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Understanding Health Trajectories among Unpaid Carers in the United Kingdom

RESEARCH

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ABSTRACT

Context: There is very little research on the impact of caring on physical health, and the evidence that exists is mixed. There is also lack of evidence on the role of other factors including both socio-economic factors and the role played by care services and unmet needs for such services.

Aims: This study aims to understand the association between physical health outcomes among unpaid carers in the United Kingdom compared to individuals who have not provided unpaid care, and investigate what is the role that time, and unmet needs for care services play in this relationship.

Methods: We used four waves of the UK Household Longitudinal Survey, a large representative sample, covering the period 2015 to 2020. We performed Propensity Score Matching to compare health outcomes of carers against non-carers and Latent Class Analysis to identify different typologies of unpaid carers.

Results: We found that the relationship between care provision and physical health is complex, that effects on health may differ between the short and medium run, and that deprivation levels and unmet need for services play an important role.

Conclusion: This research contributes original insights into our understanding of the impact of different care trajectories on the health of the carer taking into consideration the characteristics of care-recipients, the effect of unmet needs, and external factors. This is crucial both in relation to their ability to provide support and in terms of their own care needs and is therefore of direct relevance to policy and practice to support unpaid carers.

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BACKGROUND

There is an international policy-driven interest in exploring quality of life, and physical and mental health outcomes of unpaid carers (Rand et al, 2019). Carer health is important in its own right (Vlachantoni et al, 2016), but also in terms of carer's ability to continue to provide support (McCann et al, 2004). For instance, Buhr, Kuchibhatla, and Clipp (2006) examined spouse cares' primary reasons for placement in institutional care and found that half of those cares took this decision based on their own health problems. Previous research has showed that provision of unpaid care is associated with poorer mental health and quality of life, particularly at higher intensities of caring (Brimblecombe et al, 2020; Robison, Inglis & Egan, 2020; Savage & Bailey, 2004; Pinquart & Sörensen, 2003). There is, however, in the UK context, much less research on the impact of caring on physical health and the role played by unmet needs for care services (Spiers et al, 2021). This scarce existing quantitative evidence regarding the relationship between unpaid care and physical health is also mostly based on cross-sectional data (Pinquart & Sörensen, 2007) and has failed to make a distinction between finding a correlation and estimating causal effects (Bom et al, 2019). Young, Grundy, and Kalogirou (2005), using a sample drawn from the 2001 census data for England and Wales, found that older people who provided 20 hours of care per week or more, reported poorer health than those who provided fewer hours of care per week. Similarly, a few previous studies have showed that carers have worse health than non-carers (e.g. Legg et al, 2013) and that intensity of caring, and relatedly, co-residence, are significantly associated with poorer health, and that duration of care provision has a significant effect, specifically on the physical health of the carer (e.g. ONS, 2013). Using longitudinal data, Brimblecombe et al. (2020) and Gallagher & Bennett (2021), also found negative physical health effects of caregiving. Conversely, Vlachantoni et al, (2016) found that individuals providing unpaid care in 2011 (regardless of carer status in 2001) exhibit lower odds of poor health in 2011 than those who did not provide care in both 2001 and 2011, but that the effect is reversed when intensity of care is taken into account.

Nevertheless, only a few of the previous studies (and only one using UK data: Brimblecombe et al, 2020) have attempted to deal with selection bias issues. That is, the fact that some individuals that are observed as providing care may be different to those that do not provide care even before they start their caregiving activities (e.g, they may have poorer health, as has been shown by Ramsay, Grundy & O'Reilly, 2013). In addition, while it is generally recognised that understanding changes in health and illness over time is central to creating and evaluating policies (Henly, Wyman & Findorff, 2011), previous longitudinal research has been constrained by small sample sizes or a relatively short or too long periods between observations. This has left the current understanding of health trajectories among carers incomplete. Furthermore, the effect of having caring responsibilities on health may also vary depending not only on carer circumstances, but also on care-recipient characteristics and external factors. For instance, given that there is an association between unmet service needs and carer stress and ability to cope (Hirst, 2004), it may be possible that unsupported carers could see their physical health deteriorate more rapidly than those receiving help. However, previous research has not given unmet needs the attention that it deserves, and it has simplified the understanding of the support needed by carers, as though all of them face similar circumstances, risks and, therefore, requiring the same type of support (Dunatchik et al, 2016; Young et al, 2020).

To narrow this evidence gap, this study explores the effect of having caring responsibilities on health trajectories. It does so by using a large longitudinal sample and a matching approach (a method that minimise selection bias concerns). It also identifies typologies of carers based on their physical health, including information about the person with care needs, something that has been highlighted as missing in previous research (Whittaker & Gallagher, 2019). In particular, this study aims to address the following questions: 1) what is the effect of caring on physical health over time? 2) can we identify different typologies of carers and are some types of carers at a greater risk of poor health? and 3) is there any association between the identified classes and unmet needs for care services.

METHODS

This research aimed to answer two overarching questions: what the impact of providing unpaid care is on the health of adults aged 16 years old or older over time; and whether carers typologies could be identified based on their health. For the first question, we focused on physical health outcomes and explored the carers in a longitudinal manner. Using data from the UK Household Longitudinal Study, UKHLS (University of Essex, 2021), we compared health of outcomes at three time-points: 2016/18, 2017/19, and 2018/20 for whose were not providing unpaid care at an earlier time-point (2014/2016) but became carers in 2015/2017. For the second question, we identified typologies of carers, including 16 years or older individuals who were providing care in 2015/2017, irrespectively of their caring responsibilities in previous years. Health outcomes analysed were self-reported health, physical health, loss of sleep and lack of concentration.

DATA

Using five waves from the UK Household Longitudinal Study, UKHLS (University of Essex, 2021), a nationally representative sample interviewing more than 40,000 households over time, we studied the relationship between health and caring responsibilities longitudinally. In particular, this paper contributes original insights into our understanding of the impact of different care trajectories on the health of the carer and explore whether carers typologies exist and could be somehow driven by the presence of unmet needs. The sample for the analysis of the effect of having caring responsibilities on health included 736 individuals who became carers at wave 7 (2015/17) and 25,899 non-carers at the same point in time. The analysis included co-resident carers that were aged 16 years old or older. Carer and non-carer health outcomes were compared at three future waves: wave 7 (2015/17), 8 (2016/18), 9 (2017/19), and 10 (2018/20). None of those included in these two groups (i.e. carer and non-carers) were found to be providing unpaid care in the previous wave on the UKHLS (wave 6, 2014/2016). We have, therefore, focused our attention on new (co-resident) carers, so the effect of having caring responsibilities on health outcomes can be better isolated. In addition, from the group of non-carers in wave 7, we have also removed those individuals that became carers in a future wave. This to avoid including carers in the comparison group at any point of time. We have provided more details about this decision in the methodology section.

For the analysis of carer typologies, as per its descriptive nature, we included all carers over 16 years old irrespectively of their caring responsibilities in previous waves and we linked their responses to their care recipient. However, the age of care-recipients was limited to 65 years old or older (due to questions about care needs and services, the UKHLS social care module, was only asked to older participants). We created care-recipient-carer pair panel members living in the same household at wave 7. We included 1,438 dyads for whom there is information on carer needs and health, care-recipient's care need and health, and social care service receipt (or non-receipt). Outcome measures, care-recipient and carer characteristics were available at wave 7 (2015/17), 8 (2016/18), 9 (2017/19), and 10 (2018/20), time 1, 2, 3 and 4, respectively.

Attrition rates in the UKHLS are relatively low (continuing participation rates from wave 1 to wave 7 range from 35% of 16–19s, to 61% of 60–69s) and there is no strong association between attrition rate and health status (Lynn & Borkowska, 2018). Ethical approval for the UKHLS was obtained by the University of Essex Ethics Committee which has approved all data collection on the UKHLS main study and innovation panel waves.

MEASURES

Caring responsibilities (unpaid care)

A binary variable for caring responsibilities was derived from the following question asked of respondents (at time 1 and time 0): 'Is there anyone living with you who is sick, disabled or elderly whom you look after or give special help to (for example, a sick, disabled or elderly relative/husband/wife/ friend etc.)?' This allowed us to identify co-resident carers present in the sample. For the carer's typology analysis, co-resident carers were then linked to their respective care-recipients based on their response.

Need for care

We used questions at baseline (time 1) that ask the care-recipient about ability to perform specific Activities of Daily Living (ADLs) and/or Instrumental Activities of Daily Living (IADLs) tasks. ADLs include ability to manage stairs, get around the house, get in and out of bed, cut toenails, bathe, use the toilet, feed oneself (including cutting up food), wash own face and hands, get dressed and undressed, and take the right amount of medicines at the right times. ADL needs are also referred to as personal care needs. IADLs include the ability to walk down the road, do the shopping, do housework or laundry, and do paperwork or pay bills. ADLs and IADLs are measures of functional abilities, have good reliability and validity (Edwards, 1990), and have been used extensively in studies of care need (Vlachantoni, 2019). For the care-recipient, we constructed a variable flagging the need for care when individuals answered that were not able to perform these tasks or that they only were able to perform them with help. More specifically, we used the definition developed by Ipsos Mori which identify users with care needs as those that have difficulties with three or more ADLs, or difficulties with two or more ADLs and poor well-being (Dunatchik et al, 2016) as this definition better operationalises the Care Act 2014 criteria. The measure of well-being used was the seven-item version of the Warwick-Edinburgh Mental Well-being Scale (SWEMWBS) (Tennant et al, 2007; Stewart-Brown et al, 2009). We defined poor well-being as having a SWEMWBS score that was at least 1 standard deviation below the mean well-being score for older people without any care needs in the total UKHLS sample of people aged 65 and older at Wave 7 (time 1) as previously done by Dunatchik, Icardi & Blake (2019).

Formal care services

Care-recipient at time 1 (Wave 7), which could eventually be the carer themselves if co-caring, were also asked about whether they had received formal care services for support with ADL and/or IADL care needs. Formal care services asked about and included in this measure of services receipt are: Home care worker/Home help/Personal Assistant; a member of the reablement/intermediate care staff team; Occupational Therapist/Physiotherapist/Nurse; Cleaner; Other. Receipt of formal care services is categorised as '0', not receiving any services; and '1' receiving some services. This categorisation only includes services that the care-recipient perceived as services for themselves rather than for the carer only.

Unmet needs

'Unmet need for services' is defined as no services received compared to some services received. Respondents were considered to have unmet needs if they had difficulties with two or more ADLs and poor well-being, but they had not received help in the last month. Unmet needs were analysed from a care recipient perspective, but also as carers could have care needs themselves, and could also be receiving care services. We have also explored the possibility that they could also have unmet needs independently of the unmet needs for services that the person they care for may have.

Outcomes

The UKHL includes two, well-attested health measures: 1) self-reported general health measure (a binary variable with 1 = Excellent, Very Good, Good health and 0 = Poor and fair health), and 2) the SF-12 Physical Component Summary (PCS) which have been validated for use in the general population (Ware, Kosinski & Keller, 1996), with lower scores indicating poorer physical health. In addition, questions about loss of sleep and loss of concentration have been included from the General Health Questionnaire, GHQ (Goldberg, Williams & University of London, 1991). Originally GHQ covers a wide range of symptoms appropriate for measuring the mental health of carers (Pot, Deeg & Van Dyck, 1997), but there is good evidence that sleeping issues are also associated with physical problems such as obesity and hypertension (Colten & Altevogt, 2006). Similarly, loss of concentration may be a consequence of hormonal imbalances (Ali, Begum & Reza, 2018). Specific health conditions (e.g. diabetes) were available in the UKHLS, but the sample sizes were too small to make use of them.

ANALYSIS

We first compared, using descriptive statistics, the socio-demographic characteristics at wave 7 and health outcomes at waves 8, 9, and 10 of individuals with and without caring responsibility at time 1 (wave 7). Chi-squared tests and tests of means (t-test) were used to determine any statistically significant group differences. To take into consideration selection bias issues (some individuals could take caring responsibilities because they have better or poorer health before they become a carer), we performed Propensity Score Matching (PSM) to create a counterfactual, that is, a comparison group that presents similar observable characteristics to those without caring responsibilities before they became carers. PSM methodology includes the estimation of the probability of treatment or participation (in our study, the probability of providing unpaid care), conditional on observed pre-treatment (time 0) characteristics (Rosenbaum & Rubin, 1983). Based on this probability, carers and non-carers were matched before their outcomes were compared. More specifically, the propensity score was estimated by looking at the probability of being a carer at wave 7 (time 1) based on individual characteristics before treatment (at wave 6, time 0). We limited this analysis to those individuals (carers and non-carers) that did not have caregiving responsibilities at the wave prior to time 1, i.e, time 0 (wave 6; 2013/2015). In this way, the effect of treatment (acquiring caring responsibilities) on outcomes (health) can be more clearly isolated. Nevertheless, including in the analysis only carers without caring responsibilities at time 0 limits the study only to those 'new carers' (those that were not carers at time 0, but became carers at time 1). This may create some limitations in terms of a reduced sample size and with regards to the interpretation of results, as they will only refer to those that have recently taken care giving responsibilities, and therefore may be providing lower intensity levels of care. Outcomes were compared at waves 8, 9 and 10, and therefore to perform PSM, we removed from the sample of non-carers those individuals that while they were not carers either at wave 6 nor at wave 7, became carers at a later wave. This was to avoid having in the non-carer comparison group individuals that became carers when comparing their physical health outcomes. Matching variables were based on factors demonstrated in previous research (Zhang, Bennet & Yeandle, 2019; House of Commons, 2021; ONS 2019; Larkin, Henwood & Milne, 2019) to influence both the participation decision (being a carer) and the outcome variable (Caliendo & Kopeinig, 2008). We used matching variables which were either constant over time or measured before participation, i.e. before starting to provide care (at time 0). The analysis included, gender (female = 1; male = 0); marital status (single = '0'; married/living with partner/in civil partnership = '1'); ethnicity (1 = White British; 0 = any other); employment status (1 = working; 0 = not working), highest educational qualification (degree or higher degree, A-level, GCSE, none); age; housing tenure (owner-occupied, private-rented; social-rented); long-standing illness (1 = with long-standing illness or disability; 0 = otherwise); and self-reported general health (1 = excellent/very good/good; 0 = fair/poor). Matching variables were the same for all the outcomes included in our analysis. We estimated the difference in physical health between the two groups (receiving 'treatment' compared to not receiving 'treatment'), that is, we focused our attention on the average treatment effect (ATE) of caring responsibilities on health outcomes at wave 8, wave 9 and wave 10 of the UKHLS to be able to identify potential health trajectories of those with caring responsibility against those without caring responsibilities. The ATE estimation included the same covariates used to estimate the propensity score. Bootstrapping (n = 1,000) was used to estimate standard errors and construct confidence intervals of the estimated treatment effect. Kernel matching was performed in order to achieve a lower variance while making use of a weighted average of all non-carer individuals to be part of the counterfactual group. We report two measures of covariate balance post-matching: The absolute standardised difference of the means of the linear index of the propensity score in the treated and matched non-treated group (Rubin's B), and the ratio of treated to (matched) non-treated variances of the propensity score index (Rubin's R). If the value of Rubin's B is less than 25 and if Rubin's R has a value between 0.5 and 2, we can assume that the samples are sufficiently balanced (Rubin, 2001). A disadvantage of PSM is that it only includes observable characteristics for creating the counterfactual group.

We also aimed to identify typologies of carers to explore whether some of them may be at greater risk of poor health and/or face unmet needs for care services. For this, we focused our attention only on carers and performed Latent Class Analysis (LCA) as complementary analysis to the PSM approach. Given that the latter makes use of carer and non-carer information, we cannot investigate the role played by characteristics that are only associated with carers, but not to those without caring responsibilities (e.g. unmet care need for services). LCA is a data-driven technique designed to classify carers into mutually exclusive and exhaustive types, or latent classes (Porcu & Giambona, 2017) based (for this study) on their health-related patterns. LCA allowed us to identify unobserved (or latent) typologies of carers based on the health outcomes previously mentioned: self-reported health, loss of sleep, lack of concentration, and physical health at time 1 (wave 7), time 2 (wave 8), time 3 (wave 9) and time 4 (wave 10). The analysis produced the probability of class membership for each carer. Each latent class can be interpreted as a subpopulation with homogenous profiles (patterns) on the multiple health-related measures included in the analysis, whereas the differences between the latent classes indicate heterogeneity in the population of carers studied. To decide the number of latent classes to be identified, we used the statistical evidence provided by the Akaike information criterion (AIC) and Bayesian information criterion (BIC). If these statistics decrease as additional classes are added, the conclusion is that the additional subgroups (classes) found exist. Once we identified the adequate number of types of carers, we estimated the probability of belonging to each class for each carer. If the probability of belonging to a specific class is higher than 0.5 for a given carer, that carer is assigned to this class. All tests of statistical significance used robust standard errors. A significance level of 0.05 was used as the criterion to determine statistical significance and 0.10 to determine marginal significance. Furthermore, we have investigated the association between latent class membership and carer and care-recipient characteristics. We present p-values for each of the characteristics of interest analysed (a logistic regression has been used to obtain their statistical significance).

We conducted all analyses using Stata 16.1 (StataCorp, 2019).

RESULTS

DESCRIPTIVE ANALYSIS

We compared socio-demographic characteristics and outcomes measures for all 16+ co-resident carers against those without caring responsibility at wave 7. These two groups statistically differ in the proportion of female (57.6% of carers versus 53% of non-carers). Carers are older than non-carers, are less likely to own a house (79.3% versus 81.2%) and twice less likely to be employed (36.8% against 60.4%). The proportion of carers with a long-standing illness or disability is higher than for those without caring responsibilities (45.5% against 29.3%, respectively) and they are more likely to belong to the poorest quintile of household income (17.1%, compared to 11.9%). Carers also present poorer general and physical health, sleep and concentration when compared to non-carers. This may confirm that we cannot compare carer and non-carer outcome measures without acknowledging that they could have decided to become carers due to their poorer baseline outcomes (e.g, selection bias). See ***Table 1*** for more details.

HEALTH TRAJECTORIES

Propensity Score Matching (PSM) was performed to deal with the possibility that the decision of becoming a carer is influenced by an individual's poorer health outcomes. We matched new carers and non-carers at wave 7 and created a suitable comparison group to estimate the effect of having caring responsibilities on health. ***Figure 1***. (and supplementary Table A) shows that carer physical health deterioration is larger over time when compared to non-carers, and that this negative effect increases over time. Similarly, new carers also experience significantly greater lack of concentration than non-carers, with this negative effect getting larger over time. These results highlight the negative impact of having caring responsibilities on physical health. Providing care also has a statistically significant detrimental effect on self-reported general health on waves 8 to 10. This effect, however, seems to be smaller at wave 9 than in

CHARACTERISTICS TIME 1 (WAVE 7)	PROVIDING UNPAID CARE TIME 1 (WAVE 7) (N = 2,926; 8.1%)	NOT PROVIDING UNPAID CARE TIME 1 (WAVE 7) (N = 33,269; 91.9%)	P-VALUE
% Female	57.6	53.1	0.000
% Ethnicity (White British)	73.8	74.6	0.313
% Married, living with partner, in civil partnership	72.3	72.7	0.628
Age (mean)	52.5	45.5	0.000
% Owns house	79.3	81.5	0.003
% Employed	36.8	60.4	0.000
% Higher education	7.1	11.4	0.000
% Long-standing illness	45.5	29.3	0.000
% Poorest quintile household income	17.1	11.9	0.000
% Richest quintile household income	11.9	23.9	0.000
% Poor or Fair (general) self-reported health	31.5	16.7	0.000
Physical health score (mean)[a]	46.2	50.7	0.000
% Loss of sleep	21.5	14.6	0.000
% Lack of concentration	21.5	14.6	0.000

Table 1 Socio-demographic characteristics and outcome measures at wave 7, baseline (unmatched sample).
[a.] Physical health score is Physical Component of the Short-Form 12 Health Survey (SF12 PCS); lower score = worse physical health.

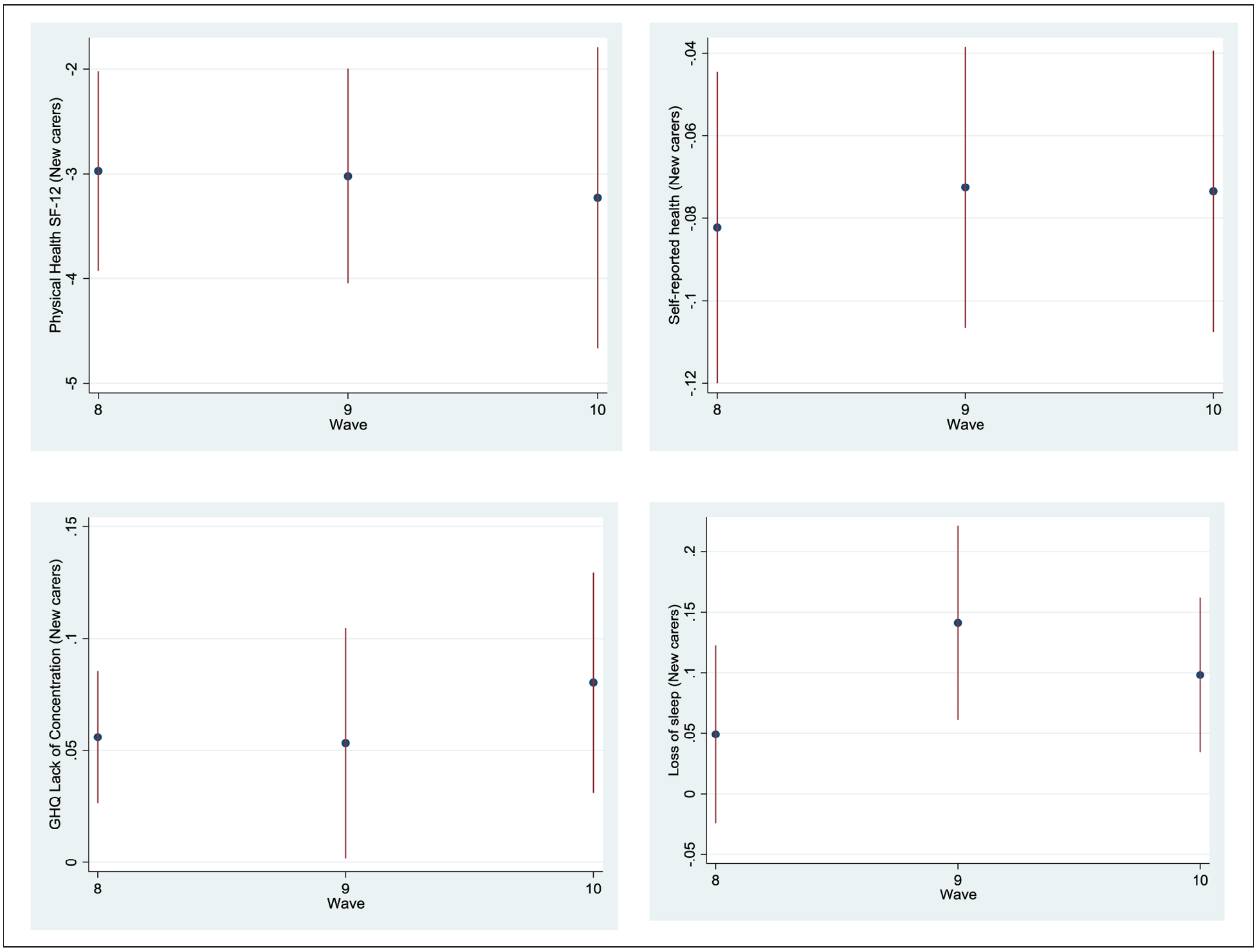

Figure 1 Effect of having caring responsibilities at wave 7 on health outcomes.[a, b]
[a] Bars represent 95% Confidence Intervals.
[b] Rubin's B of 24.4 and a Rubin's R of 0.93.

wave 8 and wave 10, as though carers feel worse off at the beginning of their journey as carers, but then they feel better in the short run. Carers do not get healthier over time, but the negative effect of having a caring responsibility may dilute. A similar pattern is seen when comparing the loss of sleep of carers against non-carers, there is a negative effect that follows a U-shaped pattern: the negative effect of caring is higher at the first wave analysed (wave 8), the negative effect decreases at wave 9, and increases again at wave 10. The disadvantaged position of carers is quite clear and consistent for all the outcomes analysed. Supplementary Table B and ***Figure 2*** show that a good balance has been achieved, between the two groups analysed (carers and non-carers), after PSM has been performed (Rubin's B and Rubin's are 24.4 and 0.93, respectively).

LATENT CLASS ANALYSIS

Four typologies of carers were identified based on self-reported health, loss of sleep, physical health, and lack of concentration. Using AIC (42,629.60) and BIC (42,993.30) we ruled out the possibility that a larger or fewer number of latent classes existed. Class 1 included 286 carers at wave 7 (20.1%), Class 2 is formed of 618 carers (43.3%). Class 3 and Class 4 included 180 (12.6%) and 342 (23.9%) carers, respectively. Class 1 is mostly characterised by having the worst, although constant, physical health of the four classes identified. Carers belonging to Class 2, are those with the best health outcomes over time. Only a small proportion of carers present a loss of sleep, lack of concentration, and poor general health. Conversely, they have on average, higher physical health scores than the other classes identified (still quite low if we consider that having less than 50 points has been suggested as a cut-off point, indicating the presence of a physical condition). Class 3 is characterised by having a large proportion of carers with loss of sleep, in particular at waves 8 and 9, and suffering from lack of concentration. Carers belonging to Class 4, on the other hand, are characterised by poor general self-reported health, most likely related to physical aspects, since their average physical score is the second lowest across all the classes identified. We also looked at the non-health related characteristics of the latent classes identified.

Class 1: Carers in poor health with unmet needs themselves

Class 1 carers have a large proportion of carers providing 20 or more hours of care (47%). In addition, almost one third (29%) of carers in this class are found in the poorest quintile of household income. A very small proportion of the carers in this class are employed or have higher education. In addition, nine out of ten carers in Class 1 themselves have a long-standing illness, 38% are co-

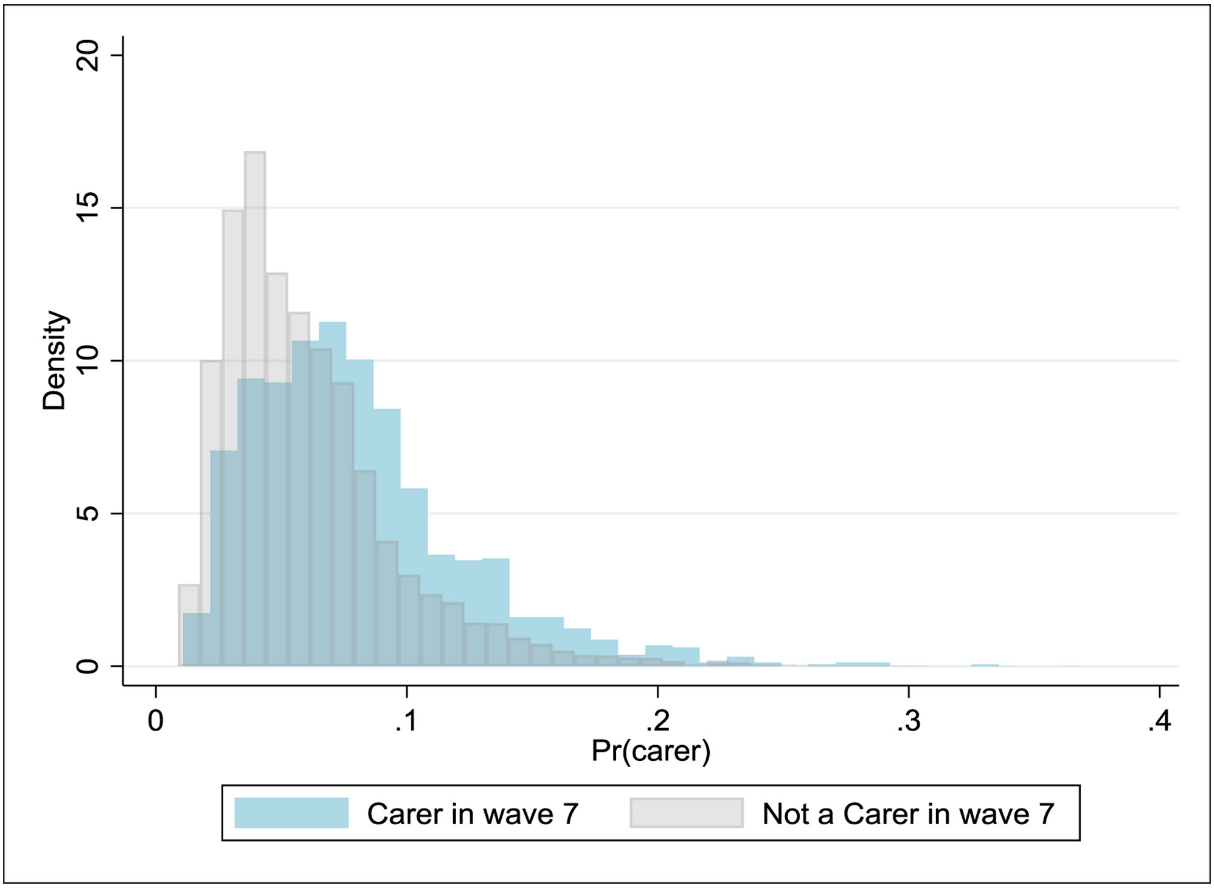

Figure 2 Propensity Score Matching, Common support.

carers (carer and care recipient simultaneously care for each other), and one third of the care-recipient and one quarter of carers themselves present unmet needs.

Class 2: Healthier and richer carers, but not recognised as such

Carers belonging to Class 2 are more likely to be employed and have a higher level of education compared to the other classes identified. Carers in this class are less likely to have a long-standing illness or disability (30%) than carers belonging to the other latent classes. However, a higher proportion of them are not recognised by care recipients as their carer (one in three carers belonging to this class). With regards to unmet needs, this class presents the lowest proportion of care recipients and carers with unmet needs. Carers belonging to this latent class also have the lowest proportion of care-recipients with a long-standing illness.

Class 3: Female carers that have problem sleeping

More than half of carers in this class are female (63.6%), and they are the youngest group from the four classes identified. Compared to other carers, those belonging to this class are more likely to have higher levels of education and provide longer hours of caring for others (54% of carers provide 20 or more hours of care), as well as having the largest proportion of carers receiving formal care services. Thirty-one percent of carers in this class belong to the poorest quintile of household income and 23% are not recognised as a carer by the care-recipient. One quarter of carer-recipients and one in five carers belonging to this class have unmet needs for services.

Class 4: Male carers with poor self-reported health with high intensity of care

This class includes the oldest carers of the four classes identified. Furthermore, more than half of carers belonging to this class are male and have a long-standing illness or disability. Nine in ten of these carers are married. More than half of the carers in this class provide 20 or more hours of care and one third belongs to the poorest quintile of household income. Most carers are recognised as such by care recipients, and 27% of care-recipients and 26% of carers have unmet needs for services. ***Tables 2*** and ***3*** show carer and care recipient characteristics by class membership. More details are shown in supplementary Table C.

DISCUSSION

For many decades, there has been a recognition that community health and social care services would struggle to cope without the contribution of unpaid carers, and therefore, the services that support them are understood as a preventative and cost-effective strategy (Department of Health, 1990; ONS, 2013; Spiers et al, 2021). Using PSM, this paper shows that the health of unpaid carers deteriorates over time, even when reducing the effect of selection bias. But this association is not always linear. Self-reported health and loss of sleep are worse one year after starting to have caring responsibilities, but the negative effect gets smaller two years later, increasing again after three years. This suggests that there may be a period of time when carers are adapting to their new role. Conversely, physical health and lack of concentration continuously deteriorate over time for carers compared to non-carers, suggesting a cumulative effect. While we cannot identify the mechanisms behind these patterns, they highlight the importance of looking at the effect of having caring responsibility over time. In the same way that it is well accepted that care needs are dynamic in their nature, our findings indicate that carer circumstances and challenges can also be.

Health inequalities among carers were explored using LCA, and we found four distinctive types of carers. A first

Class 1 ➢ Worst (but constant) physical score ➢ Carers are more likely to be unemployed ➢ Co-caring (and carers themselves are more likely to have a long-standing illness or disability) ➢ Highest proportion of carers and care-recipients with unmet needs ➢ Carers receive recognition as such by care recipient.	Class 2 ➢ Best health ➢ Carers are more likely to be employed ➢ Less than one third of carers have a long-standing illness or disability ➢ One third of carers are not recognised as such by care recipients. ➢ Lowest proportion of care recipients and carers with unmet needs.
Class 3 ➢ Loss of sleep and concentration ➢ Female ➢ High intensity of care (20+ hours a week) ➢ Not recognised as carer ➢ Poorer ➢ One quarter of carers and care-recipients with unmet needs	Class 4 ➢ Poor general health ➢ Male ➢ High intensity of care (20+ hours a week) ➢ Recognised as carer ➢ Poorer ➢ Large proportion of carers and care-recipients with unmet needs

Table 2 Latente Class characteristics.

CARER CHARACTERISTICS	C1	P-VALUE	C2	P-VALUE	C3	P-VALUE	C4	P-VALUE
% Female	53.2	0.390	49.3	0.286	63.6	0.000	45.4	0.021
% Ethnicity (White British)	85.9	0.940	83.3	0.606	84	0.473	85.6	0.910
% Married, living with partner, in civil partnership	86.4	0.166	81.2	0.029	76.1	0.004	89.8	0.001
Age (mean)	71.4	0.000	65.1	0.000	64.3	0.000	72.7	0.000
% Owns house	82.3	0.002	90.6	0.009	86.2	0.458	88.7	0.604
% Employed	4.3	0.000	26.5	0.000	24.1	0.009	6.9	0.000
% Higher education	1.5	0.005	8.5	0.003	10.1	0.045	3.1	0.029
% Long-standing illness	91.1	0.000	30.2	0.000	48	0.125	66.5	0.000
% Co-caring	37.8	0.000	7.3	0.000	9.4	0.007	18.7	0.000
% <10 hrs of care	42.9	–	44.6	–	31.0	–	31.4	–
% 10–20 hrs of care	9.8	0.251	13.4	0.718	15.0	0.111	10.3	0.853
% 20+ hrs of care	47.4	0.433	42.0	0.002	54.0	0.095	58.4	0.005
% Not recognised as carer by care recipient	1.3	0.005	33.3	0.000	22.7	0.043	3.0	0.159
% Poorest quintile household income	28.5	–	25.1	–	30.9	–	30	–
% Richest quintile household income	3.6	0.005	9.4	0.005	10.9	0.269	5.3	0.060
% Receiving formal care services	29.2	0.637	30.0	0.545	40.0	0.000	30.0	0.787
% Unmet needs (2+ ADLs and Poor wellbeing & No services)	25.8	0.000	18.1	0.204	22.1	0.690	26.3	0.002
Care recipient characteristics								
Age (mean)	75.6	0.707	74.5	0.004	75.8	0.244	76.1	0.033
% Owns house	82.1	0.002	90.4	0.008	85.5	0.330	88.7	0.517
% Employed	4.6	0.745	5.9	0.129	5.6	0.589	3.0	0.064
% Higher education	1.4	0.140	3.6	0.328	5.9	0.059	2.0	0.258
% Long-standing illness	87.7	0.021	80.9	0.037	87.2	0.174	81.4	0.414
% Receiving formal care services	25.6	0.600	24.4	0.958	27.4	0.325	21.9	0.232
% Unmet needs (2+ ADLs and Poor wellbeing & No services)	27.7	0.099	19.8	0.001	24.6	0.753	27.3	0.051

Table 3 Carer and Care recipient characteristics by class membership.
* p-values from univariate logistic regression model.

group of carers that is characterised by having the worst physical health of all those with caring responsibilities, who are mostly co-caring, and their care recipient and themselves have unmet needs for care. This group could benefit from receiving care services that better cover their and their care-recipient's needs so as to prevent the carer's health from deteriorating further and/or to mitigate existent poor health. A second group of carers is at the other extreme, with fairly good health outcomes, providing care at lower intensity, and with more advantageous socio-economic characteristics. They could perhaps benefit from receiving signposting and universal services. A third group of carers was identified as having difficulties with their sleep and concentration, also characterised by being largely a group of female carers who have higher educational levels. This group seems to be affected by stress and worries, which are not only associated with well-being levels, but also with obesity, heart problems, and are even a key component in risk for Alzheimer's disease (Patel & Hu, 2008; Nagai, Hoshide & Kario; 2010; Shokri-Kojori et al, 2018). It may be possible that they benefit from receiving services that give them support and advice (e.g. support groups). Finally, a fourth group of carers was found to have poorer general health, and have unmet need themselves and also the person they care for, providing long hours of care. This group could potentially benefit from receiving services designed to give them a break from caring (i.e. respite services) and from receiving services that support and cover their care needs (and their care recipient's needs). These differences across carers may suggest that policies designed to support them need to better acknowledge that a 'one size fits all' solution may not be adequate. For this, targeting as well as tailoring care service may be necessary as some carers are a greater risk than others.

There are some methodological limitations associated with our study. We are only including new carers in this study, and therefore we accept that unintentionally, we have ended up with a sample of carers that provides caring responsibility for a lower number of hours a week than carers overall – caring responsibility usually increases over time, in line with the increase of care needs experienced by care recipients. This may cause an underestimation of the health effects of having caring responsibilities. The strengths of this study are that it has used a large representative longitudinal sample that allows for the creation of a credible comparison group and for the identification of distinct groups of carers who have different risk and need profiles and, that it looks at the changes experienced by carers over time showing that the physical health of carers is at risk when providing support for others. This is particularly important to consider because poor health in the carer population can have implications for service planning in the formal health and social care sectors. Carers often have their own long-term conditions and disability, and, as we showed in this study, carers have unmet needs of their own.

Understanding more about the health risks faced by carers is important for several reasons. It matters whether the challenges faced by carers have unmet needs for health and social care as a source, because having caring responsibilities is not always a choice, and because local service provision may limit or prevent better health outcomes for carers. We believe that the evidence presented here on carer health trajectories provides a foundation for a better understanding of the life-course of carers and the dynamic nature of their care provision. We still have much to learn about the mechanism behind these patterns, how they are associated with unmet needs and external risks factors, and how we could better mitigate risks to carers and support them better. Future research could focus on gaining a better understanding of the effect of unmet needs for carer outcomes, but also on exploring the extent to which carers themselves have unmet care needs.

CONCLUSION

This paper adds a number of key messages to the existing literature with regards to the effect of caring responsibilities and health outcomes: 1) the effect of caring on physical health is not always linear over time, and 2) there are identifiable different types of carers and as such, we should consider providing differential support for them, and 3) unmet needs for care services are associated with the effect that caring has on health. These findings highlight the importance of gaining a better understanding of carers, as a whole, but also as a diverse group. In addition, they show the need for supporting carers as those providing care, but also as individuals that could be at risk of having unmet needs for health and social care. Looking at carers with different circumstances and needs is particularly relevant when designing policies that aim to support their care journey and the challenges that they face.

ADDITIONAL FILE

The additional file for this article can be found as follows:

- **Supplementary File.** Tables A, B and C. DOI: *https://doi.org/10.31389/jltc.124.s1*

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