Why are older informal carers in better health? Solving a causality problem

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Abstract

Informal care is a widespread and important segment of long-term care, which is carried out independently of or in parallel with formal care, i.e. as a complement or replacement. Informal caregivers represent the backbone of long-term care, as has been witnessed by numerous international studies. In our article we focus on the relationship between the health status of the respondent and the decision to provide informal help to others as well as the intensity of the care. We show that this relationship is endogenous (reverse causality), using different measures of health and instrumental variables from Wave 5 and Wave 3 of SHARE Survey, and determine the causal effects of health on informal care, provided within and/or outside household. We also model the effect of various different covariates on informal caregiving. In conclusion we provide reflections on the research and discuss the policy relevance of the study.

Keywords: informal care, caregivers, health, reverse causality, instrumental variables, SHARE

1 INTRODUCTION AND LITERATURE REVIEW

The causal relationship between informal caregiving and (poor) health has been established in several studies (e.g. Schulz and Sherwood, 2008; Schulz and Beach, 1999; Pinquart and Sörensen, 2003; Roth et al., 2009; Vitaliano, Zhang and Scanlon, 2003). Yet, what still remained under-researched is the effect of health on informal caregiving. As we show in the article, the results of basic correlations using common datasets on ageing in Europe (like SHARE) often confirm the negative sign of the relationship: particularly for caregivers within a household, those with worse health tend to give help more often. The question that motivating this article therefore, is: *what is driving this relationship*.

As stated in Hlebec, Srakar and Majcen (2017), long term care is considered an emerging key issue in discussing the social inclusion or exclusion of the older population in modern European society (e.g. Theobald, 2005; Motel-Klingebiel, Tesch-Roemer and von Kondratowitz, 2005). Cross-national econometric studies of the relationship between formal and informal care for older adults in western European countries have become a booming field (Suanet, van Groenou and van Tilburg, 2012).

Organizing care for older people is one of the most important issues in European countries which are characterized by a rise in the share of the elderly, which is caused by longer life expectancy and declining fertility rates. The share of the population aged 80 years and over, which is the most likely to need care, grew from 1.5% in 1960 to nearly 5% in 2010 in Europe as a whole, and is expected to rise to 11% by 2050 and 12% by 2060 (OECD, 2013; The Ageing Report, 2015). The share of people aged 20-64 will decline substantially from 61% in 2013 to 51% by 2060 (ibid.). Thus, we can expect a big increase in the need for care on one hand, and a smaller number of potential informal carers on the other.

Both trends are likely to place greater demands on formal care systems across Europe.

The majority of older people wish to age and receive care in their own homes (Cantor, 1979; Iecovich, 2014). In 2011, in OECD countries 8.7% of people aged 65+ received care in their own homes as against 4.1% in institutions (OECD, 2013). For people living at home, care can be provided by different parts of informal social networks like family members, friends or neighbours (Cantor, 1979; Wenger, 1994; Allen, Goldscheider and Ciambrone, 1999; Blomgren et al., 2008). Care can also be provided by formal care workers such as providers of health and social care or migrant care workers (Iecovich, 2010; Walsh and O'Shea, 2010; Shutes and Chiatti, 2012; Stevens, Hussein and Manthorpe, 2012; Williams, 2012). Very often, older people combine care from different sources: private and public care, formal and informal care, informal care by spouses, children and other informal sources (Litwin and Attias-Donfut, 2009; Gannon and Davin, 2010).

The type of care older people use depends on their preferences and their individual and social contexts (Andersen and Newman, 2005). Some people prefer only informal care (Cantor, 1979; 1991) and seek care first from their partners and children, then other family members, friends and neighbours. Only in cases where no informal caregivers are available will they accept formal care, provided they can afford it financially and depending on the range of services provided by the community. Formal care, therefore, may compensate for a lack of informal care and complement informal care when needs grow (Chappell and Blandford, 1991; Denton, 1997).

Informal carers provide a vast amount of care to older people in Europe as shown by data from the European Quality of Life Survey. About 6.4% (Denmark) to 20.1% (Lithuania) of the adult population in Europe provides care to their elderly or disabled relatives at least once or twice a week. On average, these family members deliver 12.5 hours of care to dependent family members. Care is frequently provided by spouses or children, sometimes also by friends and neighbours (Cantor, 1979; Stoller and Pugliesi, 1988; Allen, Goldscheider and Ciambrone, 1999; Barrett and Lynch, 1999). Most European countries support informal carers with specific policy measures (Mestheneos and Triantafillou, 2005; Saraceno and Keck, 2010; Colombo et al., 2011). Support for informal carers encompasses a variety of services in cash and in kind, services specified for working carers and others (e.g. a carer's allowance, an allowance for the person being cared for, tax credits, additional benefits, paid leave, unpaid leave, flexible work arrangements, training/education, respite care, counselling).

There is a lot of literature (primary and meta-analysis) on the impacts of informal caregiving on caregivers' health (e.g. Roth et al., 2013; Hiel et al., 2015; Vlachantoni, 2013; Schulz and Sherwood, 2008; Pinquart and Sorensen, 2003; 2006; 2007). Interdisciplinary research has provided different research designs, sam-

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pling procedures, statistical methods of a heterogeneous nature. Health has been studied as psychological health and physical health (separately or simultaneously). Meta-analyses and other systematic reviews typically conclude that caregivers are more likely to experience depressive symptoms and have poorer physical health outcomes when compared with various samples of non-caregivers (Pinquart and Sörensen, 2003; Schulz and Sherwood, 2008; Vitaliano, Zhang and Scanlon, 2003). Recent review (Bauer and Sousa-Poza, 2015) pointed out that caregiving tends to lower the quality of the caregiver's psychological health, which also has a negative impact on physical health outcomes. Some studies (Schoenmakers, van Tilburg and Fokkema, 2015; Bauer and Sousa-Poza, 2015) noted that: (a) literature reviewed is very heterogeneous – minimally comparable; (b) most studies are cross-sectional and thus do not/cannot account for endogeneity; (c) research often omits important controls (e.g. pre-existing illness).

However, insufficient attention has been paid to estimating and explaining the (reverse) causal relationship between health and caregiving, i.e. the effects of health *on the* provision of caregiving. The aim of the article is to explain this relationship in detail, including the heterogeneous behaviour across different types of care provision (within or outside a household).

In a recent article, Kaschowitz and Brandt (2017) provided a longitudinal analysis of the health effects of informal caregiving across Europe. Using data from the Survey of Health, Ageing and Retirement (SHARE, waves 1, 2, 3 and 5) and from the English Longitudinal Study of Ageing (ELSA, waves 2-5) they examined the connection between informal caregiving and self-perceived as well as mental health in a country=comparative perspective. They were able to show distinct differences in the relationship between reported health and the provision of informal care depending on whether individuals give care to someone inside or outside the household. Caregivers inside the household reported worse, while caregivers from outside the household reported better, health than non-caregivers. Their explanation is largely related to selection into caregiving: according to their findings, people in worse health take up care inside while people in better health take up care outside the household. Their results also show that the health consequences of caregiving vary not only between different welfare regimes but also among countries of similar welfare state types.

Based on the above, in our article we test three main hypotheses:

H1: Older people in better health tend to provide more help to others[1].

H2: The relationship between informal caregiving and health is of an endogenous, reverse causal nature.

[1] All of those hypotheses relate to decision of providing care and not to quality or type of care.

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H3: There are significant differences in the relationship of health and informal caregiving or help-giving[2] within and outside a household[3].

The main method we use to verify the above hypotheses is regression analysis, using instrumental variables models to appropriately model the assumed reverse causality in the relationships studied.

The article is structured in the following way. In the next section, we will present basic considerations about the data and method used. In the third section, we will present the main results and robustness tests. In the final section, we will conclude with reflections on the research findings and policy implications.

2 DATA AND METHOD

We use dataset derived from Wave 5 of the SHARE survey[4]. The Survey of Health, Ageing and Retirement in Europe (SHARE) is a multidisciplinary and cross-national panel database of micro data on health, socio-economic status and social and family networks of approximately 123,000 individuals (more than 293,000 interviews) from 20 European countries (+Israel) aged 50 or older[5]. SHARE is centrally coordinated by the Munich Centre for the Economics of Aging (MEA), the Max Planck Institute for Social Law and Social Policy. It is harmonized with the U.S. Health and Retirement Study (HRS) and the English Longitudinal Study of Ageing (ELSA) and has become a model for several ageing surveys worldwide. In the analysis, we also use data from Wave 3, SHARELIFE, which provides data on life-histories of the respondents.

SHARE data collection is based on computer-assisted personal interviewing (CAPI). Exceptions are the drop off and vignette questionnaires, which are conducted via paper & pencil as well as the end-of-life interviews that can be conducted via CATI (computer-assisted telephone interview), too. The SHARE study is subject to continuous ethics review. During Waves 1 to 4, SHARE was reviewed and approved by the Ethics Committee of the University of Mannheim. Wave 4 and the continuation of the project were reviewed and approved by the Ethics Council of the Max Planck Society. In addition, the country implementations of SHARE were reviewed and approved by the respective ethics committees or institutional review boards whenever this was required (Börsch-Supan and Jürges, 2005).

[2] In the article, we use the terms caregiving and help-giving as synonymous.

[3] The studies also report a noticeable difference in respondents' answers about the type of help received from other people (e.g. personal care vs. practical household help, see Hoefman, Meulenkamp and de Jong, 2017). In providing care within the household, assistance is related to personal care. Help-giving outside a household refers to personal care and practical care.

[4] This paper uses data from SHARE Wave 5 (http://doi.org/10.6103/SHARE.w5.100), see Börsch-Supan et al. (2013) for methodological details. The SHARE data collection has been primarily funded by the European Commission through FP5 (QLK6-CT-2001-00360), FP6 (SHARE-I3: RII-CT-2006-062193, COMPARE: CIT5-CT-2005-028857, SHARELIFE: CIT4-CT-2006-028812) and FP7 (SHARE-PREP: N°211909, SHARE-LEAP: N°227822, SHARE M4: N°261982). Additional funding from the German Ministry of Education and Research, the U.S. National Institute on Aging (U01_AG09740-13S2, P01_AG005842, P01_AG08291, P30_AG12815, R21_AG025169, Y1-AG-4553-01, IAG_BSR06-11, OGHA_04-064) and from various national funding sources is gratefully acknowledged (see www.share-project.org).

[5] For more details, see Börsch-Supan et al., 2013; 2015; Malter and Börsch-Supan, 2015; Börsch-Supan, 2016.

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After including instruments from SHARE Wave 3, our final sample consists of 14,564 respondents from 11 European countries (Austria, Germany, Sweden, Netherlands, Spain, Italy, France, Denmark, Switzerland, Belgium, Czech Republic).

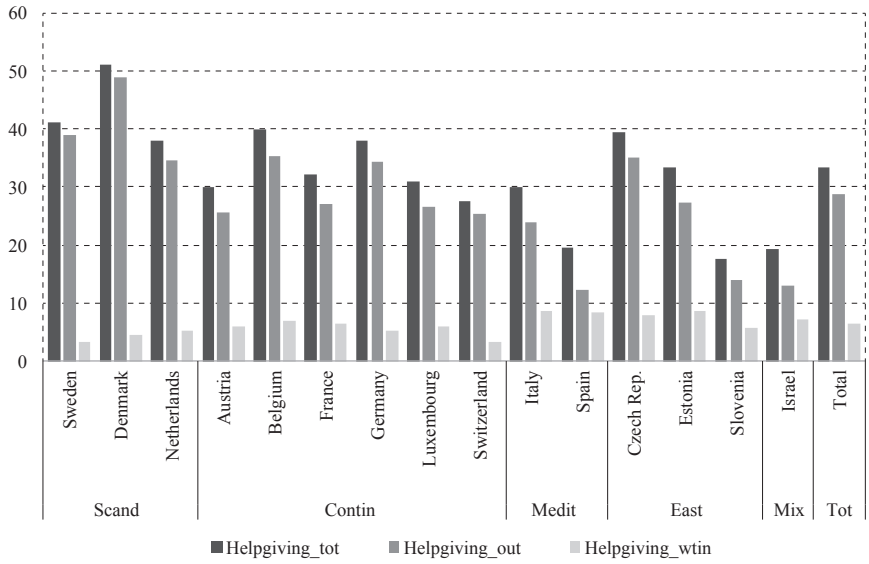
We include three main help-giving variables:

Help-giving_out: binary variable for providing help outside a household.
Help-giving_wtin: binary variable for providing help within a household.
Helpgiving_tot: joined variable of Help-giving_out and Help-giving_wtin[6].

Graph 1 presents the distribution of the three variables over the countries and welfare regimes. We can see that the countries with the highest percentage of total help-giving and help-giving outside household are the Social Democratic/Scandinavian countries. They are followed by continental countries and some Eastern European ones, while, in particular, Mediterranean countries and Israel fall quite behind. Interestingly, those are the countries that, on the other hand, have the largest percentages of help-giving within a household.

Graph 1

Distribution of the help-giving variables (%)



Source: Own calculations.

Table 1 provides the actual quantities of people in the population providing help. Most of the relationships observed in graph 1 can be seen here as well, in particular the large number of people providing help within the household in Mediterranean countries.

[6] For the explanation of the two variables, see descriptions above

Table 1

Estimation of total help-givers, Deville-Särndal's procedure

	Country	Helpgiving_tot	Helpgiving_out	Helpgiving_wtin
Scand	Sweden	1,527,567	1,460,927	113,159
	Denmark	1,048,569	1,005,553	92,927
	Netherlands	2,376,857	2,163,370	315,709
Contin	Austria	953,164	833,773	177,566
	Belgium	1,637,570	1,426,540	331,931
	France	8,371,773	7,252,966	1,507,020
	Germany	12,648,003	11,455,470	1,745,328
	Luxembourg	52,710	45,376	10,395
	Switzerland	839,445	790,900	90,097
Medit	Italy	7,153,458	6,053,197	1,691,223
	Spain	3,572,164	2,512,323	1,268,977
East	Czech Rep.	1,483,696	1,341,115	298,467
	Estonia	172,302	150,356	36,329
	Slovenia	131,627	106,774	39,095
Mix	Israel	306,143	198,250	119,050
Tot	Total	42,275,048	36,796,889	7,837,273

Source: Own calculations.

The main health variables we use in the analysis are:

- Physical health: number of chronic diseases (dummy: 1 if a respondent has two or more chronic diseases; and 0 otherwise).
- Mental health: depression (dummy: 1 if a respondent has a score of 4 or more on the Euro-D Depression scale; and 0 otherwise).
- Subjective assessment of health: self-rated health status (dummy: 1 if less than very good; and 0 otherwise).

As control variables we use:

- Gender: gender of the respondent, 0 for male, 1 for female.
- Age: age of the respondent in years.
- Education: education of the respondent in years of his/her schooling period.
- Income: nominal household income (variable *thinc2* from the generated SHARE variables), winsorised to prevent the impact of outliers and transformed into tertiles (by country).
- Employment status: categorical variables, describing whether the respondent is employed, retired or in any other status (e.g. unemployed).
- Household size: size of the household of the respondent.
- Physical inactivity: binary variable, defined as never or almost never engaging in either moderate or vigorous physical activity.
- Memory: number of words, recalled after reading a list of ten words[7].

[7] In SHARE, there is also the variable of delayed recall of words which is not used here – but robustness checks have been done using this variable as a control as well with no significant changes in the results.

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– Welfare regimes: classification of the country of the respondent, based on Esping-Andersen (1990), into four types: 1 – continental (Austria, Germany, Netherlands, France, Switzerland, Belgium, Luxembourg); 2 – social democratic (Sweden, Denmark); 3 – Mediterranean (Spain, Italy); 4 – Eastern European (Czech Republic, Slovenia, Estonia).

We also use the following auxiliary variable:

– Receiving help: 1 if the respondent is receiving informal care within the household and 0 otherwise.

As instruments we use the following variables, all from Wave 3 of SHARE – SHARELIFE:

– As instrument for the number of chronic diseases: sl_hs006: "childhood health: in hospital for 1 month+".
– As instrument for mental health (depression): sl_hs009d3: "childhood illness 2: emotional, nervous, or psychiatric problem".
– As instrument for self-rated health: sl_hs003_: childhood health status.

All instruments satisfy the two instrumental variable restrictions (see e.g. Wooldridge, 2010), the second and the third are also very strong.

Instrumental variable (IV) estimation faces three perils of its own (Murray, 2006):

– IV estimation is inconsistent if the instruments are correlated with the disturbance term. This is the problem of "bad" or "invalid" instruments.
– IV estimation suffers persistent biases and size-of-test biases in even very large samples if the instruments used are only weakly correlated with explanatory variables responsible for bias in an OLS estimation. This is the problem of "weak" instruments.
– Interpreting the economic meaning of IV estimates can become problematic if the slope coefficients in one's model are heterogeneous across observations. This is the problem of "ugly" instruments.

In our case, we face the problem of "ugly" instruments (this was confirmed by initial modellings not presented here) and to derive the proper results we have to model help-giving within and outside a household separately to model the heterogeneity in the model appropriately.

The main formal model we use is instrumental variables probit which fits models with dichotomous dependent variables and endogenous regressors. Formally, the model can be stated as:

$$y^*_{1i} = y_{2i}\beta + x_{1i}\gamma + u_i \tag{1}$$

$$y_{2i} = x_{1i}\Pi_1 + x_{2i}\Pi_2 + v_i \tag{2}$$

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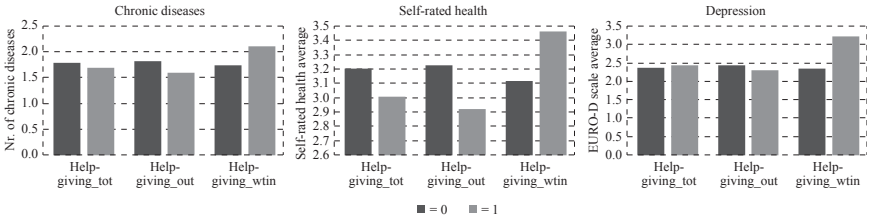
We do not observe y^*_{1i}, instead, we observe

$$y_{1i} = \begin{cases} 0 & y^*_{1i} < 0 \\ 1 & y^*_{1i} \geq 0 \end{cases} \quad (3)$$

Graph 2 provides the basic picture we want to explore. It provides the distribution of health variables for those that provide help in total, outside and within a household. We can clearly see that for all three health variables, the providers of help in total and outside a household face lower problems with health, while those within a household face even higher health problems. This is a puzzle we will solve and provide an explanation for in our analysis.

GRAPH 2

Distribution of the main three health variables (left: number of chronic diseases; middle: self-rated health; right: EURO-Depression scale), based on help-giving within and outside the household and total help-giving



Source: Own calculations.

3 RESULTS AND ROBUSTNESS CHECKS

Table 2 shows the results when using the "ordinary" econometric models with no endogeneity provided for (all models all of probit variety). Interestingly and surprisingly, it is apparent that the more health problems there are (i.e. the more chronic diseases, worse self-rated health and more depression symptoms) the greater the provision of help to others.

What is driving these results? This is of course the main research question of the article, elaborated in the introductory section. An apparent possibility is consideration of the reverse causality in the model. The supposed and basic causality structure imposes health as influencing informal caregiving. Yet, as we noted at the start when reviewing the evidence from the literature, informal caregiving can have (adverse) effects on health indicators as well.

To properly provide for this observation, we include instrumental variables for each of the three health variables. We instrument for number of chronic diseases by childhood health (whether the respondent was in a hospital for 1 month or more during his/her childhood); for mental health by having an emotional, nervous, or psychiatric problem in childhood; and for self-rated health by childhood health status.

Table 2

Results of the models with no endogeneity provided for

Probit: *Help_outside*	Coeff.	z	P>z	Coeff.	z	P>z	Coeff.	z	P>z
Gender	0.0095	0.84		0.0104	0.91		-0.0016	-0.14	
Age	-0.0239	-28.51	***	-0.0234	-28.12	***	-0.0233	-27.80	***
Edu_Years	0.0190	13.59	***	0.0190	13.61	***	0.0191	13.63	***
Income_Middle	0.0371	2.67	***	0.0373	2.69	***	0.0392	2.81	***
Income_Upper	0.1028	7.19	***	0.1026	7.16	***	0.1077	7.48	***
Retired vs. Employed	0.0789	4.76	***	0.0818	4.94	***	0.0789	4.75	***
Other vs. Employed	-0.0225	-1.20		-0.0162	-0.87		-0.0260	-1.38	
Hh_Size	-0.0514	-8.12	***	-0.0513	-8.11	***	-0.0510	-8.02	***
Physical_Inactivity	-0.3691	-16.73	***	-0.3638	-16.52	***	-0.3883	-17.27	***
Memory	0.0377	13.23	***	0.0369	12.91	***	0.0384	13.33	***
Continental	0.1064	7.68	***	0.1045	7.51	***	0.1037	7.43	***
Socialdemocratic	0.4534	25.15	***	0.4553	24.65	***	0.4624	25.46	***
Mediterranean	-0.1866	-9.79	***	-0.1893	-9.93	***	-0.1897	-9.90	***
Chronic diseases	0.0404	3.50	***						
Self-rated health				0.0077	0.60				
Depression							0.1052	7.93	***
Constant	0.5855	8.89	***	0.5676	8.53	***	0.5541	8.35	***
Observations	62257			62330			61547		
LR Chi2	5073.81	***		5032.93	***		5001.36	***	
Pseudo R2	0.0673			0.0667			0.0670		
Log Likelihood	-35168.70			-35221.55			-34847.12		

Source: Own calculations.

Furthermore, as is shown on the right side of graph 3, we also need an additional intervention in the case of caregiving within a household. We need to include an additional, auxiliary variable for "receiving care" within a household, as we assume that care within a household is mutual (see e.g. Kaschowitz and Brandt, 2017) and, therefore, it is likely that the health conditions of the members of the same household are connected with each other. The final causality structure is shown in graph 3 – at the left is the causal structure for help-giving in total and outside a household, where only reverse causality is present, while on the right is the causal structure for help-giving within a household, where beside reverse causality an auxiliary variable of receiving care within a household also needs to be included to provide consistent results.

As it turns out, all the models work very well when taking into account endogeneity and causal problems. Firstly, in table 3, we provide results for total help-giving where it is apparent that with the inclusion of the instrument (the endogeneity tests confirm the presence of reverse causality in all cases) all coefficients on health variables, which are of our main interest, are now of the expected, negative sign and significant.

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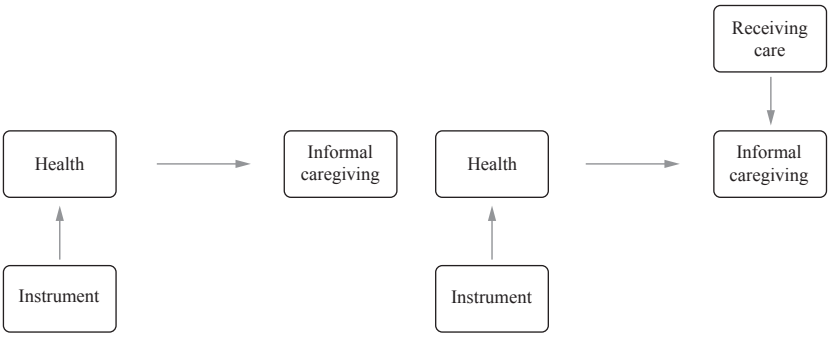
Graph 3

Modelling of reverse causality in the model



Source: Own elaboration.

Table 3

Results of models, endogeneity controlled for, total help-giving

Help_total	Coeff.	z	P>z	Coeff.	z	P>z	Coeff.	z	P>z
Gender	0.0246	2.72	***	0.0183	2.11	**	0.0282	2.82	***
Age	-0.0071	-10.03	***	-0.0078	-12.34	***	-0.0079	-12.62	***
Edu_Years	0.0030	2.86	***	0.0028	2.64	***	0.0032	3.07	***
Income_Middle	0.0133	1.33		0.0108	1.09		0.0132	1.33	
Income_Upper	0.0161	1.45		0.0124	1.10		0.0174	1.57	
Retired vs. Employed	0.0258	1.69	*	0.0159	1.16		0.0068	0.52	
Other vs. Employed	0.0112	0.60		-0.0013	-0.08		-0.0088	-0.56	
Hh_Size	0.0026	0.48		0.0022	0.40		0.0021	0.37	
Physical_ Inactivity	-0.0391	-2.30	**	-0.0504	-3.29	***	-0.0439	-2.62	***
Memory	0.0061	2.69	***	0.0060	2.60	***	0.0065	2.86	***
Continental	-0.0140	-0.77		-0.0042	-0.25		0.0037	0.22	
Socialdemocratic	0.0652	3.42	***	0.0512	2.40	**	0.0784	4.36	***
Mediterranean	-0.0669	-3.41	***	-0.0553	-3.00	***	-0.0471	-2.53	**
Chronic diseases	-0.1309	-2.49	**						
Self-rated health				-0.0936	-2.46	**			
Depression							-0.0739	-1.97	**
Constant	0.7908	14.58	***	0.8617	14.07	***	0.7942	14.63	***
Observations	13232			13179			13149		
Wald Chi2	650.65	***		660.09	***		654.60	***	
Log Likelihood	-17116.06			-15074.79			-14999.20		
Test of endogeneity	7.04	***		4.87	**		8.52	***	

Source: Own calculations.

Also in table 4, we show the results for help-giving outside a household. Here, the significance of the relationship becomes even stronger, confirming the problem of the ugly instrument we have been discussing previously. All the other considerations (signs and significance of the coefficients on main and control variables) from table 3 are almost the same.

Table 4

Results of models, endogeneity controlled for, help-giving outside a household

Help_outside	Coeff.	z	P>z	Coeff.	z	P>z	Coeff.	z	P>z
Gender	0.0136	1.57		0.0055	0.66		0.0235	2.5	**
Age	-0.0083	-12.56	***	-0.0093	-15.51	***	-0.0095	-15.75	***
Edu_Years	0.0039	3.92	***	0.0038	3.81	***	0.0041	4.14	***
Income_Middle	0.0096	1.00		0.0070	0.74		0.0077	0.8	
Income_Upper	0.0163	1.53		0.0144	1.35		0.0165	1.55	
Retired vs. Employed	0.0333	2.34	**	0.0156	1.21		0.0086	0.68	
Other vs. Employed	0.0131	0.76		-0.0092	-0.59		-0.0103	-0.68	
Hh_Size	-0.0275	-5.19	***	-0.0277	-5.23	***	-0.0288	-5.39	***
Physical_ Inactivity	-0.0488	-3.07	***	-0.0690	-4.78	***	-0.0465	-2.94	***
Memory	0.0086	3.97	***	0.0092	4.28	***	0.0082	3.77	***
Continental	-0.0139	-0.81		0.0033	0.21		0.0131	0.83	
Socialdemocratic	0.0780	4.31	***	0.0727	3.74	***	0.0965	5.6	***
Mediterranean	-0.0799	-4.30	***	-0.0624	-3.56	***	-0.0491	-2.75	***
Chronic diseases	-0.1749	-3.92	***						
Self-rated health				-0.0839	-2.74	**			
Depression							-0.1404	-4.24	***
Constant	0.9109	17.49	***	0.9716	17.21	***	0.9227	17.71	***
Observations	13236			13183			13153		
Wald Chi2	1036.86	***		1062.89	***		1053.86	***	
Log Likelihood	-16505.67			-14463.15			-14398.63		
Test of endogeneity	14.92	***		5.08	**		18.90	***	

Source: Own calculations.

Finally, table 5 presents the results for the modelling of help-giving within a household. Here, one does not observe the expected relationships even after the endogeneity is provided for by the instrumental variable correction. On the other hand, the final intervention, inclusion of the auxiliary variable of receiving care within household finally solves the issue and provides the (negative) sign and significance of all of the coefficients (except for depression, where the coefficient is not statistically significant) which is in accordance with the expectations and our hypotheses.

Table 5

Results of models, endogeneity controlled for, help-giving within household

Help_within	Coeff.	z	P>z	Coeff.	z	P>z	Coeff.	z	P>z
Gender	0.0297	2.63	***	0.0136	1.34		0.0281	2.76	***
Age	0.0018	2.36	**	0.0013	1.86	*	0.0019	2.91	***
Edu_Years	-0.0010	-0.74		-0.0014	-1.12		-0.0004	-0.33	
Income_Middle	0.0042	0.34		-0.0083	-0.73		0.0002	0.02	
Income_Upper	-0.0237	-1.65	*	-0.0407	-3.15	***	-0.0131	-1.09	
Retired vs. Employed	0.0682	3.56	***	0.0382	2.23	**	-0.0008	-0.05	
Other vs. Employed	0.0833	3.96	***	0.0509	2.70	***	0.0030	0.18	
Hh_Size	0.0182	3.01	***	0.0188	3.25	***	0.0273	4.19	***
Physical_ Inactivity	0.0518	3.32	***	0.0389	2.77	***	0.0086	0.62	
Memory	-0.0055	-1.97	**	-0.0055	-2.21	**	-0.0011	-0.46	
Receiving_help	0.1061	7.36	***	0.0819	5.88	***	0.0902	5.87	***
Continental	-0.1043	-5.39	***	-0.0729	-4.20	***	-0.0532	-3.32	***
Socialdemocratic	-0.1090	-4.92	***	-0.1615	-8.06	***	-0.0792	-4.32	***
Mediterranean	-0.0548	-2.54	**	-0.0404	-2.09	**	-0.0260	-1.41	
Chronic diseases	-0.4332	-34.91	***						
Self-rated health				-0.4326	-36.13	***			
Depression							0.0119	0.36	
Constant	0.2021	3.08	***	0.3982	6.60	***	-0.0962	-1.68	*
Observations	4656			4634			4615		
Wald Chi2	1318.33	***		1397.63	***		136.85	***	
Log Likelihood	-3592.05			-2002.05			-3583.52		
Test of endogeneity	299.29	***		525.46	***		0.38		

Source: Own calculations.

In table 6, we provide results of several robustness checks to verify our main findings. Firstly, we exclude the additional health variables (physical inactivity, memory) which influence the provision of help-giving but could be related also to our three main health variables. The results do not change in any manner – indeed, the coefficient becomes of even stronger significance.

Secondly, we restrict the age of the respondents to 65+[8]. Once again, there are no changes, furthermore, now even the coefficient on depression for the help-giving within a household becomes significant and of the expected sign.

Finally, we include an additional instrument (presence of formal care) to control for possible reverse causality between providing and receiving help within household. Again, no significant changes can be observed in the main relationship under study.

[8] An additional check for the group of 80+ has been done with no changes in results.

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Table 6

Results of robustness tests, top: exclusion of additional health variables due to additional endogeneity problems; middle: restricting the age of the respondents: 65+, bottom: including an additional instrument to control for reverse causality between providing and receiving help within a household

	Help_total		Help_outside		Help_within	
Chronic diseases	-0.1545	***	-0.1837	***	-0.5459	***
Self-rated health	-0.1095	***	-0.1108	***	-0.5537	***
Depression	-0.0939	**	-0.1559	***	0.0130	

	Help_total		Help_outside		Help_within	
Chronic diseases	-0.1493	***	-0.1924	***	-0.6022	***
Self-rated health	-0.1264	***	-0.0915	**	-0.5451	***
Depression	-0.0806	*	-0.1685	***	-0.0687	*

	Help_total		Help_outside		Help_within	
Chronic diseases	-0.0904	*	-0.0910	*	-0.1170	*
Self-rated health	-0.0243		-0.0352	*	-0.3504	**
Depression	-0.0569	*	-0.0857	*	0.0025	

Source: Own calculations.

4 CONCLUSION

In conclusion, let's firstly summarize the findings by the set of initial three hypotheses and present the main results of the paper. The latter are summarized in table 7.

Table 7

Summarized main results of the paper by type of help-giving

	Effects of health variables	Effects of confounders	Reverse causality issues
Help-giving Total	All coefficients on health variables, which are of our main interest, are of the expected, negative sign and significant; but only after controlling for reverse causality	Significant and of expected sign: gender, age, education, physical inactivity, memory, welfare regimes	Only with the inclusion of the instruments for each health variable, are the results as expected
Help-giving Outside	All coefficients on health variables, which are of our main interest, are of the expected, negative sign and significant; but only after controlling for reverse causality	Significant and of expected sign: age, education, household size, physical inactivity, memory, welfare regimes	Only with the inclusion of the instruments for each health variable, are the results as expected

	Effects of health variables	Effects of confounders	Reverse causality issues
Help-giving Within	All coefficients on health variables, which are of our main interest, are of the expected, negative sign and significant; but only after controlling for reverse causality and including an auxiliary variable	Significant and of expected sign: gender, age, income, employment status, household size, physical inactivity, memory, welfare regimes	One does not observe the expected relationships even after endogeneity is provided for by the instrumental variable correction. Only with the final intervention, inclusion of the auxiliary variable of receiving is care within household the issue solved, providing the (negative) sign and significance of almost all of the coefficients on health variables.

Source: Own calculations.

H1: Older people in better health tend to provide more help to others.

The hypothesis is clearly confirmed. In all three cases we were able to confirm it and provide strong reasoning for the somewhat strange results that could be observed by basic descriptive statistics and basic econometric modellings not taking into account the specific causal relationships in the model. Indeed, the solution to this problem is the main contribution of the article and an important resource for future research in this area. It contributes significantly to the previous findings in e.g. Kaschowitz and Brandt (2017) and relates to the recent analysis in Calvó-Perxas et al. (2018).

H2: Relationship between informal caregiving and health is of an endogenous, reverse causal nature.

We confirm the hypothesis on the basis of the testing as reported in tables 3, 4 and 5. All the tests confirmed the expected reverse causality, which is in line with the findings of the literature, standing for the presence of the negative effects of help-giving on the health of the provider. As noted in the introductory section of our article, it is widely accepted that caregiving has an impact on caregivers' health (Zarit, Reever and Bach-Peterson, 1980; Hiel et al., 2015), and most caregivers have to deal with their own chronic illnesses as well (Jowsey et al., 2013; Stacey et al., 2016). Support measures are thus necessary to keep caregivers in good health, to maintain their quality of life, and to keep costs down, so that the informal caregiving system is maintained (Kaschowitz and Brandt, 2017; Verbakel et al., 2017).

H3: There are significant differences in the relationship of health and informal caregiving between help-giving within and outside a household.

We confirm the hypothesis, which is clearly demonstrated by the descriptive statistics visualized in graph 2. Furthermore, we manage to provide an econometric/causal solution that is able to explain the difference and control for it when modelling for our main relationship between health and informal help-giving. The findings strongly relate to the recent analysis of Calvó-Perxas et al. (2018) which finds that "the poorest health was reported by those giving care inside their households, which may be due to the fact of being emotionally closer to the recipient of care and to the fact that they cannot evade the care situation easily as those giving care outside their household" (Calvó-Perxas, 2018).

The link to theory, presented in the initial section of the article, seems strong. We were able to connect the relationship of health and caregiving to theoretical expectations, but demonstrated that the usual positive link is to be found only after some econometric corrections and additional controlling variables. Also, we were able to confirm the findings of Kaschowitz and Brandt (2017) about the heterogeneity in the provision of care, with care provided within and outside a household having very opposite characteristics. Based on our findings, one would be tempted to ask for this heterogeneity in the provision of care to be explored to an even greater extent and in more detail, to find and explain the distinctions using, e.g. latent class modelling or cluster analysis of any other type.

Limitations of the analysis relate to the sample used, methods and theoretical background. In terms of the sample, the analysis is based on a cross section and should be extended in future also to a dynamic context. Also, constraints on respondents included could be imposed, related to their health and social condition. Also, the dataset allows us only to include help to a family member living outside one's own household, a friend or neighbour. This should be extended also to people the respondent does not know, although SHARE does not allow such an extension. In terms of methods, other causal inference methods like directed acyclic graphs (possibly, using Bayesian networks), structural equation modelling and even mediation analysis could be used. If put in a dynamic context, more consistent causal analysis could be performed, using difference-and-differences, changes-in-changes and similar methods. Also, heterogeneity in the results could be analysed using latent class methods, quantile methods or cluster analysis. Finally, in terms of theoretical background and variables used, it could be interesting to extend the analysis to other health characteristics, linking the results also to limitations of daily life (ADL, IADL, GALI or functional limitations) or similar indicators.

The scientific contributions of the paper are clear. On the one hand, the article provides what seems to be a conclusive explanation for some "puzzles" in the data, observed previously by, e.g. Kaschowitz and Brandt (2017). The explanation is novel in particular for the help-giving provided within a household and is sup-

ported by some recent findings of Calvó-Perxas et al. (2018). Secondly, we provide some novel instruments to control reverse causality where health variables are included, based on Wave 3, i.e. the retrospective life histories of respondents. Finally, we provide a reflection on the policy recommendations to support the help-giving measures being implemented in many European countries.

There are some important pathways for future research. Firstly, improvements in the instrumental variable models used could be made, using additional variables, including social and material deprivation, relationship to the person receiving help, frequency of the help provided (some of this has been tried and the results are, again, very robust). We also confirm that Wave 3 of SHARE is a rich and interesting source for the construction of instrumental variables, something confirmed by the literature in the field. Possibly, additional instruments based on Wave 5 (the cross section used) could be tried and tested as well. It would also be interesting to model more deeply which is the more important predictor of informal caregiving: physical, mental or self-rated health? According to our results, physical health performed the best, but this question remains to be studied in future research. Finally, it would be interesting to model also the longitudinal aspects of the studied relationship and explore if it is dependent upon the contextual variables in the country studied.

Regarding the practical and policy recommendations, adopting measures to stimulate the health of potential and actual caregivers would tend to raise the level of help provided significantly, which was proven by our analysis. Although the finding might sound trivial, we observed that it could lead to absurd (opposite) conclusions if observed only by basic descriptive statistics or correlations. To this end, it was important to provide an explanation which is novel in the literature and differs quite significantly from the previous explanations, found, e.g. in Kaschowitz and Brandt (2017). In policy terms, measures used to stimulate health would contribute to the welfare of caregivers and by this to a better system of (informal) long term care which should be the desire of all. The question remaining for study here is how the effect we observed and studied is distributed among the studied population and whether it significantly differs not just by the type of provided help (outside or within a household) but also by some other characteristic of the respondent, the care receiver or context/country under study.

Disclosure statement

The authors declare there is no conflict in interest related to this article.

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