HOUSING CONDITIONS AND SELF-REPORTED HEALTH: A CROSS-EUROPEAN ANALYSIS

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ABSTRACT

It is now over 20 years since Townsend’s seminal research on poverty in the UK which stressed, amongst other things, the importance of housing conditions as a potential causative factor in poor health. Since then, fuel poverty has been recognised by Government as a valid social problem affecting substantial portions of British households. The relationship between fuel poverty and poor housing conditions on health has been analysed to some extent in the UK, however there remains uncertainty about the relative importance of inadequate housing on human health. Furthermore, there has been virtually no published empirical research on housing and health elsewhere in Europe. This paper attempts to rectify this research deficit. It employs datasets from the European Community Household Panel to assess the impact of various ‘consensual’ indicators of housing deprivation on health status for 14 European countries. The research represents the first comparative assessment of housing conditions and health in Europe. The results demonstrate strong associations between poor self-reported health and indicators of inadequate housing, fuel poverty, low levels of affordability and dissatisfaction with housing, although there appears to be no clear relationship across Europe with regard to the effects of overcrowding on health.

KEYWORDS

Self-reported health, Housing conditions, Fuel poverty, Affordability, Housing satisfaction, Europe
I. INTRODUCTION

Studies analysing the determinants of inequalities in health have, over the past two decades or so, drifted toward a consensus regarding the major explanations for the ‘health divide’ apparent in modern industrial societies. While cultural and genetic explanations have some relevance, most health inequalities are explained by what Peter Townsend has called ‘materialist’ or ‘structural’ explanations [1]. Townsend’s seminal study concluded that much of the inequality can only be understood in terms of the diffuse consequences of the class structure in terms of poverty, work conditions and deprivation in its various forms [1]. Class inequalities in health have been shown to be fundamental in this ‘structuralist’ explanation of health divides. Poor people have been shown to suffer from higher levels of ill health than the more affluent for a variety of ‘materialist’ reasons. The less well-off may lack the necessary resources for achieving a healthy lifestyle; in particular, this can entail inadequate, unhealthy diets [2]. Furthermore, they may also expose themselves to health risks working in more dangerous, risky environments where significant health hazards exist [3]. The poor may expose themselves to higher levels of lifestyle risk factors strongly associated with ill health, such as high smoking rates [4]. It has also been shown that people on low incomes often lose out in the provision of healthcare support [5]. In addition, they may live in poor housing because of low household income and expose themselves to chronic cold and damp conditions [6]. All of the above factors play key roles in explaining the modern-day ‘health divide’.

It is now over 20 years since Peter Townsend’s path-breaking research on UK poverty and inequality. One of the main conclusions in that research stressed the importance of the home (i.e. housing conditions) as a potential causative factor in poor health. Within a decade or so, Brenda Boardman demonstrated that large proportions of households in the UK were so
deprived in their housing conditions, and so inadequately protected from the cold, that large numbers were dying each year during Britain’s winter months because they were fuel-poor [7]. Since then, the UK government has recognised fuel poverty as a *bona fide* social problem. However, there is still a large degree of uncertainty regarding the relative importance of fuel poverty and poor housing conditions on human health. There is a growing body of research testing this health linkage. Recent research testing the association between ill health and poor housing conditions, especially in relation to inadequately heated, damp housing, has been demonstrating strong adverse health implications [8,9]. However, almost all of this research is conducted in the UK – where most fuel-poverty research has occurred – and very little analysis has assessed the relationship between housing conditions and health in the rest of Europe, especially in Mediterranean countries. In addition, there is a dearth of research that identifies the health effects of housing dissatisfaction and housing affordability. This research deficit has occurred, not because of a lack of interest in the area, but because of some major logistical reasons, most obviously the lack of comparable cross-country data.

In addition to public-health implications of poor housing conditions and fuel poverty, there is a strong environmental-policy perspective. Many countries demonstrating poor levels of domestic energy efficiency are consuming greater amounts of energy than necessary, as energy inefficient households must consume more fuel to heat their homes adequately. This is of considerable importance for policy-makers given that many European countries are having extreme difficulty in meeting their agreed targets for stabilisation of greenhouse-gas emissions under the Kyoto Protocol and acidification precursors under the Gothenburg Agreement [10].
This paper tests the relationship between health and a number of consensual social indicators of housing deprivation across 14 countries in Europe using data from the first pan-European survey on social conditions, the European Community Household Panel. The longitudinal data cover the four-year period 1994-97, and the following four groups of indicators are analysed:

- Fuel poverty
- Housing conditions
- Housing affordability
- Housing satisfaction

The paper’s European study frame is important, not just because there is so little cross-European research on health and housing, but because there is a growing concern that large proportions of Europeans are living in sub-standard housing, with households considerably under-protected from the outdoor environment [11]. Thus, there is a strong need to assess comparatively whether, and to what extent, poor housing is responsible for adverse health outcomes throughout the Member States. The next section describes the European context in more detail and there follows a subsequent section outlining the methodology for the study, before the cross-country results are presented sequentially. In addition, the key policy implications of the findings are discussed at the end of the analysis.

II. HOUSING: THE EUROPEAN CONTEXT

Housing standards, especially those pertaining to energy efficiency, vary considerably across Europe [11]. Of course, certain countries prioritise thermal measures in the design and
construction of new housing, as it is essential protection to combat the relatively severe winters experienced in these colder climates where winter temperatures are often below freezing [6]. Nonetheless, the UK has been shown for some time to suffer from among the highest rates of seasonal mortality in northern Europe [12]. More recent cross-country analysis also identified Ireland as a country marked by similarly large variations in excess winter mortality in northern Europe, and it has been shown that such mortality rates result, in no small part, from the inadequately protected, thermally inefficient housing stocks in these countries [13,14]. There are also studies showing strong associations between inadequately heated homes and increased rates of morbidity; higher incidences of various cardiovascular and respiratory diseases have been associated with cold exposure from within the home [15,16]. Thus, when temperatures fall during a typical British or Irish winter, households need to increase their expenditure on fuel considerably to heat their home adequately, owing to the poor level of heat retention in their dwellings. The problem of fuel poverty occurs, therefore, when a household does not have the adequate financial resources to meet these winter home-heating costs, and because the dwelling’s heating system and insulation levels prove to be inadequate for achieving affordable household warmth. The adverse health effects are thought to be a serious cause for concern\(^1\).

Households in EU-14 are asked about various aspects of their housing conditions in the European Community Household Panel (ECHP) survey each year. The indicators selected for this analysis pertain to the energy-efficiency of the dwelling, overcrowding, affordability and satisfaction with housing conditions. The questions relating to objective housing conditions and energy efficiency ask householders about physical attributes, such as whether they have leaky roofs, damp walls, ceilings or floors or rotten windows. Subjective questions also

\(^1\) There is some ongoing research in this area in the UK, but very little elsewhere in Europe. Rudge and Nicol present an overview of current British research in this area [9].
attempt to elicit levels of overcrowding, ability to heat the home and pay utility bills, as well as housing affordability and satisfaction with housing.

Data on housing conditions and energy-efficiency levels in southern Europe are notoriously difficult to obtain, and their reliability is often questionable. However, a provisional cross-country analysis of housing conditions, together with the limited data presented in Table 1, indicates that high levels of energy efficiency in southern-European housing are not prioritised in building regulations [17]. It is an often-overlooked fact that many parts of southern Europe also face cold winter temperatures, yet their housing stocks appear to be poorly protected from the cold, and they are also the poorest countries in Europe using measures such as income poverty and inequality as well as macroeconomic indicators like GDP per capita\(^2\). Despite this, there has been virtually no published research on housing conditions, fuel poverty and health in southern Europe, despite a growing body of research on this area in the UK and Ireland. This paper attempts to rectify this research deficit by testing the hypothesis that households reporting indicators of housing deprivation (based on socially perceived necessities) realise higher (proportionate and absolute) variations in the incidence of self-reported poor health.

Table 1 about here

The British and Irish housing stocks appear to be among the most energy inefficient in northern Europe when examined using multiple criteria, though the Austrian and Belgian stocks are also relatively below-par in this regard. From Table 1 it can be seen that levels of cavity-wall insulation are considerably below the EU-average in both the UK and Ireland.

\(^2\) Italy being the exception here, with GDP per capita considerably above EU-average.
Ireland has the lowest level of double-glazing in this group of northern European countries, with just one-third of all dwellings fitted with this measure; France, Austria and the UK are also performing badly in this regard. The UK has the lowest level of floor insulation in northern Europe, with just 4% of dwellings equipped. The only energy-efficiency measure with which Irish and British households perform satisfactorily is roof insulation. Conversely, countries such as Denmark, Finland, Sweden and Norway demonstrate exemplary thermal-efficiency standards. It is, of course, unlikely to be a coincidence that such countries also exhibit the lowest levels of fuel poverty in Europe, as Table 2 reports. Similarly, it is equally unlikely to be a coincidence that southern-European nations, which appear to be the least energy efficient homes in Europe, also suffer by far from the highest levels of fuel poverty in Europe (Table 2).

Many countries demonstrating poor levels of domestic energy efficiency are consuming greater amounts of energy than necessary, as people inhabiting inefficient dwellings must consume more fuel to heat their homes adequately. As can be seen from Table 1, Irish energy consumption per household is the highest in northern Europe, at 102,000 Megajoules per annum, compared to an EU-13 average of 77,000 MJ. Consequently, environmental emissions, such as CO₂, SO₂, NOₓ and particulate matter, are also greater. This is of considerable importance given that many European countries – including Ireland – are having extreme difficulty in meeting their agreed targets for stabilisation of greenhouse-gas emissions under the Kyoto Protocol and acidification precursors under the Gothenburg Protocol [10]. These are legally binding commitments, and failure to achieve the challenging targets set for 2010 will entail heavy punitive fines for countries breaching their agreed targets.
There are a number of other adverse housing conditions relating to the energy efficiency of the dwelling which are likely to be pernicious to human health, and these are reported in Table 2. Households lacking central heating, those unable to pay on time their utility bills, those that suffer from household damp and rotten windows, and those with inadequate heating facilities are likely to be suffering from some form of either intermittent or chronic fuel poverty. These social indicators of housing deprivation – most of which are deemed socially perceived necessities [17,18] – have been employed to derive a composite estimate of fuel poverty for each country in EU-14. It is clear that southern Europe suffers from the most persistent problems of fuel poverty and housing deprivation, however it should also be noted that certain indicators of housing deprivation are more suited to colder northern climates than southern ones. For instance, 91.7% of Portuguese households lack central heating and, thus, exhibit housing deprivation. However, the lack of central heating is of more consequence in colder, northern climates that in warmer, southern countries. Across northern Europe, pockets of deprivation exist. There are substantial proportions of households in France lacking adequate heating facilities. Damp appears to be problematic in Belgium, France and the UK; the latter two countries also display significant problems with rotten windows. Almost a quarter of Belgian households lack central heating, while over a fifth of Irish dwellings are not equipped with this type of heating system (Table 2).

*Table 2 about here*

In addition to fuel poverty and energy inefficiency, there are other housing conditions which are thought to provoke adverse health outcomes. These conditions include overcrowding, unaffordable housing costs and general housing dissatisfaction. In relation to the former, there is a long-standing debate about the relative importance of household crowding, and the
literature showing the relationship between crowding and ill health reports somewhat mixed results. Table 2 shows that there are significant variations in the levels of overcrowding across EU-14, with the highest incidences again in southern countries, so this study aims to shed some light on the relationship between household crowding and health using pan-European data. The lack of affordable housing has been identified as a key factor in the “dismal housing situation” facing prospective home-owners in Accra, and strong links between affordability and satisfaction with housing have been shown [19]. The lack of affordable housing, and the associated high housing costs, is a considerable problem in Europe, as Table 2 demonstrates. Over a third of Italian households are suffering from heavily burdensome housing costs, and 32% of households in Spain report similar difficulties. Similarly stark results are found in Belgium and Greece, where a quarter of households face such difficulties.

This paper tests the (attendant) hypothesis that unaffordable housing costs impact on the incidence of poor health across Europe. Table 2 also illustrates how levels of housing dissatisfaction across Europe are substantial, with over 13% of Greek households and one-in-nine households in Italy and Portugal respectively “completely or very dissatisfied” with their housing. The link between housing satisfaction and happiness is well-researched and highly correlated; indeed, it has been shown by Barresi, amongst others, to be the key factor influencing happiness, especially in older populations [20]. Southern Europe appears to generally be more dissatisfied with their housing conditions than northern-European households (Table 2). In light of these facts, the final part of the analysis on housing and health in this paper tests for a relationship between housing satisfaction and health status across Europe.
III. EUROPEAN COMMUNITY HOUSEHOLD PANEL (ECHP)

The ECHP is a standardised, multi-purpose and longitudinal survey, providing comparable information across European-Union Member States on income, work and employment, poverty and social exclusion, housing, health and other diverse social indicators regarding the living conditions of private households and persons. The crucial feature of the ECHP is the harmonisation of its methodology and results, through the creation of a centralised questionnaire. During the first ‘wave’ of the questionnaire, the collection of data occurred in 12 countries in Europe (all EU Member States in 1994); this increased to 13 in 1995 (when Austria joined), 14 in 1996 (with the inclusion of Finland), and 15 in 1997 (Sweden is now on board). Consequently, some flexibility was granted to each participating country to adapt common procedures to acquiesce with their own local situations. Data are collected by National Data Collection Units in each country. These Units – normally research institutes or national statistics’ centres – tailor the questionnaire to make it suitable for their own respective countries. High response rates of about 70% were obtained for the first four years of the survey, and some 60,000 households and approximately 130,000 adults are interviewed successfully in each wave. The data used in this paper come from the first four years of the ECHP, (i.e. 1994-1997). More details of the survey are available in the ECHP Methodology publication [21].

It should be noted that some data from the ECHP were either unavailable or statistically insignificant and have been omitted; such omissions are marked ‘–’. The guidelines imposed by Eurostat regarding the use of the ECHP users’ database are strictly adhered to, so that the anonymity and statistical robustness of the datasets are upheld. Due to the late adoption of the
ECHP survey by Austria (1995) and Finland (1996) data for these countries are unavailable prior to their joining the ECHP team.

IV. HEALTH & HOUSING CONDITIONS

In this section, the incidence of self-reported poor health (households reporting either “very bad” or “bad” health status) is analysed against self-reported housing conditions to assess if such households are displaying significantly higher rates of poor health. As should always be noted with self-reported data, there are some important caveats, especially in relation to the margin of error which can be attributed to self-reporting. However, the very large sample size of the ECHP dataset acts, somewhat, as a compensating factor regarding the potential margin of error normally expected with self-reporting. There are seven social indicators of housing deprivation. The first relates specifically to fuel poverty. The remaining deprivation indicators (with the exception of overcrowding) relate to the thermal efficiency of the dwelling and, as such, can be considered social indicators of fuel poverty [17,22].

Inability to Adequately Heat Home

The analysis begins by analysing the levels of self-reported poor health in those households declaring an inability to adequately heat the home – a key indicator of fuel poverty – against those that do not declare such difficulties. Gordon et al., using data from a recent UK Omnibus Survey, reported that the ability to heat living areas of the home adequately is regarded as essential by 94% of respondents, making this socially perceived necessity the

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3 Most countries are ‘over-sampled’ in the ECHP. This is because households are followed and re-surveyed year after year and, as would be expected, the number of respondent households declines each year (some move address, others are unavailable for interview, etc.). To illustrate the level of sampling, over 4,000 households
strongest indicator of material deprivation after ‘the ability to provide a bed for everyone in
the household’ (95%) [18]. Energy inefficiency in the home can make home-heating such a
burden to low-income householders that they cannot afford to heat their home adequately and,
as such, live in fuel poverty [7]. This analysis tests the hypothesis that fuel poverty and
inadequately heated homes result in higher incidences of poor health status.

The results show a clear relationship between fuel poverty and self-reported poor health status
(Fig. 1). The proportion of households demonstrating bad health is significantly higher among
fuel-poor households (those that cannot adequately heat their home) for each of the 14
Member States under analysis. Across EU-14, 6.8% of households that can afford to
adequately heat home report ill health (95% confidence intervals (CI) of 5.5% and 8.1%),
compared with 15.5% of those households unable to adequately heat their homes (CI=12.9,
18.2, α=0.05). T-tests demonstrate that the results are highly significant (P<0.001). A strong,
statistically significant correlation is found between both sets of self-reported health data
across EU-14 (R=0.75, P=0.002). This indicates that the data are ‘behaving’; countries with
high levels of poor health status among households that can afford to heat their homes are
consistently reporting higher levels of poor health among households that cannot afford to
heat the home, and vice versa, as theory would predict. These results, based on subjective
data, appear to corroborate the results of Collins [15], and more recent research by Evans et
al. [16], in showing an association between sub-optimally heated homes and decreased health
status.

Figure 1 about here

were interviewed successfully in Ireland for 1994. This is almost three times the number necessary to be
statistically significant.
The most notable differences occur in the Netherlands (where 14.3% more households declare poor health if fuel-poor), Portugal (a 14.0% variation), the UK (11.7%) and Germany (11.4%). The highest levels of poor health status are reported in Portugal, where 26.2% of fuel-poor households are declaring either “very poor” or “poor” health; Portugal is also found to have the highest level of fuel poverty in Europe, with half of Portuguese households affected. However, perhaps the most important findings relate to the proportionate variations reported in health status among households declaring the deprivation indicator. The largest variations in health status in proportionate terms occur in the Netherlands, where fuel-poor households are some 3.4 times more likely to declare poor health status than other households, followed by the UK (1.9 times higher incidence among fuel-poor households). Conversely, proportionate increases in levels of poor health are far smaller for Finish households.

Adequate Heating Facilities

Households without adequate heating systems may find it difficult to heat their homes adequately at an affordable cost and, as such, may be living in fuel poverty. The relationship between poor health and fuel poverty was shown to be strong in a previous section, so it is useful to assess the relative importance of the heating system (one of the three crucial components of the fuel-poverty equation) as a determinant of health status.

The results in this analysis demonstrate that households without adequate heating facilities demonstrate substantially and persistently higher levels of poor health across Europe, as might be predicted. An average of 12.0% of households without adequate heating facilities across EU-14 are reporting poor or very poor health status (confidence intervals of 9.1% and 14.9%,
α=0.05) compared with 7.4% of households without this adverse housing condition (CI=5.4%, 9.5%, α=0.05). T-tests reject the null hypothesis that these variations are insignificant, and a very strong P-value is found (P<0.001). The correlation between the incidence of poor health among households lacking adequate heating facilities and those households with adequate facilities is very strong (R=0.92, P<0.001), and all countries report higher incidences of poor health among households lacking adequate facilities. Fig. 2 illustrates the mean incidences of poor health among households with and without this deprivation indicator.

Figure 2 about here

The biggest percentage-point variations in the incidence of poor health status occur in Italy (8.8% difference in the incidence of poor health between households lacking adequate heating facilities and those with adequate heating facilities), Greece and Spain (8.3% respectively). It is noteworthy that these countries, by and large, endure the mildest winter climates in Europe, yet they appear to exhibit strong associations between inadequate heating systems and adverse health outcomes. The highest overall level of poor health is found in Portugal, where almost a quarter (24.1%) of households lacking adequate heating facilities are self-declaring poor health. Ireland appears to demonstrate the largest proportionate variations in health status, with an incidence of poor health some 1.5 times higher among households displaying the lack of this socially perceived necessity. This result indicates that the relatively high levels of fuel poverty and excess winter morbidity could be alleviated, in part, by upgrading the heating systems of fuel-poor households. The Netherlands and Greece follow closely, with an increased incidence of poor health of approximately 127% and 95% above the incidence among households with adequate facilities. It is interesting to compare the results of this
subjective indicator relating to the heating system of the dwelling with the objective indicator regarding the lack of central heating. This is done in a later section.

**Damp**

The presence of damp indicates that the dwelling may not be energy efficient. It may also be a manifestation of a continuously unheated or ineffectively heated home. In both cases, it acts as a good objective indicator of fuel poverty, as well as a strong indicator of housing deprivation across EU-14 [8]. In fact, it has been reported that 93% of British households regard a damp-free home as a key socially perceived necessity (third-highest in a list of over 50 items) [18]. There is a very substantial epidemiological and public-health literature showing causal relationships between household damp and ill health, and particularly regarding an increased incidence of asthma [23-25]. In addition, chronic, long-term exposure to cold and damp in the home has been associated with premature mortality [26], although it has been demonstrated that indoor cold exposure, through being unable to adequately heat the home, is more strongly associated with health outcomes than damp *per se* [16].

Households are assessed to identify if there are any patches of damp on the walls, floors or foundations in their home. Households are, again, split into those reporting the presence of household damp and poor health status versus those reporting poor health status but no household damp. The results corroborate the vast majority of medical literature in showing a strong relationship between damp housing and poor health status. Across EU-14, a consistently higher incidence of poor health status is reported among households with damp; mean levels of 12.1% (CI=8.0%, 16.2%, α=0.05) and 7.6% (CI=5.5%, 9.8%, α=0.05) are found. T-tests reject the null hypothesis that these variations are not significant (P<0.001), and
a correlation coefficient of 0.95 (P<0.001) is found between the incidences of poor health among households with damp against those households with poor health and no problems of damp. These results can be seen in Fig. 3.

Figure 3 about here

Large variations of self-reported health are found in Portugal (13.3% in percentage-point terms) and Italy (9.1%). The highest overall level of poor health is found in damp households in Portugal, where some 31.4% are affected, followed by 19.9% in Italy. The largest proportionate variations in health are found again in Ireland, with an incidence 182% higher among households declaring damp, followed by Greece (102%) and Italy (84%). It has long been speculated that damp in Ireland (particularly on the western Atlantic seaboard) is problematic, and the results seem to suggest a strong link between damp exposure and adverse health impacts.

Rot

Window frames which have become rotten are not energy efficient and, as such, can be considered a good (objective) indicator demonstrating either the existence of, or the potential for, fuel poverty and general housing deprivation. Again, households declaring this housing condition and reporting poor health status are compared against those households free of problems with rot but who also report poor health status.

Another strong result is found, with consistently higher levels of poor health found amongst households with rotten windows. Mean incidences of 12.5% of households (CI=8.2%, 16.9%,
α=0.05) and 7.7% of households (CI=5.5%, 9.9%, α=0.05) are found across EU-14 for poor health status and household rot against poor health status and no household rot (Fig. 4). T-tests show that this relationship is statistically significant, albeit not quite as strongly as previously (P=0.001), while a correlation coefficient of 0.94 (P<0.001) indicates the consistency of the association between increased incidence of poor health and presence of household rot.

*Figure 4 about here*

The largest percentage-point variations in poor health status are found in Portugal (13.5%) and Greece (10.0%), with the former also reporting the highest overall level of ill health (some 31.7% of households with rotten windows are declaring either very poor or poor health). Ireland, Greece and Italy again demonstrate the largest proportionate increase in the incidence of poor health; those with rotten windows are reporting incidences of poor health status 168%, 120% and 91% (respectively) more than those without rotten windows. Rotten windows are likely to be of more consequence to human health in colder, wetter climates, and the Irish data again appear to be indicating strong health associations with this indicator.

**Central Heating**

Households not possessing central heating or similar heating systems generally find it more difficult to efficiently heat the home than households that do possess such systems. The lack of either central heating or electric-storage heating is a potentially good objective indicator of fuel poverty and a very good indicator of housing deprivation, especially in northern Europe.
The results of this analysis show that households lacking such heating systems in Europe are persistently reporting higher incidences of poor health than those households equipped with central or electric-storage heating. A mean incidence of poor health of 6.9% (CI=5.2%, 8.5%, $\alpha=0.05$) of households is calculated for those possessing central and electric-storage heating, compared with 12.3% (CI=9.6%, 15.0, $\alpha=0.05$) of households lacking such heating equipment. T-tests show that this is a significant result (P<0.001), while a correlation coefficient of 0.95 (P<0.001) indicates that there is a high level of consistency in the association between increased incidences of poor health among households without central-heating systems versus those possessing such systems. These levels correspond very well with the subjective data pertaining to the lack of adequate heating systems in an earlier section. Self-reported health among households lacking adequate heating facilities was 12.0% (compared with 12.3% for those without central heating) and 7.4% for those with adequate heating systems (compared with 6.9% for those with central heating. Thus, the objective and subjective data appear to be well-matched and yield comparable results.

*Figure 5 about here*

The largest variations (in percentage points) in poor health status are found in Portugal (8.7% difference in incidence between those with and without central heating), Italy (8.3%) and Greece (7.4%), as can be seen in Fig. 5. Once again, the highest incidence of poor health is found in Portuguese households, with 23.7% of households lacking central or electric-storage heating suffering from either poor or very poor health. The largest variations proportionately in poor health status are found in Greece (121% increase in incidence among households with no central heating), Ireland (116%) and Luxembourg (115%).
Leaky Roofs

A leaking roof has a number of adverse impacts on households’ well-being. Besides the obvious implications for energy efficiency (and the associated excess fuel bills), a leaking roof may cause damp and mould spores to develop in the dwellings’ ceilings and walls. Such spores are especially pernicious to human health, especially for the very young and the elderly, and can lead to respiratory conditions, such as bronchitis and asthma [8]. In addition, 82% of British households regard the ability to maintain the home in a decent state as essential, while 93% regard a home free of damp as a necessity. As such, the presence of a leaky roof acts as a solid indicator of housing deprivation, as it appears to be a strong socially perceived necessity.

While leaking roofs are, again, most commonly found in southern parts of Europe, it is calculated that 12.6% of households suffering from this housing condition are reporting “poor” or “very poor” health status across Europe (CI=8.1, 17.1, \( \alpha = 0.05 \)), compared with 8.0% of households not demonstrating such problems (CI=5.6, 10.3, \( \alpha = 0.05 \)). T-tests show that these results are significant at the 5% level (P<0.001). A very strong correlation coefficient is found for the two sub-samples (R=0.96, P<0.001) with only Germany breaking the trend, showing a marginally higher incidence of poor health among households without leaking roofs.

Figure 6 about here
The largest percentage-point variations are found in Portugal (14.3% more households without adequate heating facilities are suffering from poor health status than those with adequate facilities), and Spain (10.4% variation). The highest level of poor health is found in Portugal, where 34.2% of households without adequate heating facilities self-report poor health (Fig. 6). Leaky roofs are likely to be of most concern to households that endure more severe, wet climates. In this regard, it is unsurprising that Ireland demonstrates the largest proportionate increase in the incidence of poor health among households with leaking roofs (138%). These results are followed by Luxembourg (95%) and Greece (84%).

Overcrowding

Household overcrowding is considered undesirable for human health, as it has been shown to be linked with increased rates of various viral and bacterial infections, especially in the respiratory tract [8]. There is a long-standing debate about the relative importance of household crowding and social problems, and the literature showing the relationship between crowding and ill health reports somewhat mixed results. Household overcrowding, when used as a socio-economic indicator, has often been defined objectively as households with more than 1 person per room, though this definition may be increased to more than 2 persons per room for more conservative results [27]; overcrowding has also been calculated in self-reporting data by asking householders whether they have enough space to meet their needs [11]. The levels of overcrowded households may be considered to be useful indicators of housing conditions and, more generally, quality of life across EU-14, however their association with health outcomes remains inconclusive. This analysis tests whether overcrowded households in Europe exhibit significantly higher levels of poor health status than uncrowded households.
Households in this analysis are asked whether they have enough space to meet their needs or are, otherwise, ‘overcrowded’. The results are interesting, as no clear relationship is found using the self-reported datasets (see Fig. 7). In fact, a slightly higher incidence of poor health is found among uncrowded households (8.5% compared with 8.1% across EU-14). While there is a strong correlation between levels of poor health in uncrowded and overcrowded households, the actual country-to-country variation is not significant across Europe (P=0.40) and neither percentage-point nor proportionate variations are significant. This is a notable finding, and it goes against recent research in the UK [8] and in New Zealand households [28], both of which showed adverse health implications of living in overcrowded environments. It is possible that the overcrowding findings may be suffering from biases sometimes associated with self-reporting data, such as the influence of cultural factors, which may explain the high level of interplay found with these results.

*Figure 7 about here*

**V. HEALTH AND HOUSING AFFORDABILITY / SATISFACTION**

There are several good social indicators in the ECHP which may be used to assess housing costs and affordability. The ability to meet housing costs without great difficulty is a good overall indicator of the level of hardship facing householders in relation to mortgage and rent payments. The level of households stating that housing costs are heavily financially burdensome is taken as an indicator of the lack of affordable housing in EU-14. Another indicator of housing finances relates to utility bills. Households unable to pay, as scheduled, their utility bills during a 12-month period are also employed as an indicator of housing
affordability. Such a deprivation indicator may also be employed in Consensual fuel-poverty analysis, as households unable to pay on time their utility bills are unlikely to be able to afford adequate home heat and may even face disconnection from their supplier, compounding the potential experience of fuel poverty. Housing satisfaction is also assessed in this section.

**Housing Costs**

Households were asked to consider their income and their expenditure on housing, i.e. their mortgage or rent payments, and declare whether or not they found these costs to be financially burdensome. As the relationship between affordability and satisfaction with housing has been previously demonstrated\(^4\), it is considered useful to test if the association between housing affordability and satisfaction may be extended to health outcomes.

Households with heavily burdensome housing costs are found to be associated with increased incidences of poor health status across EU-14, with the exception of Greece, where the relationship is negative. An overall average incidence of poor health of 12.7% (CI=9.2%, 16.3%, \(\alpha=0.05\)) is calculated for households whose housing costs are heavily financially burdensome, compared with just 7.2% (CI=4.8%, 9.5%, \(\alpha=0.05\)) of those households whose housing costs are easily met. T-tests reject a null-hypothesis scenario with ease (\(P<0.001\)), although a somewhat lower correlation coefficient is found between the two sub-samples (\(R=0.75, P=0.002\)), indicating a less-than-perfect fit in the model; this is attributable, to a large degree, to the somewhat anomalous Greek data (Fig. 8).

\(^4\) [19].
Large variations in self-reported poor health are found in Luxembourg (13.4%) and Portugal (12.2%). Once again, the highest overall level of poor health is reported for Portuguese households, with 30.3% of households whose housing costs are financially burdensome declaring poor or very poor health. The main cause for concern with this indicator relates to the proportionate results. In the Netherlands, a very large proportionate increase is calculated in the incidence of poor health among those with burdensome housing costs – 3 times that found among households not declaring burdensome costs. Luxembourg and the UK also demonstrate large proportionate increases (250% and 130% respectively).

**Utility Bills**

A household which has been unable to pay on time a scheduled utility (gas or electric) bill over the previous 12 months is most likely finding it difficult to keep the home adequately heated and, as such, this affordability indicator also assists in identifying fuel poverty.

The results in this paper indicate a negative health outcome with this affordability indicator. About 12.8% (CI=9.1%, 5.5%, α=0.05) of households unable to do this are self-reporting poor health status, compared with 7.6% (CI=5.5%, 10.9%, α=0.05) of households able to afford their utility bills; t-tests show that these variations are highly significant (P<0.001). A strong correlation coefficient (R=0.85, P<0.001) demonstrates that there is a high degree of consistency in the self-reported health data, with all countries reporting higher incidences of poor health among households that experience difficulties in paying their utility bills as scheduled (Fig. 9).

*Figure 9 about here*
Large variations in the incidence of poor health are calculated in percentage-point terms for Luxembourg (13.7%) and Portugal (7.2%). Portuguese households unable to pay utility bills on time demonstrate the highest overall level of poor health, with 29.6% affected. In proportionate terms, Luxembourg appears to have the highest variation in the incidence of poor health among households declaring an inability to pay utility bills, with an incidence of 210% more than households that can meet utility bills as scheduled. Both Belgium and the Netherlands also display similar health outcomes, with an increase in the incidence of poor health of 124% respectively.

**Housing Satisfaction**

In this section households are asked to rate their satisfaction with their housing on a scale of 1 (“completely satisfied”) to 6 (“completely dissatisfied”). The proportion of households who are either “completely dissatisfied” or “very dissatisfied” (5 or 6 ratings) are combined as a measure of housing dissatisfaction, and households either “completely satisfied” (1) or “very satisfied” (2) are combined as a measure of satisfaction with housing. Self-reported health data are compared across the sample. These results are considered important, as housing is a fundamental quality-of-life indicator. The link between housing satisfaction and happiness is well-researched and highly correlated; indeed, it has been shown to be the key factor influencing happiness, especially in older populations [20]. It was though beneficial, therefore, to test the link between happiness, housing satisfaction and poor health status, as such a result may have strong policy implications.

The results are remarkable in terms of their magnitude, as they show a very powerful relationship between satisfaction with housing and health status. Across EU-14, repeatedly
higher incidences of poor health are reported among dissatisfied households for all countries considered in the analysis. A mean incidence of 14.2% (CI=10.1%, 18.2%, $\alpha=0.05$) of households “completely” or “very” satisfied with their housing report poor health, compared with 30.5% (CI=22.1%, 38.8%, $\alpha=0.05$) of households “completely” or “very” dissatisfied with their housing conditions. T-tests show that this variation is highly significant ($P<0.001$), while a correlation coefficient of 0.91 ($P<0.001$) demonstrates the consistency of the relationship between the two self-reported health datasets.

The largest variations in poor health are calculated for Portugal, where a difference of 35.2% is found, followed by Italy (24.3%), Greece (23.6%) and France (23.3%), as can be seen in Fig. 10. One of the most startling results in this analysis relates to the level of poor health found among Portuguese households “completely” or “very” dissatisfied with their housing; a remarkable 69.7% of these households are demonstrating poor health status which is a serious cause for concern. Such levels of poor health are over twice the average rate found in the dissatisfied households’ group across EU-14 and some five times the incidence calculated for satisfied households across Europe. In proportionate terms, variations in health are most notable in the Netherlands, where dissatisfied households demonstrate an increase in the incidence of poor health of 240% above that among satisfied households. France and Greece also display large proportionate variations in health outcomes (incidence of poor health in dissatisfied households 180% and 171% more than satisfied households respectively). While these results may have implications for public health in such countries, it is important to bear in mind that the incidence of dissatisfaction with housing across Europe is generally low to
moderate, with only Italy, Greece and Portugal demonstrating levels of more than one-in-ten dissatisfied households.

VI. DISCUSSION

This paper has presented a comparative analysis of the association between health and a variety of social indicators of housing deprivation in Europe using the first standardised, longitudinal, pan-European dataset on social indicators. This empirical analysis has shown that there are a number of serious causes for concern. The first major conclusion pertains to the strong relationship found between housing conditions and health. A number of social indicators relating to housing deprivation were employed to assess the health effects of lacking various socially perceived necessities. The results show that, with the exception of overcrowding (for which no relationship is found), all other (6) indicators are found to be significantly associated with increased incidence of poor health status in EU-14. The (in)ability to adequately heat the home – a key socially perceived necessity and indicator of fuel poverty – is found to result in particularly higher incidences of poor health status in the Member States analysed, with over twice the level of poor health reported among fuel-poor households. It was also found that the least energy efficient housing stocks tend to suffer from the highest incidences of poor health. Generally, the highest levels of aggregate poor health were found in southern Europe, where housing conditions (regarding both thermal efficiency and general housing deprivation) appear to be the poorest. In northern Europe Austria, France, Luxembourg and the UK demonstrate high incidences of poor health among deprived households and those with below-par housing conditions. Table 3 summarises the statistical results of the paper.
Housing affordability is also found to be related to health status in EU-14, with significantly increased levels of poor health reported among those with financially burdensome housing costs and those unable to pay utility bills on time. In addition, poor health is found to be highly associated with housing dissatisfaction, with 30.5% of dissatisfied households in EU-14 declaring poor or very poor health; the incidence of poor health of 69.7% among dissatisfied households in Portugal is especially worrying (Table 3).

It is important to bear in mind that, while the incidence of poor health is important across EU-14 in identifying aggregate health outcomes, it is perhaps more useful to compare the proportionate variations in the incidence of poor health associated with various social indicators, as this indicates more precisely the health effects of a given deprivation indicator. This is because poorer countries (like Greece, Spain and Portugal) are more likely to report higher incidences of poor health regardless of whether or not they declare deprivation indicators. Some distinct patterns emerge when proportionate variations in health are examined across EU-14. Ireland appears to suffer from the largest proportionate increases in poor health among households demonstrating an indicator of fuel poverty or poor housing conditions; Greece and Italy also suffer from large proportionate increases in poor health with regard to housing deprivation and fuel poverty. The Netherlands suffers persistently from the largest proportionate increases in poor health with regard to housing affordability and satisfaction with housing, while Luxembourg also performs poorly with regard to the former indicator.
Although many results appear to corroborate the majority of research regarding the relationship between housing deprivation and health, there are some apparent anomalies. Despite having among the least energy efficient housing stocks in northern Europe (Table 1), high levels of housing deprivation (Table 2), and among the highest levels of income poverty, and inequality in Europe [29], Irish households persistently report among the lowest absolute levels of poor health in EU-14. A number of interpretations are possible, however one plausible explanation is that the Irish, either unintentionally or otherwise, ‘under-declare’ their self-perceived levels of poor health. As was discussed earlier, cultural idiosyncrasies often play a part in self-reported results, and it is possible that they affect the (relatively low) magnitude of absolute levels of self-reported poor health in Ireland. The findings regarding the lack of a relationship between health and overcrowding also require some additional comments. There is a considerable medical and social-policy literature highlighting the effects of health on crowding in the home. However, much of this research uses objective measures of overcrowding (as opposed to subjective, self-reporting measures). It is possible that the results are showing some interplay across EU-14 owing to cultural factors. Many households may feel embarrassed to declare shortage of space, while others may not regard their housing conditions as crowded when, using an objective measurement, such households may be defined as objectively overcrowded\(^5\).

VII. POLICY RECOMMENDATIONS

The are some fundamental policy implications of these findings. The first relates to the relationship between poor housing conditions – especially as regards fuel poverty – and adverse health outcomes. The market failure surrounding domestic energy efficiency begs for

\(^5\) In a recent cross-country analysis of housing conditions in Europe, it was showed that Irish and Italian households continuously under-declare their perceived levels of household crowding, despite objective measures
government intervention to alleviate the social problems associated with fuel poverty. Much has been done in the UK over the past decade to reduce fuel poverty, and the latest estimates show that the proportion of British households living in fuel poverty has declined from 34.7% in 1991 to 22.2% in 1996 to 16.4% in 1998, representing a 53% reduction over seven years [30]. It is likely that these reductions have translated into reduced levels of poor health in the UK, as the results of this paper demonstrate that British households are reporting only moderate variations in poor health among deprived households. The same cannot be said for Irish households, who report the largest variations in poor health associated with housing conditions. The relatively poor housing conditions in Ireland are, thus, of considerable public-health concern. Southern-European Member States (Greece, Italy, Portugal and Spain) demonstrate the highest aggregate levels of fuel poverty and housing deprivation in Europe (Table 2) and, unsurprisingly, this study has shown that they also exhibit large health divides associated with housing deprivation.

Large-scale, State-backed energy efficiency programmes in the domestic sector have been shown to be highly cost-effective, and can be conducted at negative cost to the exchequer [31]. This paper argues for similar State-led programmes aimed at improving housing conditions and energy-efficiency levels in those countries exhibiting large levels of housing deprivation and associated poor health. Such a programme could increase the affordability of housing (by reducing home-heating costs) and reduce fuel poverty and associated poor health. In addition to the public-health benefits, such a programme would also reduce domestic energy consumption and attendant environmental emissions, and assist governments in achieving environmental-policy agreements on greenhouse gases and acidification precursors. It is likely that such government intervention would also be politically beneficial, as it is
probable that, along with positive health outcomes, levels of housing satisfaction (which were shown to be strongly related to people’s happiness) would also improve as a result.

However, the large initial capital investment required for such remedial programmes is by no means trivial⁶, and it is unlikely that (myopic) governments will invest in such measures because of the long-term nature of the pay-off to society. Thus, it is important to urge those households with adequate disposable incomes to invest in housing improvements without State subsidisation. This can be done to varying levels of success by information and awareness campaigns highlighting the net private benefits of installing energy-saving measures in the home. Nonetheless, governments wishing to tackle the problem of fuel poverty and related ill health must acknowledge that the majority of fuel-poor homes, being low-income households, are unable to afford this remedial work and will need State assistance. This paper has indicated that the potential benefits to human health alone of implementing such programmes could be very substantial.

**ACKNOWLEDGEMENTS**

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⁶ Costs of such work in Ireland have been estimated to be €1.6 billion for Ireland, a country with just 1.3 million dwellings.
REFERENCES


Figure 1

% of Households with Poor Health and Ability to Adequately Heat Home (Mean, 1994-97)

- Can heat home
- Can't heat home
Figure 2

% of Households with Poor Health and Adequate Heating Facilities (Mean, 1994-97)
Figure 3

% of Households with Poor Health and Damp (Mean, 1994-97)
Figure 4

% of Households with Poor Health and Rot (Mean, 1994-97)
Figure 5

% of Households with Poor Health and Central Heating (Mean, 1994-97)
Figure 6

% of Households with Poor Health and Leaky Roofs (Mean, 1994-97)

Households with leaky roofs
Households without leaky roofs

D DK NL B L F UK IRL I EL E P A FIN
Figure 7

% of Households with Poor Health and Overcrowding (Mean, 1994-97)
Figure 8

% of Households with Poor Health and Burdensome Housing Costs (Mean, 1994-97)
Figure 9

% of Households with Poor Health and Ability to Pay Utility Bills (Mean, 1994-97)

- Households unable to pay utility bills
- Households able to pay utility bills

[Chart showing the percentage of households in various countries with poor health and their ability to pay utility bills. The x-axis represents different countries, while the y-axis shows the percentage ranging from 0 to 30. The chart compares the two categories, with varying levels across different countries.]
Figure 10

% of Households with Poor Health and Housing Satisfaction (Mean, 1994-97)

Households "completely" or "very" satisfied
Households "completely" or "very" dissatisfied
Table 1

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>DK</th>
<th>FIN</th>
<th>F</th>
<th>D</th>
<th>EL</th>
<th>IRL</th>
<th>NL</th>
<th>NOR</th>
<th>P</th>
<th>S</th>
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<th>Mean</th>
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<td>92</td>
<td>81</td>
<td>87</td>
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<td>82</td>
<td>37</td>
<td>86</td>
<td>72</td>
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</tbody>
</table>


\[7\] Data on energy-efficiency levels and energy use per household in Italy and Spain are unavailable from this survey.
Table 2

Proportion of households suffering from selected housing indicators in EU-14 (mean, 1994-97)\(^8\)

<table>
<thead>
<tr>
<th></th>
<th>Fuel poverty</th>
<th>Inadequate heating facilities</th>
<th>Damp</th>
<th>Rot</th>
<th>No central heating</th>
<th>Leaky roof</th>
<th>Crowding</th>
<th>Housing costs burdensome</th>
<th>Can’t pay utility bills</th>
<th>Dissatisfied households</th>
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<td>4.8</td>
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<td>4.3</td>
<td>15.0</td>
<td>12.5</td>
<td>1.8</td>
<td>6.3</td>
</tr>
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<td>5.6</td>
<td>1.8</td>
<td>3.9</td>
<td>16.0</td>
<td>6.8</td>
<td>2.7</td>
<td>3.8</td>
</tr>
<tr>
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<td>6.2</td>
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<td>10.8</td>
<td>9.7</td>
<td>12.9</td>
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<td>9.8</td>
<td>4.8</td>
<td>1.3</td>
<td>2.6</td>
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<tr>
<td>Belgium</td>
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<td>7.9</td>
<td>14.4</td>
<td>9.1</td>
<td>23.9</td>
<td>5.7</td>
<td>14.6</td>
<td>24.9</td>
<td>6.9</td>
<td>5.0</td>
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<td>5.3</td>
<td>7.5</td>
<td>4.8</td>
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<td>5.0</td>
<td>11.5</td>
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<td>2.7</td>
<td>3.7</td>
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<td>11.0</td>
<td>16.3</td>
<td>10.4</td>
<td>9.9</td>
<td>5.3</td>
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<td>7.6</td>
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<td>13.0</td>
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<td>18.0</td>
<td>17.2</td>
<td>8.1</td>
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<td>7.9</td>
<td>9.6</td>
<td>7.3</td>
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<td>4.1</td>
<td>12.5</td>
<td>19.5</td>
<td>6.4</td>
<td>5.9</td>
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<td>17.9</td>
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<td>6.2</td>
<td>20.1</td>
<td>6.3</td>
<td>19.9</td>
<td>35.1</td>
<td>4.1</td>
<td>11.3</td>
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<td>Greece</td>
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<td>9.3</td>
<td>45.7</td>
<td>16.4</td>
<td>26.9</td>
<td>25.1</td>
<td>32.0</td>
<td>12.9</td>
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<td>21.5</td>
<td>7.6</td>
<td>67.2</td>
<td>11.4</td>
<td>21.6</td>
<td>31.9</td>
<td>4.3</td>
<td>8.9</td>
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<td>19.5</td>
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<td>11.3</td>
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<td>2.9</td>
<td>15.3</td>
<td>14.5</td>
<td>5.7</td>
<td>3.5</td>
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</tbody>
</table>

\(^8\) Source: Taken from Healy (2001, 2002).
## Table 3

**Summary of Statistical Analysis on Deprivation Indicators and Poor Health**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>‘Yes’ mean %</th>
<th>‘Yes’ 95% CI mean %</th>
<th>‘No’ mean %</th>
<th>‘No’ 95% CI mean %</th>
<th>P-value</th>
<th>R</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unable to heat home</td>
<td>15.5</td>
<td>12.9, 18.2</td>
<td>6.8</td>
<td>5.5, 8.1</td>
<td>&lt;0.001*</td>
<td>0.75</td>
<td>0.002*</td>
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<tr>
<td>Inadequate heating facilities</td>
<td>12.0</td>
<td>9.1, 14.9</td>
<td>7.4</td>
<td>5.4, 9.5</td>
<td>&lt;0.001*</td>
<td>0.92</td>
<td>&lt;0.001*</td>
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<tr>
<td>Damp</td>
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<td>8.0, 16.2</td>
<td>7.6</td>
<td>5.5, 9.8</td>
<td>&lt;0.001*</td>
<td>0.95</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Rot</td>
<td>12.5</td>
<td>8.2, 16.9</td>
<td>7.7</td>
<td>5.5, 9.9</td>
<td>0.001*</td>
<td>0.94</td>
<td>&lt;0.001*</td>
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<tr>
<td>Lacking central heating</td>
<td>12.3</td>
<td>9.6, 15.0</td>
<td>6.9</td>
<td>5.2, 8.5</td>
<td>&lt;0.001*</td>
<td>0.95</td>
<td>&lt;0.001*</td>
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<tr>
<td>Leaky roofs</td>
<td>12.6</td>
<td>8.1, 17.1</td>
<td>8.0</td>
<td>5.6, 10.3</td>
<td>&lt;0.001*</td>
<td>0.96</td>
<td>&lt;0.001*</td>
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<tr>
<td>Overcrowding</td>
<td>8.1</td>
<td>5.2, 11.1</td>
<td>8.5</td>
<td>5.8, 11.1</td>
<td>0.40†</td>
<td>0.97</td>
<td>&lt;0.001*</td>
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<tr>
<td>Housing costs financially burdensome</td>
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<td>9.2, 16.3</td>
<td>7.2</td>
<td>4.8, 9.5</td>
<td>&lt;0.001*</td>
<td>0.75</td>
<td>0.002*</td>
</tr>
<tr>
<td>Unable to meet utility bills</td>
<td>12.8</td>
<td>9.1, 16.5</td>
<td>7.6</td>
<td>5.5, 10.9</td>
<td>&lt;0.001*</td>
<td>0.85</td>
<td>&lt;0.001*</td>
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<tr>
<td>Dissatisfied with housing</td>
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<td>10.1, 18.2</td>
<td>&lt;0.001*</td>
<td>0.91</td>
<td>&lt;0.001*</td>
</tr>
</tbody>
</table>

* Significant at the 1% level.

† Not significant.