Netspar

Network for Studies on Pensions, Aging and Retirement

NETSPAR ACADEMIC SERIES

Is the grass greener on the other side? Comparing the health impact of providing informal care between the UK and the Netherlands

Judith Bom and Jannis Stöckel

DP 07/2020-022

Is the grass greener on the other side? Comparing the health impact of providing informal care between the UK and the Netherlands

Judith Bom[a] and Jannis Stöckel[a]

a Erasmus School of Health Policy & Management, Erasmus University Rotterdam, the Netherlands

July 2020

Abstract

While various studies report the impact of providing informal care on the health of caregivers, it is less clear whether and to what extent this impact differs across countries. Using propensity score matching we match caregivers to similar non-caregiving individuals using four waves of the Dutch Study on Transitions in Employment, Ability and Motivation and the UK Household Longitudinal Study.

We explore whether the health impact of providing informal care differs by country once similar caregivers, in terms of the intensity of provided care, are compared. In both countries we find negative mental health effects of providing informal care. While these effects slightly differ by country, the main differences arise between subgroups of caregivers. Irrespective of large differences in LTC systems, individuals that provide more than 20 hours of informal care per week experience the most severe negative mental health effects.

1. Introduction

Facing rapidly ageing populations, many Western countries search for ways to meet the growing long-term care (LTC) demand. Informal care, care provided by friends and family members, is one of the ways in which this demand can be (partially) met while limiting direct monetary costs. Reliance on informal care, however, is not without disadvantages. Next to its potential impact on caregivers' labor market participation, various studies indicate that the provision of informal care negatively affects informal caregivers' health (see Pinquart & Sorensen, 2003 and Bom et al., 2019a for reviews). These health effects are not the same for all caregivers. Individual and contextual elements like age, the intensity of care provided and health of the care recipient may affect the care burden (e.g. Pearlin et al. 1990, Pinquart & Sorensen, 2011). At the same time, country-level factors like generosity of the welfare state and cultural norms might also influence the impact of caregiving as they shape the societal environment in which informal care is provided (Brandt, 2013).

The country specific context can affect the health impact of providing informal care in various ways. First, country specific elements could influence the type and intensity of provided care (Brandt, 2013). The *specialization theory* hypothesizes that in countries with a generous welfare state, division of labor between formal and informal caregivers is higher (Motel-Klingebiel, Römer & Von Kondratowitz, 2005; Igel et al. 2009). While formal LTC professionals provide intensive, highly skilled care services, informal caregivers can dedicate themselves to fulfilling lower intensity care activities. In less generous welfare states, on the contrary, family members are required to provide even the most intensive care themselves. Accordingly, this implies that the generosity of LTC schemes directly shapes the population of informal caregivers, both regarding the care intensity as well as who provides care in the light of other obligations, such as childcare or economic activity. And indeed, there is evidence for the LTC-system generosity directly influencing the population characteristics of informal caregivers (Bakx et al., 2015). Differences in the composition of the caregiver population could lead to differences in the average and aggregate health impact of relying on informal caregivers as highly intensive and specialized care tasks are often more stressful for the care provider (Pearlin et al., 1990).

A second way in which the country context might affect the relationship between informal care and caregivers' health points towards social norms and expectations about the role of the family in meeting care demand. In countries where caregiving is considered a duty of family-members, informal caregivers might feel more pressured to provide care (Verbakel, 2014). This role-captivity, the feeling of being obliged to provide care, might largely influence the impact of care tasks on well-being (Pearlin et al., 1990). Furthermore, available support options could moderate the relationship between care provision and one's own health as well. The most common types of support in the European Union are financial aid, respite care and coaching (Courtin et al., 2014). Despite a common core with

regards to the breadth of support policies implemented, countries differ considerably in the depth and efforts to identify or inform caregivers in need of support.

Up to now, several studies investigated whether the health difference between informal caregivers and non-caregivers differs across countries. One of the common pitfalls in this area of research however relates to the inability to estimate causal effects as researchers mostly had to rely on cross-sectional data. As such, they are unable to rule out differential selection into care provision across countries and hence cannot unravel whether caregiving leads to health problems or whether care provision and health are simply correlated for example because individuals in worse health more often provide informal care.

A small number of recent studies however tried to provide a cross-country perspective on the causal effect of informal care on caregivers' health outcomes with differing conclusions. Brenna & Di Novi (2016) estimated the effect of maternal informal care on caregiving daughters' health using propensity score matching methods to address endogeneity concerns and using the European SHARE panel dataset. Their results indicate a clear North-South-gradient in the mental health effects of caregiving with negative effects only occurring within the context of Southern-European countries where LTC schemes provide little public support. Subsequently, Kaschowitz & Brandt (2017) use the same dataset in combination with comparable panel data from the UK to estimate a set of fixed-effects models. Contrary to Brenna & Di Novi (2016) their results indicate that caregiving negatively affects mental health across most European countries, irrespective of the specific policy context. Instead, the specific care context, indicating whether care is provided inside or outside the household, and the likely associated differences in care intensity seem to be the main determinant of the size of the observed differences. However, as the informal care intensity is not captured in the SHARE dataset, Kaschowitz & Brandt (2017) cannot test this hypothesis directly. Most recently Van den Broek & Grundy (2018) study the difference between caregiving effects in Sweden and Denmark by using a difference-in-differences model to explore the impact of a policy-change that reduced formal LTC availability in Denmark. Using the respective SHARE country samples, their results indicate that the reduced LTC availability led to lower quality of life among Danish caregivers. Hence, they conclude that LTC coverage directly shapes the impact of caregiving on caregivers' mental health, however again unavailable information on care intensity obstructs a more nuanced analysis that would allow policymakers to identify those groups of caregivers most vulnerable of insufficient LTC coverage.

As becomes clear from the existing literature there are various open questions about the extent to which caregiving effects differ across countries and why. We add to this existing literature in three ways. First, we extend the evidence by combining two different independent panel datasets from the Netherlands and the UK that are not part of the SHARE-family of datasets. Second, the availability of

detailed information on the caregiving context allows us to explore whether caregiving effects differ by country once compared at similar levels of intensity while also exploring the differential impact on caregivers mental and physical health. Lastly, we explicitly focus on starting informal caregivers. This allows us to measure the causal impact of becoming an informal caregiver on individuals' health without the potential bias that results from jointly analyzing long-term and new caregivers. We therefore contribute to the ongoing debate on the cross-country differences in caregiving effects by disentangling these effects at the intensive and extensive margin, an important distinction for LTC policymakers.

We find that not differences in the country context, but mainly differences in the caregiving context drive differences in the experienced health effects of care provision. In both countries, individuals that provide more than 20 hours of informal care per week experience the largest negative mental health effects. Additionally, we observe positive effects of care provision on physical health for low intensity caregivers without full-time employment in both countries.

2. Background

To study the difference in caregiving effects between the Netherlands and the UK it is important to understand in what ways both countries differ with respect to their LTC systems. Table 1 provides an overview of some key characteristics of the two LTC systems. Both countries are relatively similar in terms of the share of (dependent) elderly within the population, with slightly more elderly in the Netherlands. The two countries, however, differ strongly in terms of LTC expenditures. Among OECD members, the Netherlands has a top position in public spending on LTC; in 2017 governmental spending on health and social components of LTC amounted to 3.7% of the GDP. In the UK 1.4% of GDP was spent by the government on LTC (OECD, 2020a).

Generosity of LTC systems

The difference in governmental LTC spending between both countries reflects the generosity of their LTC systems. The Netherlands has a universal and comprehensive LTC system, irrespective of age or income, everyone in need of care is entitled to the benefits of this scheme (Mot, 2010). The system is largely publicly funded, copayments solely entail a small part of the total financing (Maarse & Jeurissen, 2016). These copayments for LTC depend on type and duration of care, age, household composition, income and (as of 2013) wealth. The payments are capped and can never exceed the costs of care nor the household income (Bakx et al., 2020).

Formal LTC in the UK is organized in a mixed-system, referring to a combination of universal and means-tested benefits and programs. Health services provided by the National Health Service (NHS) are free at the point of delivery. Health related components of LTC, such as nursing care for elderly, are funded via the NHS (Colombo et al., 2011). Other types of LTC, such as home care, day care and nursing home care are the responsibility of local authorities (Glendinning, 2013). This care is offered

via a safety-net structure, meaning that users are required to deplete their wealth before becoming eligible for publicly funded care (Colombo et al., 2011). The height of one's income and assets define whether a service is (partly) covered (NHS, 2018a). Under the current regime, only individuals with assets below GBP 14,250 (approximately €16,886) will have their costs completely covered (NHS, 2018b).

Role of informal carers in the system and available support

In both countries, many individuals provide informal care: about 17-18% of the 50+ population identified him/herself as an informal caregiver (OECD, 2019 – based on SHARE and ELSA surveys). Among informal caregivers, the average time spent caring however strongly differs by country. According to the European Social Survey of 2014, 17% of the UK caregivers provides more than 20 hours of care per week compared to 8% of the informal caregivers in the Netherlands. This higher number of intensive informal caregivers in the UK seems to reflect the country's strong reliance on informal caregivers, which can be a result of only publicly funding non-health related formal LTC in case of low income/wealth and primarily directing formal care at people who do not receive informal care (Comas-Herrera et al., 2010). Both countries offer a wide range of support to informal care providers and are among the few countries that have a national policy that is targeted at informal caregivers. Furthermore, both countries offer (under different regulations) financial support, respite care, training and counseling for caregivers (Courtin et al., 2014).

Hypotheses concerning the impact of informal care

Facing a different context, we formulate the following hypotheses regarding the differences in caregiving effects between the Netherlands and the UK: (i) As the Netherlands offers more comprehensive and generous formal LTC compared to the UK, we expect caregivers in the Netherlands to 'specialize' and provide more low intensity care which might have a lower impact on their health. (ii) Additionally, norms and caregiving support might affect the relation between informal care provision and health. Whereas both countries offer a relatively comparable level of support for caregivers, norms potentially differ. Responses to the Eurobarometer (2007) for example indicate that UK citizens more often consider elderly care the responsibility of the family. Also more recent studies indicate different norms between the UK and the Netherlands. In 2016, 9% of the UK population believes that care to older individuals should be primarily provided by family, relatives and friends (British Social Attitudes Survey, 2016), while only 4% of Dutch respondents indicated that care for a dependent parent was predominantly a task for the family (SCP, 2016).[1] These different attitudes

[1] Please note: The two surveys do not use identical questions. In the UK survey, individuals were asked the indicate who, according to their beliefs, should primarily provide care for elderly and received several answer options (e.g. family, government, non-profit organizations). The Dutch survey specifically asked about care for a dependent parent and only allowed individuals to choose whether this care was predominantly/more a task of government/family.

might make caregivers in the UK feel more pressured towards providing care. Therefore, we expect a larger caregiving burden among UK caregivers compared to similar Dutch caregivers.

Table 1: Key figures regarding the LTC systems in the Netherlands and the UK

	Netherlands	**United Kingdom**
Share of population aged 65+[1]	18.7%	18.1%
Share of 65+ reporting some/severe limitations in daily activities[2]	47.9%	44.9%
Long-term care expenditures (health and social components) governmental and compulsory schemes (% GDP)[3]	3.7%	1.4%
Beds in LTC facilities per 1000 65+ inhabitants[4]	74.8	45.6
% informal caregivers among 50+ population[5]	16.8%	18.2%
% of caregivers providing at least 20 hours of care per week[6]	8%	17%
Care services available to informal caregivers[7]	Carers allowance, Allowance for the person being cared for, additional benefits, paid leave, unpaid leave, flexible work arrangements, training/education, respite care, counseling	Carers allowance, Allowance for the person being cared for, additional benefits, unpaid leave (for couple days under emergency situations), flexible work arrangements, training/education, respite care, counseling

Data concerning 2017 from 1. OECD (2020b); 2. OECD (2019); 3. OECD (2020a) and 4. OECD (2020c). 5. Data for 2017 from SHARE/ELSA from OECD (2019), UK in this case refers to England. 6. European Social Survey (2014). 7.Data from Colombo et al. (2011) for 2010.

3. Methods

It is not possible to study the causal impact of informal care provision on health by simply comparing the health of caregivers and non-caregivers as certain individuals, for example those with lower initial health, might be the ones to provide informal care. To make informal caregivers comparable to their non-caregiving counterparts we make use of propensity score matching. Following the approach of Schmitz & Westphal (2015) we construct a score of someone's propensity of providing informal care. This propensity score of informal caregiving is based on various elements that might affect the caregiving decision. Examples of such elements are someone's own health status, the presence of other family members potentially in need of care or able to provide informal care and other obligations like income, employment and having children living at home. By matching caregivers and non-caregivers based on their propensity of providing informal care we assume that the difference in health still left between both groups is due to caregiving. Or phrased differently, in absence of informal care provision the health of caregivers and (matched) non-caregivers would be similar and differences are causally attributable to the provision of informal care. To make this conditional-independence

assumption more credible, we follow Lechner (2009) and match upon control variables reported in the year before caregiving starts as the previous caregiving status captures most unobserved heterogeneity and to ensure that informal caregiving cannot affect the covariates.
The propensity scores are calculated using probit models that estimate the propensity of starting informal care provision in the second wave conditional upon all variables affecting the care decision in the first wave (living parents, employment, own health etc.). We separately estimate these propensity scores for the Dutch and UK sample using the same approach and covariates.

After estimating the propensity scores, we match starting caregivers to non-caregivers using a kernel matching approach. We make use of the Stata command psmatch2 (Leuven & Sianesi, 2003) using an Epanechnikov kernel with a bandwidth of 0.03. Using alternative specifications with higher and lower bandwidth values (0.01 and 0.06) led to highly similar results (results available upon request). We regress informal care provision on health while adding all covariates from the pre-treatment wave. This approach of adding the covariates to the regression next to matching based on the same covariates is often referred to as double-robustness. This corrects for remaining differences in covariates distributions between the two groups (Lechner, 2009; Rubin, 1979). With this analysis we estimate the average treatment effect on the treated (ATT). The ATT represents the mean difference in health between the group of informal caregivers (the treated) and the non-caregiving individuals that are comparable to them.

We assess whether our matching strategy achieved its goal of balancing covariates using the standardized bias (Rosenbaum & Rubin, 1985). The standardized bias can be calculated for each covariate in the model by taking the difference in means between the treatment and control group and dividing it by the standard deviation of the control group.

4. Data

We use two similar datasets providing representative samples of the Dutch and UK population. The *Study on Transitions in Employment, Ability and Motivation* (STREAM) panel survey was carried out in the Netherlands. The dataset includes the first four waves of data annually collected from 2010 to 2013 among the Dutch population aged 45-64 years. This sample is drawn from an existing internet panel (Ybema et al., 2014). To capture the impact of providing informal care among UK caregivers, we use the first four waves of the United Kingdom Household Longitudinal Survey, commonly known as Understanding Society (USoc ; University of Essex, 2019). This dataset is annually conducted among the 16+ population starting in 2009. The survey started as the successor of the British Household Panel Survey (BHPS), in 2010, members of the last BHPS-wave were invited to join the USoc.

Informal care definition

In both surveys, respondents were asked whether they provided any informal care, we use this information to construct a binary variable indicating whether an individual provides informal care. In the Dutch survey informal caregivers are identified in case they positively answered to the following question and answer option: *'Did you in the past 12 months spend part of your time on any of the following activities?'* answer option: *'Providing informal care'*. In the UK sample individuals are identified as caregivers in case they affirmatively answered to at least one of the following two questions: '*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.)?'* or *'Do you provide regular service or help for any sick, disabled or elderly person not living with you? [Exclude help provided in course of employment]'*.

Both studies furthermore ask for care intensity, the average number of hours someone provides informal care per week. For both samples we construct dummy variables indicating low intensity (less than 10 hours of care per week), medium intensity (between 10 – 20 hours of care per week) and high intensity caregivers (more than 20 hours of care per week).

Health outcomes

To capture the health effect of providing informal care we make use of the 12-item Short Form Health Surveys (SF-12). Both studies ask individuals to answer this health survey, which consists of 12 self-reported questions related to health in the past four weeks. Based on these questions the Physical Component Summary (PCS) and the Mental Component Summary (MCS) can be derived, relating to physical and mental health. The PCS is composed of subscales assessing the physical functioning, role limitations because of physical functioning, bodily pain and general health. The MCS comprises the subscales vitality, social functioning, role limitations due to emotional problems and mental health. Both scales are validated and range from 0 (lowest health) to 100 (optimal health). The scales are transformed to have a mean of 50 and a standard deviation of 10 (Ware, Kosinski, & Keller, 1995).

Other covariates

We estimate the individual's propensity of providing informal care based on a broad set of variables that might affect someone's caregiving decision. Variables related to the health and demographics of the respondent are present in both datasets and in most cases easily comparable as (a) the same question-set is used (e.g. the MCS and PCS) or (b) because the asked questions are straightforward and highly similar in both countries (e.g. age or employment status of respondent). We however want to match on a broad set of variables that also contains information about the family structure of the respondent like whether the respondent has any siblings or young children. This information is available in the USoc but not in STREAM. We therefore enrich the Dutch survey dataset with information from administrative sources covering information on: personal and household income from the tax authority and information about the family structure from the municipal register.

For the variables related to family structure we argue that the differences between the self-reported versus administrative data are minimal. Comparing self-reported and tax-registered income we however have to be careful as self-reported income might suffer from reporting bias. However, we use the variables to predict informal care provision separately for both countries, hence no direct comparison between both values is needed. For our analysis we assume that any reporting bias in the income variable is stable throughout the income distribution. An overview of all used variables, their definition and origin is available in Online Appendix 1.

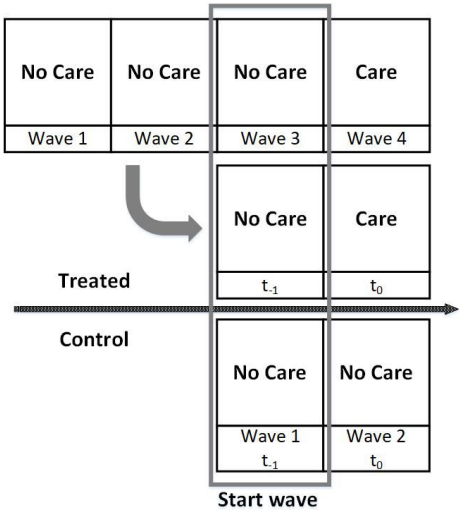
Sample selection

In order to make both datasets comparable we restrict the samples as follows: (i) We solely include respondents aged 45-65 in the first wave; (ii) we use information from the first four waves of the surveys ranging from 2009/2010 – 2013/2014; (iii) we condition the datasets on availability of all needed control variables in the first wave and all needed outcome variables in the first and second wave; (iv) we exclude all individuals that already provided informal care in the first wave as we only look at starting caregivers. Eventually the samples consist of 8,141 Dutch and 7,187 UK respondents.

Time structure

For both datasets we define a relative time variable (t) whose value depends on an individual's first reported care-episode (see figure 1 for a graphical representation). Within the control group t_{-1} is normalized to the individuals first appearance in the survey as these respondents do not report any care episode during their participation. Among caregivers t_{-1} is defined as the period before the first reported caregiving episode. For example, an individual entering the panel in 2010 and responding to the survey for four consecutive waves but only starting to provide informal care in wave 4 is included for two periods, t_{-1} (wave 3) to t_0 (wave 4). This time structure is chosen to maximize the number of informal caregivers that we can observe.

Figure 1: Visualization of the constructed time structure of the sample



5. Results

Descriptives & matching results

Table 2 provides an overview of the composition of caregivers in both datasets. As explained above, these samples are constructed to maximize the number of starting caregivers and hence contain all individuals who started care provision in 2011-2013. There are slightly more starting caregivers in the UK where about 23.8% of the sample starts care provision compared to 21.1% of the Dutch sample. The share of female caregivers is higher in the UK (58.5%) than in the Netherlands (50.6%) and a larger share of the caregivers in the UK provides medium or high intensity care compared to the Dutch sample. About half of the caregivers in both countries have a full-time job next to their caregiving duties.

Table 2: Descriptive statistics of both samples

	Dutch Sample		**UK Sample**	
Starting caregiver (% of sample)	1711	(21.1%)	1713	(23.8%)
Female caregivers (% of caregivers)	865	(50.6%)	1019	(58.5%)
Low Intensity caregivers (% of caregivers)	1378	(80.5%)	1302	(76.0%)
Medium Intensity caregivers (% of caregivers)	181	(10.6%)	205	(12.0%)
High Intensity caregivers (% of caregivers)	135	(7.9%)	177	(10.3%)
Caregiver is also full-time employed (% of caregivers)	856	(50.0%)	844	(49.3%)
Total number of included individuals (caregivers and matched controls)	8129		7186	

In order to match caregivers and non-caregivers we estimate propensity scores of providing informal care. Table 3 provides a detailed overview of the propensity score estimations for the Dutch and UK sample. In both countries, especially the variables related to care obligations are strongly correlated to someone's propensity of providing informal care. As spouses often tend to provide care to each other, presence of both parents diminishes the propensity of providing informal care for the adult child. The age of these parents, which most probably acts as a proxy for the rate of dependency of the individual, increases the propensity of informal care. In both countries, furthermore, females and more highly educated individuals are more likely to provide care whereas the presence of young children is negatively related to informal care provision.

In both the Netherlands and the UK informal caregivers differ from non-caregivers. As can be seen in tables A1 and A2 in the Appendix there is a strong initial imbalance between the individuals that started to provide care and those who did not do so which highlights the need for matching. Figure 2 graphically depicts the initial imbalance in covariates between the treatment and control group and shows that the propensity score estimation succeeds in correcting this imbalance. For all analyses we exclude respondents that were identified as off support, this equals to 1 in the UK and 12 in the Dutch sample.

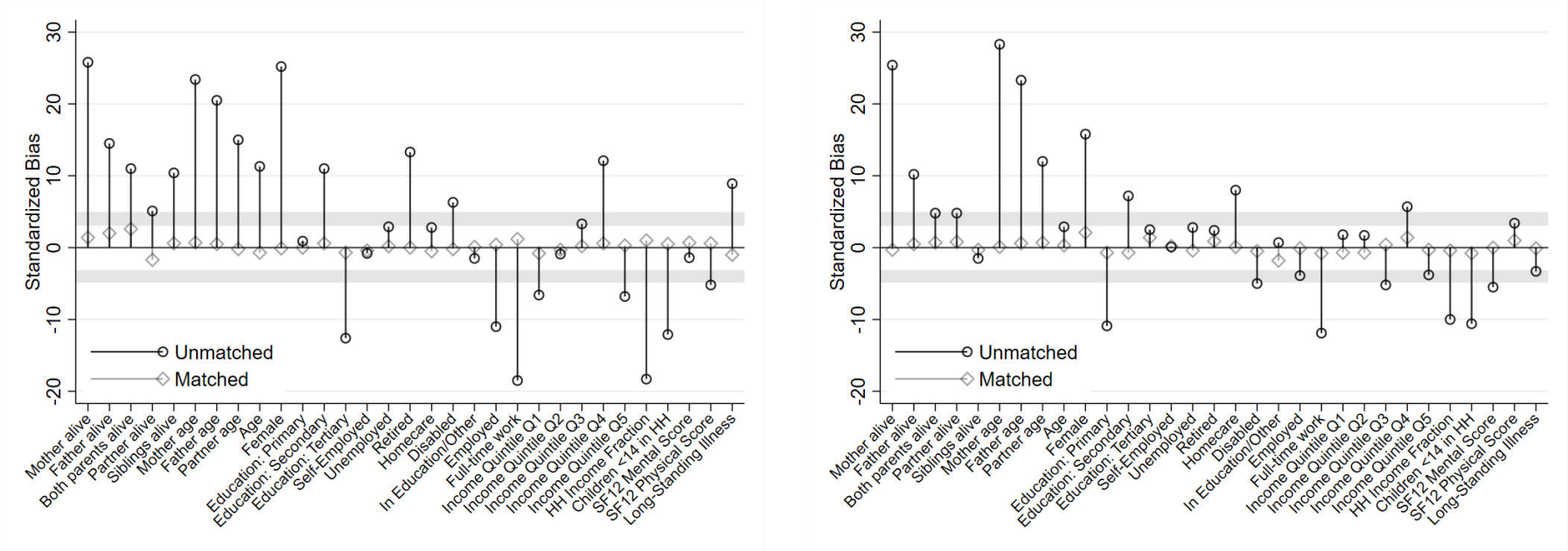
Table 3: Propensity score estimates

	Dutch sample		UK sample	
	Coefficient	Standard Error	Coefficient	Standard Error
Care Obligations				
Mother alive	0.425***	(0.044)	0.451***	(0.047)
Father alive	0.429***	(0.069)	0.428***	(0.071)
Both parents alive	-0.259**	(0.084)	-0.459***	(0.085)
Living partner	0.103*	(0.042)	0.063	(0.043)
Living siblings	-0.003	(0.051)	-0.061	(0.056)
Age of mother	0.023***	(0.005)	0.026***	(0.005)
Age of father	0.022***	(0.006)	0.023***	(0.006)
Age of partner	0.000	(0.004)	0.008*	(0.003)
Willingness to Care				
Age	0.014**	(0.005)	-0.003	(0.005)
Female	0.309***	(0.043)	0.113**	(0.039)
Secondary Education (*Ref. Primary education*)	0.154***	(0.041)	0.156***	(0.044)
Tertiary Education	0.232***	(0.045)	0.098*	(0.048)
Self-employed *(Ref. Employed)*	-0.138	(0.064)	0.036	(0.057)
Unemployed	0.118	(0.104)	0.064	(0.087)
Retired	0.396***	(0.094)	-0.016	(0.065)
Homecarer	0.109	(0.153)	0.124	(0.093)
Disabled	0.121	(0.084)	-0.167	(0.093)
Studying or other activities	-0.273	(0.437)	0.003	(0.260)
Working Full-Time	-0.071	(0.047)	-0.167**	(0.049)
Income quintile 2 (Ref. Income quintile 1)	-0.007	(0.050)	0.066	(0.053)
Income quintile3	-0.038	(0.052)	0.066	(0.055)
Income quintile 4	0.054	(0.054)	-0.051	(0.059)
Income quintile 5	0.158**	(0.057)	0.072	(0.060)
HH Income Fraction	-0.066	(0.084)	-0.034	(0.070)
Children<14 in household	-0.097	(0.057)	-0.146**	(0.052)
Ability to Care				
SF12 - Mental Score	-0.001	(0.002)	-0.006**	(0.002)
SF12 - Physical Score	0.001	(0.002)	0.000	(0.002)
Longstanding illness	0.107**	(0.038)	-0.033	(0.040)
Observations	**8141**		**7187**	
Pseudo R^2	0.06		0.05	

Figure 2: Standardized bias before and after matching.

(a) Dutch sample

(b) UK sample



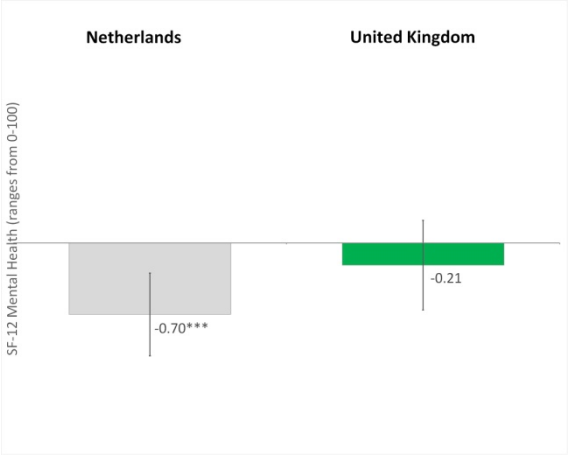
Note: The grey lines mark the standardized bias range of 3-5%, following the rule of thumb suggested by Caliendo & Kopeinig (2008) we consider balance to be sufficient when the bias is below 3-5%.

Main results

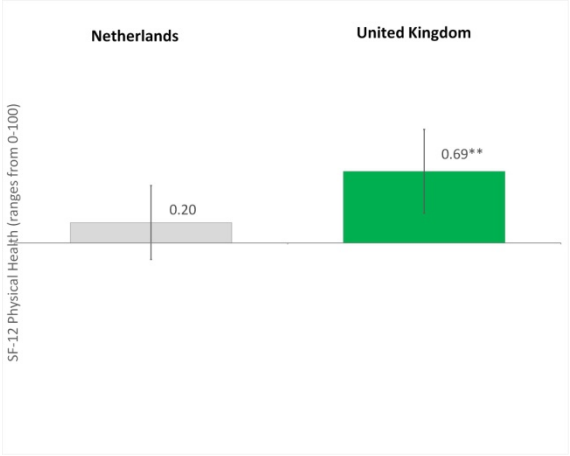
Our baseline analysis estimates the impact of any informal care provision, irrespective of the hours of care provided, on health. Throughout the main text we will only present our results graphically, results tables can be found in Appendix A3 to A5. Figure 3 presents the impact of any care provision on (a) mental and (b) physical health for both countries. The bar presents the ATT, the confidence intervals are depicted at 95%. Dutch caregivers experience a direct negative mental health effect of -0.69 ($p<0.001$), whereas the negative impact of care provision in the UK is considerably smaller and insignificant. For physical health, on the contrary, informal care provision has a positive effect of 0.66 ($p<0.01$) in the UK, whereas no significant impact is present among the Dutch caregivers.

Figure 3: Impact of any informal caregiving on mental/physical health

(a) Mental health



(b) Physical health

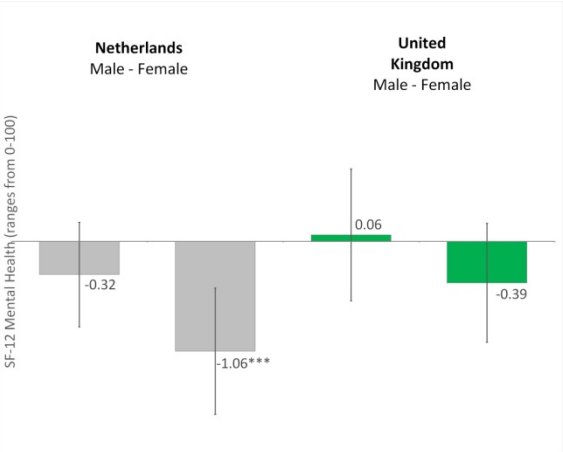


*Confidence intervals at 95%, *p<0.05, ** p<0.01 *** p<0.001*

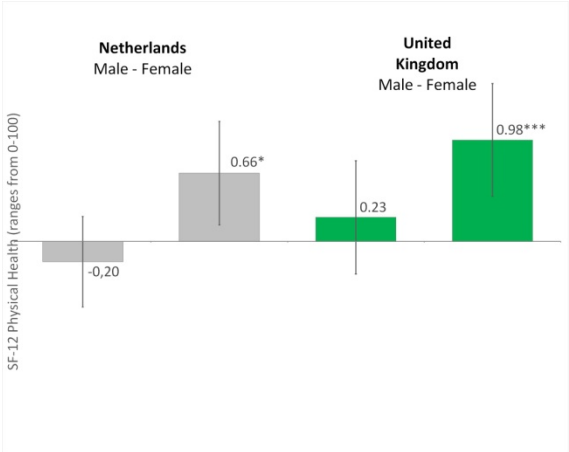
As some studies indicate potential differences in the caregiving effect between males and females, we separately estimate the caregiving effect for both genders. When stratifying Dutch caregivers by gender we find a negative mental health effect of -1.06 ($p<0.001$) for females and no significant impact on males. In the UK, the mental health impact of care provision is larger for females than for males although both estimates are insignificant at a 95% level. Turning to physical health, we observe a different pattern. In both countries any informal care provision has a positive effect on the physical health of female caregivers. For male caregivers no effects are found in the physical health domain in either of the two countries.

Figure 4: Impact of any informal care on mental/physical health by gender

(a) Mental health



(b) Physical health



*Confidence intervals at 95%, *p<0.05, ** p<0.01 *** p<0.001*

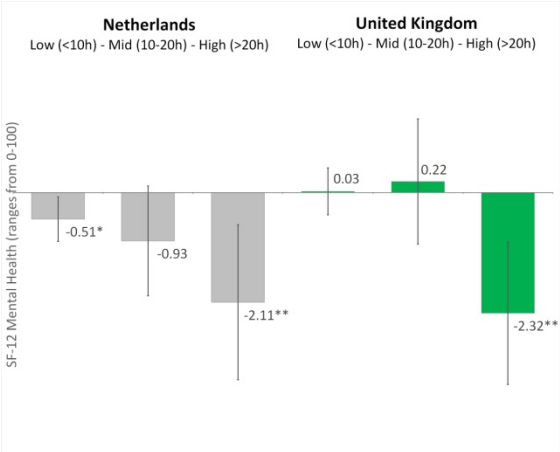
By comparing the health impact of any care provision between both countries we ignore underlying differences in the composition of the caregiver population. This composition might however especially differ per country, for example as a result of differences in the LTC system. As presented in Table 2, there are for example slightly more medium and high intensity caregivers in the UK. To compare similar caregivers across the two countries we construct three groups based on the hours of care provided.

In Figure 5 we present the treatment effects when separately estimated for low, medium and high intensity caregivers. The figure clearly depicts that the impact of care provision strongly differs by the amount of care provided. In both countries, high intensity caregivers experience the largest mental health effects. This health impact of providing more than 20 hours of informal care per week is very similar in both countries with an impact of -2.11 ($p<0.01$) on the MCS in the Netherlands compared to -2.32 ($p<0.01$) in the UK. The pattern of the impact of informal care provision by care intensity however slightly differs between the two countries. In the Netherlands, a clear dose-response relationship is visible; all caregivers experience negative mental health effects that grow in response to care intensity. In the UK, low and medium intensity care providers are not affected, only high intensity caregivers experience a strong decline in their mental health.

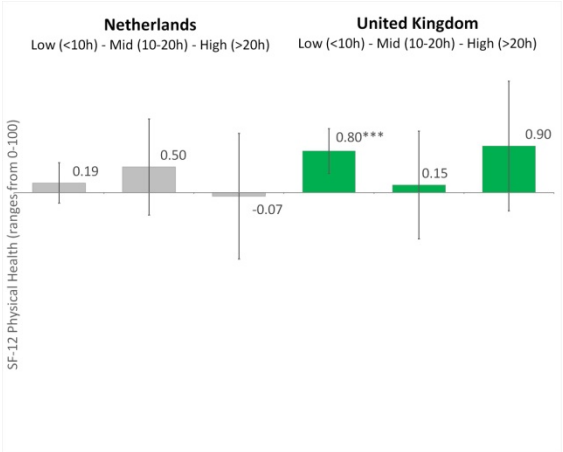
The intensity-patterns also differ when focusing on physical health. In the Netherlands, no health effects are present when separating the sample by care intensity. In the UK, an initial positive physical health effect is present for low intensity caregivers and absent for medium intensity caregivers. For individuals providing more than 20 hours of care per week the estimates seem to point again to a positive effect although the results are insignificant.

Figure 5: Impact of informal caregiving on mental/physical health by care intensity

(a) Mental health



(b) Physical health



*Confidence intervals at 95%, *p<0.05, ** p<0.01 *** p<0.001*

Next to the intensity of care provided, other contextual elements could influence the care burden. Individuals might for example experience caregiving strain when providing informal care in combination to full-time employment. Using German data, Schmitz & Stroka (2013) for example found that individuals experiencing such a double burden of care and work were more likely to use antidepressant drugs and tranquillizers. Again, country differences in terms of available alternatives and norms and support could make this situation more prevalent or straining.

To estimate the impact of care provision for individuals experiencing a double burden we compare the health impact of care provision between individuals with a full-time job to those not working full-time. We solely focus on individuals with stable workforce participation to exclude individuals that overcome the double burden of care and work by cutting down on working hours. In our samples this relates to excluding 7% (Netherlands) to 10% (UK) of our sample as these individuals experience changes in their work participation (from full-time to no work/part-time and vice versa). Starting informal caregivers seem slightly more likely to adjust their work participation than the control group of non-caregivers. In the UK, 10.7% of the starting caregivers change work participation compared to 9.6% in the control group. In the Netherlands these numbers equal 7.6% among caregivers and 6.8% among non-caregivers. Additionally, due to sample size limitations we solely compare employment status by individuals providing either low or medium to high intensity care provision (>10h of care per week).

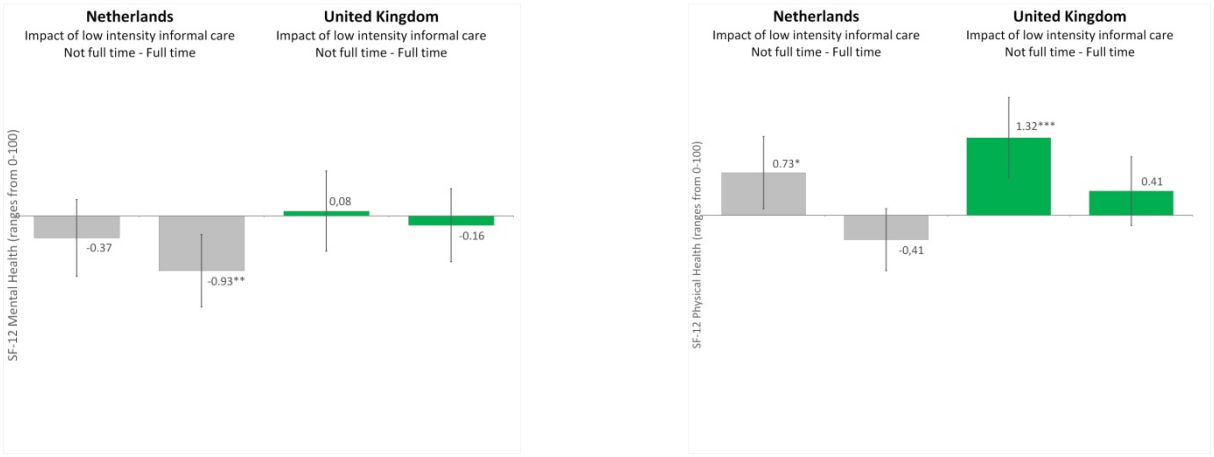
Figure 6 shows that the experienced mental health effect of providing low intensity informal care slightly differs by employment status. In the Netherlands, the estimates of the caregiving effect point in the negative direction for all low intensity caregivers. The impact is however larger and significant (-0.93, $p<0.01$) among full-time workers. In the UK no mental health effects are present for either of the two groups. With regards to physical health effects we observe larger differences between full-time

working individuals and those who work less hours or without formal employment. In both countries, the latter group experiences a positive physical health effect of caregiving of respectively 0.73 ($p<0.05$) and 1.32 ($p<0.001$). This effect on physical health is absent or even negative among full-time working individuals.

A double burden might especially be present for individuals who next to a full-time job provide many hours of informal care. Figure 7 shows that in both countries indeed the mental health effect of providing more than 10 hours of informal care per week is larger for individuals working full-time. Interestingly the mental health effect of medium or high-intensity care even becomes insignificant among individuals who do not work full-time. For physical health, the initial positive effects disappear when focusing on intensive informal care.

Figure 6: Impact of low informal caregiving on mental/physical health by employment

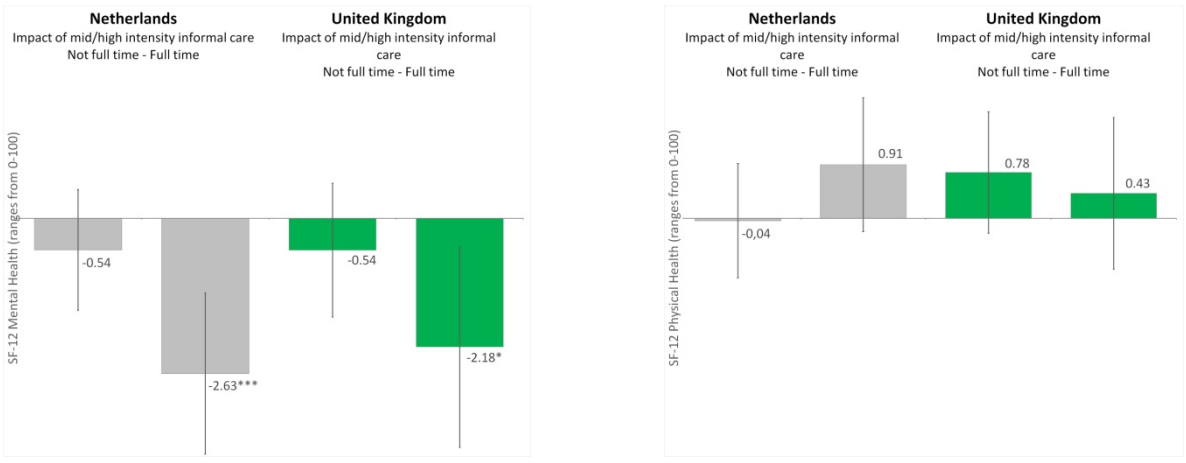
(a) Mental health *(b) Physical health*



*Confidence intervals at 95%, *p<0.05, ** p<0.01 *** p<0.001*

Figure 7: Impact of mid/high intensity informal caregiving on mental/physical health by employment

(a) Mental health *(b) Physical health*



*Confidence intervals at 95%, *p<0.05, ** p<0.01 *** p<0.001*

6. Robustness checks

To assess the robustness of our results to our choice of methods and violations in the underlying assumptions we perform various robustness checks. First, we assess whether our results are robust to our choices in the matching strategy. We check whether our results are driven by extreme propensity scores by excluding the 5% highest and lowest scores from our sample. Additionally, we check whether our results differ when re-estimating the propensity scores for specific subgroups of caregivers divided by reported intensity. Calculating the propensity scores for the entire sample might namely lead to bias in our results when applying the resulting weights to specific samples of caregivers. In both samples the results show to be robust to the exclusion of extreme propensity scores and when matching on specific subgroups of caregivers: The results are highly comparable to the results presented in the main specification.[2]

Second, we test how sensitive our results are with regards to a violation of the main identifying assumption of conditional-independence by following the work of Ichino et al. (2008). Ichino et al. (2008) propose a simulation-based method to assess the sensitivity of propensity-score based treatment effects to unobserved variables that should have been included in the propensity score estimation. In the given context such an unobserved variable might be personality characteristics or individual norm perceptions that would influence an individual's likelihood to provide care (selection effect *s*) and their mental health in absence of providing care (outcome effect *d*). The method proposed by Ichino et al. (2008) simulates a confounder with specific values for *s* and *d* in order to assess the sensitivity of estimated treatment effects to the inclusion of such an unobserved confounder. To estimate a sensible set of values for *s* and *d* we estimate the associated values for all covariates used in our propensity score estimation, following the recommendation by Ichino et al. (2008).[3] Appendix Table A6 depicts the estimated selection and outcome effects for all our covariates. The largest selection effects are estimated for being employed and working full-time (s=-0.19) while the largest outcome effects among non-health outcomes are found for having a living partner (d=0.12). Unsurprisingly, the outcome effects for health outcomes are the largest (d=0.45), illustrating again the importance of conditioning on pre-treatment health. Table 4 depicts our estimated treatment effects when simulating a confounder that combines the strongest observed selection and outcome effects. As the estimated values illustrate, our results are robust to such a simulated confounder, even though this confounder combines an unrealistic combination of selection and outcome effects.

2 Detailed results are available upon request.

3 The estimation of selection and outcome effects as well as the associated sensitivity analysis were conducted using a customized version of the Stata command proposed by Nannicini (2007). As this command uses a slightly different estimation strategy without regression adjustment, results can slightly differ with our main specification.

Table 4: Mental Health Effects of High Intensity Caregiving - Sensitivity Analysis

	Dutch Sample		UK Sample	
	MCS	**PCS**	**MCS**	**PCS**
Confounder with properties: s=-0.2 d=0.15	-2.716***	-1.109	-2.478***	0.408
	(0.849)	(0.743)	(0.789)	(0.779)
Confounder with properties: s=0.2 d=0.15	-2.875***	-1.103	-2.910***	0.073
	(0.843)	(0.728)	(0.784)	(0.757)
Confounder with properties: s=-0.2 d=0.45	-2.548***	-1.143	-2.149***	0.646
	(0.863)	(0.766)	(0.824)	(0.814)
Confounder with properties: s=0.2 d=0.45	-3.131***	-1.124	-3.519***	-0.418
	(0.868)	(0.739)	(0.789)	(0.761)
Control	6418		5473	
Treatment	135		177	

**p<0.05, **p<0.01, *** p<0.001, standard errors in parentheses.*

7. Discussion & Conclusion

While a number of studies have reported negative health effects of informal care provision on the caregivers' health, there remains considerable uncertainty with regards to their causal nature and the differences of these effects across countries and subgroups of caregivers. Using a propensity score matching approach and two comparable panel-data sets, we estimated the health impact of providing care for subgroups of caregivers in the UK and the Netherlands. Doing so, we were able to investigate whether the commonly observed average health differences between informal caregivers and non-caregivers within and across countries are attributable to the composition of the caregiver populations in each country.

First, our results highlight the link between the generosity of LTC systems and the distribution of caregiving intensity across informal caregivers. We hypothesized that the share of high intensity caregivers would be higher in the UK than in the Netherlands as the LTC system is less generous in the former. In our samples this is indeed the case with slightly more caregivers providing more than 10 hours of weekly care in the UK than in the Netherlands. However, it is noteworthy that our samples seem to understate the true differences that become apparent when looking at population wide estimates (ONS, 2013; SCP, 2016) or results from the ESS (2014) which indicate that the share of intensive caregivers is much higher in the UK compared to the Netherlands.

Second, we provide evidence for the importance of these underlying differences when comparing average caregiving effects across countries. In both countries the intensity of care provided is a large driver of the experienced health effects: Individuals that provide more than 20 hours of informal care per week experience large negative mental health effects. The more care someone provides, the more straining the situation becomes. Individuals providing less than 20 weekly hours of care do not experience any mental health effect (United Kingdom) or a similar negative but considerably smaller

health effect (Netherlands). These findings align with previous studies that report negative mental health effects of informal care provision (Bom et al., 2019a). They are, furthermore, consistent with the findings of Kaschowitz & Brandt (2017) who hypothesized that especially differences between groups of caregivers (like care intensity) determine the impact of caregiving.

Third, our results uncover some interesting patterns with regard to caregiving effects on physical health and their relation to caregiving intensity. Contrary to the mental health effects, the dose-response relationship seems to be inverted as we observe small positive physical health effects among caregivers who provide less than 10 hours of care per week and (for the Dutch sample) do not work full-time. While these small positive effects disappear with increasing care intensity, they indicate that low intensity caregiving can lead to small increases in physical health, possibly due to increased physical activity. However, these results should be taken with a pinch of salt. Di Novi et al. (2016) point out that self-reported health measures are prone to bias as individuals might change their judgement by taking the care-recipients health as a reference point. Although our use of a multi-item physical health measure that emphasizes the ability to perform certain tasks should mitigate this concern, it cannot be ruled out.

Lastly, our analysis of subgroups of caregivers that combine their caregiving duty with full-time employment indicates that this group experiencing a 'double burden' are the ones experiencing the largest negative mental health effects. These results are estimated only on those individuals who are in stable full-time employment and hence exclude individuals who, potentially as a result of their caregiving tasks, changed their employment status. This could for example be the case when someone needs to cut back working hours when he or she experiences health issues caused by care provision. While this might introduce a downward bias and raise concerns about the external validity of our results, recent evidence for the Netherlands suggests that there is no effect of informal caregiving on labour market outcomes both at the extensive and intensive margin (Rellstab et al., 2020). In the UK informal care also does not seem to have an effect on labour force participation (Heitmüller, 2007) but intensive caregiving leads to lower outcomes at the extensive margin, decreasing work hours and labour earnings (Heitmüller & Inglis, 2007). However, across countries the relationship between informal care and labour market outcomes is diverse (for a review see Bauer & Sousa-Poza, 2015), underlining the need for further research into the complex relationship between mental, health, labour market outcomes and the long-term care system.

The bulk of our results strongly suggests that once the focus is narrowed down to specific subgroups of caregivers the effects of informal caregiving are similar despite large differences across country's LTC systems. However, some differences between both countries still emerge. Dutch low-intensity caregivers experience small negative mental health effects whereas this is not the case in the UK. In turn, only UK caregivers experience small positive health effects among low-intensity caregivers while in the Netherlands this only occurs among unemployed or part-time working individuals. Lastly,

there is some suggestive evidence that women in the Netherlands experience a larger mental health burden. These differences can be driven by variation in support options or attitudes towards care provision, but also by differences in for example the type of care someone provides (e.g. personal care, household help) or the social norms associated with caregiving. The country-specific differences in effect size are however considerably smaller compared to differences between subgroups of caregivers. Nonetheless they point towards important questions for future research taking into account specific caregiving contexts such as tasks conducted and formal care services consumed alongside informal care.

While our study provides important insights, some concerns remain. We were unable to disentangle the caregiving effect, the impact of caring for someone, from the family effect, the impact of caring about someone (Bobinac et al., 2010). Possibly the observed mental health effects are driven by severe illness of a family member instead of the act of caring itself. Previous studies investigating the caregiving and family effect in the Netherlands (Bom et al., 2019b) and the UK (Stöckel & Bom, 2020) however found that correcting for the family effect, does not affect the estimates of the caregiving effect. In addition, the absence of strong negative health effects among high-intensity caregivers who are not in full-time work seems to contradict that the effects we find are driven by the family effect. Importantly though this does not mean that there is a no direct mental health effect associated with caring for the health of a family-member. Rather it seems likely that such an effect is already captured when conditioning on the mental health outcomes in the year prior to providing informal care.

Concluding, our results provide interesting insights for both researchers and policy makers. First, they indicate that especially differences in caregiver characteristics, not other country differences, drive the differences in observed health effects of care provision. These differences in caregiver characteristics can be used to specifically target support to the subgroups of caregivers who experience the largest burden: those who provide most hours or care and those experiencing a double burden of care and full-time employment. Second, while we do not find large differences in health effects between both countries when comparing similar caregivers, this does not mean that country characteristics do not play a role. In countries with more generous LTC systems, and hence more formal care alternatives to informal care, less individuals will provide highly intensive care. As a result, less individuals experience severe health effects of care provision. It is important for policymakers to be aware of this relation between the coverage of LTC system and the composition (and hence experienced health effects) of caregivers in order to make deliberate trade-offs between the aggregate costs of formal care versus the implications of informal care.

Acknowledgements

We gratefully acknowledge comments provided by Pieter Bakx, Erik Schut, and Eddy van Doorslaer, participants at the LSE Care Policy Evaluation Centre seminar, the 2019 International Health Economics Congress and the ESE/ESHPM PhD Research Symposium. We thank TNO, Statistic Netherlands and the Institute for Social and Economic Research for providing access to survey and administrative data. This study received financial support from the Network for Studies on Pensions, Ageing and Retirement Grant *optimal saving and insurance for old age: The role of public-long term care insurance* (Bom) and the *Smarter Choices for Better Health Initiative* financed by the Erasmus University Rotterdam (Stöckel). All remaining errors are our own.

References

Bakx, P., De Meijer, C., Schut, F., & Van Doorslaer, E. (2015). Going formal or informal, who cares? The influence of public long-term care insurance. *Health economics*, *24*(6), 631-643. https://doi.org/10.1002/hec.3050

Bakx, P., Bom, J., Tenand, M., & Wouterse, B. (2020). Eigen bijdrage aan ouderenzorg. *Netspar Design Paper 13.* https://www.netspar.nl/publicatie/eigen-bijdrage-aan-ouderenzorg/

Bauer, J. M., & Sousa-Poza, A. (2015). Impacts of informal caregiving on caregiver employment, health, and family. *Journal of Population Ageing*, *8*(3), 113-145.

Bobinac, A., Van Exel, N. J. A., Rutten, F. F., & Brouwer, W. B. (2010). Caring for and caring about: disentangling the caregiver effect and the family effect. *Journal of Health Economics*, 29(4), 549-556. 10.1016/j.jhealeco.2010.05.003

Bom, J., Bakx, P., Schut, F., & van Doorslaer, E. (2019a). The Impact of Informal Caregiving for Older Adults on the Health of Various Types of Caregivers. *The Gerontologist*, 59(5), e629-e642. https://doi.org/10.1093/geront/gny137

Bom, J., Bakx, P., Schut, F., & van Doorslaer, E. (2019b). Health effects of caring for and about parents and spouses. *The Journal of the Economics of Ageing*, 14. https://doi.org/10.1016/j.jeoa.2019.100196

Brandt, M. (2013). INTERGENERATIONAL HELP AND PUBLIC ASSISTANCE IN EUROPE: A case of specialization? *European Societies, 15*(1), 26-56. https://doi.org/10.1080/14616696.2012.726733

Brenna, E., & Di Novi, C. (2016). Is caring for older parents detrimental to women's mental health? the role of the european North-South gradient. *Review of Economics of the Household, 14*(4), 745-778.

van den Broek, T., & Grundy, E. (2018). Does long-term care coverage shape the impact of informal care-giving on quality of life? A difference-in-difference approach. *Ageing and Society,* 40 (6). pp. 1291-1308. 10.1017/S0144686X18001708

Caliendo, M., & Kopeinig, S. (2008). Some practical guidance for the implementation of propensity score matching. *Journal of Economic Surveys*, *22*(1), 31-72. https://doi.org/10.1111/j.1467-6419.2007.00527.x

Colombo, F., Llena-Nozal, A., Mercier, J., & Tjadens, F. (2011). Help wanted? PROVIDING AND PAYING FOR LONG-TERM CARE. OECD Health Policy Studies, OECD Publishing. http://dx.doi.org/10.1787/9789264097759-en

Comas-Herrera, A., Pickard, L., Wittenberg, R., Malley, J., & King, D. (2010). *European network of economic policy research institutes assessing needs of care in european nations THE LONG-TERM CARE SYSTEM FOR THE ELDERLY IN ENGLAND*

Courtin, E. Jemiai, N. & Mossialos, E (2014). Mapping support policies for informal carers across the European Union, *Health Policy*, 118(1): 84-94, https://doi.org/10.1016/j.healthpol.2014.07.013.

Di Novi, C., Jacobs, R., & Migheli, M. (2015). The quality of life of female informal caregivers: From Scandinavia to the Mediterranean Sea. European Journal of Population, 31, 309–333. doi:10.1007/s10680-014-9336-7

ESS Round 7: European Social Survey Round 7 Data (2014). Data file edition 2.2. NSD - Norwegian Centre for Research Data, Norway – Data Archive and distributor of ESS data for ESS ERIC. doi:10.21338/NSD-ESS7-2014.

Eurobarometer (2007). Health and long-term care in the European Union ec.europa.eu/public_opinion/archives/ebs/ebs_283_en.pdf

Glendinning, C. (2013). Long term care reform in England: A long and unfinished story. In *Reforms in long-term care policies in Europe* (pp. 179-200). Springer, New York, NY.

Heitmueller, A. (2007). The chicken or the egg?: Endogeneity in labour market participation of informal carers in England. *Journal of Health Economics*, *26*(3), 536-559. https://doi.org/10.1016/j.jhealeco.2006.10.005

Heitmueller, A., & Inglis, K. (2007). The earnings of informal carers: Wage differentials and opportunity costs. *Journal of Health Economics*, *26*(4), 821-841. 10.1016/j.jhealeco.2006.12.009

Ichino, A., Mealli, F., & Nannicini, T. (2008). From temporary help jobs to permanent employment: what can we learn from matching estimators and their sensitivity?. Journal of Applied Econometrics, 23(3), 305-327. https://doi.org/10.1002/jae.998

Igel, C., Brandt, M., Haberkern, K. and Szydlik, M. (2009). Specialization between family and state. Intergenerational time transfers in western Europe, *Journal of Comparative Family Studies,* 40(2): 203-226. https://doi.org/10.3138/jcfs.40.2.203

Kaschowitz, J., & Brandt, M. (2017). Health effects of informal caregiving across europe: A longitudinal approach. *Social Science and Medicine, 173*, 72-80. https://doi.org/10.1016/j.socscimed.2016.11.036

Lechner, M. (2009). Sequential causal models for the evaluation of labor market programs. *Journal of Business & Economic Statistics*, *27*(1), 71-83. https://doi.org/10.1198/jbes.2009.0006

Leuven, E., & Sianesi, B. (2003). PSMATCH2: Stata module to perform full Mahalanobis and propensity score matching, common support graphing, and covariate imbalance testing. Boston College Department of Economics, Statistical Software Components. Downloadable from http://ideas.repec.org/c/boc/bocode/s432001.html.

Maarse, J. A. M. H., & Jeurissen, P. P. P. (2016). The policy and politics of the 2015 long-term care reform in the Netherlands. *Health Policy, 120*(3), 241-245. 10.1016/j.healthpol.2016.01.014

Mot E. (2010). The Dutch System of Long-Term Care, CPB Document, No. 204. Netherlands Bureau for Economic Policy Analysis, The Hague.

Motel-Klingebiel, A., Tesch-Römer, C. and von Kondratowitz, H.-J. (2005). Welfare states do not crowd out the family : evidence for mixed responsibility from comparative analyses. *Ageing & Society*, 25, 6, 863–882. https://doi.org/10.1017/S0144686X05003971

Nannicini T. (2007). Simulation-based sensitivity analysis for matching estimators. *Stata Journal,* 7(3): 334– 350.

NatCen Social Research. (2017). British Social Attitudes Survey, 2016. [data collection]. UK Data Service. SN: 8252, http://doi.org/10.5255/UKDA-SN-8252-1

NHS (2018a). Financial assessment, https://www.nhs.uk/conditions/social-care-and-support-guide/help-from-social-services-and-charities/financial-assessment-means-test/

NHS (2018b).When the council might pay for your care, https://www.nhs.uk/conditions/social-care-and-support-guide/money-work-and-benefits/when-the-council-might-pay-for-your-care/

OECD (2019). Health at a Glance. https://doi.org/10.1787/4dd50c09-en

OECD (2020a). Health expenditure and financing. Last assessed April 2nd 2020. https://stats.oecd.org/Index.aspx?DataSetCode=SHA

OECD (2020b). Long term care. Last assessed April 2nd 2020. https://www.oecd.org/els/health-systems/long-term-care.htm

OECD (2020c). Long-term care resources and utilization: long-term care (health) recipients. Last assessed April 2nd 2020. https://stats.oecd.org/index.aspx?DataSetCode=HEALTH_STAT#

ONS (2013). 2011 Census Analysis: Unpaid care in England and Wales, 2011 and comparison with 2001. https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthcaresystem/articles/2011censusanalysisunpaidcareinenglandandwales2011andcomparisonwith2001/2013-02-15

Pearlin, L. I., Mullan, J. T., Semple, S. J., & Skaff, M. M. (1990). Caregiving and the stress process: An overview of concepts and their measures. *Gerontologist, 30*(5), 583-594. 10.1093/geront/30.5.583

Pinquart, M., & Sörensen, S. (2003). Differences between caregivers and noncaregivers in psychological health and physical health: A meta-analysis. *Psychology and Aging, 18*(2), 250. 10.1037/0882-7974.18.2.250

Pinquart, M., & Sörensen, S. (2011). Spouses, adult children, and children-in-law as caregivers of older adults: A meta-analytic comparison. *Phychology and Aging, 26*(1), 1-14. 10.1037/a0021863

Rellstab, S., Bakx, P., García-Gómez, P., & van Doorslaer, E. (2020). The kids are alright - labour market effects of unexpected parental hospitalisations in the Netherlands. *Journal of Health Economics*, *69*. https://doi.org/10.1016/j.jhealeco.2019.102275

Rosenbaum, P. R., & Rubin, D. B. (1985). Constructing a control group using multivariate matched sampling methods that incorporate the propensity score. *The American Statistician*, *39*(1), 33-38. https://doi.org/10.2307/2683903

Rubin, D. B. (1979). Using multivariate matched sampling and regression adjustment to control bias in observational studies. *Journal of the American Statistical Association*, *74*(366a), 318-328. 10.2307/2286330

Schmitz, H., & Stroka, M. A. (2013). Health and the double burden of full-time work and informal care provision—Evidence from administrative data. *Labour Economics*, 24, 305-322. https://doi.org/10.1016/j.labeco.2013.09.006

Schmitz, H., & Westphal, M. (2015). Short- and medium-term effects of informal care provision on female caregivers' health. *Journal of Health Economics, 42*, 174-185. 10.1016/j.jhealeco.2015.03.002

SCP (2016). Voor elkaar? https://www.scp.nl/Publicaties/Alle_publicaties/Publicaties_2017/Voor_elkaar?utm_source=e-mailnieuwsbrief&utm_medium=email&utm_campaign=Nieuwe+publicatie+SCP

Stöckel, J. & Bom, J. (2020). The Dynamic Effects of Informal Caregiving on the Caregivers' Health. Netspar Discussion Paper 02/2020-011. https://www.netspar.nl/publicatie/the-dynamic-effects-of-informal-caregiving-on-caregivers-health/

University of Essex. Institute for Social and Economic Research. (2019). *Understanding Society: Waves 1-9, 2009-2018 and Harmonised BHPS: Waves 1-18, 1991-2009*. [data collection]. *12th Edition.* UK Data Service. SN: 6614, http://doi.org/10.5255/UKDA-SN-6614-13

Verbakel, E. (2014). Informal caregiving and well-being in Europe: What can ease the negative consequences for caregivers? *Journal of European Social Policy, 24*(5), 424-441. https://doi.org/10.1177/0958928714543902

Ware, J. E., Kosinski, M., & Keller, S. D. (1995). *SF-12: How to score the SF-12 physical and mental health summary scales* (2nd. ed). Boston, Massachusetts, The Health Institute, New England Medical Center

Ybema, J. F., Geuskens, G. A., Van Den Heuvel S. G., De Wind A., Leijten, F. R. M., Joling, C., et al. (2014). Study on transitions in employment, ability and motivation (STREAM): The design of a four-year longitudinal cohort study among 15,118 persons aged 45 to 64 years. *British Journal of Medicine & Medical Research, 4*(46), 1383-1399.

Appendix

Table A1: UK Sample Descriptive Statistics – Treatment and Control Groups

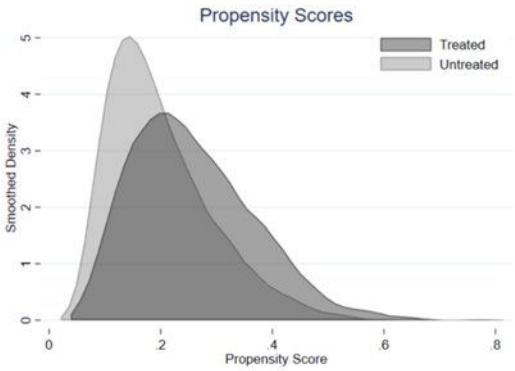
UK	Treated		Control		Matched Controls		Standardized Bias	
	Mean	SD	Mean	SD	Mean	SD	Un matched	Matched
Care Obligations								
Mother alive	0.56	0.5	0.44	0.5	0.56	0.50	25.40	-0.30
Father alive	0.34	0.47	0.29	0.46	0.34	0.47	10.20	0.50
Both parents alive	0.26	0.44	0.24	0.42	0.25	0.43	4.80	0.70
Living partner	0.67	0.47	0.65	0.48	0.67	0.47	4.80	0.80
Living siblings	0.9	0.31	0.9	0.3	0.90	0.30	-1.50	-0.30
Age of mother	78.32	4.85	77.01	4.37	78.30	4.96	28.30	0.10
Age of father	78.76	3.52	77.97	3.25	78.72	3.50	23.30	0.60
Age of partner	54.4	6.87	53.55	7.22	40.71	24.11	12.00	0.70
Willingness to Care								
Age	53.99	5.76	53.82	5.99	53.97	5.77	2.90	0.30
Female	0.6	0.49	0.52	0.5	0.58	0.49	15.80	2.10
Secondary Education	0.4	0.49	0.36	0.48	0.40	0.49	7.20	-0.70
Tertiary Education	0.38	0.48	0.36	0.48	0.37	0.48	2.50	1.40
Primary Education	0.23	0.42	0.28	0.45	0.23	0.42	-10.90	-0.70
Self-Employed	0.1	0.3	0.1	0.3	0.10	0.30	0.10	0.20
Unemployed	0.06	0.23	0.05	0.22	0.06	0.23	2.80	-0.40
Retired	0.14	0.35	0.14	0.34	0.14	0.35	2.40	0.90
Homecarer	0.05	0.22	0.03	0.18	0.05	0.21	8.00	0.10
Disabled	0.06	0.23	0.07	0.25	0.06	0.23	-5.00	-0.50
Education_other	0	0.06	0	0.06	0.00	0.07	0.70	-1.80
Employed	0.59	0.49	0.61	0.49	0.59	0.49	-3.90	-0.10
Full-time employee	0.49	0.5	0.55	0.5	0.50	0.50	-11.90	-0.80
Income quintile 2	0.23	0.42	0.25	0.43	0.21	0.41	1.80	-0.70
Income quintile 3	0.21	0.41	0.2	0.4	0.20	0.40	1.70	-0.70
Income quintile 4	0.2	0.4	0.19	0.39	0.17	0.37	-5.20	0.40
Income quintile 5	0.17	0.38	0.19	0.39	0.19	0.39	5.70	1.40
Income quintile 1	0.19	0.4	0.17	0.38	0.23	0.42	-3.80	-0.30
HH Income Fraction	0.54	0.31	0.57	0.31	0.54	0.31	-10.00	-0.40
Children < 14 in Household	0.14	0.35	0.18	0.38	0.14	0.35	-10.60	-0.80
Ability to Care								
SF12 - Mental Score	50.6	9.61	51.13	9.59	50.58	9.87	-5.50	0.00
SF12 - Physical Score	49.48	11.1	49.09	11.57	49.33	11.44	3.40	1.00
Longstanding illness	0.4	0.49	0.42	0.49	0.41	0.49	-3.30	-0.10
Number of Individuals	1714		5473		5473			

Table A2: Dutch sample Descriptive Statistics – Treatment and Control Groups

	Treated		Control		Matched Controls		Standardized Bias	
	Mean	SD	Mean	SD	Mean	SD	Un matched	Matched
Care Obligations								
Mother alive	0.56	0.50	0.44	0.50	0.56	0.50	25.80	1.40
Father alive	0.32	0.47	0.25	0.43	0.30	0.46	14.50	2.00
Both parents alive	0.24	0.42	0.19	0.39	0.22	0.42	11.00	2.60
Living partner	0.72	0.45	0.70	0.46	0.73	0.44	5.10	-1.70
Living siblings	0.88	0.33	0.84	0.37	0.88	0.33	10.40	0.60
Age of mother	80.52	4.71	79.44	4.57	44.96	4.83	23.40	0.70
Age of father	80.39	37.64	79.74	3.10	24.94	3.12	20.50	0.50
Age of partner	54.47	5.63	54.60	5.56	39.73	5.66	15.00	-0.20
Willingness to Care								
Age	54.83	5.31	54.22	5.56	54.83	5.38	11.30	-0.70
Female	0.51	0.50	0.38	0.49	0.51	0.49	25.20	-0.10
Secondary Education	0.38	0.49	0.38	0.48	0.38	0.48	0.90	0.00
Tertiary Education	0.37	0.48	0.32	0.47	0.37	0.44	11.00	0.60
Primary Education	0.25	0.43	0.31	0.46	0.25	0.27	-12.60	-0.70
Self-Employed	0.08	0.27	0.08	0.28	0.08	0.17	-0.80	-0.40
Unemployed	0.03	0.17	0.02	0.16	0.03	0.21	2.90	0.20
Retired	0.05	0.22	0.02	0.16	0.04	0.12	13.30	0.00
Homecarer	0.01	0.11	0.01	0.10	0.01	0.27	2.80	-0.50
Disabled	0.08	0.27	0.06	0.24	0.08	0.03	6.3	-0.20
Education_other	0.00	0.03	0.00	0.04	0.00	0.43	-1.50	0.10
Employed	0.75	0.43	0.79	0.41	0.75	0.50	-11.00	0.40
Full-time employee	0.50	0.50	0.59	0.49	0.49	0.40	-18.50	1.20
Income quintile 2	0.21	0.41	0.24	0.43	0.19	0.40	-6.60	-0.80
Income quintile 3	0.19	0.39	0.22	0.41	0.19	0.40	-0.90	-0.30
Income quintile 4	0.20	0.40	0.20	0.41	0.20	0.40	3.30	0.20
Income quintile 5	0.20	0.40	0.18	0.39	0.20	0.40	12.10	0.60
Income quintile 1	0.20	0.40	0.15	0.36	0.21	0.41	-6.80	0.30
HH Income Fraction	0.76	0.30	0.81	0.27	0.76	0.30	-18.30	1.00
Children < 14 in Household	0.10	0.31	0.14	0.35	0.10	0.30	-12.10	0.50
Ability to Care								
SF12 - Mental Score	52.19	8.70	52.31	8.56	52.11	8.79	-1.40	0.70
SF12 - Physical Score	48.43	9.99	48.95	9.87	48.36	10.40	-5.20	0.60
Longstanding illness	0.65	0.48	0.60	0.49	0.65	0.48	8.90	-1.00
Number of Individuals	1723		6418		6418			

Figure A1: Propensity score distributions

(a) The Netherlands



(b) UK

Table A3: Estimation results by care intensity

	Dutch Sample		**UK Sample**	
	MCS	PCS	MCS	PCS
Any care	-0.698***	0.197	-0.211	0.687**
	(0.204)	(0.183)	(0.219)	(0.207)
Low intensity	-0.510*	0.186	0.025	0.802***
<10h weekly care	(0.222)	(0.200)	(0.231)	(0.224)
Medium intensity	-0.930	0.495	0.215	0.147
10-20h weekly care	(0.530)	(0.475)	(0.601)	(0.533)
High intensity	-2.106**	-0.068	-2.322**	0.898
>20h weekly care	(0.775)	(0.620)	(0.739)	(0.641)
Control	6418		5473	
Treatment	1711		1713	
Low	1378		1302	
Medium	181		205	
High	135		177	

*p<0.05, **p<0.01, *** p<0.001, standard errors in parentheses.

Table A4: Estimation results by gender

	Dutch Sample				UK Sample			
	Males		Females		Males		Females	
	MCS	PCS	MCS	PCS	MCS	PCS	MCS	PCS
Any care	-0.321	-0.196	-1.059***	0.658*	0.063	0.231	-0.390	0.977***
	(0.258)	(0.245)	(0.312)	(0.268)	(0.326)	(0.307)	(0.293)	(0.280)
Control	3953		2465		2644		2829	
Treatment	846		865		694		1019	

*p<0.05, **p<0.01, *** p<0.001, standard errors in parentheses.

Table A5: Estimation results by care intensity and employment-status

	Dutch Sample		UK Sample	
	MCS	PCS	MCS	PCS
Not full-time work & <10 h	-0.374	0.725*	0.082	1.317***
	(0.336)	(0.305)	(0.360)	(0.360)
Full-time work & <10h	-0.932**	-0.412	-0.156	0.412
	(0.312)	(0.276)	(0.316)	(0.299)
Not full-time & >=10h	-0.535	-0.040	-0.542	0.778
	(0.620)	(0.522)	(0.604)	(0.543)
Full-time & >=10h	-2.633***	0.911	-2.179*	0.426
	(0.674)	(0.565)	(0.882)	(0.668)
Control				
Not full-time	2520		2276	
Full-time	3459		2670	
Treatment				
Not full-time & Low IC	638		566	
Full-time & Low IC	639		598	
Not full-time & High IC	184		240	
Full-time & High IC	120		125	

*p<0.05, **p<0.01, *** p<0.001, standard errors in parentheses.

Table A6: Estimated selection and outcome effects

	Dutch Sample		UK Sample	
Variable	**Selection Effect (s)**	**Outcome Effect (d)**	**Selection Effect (s)**	**Outcome Effect (d)**
Care Obligations				
Mother alive	0,07	-0,03	0,01	-0,03
Mother aged 60-64	0,00	0,00	-0,01	0,00
Mother aged 65-69	0,01	-0,01	-0,01	-0,01
Mother aged 70-74	-0,03	-0,01	-0,09	-0,01
Mother aged 75-79	0,04	0,00	0,03	0,02
Mother aged 80-84	-0,07	0,04	0,04	-0,01
Mother aged 85-89	0,03	0,01	0,01	0,01
Mother aged 90-94	0,01	-0,01	0,01	0,00
Mother aged 95-99	0,00	0,00	0,01	0,00
Father alive	0,04	-0,01	-0,01	-0,03
Father aged 60-64	0,00	0,00	0,00	0,00
Father aged 65-69	0,01	0,00	0,00	-0,01
Father aged 70-74	-0,03	-0,01	-0,05	-0,02
Father aged 75-79	-0,01	-0,01	-0,01	0,02
Father aged 80-84	-0,03	0,02	0,02	-0,01
Father aged 85-89	0,00	0,00	0,03	0,01
Father aged 90-94	0,00	0,00	0,00	-0,01
Father aged 95-99	0,00	0,00	0,00	0,00
Both parents alive	0,02	-0,01	-0,06	-0,02
Siblings alive	0,00	-0,03	0,01	-0,04
Living partner	0,04	0,09	0,01	0,12
Partner aged 30-39	0,00	0,00	-0,03	-0,01
Partner aged 40-49	-0,03	-0,01	-0,06	-0,01
Partner aged 50-59	-0,03	-0,04	0,03	-0,06
Partner aged 60-69	0,01	0,04	0,02	0,07
Partner aged 70-79	0,01	0,00	0,04	0,00
Willingness to Care				
Age 45-49	-0,02	-0,07	-0,10	-0,06
Age 50-54	-0,04	-0,04	0,04	-0,05
Age 55-59	0,04	0,01	0,03	0,00
Age 60-64	-0,03	0,08	0,01	0,09
Female	0,06	-0,08	0,11	-0,07
Education: Primary	0,02	-0,04	0,10	-0,04
Education: Secondary	0,03	0,04	0,00	0,02
Education: Tertiary	-0,07	0,00	-0,09	0,02
Self-Employed	-0,01	0,02	-0,02	0,02
Unemployed	0,02	-0,02	0,04	-0,03
Working full-time	-0,13	0,06	-0,19	0,07
Retired	0,03	0,01	0,02	0,06
Homecare	0,02	0,00	0,05	-0,01

Education_other	0,00	0,00	0,01	0,00
Employed	-0,13	0,09	-0,18	0,08
Disabled	0,09	-0,10	0,08	-0,12
Income Quintile 1	0,05	-0,08	0,12	-0,09
Income Quintile 2	-0,03	0,00	0,05	-0,01
Income Quintile 3	0,02	0,00	-0,04	0,02
Income Quintile 4	-0,04	0,03	-0,06	0,03
Income Quintile 5	0,01	0,06	-0,07	0,05
Income Fracion > 0.5	-0,10	0,01	-0,03	-0,04
Children in HH	-0,02	-0,02	-0,05	-0,02
Ability to Care				
MCS > 50	-0,12	0,45	-0,16	0,43
PCS > 50	-0,12	0,19	-0,18	0,18
Long-Standing Illness	0,10	-0,16	0,08	-0,18

Note: Depicted are only the outcome and selection effects for mental health. The effects for physical health differ slightly, e.g. indicating younger age-dummies to have a positive outcome effect but the same selection effect. For the majority of variables however the differences are neglible and the maximum values used for the simulation would remain the same.

For online appendix

Table O1: Overview comparability variables

		STREAM (NL)		USoc (UK)
Informal Care Provision				
Informal care	S	Binary; 1 if yes. Have you spent part of your time on one of the following activities in the past 12 months? Informal care (for example taking care of an invalid person in your close environment without being paid. Does not include looking after healthy children)	*S*	Binary; 1 if yes 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.)?' or 'Do you provide regular service or help for any sick, disabled or elderly person not living with you? [Exclude help provided in course of employment]'
Care intensity	S	How many hours per week have you spent on informal care in the past 12 months? ……hours per week	S	Now thinking about everyone who you look after or provide help for, both those living with you and not living with you - in total, how many hours do you spend each week looking after or helping them?
Care Obligations				
Mother alive	A	Binary	S	Binary
Father alive	A	Binary	S	Binary
Both parents alive	A	Binary	S	Binary
Living partner (married, registered partnership)	A	Binary	S	Binary
Living siblings	A	Binary	S	Binary
Age of mother	A	Age in years if alive	S	Age in years if alive
Age of father	A	Age in years if alive	S	Age in years if alive
Age of partner	A	Age in years if alive	S	Age in years if alive
Willingness to Care				
Age	S	Age in years	S	Age in years
Female	S	Binary; 1 if female	S	Binary; 1 if female
Primary Education	S	Level of Education 1 if Low (registered by internet panel) or Everything below secondary education	S	Current status highest educational or vocational qualification. 1 if Other qualification or No qualification.
Secondary Education	S	Level of Education 1 if Mid (registered by internet panel) or Degree from secondary education or qualification to enter job market	S	Current status highest educational or vocational qualification. 1 if A-level or GCSE
Tertiary Education	S	Level of Education 1 if High (registered by internet panel) or Tertiary degree.	S	Current status highest educational or vocational qualification. 1 if Degree or Other higher degree

Employed	S	Are you currently… *(several answers possible)**	S	Which of these best describes your current employment situation?
		Having one paid job as an employee (salaried employment, temporary employee or stand-by employee); Having several jobs as an employee		Paid employment, on maternity leave, unpaid worker in family business, apprenticeship
Self-Employed	S	Are you currently… *(several answers possible)* *	S	Which of these best describes your current employment situation?
		Self-employed or entrepreneur		Self employed
Unemployed	S	Are you currently… *(several answers possible)* *	S	Which of these best describes your current employment situation?
		Unemployed		Unemployed; Government training scheme
Retired	S	Are you currently… *(several answers possible)* *	S	Which of these best describes your current employment situation?
		Retired early; Retired		Retired
Homecarer	S	Are you currently… *(several answers possible)* *	S	Which of these best describes your current employment situation?
		Housewife/homemaker		Looking after family or home
Disabled	S	Are you currently… *(several answers possible)* *	S	Which of these best describes your current employment situation?
		Long-term sick or disabled		Work disabled
Education_other		Are you currently… *(several answers possible)* *		Which of these best describes your current employment situation?
		Studying		Full-time student; doing something else
Working Full-Time	S	WN: How many hours per week do your work according to your contract? 1 if >=30	S	If employed full time (i.e. greater than 30 hours per week). This measure is based on total hours, i.e. including both normal and overtime hours.
Income quintiles	A	Equivalized household disposable income Converted into 5 quintiles	S	Equivalized total household net income Converted into 5 quintiles
HH Income Fraction	A	Personal income divided by household disposable income	S	Total net personal income (no deductions) divided by total household net income (no deductions)
Children < 14 in Household	A	Binary	S	Binary
Ability to Care				
SF12 - Mental Score	S	computed score, 0-100	S	computed score, 0-100
SF12 - Physical Score	S	computed score, 0-100	S	computed score, 0-100
Longstanding illness	S	Binary: 1 if yes to any of the options.	S	Binary; 1 if yes.
		Do you have one or more of the		Do you have any long-standing

	following longstanding diseases, conditions, or handicaps, and if yes, please indicate which one? (*several answers possible*) H26a Complaints of the hands or arms (also arthritis, RSI) H26b Complaints of the legs or feet (also arthritis) H26c Complaints of the back and neck (also arthritis, RSI) H26d Migraine or severe headache H26e Cardiovascular diseases H26f Asthma, bronchitis, emphysema H26g Gastrointestinal disorders H26h Diabetes H26i Severe skin disease H26j Psychological complaints/disorders H26k Hearing problems H26l Epilepsy H26m Life-threatening diseases (e.g. cancer, AIDS) H26n Problems with vision H26o Other, e.g. …… H26p No	physical or mental impairment, illness or disability? By 'long-standing' I mean anything that has troubled you over a period of at least 12 months or that is likely to trouble you over a period of at least 12 months.

(A) From Administrative register data, (S) from survey data

** For this question several answer options are possible. To mimic the USoc sample, answer options are made exclusive. In case someone registered as being (self-)employed next to another answer options (e.g. homemaker), employment was registered.*