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Does care to dependent elderly people living at home increase their mental health?

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Abstract
In France, the number of dependent elderly should double by 2060. It is thus important to address the well-being of this growing share of the population. This work aims at estimating the effects of informal care and formal care on the mental health of dependent elderly. Furthermore, we allow the effect of care to vary depending on the level of dependence, the gender of the dependent elderly and the relationship between the elderly and the primary informal caregiver. Many theoretical models include a production function of health which has two inputs, formal care and informal care but this function has not been the subject of many empirical studies.
In order to estimate the health production function, we use the French Disability and Health Survey (2008). Using a sample of 4,067 dependent elderly, three equations are jointly estimated by the maximum-likelihood method: mental health, informal care and formal care. Correlated residuals partially take into account the relationship between formal and informal cares and the reverse causality of mental health on care received. We use two mental health indicators: depression and the Mental-Health Inventory (MHI-5).
The results show a positive effect of informal care on mental health, for slightly dependent elderly, for individuals receiving care from friends or neighbors and for men receiving care from a daughter or from siblings. Formal care decreases the risk of depression and improves the MHI-5 of elderly dependent people, this last effect being higher for women.

Key words: long-term care; informal care; formal care; depression; mental health; qualitative variables model.
JEL: D130; I120; J140; J160; C350.

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1. Introduction

The aging of baby-boomers coupled with the increase in life expectancy leads to a greater risk of old-age dependence in France. Thus, the number of dependent elderly is expected to double by 2060 to reach 2.3 million people. More generally, between 2000 and 2060, the proportion aged 75 and over will increase from 8% to 16% (French National Institute of Statistics and Economic Studies). The increase in the ratio of the elderly relative to people of working age will generate high social costs (e.g. to ensure the Pay-As-You Go System equilibrium). Moreover, French public total spending on long-term care represented 24 billion euro in 2010 (1.2% of GDP), including 14 billion for health expenditure, 7.5 billion for long-term care and 2 billion for accommodation.

Beyond this volume effect, the quality of life of older people, particularly mental health, is a key variable to understand their healthcare expenditure and respond in the best way to their needs. In addition, maintaining the mental health of old people is important because a bad mental health status may accelerate the disablement process[3]. Indeed, the effect of pathology on impairments and the effect of functional limitations on disability are higher for depressed individuals than for non-depressed ones (Van Gool *et al.*, 2005). Otherwise, mental health is a major political concern as underlined in the Comprehensive mental health action plan 2013-2020 (WHO) and in the European Pact for Mental Health and Well-being launched in 2008. This later initiative makes mental health of older people one of its five priority areas and invites policy makers and stakeholders to "*provide measures to promote mental health and well-being among older people receiving care (medical and/or social) in both community*

[3] The disablement process model (Verbrugge and Jette, 1994) involves four consecutive phases: pathology, impairments, functional limitations and disability.

and institutional settings". At the French level the future Autonomy law, currently under discussion, highlights the role of preventing suicide among elderly persons.

Support of elderly people in France is mainly based on a family model and informal caregivers. Thus, the French High Family Council estimates that 3.6 million elderly people live in ordinary households and receive care due to health problems; 48% of them receive only informal care, 20% only formal care and 32% are helped by both formal and informal cares. Care hours provided by family caregivers are estimated at over one billion hours, which would represent 77% of the total hours of care.

Several theoretical models include a health production function which has two inputs, formal and informal cares. However, to the best of our knowledge, this function has not received much attention in the empirical literature. Our goal is to estimate on French data the effects of formal care (provided by professional workers) and informal care (provided by the family and other relatives) on the mental health of dependent elderly living at home using two mental health indicators – depression and the Mental-Health Inventory (MHI-5). We take into account the potential endogeneity of care by jointly estimating mental health, informal care and formal care. In addition, we allow informal and formal cares to have different effects on mental health depending on the level of dependence, the gender of the dependent elderly and the relationship between the elderly and the primary informal caregiver. While most of the studies focus on the caregiving support provided by a spouse or by children, we consider here all kinds of relationships. From a public policy perspective, this study identifies the most effective care arrangements in terms of mental health.

The article is organized as follows: section 2 offers a summary of the existing literature; part 3 presents the data and methodology used; part 4 provides some descriptive statistics, the results

of the estimations and robustness tests. Finally, the last part is devoted to discussion and the conclusion.

2. Background

While a literature suggests that informal care may have both positive[4] and negative effects[5] on the emotional well-being of elderly (see for example Fast *et al.*, 1999, for a literature review), the economic literature sees formal and informal cares as inputs in an elderly's health production function. A first type of theoretical models on long-term care arrangements considers a unique utility function for the entire family. Hoerger *et al.* (1996) are interested in the effect of public subsidies on the living arrangements of a dependent elderly (living alone, living with a child or moving in a nursing home). They assume that the family utility increases with informal and formal cares and that the marginal utility of care raises with the severity of disability but they do not formalize a health production mechanism. Pezzin *et al.* (1996) also study the impact of a public program on living arrangements and define a health production function. The production of disabled elderly person's functioning, conditional on the level of disability, requires formal or informal cares. Stabile *et al.* (2006) study the ability of dependent elderly to perform ADLs (activities of daily living). This level of ability is determined by a production function which depends positively on informal and formal cares, for a given health status.

Other models examine the decisions of two individuals – a disabled parent and a child – who have different utility functions. Pezzin and Schone (1999) consider informal care and labour supply of a daughter who has a dependent parent, and living arrangements. Parent's physical

[4] Elderly people cared for by their children declare to be less restless, lonely, bored and unhappy in comparison with other older people.

[5] Loss of personal control in their lives, stress, tension between needing care and not wanting to be a burden, restricted future outlook, lower psychological morale.

health or well-being, is defined as a public good whose production depends on formal care (purchased in the market by the parent) and informal care (provided by the daughter) conditional on the parent's functional or cognitive disability. More recently, Thiébaut *et al.* (2012) build a theoretical model to study the impact of a French reform which would consist in recovering public contributions paid to dependent elderly from part of their estate after their death. They consider a quality of life production function with two inputs, formal and informal cares. They assume that informal care is preferred to formal care by the parent and that the marginal productivity of formal care is constant (possible turnover of professional workers) while the marginal productivity of informal care is decreasing (informal caregivers tire more easily).

Finally, some models allow the presence of multiple potential informal caregivers. Van Houtven and Norton (2004) define the parent's health status as a function (adapted from Grossman, 1972) of the aggregate level of informal care (from all children), of formal medical care and of human capital. Byrne *et al.* (2009) specify a game-theoretic model of family's decisions in which children allocate time to work, leisure, informal care and allocate money to consumption and formal care. The elderly individual(s) (it may be a couple) allocate time to informal care and leisure and allocate money to consumption and formal care. The health quality of the elderly – which is defined as an *"aggregate measure of true health […] and accommodations made for health problems"* – depends on informal care, formal care and on a set of demographic characteristics. In the latter two references, children are altruistic in the sense that their utility depends on the parent's health.

To the best of our knowledge, only Stabile *et al.* (*op. cit.)* and Byrnes *et al.* (*op. cit.)* provide empirical results on the effects of formal care and informal care on health. The first study uses Canadian data (National Population Health Survey 1994-1999 and General Social Survey

1992-1996) and shows that a higher generosity of public home care programs (at the provincial level) leads to a higher probability of reporting good self-assessed health. When it takes into account the potential endogeneity of public generosity, the effect becomes insignificant. Nevertheless, this work does not estimate the effect of informal care.

Byrnes *et al.* (op. cit.) use US data (1993 wave of Assets and Health Dynamics Among the Oldest Old) and find that formal care and informal care – especially care provided by a spouse – have only small positive effects on the parent's health quality[6]. Furthermore, they show that informal care provided by a child is more effective than formal care; an additional hour of informal care implies a 0.12 % increase in health quality of parents.

Finally, Rice *et al.* (2009) do not study directly health but show that more hours of care decrease the probability of unmet needs for assistance in daily life activities. However, this study cannot be easily generalized since it only concerns very frail elderly (Medicare and Medicaid dually enrolled elderly) of six states of the US.

3. Method

Data

In order to estimate the health production function, we use the Ordinary Households section of the French Disability and Health Survey (*Enquête Handicap Santé Ménage*) which was carried out in 2008 among non-institutionalized people by the French Institute of Statistics and the Ministry of Health. This survey provides information on socioeconomic and socio-demographic characteristics of 29,931 individuals, as well as on their family situation. Furthermore, it gives details on deficiencies, functional limitations, activity restrictions and health problems faced by individuals.

[6] Since there is no direct measure for health quality of parents available in the data, the authors observe it indirectly through its effect on utility (which is measured by a dummy variable indicating if the elderly person was happy during the past week).

We select a sample of 4,067 dependent elderly persons aged 65 and over based on activity restrictions. An individual is considered as a dependent if he reports difficulties in performing alone at least one ADL or one instrumental activity of daily living (IADL). ADLs are the most essential activities of daily life and refer to personal care and functional mobility: bathing, dressing and undressing, eating and drinking, using the bathroom, lying down in and getting up from bed, sitting down in and getting up from a chair. IADLs support an independent life style: shopping, cooking, doing common household chores, doing less common chores, doing administrative tasks, managing medication, moving around in all of the rooms of a floor, leaving home, using transportation, finding your way, using a telephone.

Variables of interest

We are interested in the effects of formal care and informal care on two mental-health variables: depression and the Mental-Health Inventory. The depression variable (*D*) has a value of 1 if the individual has had depression in the twelve months prior to the survey and 0 otherwise. A disadvantage of this variable is that it refers to a specific disease. Therefore, we also use a general mental health measure: the Mental-Health Inventory (*MHI-5*). This indicator is constructed from five questions of the Short Form Health Survey (SF-36) that was included in a mail-back questionnaire left to the surveyed individuals. The questions are the following: "*Over the past four weeks, were there times when you… i) felt very anxious; ii) felt so discouraged than nothing could make you feel better; iii) felt calm and relaxed; iv) felt sad and demoralized and v) felt happy.*" For each question, there are five response categories (always, often, sometimes, rarely, never) scored between 1 and 5. The total score is then transformed to a 0-100 scale, 100 being the best possible health. The MHI-5 is a validated and reliable general mental health measure but there exist no determined cut-off point that can be used to screen for depressive symptoms (Kelly *et al.*, 2008). Similarly, Hoeymans *et al.*

(2004) stress the need for a valid and internationally comparable cut-off point[7]. For these reasons and because we are interested in a very particular population, we will use the MHI-5 as a general mental health score and not try to screen for specific symptoms. The estimations of the effect of care on the MHI-5 will focus on the 2,117 individuals which have completed the paper questionnaire (we take into account the potential selection bias in the "Robustness tests" part of section 4).

The main explanatory variables are informal care (*IC*) and formal care (*FC*). The informal care variable is equal to 1 if the dependent elderly receives help from family members or others relatives and 0 otherwise. We use a binary care variable due to missing values (27%) in informal care hours received, especially when the caregiver and the dependent elderly live in the same household. On the contrary, we are well-informed about formal care hours (only 3.5% of missing values). From information on the frequency of formal care (daily, weekly or monthly) and care hours received per unit of time, we build a unique variable which gives formal care hours received per week. Finally, it should be mentioned that the care being considered here is aid with daily life tasks activities: i) personal care (bathing, dressing, meals); ii) household chores (cleaning, making meals); iii) managing the budget, paperwork and administrative processes; iv) ensuring a company; v) ensuring a supervision; vi) taking care of the health problems; vii) shopping or viii) other activities.

Interaction variables

In addition, we introduce interaction terms between informal and formal cares, on one hand and the level of dependence (number of moderate and severe restrictions in IADLs and ADLs), on the other hand. Moderate restrictions refer to activities that can be performed alone but with some or great difficulties while severe restrictions correspond to activities that the individual cannot do alone. These interaction terms give a measure of marginal effectiveness

[7] The commonly used cut-off point is 52 but many other limits exist (Thorsen *et al.*, 2013).

of formal and informal cares. Furthermore, interactions of both types of care with the gender of the dependent elderly reflect the different attitudes between men and women toward the Healthcare system and allow for different effectiveness of care depending on the gender of the elderly. For instance, Byrnes *et al.* (*op. cit.*) find that the number of ADLs has an insignificant negative effect on care effectiveness and stress that informal care provided to women is significantly less effective than informal care to men, controlling for the gender of the caregiver.

Finally, the effect of informal care may depend on the relationship between the dependent elderly and the caregiver. For example, Byrnes *et al.*'s estimations show that daughters provide higher quality care than do sons. In our sample, 73% of the individuals receiving informal care have a single caregiver. When there are several informal caregivers, we assume that the primary caregiver is: i) the caregiver who lives in the same household as the elderly when there is only one co-residing caregiver (93% of the cases of co-residence) or ii) the first caregiver mentioned by the elderly in other cases. Then for the sake of simplicity, we only study the link between the elderly and the primary caregiver. By combining the gender of the dependent elderly and the relationship with the primary caregiver, we obtain 12 possible elderly dependent/caregiver patterns: i) husband/wife (reference category), ii) wife/husband, iii) father/daughter, iv) mother/daughter, v) father/son, vi) mother/son, vii) man/siblings, viii) woman/siblings, ix) man/friends or neighbors, x) woman/friends or neighbors, xi) man/other relatives and xii) woman/other relatives.

Econometric model

The equation of interest (1) estimates the effect of care (IC and FC) on both mental health measures. We perform a probit model in order to estimate the probability of depression where D^* represents the latent health status (1a). In a standard linear model, we estimate the Mental-Health Inventory, which is a continuous variable (1b). The variables $IC * L$ and $FC * L$

represent interactions of care with the level of dependence. $FC * F$ is the interaction term between formal care and the elderly's gender and $IC * A$ combines informal care and care arrangements. X_h is a set of characteristics of the dependent elderly and the family. We control for activity restrictions and functional limitations (moderate and severe ADLs restrictions, moderate and severe IADLs restrictions and motor, sensory and cognitive limitations), for demographic variables (age and gender), socioeconomic variables (education level, monthly income, rural area) and family characteristics (living with a partner, having children, recent widowhood, seeing the family less than once a month). We also take into account if individuals answer the survey for themselves or if a third party helps them answer or respond for them (in other words, we control for proxy respondents). All variables are described in table I below.

$$(1a)\ D^* = \alpha_i IC + \alpha_{il} IC * L + \alpha_{ia} IC * A + \alpha_f FC + \alpha_{fl} FC * L + \alpha_{ff} FC * F + X_h \beta_h + \epsilon_h;$$

$$D = \begin{cases} 1\ if\ D^* > 0 \\ 0\ otherwise \end{cases}$$

$$(1b)\ MHI = \alpha_i IC + \alpha_{il} IC * L + \alpha_{ia} IC * A + \alpha_f FC + \alpha_{fl} FC * L + \alpha_{ff} FC * F + X_h \beta_h + \epsilon_h$$

Estimating the unbiased effects of informal and formal cares on mental health is not a straightforward task because these variables are potentially endogenous. First, health measurement errors may exist. We try to limit this bias by introducing two mental health measures. Second, a bad mental health status may increase the probability of receiving formal or informal care and the intensity of the help (*reverse causality*). The empirical literature has mainly highlighted the positive effect of activity restrictions on the probability of receiving formal care (Bonsang, 2009) and informal care (Fontaine *et al.*, 2007; Haberkern and Szydlik, 2010) and care hours (Golberstein *et al.*, 2009). Some chronic diseases (hypertension, diabete, stroke, dementia, cancer) increase the probability or the intensity of informal care

(Golberstein *et al.*, 2009). Moreover, a bad or very bad self-reported health status increases the use of informal care (Bonsang, 2007) and the probability of formal care (Stabile *et al.*, *op. cit.*). Finally, some research has found "*significant influences of emotional and mental disabilities […] on long-term care utilization*" (Portrait *et al.*, 2000).

Third, there exist unobserved factors influencing the elderly's mental health that are correlated with formal and informal cares. For example, children's health plays a role in the provision of informal care and may impact parents' mental health. Similarly, family history of mental health problems may change the elderly's attitude toward formal care; it also may increase awareness amongst potential informal caregivers. Furthermore, the medicalization of the health of the elderly facilitates the diagnosis of depression and may increase informal care due to information or guilt put on family members by medical institutions (Weber, 2010).

In order to address the latter two endogeneity problems, we estimate jointly mental health (equation 1), the receipt of informal care (equation 2 below, probit model) and formal care hours (equation 3, linear model). In equations (2) and (3), X_i and X_f contain variables related to the elderly dependent and the family. Error terms of equation (1), (2) and (3) (respectively $\epsilon_H, \epsilon_i, \epsilon_f$) are assumed to follow a multivariate normal distribution. It should be noted that while we address the endogeneity of care, we assume that the informal caregiver type (spouse, daughter, son, siblings, friends or neighbors) is exogenous. Indeed, we think that it is determined by social norms and caregiver's availability rather than by the mental health of the elderly.

$$(2)\ IC^* = X_i\beta_i + Z_i\gamma_i + \epsilon_i; \quad IC = \begin{cases} 1\ if\ IC^* > 0 \\ 0\ otherwise \end{cases}$$

$$(3)\ FC = X_f\beta_f + \gamma_f Z_f + \epsilon_f$$

$$(\epsilon_h, \epsilon_i, \epsilon_f) \sim N\left(0, \begin{pmatrix} 1 & \rho_{HI} & \rho_{HF} \\ \rho_{IH} & 1 & \rho_{IF} \\ \rho_{FH} & \rho_{FI} & 1 \end{pmatrix}\right)$$

To achieve identification of this model, we use exclusion variables that are correlated with informal care and formal care (respectively the matrix Z_i and the vector Z_f) but not directly associated with mental health. The empirical literature dealing with the effects of informal care on formal care utilization provides good instruments for informal care based on family variables. Van Houtven and Norton (*op. cit.*) instrument informal care by the number of children of the elderly and whether the eldest child is a daughter or not; Charles and Sevak (2005) use a set of instruments combining the gender of the children, their marital status and their location; Bolin *et al.* (2008) use the number of children and whether the oldest child lives more than 100 kilometers away or not and Bonsang (2009) choose the geographical distance and the proportion of daughters. In our study, we select four exclusion variables for informal care: i) the proportion of daughters, ii) having at least one child who has no child, iii) having at least one child who has no partner and iv) having at least one child who lives close (same building, same town or same department[8]). We assume that: i) daughters have a higher propensity to provide care (although this idea should be nuanced in modern societies), a child who has no child (ii) or no partner (iii) can allocate more time to informal care, and iv) the opportunity cost of informal care is lower when children live close to the elderly. The exogeneity of children location has been challenged in the literature (e.g. children with sick parents may live closer). We nevertheless choose to keep this variable because it passed over-

[8] French departments are equivalent to UK counties.

identification tests in empirical works (Bolin *et al.*, *op. cit.*; Bonsang, 2009) and it has been shown that the effect of child distance on care arrangements is very large (Stern, 1995). In section 4, we test the robustness of our results by using different subsets of exclusion variables.

On the other hand, instruments are much less developed for formal care. To the best of our knowledge, only Stabile *et al.* (*op. cit*) instrument public home care generosity by the share of the population aged 65 and older in each Canadian province, the level of provincial spending on education and the provincial tax rate. These instruments passed the over-identification tests (but were not necessary in most of the cases since the exogeneity of public home care generosity could not be rejected). In the present work, the exclusion variable for formal care is the proportion of individuals aged 75 and over receiving the Personal Autonomy Allowance (PAA, *Allocation Personnalisée d'Autonomie*) at the departmental level in 2007[9]. The amount of aid depends on the level of dependence which is assessed by a medico-social team during a visit to the elderly's home and the beneficiary pays a contribution based on income. We use the proportion of beneficiaries at the departmental level to take into account French disparities in access to PAA[10]. Indeed, the General Councils have set up heterogeneous appraisal and decision-making processes[11]. For instance, application files display varying degrees of complexity and require different number of supporting documents. Moreover, the grid used to assess the level of dependence is very sensitive and likely to lead to departmental inequalities

[9] The Personal Autonomy allowance, launched in 2002, is a needs-based national program administered at the departmental level by the General Councils; it covers part of formal home care received by individuals of at least 60 years of age who need help for activities of daily living.

[10] Approximately 30% of these disparities are neither explained by the socio-demographic structure of the departments nor by departmental policies.

[11] This view is supported by several reports from French authorities: the Inspectorate of Social Affairs (2009), the Court of Auditors (2009), the National Assembly (2010).

of eligibility to PAA. Finally, the professional profile of medico-social teams and the period of entitlement to PAA may vary between departments.

The parameters of this three-equation model (α, β, γ) are estimated by the maximum-likelihood method using STATA (Cmp package; Roodman, 2011). The correlation coefficients between the residuals of the mental health equation and care equations allow taking into account the endogeneity of the use of formal and informal cares. Furthermore, the coefficient of correlation between the residuals of informal care and formal care equations captures the relationship between these two types of care. Indeed, the empirical literature shows that informal care substitutes for formal home care once controlling for endogeneity (Greene, 1983; Van Houtven and Norton (*op. cit.*); Bolin et al. (*op. cit*)) and that this substitution effect tends to disappear as the level of disability of the elderly person increases (Bonsang, (*op. cit.*)). However, it should be noted that significant correlation coefficients may also simply be due to unobserved confounding factors (e.g. family history of mental health problems, children' health).

4. Results

Descriptive statistics

Table I below provides descriptive statistics of the variables used in our analysis, for both the total sample (4,067 observations), that will be used for the estimations of depression, and the subsample of individuals that have completed the paper questionnaire (2,117) that will be used for the estimations of the MHI-5. These two samples have similar demographic and socioeconomic characteristics: the mean age of dependent elderly individuals is 79 years old, there is a large majority of women (around 70%), three quarters of individuals have a low or medium education level, most individuals (76%) live in an urban area and the mean proportion of individuals aged 75 and older receiving the Personal Autonomy Allowance at

the departmental level is around 23%. They are also comparable in terms of family characteristics: 45% of surveyed individuals live with a partner, 4-5% of elderly are recently widowed, 87% have at least one child and 13% see their family less than once a month. Among individuals with a child, a majority (76%) have at least one child who lives close, around half have one child who has no partner and 35% have one child who has no child.

By contrast, the two samples are characterized by different levels of dependence. Indeed, in the subsample, 18% declare at least one severe restriction in ADLs and 67% have at least one severe restriction in IADLs as compared to 24% and 72% respectively for the total sample. They are also less frequently limited: 32% report sensory limitations and 31% report cognitive limitations *versus* 37% and 38% respectively for the total sample. This better health status of individuals in the subsample probably explains why they receive less formal care hours and why proxy respondents are less present.

As far as our variables of interest are concerned, around 8% of individuals have had depression in the twelve months prior to the survey. The MHI-5 is characterized by a first quartile of 35 (out of 100), a median of 50 and a third quartile of 65.

A significant proportion of dependent elderly benefits from care. In the total sample, 68% of individuals receive informal care and 56% receive formal care. The heterogeneity of the total sample is embodied in the significant dispersion of formal care intensity: 25% of individuals receive less than 3 hours of formal care per week, 50% are helped between 3 and 14 hours per week and 25% receive more than 14 hours of formal care per week.

The most common informal care arrangements are husbands cared for by their wives (21%), wives cared for by their husbands (21%) and mothers cared for by a daughter (19%) or a son

(12%). Women are mostly cared for by children because they are more often widowed[12] due to their higher life expectancy and the age difference traditionally observed between spouses. It is interesting to note that individuals primarily helped by friends or neighbors (statistics not reported here, available upon request) are slightly dependent: only 11% have severe restrictions in ADLs and 59% have severe restrictions in IADLs (in comparison with 24% and 72% for the total sample). Moreover, these individuals are more likely to have no family support: 88% do not live in a couple, 45% have no children and 41% see their family less than once a month (as compared to 55%, 13% and 14% respectively for the total sample). Finally, children of individuals primarily helped by friends or neighbors have less time to allocate to informal care: only 31% have no partner, 19% have no child and 47% live close as compared to 50%, 64% and 76% respectively in the total sample.

[12] In our sample the proportion of individuals who live in a couple is 35% for women and 70% for men.

Table I – Descriptive statistics for the total sample (N=4,067) and for individuals that have completed the paper questionnaire (N=2,117)

	N=4,067 Total sample	N=2,117 subsample
Care variables		
Proportion of individuals receiving informal care (%)	68.33	65.75
Proportion of individuals receiving formal care (%)	55.99	54.27
Informal care arrangements (if any, %)		
Care received by a husband from his wife	21.12	21.33
by a wife from her husband	20.98	24.14
by a father from a daughter	4.35	2.59
by a mother from a daughter	18.86	17.60
by a father from a son	2.12	2.01
by a mother from a son	11.87	11.93
by a man from his siblings	1.15	1.15
by a woman from her siblings	2.41	2.23
by a man from friends or neighbors	1.33	1.36
by a woman from friends or neighbors	2.88	3.38
by a man from other relatives	2.81	2.51
by a woman from other relatives	10.11	9.77
Number of formal care hours per week (if any)		
1st quartile	3	2
Median	6	5
3rd quartile	14	10
Mental health variables		
Depression (%)		
Yes	7.80	7.94
No	92.20	92.06
MHI-5		
1st quartile	-	35
Median	-	50
3rd quartile	-	65
Activity restrictions and limitations		
At least one moderate restriction in ADLs (%)		
Yes	36.19	34.62
No	63.81	65.38
At least one severe restriction in ADLs (%)		
Yes	23.73	18.42
No	76.27	81.58
Mean number of moderate restrictions in ADLs	0.65	0.60
Mean number of severe restrictions in ADLs	0.68	0.49
At least one moderate restriction in IADLs (%)		
Yes	63.76	67.31
No	36.24	32.69
At least one severe restriction in IADLs (%)		
Yes	71.55	67.26
No	28.45	32.74
Mean number of moderate restrictions in IADLs	1.31	1.35
Mean number of severe restrictions in IADLs	3.36	2.78
Motor limitation (%)	90.88	89.09
Sensory limitation (%)	36.98	32.12
Cognitive limitation (%)	38.04	31.03
Demographic variables		
Age (mean)	79.19	78.68

Gender (%)		
Male	29.53	27.11
Female	70.47	72.89
Socioeconomic variables		
Education level (%)		
Low	45.19	40.86
Medium	32.21	34.58
High	22.60	24.56
Monthly income (%)		
Less than 1000 EUR	23.95	23.19
1000/1500 EUR	25.25	25.84
1500/2000 EUR	16.33	16.91
More than 2000 EUR	24.71	25.08
Missing value	9.76	8.98
Rural area (%)		
Yes	24.05	24.28
No	75.95	75.72
Mean proportion of individuals aged 75+ receiving the PAA at the departmental level (per 1,000 inhabitants)	227.46	225.76
Family variables		
Living with a partner (%)		
Yes	45.14	45.21
No	54.86	54.79
Widowhood < 2 years (%)		
Yes	4.23	4.77
No	95.77	95.23
Having at least one child (%)		
Yes	87.02	86.77
No	12.98	13.23
Seeing the family less than once a month (%)		
Yes	13.79	13.08
No	86.21	86.92
Proxy respondent (%)		
Yes	34.05	26.41
No	65.95	73.59
Characteristics of children (if at least one child)		
Having at least one child who has no partner (%)		
Yes	50.01	47.47
No	49.99	52.53
Having at least one child who has no child (%)		
Yes	35.63	34.46
No	64.37	65.54
Having at least one child who lives in the same building, town or department (%)		
Yes	75.67	75.83
No	24.33	24.17
Proportion of daughters (%)	50.60	50.69

Source: French Disability and Health Survey, 2008.
Field: Dependent individuals, aged 65 and over (1st column: total sample, 2nd column: subsample of individuals that have completed the paper questionnaire).

Estimation results

Informal care and formal care equations

Tables II and III (see below) present the results of the three-equation models respectively for depression and for the MHI-5. Let us begin with informal care and formal care equations. Exclusion variables are all significant and have the expected sign. The departmental proportion of individuals aged 75 and over receiving the Personal Autonomy Allowance has a positive effect on formal care hours received at the 1% significance level, whatever is the measure of mental health. This result confirms the assumption that the departmental proportion of beneficiaries is correlated with access to PAA and thus with formal care. In the informal care equation, having a child who has no partner, having a child who has no child, having a child who lives close and the proportion of daughters all have a significant and positive effect. In the depression model, these variables are significant at the 1% or at the 5% level; in the MHI-5 model (smaller sample), having a child who has no partner is significant at the 5% level and other variables are significant at the 10% level. In short, children's availability and propensity to help are good predictors of informal care.

The effect of control variables in formal care and informal care equations are generally consistent with the literature. First, activity restrictions have a positive effect on the receipt of informal care and formal care hours. On the contrary, limitations do not seem to play a role, except for motor limitations. Second, women receive more formal care than men and have a lower probability of receiving informal care. This could be explained by the fact that women have less potential caregivers than men, or by the fact that for a same level of dependence husbands who have to care for their spouse use more frequently formal care than wives. The age of the dependent elderly has a negative effect on informal care and a positive effect on formal care. In the literature, the effect of age on informal care is rather positive. At first, we have good control variables for the health status of the elderly; age variable thus do not

explains a health effect. We can find another explanation by assuming that elderly's age may be interpreted as a proxy for the age of children: the older are the children the frailer they are and the less they are likely to provide informal care. With regard to socioeconomic variables, the elderly's education level decreases the probability of informal care and increases formal care hours. Indeed, highly educated individuals are more aware and better informed of public available formal programs (Stabile *et al., op. cit.*). In addition, the elderly education is partially a proxy for children education. Children with a higher education probably have a higher wage on the labor market and thus a higher opportunity cost of informal care. The probability of receiving informal care rises with monthly income. It may be due to an exchange motive: the elderly compensates children by leaving them a bequest (Bonsang, 2007). However, in accordance with Van Houtven and Norton (*op. cit.*) and Bonsang (2009), the income does not influence the intensity of formal care. Finally, family variables play a significant role on care received. The literature has focused on care by children and found a positive effect of living alone on informal care. In this study we are not only interested in informal care provided by children but also in informal care provided by other family members and relatives such as husbands and wives. Consequently, we find that having a partner has a positive effect on informal care probability and a negative effect on formal care hours. Moreover, being recently widowed increases formal care hours and seeing the family less than once a month diminishes the use of informal care. Having at least one child has a negative impact on formal care but has an unclear effect on informal care. This may be due to the fact that children's behavior differs depending on whether the parent lives in a couple or not. When the elderly has a partner, children's decisions are individual and the probability of informal care increases with the number of children; when the elderly lives alone, decisions are taken at the siblings level and the probability of informal care is constant (Fontaine *et al., op. cit.*).

The estimated correlation coefficients of the residuals between formal care and informal care equations are significant and negative (-0.18). Although this result cannot be interpreted in terms of causality due to unobserved confounding factors, it is consistent with the empirical literature that shows that informal care is a substitute for formal care.

Table II – Estimation of the model: Depression (4,067 observations)

		Depression probit equation (1)	Informal care probit equation (2)	Formal care linear equation (3)
Intercept		-0.188	0.097	-14.070***
Care variables				
IC	*Yes*	-0.608*	-	-
	No	Ref.	-	-
IC*number moderate IADLs		-0.100**	-	-
IC*number severe IADLs		-0.015	-	-
IC*number moderate ADLs		0.052	-	-
IC*number severe ADLs		-0.034	-	-
IC*husband cared for by wife		Ref.	-	-
IC*wife cared for by husband		-0.013	-	-
IC*father cared for by daughter		0.088	-	-
IC*mother cared for by daughter		-0.006	-	-
IC*father cared for by son		0.188	-	-
IC*mother cared for by son		-0.026	-	-
IC*man cared for by siblings		0.210	-	-
IC*woman cared for by siblings		-0.017	-	-
IC*man cared for by friends neighbors		-0.088	-	-
IC*woman cared for by friends neighbors		-0.144	-	-
IC*man cared for by other relatives		0.081	-	-
IC*woman cared for by other relatives		-0.058	-	-
Number of FC hours		-0.057***	-	-
FC*Female		-0.002	-	-
FC*number moderate IADLs		-0.003*	-	-
FC*number severe IADLs		-0.000	-	-
FC*number moderate ADLs		-0.001	-	-
FC*number severe ADLs		-0.002	-	-
Activity restrictions and limitations				
Number of moderate ADL restrictions		0.050	0.080***	0.906***
Number of moderate IADL restrictions		0.155***	0.131***	0.419***
Number of severe ADL restrictions		0.159***	-0.035	2.272***
Number of severe IADL restrictions		0.092***	0.156***	0.608***
Motor limitation	*Yes*	0.114	0.186**	0.233
	No	Ref.	Ref.	Ref.

Sensory limitation	*Yes*	0.039	0.059	-0.450
	No	Ref.	Ref.	Ref.
Cognitive limitation	*Yes*	0.213***	0.005	0.715
	No	Ref.	Ref.	Ref.
Demographic variables				
Age		-0.010	-0.008**	0.166***
Gender	*Male*	Ref.	Ref.	Ref.
	Female	0.348***	-0.205***	1.583***
Socioeconomic variables				
Education level	*Low*	Ref.	Ref.	Ref.
	Medium	0.078	-0.109**	0.891*
	High	0.069	-0.369***	1.794***
Monthly income	*< 1000 €*	Ref.	Ref.	Ref.
	1000/1500	0.057	0.056	0.138
	1500/2000	0.032	0.197***	0.666
	> 2000 €	-0.001	0.289***	-0.094
Living in a rural area	*Yes*	0.035	-	0.590
	No	Ref.	-	Ref.
Family variables				
Living with a partner	*Yes*	0.004	0.478***	-1.403***
	No	Ref.	Ref.	Ref.
Widowhood < 2 years	*Yes*	0.187	-0.161	4.292***
	No	Ref.	Ref.	Ref.
Having at least one child	*Yes*	-0.080	-0.131	-1.526***
	No	Ref.	Ref.	Ref.
Seeing the family less than once a month	*Yes*	0.035	-0.327***	0.048
	No	Ref.	Ref.	Ref.
Proxy respondent	*Yes*	0.053	-	-
	No	Ref.	-	-
Exclusion variables				
At least one child who has no partner	*Yes*	-	0.110**	-
	No	-	Ref.	-
At least one child who has no child	*Yes*	-	0.167***	-
	No	-	Ref.	-
At least one child who lives close	*Yes*	-	0.139**	-
	No	-	Ref.	-
Proportion of daughters		-	0.215***	-
Proportion of individuals aged 75+ receiving the PAA in the department per 1,000 inhabitants		-	-	0.009***
Correlation coefficients				
ρ_{HI}	0.256			
ρ_{HF}	0.785**			
ρ_{IF}	-0.182***			

*: significant at the 10% level, **: 5% level, ***: 1% level.

Table III – Estimation of the model: the Mental-Health Inventory (2,117 observations)

		MHI-5 linear equation (1)	Informal care probit equation (2)	Formal care linear equation (3)
Intercept		55.566***	0.756*	-14.368***
Care variables				
IC	*Yes*	-1.509	-	-
	No	Ref.	-	-
IC*number moderate IADLs		1.047	-	-
IC*number severe IADLs		0.915*	-	-
IC*number moderate ADLs		0.605	-	-
IC*number severe ADLs		-2.319	-	-
IC*husband cared for by wife		Ref.	-	-
IC*wife cared for by husband		3.991	-	-
IC*father cared for by daughter		6.372*	-	-
IC*mother cared for by daughter		1.221	-	-
IC*father cared for by son		2.374	-	-
IC*mother cared for by son		2.570	-	-
IC*man cared for by siblings		9.711*	-	-
IC*woman cared for by siblings		-0.978	-	-
IC*man cared for by friends neighbors		9.775**	-	-
IC*woman cared for by friends neighbors		8.617**	-	-
IC*man cared for by other relatives		4.059	-	-
IC*woman cared for by other relatives		3.469	-	-
Number of FC hours		1.677*	-	-
FC*Female		0.178*	-	-
FC*number moderate IADLs		0.032	-	-
FC*number severe IADLs		0.019	-	-
FC*number moderate ADLs		0.040	-	-
FC*number severe ADLs		-0.010	-	-
Activity restrictions and limitations				
Number of moderate ADL restrictions		-3.671***	0.065*	0.608**
Number of moderate IADL restrictions		-1.229	0.140***	0.151
Number of severe ADL restrictions		-3.234	0.022	2.287***
Number of severe IADL restrictions		-2.869***	0.158***	0.569***
Motor limitation	*Yes*	-7.024***	0.257***	0.350
	No	Ref.	Ref.	Ref.
Sensory limitation	*Yes*	-1.787	0.096	0.078
	No	Ref.	Ref.	Ref.
Cognitive limitation	*Yes*	-7.554***	-0.001	0.952
	No	Ref.	Ref.	Ref.
Demographic variables				
Age		0.101	-0.016***	0.152***
Gender	*Male*	Ref.	Ref.	Ref.
	Female	-6.591**	-0.254***	2.052***
Socioeconomic variables				
Education level	*Low*	Ref.	Ref.	Ref.
	Medium	-0.339	-0.100	0.546
	High	-1.038	-0.336***	1.630**

Monthly income	*< 1000 €*	Ref.	Ref.	Ref.
	1000/1500	0.791	0.645	-0.540
	1500/2000	2.889	0.169	-0.279
	> 2000 €	3.101	0.343***	-0.007
Living in a rural area	*Yes*	1.578	-	-0.096
	No	Ref.	-	Ref.
Family variables				
Living with a partner	*Yes*	-1.320	0.540***	-1.138**
	No	Ref.	Ref.	Ref.
Widowhood < 2 years	*Yes*	-9.446**	-0.188	2.597**
	No	Ref.	Ref.	Ref.
Having at least one child	*Yes*	-0.748	-0.225*	-0.149
	No	Ref.	Ref.	Ref.
Seeing the family less than once a month	*Yes*	-3.462	-0.341***	0.559
	No	Ref.	Ref.	Ref.
Proxy respondent	*Yes*	3.044**	-	-
	No	Ref.	-	-
Exclusion variables				
At least one child who has no partner	*Yes*	-	0.183**	-
	No	-	Ref.	-
At least one child who has no child	*Yes*	-	0.134*	-
	No	-	Ref.	-
At least one child who lives close	*Yes*	-	0.139*	-
	No	-	Ref.	-
Proportion of daughters		-	0.166*	-
Proportion of individuals aged 75+ receiving the PAA in the department per 1,000 inhabitants		-	-	0.010***
Correlation coefficients				
ρ_{HI}	0.053			
ρ_{HF}	-0.724**			
ρ_{IF}	-0.181***			

*: significant at the 10% level, **: 5% level, ***: 1% level.

Mental-health equations

Few control variables have a significant effect on both mental health measures apart from activity restrictions, cognitive limitations and the gender of the dependent elderly (see tables II and III above). The risk of depression significantly increases with moderate restrictions in IADLs, with severe restrictions in ADLs and IADLs and with cognitive limitations. On the other hand, the mental health score (MHI-5) is significantly deteriorated with severe restrictions in IADLs, moderate restrictions in ADL, motor limitations and cognitive limitations. It is worth noting that while cognitive limitations influence neither the provision of informal care nor formal care, they affect mental health. Furthermore, women have a significantly higher risk of depression and a significantly lower MHI-5. Socioeconomic and family variables have no effect on mental health, except for being recently widowed which decreases the MHI-5 by 9 points and for the presence of proxy respondents which improves the MHI-5 by 3 points.

However, while family variables do not have a direct effect on mental health, they play a significant role through informal care. Indeed, receiving informal care significantly reduces the risk of depression and this effect increases with the number of moderate restrictions in IADLs. For example, the mean estimated probability of depression in our sample is 0.33 for individuals who do not receive informal care while it is 0.21 for individuals who are cared for by family members or other relatives. In the MHI-5 equation, the effect of informal care depends on the level of dependence and on the relationship between the elderly dependent and the primary caregiver. Informal care improves the MHI-5 only for individuals who have severe restrictions in IADLs. A possible explanation may be that informal caregivers are not able to manage effectively high levels of dependence (restrictions in ADLs). As regards the relationship between the elderly and the primary caregiver, familial care has a significant and

positive effect on the MHI-5 only for dependent elderly men who receive care from a daughter or siblings (a sister in 69% of cases). This is in accordance with the results of Byrnes *et al.* (*op. cit.*) suggesting that informal care provided to women is significantly less effective than informal care to men, and that care provided by daughters is more effective than care provided by sons. The most common care arrangement – men cared for by their wives – is not significant. One explanation is that some men may consider as "normal" the help received from their wives due to the gendered allocation of roles within the household. While care from the family network has an effect only on men, care from the social network (friends and neighbors) improves the MHI-5 for both elderly men and women. For instance, the mean estimated MHI-5 of a man cared for by his wife is 48.3 while it is 61.9 for a man cared for by a daughter, 57.6 for a man cared for by siblings and 61.8 for a man who receives help from friends or neighbors. The mean estimated MHI-5 of a woman cared for by a daughter is 46.1 while it is 51.5 for a woman cared for by friends or neighbors.

As far as formal care is concerned, it has a beneficial effect on mental health. Formal care hours reduce the risk of depression, especially when the number of moderate restrictions in IADLs increases. Furthermore, it improves the MHI-5 regardless of the level of dependence and this effect is increased for dependent elderly women. This gendered effect of formal care may be the consequence of different attitudes of men and women toward the Healthcare system: in France, women appear to be more attentive to their health (prevention) and rely more on GPs and specialists throughout their life (Ministry of Health, 2010). To illustrate, the mean estimated probability of depression is 0.23 if individuals receive formal care and 0.27 if they do not. Individuals who do not receive formal care have a mean estimated MHI-5 of 44.0 (42.7 for women, 46.2 for men) while individuals receiving formal care have a mean MHI-5 of 54.1 (for both women and men).

The estimated correlation coefficients of residuals between formal care and mental health equations (0.78 for depression and -0.72 for the MHI-5) are significant and consistent with the existence of reverse causality: depression and a low MHI-5 increase hours of formal care. These significant correlations may also be due to unobserved confounding factors (e.g. family history of mental health problems). On the contrary, the estimated correlation coefficients of residuals between informal care and mental health equations are not significant. However, this should not be interpreted as an absence of interaction between mental health and provision of informal care. Indeed, it is possible that the effect of unobserved confounding factors compensate the potential reverse causality of mental health on the provision of informal care.

Robustness tests

Correction of the potential selection bias in the MHI-5 study

As outlined above, only about half of the surveyed individuals (2,117 out of 4,067) have completed and returned the paper questionnaire which allows measuring the MHI-5. Descriptive statistics show that respondents to the questionnaire have less severe restrictions in ADLs and IADLs and are less frequently limited. This non-random aspect of the sample does not on its own bias the estimation of the MHI-5 if all variables influencing selection are controlled in the mental health equation (Sartori, 2003). Of greater concern is that unobserved factors influencing selection may be correlated with the error term in our equation of interest. The selection bias is thus equivalent to an omitted variable bias (Heckman, 1979). In this case, selection skews the results in inconsistent estimates. We thus add a selection equation (equation 4 below, probit model) to our model. The observed dependent variable S takes the value 1 if the surveyed individual has completed and returned the questionnaire and 0 otherwise. Explanatory variables X_s include the same set of characteristics of the dependent elderly and the family as in the MHI-5 equation (X_h) as well as informal care and formal care

hours[13]. More specifically, the selection equation (equation 4), the informal care equation (2) and the formal care equation (3) are estimated on the total sample of surveyed dependent elderly while the MHI-5 equation (1) is estimated on the subsample of selected individuals. In order to identify our model, we need an exclusion variable (Z_s) that appears in the selection equation but does not affect mental health[14]. We use the fact of having voted or not in the 2007 French presidential and legislative elections. Even if we cannot completely rule out the possibility that the act of voting may be influenced by mental health, we think it is above all a good indicator of social participation and of the desire to give its opinion (and thus of the probability of completing and returning the questionnaire).

$$(4)\ S^* = X_s\beta_s + \gamma_s Z_s + \epsilon_s; \quad IC = \begin{cases} 1\ if\ S^* > 0 \\ 0\ otherwise \end{cases}$$

Estimation results (see Appendix A1) show that having not voted in the 2007 presidential and legislative elections significantly decreases the probability of completing the paper questionnaire. In addition, having sensory or cognitive limitations, seeing the family less than once a month and needing assistance from a third party to respond to the face to face interview (proxy respondent) reduce the probability of completing the questionnaire. On the contrary, elderly dependent people with high incomes are more likely to complete it. Furthermore, residuals of our equation of interest are not correlated with residuals of the

[13] Results remain unchanged if we add interaction terms between care variables and the level of dependence, the gender of the elderly, the relationship between the elderly and the primary caregiver. To keep the model simple, we present the results without interaction terms in the selection equation.

[14] The model is technically identified even if the same set of variables appears in the selection equation and in the mental health equation. However, in this case, identification is due to distributional assumptions about the residuals (non-linearity) and may lead to imprecise estimates (Sartori, *op. cit.*).

selection equation. Consequently, the effects of care variables and interaction terms on the mental health of dependent elderly individuals remain unchanged (except that the negative effect of informal care to individuals with severe restrictions in ADLs, which had a p-value of 0.105 in previous results, is now significant at the 10% level). It is possible that the burden associated with care to highly dependent people decreases the informal caregiver well-being which in turns deteriorates the MHI-5 of the dependent elderly.

Robustness tests on exclusion variables for informal care

We have four exclusion variables for informal care; we can therefore test the robustness of our results for different subsets of exclusion variables. We estimate the model described in the method section for 15 different combinations of exclusion variables: specification 0 is the one described in the "Estimation results" subsection; specifications 1 to 4 use only one exclusion variable, specifications 5-8 use subsets of three exclusion variables and specifications 9-14 use subsets of two exclusion variables. In addition, we remove one by one the exclusion variables and include it in our equation of interest to see if they significantly influence the mental health of dependent elderly people. Results (available upon request) show that no exclusion variable seems to be significantly related with the MHI-5. On the other hand, "having at least one child who has no child" decreases the risk of depression. Accordingly, specifications which do not include this exclusion variable should be preferred for the study of depression (that is why table A2 in appendix presents only the results of specifications 1, 3, 4, 8, 10, 11 and 14; results for other specifications are available upon request).

Our effects are stable across the different specifications (see Appendices A2 and A3), except for some effects significant at the 10% level. Concerning the risk of depression, informal care decreases the risk of depression for slightly dependent individuals (individuals with moderate restrictions in IADLs) while formal care hours reduce the probability of depression

independently of the level of dependence[15]. Regarding the mental health score, as it has been underlined in the "Estimation results" subsection, the effect of informal care depends on the level of dependence of the elderly and on care arrangements while formal care has a general positive effect which is increased for women. More precisely, we still have a positive effect of informal care for individuals who have severe restrictions in IADLs, for men receiving care from a daughter or siblings and for both men and women receiving care from friends or neighbors. In addition, effects that were slightly insignificant in the previously described results (p-values of 0.105 and 0.108), become significant at the 10% level. Informal care provided to dependent elderly with severe restrictions in ADLs decreases the MHI-5 by 2.4 points (in 7 specifications) and informal care provided by a husband to his wife improves the mental health score by 4.1 points (in 5 specifications).

5. Discussion

Our contribution to the literature was to estimate empirically the effects of informal care and formal care on mental health while controlling for the endogeneity of care. We used two mental health indicators – depression and the Mental-Health Inventory (MHI-5) – and we allowed the effect of care on mental health to vary depending on the level of dependence, the gender of the dependent elderly and the relationship between the elderly and the primary informal caregiver. Our results indicate that both informal and formal cares have beneficial effects on mental health. Informal care is effective in managing low levels of dependence (people with restrictions in instrumental activities of daily living). On the contrary, it may have an adverse effect (on the MHI-5) when dependent elderly have severe restrictions in essential activities of daily living. Furthermore, the effect of informal care on the MHI-5

[15] In specifications which include the exclusion variable "having at least one child who has no child", not represented here, both informal care and formal care have a general negative effect on the risk of depression, and this effect is higher for slightly dependent people.

depends on the relationship between the elderly and the informal caregiver. Care provided by the family network improves the MHI-5 for dependent men helped by a daughter or siblings (and for women helped by their husbands in some specifications) while care from the social network (friends and neighbors) is highly significant for both men and women. As far as formal care hours are concerned, they decrease the risk of depression and increase the MHI-5 independently of the level of dependence. In addition, the positive effect of formal care on the MHI-5 is higher for women than for men.

In terms of public policies, these results call for two proposals. First, due to the lack of effect of informal care on the mental health of highly dependent elderly people – and even negative effect on the MHI-5 – care for these individuals should be mostly based on formal services. Second, formal care should be considered as particularly relevant for dependent elderly women. Indeed, formal care is especially effective for women's MHI-5 while family care is effective mainly for men's MHI-5.

Despite these interesting results, our study has some limitations. We use declarative data and subjective measures of mental health which may result in response biases (recall bias, social desirability bias). More objective measures such as medical consumption of antidepressants may be interesting, but are not available in the survey. In addition, longitudinal data would allow us to control for unobserved individual heterogeneity (e.g. individuals who always report poor mental health) and would enable to observe the effects of formal care and informal care for a same individual throughout the whole process of dependence. Finally, larger samples of dependent elderly individuals would make it possible to reinforce our effects and to study in more detail the diversity of care arrangements, for instance by comparing care provided by biological children and by children-in-law. Indeed, Byrnes *et al.* (*op. cit.*), find that care from children is more effective than care from children-in-law.

Future research could focus on the effects of formal and informal cares on informal caregivers. We have shown that informal care improves the mental health of slightly dependent elderly. What about its impact on informal caregivers' health? Aside from improving the mental health of elderly, do formal services reduce the burden associated with informal support? To answer such questions, the Informal Caregivers section of the French Disability and Health Survey could be mobilized.

6. Appendix

Table A1 – Correction of the potential selection bias in the MHI-5 study

		MHI-5 linear equation (1)	Informal care probit equation (2)	Formal care linear equation (3)	Selection equation (4)
Intercept		59.845***	0.153	-14.056***	0.977***
Care variables					
IC	*Yes*	-2.029	-	-	-0.288
	No	Ref.	-	-	Ref.
IC*number moderate IADLs		1.037	-	-	-
IC*number severe IADLs		0.906*	-	-	-
IC*number moderate ADLs		0.621	-	-	-
IC*number severe ADLs		-2.412*	-	-	-
IC*husband cared for by wife		Ref.	-	-	-
IC*wife cared for by husband		4.058	-	-	-
IC*father cared for by daughter		6.498*	-	-	-
IC*mother cared for by daughter		1.369	-	-	-
IC*father cared for by son		2.399	-	-	-
IC*mother cared for by son		2.736	-	-	-
IC*man cared for by siblings		9.701*	-	-	-
IC*woman cared for by siblings		-0.908	-	-	-
IC*man cared for by friends neighbors		9.822**	-	-	-
IC*woman cared for by friends neighbors		8.654**	-	-	-
IC*man cared for by other relatives		4.147	-	-	-
IC*woman cared for by other relatives		3.594	-	-	-
Number of FC hours		1.830*	-	-	0.031
FC*Female		0.176*	-	-	-
FC*number moderate IADLs		0.032	-	-	-
FC*number severe IADLs		0.020	-	-	-
FC*number moderate ADLs		0.039	-	-	-
FC*number severe ADLs		-0.010	-	-	-
Activity restrictions and limitations					
Number of moderate ADL restrictions		-4.362***	0.078***	0.906***	-0.038
Number of moderate IADL restrictions		-1.747*	0.132***	0.419***	-0.013
Number of severe ADL restrictions		-3.404	-0.035	2.273***	-0.091
Number of severe IADL restrictions		-2.944***	0.155***	0.609***	-0.029
Motor limitation	*Yes*	-6.447***	0.191**	0.234	-0.117
	No	Ref.	Ref.	Ref.	Ref.
Sensory limitation	*Yes*	-0.387	0.060	-0.450	-0.089*
	No	Ref.	Ref.	Ref.	Ref.

Cognitive limitation	*Yes*	-6.937***	0.003	0.715	-0.136***
	No	Ref.	Ref.	Ref.	Ref.
Demographic variables					
Age		0.044	-0.008**	0.166***	-0.008
Gender	*Male*	Ref.	Ref.	Ref.	Ref.
	Female	-6.267**	-0.203***	1.583***	0.039
Socioeconomic variables					
Education level	*Low*	Ref.	Ref.	Ref.	Ref.
	Medium	-1.457	-0.125**	0.891*	0.091
	High	-1.928	-0.374***	1.792***	0.020
Monthly income	*< 1000 €*	Ref.	Ref.	Ref.	Ref.
	1000/1500	-0.695	0.055	0.137	0.072
	1500/2000	0.735	0.202***	0.665	0.098
	> 2000 €	3.145	0.288***	-0.095	0.136**
Living in a rural area	*Yes*	0.074	-	0.585	0.012
	No	Ref.	-	Ref.	Ref.
Family variables					
Living with a partner	*Yes*	-0.421	0.488***	-1.403***	0.082
	No	Ref.	Ref.	Ref.	Ref.
Widowhood < 2 years	*Yes*	-13.790**	-0.162	4.292***	-0.007
	No	Ref.	Ref.	Ref.	Ref.
Having at least one child	*Yes*	2.169	-0.125	-1.526***	0.020
	No	Ref.	Ref.	Ref.	Ref.
Seeing the family less than once a month	*Yes*	-2.254	-0.351***	0.047	-0.156**
	No	Ref.	Ref.	Ref.	Ref.
Proxy respondent	*Yes*	3.461***	-	-	-0.169***
	No	Ref.	-	-	Ref.
Exclusion variables					
At least one child who has no partner	*Yes*	-	0.135***	-	-
	No	-	Ref.	-	-
At least one child who has no child	*Yes*	-	0.136**	-	-
	No	-	Ref.	-	-
At least one child who lives close	*Yes*	-	0.122**	-	-
	No	-	Ref.	-	-
Proportion of daughters		-	0.186***	-	-
Proportion of individuals aged 75+ receiving the PAA in the department per 1,000 inhabitants		-	-	0.009***	-
Has not voted in the 2007 French presidential and legislative elections		-	-	-	-0.109**
ρ_{HI}	0.083		ρ_{SH}	0.246	
ρ_{HF}	-0.787***		ρ_{SI}	0.262*	
ρ_{IF}	-0.182***		ρ_{SF}	-0.435	

Table A2 – Robustness tests on exclusion variables (depression)

Specification	1	3	4	8	10	11	14
IC	ns	ns	ns	ns	ns	ns	ns
IC*moderate IADLs	-**	-**	-**	-**	-**	-**	-**
IC*severe IADLs	ns	ns	ns	ns	ns	ns	ns
IC*moderate ADLs	ns	ns	ns	ns	ns	ns	ns
IC*severe ADLs	ns	ns	ns	ns	ns	ns	ns
IC* relationship between the elderly and the primary informal caregiver	ns	ns	ns	ns	ns	ns	ns
Number of FC hours	-***	-***	-***	-***	-***	-***	-***
FC*Female	ns	ns	ns	ns	ns	ns	ns
FC*moderate IADLs	ns	ns	ns	ns	ns	-*	ns
FC*severe IADLs	ns	ns	ns	ns	ns	ns	ns
FC*moderate ADLs	ns	ns	ns	ns	ns	ns	ns
FC*severe ADLs	ns	ns	ns	ns	ns	ns	ns

ns: not significant, *: significant at the 10% level, **: significant at the 5% level, ***: significant at the 1% level.

Specification 1: only one exclusion variable ("having at least one child who has no partner"); specification 3: only one exclusion variable ("having at least one child who lives close"); specification 4: only one exclusion variable (proportion of daughters); specification 8: all exclusion variables except "having at least one child who has no child"; specification 10: two exclusion variables ("having at least one child who has no partner" and "having at least one child who lives close"); specification 11: two exclusion variables ("having at least one child who has no partner" and the proportion of daughters); specification 14: two exclusion variables ("having at least one child who lives close" and the proportion of daughters).

Table A3 – Robustness tests on exclusion variables (MHI-5)

Specification	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
IC	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
IC*moderate IADLs	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
IC*severe IADLs	+*	+*	+*	+*	ns	+*	+*	+*	+*	+*	+*	+*	+*	ns	+*
IC*moderate ADLs	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
IC*severe ADLs	ns	-*	-*	ns	-*	ns	-*	ns	ns	-*	ns	-*	ns	-*	ns
IC*wife/husband	ns	ns	+*	ns	+*	ns	+*	ns	ns	ns	ns	+*	ns	+*	ns
IC*father/daughter	+*	+*	+*	+*	+*	+*	+*	+*	+*	+*	+*	+*	+*	+*	+*
IC*mother/daughter	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
IC*father/son	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
IC*mother/son	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
IC*man/siblings	+*	+*	+*	+*	+*	+*	+*	+*	+*	+*	+*	+*	+*	+*	+*
IC*woman/siblings	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
IC*man/friends neighbors	+**	+**	+**	+**	+**	+**	+**	+**	+**	+**	+**	+**	+**	+**	+**
IC*woman/ friends neighbors	+**	+**	+**	+**	+**	+**	+**	+**	+**	+**	+**	+**	+**	+**	+**
IC*man/others	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
IC*woman/others	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Number of FC hours	+*	+*	+*	+*	+*	+*	+*	+*	+*	+*	+*	+*	+*	+*	+*
FC*Female	+*	+*	+*	+*	+*	+*	+*	+*	+*	+*	+*	+*	+*	+*	+*
FC*level of dependence	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

ns: not significant, *: significant at the 10% level, **: significant at the 5% level, ***: significant at the 1% level.

Specification 0: with the four exclusion variables for informal care; specification 1: only one exclusion variable ("having at least one child who has no partner"); specification 2: only one exclusion variable ("having at least one child who has no child"); specification 3: only one exclusion variable ("having at least one child who lives close"); specification 4: only one exclusion variable (proportion of daughters); specification 5: all exclusion variables except the proportion of daughters; specification 6: all exclusion variables except "having at least one child who lives close"; specification 7: all exclusion variables except "having at least one child who has no partner"; specification 8: all exclusion variables except "having at least one child who has no child"; specification 9: two exclusion variables ("having at least one child who has no partner" and "having at least one child who has no child"); specification 10: two exclusion variables ("having at least one child who has no partner" and "having at least one child who lives close"); specification 11: two exclusion variables ("having at least one child who has no partner" and the proportion of daughters); specification 12: two exclusion variables ("having at least one child who has no child" and "having at least one child who lives close"); specification 13: two exclusion variables ("having at least one child who has no child" and the proportion of daughters); specification 14: two exclusion variables ("having at least one child who lives close" and the proportion of daughters)

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8. References

Bolin K, Lindgren B, Lundborg P. 2008. Informal and formal care among single-living elderly in Europe. *Health Economics* **17**: 393-409.

Bonsang E. 2007. How do middle-aged children allocate time and money transfers to their older parents in Europe? *Empirica* **34**: 171-188.

Bonsang E. 2009. Does informal care from children to their elderly parents substitute for formal care in Europe? *Journal of Health Economics* **28**: 143-154.

Bradford Rice J, Kasper JD, Pezzin LE. 2009. A comparative analysis of Medicaid long-term care policies and their effects on elderly dual enrollees. *Health Economics* **18**: 275-290.

Byrne D, Goeree MS, Hiedemann B, Stern S. 2009. Formal home health care, informal care, and family decision making. *International Economic Review* **50(4)**: 1205-1242.

Charles KK, Sevak P. 2005. Can family caregiving substitute for nursing home care? *Journal of Health Economics* **24**: 1174-1190.

Fast JE, Williamson DL, Keating NC. 1999. The hidden costs of informal elder care. *Journal of Family and Economic Issues* **20(3):** 301-326.

Fontaine R, Gramain A, Wittwer J. 2007. Les configurations d'aide familiale mobilisées autour des personnes âgées dépendantes en Europe. *Economie et Statistique* **403-404**.

Golberstein E, Grabowski DC, Langa KM, Chernew ME. 2009. The effect of Medicare home health care payment on informal care. *Inquiry* **46(1)**: 58-71.

Greene VL. 1983. Substitution between formally and informally provided care for the impaired elderly in the community. *Medical Care* **21(6)**: 609-619.

Grossman M. 1972. On the concept of health capital and the demand for health. *The Journal of Political Economy* **80(2)**: 223-255.

Haberkern K, Szydlik M. 2010. State care provision, societal opinion and children's care of older parents in 11 European countries. *Ageing and Society* **30(02)**: 299-323.

Heckman JJ. 1979. Sample selection bias as a specification error. *Econometrica* **47(1)**: 153-161.

Hoerger TJ, Picone GA, Sloan F. 1996. Public subsidies, private provision of care and living arrangements of the elderly. *The Review of Economics and Statistics* **78(3)**: 428-440.

Hoeymans N, Garssen AA, Westert GP, Verhaak P FM. 2004. Measuring mental health of the Dutch population: a comparison of the GHQ-12 and the MHI-5. *Health and Quality of Life Outcomes* **2:23**.

Kelly MJ, Dunstan FD, Lloyd K, Fone DL. 2008. Evaluating cutpoints for the MHI-5 and MCS using GHQ-12: a comparison of five different methods. *BMC Psychiatry* **8:10**.

Pezzin LE, Kemper P, Reschovsky J. 1996. Does publicly provided home care substitute for family care? Experimental evidence with endogenous living arrangements. *The Journal of Human Resources* **31(3)**: 650-676.

Pezzin LE, Schone BS. 1999. Intergenerational household formation, female labor supply and informal caregiving: a bargaining approach. *The Journal of Human Resources* **34(3)**: 475-503.

Portrait F, Lindeboom M, Dorly D. 2000. The use of long-term care services by the Dutch elderly. *Health Economics* **9**: 513-531.

Roodman D. 2011. Fitting fully observed recursive mixed-process models with cmp. *The Stata Journal* **11(2)**: 159-206.

Sartori AE. 2003. An estimator for some binary-outcome selection models without exclusion restrictions. *Political Analysis* **11(2)**: 111-138.

Stabile M, Laporte A, Coyte PC. 2006. Household responses to public home care programs. *Journal of Health Economics* **25**: 674-701.

Stern S. 1995. Estimating family long-term care decisions in the presence of endogenous child characteristics. *The Journal of Human Resources* **30(3)**: 551-580.

Thiébaut SP, Ventelou B, Garcia-Penalosa C, Trannoy A. 2012. Une analyse microéconomique du gage patrimonial dans l'aide aux personnes dépendantes. *Revue Economique* **63(2)**: 339-372.

Thorsen SV, Rugulies R, Hjarsbech P, Bjorner JB. 2013. The predictive value of mental health for long-term sickness absence: the Major Depression Inventory (MDI) and the Mental Health Inventory (MHI-5) compared. *BMC Medical Research Methodology* **13:115**.

Van Gool C H, Kempen G IJM, Penninx B WJH, Deeg D JH, Beekman A TF, Van Eijk J TM. 2005. Impact of depression on disablement in late middle aged and older persons: results from the Longitudinal Aging Study Amsterdam. *Social Science & Medicine* **60**: 25-36.

Van Houtven CH, Norton EC. 2004. Informal care and health care use of older adults. *Journal of Health Economics* **23**: 1159-1180.

Verbrugge LM, Jette AM. 1994. The disablement process. *Social Science & Medicine* **38(1)**: 1-14.

Weber F. 2010. Les rapports familiaux reconfigurés par la dépendance. *Regards croisés sur l'économie* **7(1)**: 139-151

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