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Conflicts of Interest

The authors declare that there are no conflicts of interest to report.

Author contributions

S Doebler was involved in the study design, data analysis, manuscript preparation and revision.

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S. Shortall was involved in the study design, manuscript preparation and revision.

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Abstract

Informal caregiving can be a demanding role which has been shown to impact on physical, psychological and social wellbeing. Methodological weaknesses including small sample sizes and subjective measures of mental health have led to inconclusive evidence about the relationship between informal caregiving and mental health. This paper reports on a study carried out in a UK region which investigated the relationship between informal caregiving and mental ill health. The analysis was conducted by linking three datasets, the Northern Ireland Longitudinal Study, the Northern Ireland Enhanced Prescribing Database and the Proximity to Service Index from the Northern Ireland Statistics and Research Agency. Our analysis used both a subjective measure of mental ill health, i.e. a question asked in the 2011 Census, and an objective measure, whether the respondents had been prescribed antidepressants by a General Practitioner between 2010 and 2012. We applied binary logistic multilevel modelling to these two responses to test whether, and for what sub-groups of the population, informal caregiving was related to mental ill health. The results showed that informal caregiving per se was not related to mental ill health although there was a strong relationship between the intensity of the caregiving role and mental ill health. Females under 50, who provided over 19 hours of care, were not employed or worked part-time and who provided care in both 2001 and 2011 were at a statistically significantly elevated risk of mental ill health. Caregivers in remote areas with limited access to shops and services were also at a significantly increased risk as evidenced by prescription rates for antidepressants. With community care policies aimed at supporting people to remain at home, the paper highlights the need for further research in order to target resources appropriately.

Key Words: Informal Caregiving, Mental Health, Multilevel Modelling, Population-based Study

What is known about this topic?

- Previous research suggests that the strain and burden associated with caregiving can be detrimental to the mental health and wellbeing of informal caregivers.

What this paper adds:

- Factors such as caregiver workload, employment, gender and proximity to services were shown to influence the mental health of informal caregivers.
- Informal caregivers delivering more than 19 hours of care per week were much more likely to suffer from mental ill health than those delivering fewer hours of care.
- There is a need to target support towards high risk caregivers with due regard to the heterogeneity of this population group and to the different support needs of men, women and young people.

Introduction

The relationship between informal caregiving and mental health is an important issue for health and social care providers and for policy makers. While there exists a sizeable body of literature on this relationship (Etters *et al.* 2008, Genet *et al.* 2011, Brown & Brown 2014, Ventura *et al.* 2014), the majority of studies rely on clinical trials or surveys with small samples. Studies that are representative of entire populations are rare (Roth *et al.* 2015). Furthermore, the majority (Cannuscio *et al.* 2004, Hirst 2005, O'Reilly *et al.* 2008, Vlachantoni *et al.* 2013) rely on subjective survey questions and do not use objective measures of mental health. Qualitative research is generally characterized by small and heterogeneous samples providing useful but incomplete data (Shortall & Radford 2012).

The findings from the literature on the relationship between informal caregiving and mental health are largely inconclusive. Several studies report links between informal caregiving and mental ill health (Morimoto *et al.* 2003, Hirst 2005, Molyneux *et al.* 2008) as a result of the strain and burden associated with a caregiving role (Morimoto *et al.* 2003, McCullagh *et al.* 2005, Etters *et al.* 2008). Many caregivers fulfil multiple and demanding roles, including caring for older relatives and children while also holding down a job. Experiences of isolation and stress were found to be common factors impairing the mental health of caregivers (Chambers *et al.* 2001, McCann *et al.* 2005). Moriarty *et al.* (2015) found that bereaved caregivers with a high burden were at a greater risk of mental ill health than non-bereaved caregivers and non-caregivers. Insufficient information about support services was also found to exacerbate experiences of stress (Chambers *et al.* 2001, Greenwood *et al.* 2015).

However, there is also evidence that informal caregiving may have positive effects on mental health (Beach *et al.* 2000, Schulz & Sherwood 2008, Brown & Brown 2014) whereas other studies have reported mixed results (Hirst 2005, O'Reilly *et al.* 2008). In a Census-based mortality study performed in Northern Ireland, O'Reilly *et al.* (2015a) found that moderate caregiving responsibilities were associated with better health and a lower risk of mortality and suicide (O'Reilly 2015b). Similar findings have been reported in America (Brown *et al.* 2009, Brown & Brown 2014) with studies reporting that informal caregiving can be emotionally rewarding (Schwartz & Gidron 2002, Raschick & Ingersoll-Dayton 2004, Brown & Brown 2014). Brown and Brown (2014) recommend caution in the interpretation of these results as many studies make ambitious assumptions based on insufficiently small samples and fail to acknowledge differences by social strata.

This present study was conducted to address several gaps in the literature on informal caregiving and mental health. Firstly, to date there is no population-representative study of the complex relationship between caregiver workload, employment status and mental health in the UK that analyses both subjective mental health and mental health medication prescriptions. Secondly, there is a striking knowledge-gap regarding gender. Informal caregiving is widely recognised as a highly gendered activity (Ryan *et al.* 2014, Ryan & McKenna 2013). The majority of full-time caregivers are women and this population group has been shown to experience high levels of burden and health problems (McCann *et al.* 2005). This could lead to bias regarding male caregivers, as their needs are often ignored (McDonnell & Ryan 2011). Qualitative studies found that men often face different challenges and struggle with (real and perceived) gendered expectations towards their caregiving role (McDonnell & Ryan 2014). Differential statistical

relationships between caregiving and mental health by gender are under-researched (McDonnell & Ryan 2011) and this study aims to address this gap.

Thirdly, the caregiver's age is important. Caregivers at different life-stages experience different challenges and the aging process itself can result in declining stress resilience. Although several studies have investigated age-effects on caregiver mental health (McCullagh *et al.* 2005, Schulz & Sherwood 2008), this was rarely done using population-representative data. Finally, geographical context-effects on caregivers' mental health are understudied due to a scarcity of sufficiently large samples. Area-remoteness and proximity to services is of particular significance in Northern Ireland as a result of rurality but also because people often travel further than their nearest provision for political and religious reasons (Shortall 2002). Such obstacles can put an additional strain on the mental health of caregivers, hence this study sought to examine whether caregivers in remote areas are at an increased risk of mental ill health. In summary, this study addressed several gaps in the literature regarding the impact of caregiver burden, employment, gender, age and proximity to services on the relationship between informal caregiving and mental health.

Method

The aim of this study was to analyse the relationship between informal caregiving and mental ill health using data from a large data linkage study representative of the population of Northern Ireland. Due to the legacy of the Northern Ireland conflict, average rates of mental ill health are higher than in other countries (Kelly *et al.* 2003, Maguire 2013). This paper asks whether

informal caregivers have higher levels of mental ill health over and above the known ‘Northern-Ireland-effect’ as a result of the burden associated with their caregiving role.

The study tested five hypotheses:

H1: The more hours per week someone spends providing care to a relative or neighbour, the more likely is this person to report mental ill health and be prescribed antidepressants.

In addition to the number of hours spent providing care, caregiver burden is also influenced by employment status, i.e. whether caregivers are employed and whether they work fulltime or part-time (Berecki-Gisolf *et al.* 2008, Juratovac & Zauszniewski 2014). We therefore hypothesized:

H2: Caregivers who provide more than 19 hours of care per week while in full-time employment are more likely to report mental ill health than caregivers who provide fewer than 19 hours of care and caregivers who work part-time or are not employed.

Regarding gender, we tested the Null-hypothesis that controlling for the caregiving workload measured in hours of care-delivery per week, employment status, deprivation and demography, there is no net-effect of gender on the caregivers’ likelihood of suffering mental ill health.

H3: All other things being equal, female caregivers are no more likely than male caregivers to suffer mental ill health.

The majority of caregivers are older than 50 years (O'Reilly *et al.* 2015a). With increasing age individuals' resilience to stress and burden decreases (Iecovich 2008). We thus expected caregiver-burden to have more adverse effects on the caregivers' mental health at older ages.

H4: The risk to informal caregivers of mental ill health increases with age.

The last step examined whether area-remoteness makes a statistically significant difference for the mental health of caregivers.

H5: Informal caregivers who live in remote areas with limited access to services are more likely to suffer mental ill health than non-caregivers in the same area and caregivers living in areas that are closer to services.

Data

The analysis was conducted by linking data from three sources, the Northern Ireland Longitudinal Study (NILS), the Northern Ireland Enhanced Prescribing Database (EPD) and the *proximity to services index* from the Northern Ireland Statistics and Research Agency (NISRA). The NILS is a representative random sample capturing approximately 28% of the population of Northern Ireland. Sampling is based on 104 out of 365 possible birth-dates. The core of the NILS data consists of health-card registration records held by GP practices linked to Northern Ireland Census records. Our study used mainly the 2011-NILS-Census-link consisting of all NILS members who were enumerated in the 2011-Census and aged 16 years or older (N=378,365). This excludes 4,918 individuals living in communal establishments such as care homes and prisons.

To analyse employment and caregiving transitions from 2001 to 2011, we also used the NILES-Census-2001 link (N=463,574). Sample attrition (due to deaths and out-migration) accounted for 127,121 individuals, and 41,912 had immigrated into the sample between 2001 and 2011. Our working sample for the analysis of employment and caregiving transitions over time consisted of N= 336,453 individuals who were enumerated in both Censuses.

The NILES contains socio-structural variables and a measure of subjective mental ill health, as asked in the 2011-Census: '*Do you have any of these conditions which have lasted, or are expected to last at least 12 months? – an emotional, psychological or mental health condition (such as depression or schizophrenia)*'. A score of one indicates a positive response and a score of zero indicates that the respondent had not reported a mental health condition. Our objective measure of mental ill health was whether respondents had been prescribed antidepressants (BNF-category 4.1.3) (British National Formulary (BNF) 2014, NHSBSA 2014) by their GP at least once in the period from 01 April 2010 to 30 March 2012. This binary measure was based on records of antidepressant prescriptions by GP practices from the EPD. All 1,298,617 prescription records of antidepressants were successfully linked from the EPD database to the NILES.

N=79,794 respondents have received antidepressants at least once during the time of study.

Our third data source consisted of publically available aggregate data on area-remoteness and income-deprivation (NISRA 2010). NISRA's index of *proximity to services* operationalizes area-remoteness as travel times by car to service providers such as GP practices, pharmacies, post offices and supermarkets on a 10-point scale (NISRA 2010). High values indicate remote areas. Our measure of income deprivation is the area-percentage of households in receipt of income benefits. The data were measured on the level of Super Output Areas (SOA) and were linked to the NILES using a unique SOA identifier. One SOA consists of 700 to 1000 households and is the

smallest geographical unit available for the analysis of Census-linked data in Northern Ireland (Office for National Statistics 2011, NISRA 2015).

Analysis

The hypotheses were tested using binary logistic multilevel models. The response variables were a) subjective mental ill health (Census question) and b) whether the respondent has been prescribed antidepressants in the period between April 2010 and April 2012. For the purpose of this study, an informal caregiver was defined as anyone who delivered unpaid care. This was operationalized via the Census question *‘Do you look after, or give any help or support to family members, friends, neighbours or others because of either: long-term physical or mental ill-health/disability/problems related to old age?’* Responses were scored as follows: 0 = No, 1 = 1-19 hours per week (moderate workload), 2 = 20- 49 hours per week (high workload), 3 = 50 or more hours per week (fulltime caregiver).

Differential effects of informal caregiving on mental health by caregiving workload, employment status, gender and age were tested via interactions with the three intensities of informal caregiving. In addition, interactions between caregiving and employment transitions from 2001 to 2011 were tested. The expectation was that individuals with higher long-term caregiving and employment workloads would be more likely to experience mental ill health. To this end, we computed binary indicators of caregiving-transitions between the two Censuses: Caregiver in 2001 and 2011; caregiver to non-caregiver; non-caregiver to caregiver, not a caregiver at either time-point. We did the same for employment transitions between 2001 and 2011 (full-time to

full-time; full-time to part-time; part-time to full-time, and full-time to non-employed)¹. ‘Not being a caregiver at either time-point’ and ‘part-time to part-time’ were left out as reference categories.

Some argue that a caregivers’ mental health is influenced by the health of the care recipient (McCullagh *et al.* 2005, Eppers *et al.* 2008). The NLS contains some information on other members of the caregivers’ households and whether they suffered from chronic illness. In order to capture caregiver-households with multimorbidity, the models included a variable picking up caregiver households with more than one chronically disabled adult. We also included a binary variable indicating whether the respondent lived with dependent children. The models adjusted for socio-economic deprivation (tenure, having no access to a car), education and marital status. Lastly, the models analysed the contextual effects of the *proximity to services* and levels of income-deprivation of the respondents’ areas of residence. Super-Output Area (SOA) was the cluster variable of the analysis. The contextual effect hypothesized in H5 was tested via cross-level interactions between the three intensities of informal caregiving and *proximity to services*.

Table 1 provides the summary statistics of all variables of the analysis.

[Table 1 here]

¹ The category “not employed” includes the retired and those who were economically inactive for reasons other than unemployment. We chose the broader category over “unemployed” because this study is interested in whether or not caregivers are employed at the two time-points and in the workload of the employment, rather than the stigma of unemployment as such.

Results

In 2011, 15% of NLS members aged 16 years or older were informal caregivers. Of these, 56% provided 1 to 19 hours, 17% provided 20 to 49 hours and 27% provided 50 or more hours of care per week. A high percentage (29%) of caregivers in 2011 had already been caregivers in 2001. The majority (59%) of caregivers were women, 38% were full-time employed, 18% part-time employed and 44% were not employed. The majority of caregivers were located in the middle-age cohorts, 73% were over 40 years old; 25.3% were aged 40 to 49 years; 24% were aged 50 to 59 years; 15% were aged 60 to 69; 7% were aged 70 to 79 and 3% were 80 years or older. In relation to the two response variables, only 7% of the respondents reported having a mental health condition in the 2011 Census but 21% had been prescribed an antidepressant at least once between April 2010 and March 2012.

Looking at bivariate distributions, caregivers with a workload above 19 hours per week were more likely than non-caregivers to report mental ill health and to have been prescribed antidepressants. Additionally, 10% of full-time caregivers, compared to 7% of non-caregivers, reported having a mental health condition. The numbers were considerably higher for antidepressant-prescriptions. A quarter of caregivers providing 20 to 49 hours of care and 29% of those providing 50+ hours had been prescribed antidepressants between 2010 and 2012, compared to 20% of non-caregivers.

Table 2 contains the coefficients and confidence intervals of the multilevel models for the two responses. The first two columns show the uncontrolled model for each response, while the second two columns show the fully controlled model. We hypothesized in *H1* that the more hours per week someone spends providing care, the more likely it is that this person will report mental ill health and be prescribed antidepressants.

[Table 2 here]

Consistent with other literature (O'Reilly *et al.* 2008; Brown & Brown 2014), the coefficients in Table 2 show that a moderate caregiving workload was not linked to mental ill health.

Respondents who provided 1 to 19 hours of care per week were even significantly less likely than non-caregivers to report mental health condition in the 2011-Census. However, caregivers who delivered more than 19 hours of care per week were more likely than non-caregivers to have been prescribed antidepressants. Those who delivered 50 hours of care were also more likely to report a mental health condition. These results partly support *H1*. Being a caregiver per se was not related to mental ill health. However, there was a clear relationship between the intensity of the caregiving role and mental ill health.

The patterns of the relationships were the same across both responses, but were stronger for antidepressants prescriptions. This was expected, as our objective measure of mental ill health was less sensitive to underreporting than questionnaire items. The models adjusted for socio-economic deprivation, gender and age. Older people and those with lower socio-economic status and low education, those who experienced divorce and those living in income-deprived areas were more likely to exhibit mental ill health on both responses. In a second step, we examined differential relationships between informal caregiving and mental ill health by caregiving workload, gender and age. Because the patterns of the relationships did not differ between the two responses, we illustrate the results at the example of the respondent's likelihood of having been prescribed antidepressants.

H2 hypothesized that caregivers who provide more than 19 hours of care per week while being full-time employed are more likely to exhibit mental ill health than those providing fewer hours of care and caregivers who were part-time or not employed. To analyse this, we included the number of hours spent caregiving, employment status and interactions between employment status and each category of caregiving (1-19 hours/week, 20-49 hours/week and 50+hours). Not being a caregiver and not being in employment were the reference categories. The coefficients of the interactions, together with the overall model fit and Wald-tests of each interaction are supplied as supporting material (Supplementary Tables 1 and 2) in an online Appendix. Figure 1 combines visualizations of each interaction we performed. The upper left plot in Figure 1 shows that across all three employment statuses, caregivers with a higher caregiving workload were more likely to experience mental ill health than caregivers who provided fewer hours of care. Among the non-caregivers, individuals who were not employed were the most likely to experience mental ill health. This may be due to the composition of this group as 21% was over 60 years old and a considerable number were unemployed and may have been suffering the known mental health effects of unemployment (Paul & Moser 2009). Contrary to expectations, among high-intensity caregivers, it was not the full-time, but the part-time employed followed by the non-employed, who were the most likely to have been prescribed antidepressants. This was not a gender effect as the model adjusted for gender. *H2* is thus not supported by our findings.

To ascertain how long-term employment and caregiving transitions interact with the caregivers' risk of mental ill health, we fitted a set of interactions over time (Figure 1, upper middle). The second bar-chart in Figure 1 (upper middle) shows that across all employment transitions, respondents who were caregivers in both 2001 and 2011 were the most likely to experience

mental ill health. Interestingly, the full-time employed caregivers and those who transitioned from part-time into full-time employment while also being a caregiver were *less* likely than most other groups to exhibit mental ill health. Those who transitioned into non-employment from 2001 to 2011 were more likely than the employed to require antidepressants, and, among this group, especially those who had also transitioned into a caregiving role. Due to the relatively small sample sizes of sub-groups, confidence intervals were quite large, hence statistical significance has to be interpreted cautiously.

Moving on to gender effects, we included interactions between caregiving workload and gender (Figure 1, upper right). In *H3* we hypothesized that all other things being equal, female caregivers were no more likely than male caregivers to suffer mental ill health. The predicted probabilities in Figure 1 (upper right) suggest evidence to the contrary. Across all intensities of caregiving, women were twice as likely as men to have been prescribed antidepressants. Surprisingly, an overall positive relationship between the intensity of caregiving and mental ill health was found in women and not in men. For women, the relationship was linear, the more hours of care they provided, the more likely they were to have been prescribed antidepressants. For men, the likelihood of being prescribed antidepressants increased only at caregiving workloads of 50+ hours per week and the increase was modest. Moderate intensities of caregiving (1 to 19 hours per week) were associated with a slightly lower likelihood of being prescribed antidepressants for men, although this interaction was not statistically significant. Men who delivered 20 to 49 hours of care per week were no more likely than male non-caregivers to have been prescribed antidepressants between 2010 and 2012. We ran the same

model for subjective mental ill health (Census question) as the response (Table 2) and the gender difference is the same. *H3* is thus not supported by the data.

We hypothesized in *H4* that the risk to informal caregivers of mental ill health increases with age. We argued that this is to be expected because of decreased stress-resilience and increased frailty associated with old age. To test *H4*, we computed ten-year age-cohorts (16-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79 and 80 plus) and then fitted the fully controlled model including interactions between being a fulltime caregiver and each age-cohort. Figure 1 (lower left) shows the differential relationships by age-cohort between full-time caregiving (50 hours+ per week) and antidepressant prescription. Contrary to expectations, it was not the older, but rather, the younger cohorts below 50 that showed strong and statistically significant relationships between full-time caregiving and mental ill health. Within the 20-29-year cohort, full-time caregivers had a 7% higher probability of being prescribed antidepressants than everybody else, and the same holds for the 30-39-year cohort. In the 40 to 49-year cohort the difference was 3%. For older cohorts over 50, the effect size of full-time caregiving was negligible. The confidence intervals show that full-time caregiving did not make a statistically significant difference to older cohort-members' probability of requiring antidepressants. Thus, *H4* is unsupported.

These results may be explained by a closer examination of the younger caregivers. Table 3 contains the percentages of younger and older caregivers with high burden and shows that 58% of caregivers under 50 had at least one child in the household and 11.2% had one or more children while also living with one or more disabled adults in the household. Not surprisingly, these numbers are much smaller for older caregivers. Across the caregiver population, it was the

younger cohorts who faced higher strain and often a double burden, while older caregivers, who have fewer professional and family roles to juggle, did not show a statistically enhanced risk of mental ill health. It is important to note that having children and living in a household with multiple disabled adults did decrease the coefficient sizes of the age and full-time caregiving interactions terms slightly, but did not fully mediate their effect. Thus, there still remains an unexplained age effect (of the younger caregiver cohorts) over and above high caregiver burden.

The last step focused on the context-effect of area-remoteness. Because access to services such as GP practices, dentists and shopping facilities is important for caregivers, we hypothesized in *H5* that informal caregivers who live in remote areas with limited access to services are more likely to suffer mental ill health than non-caregivers in the same area and caregivers living closer to services. To test this, we fitted cross-level interactions between the three categories of (hours spent) caregiving and NISRA's *Proximity to Services* index whereby high values indicate remote areas. Figure 1 (lower right) shows the marginal effects for each category of caregiving across the degrees of area-remoteness, confirming that individuals who provide care for more than 19 hours per week do indeed show a strong increase in their likelihood of mental ill health by area-remoteness. The further away their area of residence was from service providers, the more likely caregivers with a workload above 19 hours were to suffer mental ill health. Caregivers with a lighter workload (1 to 19 hours per week) and non-caregivers did not show a significant change in their likelihood of mental ill health by area-remoteness. Caregivers with a workload of 20+ hours were significantly more likely than non-caregivers to require antidepressant prescriptions and the gap increased with area-remoteness. *H5* is thus confirmed by the analysis.

Discussion

The results confirm some known patterns and contribute to new insights regarding differential relationships between caregiving workload, employment, gender, age and *proximity to services* and the mental health of informal caregivers. The relatively high antidepressant prescription rates of our baseline sample (21% of the population) may come as a surprise to some readers but it is a well-documented phenomenon (Kelly *et al.* 2003, Maguire 2013) and has been attributed to the unique history of the Northern Ireland conflict, which caused and continues to cause distress and mental ill health for a large percentage of the population (Bunting *et al.* 2012, Bunting *et al.* 2013). A second finding of significance is the overall lower number of respondents who reported mental ill health in the Census compared to the high number that were prescribed antidepressants. This may be due to the stigma associated with mental health problems and a resulting reluctance to talk about them. Mental ill health is a sensitive topic and under-reporting in the Census was expected.

To ensure the validity and reliability of the results, it was important for this study to include measures of mental ill health that were not reliant on questionnaire responses. Although the percentages differed across our two measures of mental ill health, the patterns of the relationships with caregiving were consistently the same.

Consistent with the findings of other researchers (Brown & Brown 2014, O'Reilly *et al.* 2015a), this study found that informal caregiving per se was not related to mental ill health. However, females under 50 who provided over 19 hours of care and who were not employed or worked part-time were at a statistically significantly enhanced risk of mental ill health. Furthermore, those who were caregivers in 2001 and in 2011 and those who transitioned into non-employment

or part-time employment while taking up caring responsibilities were significantly more likely than full-time employed caregivers to experience mental ill health. High caregiver workload was clearly related to a higher risk of mental ill health irrespective of gender and age. This is consistent with previous findings from the literature on carer burden (McCullagh *et al.* 2005, Molyneux *et al.* 2008, Ethers *et al.* 2008, Iecovich 2008). However, in the present study, the adverse effect of not having employment on mental health appeared to be stronger than the effect of (moderate to high intensity) caregiving. Contrary to H2, fulltime employed caregivers were *better* off than those who worked part-time or were not employed. The models controlled for age and prior chronic disabilities of the caregiver.

There are a number of plausible explanations for these results. Firstly, people in full-time employment tend to be more financially secure and less likely to be distressed by financial pressures. Many part-time jobs are in the low income sector. The majority of part-time employed caregivers in our sample had lower levels of education, lived in rented rather than owned accommodation and resided in more deprived areas than the fulltime employed. Given that informal caregiving is associated with considerable personal and financial costs (Wolff *et al.* 2006, Heitmueller & Inglis 2007), caregivers who are not in fulltime employment may likely face higher financial strain and be less able to afford external help. All of these factors may well have contributed to the poor mental health among this group in our study. Another important aspect is that full-time employment can be associated with higher social status and self-fulfilment and this, too, may have contributed to the respondents' mental health. Furthermore, full-time employment can sometimes help individuals maintain social contacts while also distracting them from the strain associated of their caregiving role. The literature on employment and caregiver mental health is inconclusive. Rozario *et al.* (2004) found that employment and

having many social contacts was beneficial for the mental health of caregivers. Juratovac and Zauszniewski (2014) acknowledged the importance of social contact but reported that caregivers who worked full-time were more likely to suffer from depression, while Cannuscio *et al.* (2004) found no relationship between full-time employment and the mental health of caregivers.

Our findings regarding gender differences merit further consideration. The models adjusted for the fact that women are generally more likely than men to admit mental health problems. Nevertheless, the analysis found significant gender-differences in the statistical effect of the caregiving workload. Women were more strongly affected by caregiver burden than men. One reason for this may be that in full-time caregiver households, it is mostly women who take on the bulk of the caregiving tasks (Casado-Marín *et al.* 2011, Vlachantoni *et al.* 2013). Even in situations where men and women share caring responsibilities for an older relative, it is often the women who manage the physically and psychologically demanding activities associated with personal care and pain-management, while men help with chores, transportation and the social aspect of caregiving. While this interpretation concurs with other studies (Pinquart & Sörensen 2006, Lee & Tang 2013), it is important to avoid over simplistic generalisations as the NILS does not contain information on the actual caregiving tasks undertaken by respondents. A second explanation why, for male caregivers, an increased caregiving workload is not statistically related to the prescription of antidepressants may be that male caregivers, like men in general, may be reluctant to seek professional help when their mental health deteriorates (Lindinger-Sternart, 2014). It is also possible that male gender-role expectations not to display signs of weakness, may have prevented male caregivers from seeking help (Vogel *et al.* 2014). Again, this interpretation remains speculative, as the NILS does not contain variables on gender-roles.

While there are qualitative studies on female caregivers that concur with our evidence, there is a dearth of research on male caregiving (McDonnell & Ryan 2011). The results of this study suggest that the interrelationships between gender and caregiving, especially the mental health of male caregivers require further investigation.

Regarding our finding of significant age differences in the relationship between caregiving workload and mental ill health, an enhanced burden on younger caregivers due to multiple and competing roles and responsibilities, lack of experience and of resources to develop coping mechanisms are all plausible interpretations. In contrast to older caregivers, younger people often find themselves in a 'sandwich-position' (Buck 2013), struggling with the burden of caring responsibilities for both children and older relatives, while at the same time holding demanding jobs. This was demonstrated in our study which showed that 58% of younger caregivers had one or more children and 11% had one or more children and lived in a household with more than one disabled adult. Our data indicates that it is the younger caregivers (<50 years) who face the highest burden and are therefore at a much higher risk of mental ill health than older caregivers and non-caregivers. In addition, a considerable number of younger caregivers may be struggling with the financial and emotional strains of not having employment. Our findings on employment status showed that particularly caregivers without employment struggled with poor mental health. This situation affects primarily the younger and middle-age groups. Young caregivers also often lack experience and are less likely than older caregivers to have developed strategies to deal with caregiver strain. As a result, they can easily be overburdened by their caregiving role especially if they do not receive the support required to help them in this role. However, a key

result of this study was that *all* caregivers with a caregiving workload higher than 19 hours per week are at a higher risk of mental ill health, if services are not within easy reach.

Limitations

The scope of this paper is constrained by the following limitations. The analysis of transitions in caregiving over time is affected by sample attrition. We cannot rule out that selective mortality of caregivers may have created some bias in our findings regarding caregivers' mental health. However, findings by O'Reilly *et al.* (2015a) of a *negative* link between caregiving and mortality in Northern Ireland suggests that selective mortality of caregivers was unlikely to be an issue in the NILS. Regarding long-term employment and caregiving transitions, the NILS only has data for the two Census years 2001 and 2011. It is possible that some individuals may have experienced transitions between the two time-points that our analysis did not detect. The NILS does not provide information on the health of the care recipient or on their relationship with the caregiver, however, previous studies found these to influence the mental health of caregivers (Etters *et al.* 2008, McDonnell & Ryan 2014). Our data did supply some information on multimorbidity of the household and the analysis adjusted for this. Factors influencing caregiver decision-making such as whether the caregiving role was commenced by choice or in response to external pressures may also impact on the caregivers' mental health. The NILS does not provide information on this, nor on the caregivers' attitudes towards their role. Future studies that allow for these subjective factors may yield important additional insights.

Conclusions

This study provides new insights into the complex relationship between caregiving workload, gender, age and service access, all of which were found to influence the mental health of informal caregivers. The results have important implications for policy makers. They suggest that females under 50 who provide over 19 hours of care and who are not employed or work part-time and long-term caregivers are at a statistically significantly enhanced risk of mental ill health. Caregivers in remote areas with limited access to shops and services were also at a significantly increased risk as evidenced by prescription rates for antidepressants. It is important to recognise and support at risk caregivers so as to enable these individuals to balance their caregiving responsibilities with a fulfilling work-life balance. Future follow-up studies could contribute in important ways by supplying qualitative in-depth insights from the perspectives of caregivers who are members of the at risk groups this study identified. With community care policies aimed at supporting people to remain at home, this paper highlights the need for policies and procedures to ensure that resources are targeted at caregivers with the greatest need. Extra support for caregivers in remote areas may also help counteract the additional mental health disadvantage faced by this particular group.

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Table 1: Frequency Distributions of all Variables used in the Analysis

Binary Variables:	N, Total Sample Obs.	Obs. in category:	Percent
Has been prescribed antidepressants 2010-12	378365	79,794	21.0
Self-reported mental ill health	378365	26,675	7.0
Caregiving: 0 hours, not a caregiver (reference category)	378365	321,972	85.1
Caregiving: 1 to 19 hours per week	378365	31,819	8.4
Caregiving: 20 to 49 hours per week	378365	9,211	2.4
Caregiving: 50plus hours/week	378365	15,363	4.1
Long-term caregiver (2001 and 2011)	336,453	15,828	4.7
Sex: female	378365	197,629	52.2
Homeowner (reference category)	378365	288,958	76.4
Social Housing	378365	44,557	11.8
Private Renter	378365	44,850	11.8
Education: low, no qualification	378365	108,948	28.8
Education: GCSE	378365	44,345	11.7
Education: A-levels (reference category)	378365	135,688	35.9
Education: Degree	378365	89,384	23.6
Fulltime Employed (2011)	378365	147,897	39.0
Part-time Employed (2011)	378365	54,335	14.4
Unemployed (2011)	378365	16,680	4.4
Retired (2011)	378365	73,552	19.4
Other economically inactive (reference category)	378365	85,901	22.8
Has Children	378365	147,818	39.0
No access to a car	378365	59,423	15.7
Multiple (Two or more) disabled adults in the household	378365	46,373	12.2
Married (reference category)	378365	185,622	49.1
Single	378365	132,287	35.0
Widowed	378365	24,746	6.5
Divorced	378365	35,710	9.4
Took part in the 2011 Census	378365	378365	100
Took part in both 2001 and 2011 Censuses:	378365	336,453	89.0

Note: Table 1 shows the frequencies and percentages of all independent and dependent variables of the analysis for the whole sample. For continuous variables, the means and standard deviations are shown.

Table 1 Continued:

Continuous Variables:	N Level-1 Obs.	Mean	Standard. Deviation	Minimum	Maximum
Age		45.74	18.63	16 years	100 plus years
N	378,365 individuals			N (16 years old): 6,583	N (100plus years old): 33
Household-size		2.32	1.06	1 individual	6 individuals
N	378,308 individuals			N (1 person-HH): 72861	N (6 person-HH): 4333
Macro-Level Variables	N Level-2 Obs. (SOA)	Mean	Std. Dev.	Min.	Max.
Proximity to Services / SOA	890 SOAs	3.01	2.07	0.5	11.37
N individuals in SOA				285	516
Income-deprivation/SOA	890 SOAs	0.25	0.15	<5% deprived	90% deprived
N individuals in SOA				5963	392

Note: Table 1 shows the frequencies and percentages of all independent and dependent variables of the analysis for the whole sample. For continuous variables, the means and standard deviations are shown. In parentheses: N (number of observations for some categories of variables).

Table 2: Binary Logistic Multilevel Models

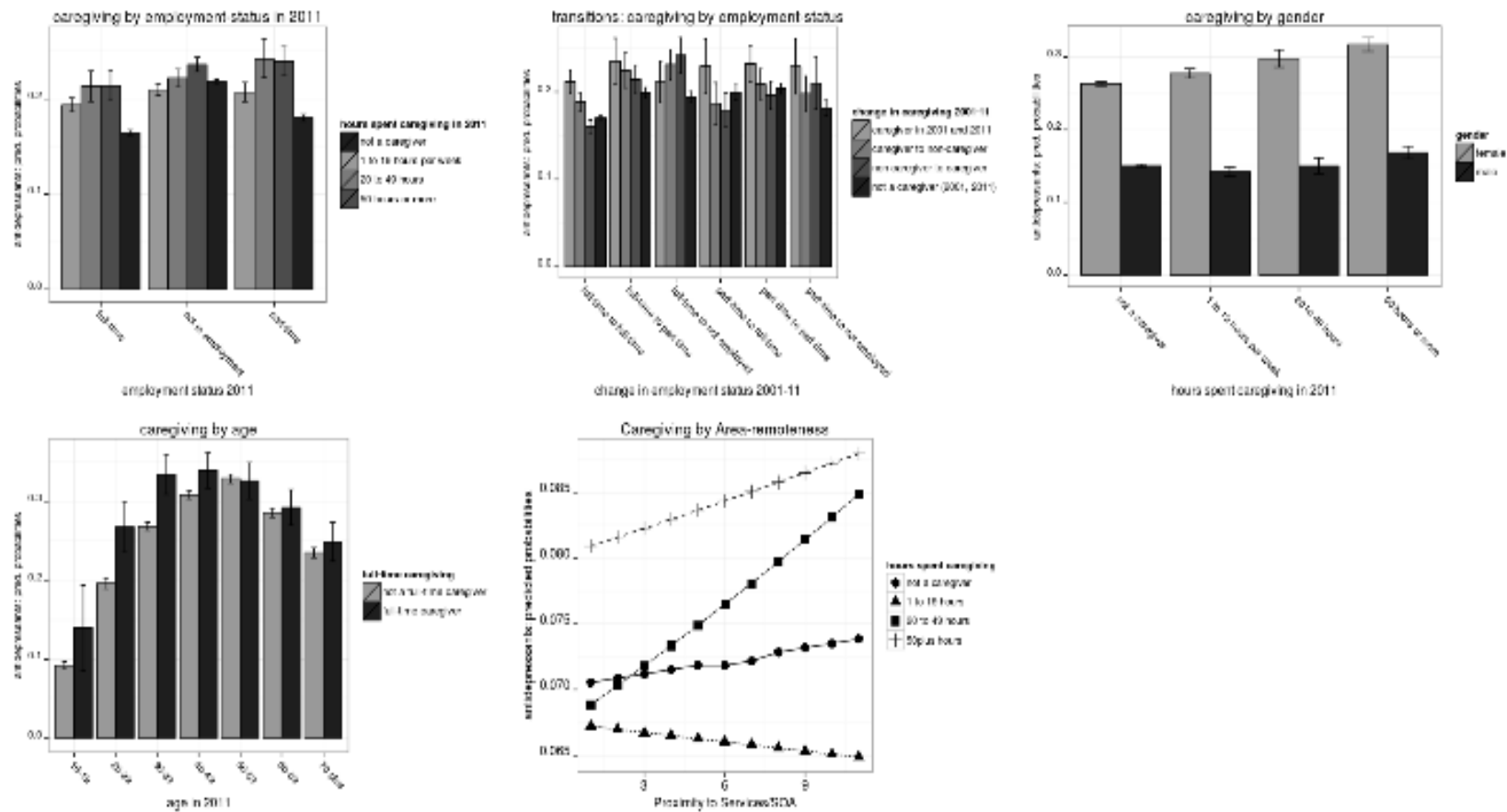
	DV: Self-reported Mental Ill Health		DV: Whether has been prescribed antidepressants	
	Coef.	95% CI	Coef.	95% CI
Caregiving: 1 to 19 hours /week	-0.053*	[-0.105, -0.008]	0.014	[-0.015, 0.043]
Caregiving: 20 to 49 hours/week	-0.034	[-0.114, 0.046]	0.098***	[0.047, 0.014]
Caregiving: 50plus hours/week	0.173***	[0.116, 0.229]	0.207***	[0.169, 0.244]
Household-size	-0.097***	[-0.112, -0.081]	-0.068***	[-0.077, -0.058]
Children	-0.126***	[-0.159, -0.092]	-0.116***	[-0.137, -0.094]
Multiple adults w. disabilities in the HH.	1.425***	[1.389, 1.460]	0.823***	[0.799, 0.846]
Age	0.010***	[0.008, 0.011]	0.014***	[0.013, 0.014]
Sex	0.350***	[0.322, 0.377]	0.743***	[0.725, 0.760]
Social housing	0.702***	[0.666, 0.737]	0.446***	[0.420, 0.471]
Private renter	0.388***	[0.348, 0.427]	0.197***	[0.169, 0.224]
Number of cars in the HH.	-0.347***	[-0.366, -0.327]	-0.154***	[-0.165, -0.142]
Education: low	0.375***	[0.341, 0.408]	0.226***	[0.204, 0.247]
Education: GCSE	-0.185***	[-0.234, -0.136]	-0.104***	[-0.133, -0.074]
Education: Degree	-0.413***	[-0.456, -0.369]	-0.294***	[-0.317, -0.270]
Unemployed	-0.648***	[-0.714, -0.581]	-0.025	[-0.066, 0.016]
Part-time employed	0.492***	[0.262, 0.721]	0.445***	[0.329, 0.560]
Retired	-0.860***	[-0.907, -0.812]	-0.404***	[-0.433, -0.374]
Single	-0.015	[-0.052, 0.222]	-0.249***	[-0.272, -0.225]
Widowed	-0.382***	[-0.440, -0.323]	-0.212***	[-0.247, -0.176]
Divorced	0.652***	[0.612, 0.691]	0.432***	[0.404, 0.459]
Proximity to Services/SOA	-0.010	[-0.021, 0.001]	-0.014***	[-0.019, -0.008]
Income-deprivation / SOA	0.844***	[0.728, 0.959]	0.468***	[0.385, 0.550]
Constant	-3.119***	[-3.207, -3.03]	-2.077***	[-2.137, -2.116]
Level-2 Variance (Sigma u)	-1.863***		-2.106***	
N	375213		377276	
BIC	168867.1		361283.8	

Note: *P<0.05, ** P<0.01, *** P<0.001, All models were run including caregiving alone as a separate step (not displayed here). Reference categories of the binary variables: caregiving - not a caregiver; sex - male; tenure - homeowner; education - low, no qualification; employment status - fulltime employed; marital status - married.

Table 3: Percentages of Caregivers with High Burden

	One or more children in the household		At least one disabled elderly in the household		More than one disabled adult in the household		Two or more disabled adults and at least one child in the household	
	N	%	N	%	N	%	N	%
Older Caregiver (>50)	18,377	11.8	11,379	41.7	8,032	29.4	856	3.1
Younger Caregiver (<50)	129,441	58.0	6,504	22.3	5,129	17.6	3,239	11.2
Overall Caregivers	22,254	39.5	17,883	31.7	13,161	23.3	4095	7.2
Non-caregivers	124,030	38.9	63,007	19.8	33,034	10.4	7,927	2.5

Figure 1: Interactions: predicted probabilities of being prescribed antidepressants by care-giving status, employment status, long-term care-giving, gender, age and area-remoteness.



Supporting Material (Online Appendix):

Supplementary Table 1: Coefficients of Interactions of Caregiving with Employment Status, Gender and Age

<i>DV: self-reported mental ill Health</i>					
Interaction-Term	Coef.	S.E.	Wald-	Wald-P	Deviance
Not a caregiver = ref. cat.	refcat	refcat	refcat	refcat	11905.54***
Caregiving: 1 to 19 hours /week*full-time employed	0.564***	0.066	81.09***	0.000	11905.54***
Caregiving: 1 to 19 hours /week*part-time employed	0.381***	0.078	16.86***	0.000	11905.54***
Caregiving: 1 to 19 hours /week*not in employment	refcat	refcat	refcat	refcat	11905.54***
Caregiving: 20 to 49 hours /week* fulltime employed	0.651***	0.118	73.02***	0.000	11905.54***
Caregiving: 20 to 49 hours /week* part-time employed	0.558***	0.132	40.30***	0.000	11905.54***
Caregiving: 20 to 49 hours /week* not in employment	refcat	refcat	refcat	refcat	11905.54***
Caregiving:50plus hours /week*fulltime employed	0.722***	0.100	101.96***	0.000	11905.54***
Caregiving:50plus hours /week*part-time employed	0.523***	0.107	55.00***	0.000	11905.54***
Caregiving:50plus hours /week* not in employment	refcat	refcat	refcat	refcat	11905.54***
Caregiving: 1 to 19 hours /week*gender	0.081	0.055	2.140	0.143	24.46***
Caregiving: 20 to 49 hours /week*gender	0.255***	0.086	8.78**	0.030	24.46***
Caregiving:50plus hours /week*gender	0.235***	0.061	14.84***	0.001	24.46***
Caregiving:50plus hours /week*aged 16-19	-.274	0.411	0.17	0.068	95.56***
Caregiving:50plus hours /week*aged 20-29	0.212	0.169	0.43	0.51	95.56***
Caregiving:50plus hours /week*aged 30-39	0.144	0.121	0.86	0.35	95.56***

Note: *P<0.05, ** P<0.01, *** P<0.001. All interaction terms were included in the fully controlled main models for both dependent variables, as displayed in Table 2.

Supplementary Table 1 Continued: Coefficients of Interactions of Caregiving with Employment Status, Gender and Age

<i>DV: self-reported mental ill Health</i>					
Interaction-Term	Coef.	S.E.	Wald-	Wald-P	Deviance
Caregiving:50plus hours /week*aged 40-49	0.158	0.116	1.85	0.173	95.56***
Caregiving:50plus hours /week*aged 50-59	-0.350**	0.118	8.82***	0.000	95.56***
Caregiving:50plus hours /week*aged 60-69	-0.256*	0.124	4.26*	0.040	95.56***
Caregiving:50plus hours /week*aged 70-79	refcat	refcat	refcat	refcat	refcat
Caregiving:50plus hours /week*aged 80plus	0.160	0.222	84.9***	0.000	95.56***
Proximity to Services/SOA* Caregiving: 1 to 19 hours	0.0027	0.085	2.96	0.08	78.12
Proximity to Services/SOA* Caregiving: 20 to 49 hours	0.0137***	0.022	36.53***	0.000	78.12
Proximity to Services/SOA* Caregiving: 50plus hours	0.0104***	0.001	41.92***	0.000	78.12
<i>DV: Prescribed Antidepressants</i>					
Interaction-term:	Coef.	S.E.	Wald-	Wald-P	Deviance
Not a caregiver = ref. cat.	refcat	refcat	refcat	refcat	refcat
Caregiving: 1 to 19 hours /week*full-time employed	-0.325***	0.037	88.63***	0.000	6075.76***
Caregiving: 1 to 19 hours /week*part-time employed	0.244***	0.043	25.81***	0.000	6075.76***
Caregiving: 1 to 19 hours /week*not in employment	refcat	refcat	refcat	refcat	6075.76***
Caregiving: 20 to 49 hours /week* fulltime employed	0.353***	0.063	66.08***	0.000	6075.76***
Caregiving: 20 to 49 hours /week* part-time employed	0.369***	0.073	54.26***	0.000	6075.76***
Caregiving: 20 to 49 hours /week* not in employment	refcat	refcat	refcat	refcat	6075.76***

Note: *P<0.05, ** P<0.01, *** P<0.001. All interaction terms were included in the fully controlled main models for both dependent variables, as displayed in Table 2.

Supplementary Table 1 Continued: Coefficients of Interactions of Caregiving with Employment Status, Gender and Age

<i>DV: Prescribed Antidepressants</i>					
Interaction-term:	Coef.	S.E.	Wald-	Wald-P	Deviance
Caregiving:50plus hours /week*fulltime employed	0.257***	0.063	45.58***	0.000	6075.76***
Caregiving:50plus hours /week*part-time employed	0.272***	0.060	40.41***	0.000	6075.76***
Caregiving:50plus hours /week* not in employment	refcat	refcat	refcat	refcat	6075.76***
Caregiving: 1 to 19 hours /week*gender	0.102***	0.033	9.50***	0.002	15.03***
Caregiving: 20 to 49 hours /week*gender	0.123**	0.055	4.97***	0.025	15.03***
Caregiving:50plus hours /week*gender	0.102**	0.040	6.37**	0.01	15.03***
Caregiving:50plus hours /week*aged 16-19	0.540***	0.028	4.80*	0.021	4194.15***
Caregiving:50plus hours /week*aged 20-29	0.337***	0.001	11.06***	0.000	4194.15***
Caregiving:50plus hours /week*aged 30-39	0.347***	0.000	20.66***	0.000	4194.15***
Caregiving:50plus hours /week*aged 40-49	0.094	0.000	11.30*	0.050	4194.15***
Caregiving:50plus hours /week*aged 50-59	0.106	0.071	2.25	0.113	4194.15***
Caregiving:50plus hours /week*aged 60-69	0.032	0.072	0.20	0.65	4194.15***
Caregiving:50plus hours /week*aged 70-79	refcat	refcat	refcat	refcat	4194.15***
Caregiving:50plus hours /week*aged 80plus	- 0.295	0.106	62.27***	0.000	4194.15***
Proximity to Services/SOA* Caregiving: 1 to 19 hours	-0.016*	0.008	1.11	0.029	31.81***
Proximity to Services/SOA* Caregiving: 20 to 49 hours	0.067***	0.015	19.91***	0.0090	31.81***
Proximity to Services/SOA* Caregiving: 50plus hours	0.004***	0.001	12.80***	0.000	31.81***

Note: *P<0.05, ** P<0.01, *** P<0.001. All interaction terms were included in the fully controlled main models for both dependent variables, as displayed in Table 2.

Supplementary Table 2: Interactions of Employment Transitions with Caregiving Transitions 2001-2011

<i>DV: self-reported mental ill Health</i>					
Interaction-Term	Coef.	S.E.	Wald-	Wald-P	Deviance
Full-time to full-time*caregiver in 2001 and 2011	1.493***	0.030	2395.00** *	0.000	3199.91***
Full-time to full-caregiver to non-caregiver (2001-11)	1.400***	0.030	2390.00** *	0.000	3199.91***
Full-time to full-time *non-caregiver to caregiver (2001-11)	-1.053***	0.066	2391.66** *	0.000	3199.91***
Full-time to part-time*caregiver in 2001 and 2011	0.293***	0.060	23.86***	0.000	3199.91***
Full-time to part-time* caregiver to non-caregiver (2001-11)	-.294***	0.060	24.60***	0.000	3199.91***
Full-time to part-time* non-caregiver to caregiver (2001-11)	-0.330***	0.064	26.54***	0.000	3199.91***
Full-time to not employed* caregiver in 2001 and 2011	0.336***	0.049	46.82***	0.000	3199.91***
Full-time to not employed* caregiver to non-caregiver (2001-11)	-0.336***	0.049	46.82***	0.000	3199.91***
Full-time to not employed* non-caregiver to caregiver (2001-11)	0.288***	0.121	5.68**	0.01	3199.91***
Part-time to full-time* caregiver in 2001 and 2011	1.165***	0.069	284.07***	0.000	3199.91***
Part-time to full-time* caregiver to non-caregiver (2001-11)	-1.164***	0.070	280.00***	0.000	3199.91***
Part-time to full-time* non-caregiver to caregiver (2001-11)	-0.772***	0.147	282.47***	0.000	3199.91***
Part-time to part-time* caregiver in 2001 and 2011	0.289***	0.000	21.47***	0.000	3199.91***
Part-time to part-time* caregiver to non-caregiver (2001-11)	-0.289***	0.062	21.47***	0.000	3199.91***
Part-time to part-time* non-caregiver to caregiver (2001-11)	-0.352***	0.067	27.71***	0.000	3199.91***
Part-time to part-time*not a caregiver at either time-point	refcat	refcat	refcat	refcat	refcat
Part-time to not employed* caregiver in 2001 and 2011	0.142***	0.070	4.06*	0.04	3199.91***
Part-time to not employed* caregiver to non-caregiver (2001-11)	-0.142***	0.070	4.06*	0.04	3199.91***
Part-time to not employed* non-caregiver to caregiver (2001-11)	0.123	0.203	0.36	0.546	3199.91***

Note: *P<0.05, ** P<0.01, *** P<0.001. All interaction terms were included into the fully controlled main models for both dependent variables, as displayed in Table 2. Being not employed in both years 2001 and 2011 and not having been a caregiver at either time-point were left out as reference categories.

Supplementary Table 2 Continued: Interactions of Employment Transitions with Caregiving Transitions 2001-2011

<i>DV: Prescribed Antidepressants</i>					
Interaction-Term	Coef.	S.E.	Wald-	Wald-P	Deviance
Full-time to full-time*caregiver in 2001 and 2011	-.591***	0.015	1434.32***	0.000	1542.29***
Full-time to full- caregiver to non-caregiver (2001-11)	-0.590***	0.015	1434.32***	0.000	1542.29***
Full-time to full-time *non-caregiver to caregiver (2001-11)	-0.434***	0.034	1450.60***	0.000	1542.29***
Full-time to part-time*caregiver in 2001 and 2011	-0.149***	0.030	24.63***	0.000	1542.29***
Full-time to part-time* caregiver to non-caregiver (2001-11)	-0.149***	0.030	24.63***	0.000	1542.29***
Full-time to part-time* non-caregiver to caregiver (2001-11)	-0.187***	0.031	38.89***	0.000	1542.29***
Full-time to not employed* caregiver in 2001 and 2011	0.137***	0.027	24.90***	0.000	1542.29***
Full-time to not employed* caregiver to non-caregiver (2001-11)	0.137***	0.027	24.90***	0.000	1542.29***
Full-time to not employed* non-caregiver to caregiver (2001-11)	0.154**	0.068	5.08*	0.020	1542.29***
Part-time to full-time* caregiver in 2001 and 2011	-.373***	0.032	129.41***	0.000	1542.29***
Part-time to full-time* caregiver to non-caregiver (2001-11)	-.373***	0.032	129.41***	0.000	1542.29***
Part-time to full-time* non-caregiver to caregiver (2001-11)	-0.207***	0.074	132.04***	0.000	1542.29***
Part-time to part-time* caregiver in 2001 and 2011	0.193***	0.031	38.58	0.000	1542.29***
Part-time to part-time* caregiver to non-caregiver (2001-11)	-0.193***	0.031	38.58	0.000	1542.29***
Part-time to part-time* non-caregiver to caregiver (2001-11)	-0.215***	0.033	41.74***	0.000	1542.29***
Part-time to part-time*not a caregiver at either time-point	refcat	refcat	refcat	refcat	refcat
Part-time to not employed* caregiver in 2001 and 2011	.0457	0.037	1.50	0.225	1542.29***
Part-time to not employed* caregiver to non-caregiver (2001-11)	.0457	0.037	1.50	0.225	1542.29***
Part-time to not employed* non-caregiver to caregiver (2001-11)	-.0192	0.106	0.03	0.85	1542.29***

Note: *P<0.05, ** P<0.01, *** P<0.001. All interaction terms were included into the fully controlled main models for both dependent variables, as displayed in Table 2. Being not employed in both years 2001 and 2011 and not having been a caregiver at either time-point were left out as reference categories.