



# Is the grass greener on the other side? The health impact of providing informal care in the UK and the Netherlands

Judith Bom<sup>\*</sup>, Jannis Stöckel

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

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## ABSTRACT

Facing rapidly ageing populations, many Western countries aim to stimulate informal care provision as a way to meet the growing long-term care (LTC) demand. 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. The samples consist of 8129 Dutch and 7186 UK respondents, among which respectively 1711 and 1713 individuals are identified as caregivers.

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. Individuals that provide more than 20 hours of informal care per week, and those who face a double burden of care and full-time employment experience the most severe negative mental health effects. These results indicate that health effects of providing informal care are mediated by the specific caregiving context, allowing policymakers to use information on this context to provide targeted aid. In addition, it suggests that previously reported differences of caregiving effects across countries could be driven by differences in the population of informal caregivers which are shaped by countries' LTC policies.

## 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 Bom et al., 2019a for a review). These health effects are not the same for all caregivers. Individual and contextual elements like age, the intensity of care provided and other responsibilities like formal employment may affect the care burden (e.g. Pearlin et al., 1990; Pinquart and Sorensen, 2011). At the same time, country-level factors like welfare state generosity 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 et al., 2005; Igel et al., 2009). While formal LTC professionals provide intensive, highly skilled care services, informal caregivers can dedicate themselves to lower intensity care activities. In less generous welfare states, on the contrary, family members are required to provide highly 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 paid work. 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 caregivers (Pearlin

<sup>\*</sup> Corresponding author. Burgemeester Oudlaan 50, 3062PA, Rotterdam, Netherlands.  
E-mail address: [bom@eshpm.eur.nl](mailto:bom@eshpm.eur.nl) (J. Bom).

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 family's role 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 influence the impact of care tasks on well-being (Pearlin et al., 1990). Additionally, the availability of formal care could influence one's experience of informal care. Knowing that formal care would be available if needed might affect the perceived control and hence the ability to deal with the situation (Wagner and Brandt, 2018). Furthermore, countries could differ in the depth and efforts to identify and help caregivers in need of support, which might affect the experience of care provision as well (Kaschowitz and Brandt, 2017).

Some studies investigated the relation between informal caregiving and health from a cross-country perspective using cross-sectional data. Dujardin et al. (2011) for example compared the health differences between informal caregivers and non-caregivers in the UK and Belgium using census data and found that high intensity British caregivers have better health than their Belgian counterparts.

More recently, various studies used the European SHARE panel dataset to estimate the cross-country health effect of informal caregiving with differing conclusions. Brenna and Di Novi (2016) estimated the effect of maternal informal care on caregiving daughters' health using propensity score matching methods to address endogeneity concerns. Their results indicate a 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. Uccheddu et al. (2019) studied transitions into and out of spousal caregiving in Europe using fixed-effects models and again found that health effects are strongest in Southern and Eastern European countries. Kaschowitz and 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 the results mentioned above, they find that caregiving negatively affects mental health across most European countries, irrespective of the specific policy context. Instead, the caregiving context, 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 informal care intensity is not captured in the SHARE data Kaschowitz and Brandt (2017) cannot test this hypothesis. Lastly, Van den Broek and Grundy (2018) studied the difference between caregiving effects in Sweden and Denmark by using a difference-in-differences approach to explore the impact 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 in-depth analysis that would allow policymakers to identify those groups of caregivers most vulnerable to insufficient LTC coverage.

A limitation of the current studies is hence that they incorporate little information on the caregiving intensity. As a result, they cannot determine whether the observed average differences in health effects are driven by differences in the caregiving population (e.g. a higher share of high-intensity caregivers) or whether other country differences (like support options and social norms) play a role as well. The current study combines two independent panel datasets from the Netherlands and the UK which contain detailed information on the caregiving context. This allows us to explore whether caregiving effects differ by country once compared at similar intensity levels. Additionally, similarity and size of both datasets facilitates a two-country comparison, instead of grouping several countries with different long-term care systems together. Lastly, we 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 longer-term and starting 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.

## 2. Background

To study the difference in caregiving effects between the Netherlands and the UK it is important to understand the differences in their LTC systems. Table 1 provides an overview of their 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. However, they differ strongly in terms of LTC expenditures.

### 2.1. Generosity of LTC systems

The difference in public LTC-spending reflects the generosity of their LTC systems. The Netherlands has a universal and comprehensive LTC system, irrespective of age or income, everyone requiring care is entitled to the benefits of this scheme (Mot, 2010). The system is largely publicly funded, copayments contribute only a small fraction (Maarse and Jeurissen, 2016). These copayments depend on type and duration of care, age, household composition, income, and (as of 2013) wealth. The payments are capped and cannot exceed the household income (Bakx et al., 2020a).

In the UK LTC is organized in a mixed-system combining universal and means-tested benefits. Health services and health related LTC components, such as nursing care, are provided for free by the National Health Service (NHS) (Colombo et al., 2011). 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 requiring users to deplete their wealth before obtaining publicly funded care (Colombo

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

	Netherlands	United Kingdom
Share of population aged 65+ <sup>1</sup>	18.7%	18.1%
Share of 65+ reporting some/severe limitations in daily activities <sup>2</sup>	47.9%	44.9%
LTC expenditures (health and social components) governmental and compulsory schemes (% GDP) <sup>3</sup>	3.7%	1.4%
Beds in LTC facilities per 1000 65+ inhabitants <sup>4</sup>	74.8	45.6
% informal caregivers among 50+ population <sup>5</sup>	16.8%	18.2%
% of caregivers providing at least 20 h of care per week <sup>6</sup>	8%	17%
Care services available to informal caregivers <sup>7</sup>	Carers and care receivers allowance, additional benefits, paid leave, unpaid leave, flexible work arrangements, training/education, respite care, counseling	Carers and care receivers allowance, 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.

et al., 2011). Individual income and assets determine whether a service is (partly) covered (NHS, 2018a). Currently only individuals with assets below GBP 14,250 (approximately €16,886) will receive full-coverage (NHS, 2018b).

## 2.2. Role of informal carers in the system and available support

In both countries informal care is common: about 17–18% of the 50+ population identified him/herself as an informal caregiver (OECD, 2019). However, the average time spent caring strongly differs. According to the European Social Survey of 2014, 17% of the UK caregivers provides more than 20 h of care per week compared to 8% 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 caregivers and are among the few countries that have a national policy that targets this group. Furthermore, both countries offer (under different regulations) financial support, respite care, training and counseling for caregivers (Courtin et al., 2014).

## 2.3. 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 it offers more 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, irrespective of the type of care that is provided. 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. More recent studies, although not using identical questions, also indicate different norms between the UK and the Netherlands. In 2016, 9% of the UK population stated that care to older individuals should be primarily provided by family 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). These different attitudes 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.

## 3. Methods

It is not possible to study the impact of informal care provision on health by comparing the health of caregivers and non-caregivers as certain individuals, for example those with lower health, might be more likely to provide informal care. To account for these selection effects, we use propensity score matching. Following Schmitz and 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. The variables included can be grouped into three categories. The first, care obligations, covers information on parents and spouses to capture the presence of individuals in potential need of care. We further include whether both parents are alive and whether siblings are present to capture alternative informal care sources. The second category contains information on respondents themselves such as personal characteristics (age, sex), socio-economic status (marital and employment status, household income) and household structure. The third category contains information on individuals' health status using the MCS and PCS values and the self-reported presence of long-standing illnesses/disability. The

complete list of variables used can be found in Table 3 as well as Appendix Table A1 and A2.

By matching caregivers and non-caregivers based on their propensity of providing informal care we assume that the remaining difference in health 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 informal caregiving. This assumption of conditional independence is the main assumption underlying our estimation strategy. To make it 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 conditional upon all variables potentially affecting the care decision in the preceding wave. 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 and 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. Adding the covariates to the regression next to matching based on the same covariates is referred to as double-robust. 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 matched non-caregiving individuals.

We assess whether our matching strategy achieved its goal of balancing covariates using the standardized bias (Rosenbaum and 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. We include the first four waves of data annually collected via self-completion online surveys 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). For the UK we use the first four waves of the United Kingdom Household Longitudinal Survey, commonly known as Understanding Society (USoc; University of Essex, 2019). Data from the USoc is collected online or via face-to-face interviews among the 16+ population, data collection is annually and started 2009. Ethics approval has been obtained by the USoc and STREAM researchers and therefore no further ethical approval was required.

### 4.1. Informal care definition

We 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: 'Giving 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 we construct dummy variables indicating low intensity (less than 10 h of care per week), medium intensity (between 10 and 20 h of care per week) and high intensity caregivers (more than 20 h of care per week).

#### 4.2. Health outcomes

To capture the health effect of informal caregiving we use the 12-item Short Form Health Surveys (SF-12). This health survey 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. Both scales are validated and range from 0 (lowest health) to 100 (optimal health) and transformed to have a mean of 50 and a standard deviation of 10 (Ware et al., 1995).

#### 4.3. 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 and health status. Variables related to the health and demographics of the respondent are present in both datasets and in most cases easily comparable as (a) they use the same instruments (e.g. the MCS and PCS) or (b) because the 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 income and family structure of the respondent. 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 must 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 of the respective country sample. An overview of the definition and source of all used variables is available in Online Appendix 1.

#### 4.4. Sample selection

In order to make both datasets comparable we restrict the samples as follows: (i) We 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. These selection criteria are motivated by the fact that the Dutch dataset only covers individuals aged 45–65 and we have access to its first four waves spanning 2010 to 2013, hence we use a similar subset of the USoc data. Further, (iii) we condition the datasets on availability of all 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 8141 Dutch and 7187 UK respondents.

#### 4.5. Time structure

For both datasets we define a relative time variable ( $t$ ) whose value

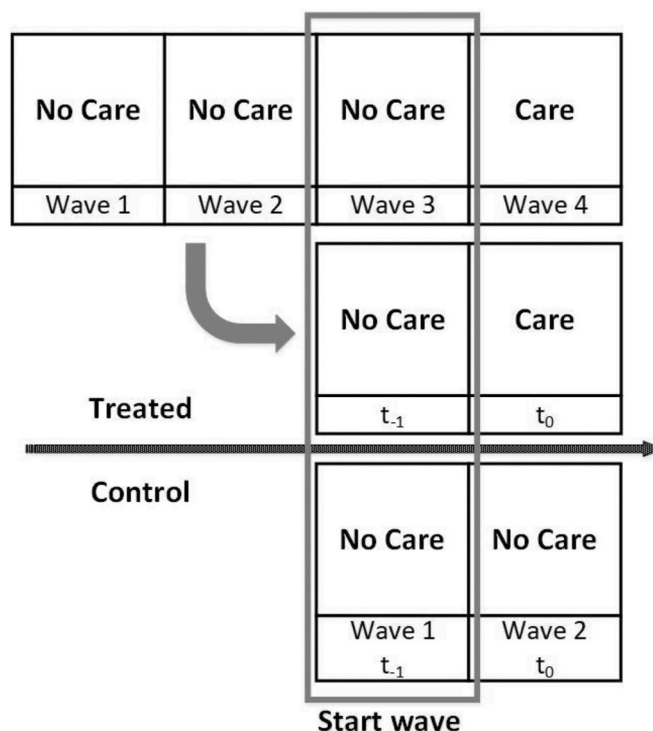


Fig. 1. Visualization of the constructed time structure of the sample (Own visualization).

depends on an individual’s first reported care-episode (see Fig. 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.

### 5. Results

#### 5.1. Descriptives & matching results

Table 2 provides an overview of the composition of caregivers in both datasets. 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 24% of the sample starts care provision compared to 21% of the Dutch sample. The share of female and parental caregivers is higher in the UK than in the Netherlands 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.

To match caregivers and non-caregivers we estimate propensity scores of providing informal care. Table 3 provides an overview of the propensity score estimations. In both samples especially the variables related to care obligations are strongly correlated to someone’s propensity of providing informal care. As parents tend to provide care to each other, the presence of both parents is negatively associated with informal care. The age of these parents, which acts as a crude proxy for the rate of dependency of the individual, increases the informal care propensity. Furthermore, females and more highly educated individuals are more likely to provide care whereas the presence of young children is



**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	1378	(80.5%)	1302	(76.0%)
Medium Intensity caregivers	181	(10.6%)	205	(12.0%)
High Intensity caregivers	135	(7.9%)	177	(10.3%)
Spousal caregivers <sup>a</sup>	203	(12.0%)	214	(12.0%)
Parental caregivers <sup>a</sup>	688	(40.0%)	954	(56.0%)
Full-time employed (% of sample)	4634	(57.0%)	3863	(53.8%)
Full-time employed & caregiver (% of caregivers)	856	(50.0%)	844	(49.3%)
<b>Number of Individuals</b>	8129		7186	

<sup>a</sup> Dutch values are imputed as information on care recipient for the Dutch data is only available in 2012–2013.

Sources: STREAM Wave 1–4 & USoc Wave 1–4.

**Table 3**  
Propensity score estimates.

	Dutch sample		UK sample	
	Coefficient	Standard Error	Coefficient	Standard Error
<b>Care Obligations</b>				
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)
<b>Personal Characteristics and Socio-Economic Status</b>				
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 quintile 3	-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)
<b>Health</b>				
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)
<b>Observations</b>	8141		7187	
<b>Pseudo R<sup>2</sup></b>	0.06		0.05	

\*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001, standard errors in parentheses. Sources: STREAM Wave 1–4 & USoc Wave 1–4.

negatively related to informal care provision. For an overview of the distribution of the propensity scores, please see Fig. A1.

In both countries informal caregivers differ from non-caregivers. As can be seen in Appendix Tables A1 and A2 there is a strong imbalance between the individuals that started to provide care and those who did not do so. This imbalance is depicted in Fig. 2 by plotting the pre-matching (black) and post-matching (grey) standardized bias values

for each control included. Before the matching there is considerable imbalance between the non-caregiver and caregiver samples with many variables exceeding the 3–5% standardized bias threshold (grey bar). The matching succeeds in correcting this imbalance with the standardized bias between the matched control group and the treatment group falling below the thresholds for all considered variables. 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.

**5.2. Main results**

Our baseline analysis estimates the impact of any informal care provision on health. Throughout the main text we present our results graphically, results tables can be found in Appendix A3 to A5. Fig. 3 presents the impact of any care provision on (a) mental and (b) physical health. The bar presents the ATT, the confidence intervals are depicted at 95%. Dutch caregivers experience a direct negative mental health effect of -0.70 (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 0.69 (p < 0.01) in the UK whereas no significant impact is present among the Dutch caregivers.

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 (Fig. 4) 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.

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 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, we construct three groups based on the hours of care provided.

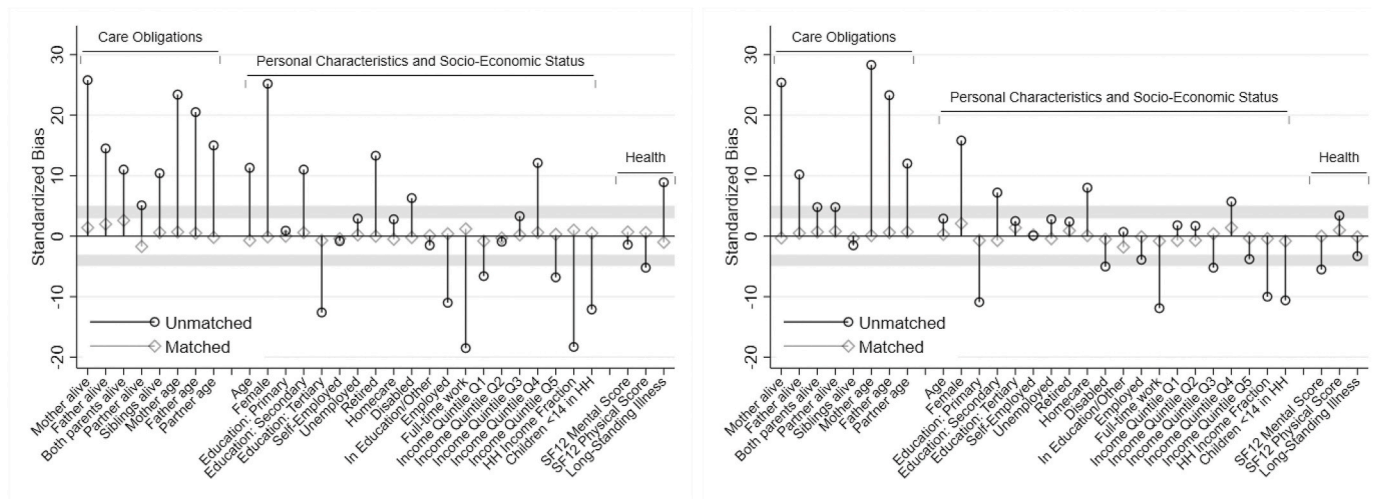
Fig. 5 presents the treatment effects when separately estimated for low, medium and high intensity caregivers. The figure clearly depicts that the impact of care provision strongly differs by the amount of care provided. In both countries, high intensity caregivers experience the largest mental health effects. This health impact of providing more than 20 h of informal care per week is 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 h of care per week the estimates seem to point again to a positive effect although the results are insignificant.

Next to the intensity of care provided, other contextual elements could influence the care burden. Individuals might for example experience increased caregiving strain when providing informal care in combination to full-time employment. Facing multiple responsibilities might namely lead to cross-pressures, like fatigue or dissatisfaction about

(a) Dutch sample

(b) UK sample

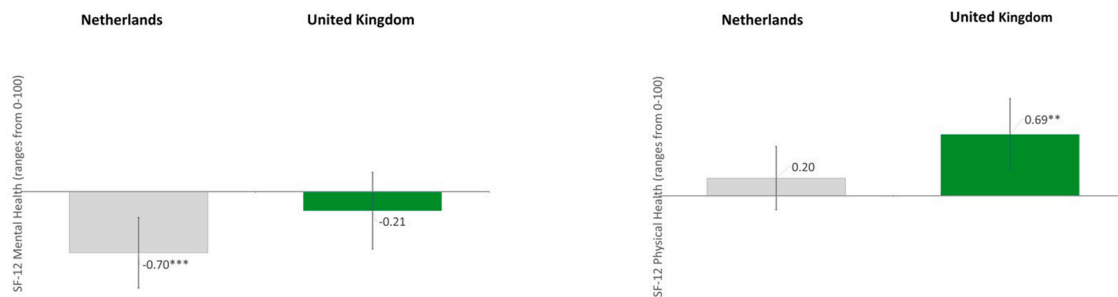


Note: The grey lines mark the standardized bias range of 3-5%, following the rule of thumb suggested by Caliendo & Kopeinig (2008) we consider balance to be sufficient when the bias is below 3-5%. Sources: STREAM Wave 1-4 & USoc Wave 1-4.

Fig. 2. Standardized bias before and after matching (Caliendo and Kopeinig, 2008).

(a) Mental health

(b) Physical health



Confidence intervals at 95%, \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\*  $p < 0.001$ . Sources: STREAM Wave 1-4 & USoc Wave 1-4.

Fig. 3. Impact of any informal caregiving on mental/physical health.

decreased productivity at work due to caregiving tasks (Pearlin et al., 1990). Using German data, Schmitz and Stroka (2013) found that individuals experiencing 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.

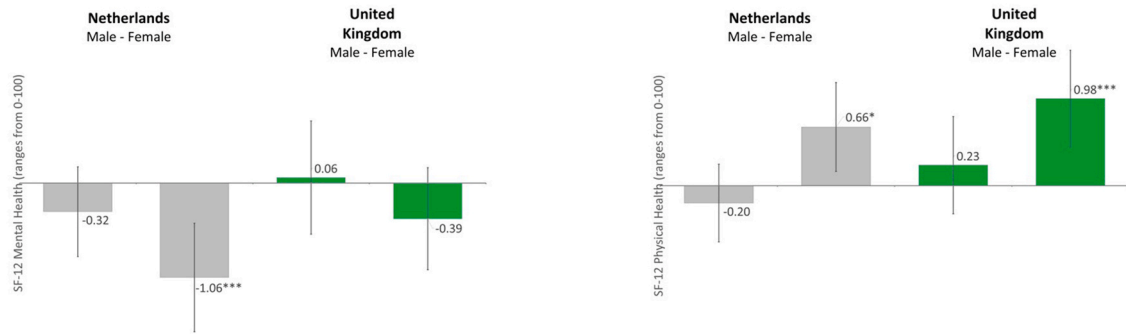
To estimate the impact of care provision for individuals experiencing a double burden we compare the health impact of care provision between individuals in full-time employment to those not working full-time. We solely focus on individuals with stable workforce participation to exclude individuals that 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% and 6.8%. Additionally, due to sample size limitations we solely compare employment status by individuals providing either low or medium to high intensity care provision (>10 h of care per week).

Fig. 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 not at all. 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) Mental health

(b) Physical health

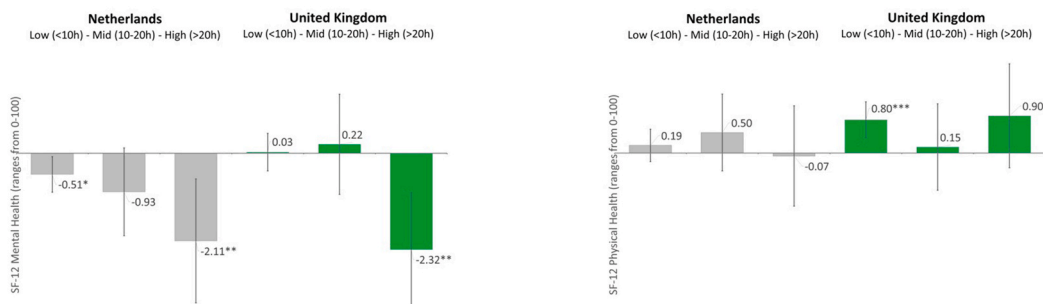


Confidence intervals at 95%, \*p<0.05, \*\*p<0.01, \*\*\* p<0.001. Sources: STREAM Wave 1-4 & USoc Wave 1-4.

Fig. 4. Impact of any informal care on mental/physical health by gender.

(a) Mental health

(b) Physical health

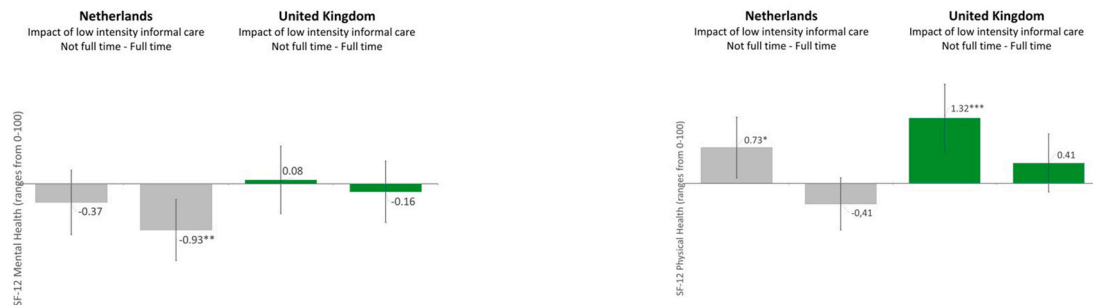


Confidence intervals at 95%, \*p<0.05, \*\*p<0.01, \*\*\* p<0.001. Sources: STREAM Wave 1-4 & USoc Wave 1-4.

Fig. 5. Impact of informal caregiving on mental/physical health by care intensity.

(a) Mental health

(b) Physical health

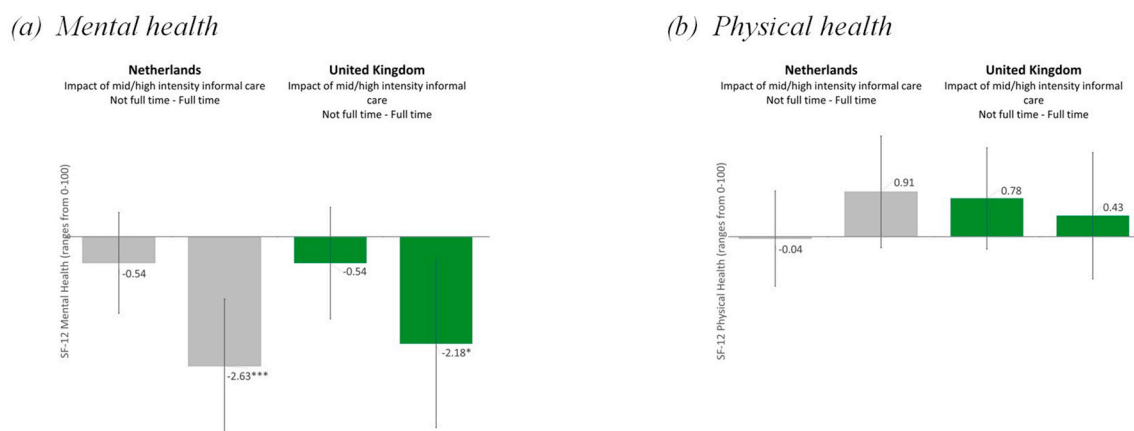


Confidence intervals at 95%, \*p<0.05, \*\*p<0.01, \*\*\* p<0.001. Sources: STREAM Wave 1-4 & USoc Wave 1-4.

Fig. 6. Impact of low informal caregiving on mental/physical health by employment.

A double burden might especially be present for individuals who next to a full-time job provide many hours of informal care. Fig. 7 shows that in both countries indeed the mental health effect of providing more than 10 h 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.



Confidence intervals at 95%, \*p<0.05, \*\*p<0.01, \*\*\* p<0.001. Sources: STREAM Wave 1-4 & USoc Wave 1-4.

Fig. 7. Impact of mid/high intensity informal caregiving on mental/physical health by employment.

6. Robustness checks

To assess the robustness of our results 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 highest/lowest 5%. Additionally, we check whether our results differ when re-estimating the propensity scores for the intensity groups separately. The results are highly comparable to those presented in the main specification (detailed results are available upon request).

Second, we test how sensitive our results are with regards to a violation of the main identifying assumption of conditional-independence. We follow Ichino et al. (2008) who propose a simulation-based sensitivity analysis for 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 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*). Another motivation for such a sensitivity analysis is the fact that we only observe caregivers before care provision ( $t_{-1}$ ) and when they report to have started caregiving ( $t_{-0}$ ). We therefore cannot observe the actual moment of caregiving onset while additionally the actual cause for caregiving onset might have a direct effect (e.g. a health shock to a family member).

The method 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 unobserved confounders. Table 4 depicts our estimated treatment effects when simulating a confounder that combines the

Table 4  
Mental health effects of high intensity caregiving - sensitivity analysis.

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

\*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001, standard errors in parentheses. Sources: STREAM Wave 1-4 & USoc Wave 1-4.

strongest observed selection and outcome effects. As the estimated values illustrate, our results are robust to such a simulated confounder. Online appendix table O2 depicts the estimated selection and outcome effects for all our covariates.

7. Discussion & conclusion

While several studies have reported negative health effects of informal care provision on the caregivers’ health, there remains uncertainty with regards to their causal nature and the differences of these effects across countries and caregiver subgroups. Using a propensity score matching approach and two comparable panel-data sets, we estimated the health impact of providing care in the UK and the Netherlands. Doing so, we investigated whether 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 hours of informal care provision. 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 our samples this is indeed the case with slightly more caregivers providing more than 10 h of weekly care in the UK compared to 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.

Second, we show the importance of considering care-intensity when comparing average caregiving effects across countries. In both countries especially individuals providing more than 20 h of weekly care experience large negative mental health effects. Individuals providing less intensive care do not experience any mental health effect (United Kingdom) or a similar negative but considerably smaller one (Netherlands). These findings are consistent with the findings of Kaschowitz and Brandt (2017) who hypothesized that differences between groups of caregivers (like care intensity) determine the average impact of caregiving.

Third, our results uncover interesting patterns regarding the physical health effects of caregiving. We observe small positive physical health effects among caregivers who provide less than 10 h 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 might 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. (2015) 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 analyses indicate that especially caregivers who combine caregiving with full-time employment experience large 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 reduced working hours due to caregiving-related health issues. While this might introduce a downward bias and raise concerns about the external validity of our results, recent evidence suggests that there is no effect of informal caregiving on labour force participation in both countries (Heitmüller, 2007; Rellstab et al., 2020). In the UK, intensive caregiving might however affect the number of hours worked (Heitmüller and Inglis, 2007). As across countries the relationship between informal care and labour market outcomes is diverse (for a review see Bauer and Sousa-Poza, 2015), there is nonetheless a need for further research into the complex relationship between health, labour market outcomes and the long-term care system.

The bulk of our results suggests that once the focus is narrowed 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 the type of care provided (e.g. personal care, household help) or the associated social norms. The country-specific differences in effect size are however considerably smaller compared to differences between subgroups of caregivers.

While our study provides important insights, there are several limitations that need to be taken into account when interpreting our results. First, we rely on a matching based empirical strategy aimed at estimating the causal effect of informal care on health. Matching estimators require the conditional independence assumption to hold and while we attempt to explore the impact of a potential violation of this assumption, an ideal empirical strategy would rely on plausible exogenous variation in informal caregiving status. As pointed out by Schmitz and Westphal (2015) many of the commonly applied instrumental variables in this literature, such as the presence of siblings or health shocks, are not without their own drawbacks. A more credible source of variation could be obtained from policy variation as recently done by Bakx et al. (2020b). However, given our cross-country perspective such an empirical strategy is not feasible.

A second limitation is that we cannot 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 and Bom, 2020) however found that inclusion of an indicator of 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 no direct mental health effect associated with concerns regarding family members' health. 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.

Lastly, while the used datasets allow for similar matching, we still lack some important information that ideally should be considered. We rely on self-reported hours as our measure of care intensity. While this measure seems sufficient to capture the general differences between intensity levels it would be ideal to not only observe hours but also the specific tasks that were conducted as they are highly disease-specific and differ with regards to their perceived burden (Pearlin et al., 1990). In addition, we cannot observe the consumption of formal care.

Concluding, our results provide insights for both researchers and policy makers. First, they indicate that especially differences in caregiver characteristics drive the differences in observed health effects of care provision across countries. These insights can be used to specifically target support to those caregivers who experience the largest burden: those who provide most hours of 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 seem to 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 systems 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.

#### Credit author statement

Judith Bom: Conceptualization, Methodology, Formal analysis, Writing – original draft, Writing – review & editing, Visualization. Jannis Stockel: Conceptualization, Methodology, Formal analysis, Writing – original draft, Writing – review & editing, Visualization.

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#### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.socscimed.2020.113562>.

Appendix

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

	Treated		Control		Matched Controls		Standardized Bias	
	Mean	SD	Mean	SD	Mean	SD	Unmatched	Matched
<b>Care Obligations</b>								
Mother alive	0.56	0.50	0.44	0.50	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	0.90	0.31	0.90	0.30	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
<b>Personal Characteristics and Socio-Economic Status</b>								
Age	53.99	5.76	53.82	5.99	53.97	5.77	2.90	0.30
Female	0.60	0.49	0.52	0.50	0.58	0.49	15.80	2.10
Secondary Education	0.40	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	0.10	0.30	0.10	0.30	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	0.00	0.06	0.00	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	0.50	0.55	0.50	0.50	0.50	-11.90	-0.80
Income quintile 1	0.23	0.42	0.25	0.43	0.21	0.41	1.80	-0.70
Income quintile 2	0.21	0.41	0.20	0.40	0.20	0.40	1.70	-0.70
Income quintile 3	0.20	0.40	0.19	0.39	0.17	0.37	-5.20	0.40
Income quintile 4	0.17	0.38	0.19	0.39	0.19	0.39	5.70	1.40
Income quintile 5	0.19	0.40	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
<b>Health</b>								
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	0.40	0.49	0.42	0.49	0.41	0.49	-3.30	-0.10
<b>Number of Individuals</b>	1714		5473		5473			

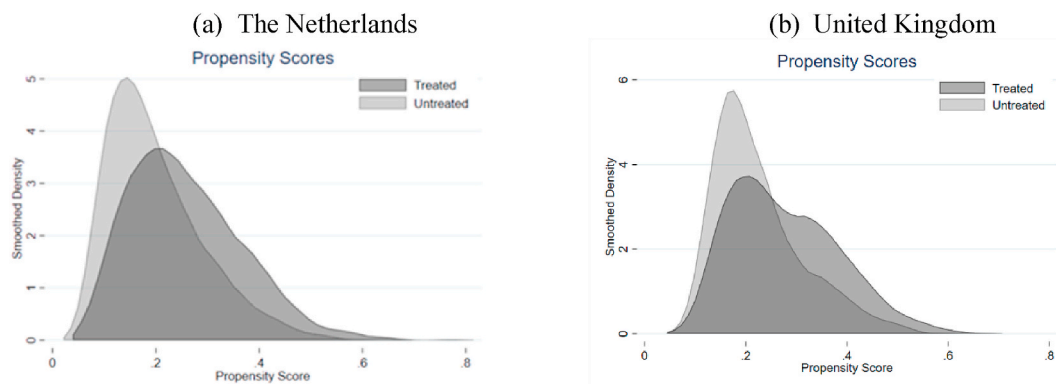
**Table A2**  
Dutch sample Descriptive Statistics – Treatment and Control Groups

	Treated		Control		Matched		Standardized Bias	
	Mean	SD	Mean	SD	Mean	SD	Unmatched	Matched
<b>Care Obligations</b>								
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	0.34	0.37	0.38	0.88	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
<b>Personal Characteristics and Socio-Economic Status</b>								
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
Home carer	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	6.30	-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	0.5	-11.00	0.40
Full-time employee	0.50	0.50	0.59	0.49	0.49	0.4	-18.50	1.20

(continued on next page)

Table A2 (continued)

	Treated		Control		Matched		Standardized Bias	
	Mean	SD	Mean	SD	Mean	SD	Unmatched	Matched
Income quintile 1	0.21	0.41	0.24	0.43	0.19	0.4	-6.60	-0.80
Income quintile 2	0.19	0.39	0.22	0.41	0.19	0.4	-0.90	-0.30
Income quintile 3	0.20	0.40	0.20	0.41	0.20	0.4	3.30	0.20
Income quintile 4	0.20	0.40	0.18	0.39	0.20	0.4	12.10	0.60
Income quintile 5	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	0.3	-18.30	1.00
Children <14 in Household	0.10	0.31	0.14	0.35	0.10	0.3	-12.10	0.50
<b>Health</b>								
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	10.4	-5.20	0.60
Longstanding illness	0.65	0.48	0.60	0.49	0.65	0.48	8.90	-1.00
<b>Number of Individuals</b>	1723		6418		6418			



Sources: STREAM Wave 1-4 & USoc Wave 1-4.

Fig. A1. Propensity score distributions.

Table A3  
Estimation results by care intensity

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

\*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001, standard errors in parentheses. Sources: STREAM Wave 1-4 & USoc Wave 1-4.

**Table A4**  
Estimation results by gender

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

\*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001, standard errors in parentheses. Sources: STREAM Wave 1–4 & USoc Wave 1–4.

**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 (0.336)	0.725* (0.305)	0.082 (0.360)	1.317*** (0.360)
Full-time work & < 10 h	-0.932** (0.312)	-0.412 (0.276)	-0.156 (0.316)	0.412 (0.299)
Not full-time & >= 10 h	-0.535 (0.620)	-0.040 (0.522)	-0.542 (0.604)	0.778 (0.543)
Full-time & >= 10 h	-2.633*** (0.674)	0.911 (0.565)	-2.179* (0.882)	0.426 (0.668)
<b>Control</b>				
Not full-time		2520		2276
Full-time		3459		2670
<b>Treatment</b>				
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. Sources: STREAM Wave 1–4 & USoc Wave 1–4.  
Source: USoc Wave 1–4., Source: STREAM Wave 1-4

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