Impacts of long-standing illness and chronic illness on working hours and household income in a longitudinal UK study

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ABSTRACT

Individuals within households encounter a variety of events including development of a disability or chronic illness. We used data from the Understanding Society, 2009–2016, to determine whether there are changes to working hours or household income as a result of an individual developing an illness. After adjusting for a variety of sociodemographic characteristics, there were few associations observed between one's own individual illness status and household income. There was a clear trend of reduction of weekly working hours with increasing severity and chronicity of the individuals' illness or disease. Individuals who were not ill, but lived in an household with an ill person worked about 30-min less per week, $b = -0.69$, 95% confidence interval (CI)= (-1.09, -0.30), while those with a limiting long-standing illness and a chronic disease worked 3.5 h less per week, $b = -3.64$, 95% CI=(-4.21, -3.08), compared to individuals with no illness in their household. Individuals with a limiting illness only had lower incomes, $b = -0.04$, 95% CI=(-0.07, -0.004) compared to individuals with no household illness. These associations were not greatly changed with the inclusion of reception of benefits or being cared for. Interactions were observed by gender, age being cared for and reception of benefits. Additionally, there were differences were observed by working age groups and between those who lived alone and those who did not. The findings suggest that while there is a reduction of working hours among individuals with an illness or who have an ill person in their home, household income is resilient to the experience of an illness, in the United Kingdom. However, this appeared to differ by household composition, i.e. whether individuals were of working age or whether they lived alone. Identification of households at highest risk of income reduction may serve to inform policy and appropriate distribution of services and support.

Introduction

Long-standing illness and its associated symptoms can disrupt everyday life, particularly around the time of diagnosis, and can impact employment status and income. The concept of "biographical disruption" (Bury, 1982) has provided a framework for many studies, almost all using a qualitative approach, about the impact a variety of illnesses such as cancer (Mathieson & Stam, 1995), rheumatoid arthritis (Bury, 1982), HIV/AIDS (Carricaburu & Pierret, 1995) has upon individuals. It has been a durable sociological concept applied to a wide range of conditions and the experiences of family members (Locock & Ziébland, 2015). There have, however, been few attempts either to quantify disruption related to diagnosis of long-standing illness or to examine the impact on the wider household. Quantification in this context requires

appropriately operationalised definitions. This paper uses data from *Understanding Society*, the UK Longitudinal Household Study (UKHLS) to analyse the impact of the onset of an individual's long-standing illness upon employment status, working hours and household income. We combine two definitions of illness to create our own definition of illness. The first definition is based on the United Kingdom (UK) Department of Health definition of a long term condition "as a condition that cannot, at present be cured; but can be controlled by medication and other therapies" (Department of Health, 2010), this is what we define as a chronic disease. We use the definition for disability under the Equality Act 2010 to define 'long-standing illness'. The Equality Act 2010 defined disability as "a physical or mental impairment that has a 'substantial' and 'long-term' negative effect on your ability to do normal daily activities"(Gov.uk, 2019); where long-term is defined as 12 months or more.

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In this paper our emphasis is on the period following diagnosis, particularly how a diagnosis of a new chronic disease or long-standing illness in the household impacts on employment status, hours worked and household income.

Impact of illness diagnosis upon household income

Whilst there may be differences between having a 'disability' (generally defined by functional impairment) and having a 'chronic disease' (generally linked to diagnosis of a specific condition), in the UK there is evidence of a relationship between household income and both disability and chronic disease. In 2015/16 in the UK, 26% of people living in a household with a disabled person were in poverty compared with 20% of people living in a household without a disabled person (Joseph Rowntree Foundation, 2017).[1] Disabled individuals and those in ill health are more likely to experience incidences of poverty and persistent poverty (Smith & Middleton, 2007). Systematic comparison of households with multiple sclerosis (MS) matched with non-MS households showed that both men and women with MS were significantly less likely to be employed than those in the general population and were significantly more likely to have a 'below average' household income, despite the fact that they were in a higher social class and had higher educational levels than people in the general population (Green et al., 2007). What is less clear, however, is the trajectory and direction of the causal relationship between diagnosis of chronic disease and household income (Smith & Middleton, 2007). There is evidence that poverty and structural disadvantage lead to higher rates of poor health and early mortality (Davey Smith et al., 2001). Bartley and Owen (1996) suggest an ill individual's ability to remain in paid employment may depend on their socioeconomic status. Individuals with poorer health and low occupational skill were less likely to remain in paid employment (Bartley & Owen, 1996). There is some evidence from the UK and Europe that onset of disability is associated with exit from employment, reduced income and entering poverty (Adelman & Cebulla, 2003; Jenkins & Rigg, 2004). In addition to how illness may impact household income and employment status, this study will also answer the following questions. How does illness impact on the hours of paid work of individuals? Does disability or health-related state support ameliorate any loss of earnings? What is the role and impact of paid or informal caregiving provided by household members?

It is generally assumed that long-standing illness will disrupt the household. According to Kleinman et al. (1995), "All that it takes to push families off their thin perch is a serious illness" (p. 1326), suggesting that long-standing illness of an individual may place a strain on household income. Jenkins and Rigg's (2001) analysis of the British Household Panel Survey indicates that long-term ill-health is one of the most important causes of poverty-related downward mobility trajectories. This may be related to direct costs associated with an illness or indirect costs relating to reduced capacity to work among the ill person or other household members who may be required to replace paid work with provision of informal care. Their analysis based on data collected 1991–1998, show employment rates fall with disability onset, and continue to fall the longer a disability spell lasts, whereas average income falls sharply with onset but then recovers subsequently (though not to pre-onset levels) (Jenkins & Rigg, 2004). The World Health Organization (WHO, 2002) suggests that the poor are particularly at risk of becoming more impoverished when they experience a health crisis in the household. A study of long-standing illness among Pakistani families in the UK found that long term ill health affected the economic activities of the entire household, "resulting in increasing economic polarisation between workless households containing long-term sick adults and

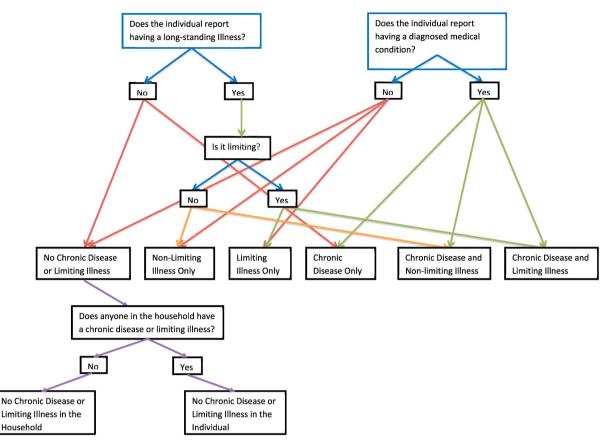multiple income households in the rest of society" (Harriss, 2008).

There is evidence from both low to middle-income countries and those countries without access to free health care that provide insight into how the downward spiral operates whereby illness accentuates poverty. Long-standing illness may require expensive treatment and care. In low to middle income countries, the economic consequences of illness are becoming increasingly severe as the burden of paying for health care is increasingly placed on the person experiencing poor health (McIntyre et al., 2006). A systematic review of 10 quantitative studies mainly conducted in high income countries reported that the prevalence of perceived financial hardship among cancer patients and their families was between 15% and 79% (Azzani et al., 2015). The most frequent and significant risk factor associated with the perception of financial difficulty was being a low income household. The studies focused on the cost of cancer treatment rather than income-related factors but nevertheless demonstrate that some families, particularly those with low incomes may struggle financially. Studies in the US (Keene et al., 2014), India (Quintussi et al., 2015), Sri Lanka (Kumara & Samaratunge, 2017) Russia (Abegunde & Stanciole, 2008), Serbia (Arsenijevic et al., 2013) and South Africa (Foster et al., 2015) and a review of studies that measured the economic costs and consequences of illness for households (Russell, 2004) showed similar findings that ill-health events pose a substantial threat to household welfare, more specifically, in resource-poor settings, illness imposed high and regressive cost burdens on patients and their households.

There is therefore clear evidence that long-standing illness imposes an economic burden in terms of direct and indirect costs associated with illness on the household and that this is particularly pronounced in studies conducted in low to middle income countries and in settings where state support is limited. However, one would expect that the burden would be considerably ameliorated in a country like the UK where all citizens have access to healthcare that is free of charge at point of delivery as well as access to illness and disability related welfare benefits such as Attendance Allowance and Disability Living Allowance that are available to all who meet the criteria regardless of their savings and income. This paper therefore explores the impact of diagnosis of long-standing illness upon household income in the UK using robust longitudinal household data that is gathered annually. We examine the longitudinal effects of the type of an individual's illness on hours worked and household income. Additionally, we explore the impact of benefits received and caring that is required.

Drawing upon the literature our overarching hypotheses are:

1. Diagnosis of a long-standing illness or chronic disease will have a negative impact on being able to work, however impact will differ by the severity and combination of illness and disease
    a. The association between illness and employment status will vary by the whether the illness is limiting (severity) or whether an individual has a chronic disease (chronicity). We hypothesis that individuals with non-limiting illness will be able to continue to work while those with limiting illness or limiting illness and chronic disease will not be employed.
2. Onset of a long-standing illness or development of a chronic disease will have a negative impact on the of hours worked, however this will differ by the combination of illness and disease
    a. The relationship between illness and hours worked will vary by the whether the severity or chronicity. We hypothesize that non-limiting illness will have less impact on working hours than limiting illness or chronic disease.
    b. The amount of hours worked will differ due to receipt of illness or disability-related benefits
3. Diagnosis of a long-standing illness will have a negative impact on household income but there will be heterogeneity in the impact of illness:
    a. We hypothesize that this impact will vary by the severity and chronicity of illness, thus we anticipate no impact where illness is

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[1] Poverty is measured as the proportion of people living in households with an after housing costs income below 60 per cent of the contemporary median household income.

Fig. 1. Individual illness status.

not limiting while limiting illness will have an impact through the ability of the diagnosed person to work or not work.

   b. There will be some compensation due to receipt of illness/disability related benefits such as attendance allowance

   c. The impact of illness on household income may vary according to level of household resilience. The potential for resilience will vary according to the following: greater in multi-person households and smaller in low-income households, level of caring required.

Methods

Sample

Data come from waves one through eight of the *Understanding Society*: the UK Household Longitudinal Study. UKHLS is a nationally, representative study where all adult household members are interviewed annually. Individuals are interviewed via computer-assisted personal and self-completed surveys. In wave 1, over 50,000 individuals in over 35,000 households participated. Due to the size of the sample, one wave of data collection takes two calendar years to complete, thus wave one was conducted from 2009 to 2010 and wave eight in years 2016–2017.

UKHLS follows individuals through time; however individuals are nested within households. Longitudinal households were created by linking individuals within households and creating indicators when changes to household structure occurred. Households could change by adding members, members leaving, deaths or loss to follow-up. The analyses conducted in this paper includes all individuals in households where no changes occurred in any of the waves, n = 31,190 with 182,743 person-years.

Measures

Household illness status was derived by the health of the adult individuals within the household. Two constructs were used to determine individual illness: diagnosed medical condition and limiting long-standing illness. Respondents were asked 'Has a doctor or other health professional ever told you that you have any of the conditions listed on this card?' Conditions included coronary heart disease, arthritis, cancer, stroke and high blood pressure. Limiting long-standing illness (LLSI) status was created from two questions. The first asks 'Do you have any long-standing physical or mental impairment, illness or disability? By 'long-standing' I mean anything that has troubled you over a period of at least 12 months or that is likely to trouble you over a period of at least 12 months.' If respondents answer yes to the first question they are then asked what type of health problem or disability they are experiencing. There are 12 different options including mobility, sight, communication and physical co-ordination. Individuals who answered yes to the first question but reported having none of the 12 disabilities were identified as having a non-limiting illness. Limiting long-standing illness was categorised: No illness, non-limiting long-standing illness and limiting long-standing illness.

Chronic disease (i.e., diagnosed medical conditions) and limiting long-standing illness were combined for each respondent to create a seven-category variable: 1)No chronic disease or limiting illness in the household (reference category), 2)No chronic disease or limiting illness of the individual, 3)non-limiting illness only, 4)limiting illness only, 5)chronic disease only, 6)non-limiting and chronic disease and 7)limiting and chronic disease. The difference between the first and second categories is that category 1 means that there is no illness in the household while category 2 is that the individual does not have any illness but other members of their household do have an illness or chronic disease (if they live with others) (Fig. 1).

Table 1
Descriptives of UKHLS individual characteristics by type of individual illness in household status at wave 1*.

	Total (n = 31,190)	Type of Individual Illness in Household Status*[+]						
		No Household Illness (n = 9675)	No Chronic Disease or Limiting Illness (n = 4651)	Non-Limiting Illness Only (n = 768)	Limiting Illness Only (n = 1487)	Chronic Disease Only (n = 5776)	Non-Limiting and Chronic Disease (n = 2568)	Limiting and Chronic Disease (n = 6265)
Gender (% Men)	45	46	53	47	47	42	46	41
Highest Educational Qualification (%)								
Degree	21	28	22	29	18	20	21	11
Other Higher[a]	11	12	10	13	11	12	12	10
A-level[b]	17	19	21	21	16	17	17	13
GCSE[c]	20	22	23	20	21	20	19	15
Other Qualification[d]	11	8	9	7	14	12	13	16
No Qualification	19	12	14	11	20	20	18	34
Partnership Status (%)								
Partnered	64	62	74	67	61	67	67	56
Single	20	26	24	18	24	17	15	13
Previously Partnered	16	12	2	15	15	17	19	31
Government Office Region (%)								
North East	4	4	3	3	3	4	4	5
North West	11	10	11	8	10	11	11	12
Yorkshire and the Humber	8	8	8	7	9	8	8	9
East Midlands	7	7	7	9	7	7	9	7
West Midlands	9	9	9	8	8	9	9	9
East of England	9	8	9	9	9	10	10	9
London	16	22	17	13	15	14	11	10
South East	12	11	13	15	13	13	14	11
South West	8	7	8	10	8	8	9	9
Wales	5	4	5	4	5	6	4	6
Scotland	7	7	6	9	10	7	10	9
Northern Ireland	4	5	4	4	5	4	3	4
Employment Status								
Not Employed	48	34	40	34	53	49	48	77
Employed	52	66	60	66	47	51	52	23
Reception of Disability Benefits (%)								
Did Not Receive Benefits	90	99	99	95	78	98	95	64
Received Benefits	10	1	1	5	22	2	5	36
Person Cared For (%)								
Not Cared For	94	98	91	95	92	94	94	90
Cared for	6	2	9	5	8	6	6	10
Age	48.40 (17.66)	40.32 (14.44)	41.61 (16.76)	47.10 (14.95)	48.21 (16.58)	52.07 (17.73)	54.14 (15.61)	60.04 (15.44)
Number of Children	0.61 (1.02)	0.91 (1.17)	0.74 (1.07)	0.66 (1.03)	0.60 (1.01)	0.49 (0.90)	0.44 (0.86)	0.26 (0.71)
Number of Pensioners	0.45 (0.73)	0.16 (0.46)	0.35 (0.69)	0.32 (0.62)	0.38 (0.67)	0.59 (0.80)	0.62 (0.79)	0.79 (0.80)
Number of Hours Worked	16.79 (19.08)	22.13 (19.13)	20.38 (19.61)	21.83 (19.41)	14.90 (18.48)	16.17 (18.71)	16.17 (18.53)	6.82 (14.59)
IHS Household Income	7.79 (1.17)	7.77 (1.36)	7.91 (0.93)	7.95 (1.01)	7.72 (1.19)	7.84 (1.08)	7.92 (0.98)	7.67 (1.07)

*Gender and highest educational qualification, housing tenure, government office region, employment status, reception of disability benefits and person cared for are frequencies. Age, number of children, and pensioners, number of hours worked and IHS household income are means and standard deviations.

[+] GCSE, General Certificate of Secondary Education; IHS, Inverse Hyperbolic Sine Transformation.

[a] Examples of other higher qualifications are teaching, nursing or diploma certifications/qualifications.

[b] A Level exam taken at age 18 (year 13).

[c] GCSE = exams taken at age 16 (year 11).

[d] Other qualifications include CSE, skills certifications, apprenticeships, clerical qualifications, etc.

Household income is provided as a derived variable in UKHLS. Income come from the following sources: labour, investment, social and personal benefit, pension and miscellaneous. Household income was adjusted for inflation and household size and structure. The results reported in this paper are from the results using transformed income. Inverse hyperbolic sine was used to transform income as it allows for the inclusion of zero income and behaves similarly to a log function at large values.

Employment status was taken from the labour force status question. Individuals who were either employed or self-employed were categorised as employed. Employment status was a binary variable with not employed as the reference category.

Job hours were taken from two questions, one was asked of those who were employed while the other was asked of self-employed persons. Employed respondents were asked "how many hours, excluding overtime and meal breaks, are you expected to work in a normal week",

Table 2

Regression parameters of employment status on ill individual in the Household*[+].

	Employment Status								
	Model 1			Model 2			Model 3		
	Estimate	95% Confidence Interval		Estimate	95% Confidence Interval		Estimate	95% Confidence Interval	
Ill Individual in the Household									
No (Ref)									
Yes	−0.19	−0.42	0.03	−0.17	−0.50	0.17	−0.19	−0.42	0.03
Reception of Disability Benefits									
Did Not Receive Benefits (Ref)									
Received Benefits				−1.55	−1.84	−1.27			
Individual Cared For									
Not Cared For (Ref)									
Cared For							−0.13	−0.36	0.10

* Models control for gender, age, age squared, highest educational qualifications, partnership status, number of sick people in the household, number of pensioners in the household, number of children in the household, region, IHS household income, lagged illness status, lagged employment status and lagged IHS household income. Model 2 also controlled for lagged reception of benefits and Model 3 controlled for lagged being cared for.
[+] IHS = Inverse Hyperbolic Sine Transformation.

while self-employed respondents were asked "How many hours in total do you usually work a week in your job". Respondents who did not have a job were given zero as the number of hours worked.

Respondents were asked if they or any one in their household received a number of health and disability-related benefits. These included: incapacity benefit, employment and support allowance, severe disablement allowance, disability living allowance, return to work credit, attendance allowance, industrial injury disablement benefit, war disablement pension, sickness and accident insurance, personal independence payments and other disability related benefit. A binary variable for reception of benefits was created. If respondents received one or more benefits they were categorised having received benefits, if they did not receive benefits then they were categorised as not having received benefits (reference category).

If any adult member of the household stated that they received informal care from a household member due to being sick, disabled or elderly, a binary caring responsibilities variable was created with responses as not cared for (reference category) and being cared for.

Socio-demographic characteristics included sex, age, number of children, number of pensioners, partnership status, highest educational qualification and region of residence. Sex was a dichotomous variable with men as the reference. Age was a continuous variable; age squared was also included in analytical models to account for the non-linear relationship between age and working hours and income. Age was centred around the mean prior to inclusion in the model and age squared was based on centred age. Number of children and number of pensioners were both continuous variables. Partnership status was a three-category variable with responses as in a partnership (reference category), single, never married and formerly partnered. Partnership included married, civil partner and cohabiting individuals. Highest educational qualification was a six-category variable ranging from no qualification to degree (reference). Region of residence was the official UK Government Office Regions; there were 9 regions in England while Wales, Scotland and Northern Ireland were each considered as their own region. London was the reference category. For all variables except gender, the largest group was chosen as the reference group.

Statistical analysis

Correlated random effects (CRE) models (Mundlak, 1978; Wooldridge, 2005) were used to test for the association between individual illness status in the household and employment status, hours worked or personal and household income. CRE models include time-varying covariate means to account for the correlation between individual-specific effects (heterogeneity) and covariates. CRE models may provide similar estimations as fixed effects models. We also include the first wave of our outcome variable in the models to address the initial conditions problem

for lag-dependent models (Woolridge, 2005). All models controlled for socio-demographic characteristics (i.e. gender, age, partnership status, highest educational qualification, region of residence, number of children and number of pensioners) as well as lagged (i.e. previous wave's) household illness and lagged transformed income. Models with reception of benefits and being cared for also included their lags. For each outcome three models were estimated: a baseline model with covariates only, model 2 was the baseline model plus reception of benefits and model 3 was the baseline model plus being cared for.

We also stratified the models by a variety of characteristics including Gender, age, being cared for, reception of benefits, whether the respondents lived alone and whether respondents were of working or pension age. Stratified models were only run on type of illness in the household models and only models with clear differences in patterns between the groups are included in the results.

Robustness checks

As ill health may impact individual income first, we also tested the associations between any illness in the household and type of illness in the household and individual income.

Results

At wave 1, there were 9675 individuals who had no illness in their household. Amongst those with an illness in their household, 4651 (22%) were not the individual who was ill (Table 1). Fewer individuals had a non-limiting long-standing illness only (n = 768, 4%) while 7% (n = 1487) of individuals had a LLSI only, 27% (n = 5776) had a chronic disease only, 12% had a non-limiting long-standing illness and a chronic disease and 295 (n = 6265) had a LLSI and a chronic disease.

There were differences in socio-demographic characteristics by type of individual illness, for example there were a larger proportion of men (53%) in the no LLSI or chronic disease group and a smaller proportion in the chronic disease only (42%) and limiting long-standing illness and chronic disease (41%) groups compared to women. Individuals who lived in households with no limiting illness or chronic disease were younger (mean = 40.32 years, standard deviation (sd) = 14.44), were more likely to be employed (66%), work more hours per week (mean = 22.13 h, sd = 19.13), were more likely to have a degree (28%), be single (26%) and live in London (22%) compared to the other groups. Conversely, individuals with both a LLSI and chronic disease were older (mean = 60.04 years, sd = 15.44), less likely to be employed (23%), worked the fewest hours (mean = 6.82 h, sd = 14.59), were more likely to have no qualification (34%), be previously partnered (31%), receive disability benefits (36%) and be cared for (10%).

Table 3

Regression Parameters of Employment Status on Type of Illness Individual has in the Household*[+].

	Employment Status								
	Model 1			Model 2			Model 3		
	Estimate	95% Confidence Interval		Estimate	95% Confidence Interval		Estimate	95% Confidence Interval	
Type of Illness									
No Household Illness (Ref)									
No Chronic Disease or Limiting Illness	−0.15	−0.39	0.09	−0.10	−0.45	0.25	−0.15	−0.39	0.09
Non-Limiting Illness Only	−0.09	−0.44	0.26	0.00	−0.50	0.50	−0.09	−0.44	0.25
Limiting Illness Only	−0.46	−0.80	−0.12	−0.49	−0.96	−0.02	−0.46	−0.80	−0.12
Chronic Disease Only	−0.26	−0.62	0.10	−0.02	−0.57	0.53	−0.26	−0.62	0.10
Non-Limiting and Chronic Disease	−0.37	−0.74	−0.001	−0.36	−0.93	0.20	−0.37	−0.74	−0.0007
Limiting and Chronic Disease	−0.74	−1.11	−0.37	−0.41	−0.97	0.15	−0.74	−1.11	−0.37
Reception of Disability Benefits									
Did Not Receive Benefits (Ref)									
Received Benefits				−1.47	−1.76	−1.18			
Individual Cared For									
Not Cared For (Ref)									
Cared For							−0.12	−0.36	0.11

* Models control for gender, age, age squared, highest educational qualifications, partnership status, number of sick people in the household, number of pensioners in the household, number of children in the household, region, IHS household income, lagged type of illness, lagged employment status and lagged IHS household income. Model 2 also controlled for lagged reception of benefits and Model 2 controlled for lagged being cared for.

+ IHS = Inverse Hyperbolic Sine Transformation.

Table 4

Regression parameters of hours worked on ill individual in the Household*[+].

	Hours Worked								
	Model 1			Model 2			Model 3		
	Estimate	95% Confidence Interval		Estimate	95% Confidence Interval		Estimate	95% Confidence Interval	
Ill Individual in the Household									
No (Ref)									
Yes	−0.63	−1.07	−0.19	−0.57	−1.15	0.01	−0.63	−1.07	−0.19
Reception of Disability Benefits									
Did Not Receive Benefits (Ref)									
Received Benefits				−2.18	−2.66	−1.70			
Individual Cared For									
Not Cared For (Ref)									
Cared For							−0.10	−0.44	0.23

* Models control for gender, age, age squared, highest educational qualifications, partnership status, number of sick people in the household, number of pensioners in the household, number of children in the household, region, IHS household income, lagged illness status, lagged employment status and lagged IHS household income. Model 2 also controlled for lagged reception of benefits and Model 3 controlled for lagged being cared for.

+ IHS = Inverse Hyperbolic Sine Transformation.

Regression analysis

Employment status

Any illness in the household

Having a sick individual in the household was not associated with higher or lower odds of being employed (Table 2). However receiving benefits was associated with lower odds of being employed, log odds = −1.55, 95% Confidence Interval (CI)=(-1.84, −1.27) Table 2 Model 2). Currently being cared for was not associated with higher or lower odds of being employed (Model 3).

Type of illness in the household

Type of illness was differentially associated with the odds of being employed (Table 3). Individuals with a limiting illness only, log odds = −0.46, 95% CI=(-0.80, −0.12) or a limiting illness and chronic disease, log odds = −0.74, 95% CI=(-1.11, −0.37), were less likely to be employed compared to individual who lived in households with no illness or disease (Model 1).

The inclusion of reception of benefits resulted in a few differences (Model 2). While individuals with limiting illness only, log odds = −0.49, 95% CI=(-0.96, −0.02), were still less likely to be employed,

individuals with limiting illness and chronic disease were no longer less likely to be employed compared to individuals who lived in households with no limiting illness or chronic disease. Reception of benefits was associated with lower odds of being employed, log odds = −1.47, 95% CI=(-1.76, −1.18).

Being cared for was not associated with higher or lower odds of being employed (Model 3).

Hours worked

Any illness in the household

Having a sick individual in the household was associated with a reduction of one's own working hours by almost 40 min, b = −0.63, CI= (-1.07, −0.19) (Table 4, Model 1). While reception of benefits, b = −2.18, 95% CI=(-2.66, −1.70) (Model 2) had a strong association or being cared for had no association with hours worked.

While having any illness within the household was associated with over 30 min per week decrease in working hours, currently receiving benefits was associated with over 2 h per week decrease in working hours, b = −2.18, 95% CI=(-2.66, −1.70) (Model 2). Being cared for was not associated with either increases or decreases in working hours.

Table 5
Regression Parameters of Hours Worked on Type of Illness Individual has in the Household*[+].

	Hours Worked								
	Model 1			Model 2			Model 3		
	Estimate	95% Confidence Interval		Estimate	95% Confidence Interval		Estimate	95% Confidence Interval	
Type of Illness									
No Household Illness (Ref)									
No Chronic Disease or Limiting Illness	−0.50	−0.98	−0.02	−0.29	−0.91	0.33	−0.50	−0.98	−0.02
Non-Limiting Illness Only	−0.37	−1.02	0.27	−0.18	−0.99	0.64	−0.38	−1.02	0.27
Limiting Illness Only	−1.05	−1.71	−0.38	−1.34	−2.19	−0.50	−1.05	−1.71	−0.39
Chronic Disease Only	−1.62	−2.32	−0.91	−1.26	−2.17	−0.35	−1.62	−2.32	−0.91
Non-Limiting and Chronic Disease	−1.90	−2.62	−1.17	−1.60	−2.52	−0.68	−1.90	−2.62	−1.17
Limiting and Chronic Disease	−2.35	−3.06	−1.63	−1.82	−0.27	−0.90	−2.35	−3.06	−1.63
Reception of Disability Benefits									
Did Not Receive Benefits (Ref)									
Received Benefits				−2.05	−2.53	−1.58			
Individual Cared For									
Not Cared For (Ref)									
Cared For							−0.06	−0.40	0.28

* Models control for gender, age, age squared, highest educational qualifications, partnership status, number of sick people in the household, number of pensioners in the household, number of children in the household, region, IHS household income, lagged type of illness, lagged employment status and lagged IHS household income. Model 2 also controlled for lagged reception of benefits and Model 2 controlled for lagged being cared for.
+ IHS = Inverse Hyperbolic Sine Transformation.

Table 6
Regression parameters of household income on ill individual in the Household*[+].

	Household Income								
	Model 1			Model 2			Model 3		
	Estimate	95% Confidence Interval		Estimate	95% Confidence Interval		Estimate	95% Confidence Interval	
Ill Individual in the Household									
No (Ref)									
Yes	−0.003	−0.03	0.03	0.03	−0.02	0.07	−0.003	−0.03	0.03
Reception of Disability Benefits									
Did Not Receive Benefits (Ref)									
Received Benefits				0.15	0.11	0.18			
Individual Cared For									
Not Cared For (Ref)									
Cared For							0.02	−0.01	0.04

* Models control for gender, age, age squared, highest educational qualifications, partnership status, number of sick people in the household, number of pensioners in the household, number of children in the household, region, IHS household income, lagged illness status, lagged employment status and lagged IHS household income. Model 2 also controlled for lagged reception of benefits and Model 3 controlled for lagged being cared for.
+ IHS = Inverse Hyperbolic Sine Transformation.

Table 7
Regression Parameters of Household Income on Type of Illness Individual has in the Household*[+].

	Household Income								
	Model 1			Model 2			Model 3		
	Estimate	95% Confidence Interval		Estimate	95% Confidence Interval		Estimate	95% Confidence Interval	
Type of Illness									
No Household Illness (Ref)									
No Chronic Disease or Limiting Illness	−0.007	−0.04	0.02	0.02	−0.03	0.07	−0.01	−0.04	0.02
Non-Limiting Illness Only	0.005	−0.04	0.05	0.04	−0.02	0.10	0.005	−0.04	0.05
Limiting Illness Only	−0.001	−0.05	0.05	0.04	−0.03	0.10	−0.0009	−0.05	0.05
Chronic Disease Only	0.008	−0.04	0.06	0.03	−0.04	0.10	0.008	−0.04	0.06
Non-Limiting and Chronic Disease	0.02	−0.03	0.07	0.04	−0.04	0.12	0.02	−0.03	0.07
Limiting and Chronic Disease	0.01	−0.04	0.06	0.03	−0.04	0.11	0.01	−0.04	0.06
Reception of Disability Benefits									
Did Not Receive Benefits (Ref)									
Received Benefits				0.14	0.11	0.18			
Individual Cared For									
Not Cared For (Ref)									
Cared For							0.02	−0.01	0.04

*$p < 0.10$, **$p < 0.05$, ***$p = 0.01$.
* Models control for gender, age, age squared, highest educational qualifications, partnership status, number of sick people in the household, number of pensioners in the household, number of children in the household, region, IHS household income, lagged type of illness, lagged employment status and lagged IHS household income. Model 2 also controlled for lagged reception of benefits and Model 2 controlled for lagged being cared for.
+ IHS = Inverse Hyperbolic Sine Transformation.

Table 8

Regression Parameters of Employment Status on Type of Illness Individual has in the Household by Gender*+.

Type of Illness	Men									Women								
	Model 1			Model 2			Model 3			Model 1			Model 2			Model 3		
	Estimate	95% Confidence Interval		Estimate	95% Confidence Interval		Estimate	95% Confidence Interval		Estimate	95% Confidence Interval		Estimate	95% Confidence Interval		Estimate	95% Confidence Interval	
No Household Illness (Ref)																		
No Chronic Disease or Limiting Illness	0.08	−0.29	0.44	0.13	−0.42	0.67	0.08	−0.29	0.45	−0.36**	−0.68	−0.04	−0.29	−0.75	0.17	−0.36**	−0.68	−0.04
Non-Limiting Illness Only	0.15	−0.37	0.67	0.10	−0.65	0.86	0.15	−0.37	0.67	−0.29	−0.75	0.18	−0.07	−0.74	0.60	−0.29	−0.76	0.18
Limiting Illness Only	−0.37	−0.87	0.13	−0.36	−1.09	0.38	−0.37	−0.87	0.13	−0.52**	−0.99	−0.06	−0.54	−1.18	0.10	−0.53**	−0.99	−0.06
Chronic Disease Only	−0.25	−0.79	0.30	0.07	−0.76	0.89	−0.25	−0.79	0.30	−0.24	−0.72	0.24	−0.03	−0.77	0.71	−0.23	−0.71	0.24
Non-Limiting and Chronic Disease	−0.29	−0.82	0.27	−0.19	−1.03	0.65	−0.29	−0.86	0.27	−0.44*	−0.93	0.06	−0.46	−1.22	0.29	−0.43*	−0.92	0.06
Limiting and Chronic Disease	−0.69**	−1.25	−0.13	−0.26	−1.11	0.58	−0.69**	−1.25	−0.13	−0.77***	−1.27	−0.28	−0.48	−1.22	0.27	−0.77***	−1.26	−0.27
Reception of Disability Benefits																		
Did Not Receive Benefits (Ref)																		
Received Benefits				−1.65***	−2.09	−1.22							−1.35***	−1.73	−0.96			
Individual Cared For																		
Not Cared For (Ref)																		
Cared For							−0.01	0.36	0.34							−0.17	−0.49	0.15

*p < 0.10, **p < 0.05, ***p = 0.01.

* Models control for age, age squared, highest educational qualifications, partnership status, number of sick people in the household, number of pensioners in the household, number of children in the household, region, IHS household income, lagged type of illness, lagged employment status and lagged IHS household income. Model 2 also controls for lagged reception of benefits and Model 3 controls for lagged being cared for.

+ IHS = Inverse Hyperbolic Sine Transformation.

Table 9

Regression Parameters of Hours Worked on Type of Illness Individual has in the Household by Gender.

Type of Illness	Men									Women								
	Model 1			Model 2			Model 3			Model 1			Model 2			Model 3		
	Estimate	95% Confidence Interval		Estimate	95% Confidence Interval		Estimate	95% Confidence Interval		Estimate	95% Confidence Interval		Estimate	95% Confidence Interval		Estimate	95% Confidence Interval	
No Household Illness (Ref)																		
No Chronic Disease or Limiting Illness	−0.91**	−1.67	−0.15	−0.36	−1.34	0.62	−0.91**	−1.67	−0.15	−0.15	−0.75	0.45	−0.19	−0.98	0.60	−0.15	−0.75	0.45
Non-Limiting Illness Only	−0.87	−1.95	0.21	0.24	−1.11	1.58	−0.87	−1.95	0.21	0.05	−0.73	0.82	−0.47	−1.48	0.53	0.05	−0.73	0.82
Limiting Illness Only	−1.41**	−2.52	−0.30	−1.46**	−2.87	−0.06	−1.41**	−2.52	−0.29	−0.72*	−1.51	0.06	−1.15**	−2.17	−1.12	−0.72*	−1.51	0.06
Chronic Disease Only	−2.13***	−3.29	−0.97	−1.33*	−2.79	0.13	−2.13***	−3.29	−0.97	−1.11**	−1.96	−0.26	−1.11*	−2.25	0.03	−1.11**	−1.96	−0.26
Non-Limiting and Chronic Disease	−2.28***	−3.46	−1.10	−1.54**	−2.99	−0.08	−2.28***	−3.45	−1.10	−1.51***	−2.39	−0.62	−1.54**	−2.71	−0.37	−1.51***	−2.39	−0.62
Limiting and Chronic Disease	−2.73***	−3.89	−1.57	−1.60**	−3.06	−0.14	−2.73***	−3.89	−1.56	−1.95***	−2.83	−1.08	−1.87***	−3.03	−0.71	−1.95***	−2.83	−1.08
Reception of Disability Benefits																		
Did Not Receive Benefits (Ref)																		
Received Benefits				−3.05***	−3.90	−2.22							−1.37	−1.92	−0.82			
Individual Cared For																		
Not Cared For (Ref)																		
Cared For							0.01	−0.56	0.58							−0.12	−0.53	0.28

*p < 0.10, **p < 0.05, ***p = 0.01.

* Models control for age, age squared, highest educational qualifications, partnership status, number of sick people in the household, number of pensioners in the household, number of children in the household, region, IHS household income, lagged type of illness, lagged employment status and lagged IHS household income. Model 2 also controls for lagged reception of benefits and Model 3 controls for lagged being cared for.

+ IHS = Inverse Hyperbolic Sine Transformation.

Table 10

Regression Parameters of Hours Worked per Week on Type of Illness Individual has in the Household by Reception of Benefits*+.

	Did Not Receive Benefits						Received Benefits					
	Model 1			Model 2			Model 1			Model 2		
	Estimate	95% Confidence Interval		Estimate	95% Confidence Interval		Estimate	95% Confidence Interval		Estimate	95% Confidence Interval	
Type of Illness												
No Household Illness (Ref)												
No Chronic Disease or Limiting Illness	−0.37	−1.01	0.27	−0.37	−1.02	0.27	−0.50	−2.57	1.58	−0.52	−2.59	1.56
Non-Limiting Illness Only	−0.15	−1.03	0.73	−0.15	−1.03	0.73	0.88	−1.40	3.15	0.86	−1.41	3.13
Limiting Illness Only	−1.08**	−2.02	−0.13	−1.08**	−2.02	−0.14	−0.20	−2.19	1.79	−0.22	−2.21	1.78
Chronic Disease Only	−1.14**	−2.13	−0.16	−1.15**	−2.14	−0.16	0.36	−1.80	2.52	0.35	−1.83	2.52
Non-Limiting and Chronic Disease	−1.52***	−2.52	−0.52	−1.52***	−2.52	−0.52	−0.42	−2.76	1.92	−0.43	−2.78	1.92
Limiting and Chronic Disease	−1.58***	−2.58	−0.58	−1.58***	−2.58	−0.58	−0.44	−2.58	1.70	−0.45	−2.59	1.70
Individual Cared For												
Not Cared For (Ref)												
Cared For				−0.12	−0.69	0.45				−0.54	−1.21	0.13

*p < 0.10, **p < 0.05, ***p = 0.01.

* Models control for gender, age, age squared, highest educational qualifications, partnership status, number of sick people in the household, number of pensioners in the household, number of children in the household, region, IHS household income, lagged type of illness, lagged hours worked per week and lagged IHS household income. Model 2 also controls for lagged individual cared for.

+ IHS = Inverse Hyperbolic Sine Transformation.

Type of illness in the household

There was a clear trend of fewer working hours with increased severity of the type of illness across all models, Table 5. For example, respondents with no LLSI or chronic illness themselves, but who lived in households with an ill person worked 30-min less per week, b = −0.50, 95% CI=(-0.98, −0.02). Individuals with a non-limiting long-standing illness and a chronic disease worked almost 2 h fewer per week, b = −1.90, 95% CI=(-2.62, −1.17) while those with both a LLSI and a chronic disease worked almost 2.5 h less per week, b = −2.35, 95% CI= (-3.06, −1.63) (Model 1).

Currently receiving benefits, b = −2.05, 95% CI=(-2.53, −1.58) was associated with fewer hours worked per week. Additionally, the number of hours worked among individuals with no illness but living with someone with an illness and those with a non-limiting illness only were no longer different from individuals with no illness in their households. Caring responsibilities was not associated with reduced working hours (Model 3).

Household income

Any illness in the household

Table 6, shows the associations between having any ill individual in the household and household income. Similar to the employment status models and in contrast to the working hours' models, there were no associations between having any ill individual in the household o and household income in any of the models. While current reception of benefits was associated with higher household income, b = 0.15, 95% CI=(0.11, 0.18) (Model 2). Currently being cared for was not associated with higher or lower household income (Model 3).

Type of illness in the household

Table 7 shows associations between the type of illness an individual had in their household (including their own illness) and household income. Similar to the previous model, there were no differences in household income by type of illness compared to households with no illness (Model 1).

Current reception of benefits was associated with household income, b = 0.14, 95% CI=(0.11, 0.18) (Model 2). Currently being cared for was not associated with household income (Model 3).

Stratified models

Gender

There were different patterns of association between type of illness and odds of being employed between men and women (Table 8). The odds of being employed were lower amongst men who had both a limiting illness and a chronic disease only, log odds = −0.69, 95% CI= (-1.25, −0.13). While among women, those who were not ill but lived in households with an ill person, log odds = −0.36, 95% CI=(-0.68, −0.04), those who had limiting illness only, log odds = −0.52, 95% CI= (-0.99, −0.06), and those with both a limiting illness and chronic disease, log odds = −0.77, 95% CI=(-1.27, −0.28), had lower odds of being employed compared to women who lived in households with no illness. Reception of benefits was associated with lower odds of being employed among both men, log odds = −1.65, 95% CI=(-2.09, −1.22), and women, log odds = −1.35, 95% CI=(-1.73, −0.96) (Model 2). Odds of being employed by type of illness were no longer different than those of men or women in households with no illness after the inclusion of reception of benefits. Being cared for was not associated with increased or decreased odds of being employed for either men or women (Model 3).

Similarly, there were differences in reduction in working hours by type of illness between men and women (Table 9). Amongst men, all categories of illness were associated with decreases in working hours, except for men with non-limiting illness only, compared to men with no illness in their households. Among women, only those with chronic illness only, b = −1.11, 95% CI=(-1.96, −0.26), non-limiting illness and chronic disease, b = −1.51, 95% CI=(-2.39, −0.62) or limiting illness and chronic disease, b = −1.95, 95% CI=(-2.83, −1.08) had reduced working hours compared to women in households with no illness. Similar to the employment model, reception of benefits was associated with decreased working hours (Model 2) while there were no associations between being cared for (Model 3) and working hours for both men and women.

Reception of benefits

Across the more severe types of illness (i.e. limiting illness only and all chronic disease categories), individuals who did not receive benefits or were in households that did not receive benefits worked fewer hours per week compared to individuals who lived in households with no illness (Table 10). Individuals who received benefits or lived in households who received benefits worked similar hours to individuals with no illness in their households regardless of the type of illness (Model 1).

Table 11

Regression Parameters of Employment Status on Type of Illness Individual has in the Household by Whether Cared For*+.

	Not Cared For						Cared For					
	Model 1			Model 2			Model 1			Model 2		
	Estimate	95% Confidence Interval		Estimate	95% Confidence Interval		Estimate	95% Confidence Interval		Estimate	95% Confidence Interval	
Type of Illness												
No Household Illness (Ref)												
No Chronic Disease or Limiting Illness	−0.16	−0.40	0.09	−0.03	−0.40	0.33	0.44	−0.41	1.29	−0.08	−1.10	0.94
Non-Limiting Illness Only	−0.06	−0.42	0.29	0.14	−0.38	0.65	0.70	−0.71	2.11	−0.08	−1.93	1.76
Limiting Illness Only	−0.55***	−0.90	−0.19	−0.45*	−0.94	0.03	0.94*	−0.09	1.97	0.52	−0.88	1.92
Chronic Disease Only	−0.31	−0.68	0.06	0.03	−0.54	0.61	0.84	−0.43	2.11	0.14	−1.56	1.83
Non-Limiting and Chronic Disease	−0.44**	−0.83	−0.06	−0.35	−0.94	0.24	0.94	−0.39	2.26	0.24	−1.56	2.04
Limiting and Chronic Disease	−0.82***	−1.20	−0.44	−0.37	−0.96	0.21	0.63	−0.72	1.98	0.03	−1.87	1.92
Reception of Disability Benefits												
Did Not Receive Benefits (Ref)												
Received Benefits				−1.83***	−2.15	−1.51				−0.58*	−1.21	0.04

*p < 0.10, **p < 0.05, ***p = 0.01.

* Models control for gender, age, age squared, highest educational qualifications, partnership status, number of sick people in the household, number of pensioners in the household, number of children in the household, region, IHS household income, lagged type of illness, lagged employment status and lagged IHS household income. Model 2 also controls for lagged reception of benefits.

+ IHS = Inverse Hyperbolic Sine Transformation.

Table 12

Regression Parameters of Hours Worked per Week on Type of Illness Individual has in the Household by Whether Cared For*+.

	Not Cared For						Cared For					
	Model 1			Model 2			Model 1			Model 2		
	Estimate	95% Confidence Interval		Estimate	95% Confidence Interval		Estimate	95% Confidence Interval		Estimate	95% Confidence Interval	
Type of Illness												
No Household Illness (Ref)												
No Chronic Disease or Limiting Illness	−0.48*	−0.98	0.03	−0.19	−0.66	0.47	−1.10	−3.12	0.91	−1.78	−4.15	0.59
Non-Limiting Illness Only	−0.28	−0.96	0.41	−0.08	−0.97	0.80	−1.00	−3.60	1.59	−1.08	−3.59	1.39
Limiting Illness Only	−1.07***	−1.78	−0.36	−1.39***	−2.30	−0.48	−0.09	−2.26	2.07	−0.59	−2.96	1.78
Chronic Disease Only	−1.73***	−2.47	−0.98	−1.31***	−2.29	−0.33	0.07	−2.36	2.50	−1.60	−4.42	1.21
Non-Limiting and Chronic Disease	−2.04***	−2.81	−1.27	−1.68***	−2.68	−0.69	0.04	−2.44	2.53	−1.41	−4.27	1.46
Limiting and Chronic Disease	−2.52***	−3.28	−1.76	−1.90***	−2.89	−0.92	0.009	−2.37	2.39	−1.32	−4.08	1.44
Reception of Disability Benefits												
Did Not Receive Benefits (Ref)												
Received Benefits				−2.68***	−3.27	−2.10				−0.79	−1.84	0.26

*p < 0.10, **p < 0.05, ***p = 0.01.

* Models control for gender, age, age squared, highest educational qualifications, partnership status, number of sick people in the household, number of pensioners in the household, number of children in the household, region, IHS household income, lagged type of illness, lagged hours worked per week and lagged IHS household income. Model 2 also controls for lagged reception of benefits.

+ IHS = Inverse Hyperbolic Sine Transformation.

Being cared for was not associated with working hours (Model 2).

Caring responsibilities

Odds of being employed differed between being cared for or not (Table 11). Amongst those who were not cared for, those with limiting illness only, log odds = −0.55, 95% CI=(-0.90, −0.19), non-limiting illness only and chronic disease, log odds = −0.44, 95% CI= (-0.83, −0.06) or limiting illness and chronic disease, log odds = −0.82, 95% CI= (-1.20, −0.44), had lower odds of being employed compared to individuals who had no illness in their households. There were no differences in the log odds of being employed by type of illness amongst those who were cared for compared to individuals with no illness in their households (Model 1). Amongst individuals who were not cared for, reception of benefits was associated with decreased odds of being employed, log odds = −1.83, 95% CI=(-2.15, −1.51). There was no association between reception of benefits and being employed amongst those who were cared for (Model 2).

Reduction in the number of hours worked differed by whether the individual was cared for or not (Table 12). Individuals who were not cared for but had a limiting illness only or chronic disease (alone and with non-limiting and limiting illness) worked fewer hours per week compared to individuals in households with no illness. While those who were cared for did not differ in the number of hours worked regardless of the type of illness they had compared to individuals with no household illness (Model 1). Reception of benefits was associated with a reduction of over 2.5 h worked per week amongst individuals who were not cared for, b = −2.68, 95% CI=(-3.27, −2.10), compared to individuals who did not receive benefits. The was no association between reception of benefits and hours worked amongst individuals who were cared for (Model 2).

Working age

Amongst the working age group, individuals with a limiting illness only, log odds = −2.14, 95% CI=(-3.03, −1.26), chronic disease only, log odds = −1.06, 95% CI=(-2.08, −0.04) or limiting illness and chronic disease, log odds = −1.22, 95% CI=(-2.25, −0.19) had lower odds of being employed (Table 13). Odds of being employed amongst the working age group were lower only for individuals with a limiting illness and chronic disease, log odds = −0.69, 95% CI = −1.10, −0.27) (Model 1). Reception of benefits was associated with lower odds of being employed amongst the working age group one, log odds = −1.67, 95%= (-1.99, −1.36) (Model 2). Being cared for was not associated with odds

Table 13
Regression Parameters of Employment Status on Type of Illness Individual has in the Household by Working Age Group*+.

	Not of Working Age						Working Age					
	Model 1		Model 2		Model 3		Model 1		Model 2		Model 3	
	Estimate	95% Confidence Interval	Estimate	95% Confidence Interval	Estimate	95% Confidence Interval	Estimate	95% Confidence Interval	Estimate	95% Confidence Interval	Estimate	95% Confidence Interval
Type of Illness												
No Household Illness (Ref)												
No Chronic Disease or Limiting Illness	−0.75**	−1.51, −0.003	−0.64	−1.89, 0.61	−0.76**	−1.51, −0.006	−0.07	−0.32, 0.19	−0.02	−0.38, 0.34	−0.07	−0.32, 0.19
Non-Limiting Illness Only	−0.93*	−1.87, 0.01	−0.34	−1.77, 1.08	−0.94*	−1.88, 0.01	0.07	−0.30, 0.45	0.16	−0.36, 0.69	0.07	−0.30, 0.44
Limiting Illness Only	−2.14***	−3.03, −1.26	−1.35**	−2.65, −0.06	−2.14***	−3.03, −1.03	−0.24	−0.61, 0.13	−0.29	−0.79, 0.21	−0.24	−0.61, 0.12
Chronic Disease Only	−1.06**	−2.08, −0.04	−0.30	−2.15, 1.55	−1.06**	−2.08, −0.04	−0.02	−0.42, 0.38	0.16	−0.43, 0.74	−0.02	−0.42, 0.38
Non-Limiting and Chronic Disease	−1.00*	−2.02, 0.02	−0.76	−2.59, 1.06	−1.01*	−2.03, 0.02	−0.23	−0.65, 0.19	−0.19	−0.80, 0.42	−0.23	−0.65, 0.19
Limiting and Chronic Disease	−1.22**	−2.25, −0.19	−0.49	−2.30, 1.32	−1.22**	−2.26, −0.19	−0.69***	−1.10, −0.27	−0.34	−0.94, 0.26	−0.69***	−1.10, −0.27
Reception of Disability Benefits												
Did Not Receive Benefits (Ref)												
Received Benefits			−0.62	−1.51, 0.27					−1.67***	−1.99, −1.36		
Individual Cared For												
Not Cared For (Ref)												
Cared For					−0.05	−0.64, 0.55					−0.15	−0.42, 0.11

*p < 0.10, **p < 0.05, ***p = 0.01.

* Models control for gender, age, age squared, highest educational qualifications, partnership status, number of sick people in the household, number of pensioners in the household, number of children in the household, region, IHS household income, lagged type of illness, lagged employment status and lagged IHS household income. Model 2 also controls for lagged reception of benefits and Model 3 controls for lagged being cared for.
+ IHS = Inverse Hyperbolic Sine Transformation.

of being employed for either group (Model 3).

Living alone

There were also differences in hours worked per week between types of illness among those who did or did not live alone (Table 14).

Amongst individuals who did not live alone only those with non-limiting illness only worked similar hours per week compared to individuals with no household illness. All others worked fewer hours per week. Amongst those who lived alone, only those with a chronic disease (only and with limiting and non-limiting illness) worked fewer hours compared to individuals who were not ill (Model 1). Reception of benefits was associated with fewer hours worked for both individuals who lived with others, b = −2.20, 95% CI=(-2.83, −1.57) and those who lived alone, b = −1.82, 95% CI=(-2.45, −1.19). However, amongst those who lived alone, only those with limiting illness and chronic disease worked fewer hours, b = −1.57, 95% CI=(-3.02, −0.13) compared to those with no illness. All others works similar numbers of hours per week. (Model 2).

Robustness checks

We ran all three models with individual income as the outcome and found no associations between either having someone ill in the household or type of illness and increasing or decreasing income. Similar to household income, reception of benefits was associated with increased individual income.

Discussion and conclusion

Contrary to expectations, we find no overall impact of diagnosis of a long-standing illness on household income, despite the clear reduction in odds of being employed and hours worked. As anticipated, however there is heterogeneity in the impact of diagnosis of a long-standing illness on income which relates to severity of illness (need for care) and household composition. Our findings suggest that households in the UK can 'compensate' for illness, thus an ill person's income may vary in the short term in response to the illness but benefits and changes in the behaviours of other residents in the household will mitigate overall impacts. Our findings of the employment status combined with the household income suggest this may be true. While individuals with more severe or chronic illness are less likely to be in paid employment, there was still no change in the household incomes of those individuals. This was also borne out in our stratified analyses where patterns and associations between illness type and household income did not differ between individuals who lived alone or not (not shown). Stratification by reception of benefits also showed no difference in household income, however there was a suggestion that individuals who received benefits has higher incomes across all illness types (p < 0.1, not shown).

What impact does long term illness have on household income in the UK?

Diagnosis of long-standing illness does not lead to a reduction in the ill person's or the household income. This is in contrast to the evidence based on studies carried out in low-income countries and in countries where people have to pay for their health care. This is primarily due to UK citizens having access to free health care including expensive and on-going treatment for long-standing illness. They may also be eligible for health-related benefits although the impact of such benefits upon household income was not significant in the long term. However the lack of impact upon individual and household income is not what previous studies conducted in the UK have found. Studies in the UK report curtailment of income among households with disability or long-standing illness (Jenkins and Rigg, 2004; Green et al., 2007, Joseph Rowntree Foundation, 2017.) Three possible explanations for the discrepancy between our results and previous studies are: firstly the way that illness/disability was categorised. In our analysis the long-standing

Table 14

Regression Parameters of Hours Worked per Week on Type of Illness Individual has in the Household by Whether Live Alone*+.

	Do Not Live Alone						Live Alone					
	Model 1			Model 2			Model 1			Model 2		
	Estimate	95% Confidence Interval		Estimate	95% Confidence Interval		Estimate	95% Confidence Interval		Estimate	95% Confidence Interval	
Type of Illness												
No Household Illness (Ref)												
No Chronic Disease or Limiting Illness	−0.59**	−1.09	−0.09	−0.28	−0.92	0.37						
Non-Limiting Illness Only	−0.35	−1.08	0.38	0.003	−0.93	0.93	−0.43	−1.47	0.61	−0.64	−1.82	0.54
Limiting Illness Only	−1.17***	−1.90	−0.43	−1.42***	−2.36	−0.48	−0.60	−1.79	0.59	−0.79	−2.21	0.62
Chronic Disease Only	−1.69***	−2.49	−0.89	−1.19**	−2.23	−0.14	−1.30**	−2.57	−0.03	−1.32*	−2.81	0.17
Non-Limiting and Chronic Disease	−1.97***	−2.80	−1.15	−1.56***	−2.62	−0.50	−1.60**	−2.89	−0.31	−1.46*	−2.95	0.02
Limiting and Chronic Disease	−2.54***	−3.36	−1.73	−1.84***	−2.90	−0.77	−1.66**	−2.94	−0.38	−1.57**	−3.02	−0.13
Reception of Disability Benefits												
Did Not Receive Benefits (Ref)												
Received Benefits				−2.20***	−2.83	−1.57				−1.82***	−2.45	−1.19

*p < 0.10, **p < 0.05, ***p = 0.01.

* Models control for gender, age, age squared, highest educational qualifications, partnership status, number of sick people in the household, number of pensioners in the household, number of children in the household, region, IHS household income, lagged type of illness, lagged employment status and lagged household income. Model 2 also controls for lagged reception of benefits.

+ IHS = Inverse Hyperbolic Sine Transformation.

illness variable was a composite variable based upon a range of limiting and non-limiting conditions. It thus included people with conditions such as high blood pressure which may be asymptomatic to those with severely limiting conditions. Second, and linked to the range of illnesses included, there was heterogeneity in the effects of illness diagnosis upon income. In our analysis, the relationship between illness diagnosis and household income varies to some extent by type of illness (type of condition and whether it is limiting or non-limiting) but without a clear pattern. Thus some effects may have been masked. Thirdly, we did not examine impact by socio-economic differences between households. Whilst many households may have capacity to compensate for illness, the literature would suggest that those which are poorest are much less able to do so (Salway & Harriss, 2008).

In our analysis, following diagnosis of long-standing illness, both the individual and the household show remarkable resilience, in that despite reductions in odds of the individual remaining in paid employment and reduction in working hours, household income does not significantly decrease. We use the term 'resilience' to refer to the capacity of groups of people who are bound together, e.g., In an organization, community or a household, to sustain their well-being in response to challenges to it (Hall & Lamont, 2013). It would seem that the household assembles its resources and takes active steps to mitigate loss (or potential loss) of earnings of the person diagnosed with a long-standing illness. This is apparent in households affected by all categories of illness including limiting as well as non-limiting long-standing illness. However, the household's capacity to compensate for long-standing illness has clear limits. If benefits cannot be maintainedthere will be a significant decline in household income in the longer term.

It is clear that some households are more able to compensate than others and not every household has the capacity to withstand the impact of long-standing illness on income. Thus our hypothesis that the impact of illness on household income may vary according to level of household resilience was confirmed. Multi-person households compared to single-person households have more resources to draw upon as evidenced by the increase in household income that accompanies the non-ill person increasing their hours of work. Older households are also cushioned from the impact of long-standing illness as income is more likely to come from a retirement pension than paid employment and is thus less affected by illness. Older households may, however, have less capacity to provide informal care. It is likely that the households on lowest incomes will be most vulnerable as the impact of illness diagnosis upon employment is socially patterned with those with low levels of occupational skill less likely to remain in paid employment (Bartley & Owen, 1996; Burstrom et al., 2000).

Whilst our research shows that household income remains relatively stable following onset of illness and provides some indication as to why this is the case, there are many limitations and avenues for further research. Heterogeneity of effects may have masked trends and in addition, the analysis was also restricted to stable households, i.e., those that demonstrated no change in composition from waves 1–8. Thus those households facing some of the most dramatic consequences of illness, such as death or relocation of the ill person to a residential home, were excluded from the analysis. Now that we know that the overall impact of diagnosis of long-standing illness upon income in the UK is not marked, it would be useful to identify those household with greatest vulnerability to offer them appropriate support.

Ethics approval declaration

Ethical approval for Understanding Society, the UK Household Longitudinal Study (UKHLS) was obtained from the university ethics committee and the National Research Ethics Service. This specific paper did not have to go through additional ethics approval as this is secondary data analysis of UKHLS. Data is available through the UK Data Service.

CRediT authorship contribution statement

Cara L. Booker: Conceptualization, Methodology, Formal analysis, Writing - original draft, Writing - review & editing. **Leanne Andrews:** Conceptualization, Writing - original draft. **Gillian Green:** Conceptualization, Writing - original draft, Writing - review & editing. **Meena Kumari:** Conceptualization, Supervision, Writing - original draft.

Declaration of competing interest

The authors declare no conflicts of interest.

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