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Sick and stuck at home – how poor health increases electricity consumption and reduces opportunities for environmentally-friendly travel in the United Kingdom

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ABSTRACT

Research on the determinants of direct and indirect energy use has identified a range of relevant socio-economic factors. However, we still know little about possible influences of people's health on their energy use. Do people in poor health use less energy because they are on lower incomes, or do they have additional domestic energy needs as they spend more time at home? Does poor health reduce mobility for all or just some (environmentally-friendly) modes of travel? This paper examines these questions through analysis of the representative UK Understanding Society survey. We find that poor health is generally linked to lower home energy use and lower engagement in all forms of travel. However, once we control for income and other socio-demographic factors, poor health is related to higher electricity consumption. These findings have important policy implications as it means that people in poor health would be additionally burdened by higher cost of electricity but, due to their low mobility, less so by higher cost of energy-intensive forms of travel. While promoting good health could support environmentally-friendly travel, additional measures would be required to prevent a rise of energy-intensive modes of travel.

1. Introduction

From a policy perspective, it is important to understand the ways in which socio-economic factors influence people's energy use because it shows which groups are likely to be especially affected by higher energy prices or taxes which may arise from energy reduction or climate change mitigation policies. If high energy use relates to individual or household characteristics that are difficult or impossible to change, people with these characteristics are at a disadvantage because they will struggle to adopt more environmentally-friendly behaviours to adjust to higher energy prices. Additional policies may be needed to protect these groups from unfair burdens and to make energy reduction policies more acceptable to them.

There is already a lot of research on the socio-economic factors for direct and indirect energy use (or related emissions). Income, household size, age, education and rural/urban location have been identified as especially important in this context [1–5]. However, health status has been largely overlooked in this research. We argue that health is a policy-relevant factor for energy use which deserves further attention.

First, if poor health was linked to high energy use, this could indicate a case of 'necessity': health conditions are not only arising from behavioural factors, but are also influenced by factors that are largely out of people's control such as age, gender, genetic disposition, and various environmental and contextual factors [6]. Here, policies may be necessary to help people save energy at low cost, or to compensate them for financial burdens of energy reduction policies that affect them. At the same time, promoting good health could be a relevant strategy for decreasing energy use in the population.

Second, if good health was related to high energy use, additional policies would be necessary to encourage (healthy) people to save energy. Which one of these scenarios is correct remains unclear; something that our paper will therefore examine.

Before we review the literature on the relationship between health and energy use, it is important to acknowledge that there is a two-way relationship between them. While health status has not yet played an important role in research on the *determinants* of householders' energy

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use or carbon emissions, there is some research on health *implications* of energy consumption, production, and reduction. For instance, several studies examine the health implications of home insulation and find largely positive effects from warmer homes, especially if increased mould or poorer air quality are avoided through appropriate ventilation [7–15]. Several studies have also shown overall positive health effects of 'active' and environmentally-friendly forms of travel such as walking or cycling which outweigh health risks associated with poor air quality or injury [16–19]. However, health benefits can vary by gender, age, and other characteristics [20].

At the macro-level, several studies focus on the health implications of different energy or electricity generation systems, for instance through their impacts on air pollution, occupational health hazards or risk of radiation (from nuclear technologies) [21–26]. In developing country contexts, several studies have examined the health implications of different indoor cooking technologies [22,25,27]. Furthermore, several studies seek to determine whether it is possible to achieve high levels of health and wellbeing at low levels of energy use. They show that while there are some countries, mostly in South America, in which life expectancy is high despite comparatively low levels of energy use (the so-called "Goldemberg corner") [28,29], energy use and good health usually increase in tandem [29–33]. However, these macro-level studies often say little about the 'direction of influence' – which likely goes both ways: high energy use might promote good health as it is generally associated with higher levels of comfort and higher living standards, while good health could also lead to higher energy use if people are more mobile and active and thus travel, work, earn and consume more.

Also lacking are studies that compare the relationships between health and energy use across behavioural domains such as heating and electricity use in the home, or different forms of travel. We think this is important because the relationship between health status and energy consumption might vary across these domains, requiring a more differentiated policy approach. Another complication is that, as pointed out above, energy use is associated with a range of other socio-demographic characteristics, some of which are also tightly linked with health. Instead of just studying bivariate relationships between energy use and health, one needs to control for these socio-demographic characteristics to establish whether health status makes an additional difference to people's energy use, holding all other factors constant. To carry out this type of investigation, we use micro-level household and individual data from the representative United Kingdom (UK) survey Understanding Society [34], examining different types of energy use separately and controlling for various socio-demographic characteristics.

The paper proceeds as follows. Section 2 develops two competing hypotheses regarding the relationships between health status and energy use for different types of behaviours. Section 3 describes the Understanding Society study, the variables included in this paper, and methods of analysis. Section 4 reports the results and section 5 discusses them and concludes.

2. Theory: competing lines of reasoning

While there is so far no comprehensive theory on the ways in which health status influences energy use in different domains of everyday life, we can draw on related bodies of literature to formulate alternative hypotheses. Generally speaking, two opposing lines of reasoning have some initial plausibility. The first focusses on the role of income and suggests that poor health might be linked to lower energy use, both in the home and related to more expensive modes of travelling. The second focusses on mobility and suggests that poor health might increase energy use in the home and decrease most forms of travel apart from perhaps car travel.

The first line of reasoning, the 'income hypothesis', assumes that poor health is, on average, associated with low income [35]. This relationship can be bi-directional as people on low incomes may be less able to afford healthier lifestyles (fresh, healthy food; gym memberships, sport club fees, etc.) and more likely to smoke or consume alcohol due to higher levels of stress. On the other hand, poor health can also contribute to low incomes as people's capacity to participate in the labour market is likely to be restricted. At the same time it is well-known from previous research that low income is one of the most important correlates of lower energy use, both in the home and whilst travelling [1,3,4,36]. If poor health and low income are related, people in poor health may have fewer resources to spend on energy consumption in the home and (relatively) expensive modes of travel such as vehicle fuels, air travel and trains while they might have to satisfy some of their mobility needs using less expensive means of travel. Expressed in CO_2 emissions, car and air travel are more energy-intensive per passenger kilometre than train or bus travel (or walking or cycling which are emission-free when performed) (see Table 1). This means that, according to the 'income hypothesis', people in poor health are predicted to consume less energy from more polluting modes of travel, but are also at a disadvantage when it comes to using more energy-friendly train travel as this is often more expensive than car travel in the UK [37].

Table 1
CO_2 emissions per passenger kilometre in the UK.

Travel mode	kg CO_2/km
Average car	0.19
UK flight	0.34
EU flight	0.19
Overseas flight	0.22
Train	0.06
Bus	0.11
Coach	0.03

Note: Data are taken from DEFRA/DECC [38]. The figures for flights relate to "average passengers", averaging out different flight classes. The figure for buses refers to average local buses.

The second 'mobility hypothesis' focuses on what determines people's mobility. More mobile and active people are likely to spend less time at home, thus consuming less energy there, and more time travelling for both high and low carbon modes of travel. Previous studies found that good health supports, and ill-health prevents, higher engagement in cycling, walking, or other physical activity [39–42]. Conversely, previous research has shown that the relationship between travel and age is inversely u-shaped, which means that while travel tends to increase with age, it drops again with old age, especially for people aged over 80 [e.g. 5]. This drop is likely to be linked to decreased mobility. However, since old age and poor health are related (Table 2 below), it would again be important to control for age in multivariate analysis.

For home energy, several other studies have shown that old age is associated with higher electricity and gas consumption [5,43] which could be explained by larger amounts of time spent at home due to limited mobility. In addition, older people might 'feel the cold' more easily in winter as they are generally less physically active, and hence require higher indoor temperatures to feel comfortable. Similar mechanisms might apply to people in poor health but it will again be crucial to control for age to determine whether poor health is linked to higher home energy use *in addition* to old age.

In summary, the 'income hypothesis' states that people in poor health use less energy in the home and for relatively more expensive modes of travel, based on the assumption that their financial circumstances are more limited than those of healthier people. The 'mobility hypothesis' expects that people in poor health use more energy at home but engage less in both high and low carbon forms of travel, based on the assumption that illness reduces people's mobility. An open question