnaire item which elicits information on the respondent’s use of cigarettes. Five response options are provided, namely “I have never tried smoking a cigarette, even a puff or two”, “I have never really smoked cigarettes, just tried them once or twice”, “I smoke cigarettes nowadays”, “I do not smoke cigarettes at all nowadays, but I used to smoke regularly (at least one a day)” and “I do not smoke cigarettes at all nowadays, but I used to smoke occasionally (less than one a day)”. For the analysis, the option identifying the respondent as a current smoker (“I smoke cigarettes nowadays”) was contrasted against all other responses.

Type of model / Additional predictors

Logistic regression / Predictor set C

B.7 Nature and extent of social contacts

B.7.1 Whether friends / relatives have been dissuaded from staying overnight due to poor housing conditions

Definition

This measure is derived from responses to the question “In the past four weeks have you put off friends / relatives coming to stay overnight because of poor housing conditions such as
dampness or cold?”. Response options are restricted to “Yes” and “No”, the analysis modelling the probability of a “Yes” response.

**Type of model / Additional predictors**

Logistic regression / Predictor set B

**B.7.2 Whether friends / relatives have been dissuaded from visiting due to poor housing conditions**

*Definition*

This measure is derived from responses to a question similar to that used in B.7.1, the slightly-modified wording reading “In the past four weeks have you put off friends / relatives coming to see you because of poor housing conditions such as dampness or cold?”. Response options are again restricted to “Yes” and “No”, and the analysis predicts the probability of a “Yes” response.

**Type of model / Additional predictors**

Logistic regression / Predictor set B

**B.7.3 Number of times respondent has gone out to visit family / friends in the past two weeks**

*Definition*

This measure is based on responses to a question asking how many times the respondent has gone out to visit family or friends in the past two weeks. The response options provided are “Not at all”, “Once or twice”, “Three-six times” and “More than six times”. For the analysis, the original responses were dichotomised such as to contrast “More than six times” against the remaining responses (i.e. those indicating six or fewer contacts in the period).

**Type of model / Additional predictors**

Logistic regression / Predictor set A

**B.7.4 Number of times respondent has been visited by family / friends at home in the past two weeks**

*Definition*

This measure is based on responses to a question asking how many times the respondent has been visited by family or friends at home in the past two weeks. The response options provided are identical to those for B.7.3 and are reduced to a binary quantity in the same way (i.e. contrasting “More than six times” against all other responses).
**Type of model / Additional predictors**

Logistic regression / Predictor set A

**B.8 Perceived financial strain**

B.8.1 Whether respondent reports any degree of financial difficulty

**Definition**

This measure is based on responses to the question “Taking everything together, which [phrase] best describes how you and your household are managing financially these days?”. The response options provided are “Manage very well”, “Manage quite well”, “Get by alright”, “Don’t manage very well”, “Have some financial difficulties” and “Are in deep financial trouble”. For the analysis, original responses were reduced to a binary quantity by contrasting “Don’t manage very well”, “Have some financial difficulties” and “Are in deep financial trouble” against the remaining options. Reshaped in this way, the measure represents an indication of whether the respondent reports some degree of financial difficulty.

**Type of model / Additional predictors**

Logistic regression / Predictor set C

**B.9 Specific symptoms and health conditions, and use of primary and secondary health services**

B.9.1 Number of reported episodes of cold / flu symptoms in past 6 months

**Definition**

This measure is derived from responses to the question “How many times have you had cold or flu symptoms in the past six months?”. Responses are collected as an absolute number of episodes.

**Type of model / Additional predictors**

Analysis of covariance / Predictor set A

B.9.2 Whether respondent has ever been diagnosed with asthma

**Definition**

This measure is derived from responses to a question asking “Which, if any, of these health problems have you been diagnosed by a doctor as having?”. Among the conditions specified is
asthma; the other health problems featured are listed in B.9.3 to B.9.7 below. Because the question seeks to establish whether the respondent has ever been diagnosed with asthma (that is, has received a first diagnosis with the condition), analysis is restricted to those who remain ‘at risk’ of such a diagnosis at the study endpoint; that is, those who indicate a diagnosis of asthma at the initial interview are excluded.

**Type of model / Additional predictors**

Logistic regression / Predictor set A

**B.9.3 Whether respondent has ever been diagnosed with bronchitis etc.**

**Definition**

As B.9.2, except that the condition specified is “Chest problems such as chronic bronchitis, pulmonary disease”.

**Type of model / Additional predictors**

Logistic regression / Predictor set A

**B.9.4 Whether respondent has ever been diagnosed with eczema**

**Definition**

As B.9.2, except that the condition specified is “eczema”.

**Type of model / Additional predictors**

Logistic regression / Predictor set A

**B.9.5 Whether respondent has ever been diagnosed with nasal allergy**

**Definition**

As B.9.2, except that the condition specified is “a nasal allergy such as hayfever”.

**Type of model / Additional predictors**

Logistic regression / Predictor set A
B.9.6 Whether respondent has ever been diagnosed with heart disease

Definition
As B.9.2, except that the condition specified is “heart disease”.

Type of model / Additional predictors
Logistic regression / Predictor set A

B.9.7 Whether respondent has ever been diagnosed with circulatory problems

Definition
As B.9.2, except that the condition specified is “circulatory problems”.

Type of model / Additional predictors
Logistic regression / Predictor set A

B.9.8 Number of reported attacks of asthma in the past 12 months

Definition
This measure is restricted to those respondents who report a clinical diagnosis of asthma at the initial interview (see B.9.2 above). Such respondents are presented with the question “How many attacks of asthma have you had in the past 12 months?” Responses are collected via a banded system offering the options “None”, “One to three”, “Four to ten” and “More than ten”. For the analysis, the original replies were dichotomised at zero (i.e. original response “None”) versus any other response. The measure thus represents whether the respondent reports at least one asthma attack over the past year.

Type of model
Logistic regression

Additional predictors
For technical reasons, this analysis required to use a modified version of Predictor set A which excluded (a) household type and (b) the life event indicators.
B.9.9 Whether respondent has been woken by shortness of breath in the past 12 months

Definition

This measure is derived from responses to the question “Have you been woken by an attack of shortness of breath at any time in the past 12 months?”. Response options are restricted to “Yes” and “No”; the analysis models the probability of a “Yes” response.

Type of model / Additional predictors

Logistic regression / Predictor set A

B.9.10 Whether respondent has been woken by tightness in chest in the past 12 months

Definition

This measure is derived from responses to the question “Have you been woken up with a feeling of tightness in your chest at any time in the past 12 months?”. Responses options are limited to “Yes” and “No”, and the probability of the former is modelled by the analysis.

Type of model / Additional predictors

Logistic regression / Predictor set A

B.9.11 Whether respondent has experienced wheezing in chest in the past 12 months

Definition

This measure is based on responses to the question “Have you had wheezing in your chest at any time in the past 12 months?”. Only “Yes” and “No” responses are accepted, and the probability of the former is modelled by the analysis.

Type of model / Additional predictors

Logistic regression / Predictor set A

B.9.12 Whether respondent experienced coughing or phlegm on most days

Definition

This measure is derived from responses to the question “Have you had coughing or phlegm on most days for a minimum of three months a year and for at least 2 successive years?”. Responses are restricted to “Yes” and “No”, and the analysis models the probability of a “Yes” response.
Type of model / Additional predictors

Logistic regression / Predictor set A

B.9.13 Whether respondent suffers from at least one respiratory health problem

Definition

This measure is derived by determining whether the respondent provides a positive (“Yes”) response to at least one of B.9.9 to B.9.11.

Type of model / Additional predictors

Logistic regression / Predictor set A

B.9.14 Whether respondent has ever been diagnosed with high blood pressure

Definition

This measure is derived from responses to the question “Have you ever been diagnosed as having high blood pressure?”. Response options are limited to “Yes” and “No”. As with B.9.2 to B.9.7, respondents who report a diagnosis at the initial interview are excluded from analysis.

Type of model / Additional predictors

Logistic regression / Predictor set A

B.9.15 Whether respondent has ever been advised to change diet or lifestyle due to high blood pressure

Definition

This measure is based on responses to the question “Have you ever been advised by a health professional to change your diet or lifestyle to reduce your blood pressure or avoid having high blood pressure?”. Only “Yes” and “No” responses are offered. Respondents who report “Yes” at the initial interview are again excluded. The analysis models the probability of a “Yes” response.

Type of model / Additional predictors

Logistic regression / Predictor set A
B.9.16 Whether respondent is currently taking action in relation to diet or lifestyle due to high blood pressure

*Definition*

This measure is based on responses to the question “Are you currently taking any action in relation to your diet or lifestyle because of concerns about your blood pressure?”. Only “Yes” and “No” responses are provided, and the analysis models the probability of the former.

*Type of model / Additional predictors*

Logistic regression / Predictor set A

B.9.17 Whether respondent is currently suffering from high blood pressure

*Definition*

This measure is derived from responses to the question “As far as you are aware, do you have high blood pressure at the present time?”. Responses are restricted to “Yes” and “No”, and the analysis models the probability of a “Yes” reply.

*Type of model / Additional predictors*

Logistic regression / Predictor set A

B.9.18 Number of GP / nurse encounters in past year

*Definition*

This measure is derived from responses to the question “Over the past year how often have you seen or spoken to a GP or nurse either at their practice or at home about yourself?”. Responses are collected as an absolute number of encounters.

*Type of model / Additional predictors*

Analysis of covariance / Predictor set A

B.9.19 Number of hospital outpatient or day bed visits in past year

*Definition*

This measure is derived from responses to the question “Over the past year how often have you visited a hospital outpatient clinic or day beds?”. While responses are collected as an absolute number of visits, the original values were (for technical reasons) dichotomised for analysis at zero versus one or more visits. Reshaped in this way, the measure represents whether the respondent has experienced at least one hospital outpatient or day bed visit in the past year.
Type of model / Additional predictors
Logistic regression / Predictor set A

B.9.20 Number of overnight hospital stays in past year

Definition
This measure is based on responses to the question “Over the past year how often have you had an overnight stay in hospital?” As with B.9.19, the original responses were reduced to a binary quantity – zero versus one or more stays – for analysis.

Type of model / Additional predictors
Logistic regression / Predictor set A

B.9.21 Number of Accident and Emergency attendances in past year

Definition
This measure is derived from responses to the question “Over the past year how often have you visited a Casualty or Accident and Emergency Department for treatment for yourself?” As with B.9.19, the original responses were dichotomised at zero versus one or more stays for analysis.

Type of model / Additional predictors
Logistic regression / Predictor set A

B.10 Self-reported health-related quality of life

B.10.1 SF-36 Physical Functioning scale

Definition
This measure is the respondent’s score on the Physical Functioning scale of the SF-36 Version 2 Health Survey. The SF-36 is a widely-used and well-validated questionnaire which elicits information on various dimensions of health and well-being. Full details of the SF-36 are given in [ref. 3].

Type of model / Additional predictors
Analysis of covariance / Predictor set A
B.10.2 SF-36 Role-Physical scale

Definition
This measure is the respondent’s score on the Role-Physical scale of the SF-36 Version 2.

Type of model / Additional predictors
Analysis of covariance / Predictor set A

B.10.3 SF-36 Bodily Pain scale

Definition
This measure is the respondent’s score on the Bodily Pain scale of the SF-36 Version 2.

Type of model / Additional predictors
Analysis of covariance / Predictor set A

B.10.4 SF-36 General Health scale

Definition
This measure is the respondent’s score on the General Health scale of the SF-36 Version 2.

Type of model / Additional predictors
Analysis of covariance / Predictor set A

B.10.5 SF-36 Vitality scale

Definition
This measure is the respondent’s score on the Vitality scale of the SF-36 Version 2.

Type of model / Additional predictors
Analysis of covariance / Predictor set A

B.10.6 SF-36 Social Functioning scale

Definition
This measure is the respondent’s score on the Social Functioning scale of the SF-36 Version 2.
**Type of model / Additional predictors**
Analysis of covariance / Predictor set A

**B.10.7 SF-36 Role-Emotional scale**

**Definition**
This measure is the respondent’s score on the Role-Emotional scale of the SF-36 Version 2.

**Type of model / Additional predictors**
Analysis of covariance / Predictor set A

**B.10.8 SF-36 Mental Health scale**

**Definition**
This measure is the respondent’s score on the Mental Health scale of the SF-36 Version 2.

**Type of model / Additional predictors**
Analysis of covariance / Predictor set A

**B.10.9 SF-36 Health Transition item**

**Definition**
This measure is the respondent’s score on the Health Transition item of the SF-36 Version 2.

**Type of model / Additional predictors**
Analysis of covariance / Predictor set A

**B.11 Long-standing illness or disability**

**B.11.1 Whether respondent suffers from long-standing illness or disability which limits daily activities / work**

**Definition**
This measure is derived from responses to the question “Do you have any long-standing illness, health problem or disability that limits your daily activities or the kind of work you can do? By disability as opposed to ill-health, I mean a physical or mental impairment, which has a
substantial and long-term adverse effect on your ability to carry out normal day-to-day activities.”. Response options are limited to “Yes” and “No”, and the analysis models the probability of the former.

Type of model / Additional predictors

Logistic regression / Predictor set A

B.12 Use of medications

B.12.1 Whether respondent is currently taking prescribed medications

Definition

This measure is derived from responses to the question “Are you currently taking any medicines prescribed to you by a doctor, including inhalers?”. Responses take the form of “Yes” or “No”.

Type of model / Additional predictors

Logistic regression / Predictor set A

B.12.2 Whether respondent is currently taking ‘over the counter’ medications

Definition

This measure is based on responses to the question “Are you currently taking any medicines that you bought yourself, without a prescription?”. Responses are restricted to “Yes” and “No”.

Type of model / Additional predictors

Logistic regression / Predictor set A
B.13 Additional predictors included in analyses

Predictor set A:

a) A binary indicator denoting whether the respondent is a central heating recipient or a comparison group respondent (coding: 0 = comparison, 1 = recipient). Estimated values of this parameter are the key results obtained from this study.

b) The age of the respondent (i.e. the household member who actually gave the initial interview, and completed the follow-up postal questionnaire), in years.

c) The gender of the respondent (coding: 0 = male, 1 = female)

d) Socioeconomic group (coded as a set of three binary indicators, denoting membership [0 = NO, 1 = YES] of classes AB; C1; and C2. When all three indicators hold zero values, membership of the reference class DE is indicated).

e) Household type (coded as a set of six binary indicators, denoting classification of household [0 = NO, 1 = YES] as single adult; single parent; couple without children; couple with children; pensioner couple; and multiple adult. The reference class of single pensioner is represented by zero values for all six indicators).

f) A simplified representation of housing tenure (coded 0 = owner-occupier, 1 = renter or other tenure type)

g) A group of five binary indicators representing whether the respondent has experienced specific life events during the year prior to the final interview. The events included were (i) serious illness, requiring hospitalisation, experienced by the respondent or a relative / close friend; (ii) divorce, separation or break-up of an intimate relationship; (iii) bereavement (death of a relative / close friend); (iv) a period of unemployment, of at least one month’s duration, experienced personally by the respondent; and (v) a period of unemployment, of at least one month’s duration, experienced by another wage earner in the respondent’s household. These events are represented in the model by binary indicators coded 0 = NO (event not experienced), 1 = YES (event experienced).

h) A representation of change in smoking exposure. This is implemented as three binary indicators, as follows. Element (i) indicates whether the respondent actively smokes at the study endpoint (coded 0 = NO, 1 = YES). Element (ii) indicates whether the respondent is exposed to passive smoking in the home at the study endpoint (coded 0 = NO, 1 = YES). Element (iii) indicates whether the respondent’s exposure to smoking has changed between the first and final data collection waves (coded 0 = NO, 1 = YES).

Predictor set B:

As Predictor Set A, but with the representation of social group and of smoking exposure excluded.

Predictor set C:

As Predictor Set A, but with the representation of smoking exposure excluded.
APPENDIX C REFERENCES


