



How Important are Carer Tasks in Determining Carer Quality of Life? Evidence from a Shapley Decomposition Approach

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Accepted: 13 January 2025
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Abstract

While there is a large literature that examines the determinants of carer quality of life, there is a dearth of research that focuses on the usual activities that carers perform and how they are related to carer-specific measures of quality of life. We use data from the Survey of Adult Carers in England to investigate the role that the tasks that carers perform play in determining carer quality of life. We model the relationship between the variables through a series of simple linear regressions, multiple linear regressions, and a Shapley decomposition. We find that all of the individual tasks that we have information on are statistically significant predictors of carer quality of life. In addition, the Shapley decomposition shows that, when taken together, carer tasks explain a higher proportion of variance in carer quality of life than any other group of determinants. These results are largely robust to different measures of carer tasks, different measures of carer quality of life, and different subgroups. We also find that there is evidence of a causal link between carer tasks and carer quality of life as carers report that their caring responsibilities have affected tangible health outcomes such as illnesses and GP visits. From a policy perspective, local government services that are used to support carers should know that policies designed to help carers with their tasks could have a large impact on carer quality of life.

Keywords Carers · Carer tasks · England · Quality of life · Shapley decomposition

JEL Classification I31 · J28 · J46 · Z13

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1 Introduction

As the global population continues to age, the proportion of people who have long-term caring responsibilities is increasing (United Nations, 2024). According to the 2021 UK census, around 5.7 million people provide unpaid, informal care, though other research estimates that this number is twice as big (Carers UK, 2023a). Informal carers are entitled to some monetary compensation in the form of the Carer's Allowance, though this amount is small and subject to numerous restrictions. As summarized by Fox et al. (2010), caring has been shown to be associated with lower income, poorer mental health, and decreased leisure time. Because of the various ways in which caring affects the caregiver, many indicators have been developed to measure the care provider's experience of caring. A widely used measure of the carer experience is the carer's quality of life. Previous studies have shown that factors such as demographic characteristics (Cohen et al., 2017), caring intensity (Cook et al., 2018), social care services (Rand et al., 2020), and even the reasons for caring (Rand et al., 2019), are predictors of carers' quality of life.

One area in this field where there is a dearth of research is examining the role that carer tasks play in determining carer quality of life. This is surprising given that carer tasks have been shown to be related to other aspects of carers' experience. For example, Halpern et al. (2017) show that carers who perform medical related tasks such as helping keep track of medications and helping with medical appointments suffer a higher emotional and psychological burden compared to carers who do not perform these tasks. They also find comparable results for non-medical tasks such as help with bills and banking. Similarly, Keeton et al. (2020) find that carers who perform medical/nursing tasks suffer higher levels of emotional stress or physical strain. Finally, Loboiko et al. (2023) find that providing emotional/social support, household assistance, personal care, support in organizational matters, and medical care, are all positively related to the overall burden of care.

While these results help to illuminate the role that carer tasks play with regards to the carer experience, knowing the relationship between carer tasks and carer quality of life offers extra benefits. To begin with, the last two decades have seen the creation of carer-specific quality of life measurements (Brouwer et al., 2006; Malley et al., 2010), rather than more general quality of life measurements such as the EQ-5D. These measures have been designed to capture quality of life along the domains most relevant to carers, which is useful when using data that directly describes the carers environment, such as the support they receive or the services they use (Rand et al., 2012). Also, unlike previously used measures such as emotional burden and physical strain, quality of life measures capture both the positive and the negative aspects of a carers experience, a significant factor given that caring or care activities may provide the carers with intrinsic satisfaction (Netten, 2011). Finally, using comprehensive measures such as quality of life (as opposed to stress or carer burden) makes policymakers better able to compare different interventions or approaches, when trying to allocate scarce resources (Rand et al., 2015).

From a policy perspective, knowing the relationship between carer tasks and carer quality of life has important implications for practice. For example, informal caregiving differs from formal labour market work in a vital dimension: employees can choose to switch jobs if the marginal cost from their role begins to exceed the marginal benefit. In comparison, carers often provide care to family, friends, and neighbours, where there is an emotional attachment to the role, even if their caring tasks are difficult. This means that there is a large degree of heterogeneity in terms of the carer experience, with some carers performing relatively straightforward tasks and some carers performing more difficult tasks (e.g., tasks

which require more time, more physical effort, more specialized knowledge). If social policy is to be designed to support informal carers in their role, then it is imperative to know which of the tasks that they perform are the best predictors of their caring experience.

We use data from the Survey of Adult Carers in England, a carer only data set that contains detailed information on the carers' quality of life and on the tasks that they perform, to answer the following research questions: "Do individual carer tasks predict carer quality of life?" and "What is the relative importance of carer tasks as a group, when compared to other variable groups, in determining carer quality of life?" To answer the first question, we use a series of multiple linear regressions to show that not only are individual carer tasks statistically significant predictors of carer quality of life, but they are also relatively large when compared to other coefficients. To answer the second question, we combine the carer tasks together, as a group, and use a Shapley decomposition of the regression R^2 to compare the importance of carer tasks to other groups of determinants, such as carer demographics or caring intensity.

The rest of this paper is organized as follows: Sect. 2 discusses the relevant literature and highlights the contribution that this paper makes; Sect. 3 describes the data and Sect. 4 outlines the methods used to answer the research questions; the results are presented in Sect. 5; the underlying mechanism is examined in Sect. 6; Sect. 7 contains a discussion of the results including comparisons with other studies, limitations, and policy implications. Finally, Sect. 8 concludes.

2 Related Literature

2.1 Carer Quality of Life

Due to the development of carer-specific measures of quality of life, a large literature has emerged which examines the determinants of carer's quality of life. Quality of life measures are constructed by getting carers to respond to a series of questions about different dimensions of their caring experience and then combining these responses together to get one overall measure. The CarerQol instrument developed by Brouwer et al. (2006) used seven dimensions: fulfilment with caring tasks; relational problems with care recipient; own mental health; balancing care and own life; financial problems from caring; support with caring; and own health problems. In developing this instrument, they found that lower family income, poor health of the carer and care recipient, living with the care recipient, caring for at least 37 h per week, and performing at least 9 carer tasks was a significant predictor of lower quality of life scores. Rand et al. (2015) developed the ASCOT Carer instrument, the measure most closely related to the one used in this paper, which is constructed with responses to questions on the following topics: meaningful occupation; control over daily life; self-care; personal safety; social participation; space and time to be yourself; and feeling encouraged and supported. Similarly, they found that female caregivers, carers not in paid employment, poor health of the carer and care recipient, living with the care recipient, and caring for at least 10 h per week were associated with lower quality of life scores. Finally, the Carer Experience Scale (CES) developed by Goranitis et al. (2014) uses six domains: activities outside of caring; social support; institutional support; fulfilment from caring; control over caring; and relationship with care recipient. They found that poor carer health, long hours of caring, and high levels of caring intensity were negatively related to

the CES score. For an excellent summary of which domains are included or excluded in the different measures, see Rand et al. (2012).

In addition to this, more recent research has focused on factors other than carer characteristics and caring intensity. For example, Rand et al. (2019) found that the reason a person cares is related to their quality of life. They found that carers who care because the care recipient doesn't want anyone else to care for them or because the idea was suggested by social services have lower quality of life scores, while carers who care because they are not working or have the skills to care report higher quality of life scores. Social care services are also important, with Rand et al. (2020) finding that higher use of social care services by the care recipient is positively associated with the carer's quality of life. Finally, van Exel et al. (2008) show that attitudes towards respite are linked to carer quality of life, with carers who need and ask for respite having positive relationships with CarerQol domains, but carers who need and don't ask for it, having negative relationships.

2.2 Carer Tasks

While carer tasks have been considered in previous studies on carers, they have typically been combined into one overall measure of tasks such as activities of daily living (ADL) or instrumental activities for daily living (IADL). ADLs and IADLs are measures used in health and social care to assess a person's functional status based on tasks such as bathing or preparing meals. They are commonly used as a count variable which is expressed as the number of tasks the care recipient needs help with or that a carer performs. For example, in examining the determinants of caring intensity Cohen et al. (2017) uses both ADLs and IADLs as a caring intensity outcome. They can also be used as explanatory variables with Cook et al. (2018) using ADLs and IADLs as determinants of carer experience such as social strain and emotional burden. Similarly, Rand et al. (2019) and Rand et al. (2020) use the number of ADLs and IADLs as explanatory variables for different quality of life outcomes. While aggregate measures of ADLs and IADLs can be useful for capturing caring intensity, they may be less useful in helping policymakers decide on the best way to support informal carers in their role. For example, if social services targeted support at carers who provided intense levels of care (in the form of number of hours or number of tasks) this could improve the quality of life of the relevant carers but could come at a large cost due to the number of tasks that need to be covered. However, there may be tasks which are short in duration, but require specialist skills and knowledge to an extent that the carer's quality of life is severely affected by performing them. Targeting services at these specific tasks could yield big improvements in carer's quality of life for relatively little cost.

In spite of the examples given above, there are other examples of studies which provide detailed descriptions of the types of care that caregivers provide. Halpern et al. (2017) looked at caregivers to cancer patients and found that caring tasks based around medical care were associated with increased emotional and psychological burden, while tasks based on non-medical issues increased psychological burden. In this case, the medical tasks they had information on included keeping track of medications, help scheduling appointments, speaking with the provider, and ordering prescriptions, while the non-medical tasks included shopping, help with bills and banking, and doing chores. Also, Loboiko et al. (2023) used structural equation modelling to show that providing intense levels of emotional/social support, household assistance, personal care, support in organizational matters, and medical care, were all significantly related to the overall burden of care. The mechanism for these results appeared to be the emotional physical burden of these tasks,

rather than the financial burden. Finally, Keeton et al. (2020) looked at the relationship between carers who performed medical/nursing tasks and their caring experience. In their case, they found that carers who performed medical/nursing tasks had higher levels of emotional stress, physical strain, and high burden of care.

This paper adds to this literature by taking detailed information on the exact types of tasks that carers perform and examining their association with a specifically designed social care related quality of life measure. We then quantify the extent to which these tasks explain the quality of life of carers and how this group compares to other groups of determinants.

3 Data

3.1 Survey of Adult Carers in England

We use data from the Survey of Adult Carers in England (SACE). The SACE is a survey of informal carers over the age of 18 who are caring for someone who is also over the age of 18. The survey contains information on the carer demographics, such as age, gender, and ethnicity, and information on their caring situation, including caring tenure, carer tasks, and any support services they receive. The survey also contains information on measures such as isolation and enjoyment, which are domains relevant to our quality of life measure. While there are many valid quality of life measures (as discussed previously), the main motivation for using this data set is that it contains detailed information on carer tasks as well as the domains required to construct a valid quality of life measurement, both of which are required to answer our research questions. Our analysis includes the first four waves of data: 2012–2013, 2014–2015, 2016–2017, and 2018–2019 which are accessible online, via the NHS Digital website (NHS Digital, 2013; NHS Digital, 2015; NHS Digital, 2017; NHS Digital, 2019). Each wave attempts to survey over 100,000 carers, and we combine the data from all four waves for the statistical analysis.

3.2 Outcome Variable

Our main outcome of interest is social care-related carer quality of life (Carer SCRQoL). This measure is constructed from six domains: enjoyment, control, neglect, safety, isolation, and support. For each domain, carers are asked to rate their current situation on a 3-point scale: ideal state, some needs, and high-level needs. Each state is assigned a numerical value from 0 to 2, with larger numbers corresponding to more desirable states. The Carer SCRQoL measure is then constructed by summing the respondents score across all six variables. This gives a measure of Carer SCRQoL ranging from 0 to 12. The wording for these questions, the responses, and the respondent numbers for each outcome, is given in Table 1.

The Carer SCRQoL measure was originally identified in a study by Malley et al. (2010) who were commissioned to develop a performance indicator for carers that reflected their experiences and outcomes. Their measure included seven domains relating to quality of life which included the six variables mentioned above, plus a question relating to space and time. However, they stated that because there was a high correlation between time and space and the other variables, and because of the conceptual overlap with measures such as control, that it is possible to drop the time and space variable

Table 1 SCRQoL domains

Variable	Carers
<i>Which of the following statements best describes how you spend your time? When you are thinking about what you do with your time, please include anything you value or enjoy, including formal employment, voluntary or unpaid work, caring for others and leisure activities</i>	
I'm able to spend my time as I want, doing things I value or enjoy (2)	15,483
I do some of the things I value or enjoy with my time but not enough (1)	63,578
I don't do anything I value or enjoy with my time (0)	13,862
<i>Which of the following statements best describes how much control you have over your daily life?</i>	
I have as much control over my daily life as I want (2)	20,910
I have some control over my daily life but not enough (1)	59,300
I have no control over my daily life (0)	12,713
<i>Thinking about how much time you have to look after yourself—in terms of getting enough sleep or eating well—which statement best describes your present situation?</i>	
I look after myself (2)	49,626
Sometimes I can't look after myself well enough (1)	27,646
I feel I am neglecting myself (0)	15,651
<i>Thinking about your personal safety, which of the statements best describes your present situation? By 'personal safety' we mean feeling safe from fear of abuse, being attacked or other physical harm</i>	
I have no worries about my personal safety (2)	78,374
I have some worries about my personal safety (1)	13,244
I am extremely worried about my personal safety (0)	1,305
<i>Thinking about how much social contact you've had with people you like, which of the following statements best describes your social situation?</i>	
I have as much social contact as I want with people I like (2)	31,492
I have some social contact with people but not enough (1)	46,327
I have little social contact with people and feel socially isolated (0)	15,104
<i>Thinking about encouragement and support in your caring role, which of the following statements best describes your present situation?</i>	
I feel I have encouragement and support (2)	32,342
I feel I have some encouragement and support but not enough (1)	41,609
I feel I have no encouragement and support (0)	18,972
Total Observations	92,923

The questions and answers are from the Survey of Adult Carers (NHS Digital, 2013; NHS Digital, 2015; NHS Digital, 2017; NHS Digital, 2019). The number in parentheses refers to the numerical code assigned to the outcome for the variable. The sum of these six variables is used to create the carer quality of life variable, "Carer SCRQoL"

from the scale and proceed with the other six. These questions were then adopted by the SACE meaning that we can construct this measure of Carer SCRQoL from the data. While this measure of quality of life would go on to be refined into the ASCOT-Carer measure (by introducing a 4th state of "no needs" and the inclusion of an additional domain relating to the carer's relationship with the care recipient), the original measure constructed here was found to be valid, and has since been used by the Department of Health as a measure of carer-reported quality of life (ASCOF 1D) (Department of Health & Social Care, 2018).

3.3 Explanatory Variables

With regards to carer tasks, which are the main explanatory variables of interest, we have information on 11 separate activities. In the SACE, carers are asked “Over the last 12 months, what kinds of things did you usually do for the person you cared for?”. Responses to this question include tasks such as personal care, physical help, give them medicine, keep an eye on them, help with care services, practical help, help with paperwork, take them out, keep them company, provide emotional support, and other help. The variables are binary, so they indicate whether the carer performs that task or not. A full list of what is involved in each task is given in Table 2. While most of the tasks have further details to explain exactly what is involved, the tasks listed as keeping an eye on him/her, giving emotional support, and other help, do not provide any further information.

We also have information on other variables that we include in our analysis such as carer demographics (age, gender, ethnicity, age of care recipient), information on their caring intensity (caring tenure, weekly caring hours, living with the care recipient, working status), and any services the care recipient uses (cover so carer can take an emergency break, cover so carer can take a short break [1–24 h], cover so carer can take a long break [> 24 h], resident in care home, lunch club, day centre or day activities, home help, meal service, personal assistant, lifeline alarm, and equipment or adaption to home), any support the carer receives from social services (information and advice, support from carer groups, training for carers, support to keep in employment), information on which wave the survey information is from, and which of the 9 regions of England the carer resides. These measures have all been dichotomized so, like carer tasks, they are all binary variables. In terms of how the variables are categorized into different groups, this is done based on how the variables are grouped together as responses to questions in the SACE for both the services the care recipient uses and for the support the carer receives, in the same way it was for carer tasks. While there is no agreed upon definition of carer demographics and caring

Table 2 Caring task question and definitions

Over the last 12 months, what kinds of things did you usually do for the person you cared for?
Personal care: Things like dressing, bathing, washing, shaving, cutting nails, feeding, using the toilet
Physical help: Such as helping with walking, getting up and down stairs, getting into and out of bed
Giving medicines: Things like making sure he/she takes pills, giving injections, changing dressings
Keeping an eye on him/her to see he/she is all right: -
Help with dealing with care services and benefits: Things like making appointments and phone calls, filling in forms
Other practical help: Things like preparing meals, doing his/her shopping, laundry, housework, gardening, decorating, household repairs, taking to doctor's or hospital
Help with paperwork or financial matters: Such as writing letters, sending cards, filling in forms, dealing with bills, banking
Taking him/her out: Such as taking out for a walk or drive, taking to see friends or relatives
Keeping him/her company: Things like visiting, sitting with, reading to, talking to, playing cards or games
Giving emotional support: -
Other help: -

The question and answers are from the Survey of Adult Carers (NHS Digital, 2013; NHS Digital, 2015; NHS Digital, 2017; NHS Digital, 2019). A similar table describing the definition of carer tasks can be found in Candon et al. (2024)

intensity in the literature, our decision on how to group these variables was based upon how they have been discussed in previous studies (Cook et al., 2018; Rand et al., 2019).

4 Methods

As stated in the Introduction, we aim to address two research questions: do individual carer tasks predict carer quality of life and what is the relative importance of carer tasks as a group, when compared to other variable groups, in determining carer quality of life? In order to address our first research question, we use a multiple linear regression model where SCRQoL is regressed on a series of carer tasks, while controlling for other relevant factors. This can be represented with the following equation,

$$SCRQoL_i = \alpha + \beta' CarerTasks_i + \gamma' CaringIntensity_i + \delta' Demographics_i + \zeta' CareServices_i + \theta' CarerSupport_i + \lambda_j + \mu_t + \varepsilon_i, \quad (1)$$

where we regress the individual, carer-level measure of SCRQoL on vectors of carer tasks, caring intensity, carer demographics, care services, and carer support. The exact variables in these vectors were outlined in subSect. 3.3. The model also contains a constant term α , in addition to region of England (λ_j) and survey wave (μ_t) fixed effects. We then estimate these parameters, and the parameters associated with these vectors ($\beta, \gamma, \delta, \zeta, \theta$), using OLS. While SCRQoL could be viewed as an ordered outcome (meaning an ordered logit may be used), we feel it makes for easier interpretation to assume that the variable is continuous, given the large number of categories. This approach has been found to valid in other disciplines (Rhemtulla et al., 2012), is commonly used in economics (Jacobsen et al., 2022; Bialowolski, 2019), and has been used before in papers which examine the quality of life of carers (Rand et al., 2019), so we feel there is precedent in the literature for this.

To address our second research question, we use the Shapley decomposition approach outlined by Shorrocks (2013). The Shapley decomposition allows us to determine what percentage of the R^2 can be apportioned to a particular group of variables in the regression. This is determined by calculating the difference in R^2 between two regression models when the group of interest is included and when it is excluded. However, this difference must be calculated for every subgroup that this variable can be included with, and then weighted by the prevalence of this subgroup. Using notation adapted from Chantreuil et al. (2019), assume that SCRQoL is made up of M components, defined to be $\{1, \dots, m\}$, where $m \geq 2$, and specific components can be identified as i and j . We then denote as a coalition S any non-empty subset of SCRQoL components and denote K as the set of non-empty subsets of SCRQoL components. The contribution of a particular component to SCRQoL, or the Shapley value of that component, can be expressed as,

$$SHAP_i = \sum_{\substack{S \subseteq K \\ i \notin S}} \frac{(m-s-1)!s!}{m!} * [R^2(S \cup \{i\}) - R^2(S)], \quad (2)$$

where $s = |S|$.

The benefit of using this method is that it allows us to see how important carer tasks are when considered as a group. While it is possible to do joint significance tests of multiple variables, such as an F -test, there are multiple combinations of tasks to consider (with 11

separate tasks there $2^{11} = 2048$ combinations of tests). Even if we did decide on a specific combination of tasks to test, a null hypothesis test would only tell us if this combination of tasks is statistically different from zero, and not provide any information on how it compares to other groups of variables. In addition, the Shapley decomposition allows for the marginal contributions of each component to be calculated in such a way that the contribution of each component sums to 100%, something that would not happen had we tried to calculate the contribution by simply removing that component (Chantreuil et al., 2019). Due to this useful property, this decomposition method is regularly used in studies on quality of life (Cabrero-García et al., 2022; Gamst-Klaussen & Lamu, 2020), poverty (Suarez Alvarez & Lopez Menendez, 2018; Verbunt & Guio, 2019), and inequality (Deutsch et al., 2018). It is also important to acknowledge that the results of the Shapley decomposition are sensitive to the measure that is used, in this case the R^2 . If we had used the SCRQoL variable to generate some sort of inequality measure that could be decomposed, then the results could be different. However, given that we are using outcomes that are currently used in other studies (such as quality of life) and are decomposing the R^2 (which is a regularly reported statistic in other studies) then this offers the best form of congruity with the current literature.

5 Results

5.1 Summary Statistics

Table 3 presents the summary statistics for the variables in the model. The means for the explanatory variables are given in column (1). Since the explanatory variables included in the model are binary, the means can be interpreted as percentages. Most carers (> 60%) perform all the carer tasks that we have information on. The only exception to this is the “other help” task which is provided by only 18% of carers. In terms of their demographics, our sample can be described as predominantly female (67%), white (91%), and caring for someone over the age of 65 (65%). Regarding their caring intensity, they care for more than 20 h per week (84%), have been caring for more than 5 years (64%), live with the care recipient (74%) and are not in paid employment (73%). In contrast to caring tasks, relatively few carers (< 32%) have care recipients that receive care services, except for receiving equipment or an adaption to their home (52%). Finally, the outcome variable, Carer SCRQoL, is the only variable which is continuous. It has a mean of 7.62 and a standard deviation of 2.66.

With regards to the state of caring in the UK, our sample does appear to be representative of current trends. A recent report by Carers UK highlighted that their sample of carers were 80% female, 31% over the age of 65, 11% ethnic minority, while 34% of carers were working, 86% cared for more than 20 h per week, and 71% had been caring for at least 5 years (Carers UK, 2023b). These numbers are similar to other developed countries, with a report from Carers Australia estimating that 27% of carers were over 65, 68% were female, 40% were working, 55% care for more than 20 h per week, and 60% have been caring for at least 5 years (Carers Australia, 2018). However, it is important to acknowledge that there are other countries, like the U.S., where the caring situation is different. A recent report by the National Alliance for Caregiving estimated that while 61% of carers were female, only 19% were over the age of 65, 61% were working, only 32% cared for more than 20 h per week, and only 29% had been caring for at least 5 years (National Alliance

Table 3 Summary statistics

	(1)	(2)	(3)	(4)	(5)
		SCRQoL if variable			
Variables	Mean	= 0	= 1	Difference	SE
<i>Carer task</i>					
Personal care	0.704	8.382	7.300	-1.082***	0.019
Physical help	0.609	8.195	7.253	-0.942***	0.018
Give them medicine	0.779	8.664	7.325	-1.339***	0.021
Keep an eye on them	0.928	8.969	7.516	-1.453***	0.033
Help with care services	0.881	8.494	7.504	-0.990***	0.027
Practical help	0.952	9.002	7.552	-1.451***	0.041
Help with paperwork	0.880	8.353	7.521	-0.833***	0.027
Take them out	0.800	7.959	7.536	-0.423***	0.022
Keep them company	0.860	8.514	7.476	-1.038***	0.025
Emotional support	0.871	8.650	7.469	-1.181***	0.026
Other help	0.184	7.801	6.826	-0.975***	0.022
<i>Caring intensity</i>					
Over 20 h per week of caring	0.835	9.324	7.284	-2.040***	0.023
Caring for more than 5 years	0.636	7.835	7.498	-0.337***	0.018
Carer lives with care recipient	0.744	8.345	7.371	-0.974***	0.020
Working	0.274	7.561	7.778	0.217***	0.020
<i>Demographics</i>					
Female	0.667	7.867	7.498	-0.369***	0.019
Under 65	0.561	7.881	7.417	-0.464***	0.018
Carer ethnicity (non-white)	0.089	7.679	7.026	-0.653***	0.031
Care recipient under 65	0.348	7.754	7.371	-0.383***	0.018
<i>Care recipient service</i>					
Emergency break	0.113	7.606	7.737	0.131***	0.028
Short break (1–24 h)	0.207	7.708	7.287	-0.421***	0.022
Long break (> 24 h)	0.188	7.604	7.693	0.088***	0.022
Resident in care home	0.054	7.568	8.534	0.966***	0.038
Lunch club	0.029	7.608	8.049	0.441***	0.052
Day center or day activities	0.243	7.633	7.583	-0.050	0.020
Home help	0.318	7.552	7.769	0.217***	0.019
Meal service	0.039	7.588	8.431	0.843***	0.045
Personal assistant	0.121	7.648	7.427	-0.221***	0.027
Lifeline alarm	0.293	7.550	7.792	0.242***	0.019
Equipment or adaption to home	0.520	7.631	7.612	-0.019	0.018
<i>Carer support</i>					
Information and advice	0.534	7.486	7.739	0.252***	0.018
Support from carer groups	0.283	7.635	7.585	-0.051*	0.019
Training for carers	0.052	7.622	7.603	-0.019	0.040
Support to keep in employment	0.029	7.613	7.867	0.254***	0.052
<i>Outcome</i>					
SCRQoL	Mean	Median	SD	Min	Max
	7.621	8	2.665	0	12
Observations	92,923				

Table 3 (continued)

SE standard error, *SD* standard deviation, *Min* minimum value, *Max* maximum value. The analogous information for survey waves and region of England are not reported but are available on request. * $p < 0.01$, ** $p < 0.005$, *** $p < 0.001$

of Caregivers, 2020). While our results may not be generalizable to the U.S. context, they should be generalizable to countries that have health systems, social security systems, and labour markets that are similar to the UK.

Finally, with regards to the SCRQoL variable, it is difficult to compare this measure to other countries, since the measure that was adapted for use in other countries was based on the new iteration of the measure (discussed in Sect. 3.2) which includes an extra variable and an extra state. When comparing it to other studies in the UK, Rand et al. (2019) also use the new measure and they find that the average value for carer quality of life in their sample is 13.43, which is higher than our value of 7.621. However, given that this new measure includes an extra variable and an extra state, the maximum value for their quality of life measure is 21, not 12. If we take the means as a fraction of the maximum value then the ratio for the sample in this study is 0.635 and the ratio for Rand et al. (2019) is 0.639, which provides evidence that this is a typical mean value for SCRQoL.

5.2 Simple Linear Regression

For the bivariate analysis, columns (2) and (3) of Table 3 show the mean values for Carer SCRQoL when the explanatory variable is equal to 0 and 1 respectively. Given that our main explanatory variables of interest are the carer tasks, it is important to note that the carers who do not perform any particular carer task have a higher average Carer SCRQoL score than the carers who do perform the task. Specifically, out of the 10 highest average values of Carer SCRQoL in columns (2) and (3), 7 involve carers who do not perform certain tasks. They are carers who do not help with paperwork (9.00), who do not help with the care services (8.97), who do not provide practical help (8.66), who do not provide emotional support (8.65), who do not look after and keep an eye on the care recipient (8.51), who do not give medicine (8.49), and who do not provide personal care (8.38). The remaining 3 high scorers are carers who care for fewer than 20 h (9.32), carers whose recipient resides in a care home (8.53), and whose recipient receives a meal service (8.43).

To calculate the difference in Carer SCRQoL based on whether carers perform certain tasks, we use simple linear regressions. The coefficients and standard errors from these regressions are presented in columns (4) and (5) respectively. The difference in Carer SCRQoL for all 11 tasks is negative, indicating that carers who perform these tasks report a worse quality of life score compared to carers who do not perform these tasks. In addition to this, the differences for all 11 tasks are statistically significant at the 0.1% level. In terms of the magnitude of the coefficients, in many cases the differences are close to 1 Carer SCRQoL point. Compared to the differences in Carer SCRQoL for the other variables,

these differences are quite large. Of the 10 largest differences in Carer SCRQoL in column (4), 8 relate to carer tasks: keep an eye on them (-1.453), practical help (-1.451), give them medicine (-1.339), provide emotional support (-1.181), personal care (-1.082), keep them company (-1.038), help with care services (-0.990), other help (-0.975). The other two differences include caring for over 20 h per week (-2.040), which is the largest difference, and when the carer lives with care recipient (-0.974).

5.3 Multiple Linear Regression

While the results described above provide evidence that carer tasks are significantly related to Carer SCRQoL, it remains to be seen to what extent these differences are because there are observable differences between these carers, or whether the task itself is directly related to Carer SCRQoL. To adjust for observable differences between the carers who do and do not perform these tasks we use a multiple linear regression model with all the caring tasks, and all the other explanatory variables, including region of England and survey wave controls, in the model. The results from this regression are presented in column (1) of Table 4. In terms of statistical significance, all the results for carer tasks are still significant at the 0.1% level. Nevertheless, a notable difference between the results presented here and the results in column (4) of Table 3 is the size of the coefficients: the coefficients in Table 4 are smaller than those in Table 3. This is to be expected since some of the differences in Carer SCRQoL reported in the previous table can be accounted for due to carer differences in other variables. For example, the coefficient on providing practical help was -1.451 in the simple linear regression but is now -0.206 in the multiple linear regression. Similarly, the coefficient on personal care was -1.082 in Table 3 but is now -0.225 in Table 4. In one case, the size of the coefficient is reduced so much that the coefficient changes sign. For the carers who take their care recipient out, the coefficient on this task is now positive at 0.282, meaning that carers who provide this activity have a higher level of Carer SCRQoL compared to carers who do not do this activity.

However, while the coefficients on carer tasks are now more similar in magnitude to the coefficients on the other explanatory variables, it is important to remember that they are still some of the largest coefficients in the model. The carer tasks with the largest coefficients include providing other help (-0.663), emotional support (-0.409), physical help (-0.388), keeping an eye of them (-0.375), and giving them medicine (-0.372). Other variables which show a large negative association with Carer SCRQoL include caring for over 20 h per week (-1.359), being under the age of 65 (-0.563), and being of non-white ethnicity (-0.312). In terms of the variables which have a positive association with Carer SCRQoL, carers who receive support from social services in the form of help to keep them in employment (0.409) and information and advice (0.293) have the largest coefficients. All other coefficients, including the remaining caring tasks, have coefficients that are smaller than 0.300 in magnitude.

5.4 Shapley Decomposition

While the previous set of analysis shows how carer tasks predict SCRQoL on an individual level, the summary statistics in Table 3 showed that each of these tasks (except for other help) is performed by 60% of the sample. To consider the fact that many of these carers are performing multiple carer tasks simultaneously, we employ the Shapley decomposition to

Table 4 Linear regression model of Carer SCRQoL on explanatory variables

	(1)	(2)	(3)	(4)
Variables	Coefficient	SE	Group % R^2	99% CI
<i>Carer task</i>			41.82	[40.06–43.59]
Personal care	-0.225***	(0.021)		
Physical help	-0.388***	(0.020)		
Give them medicine	-0.372***	(0.023)		
Keep an eye on them	-0.375***	(0.035)		
Help with care services	-0.280***	(0.032)		
Practical help	-0.206***	(0.041)		
Help with paperwork	-0.245***	(0.032)		
Take them out	0.282***	(0.022)		
Keep them company	-0.281***	(0.026)		
Emotional support	-0.409***	(0.027)		
Other help	-0.663***	(0.021)		
<i>Caring intensity</i>			34.87	[33.24–36.50]
Over 20 h per week of caring	-1.359***	(0.026)		
Caring for more than 5 years	-0.097***	(0.018)		
Carer lives with care recipient	-0.241***	(0.024)		
Working	0.064**	(0.021)		
<i>Demographics</i>			9.03	[7.87–10.20]
Female	-0.280***	(0.018)		
Under 65	-0.563***	(0.019)		
Carer ethnicity (non-white)	-0.312***	(0.031)		
Care recipient under 65	-0.016	(0.021)		
<i>Care recipient service</i>			5.16	[4.40–5.91]
Emergency break	0.153***	(0.028)		
Short break (1–24 h)	-0.199***	(0.021)		
Long break (> 24 h)	0.212***	(0.023)		
Resident in care home	0.012	(0.038)		
Lunch club	0.090	(0.049)		
Day center or day activities	0.102***	(0.020)		
Home help	-0.050	(0.019)		
Meal service	0.156***	(0.043)		
Personal assistant	0.056	(0.026)		
Lifeline alarm	-0.082***	(0.020)		
Equipment or adaption to home	0.087***	(0.018)		
<i>Carer support</i>			2.06	[1.50–2.61]
Information and advice	0.293***	(0.018)		
Support from carer groups	-0.084***	(0.020)		
Training for carers	0.060	(0.038)		
Support to keep in employment	0.409***	(0.049)		
<i>Wave and region fixed effects</i>			7.06	[5.98–8.14]
Total R^2	0.163			
Observations	92,923			

SE standard error. Group % R^2 % of overall model R^2 that is due to this group of variables. CI confidence interval. The regression coefficients for survey waves and region of England are not reported but are available on request. * $p < 0.01$, ** $p < 0.005$, *** $p < 0.001$

gauge the relative importance of the variables when they are grouped together by their categories. The results for the Shapley decomposition are presented in column (3) of Table 4. Overall, carer tasks account for almost 42% of the variation in the R^2 from the multiple linear regression, which is the largest percentage in our model. The remaining variation can be accounted for by caring intensity (34.87%), demographics (9.03%), care recipient services (5.16%), carer support (2.06%), and wave and regional variables (7.06%). In addition to the point estimates of the decomposition, we also employ a bootstrap resampling technique to highlight the level of uncertainty surrounding the estimates. Using 100 bootstrap replications, we generate confidence intervals at the 99% level for each estimate. These results are presented in the final column of Table 4. The results show that the confidence levels for carer tasks and carer intensity do not overlap, indicating there is a statistically significant difference in the two groups of variables.

5.5 Pure Marginal Contribution and Pairwise Interactions

Now that we know how much each group of variables contributes to the overall R^2 , the next step is to consider how these results can be used to predict the impact of any policy changes on carer SCRQoL. For example, what would be the impact on SCRQoL if, hypothetically, all carers performed the exact same carer tasks? Or, in a more practical example, what if social care services were expanded to the point where no informal carer performs any of these tasks because they are now performed by formal carers funded by the local government? In these cases, if carer tasks were no longer a determinant of SCRQoL because tasks no longer vary among carers, what would the R^2 decrease by? Would it decrease by the Shapley value of 42%? This turns out not to be the case. Chantreuil et al. (2019) devised a method by which the Shapley value can be further decomposed into the Pure Marginal Contribution (PMC) of each group of variables and their pairwise interactions with the other groups of variables. First, we denote the PMC of component i as,

$$PMC_i = R^2(M) - R^2(M \setminus \{i\}), \quad (3)$$

And denote a pairwise interaction between components i and j as,

$$Int(i, j, T) = R^2(\{i, j\} \cup T) - R^2(\{i\} \cup T) - R^2(\{j\} \cup T) + R^2(T), \quad (4)$$

where T is subset of SCRQoL components not containing i and j . The extension of the Shapley decomposition can now be expressed as,

$$SHAP_i = PMC_i - \sum_{\substack{j \in M \\ i \neq j}} INT(i, j, T), \quad (5)$$

where

$$INT(i, j, T) = \sum_{\substack{T \subseteq K \\ i, j \notin T}} \frac{(m-t-2)!(t+1)!}{m!} * (Int(i, j, T)), \quad (6)$$

And $m = |M|$ (the number of overall components), and $t = |T|$ (the number of components in coalition T). This method was then further extended by Fourrey (2023). This new approach can be used with a single regression model (as opposed to the numerous models

required for the Chantreuil et al. (2019) approach), and the components of the outcome do not need to follow an additive structure. Also, in this method, the interaction terms can be used to analyse if the two variables under consideration offset each other, or accumulate together, to explain variations in the outcome. Despite these advantages, we consider the interactions as defined by Chantreuil et al. (2019), applied within the framework of Huettner and Sunder (2012) (one estimated equation per coalition of explained variables), to quantify the interaction between components by examining how the explained variance changes when different components are excluded. For example, given that carer tasks and caring intensity appear to be the two most important components, and we may expect carers who perform more tasks to be caring more intensely. We can now use this method to demonstrate how much of the variation in R^2 is caused directly by carer tasks, and how much is due to an overlap between carer tasks and caring intensity, or other groups of variables like demographics.

The matrix that is Table 5 presents the results from this further decomposition. The diagonal of the matrix represents the PMC of a variable, while the off-diagonal elements represent the pairwise interactions between the groups. These interactions are symmetric, which is why we only present the upper triangle. The original Shapley values from Table 4 are also included in the final row and column for comparison. In this case, if all carers did the same tasks, the R^2 would fall by 28%. Similarly, if all carers had the same level of caring intensity, the R^2 would fall by 20%. The PMCs for the remaining groups were below 10%, like their Shapley values. We note two interesting findings from this table. The first is that, even after accounting for the pairwise interactions between the groups of variables, carer tasks are still the largest determinant of SCRQoL, like they were in Table 4. The second is that the PMC for carer tasks is 28%, not 42%. This is because there is a great deal of overlap between carers who perform these carer tasks and carers who care with high levels of intensity. The pairwise interaction for these two groups is 12.5%, which is large considering all other pairwise interactions are close to 1%. There are numerous reasons as to why we would expect to find this relationship. The first is the more tasks that a carer does, the longer the hours of care are required. The second is that if the carer and care recipient live together, the more likely the carer is to do all the carer tasks that are listed. The final one is that the longer that the carer has been caring for the recipient, the worse the recipient's condition might get, and so the carer begins to do more tasks for them. Nevertheless, the PMC for carer tasks gives us an indication of what we would expect to happen to SCRQoL with regards to a change in policy, a topic we return to in Sect. 7.

6 Causal Mechanism

While we have provided evidence of a clear association between carer tasks and SCRQoL, there are two potential criticisms of the results so far. The first relates to the causal relationship between carer tasks and SCRQoL. So far, we are unable to establish whether carers provide tasks which then negatively impact their quality of life, or if they have lower quality of life to begin with and this is why they perform these tasks, or a combination of the two. This is important for any policies that are derived from these results as any policies designed to improve Carer SCRQoL by helping them with the tasks will only work if the tasks have a causal impact on the carer's quality of life. In addition, any simultaneity bias would affect both the regressions and decompositions, undermining the effectiveness of any new policy. The second criticism is that what we

Table 5 Pure marginal contribution (PMC) and pairwise interactions of groups of variables

	Carer tasks	Caring intensity	Demographics	Recipient services	Carer support	Fixed effects	Shapley value
Carer tasks	28.0200	-12.4979	-0.8729	-0.8870	0.3679	0.0863	41.8236
Caring intensity	20.1158		0.7039	-1.9802	-0.2404	-0.7400	34.8705
Demographics			8.3131	-0.0249	0.0013	-0.0660	9.0326
Recipient services				1.7705	-0.1262	-0.2393	5.1561
Carer support					2.0403	-0.0254	2.0562
Fixed effects						5.7368	7.0610
Shapley value	41.8236	34.8705	9.0326	5.1561	2.0562	7.0610	

have observed is that we are trying to explain a social care related outcome by using variables related to social care, meaning that we are likely to find a statistically significant association, even if performing these tasks has no tangible or concrete impact on the carers' welfare. In order to address both criticisms, we examine the impact that these tasks have on the health of the carer. The 16/17 and 18/19 version of the SACE contain the question "In the last 12 months, has your health been affected by your caring role in any of the ways listed below?", along with a list of 12 health conditions. We use these health outcomes as the dependent variable in Eqs. (1) and (2) and re-estimate the models. This helps to address the criticisms by demonstrating that performing these carer tasks determines actual health outcomes for the carers, while also helping to illuminate the causal pathway by highlighting that it is the tasks which are affecting the outcomes, and not the other way round.

The results of these analyses are presented in Table 6. To begin with, we create a new outcome variable which is the sum of 11 separate binary health conditions. They are: feeling tired; feeling depressed; loss of appetite; disturbed sleep; general feeling of stress; physical strain [e.g. back]; short tempered/irritable; had to see own GP; developed my own health conditions; made an existing condition worse; other. We then regress this new outcome on carer tasks, and the remaining control variables used in Table 4 in column (1). In this regression, 9 of the carer tasks show a statistically significant positive relationship with the set of health problems. Like the results for SCRQoL, the tasks physical help, keep an eye on them, emotional support, and other help, all have large coefficients compared to the other tasks. Also, like the results for SCRQoL, the take them out task has a negative relationship with the health problems. Based on the wording of the question, this lends support to the idea that the causality runs from the carer tasks to the health outcomes.

However, it is possible that despite the wording of that question, carers struggle to distinguish between changes due to caring and changes due to other circumstances. To provide evidence that this is not the case, we use the remaining binary health condition, "No, none of these", as the outcome in a new regression. If there is a causal relationship between performing carer tasks and the health outcomes, then we would expect carers who do not perform these tasks to then not report these health conditions. This is exactly what we find in column (2). In a reversal of the results in column (1), 8 of the carer tasks show a statistically significant negative relationship with reporting no health problems, while carers who take their care recipient out report a positive relationship with not reporting a health condition. While it would be possible to test these differences with simple differences in means, like in Table 3, we would like to test these hypotheses in the same conditions that we tested the previous outcome, which is why we use it as the outcome of a multiple regression model.

While these results provide evidence of a causal relationship between carer tasks and health outcomes, we still need to establish this relationship for SCRQoL. To do this, we create a new, predicted value of SCRQoL that stems from regressing the SCRQoL variable on the 11 health conditions listed earlier and obtaining the fitted values of SCRQoL. The predicted values from this regression should contain variation in SCRQoL that is caused by caring responsibilities, while the residuals contain variation in SCRQoL that is not due to caring responsibilities. We then take the predicted values of SCRQoL that this regression creates and regress them on carer tasks and the other control variables, as in the main analysis. This method was used by Bound et al. (1999) where a health index was generated by regressing a 5-point Likert scale of self-reported health on a series of objective health conditions, essentially instrumenting an endogenous self-reported measure of health with a series of plausibly exogenous objective health measures. While Bound et al. (1999) used

Table 6 The effect of carer tasks on health and SCRQoL outcomes

Carer tasks	(1) Number of health issues	(2) No new health issue	(3) Fitted values of SCRQoL
Personal care	0.075 (0.030)	-0.015*** (0.003)	-0.055** (0.019)
Physical help	0.504*** (0.029)	-0.023*** (0.003)	-0.308*** (0.018)
Give them medicine	0.310*** (0.034)	-0.020*** (0.004)	-0.197*** (0.021)
Keep an eye on them	0.403*** (0.050)	-0.023*** (0.005)	-0.268*** (0.031)
Help with care services	0.301*** (0.046)	-0.018*** (0.005)	-0.200*** (0.029)
Practical help	0.335*** (0.059)	-0.058*** (0.006)	-0.205*** (0.037)
Help with paperwork	0.136** (0.045)	-0.012 (0.005)	-0.088** (0.028)
Take them out	-0.185*** (0.032)	0.010** (0.003)	0.127*** (0.020)
Keep them company	0.283*** (0.038)	0.005 (0.004)	-0.190*** (0.024)
Emotional support	0.668*** (0.038)	-0.055*** (0.004)	-0.433*** (0.024)
Other help	0.643*** (0.032)	-0.016*** (0.003)	-0.397*** (0.020)
<i>N</i>	43,526	43,526	43,526
<i>R</i> ²	0.139	0.059	0.143
<i>Group % R</i> ²			
Carer tasks	51.43 [48.25–54.61]	46.48 [40.26–52.70]	52.15 [49.03–55.27]
Intensity	14.52 [12.48–16.55]	14.00 [10.08–17.92]	14.08 [12.04–16.12]
Demographics	15.47 [13.19–17.75]	16.74 [12.51–20.97]	16.21 [13.85–18.56]
Care services	6.10 [4.76–7.43]	6.81 [4.28–9.35]	5.79 [4.49–7.09]
Carer support	9.29 [7.73–10.86]	10.21 [7.30–13.11]	8.45 [7.00–9.90]
Fixed effects	3.19 [2.05–4.34]	5.76 [3.28–8.24]	3.33 [2.18–4.47]

The regression coefficients for the remaining explanatory variables are not reported but are available on request. *Group % R*² % of overall model *R*² that is due to this group of variables. 99% confidence intervals in square brackets. * $p < 0.01$, ** $p < 0.005$, *** $p < 0.001$

this as an explanatory variable, this type of index was used by Coe and Zamarro (2011) as an outcome variable in their analysis of retirement on health. Like Coe and Zamarro (2011) we also use this type of index as an outcome variable. The results from this analysis are presented in column (3). In terms of sign and significance, the results are the same as those in Table 4. However, the magnitude of many coefficients is smaller. This lends support to the idea that there may be some reverse causality between carer tasks and SCRQoL that we cannot capture with our cross-sectional data. However, the fact that the coefficients are still statistically significant and negative, for an outcome where the variation is caused by carer tasks, supports the idea that there is a causal relationship between the tasks and SCRQoL.

The Shapley decompositions for each of these regressions can be found in the bottom part of the table. In each case, the results conform to what we have seen previously, carer tasks are the most important group of variables when it comes to explaining variation in SCRQoL.

7 Discussion

In terms of how these results relate to other results from the literature, many of our results conform to what previous studies have shown. For example, our regression analysis reports a negative correlation between Carer SCRQoL and hours of care, a commonly found result in the literature (Cook et al., 2018; Rand et al., 2019). We also find that male carers, and carers who work, report high values of Carer SCRQoL (Rand et al., 2019). With regards to carer tasks, we find that carers who give medicine to the care recipient have a lower quality of life compared to carers who do not give medicine. A negative relationship between these tasks and outcomes such as emotional burden, emotional stress, physical burden, physical stress, psychological burden, and financial burden has already been documented in previous studies (Halpern et al., 2017; Keeton et al., 2020; Loboiko et al., 2023).

In addition to this, we also find results that have not been reported elsewhere. For example, the physical help task is one of the most important predictors of Carer SCRQoL in our model, yet it is not considered explicitly in any of the studies mentioned previously. This is despite the effect of caring on physical health and strain being used as a common measure of carer experience. Trying to find measures of the physicality of carer tasks could be an important variable to consider in future studies. Also, we find that carers who take the care recipient out report higher levels of Carer SCRQoL when compared to carers who do not do this task. This shows the benefit of using the Carer SCRQoL outcome, which captures both positive and negative aspects of caring, as opposed to outcomes which only capture the negative elements. Finally, even with many variables describing carer tasks, the task that denotes the other help that carers provide has a consistently large regression coefficient in the majority of models. This offers an avenue for further research where the exact meaning behind opaque responses such as this can be explored to determine the mechanism behind this result.

Before we discuss the implications for policy, it is important to know how social care works in the UK. Social care describes the provision of social support services to people dealing with old age, disability, or poverty. Unlike with health care provision, social care in the UK is not free at the point of use: it needs to be paid for privately by the care recipient or can be contributed to by the local government should it be determined that the recipient is both in need of care and does not have the financial ability to purchase care. Because of this expense, in many cases the social care is provided informally by family

members, neighbours, and friends, and these are the people known as informal carers, who we examine in this study.

In terms of financing, local governments are responsible for funding the provision of social care services in their locality. Examples of the services they provide are the care recipient services that are listed in Table 3. These include things like home help (or domiciliary care), which involves a formal carer visiting the care recipient in their house to help them, day centres where older people can go to eat and socialize, care homes which provide accommodation as well assistance with personal care, and many more. In total, local governments spent £28 billion on social care services such as these in 2022/2023 (Kings Fund, 2024). While our analysis suggests that these services are related to higher SCRQoL scores, the size of increase in quality of life appears to be relatively modest, at least compared to the effect of carer tasks on SCRQoL. Considering ways to improve the benefit of these services to carers is important, since other economic analysis has valued the work that informal carers perform at £162 billion per year (Petrillo & Bennett, 2023). For example, Table 3 shows that the care recipient being in a care home has a large positive effect on carer SCRQoL, but only 5% of carers find themselves in this situation, meaning that this doesn't show up as important when considered with the other services in the Shapley decomposition. Home help is something that is more regularly used (31%) but this doesn't seem to be as effective, especially when most tasks are still performed by 80% of the carers in our sample. This is unsurprising, as recent research by Dalgarno et al. (2021) has shown that formal, domiciliary carers often struggle to implement the care plan, which is the agreed upon set of tasks and actions that the care recipient requires to best meet their needs. In particular, they note that "Care plans were often reported by participants as inadequately detailed, inflexible, uninformative, misused or not used at all" (Dalgarno et al., 2021). In these situations, it is left to the informal carers to compensate for the deficit.

This offers two important points for policy in the future. The first is to make sure that any formal home help provided is targeted at the tasks that informal carers perform, as these seem to have some of the largest effects on SCRQoL. This is supported by the analysis in Tables 3 and 4 which shows that many of the carer tasks have negative impacts on SCRQoL, meaning that carers who do not perform them have higher values of SCRQoL. The second is that any future funding of care services could be targeted towards home help, where this help is then directed at the tasks highlighted here, as opposed to some of the other services that the local government may provide. This is supported by the analysis in Table 5 which shows that the PMC for the carer tasks is larger than the PMC for any other group of variables, meaning that they offer the most explanatory power into what causes variation in SCRQoL. Do we know that ceasing to perform these tasks will have a causal impact on SCRQoL? The evidence in Table 6 would appear to suggest so, as the outcomes examined here are directly influenced by the respondents' caring behaviour. It is also worth noting that this is an issue which is likely to be exacerbated in the coming years as a recent report from the Carers Trust in the UK found that demands on informal carers are increasing. Specifically, they found that 41% of carers report that their time spent caring has increased over the last 12 months and that they "have to provide care for people with increasingly complex needs" (Carers Trust, 2023). Given the importance of carer tasks in determining quality of life, targeting resources towards supporting carers performing these tasks offers an opportunity to improve the carer experience at a time when carers are under an unprecedented burden.

Finally, it is also important to highlight the limitations of the study. The first is that there is no information on whether the carers receive the Carer's Allowance, so we cannot include this as a control variable or split our sample based on who receives it. Carer's

Allowance is a form of financial support available for informal carers and could conceivably be thought to be a determinant of carer SCRQoL. However, it is important to note that there are strict eligibility requirements for Carer's Allowance, and the amount received is relatively small. As of 2024, the current value of Carer's Allowance is £81.90 per week, which is similar in size to the Jobseeker's Allowance (financial support for those looking for employment) of between £71.70–£91.50 (HM Government, 2024a, 2024b). Also, the minimum wage in the UK for a 21-year-old is currently £11.44 per hour (HM Government, 2024c). If that person worked 35 h per week, which is the number of hours someone would need to provide informal care for to qualify for Carer's Allowance, then their weekly earnings would be £400.4. This means that the Carer's Allowance is 20% of a minimum wage salary, which is not a sustainable stipend. The second limitation is that the data we have used finishes in 2019, meaning that the results have not been impacted by the COVID-19 pandemic. The decision to exclude the newer waves of the SACE that cover this period were made because of the dramatic impact that COVID-19 had on social care, including rules such as social distancing, staff illness which increased workload, and issues surrounding personal protective equipment (PPE) (Prout et al., 2022). Taken together, it is likely that these issues may have compromised the caring experience during this time. For example, if a care recipient was receiving home care in 2019 and 2020 then the carer may report that their recipient receives these services, while the level of care and interaction might be drastically different across these years, impacting our results. Excluding these waves allows us to analyse the effect these tasks and services have on SCRQoL, without being contaminated by this event. Future research that examines the impact the COVID-19 had on SCRQoL can use these results as a comparison. Finally, while we have focused our analysis on carer quality of life, it would be interesting to know how the care recipient quality of life is varying concurrently. While we have recommended policies that can improve carer SCRQoL, this should not be done at the expense of the care recipient's quality of life. Unfortunately, finding information on carer tasks, carer quality of life, and the care recipient quality of life in the same data set is difficult. Rand et al. (2022) suggest a number of reasons why this “dyadic outcomes approach” to social care is lacking in the UK, though they suggest that the approach has many benefits if these barriers can be overcome.

8 Conclusion

In this article, we examine whether carer tasks are related to Carer SCRQoL, how they compare to other determinants of Carer SCRQoL, and how carer tasks as a group compare to other characteristics, such as demographics. We find that there is a statistically significant relationship between all our carer task variables and Carer SCRQoL, even after controlling for other carer characteristics. We also find that, as a group, carer tasks account for a larger percentage in variation of Carer SCRQoL than other categories of variables, such as caring intensity or carer support. Directing future social policy towards supporting carers to perform these tasks could help improve their quality of life.

Appendix

Robustness Checks

The results presented in Tables 3 and 4 present a large amount of evidence in favour of the hypothesis that carer tasks are important predictors of carer quality of life on an individual level, and when considered together as a group. However, it is important to consider whether the results that we have found are simply due to the way in which we have constructed our carer task variables or our quality of life variable. In particular, Shapley decompositions can be sensitive to the way in which the variable groups are aggregated (Suarez Alvarez & Lopez Menendez, 2018). To do this, we re-estimate the models using different measures of carer tasks and different measures of Carer SCRQoL. These results are presented in Table 7. Column (1) presents the results from estimating Eq. (1) using a binary measure of carer tasks, where the variable indicates whether the carer performs the median (9) number of carer tasks. The regression coefficient on the binary measure is -0.902 , which is larger than any coefficient on carer tasks presented in Table 4. This is unsurprising given that it is now the sole measure of variation in carer tasks. However, the relative importance measure is now much smaller than in Table 4, at 27.93%, and is significantly smaller than the value of caring intensity. This demonstrates the importance of having specific measures of caring activities, as without them, their importance may be assigned to other variables. Column (2) uses a continuous measures of carer tasks which ranges from 1 to 11 and the coefficient on this variable is 0.273. This means for every one unit increase in carer tasks the value of Carer SCRQoL will fall by 0.273 units. The relative importance of carer tasks is now 36.57% which shows that even one variable for carer tasks can account for a large amount of explained variation if the variable is continuous. Column (3) presents the results when both the binary and continuous measure, as well as an interaction between the two, are included in the model. Here the coefficient on the continuous measure represents the change in Carer SCRQoL when carer tasks increase by one unit, while the coefficient on the interaction term represents the extra change in Carer SCRQoL when the increase in tasks occurs above the median value of tasks. It should be noted that this model only offers a marginal increase in the R^2 and relative importance of carer tasks over the model in column (2). In all three cases, the R^2 is smaller than in the model where the carer tasks are entered individually. This demonstrates that in the model that explains the largest amount of Carer SCRQoL, carer tasks account for the largest proportion of explained variation.

We next stratify the sample by different values of the outcome variable. While Carer SCRQoL has a median value of 8, we divide the sample into carers who have a Carer SCRQoL of greater than 7 or less than and equal to 7, which is threshold that gets closest to a 50–50 split, and re-estimate Eqs. (1) and (2). These results are presented in columns (4) and (5) of Table 7. While there are some variables which are statistically significant in both models, such as personal care, physical help, and giving medicine, there are other variables which are only significant in column (5) such as keeping an eye on the care recipient, providing practical help, and help with the paperwork. Also, the task involving taking the care recipient out, which is the only task that had a positive coefficient in Table 4, is only positive for the carers with low SCRQoL scores and is zero for carers with high SCRQoL scores. Regarding the relative importance of different groups of variables, carer tasks account for the largest proportion of explained variation in both models. Interestingly,

Table 7 Linear regression models using different measures of carer tasks and Carer SCRQoL

	(1)	(2)	(3)	(4)	(5)
				(SCRQoL ≤ 7)	(SCRQoL > 7)
Carer tasks	Carer SCRQoL	Carer SCRQoL	Carer SCRQoL	Carer SCRQoL	Carer SCRQoL
Binary	-0.902 ^{***} (0.018)		1.425 ^{***} (0.162)		
Continuous		-0.273 ^{***} (0.004)	-0.221 ^{***} (0.008)		
Binary X Continuous			-0.166 ^{***} (0.017)		
Personal care				-0.104 ^{***} (0.021)	-0.065 ^{***} (0.016)
Physical help				-0.163 ^{***} (0.019)	-0.107 ^{***} (0.015)
Give them medicine				-0.148 ^{***} (0.024)	-0.175 ^{***} (0.017)
Keep an eye on them				-0.092 (0.041)	-0.184 ^{***} (0.024)
Help with care services				-0.083 (0.034)	-0.134 ^{***} (0.023)
Practical help				0.078 (0.049)	-0.161 ^{***} (0.028)
Help with paperwork				-0.060 (0.033)	-0.124 ^{***} (0.023)
Take them out				0.223 ^{***} (0.022)	0.000 (0.017)
Keep them company				-0.104 ^{***} (0.028)	-0.104 ^{***} (0.019)
Emotional support				-0.131 ^{***} (0.029)	-0.157 ^{***} (0.019)
Other help				-0.338 ^{***} (0.018)	-0.135 ^{***} (0.018)
<i>N</i>	92,923	92,923	92,923	44,317	48,606
<i>R</i> ²	0.141	0.153	0.154	0.060	0.103
<i>Group % R</i> ²					
Carer tasks	27.93 [25.98–29.88]	36.57 [34.73–38.41]	36.97 [35.1–38.84]	31.05 [26.86–35.25]	43.09 [40.26–45.92]
Intensity	45.03 [43.13–46.93]	38.51 [36.69–40.33]	38.29 [36.49–40.08]	19.22 [16.11–22.34]	36.95 [34.01–39.89]
Demographics	10.52 [9.16–11.88]	9.39 [8.17–10.61]	9.30 [8.09–10.5]	15.57 [11.7–19.44]	1.84 [0.97–2.71]

Table 7 (continued)

	(1)	(2)	(3)	(4)	(5)
				(SCRQoL <= 7)	(SCRQoL > 7)
Carer tasks	Carer SCRQoL	Carer SCRQoL	Carer SCRQoL	Carer SCRQoL	Carer SCRQoL
Care services	6.22 [5.29–7.15]	5.68 [4.85–6.5]	5.66 [4.84–6.48]	8.93 [6.24–11.62]	11.01 [9.02–13]
Carer support	2.26 [1.63–2.88]	2.30 [1.71–2.9]	2.26 [1.67–2.86]	17.56 [13.98–21.13]	2.23 [1.29–3.17]
Fixed effects	8.05 [6.76–9.34]	7.55 [6.38–8.72]	7.52 [6.35–8.69]	7.67 [5.04–10.29]	4.88 [3.32–6.44]

Standard errors in parentheses. *Group % R²* % of overall model *R²* that is due to this group of variables. 95% confidence intervals in square brackets. The regression coefficients for the remaining explanatory variables are not reported but are available on request. * $p < 0.01$, ** $p < 0.005$, *** $p < 0.001$

the carer support variables, which generally have low values in most models, account for 17.56 of the explained variance, almost as much as caring intensity.

Subgroup Analysis

In addition to the robustness checks, it would be useful to know if our results are being driven by a particularly important subgroup. To do this, we break the sample down by the different demographic variables. While it is possible to do this for every variable in the sample, we choose the demographic variables as there is no behavioural component associated with the outcome observed i.e., respondents don't choose their age in the way they choose to work in paid employment. The results for these analyses are presented in Table 8. Interestingly, the results are remarkably consistent across all eight subgroup models. There are some statistically insignificant results in column (5), which is the group representing non-white carers. However, given that the sign of the coefficients is the same as in the other models, the insignificance may be due to the small sample size, since this group has the smallest number of observations out of any subgroup. In all eight models, carer tasks account for at least 40% of the explained variation in SCRQoL.

Mechanism

Finally, we use the binary health variables that were used in Table 6 as outcomes in individual regressions. The results are presented in Table 9 and they show a similar pattern to the results presented in earlier analysis. Carer tasks such as physical help, giving medicine, and emotional support, are all positively associated with negative health outcomes such as feeling tired, feeling depressed, disturbed sleep, stress, physical strain, and needing to see the GP.

Table 8 Linear regression models using different subgroups

	(1) Female	(2) Male	(3) Under 65	(4) At least 65
Carer tasks	Carer SCRQoL	Carer SCRQoL	Carer SCRQoL	Carer SCRQoL
Personal care	-0.185*** (0.026)	-0.307*** (0.035)	-0.224*** (0.029)	-0.239*** (0.031)
Physical help	-0.418*** (0.024)	-0.312*** (0.035)	-0.368*** (0.027)	-0.408*** (0.029)
Give them medicine	-0.361*** (0.028)	-0.391*** (0.039)	-0.369*** (0.030)	-0.360*** (0.036)
Keep an eye on them	-0.419*** (0.043)	-0.286*** (0.059)	-0.322*** (0.046)	-0.433*** (0.052)
Help with care services	-0.300*** (0.043)	-0.275*** (0.050)	-0.274*** (0.046)	-0.291*** (0.045)
Practical help	-0.223*** (0.053)	-0.187** (0.066)	-0.289*** (0.057)	-0.115 (0.059)
Help with paperwork	-0.289*** (0.041)	-0.178*** (0.051)	-0.274*** (0.044)	-0.216*** (0.045)
Take them out	0.261*** (0.027)	0.319*** (0.038)	0.199*** (0.032)	0.337*** (0.030)
Keep them company	-0.262*** (0.033)	-0.306*** (0.043)	-0.230*** (0.038)	-0.319*** (0.037)
Emotional support	-0.443*** (0.034)	-0.364*** (0.042)	-0.513*** (0.037)	-0.297*** (0.038)
Other help	-0.665*** (0.025)	-0.663*** (0.037)	-0.737*** (0.028)	-0.554*** (0.032)
<i>N</i>	61,953	30,970	52,104	40,819
<i>R</i> ²	0.161	0.160	0.169	0.148
<i>Group % R</i> ²				
Carer tasks	42.16 [40.04–44.28]	42.71 [39.57–45.86]	41.40 [39.33–43.46]	45.01 [42.15–47.87]
Intensity	37.23 [35.19–39.27]	33.07 [30.36–35.78]	38.34 [36.35–40.33]	33.06 [30.44–35.67]
Demographics	6.02 [4.75–7.28]	8.86 [6.91–10.81]	3.24 [2.46–4.02]	6.62 [5.03–8.21]
Care services	5.44 [4.52–6.37]	5.37 [4.2–6.53]	6.41 [5.34–7.48]	7.00 [5.57–8.42]
Carer support	1.87 [1.26–2.48]	2.81 [1.79–3.83]	2.60 [1.77–3.42]	1.68 [0.93–2.44]
Fixed effects	7.27 [5.99–8.56]	7.18 [5.45–8.91]	8.01 [6.59–9.43]	6.63 [5.07–8.2]
	(5) Non-white	(6) White	(7) Recipient Under 65	(8) Recipient least 65
Carer tasks	Carer SCRQoL	Carer SCRQoL	Carer SCRQoL	Carer SCRQoL
Personal care	-0.256**	-0.221***	-0.118**	-0.305***

Table 8 (continued)

	(5)	(6)	(7)	(8)
	Non-white	White	Recipient Under 65	Recipient least 65
Carer tasks	Carer SCRQoL	Carer SCRQoL	Carer SCRQoL	Carer SCRQoL
	(0.078)	(0.022)	(0.039)	(0.025)
Physical help	-0.407*** (0.073)	-0.387*** (0.020)	-0.339*** (0.035)	-0.377*** (0.024)
Give them medicine	-0.358*** (0.087)	-0.369*** (0.024)	-0.269*** (0.039)	-0.425*** (0.028)
Keep an eye on them	-0.362** (0.121)	-0.370*** (0.036)	-0.392*** (0.057)	-0.383*** (0.044)
Help with care services	-0.167 (0.109)	-0.292*** (0.034)	-0.321*** (0.056)	-0.288*** (0.039)
Practical help	-0.363* (0.130)	-0.173*** (0.044)	-0.246*** (0.067)	-0.207*** (0.052)
Help with paperwork	-0.272* (0.102)	-0.247*** (0.033)	-0.267*** (0.054)	-0.253*** (0.039)
Take them out	0.212 (0.083)	0.283*** (0.023)	0.291*** (0.046)	0.270*** (0.025)
Keep them company	-0.067 (0.102)	-0.296*** (0.027)	-0.371*** (0.045)	-0.265*** (0.033)
Emotional support	-0.500*** (0.097)	-0.400*** (0.028)	-0.467*** (0.053)	-0.330*** (0.031)
Other help	-0.661*** (0.072)	-0.662*** (0.022)	-0.717*** (0.035)	-0.627*** (0.026)
<i>N</i>	8256	84,667	32,320	60,603
<i>R</i> ²	0.126	0.165	0.134	0.185
<i>Group % R</i> ²				
Carer tasks	48.79 [42.58–55]	41.82 [40.06–43.59]	42.67 [39.39–45.94]	41.88 [39.89–43.87]
Intensity	30.01 [23.65–36.37]	35.65 [33.93–37.37]	21.19 [18.38–24]	37.60 [35.55–39.65]
Demographics	3.26 [0.54–5.98]	7.94 [6.94–8.94]	13.43 [10.96–15.89]	6.58 [5.52–7.64]
Care services	9.10 [4.68–13.52]	5.39 [4.6–6.19]	10.57 [8.52–12.62]	6.15 [5.3–7]
Carer support	6.98 [3.53–10.42]	1.85 [1.31–2.4]	3.35 [2.13–4.56]	1.63 [1.11–2.15]
Fixed effects	1.86 [-0.3–4.03]	7.34 [6.19–8.48]	8.80 [6.61–10.99]	6.16 [5.08–7.24]

Standard errors in parentheses. *Group % R*² % of overall model *R*² that is due to this group of variables. 95% confidence intervals in square brackets. The regression coefficients for the remaining explanatory variables are not reported but are available on request. * $p < 0.01$, ** $p < 0.005$, *** $p < 0.001$

Table 9 Linear regression models using health outcomes

	(1)	(2)	(3)	(4)
Carer tasks	Feeling tired	Feeling depressed	Loss of appetite	Disturbed sleep
Personal care	0.026*** (0.005)	-0.008 (0.006)	-0.008 (0.004)	0.036*** (0.006)
Physical help	0.051*** (0.005)	0.034*** (0.006)	0.023*** (0.004)	0.078*** (0.005)
Give them medicine	0.043*** (0.005)	0.030*** (0.007)	0.018*** (0.005)	0.065*** (0.006)
Keep an eye on them	0.025** (0.008)	0.062*** (0.010)	0.032*** (0.007)	0.082*** (0.009)
Help with care services	0.028*** (0.007)	0.054*** (0.009)	0.017 (0.007)	0.043*** (0.008)
Practical help	0.062*** (0.009)	0.006 (0.012)	0.011 (0.008)	0.036*** (0.011)
Help with paperwork	0.012 (0.007)	0.011 (0.009)	-0.009 (0.006)	0.028*** (0.008)
Take them out	-0.013 (0.005)	-0.029*** (0.006)	-0.037*** (0.005)	-0.018** (0.006)
Keep them company	0.029*** (0.006)	0.036*** (0.008)	0.024*** (0.005)	0.038*** (0.007)
Emotional support	0.084*** (0.006)	0.077*** (0.008)	0.019** (0.005)	0.105*** (0.007)
Other help	0.038*** (0.005)	0.053*** (0.006)	0.052*** (0.005)	0.052*** (0.006)
<i>N</i>	43,526	43,526	43,526	43,526
<i>R</i> ²	0.077	0.053	0.024	0.099
<i>Group % R</i> ²				
Carer tasks	50.34 [46.2–54.48]	36.07 [30.91–41.23]	42.85 [35.62–50.07]	58.33 [54.63–62.03]
Intensity	16.98 [13.61–20.35]	10.25 [6.93–13.58]	18.61 [13.85–23.37]	16.22 [13.73–18.7]
Demographics	16.68 [12.96–20.41]	30.66 [25.95–35.37]	20.55 [14.06–27.03]	8.49 [6.3–10.69]
Care services	7.52 [5.25–9.78]	4.53 [2.37–6.68]	9.50 [5.42–13.58]	6.19 [4.65–7.73]
Carer support	5.15 [3.48–6.82]	12.43 [9.6–15.26]	4.19 [1.08–7.3]	6.65 [5.01–8.29]
Fixed effects	3.33 [1.72–4.93]	6.06 [3.61–8.51]	4.31 [1.29–7.33]	4.12 [2.71–5.54]
	(5)	(6)	(7)	(8)
Carer tasks	General stress	Physical strain	Irritable	See own GP
Personal care	-0.005 (0.006)	0.053*** (0.006)	0.002 (0.006)	-0.008 (0.006)
Physical help	0.023*** (0.005)	0.146*** (0.005)	0.038*** (0.006)	0.041*** (0.005)

Table 9 (continued)

	(5)	(6)	(7)	(8)
Carer tasks	General stress	Physical strain	Irritable	See own GP
Give them medicine	0.032*** (0.006)	0.022*** (0.006)	0.039*** (0.007)	0.031*** (0.006)
Keep an eye on them	0.076*** (0.010)	0.027** (0.009)	0.046*** (0.010)	0.020 (0.009)
Help with care services	0.064*** (0.009)	0.008 (0.009)	0.038*** (0.009)	0.018 (0.009)
Practical help	0.072*** (0.011)	0.014 (0.011)	0.052*** (0.012)	0.029* (0.011)
Help with paperwork	0.051*** (0.009)	0.019 (0.009)	0.028** (0.009)	0.001 (0.008)
Take them out	-0.014 (0.006)	-0.021*** (0.006)	0.024*** (0.006)	-0.017** (0.006)
Keep them company	0.040*** (0.007)	0.039*** (0.007)	0.015 (0.008)	0.015 (0.007)
Emotional support	0.103*** (0.007)	0.050*** (0.007)	0.049*** (0.008)	0.062*** (0.007)
Other help	0.056*** (0.006)	0.081*** (0.006)	0.048*** (0.006)	0.061*** (0.006)
<i>N</i>	43,526	43,526	43,526	43,526
<i>R</i> ²	0.091	0.099	0.048	0.048
<i>Group % R</i> ²				
Carer tasks	40.77 [36.52–45.01]	56.87 [53.38–60.36]	41.90 [36.58–47.22]	31.44 [26.14–36.75]
Intensity	10.45 [8.37–12.53]	17.33 [15.01–19.65]	11.15 [7.7–14.6]	15.29 [12.14–18.43]
Demographics	27.73 [24.23–31.23]	8.09 [5.99–10.2]	20.45 [16.39–24.51]	18.14 [14.21–22.07]
Care services	5.48 [3.95–7.01]	15.51 [13.1–17.91]	8.90 [6.49–11.32]	7.70 [4.85–10.55]
Carer support	12.42 [9.98–14.85]	0.41 [0.01–0.82]	12.00 [8.95–15.05]	23.76 [19.42–28.1]
Fixed effects	3.16 [1.83–4.48]	1.79 [0.82–2.75]	5.59 [3.14–8.05]	3.67 [1.6–5.74]
	(9)	(10)	(11)	(12)
Carer tasks	New condition	Condition worse	Other issue	None
Personal care	-0.005 (0.005)	-0.007 (0.005)	-0.001 (0.002)	-0.015*** (0.003)
Physical help	0.032*** (0.005)	0.035*** (0.005)	0.003 (0.002)	-0.023*** (0.003)
Give them medicine	0.012 (0.006)	0.016* (0.006)	0.003 (0.002)	-0.020*** (0.004)
Keep an eye on them	0.013 (0.009)	0.020 (0.008)	0.000 (0.004)	-0.023*** (0.005)

Table 9 (continued)

	(9)	(10)	(11)	(12)
Carer tasks	New condition	Condition worse	Other issue	None
Help with care services	0.011 (0.008)	0.022** (0.008)	-0.002 (0.003)	-0.018*** (0.005)
Practical help	0.029** (0.010)	0.021 (0.010)	0.002 (0.004)	-0.058*** (0.006)
Help with paperwork	-0.000 (0.008)	-0.004 (0.008)	-0.002 (0.003)	-0.012 (0.005)
Take them out	-0.026*** (0.006)	-0.030*** (0.005)	-0.003 (0.002)	0.010** (0.003)
Keep them company	0.006 (0.007)	0.032*** (0.006)	0.008** (0.003)	0.005 (0.004)
Emotional support	0.058*** (0.007)	0.060*** (0.006)	-0.000 (0.003)	-0.055*** (0.004)
Other help	0.063*** (0.006)	0.082*** (0.005)	0.057*** (0.002)	-0.016*** (0.003)
<i>N</i>	43,526	43,526	43,526	43,526
<i>R</i> ²	0.033	0.040	0.019	0.059
<i>Group % R</i> ²				
Carer tasks	34.06 [1564–39.67]	46.11 [40.61–51.61]	76.81 [69.05–84.56]	46.48 [40.26–52.7]
Intensity	36.58 [30.83–42.33]	21.30 [17.48–25.11]	3.60 [0.94–6.26]	14.00 [10.08–17.92]
Demographics	13.98 [10–17.97]	14.05 [10.13–17.96]	7.38 [2.87–11.88]	16.74 [12.51–20.97]
Care services	6.32 [3.39–9.25]	7.72 [4.51–10.94]	2.88 [-0.01–5.76]	6.81 [4.28–9.35]
Carer support	5.35 [2.58–8.11]	6.61 [4.17–9.06]	4.77 [0.36–9.17]	10.21 [7.3–13.11]
Fixed effects	3.70 [1.04–6.37]	4.21 [1.61–6.81]	4.57 [0.38–8.77]	5.76 [3.28–8.24]

Standard errors in parentheses. *Group % R*² % of overall model *R*² that is due to this group of variables. 95% confidence intervals in square brackets. The regression coefficients for the remaining explanatory variables are not reported but are available on request. * $p < 0.01$, ** $p < 0.005$, *** $p < 0.001$

Author Contributions DC, MH, YLYS, & PM were involved in conceptualization, DC performed the formal analysis and wrote the original draft, and DC, MH, YLYS, & PM were involved with reviewing and editing the final draft.

Funding There is no funding source that provided financial support for the research and/or preparation of the article. This applies to the collection, analysis, and interpretation of data; in the writing of the manuscript; and in the decision to submit the article for publication.

Data Availability The data used in this paper is from the Survey of Adult Carers in England, a publicly available data set from NHS Digital. All material relating to the Survey of Adult Carers in England is the copyright of NHS Digital. The computer code used to generate the results is available on request.

Declarations

Conflict of interest We have no competing interests to disclose.

Ethics Approval Not applicable. The study is a statistical analysis of secondary data.

Consent to Participate Not applicable.

Consent to Publication Not applicable.

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