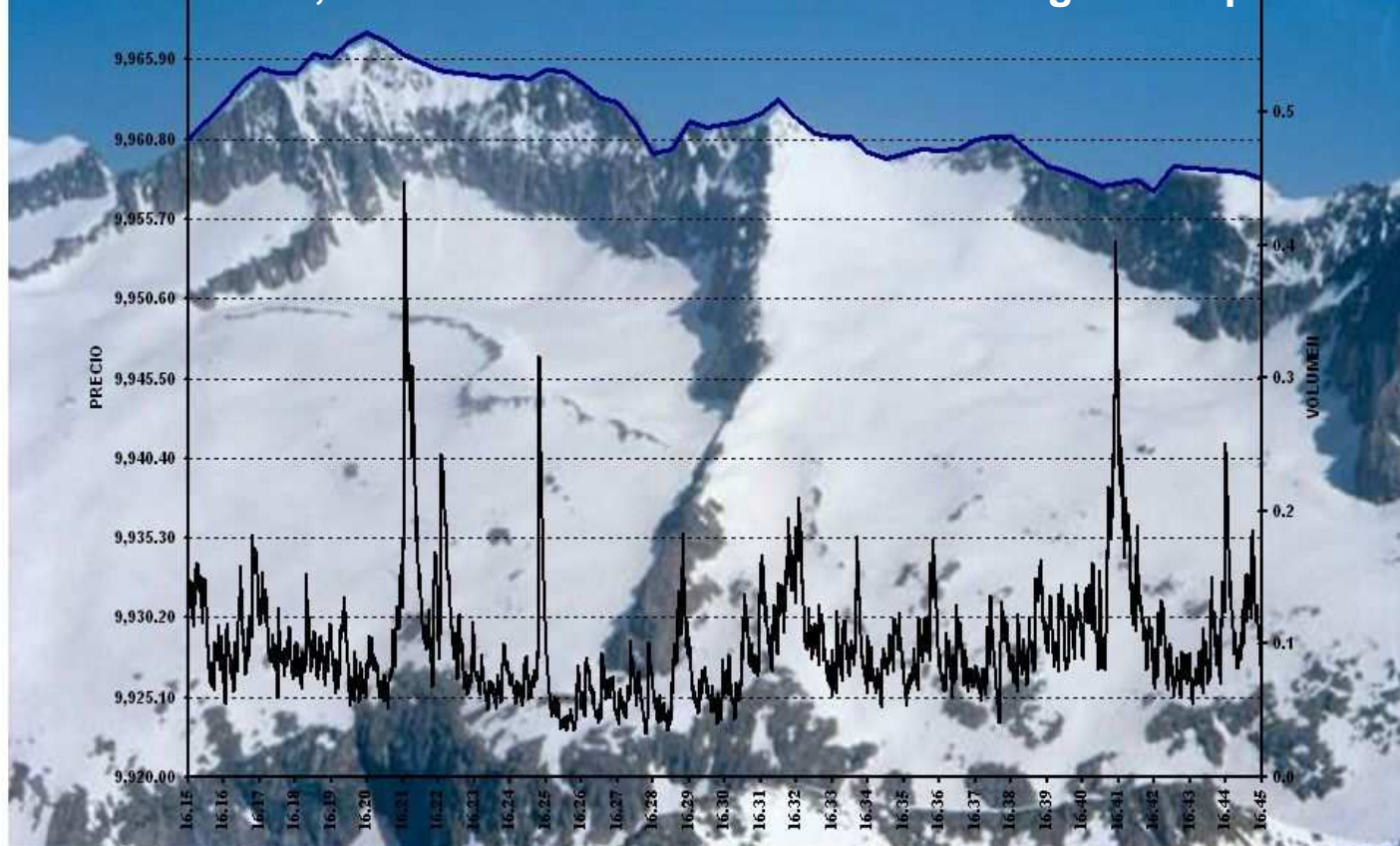


Economics, Finance and Mathematics from a high standpoint



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Abstract

Cognitive impairment (CI) is a chronic disease. In estimating the total cost of this condition, several studies have reported that the percentage corresponding to informal care is superior to the cost of health care per se. The cost of informal caregiving time for older adults with CI residing in their homes is estimated in this study.

A cross-sectional observational study was developed in which the Resident Assessment Instrument Home Care (RAI-HC) was used to compile information on the sociodemographic variables, characteristics of the informal caregivers, disease diagnoses, hearing and vision function, use of formal support services, use of locomotion aids, the Cognitive Performance Scale (CPS) score and hours of informal care. The hours of informal care for CI and its cost were estimated using a multiple linear regression model.

A mean of 282.61 hours per year was attributable to CI alone, which is equivalent to a cost of 3956.54€. This paper is the first in Spain that estimates informal caregiving time in older adults with cognitive impairment. It provides valuable information for health professionals and policy makers and removing some uncertainty. These results are not different than USA studies and European countries studies.

Keywords: caregiving informal · cognitive impairment · informal care · costs · Spain · dementia

The increase in the number of older adults in the population is currently an issue in the social policy agendas of many countries. The increase in the number of older adults, which is related with increased life expectancy, means that the cost of chronic diseases that appear with age rises and generates a greater demand on social, medical and health services (Bulati et al. 2008; Crews & Zavotka 2006). Chronic diseases contribute to dependence. According to official statistics, the global mean prevalence in the world of people aged 60 years or older with moderate to severe dependence is estimated at 46% (Mathers C 2008).

Cognitive impairment (CI) is a chronic degenerative disease that disturbs mental functions like memory, orientation, language, visual recognition, and conduct that originates dependence for activities of daily living. CI and dementia are similar concepts that are differentiated only by the intensity of the disorder. A comparative analysis in 9 countries of the OECD shows that the prevalence of dementia ranges from 0.3 to 52.8% and increasing exponentially with age (Moise P 2004). Other recent study on Nationally Representative Community and Institutional Surveys in United States show similar results (Bernstein & Remsburg 2007).

Different nonpharmaceutical interventions have been developed to palliate CI as much as possible. Although some interventions have a positive impact, they are not being carried out systematically by public administrations because their effectiveness has not been fully evaluated (Novoa et al. 2008; Spijker et al. 2008). The lack of cost analyses on these interventions is probably a factor in their spotty implementation.

There is a relation between the severity of CI and the amount of informal care available. Some studies indicate that the cost of informal care for patients with CI outweighs the cost of health care, although other studies do not confirm this finding. In any case, the cost of informal care is responsible for a large percentage of total cost (Nordberg et al. 2005; Wimo et al. 2007). A recent study shows a decline in the participation of middle-aged women in the work market as they are required to function as informal caregivers (Berecki-Gisolf et al. 2008). Other studies demonstrate that informal caregivers are more prone to developing certain diseases that increase the indirect cost of health care services and other indirect costs, such as the loss of work productivity due to fatigue, stress or lost work days, among other reasons (Etters et al. 2008; Meredith B. Lilly 2007).

The methods used and cost estimates obtained on the informal care for subjects with CI vary widely in the literature. In the U.S., the estimated annual cost of informal care is \$2610 to \$23310 depending on the

degree of deterioration (Langa et al. 2001). A review of studies on the costs of mental disease in European countries finds a range of 624.72 to 17184 € depending on the country, methodology and CI grade (Jonsson 2004).

This study was designed to calculate the cost of informal caregiving time using the hours of informal care that older people with CI residing in their homes receive. The factors associated with more or fewer hours of informal care were identified to use them as control variables in regression analysis.

It is useful from an economic and social point of view to be able to offer government officials and health managers estimates of the costs of mitigating the effects of caring for older people with CI and a model for estimating this cost. This study will contribute to the existing literature in this field.

The paper proceeds as follows. First, the sample, assessment instrument, health and other measures, empirical model and cost will be presented. Second, the results are reported. The paper concludes with a discussion of our results.

Design and Methods

Sample

A cross-sectional observational study was conducted in 242 people aged over 64 years residing in their homes. The study sample was selected randomly from the patients of rural public health centers. In order to ensure that the study population would have a high percentage of people with dependence (and, consequently, CI), only subjects with a score of 3 or more (mild cognitive deterioration) on the Pfeiffer index (Pfeiffer 1975) and 95 or less (mild dependence) on the Barthel test (Mahoney & Barthel 1965) were included. All of the participants were informed of the study objectives and signed an informed consent form in which they agreed to participate in the study.

The data were collected from 2004 to 2007 by means of personal interviews carried out by a group of nurses who had been trained by the investigative team.

Assessment instrument

The comprehensive Resident Assessment Instrument for Home Care (RAI-HC) was used to evaluate the functional, physical, psychological, social, and environmental status, strengths, preferences, and needs, and a variety of subscales included in the instrument and used as health outcomes of older adults living at

home. The RAI-HC has been disseminated by the interRAI association (<http://interRAI.org>), an international nonprofit research network whose primary objective is to develop health assessment systems for different health care settings. Numerous studies have demonstrated the reliability and validity of the instrument (Hawes et al. 1995; Hirdes et al. 2004; Morris et al. 1997). It is being used in Canada, the United States and, more recently, in eleven European countries (Carpenter et al. 2004; Sorbye et al. 2009).

Health measures

CI was measured using the Cognitive Performance Scale (CPS), which grades subjects into seven levels of cognitive performance from 0 (intact) to 6 (seriously deteriorated) (Morris et al. 1994). This score derives from four RAI-HC items: short-term memory, decision-making, ability to make oneself understood, and feeding dependence. The scale correlates well with other frequently used and accepted research scales, including the Mini-Mental Status Examination (MMSE) (Paquay et al. 2007). It has been used in different care settings (nursing homes, retirement homes, home care, geriatric patients, etc.) with positive evaluations (Hansebo et al. 1998). A cutoff point of 3 (MMSE <19.2), which differentiates subjects with cognitive deterioration from dementia, was used to examine the differences between the two groups of subjects. This classification method has been used in other studies (Carpenter et al. 2006; Paquay et al. 2007; van der Steen et al. 2006).

Possible hearing impairment was evaluated in each subject using item C1 of RAI-HC. The subject was asked about his or her level of hearing: adequate hearing (0), minimal difficulties (1), hearing only in special circumstances (2), or hearing loss (3). This variable was categorized by overlapping grades, 0-1 and 2-3.

Vision deficits were evaluated with the D1 item of the RAI-HC. The subject's visual function was graded according to 5 levels (adequate, altered, moderately altered, much altered, and seriously altered). This variable was categorized by overlapping grades, 0-2 and 3-4.

The RAI-HC has a section dedicated to the diagnosis of diseases in which the subject is asked about diseases that affect the subject's state or require treatment or monitoring of symptoms. The presence or absence of the diseases that were frequent enough for comparative analyses to be made between the two CI groups was assessed in the study. These diseases were congestive heart failure, coronary artery disease, hypertension, cardiac arrhythmias, parkinsonism, arthritis, osteoporosis, cancer, diabetes, emphysema/asthma/COPD, renal failure, hyper- or hypothyroidism.

Finally, it was necessary to include the variables of the physical function domain of the RAI-HC to assess the use of the following locomotion aids: cane, walker, or wheelchair.

Other measures

The weekly hours informal care ($IC_{h/wk}$) obtained were the sum of the time items dedicated to care provided by either a primary caregiver or a secondary caregiver, on weekdays and weekends (Section G3 of informal care items). A limit of sixteen hours of daily informal care was set to allow the caregiver eight hours of sleep, which affected a small percentage of the sample (<5%) (Ernst & Hay 1994).

The particular characteristics of each subject (sex, age, marital status, and education), the particular characteristics of each primary and secondary caregiver (relation with the subject evaluated and caregiver cohabitation with the subject), and the use of formal care (House-aid, at-home nurses, and domestic service) were assessed.

Other RAI-HC items were evaluated in a preliminary analysis to rule out their inclusion in the study.

Empirical model

Two main methods were used to correctly identify the hours of informal care required by CI. One method was to directly ask informal caregivers to identify the tasks required by subjects with CI. Other studies use statistical models to identify the network of care attributable to CI after adjusting for the presence or coexistence of disease and other particular subject characteristics. The latter method was used in this study (Langa et al. 2001).

In order to develop an empirical model for calculating the $IC_{h/wk}$ derived from CI, we started with the assumption that $IC_{h/wk}=0$ in subjects without CI or other comorbidity. Consequently, analyses were made of subjects with some degree of CI ($CPS \geq 3$) and subjects without CI to find the differences between the groups.

Like the cost data that economists frequently use, $IC_{h/wk}$ is plagued with problems of heteroscedasticity and kurtosis. Different methods are used depending on the situation. Regression models or a variant using the logarithm, $\ln(y)$, as the dependent variable are among the methods most often employed (Glick HA 2007).

In this study, we estimated a multiple linear regression model of the log of $IC_{h/wk}$ derived from CI that took into account the heterogeneity of each individual by including covariates of sociodemographic

characteristics (of the subject and caregiver), comorbidities, vision problems, hearing problems, the use of locomotion aids, and the use of formal support services.

The regression model is

$$\ln(IC_{h/wk}) = CI + CV + \varepsilon \quad (1)$$

where CI represents cognitive impairment and CV is the covariate adjustment dataset. If the error term (ε) is distributed normally $N(0, \sigma^2)$ and CV is assumed to be 0, then

$$E(IC_{h/wk} | CI) = \exp(CI + 0.5\sigma^2) \quad (2)$$

where the last term in the equation (smearing factor, commonly used in this type of retransformation) allows the efficiency of $IC_{h/wk}$ estimates to be improved (Manning 1998; Manning & Mullahy 2001; Moya Martinez et al. 2009).

In the first step, all the variables were introduced in the model. Later, and with the aim of developing the most parsimonious model capable of explaining $IC_{h/wk}$, the backward method was used on the previous model. The beta coefficients of the vector of variables that represent CI did not experience major changes. All the variables were recoded as dummy type variables, if feasible. Problems of multicollinearity (VIF and tolerance statistics), self-correlation (Durbin-Watson statistics), and heteroscedasticity (graph of typified residues versus typified prognostic values) were not encountered.

Costs

Although the cost of informal care strongly correlates with the time dedicated to informal care, valid methods must be used to calculate this time. Some methods are the proxy good method, contingent evaluation, and conjoint analysis (Koopmanschap et al. 2008; van den Berg et al. 2004). Due to the nature of our data, we used the proxy good method, which consists of assessing the time dedicated to informal care using market prices or a close surrogate. In this way, with the adjusted $IC_{h/wk}$ obtained from the regression model the cost of informal care derived from CI was calculated by multiplying the number of hours by the mean cost per hour of formal care by a specialized company in Spain (10 to 14 €) and by a private party (7 to 10 €). This hourly cost were acquired from a special report of DBK enterprize (<http://dbk.es>).

Results

A total of 242 assessments of people aged over 64 years were analyzed. Mean subject age was 81.09 \pm 7.08 years (women: 81.3 \pm 7.09; men: 80.8 \pm 7.07). Mean CPS scale for subjects with CI were 4.70 \pm 1.06 (CPS scale grades from 0 to 6). The prevalence of CI was 39.3%. There were no significant differences in the prevalence of CI between men (44.0%) and women (36.4%). By age groups, subjects older than 85 years had a higher percentage of CI (52.5%) than subjects aged 75 to 85 years (34.7%) and subjects aged 64 to 75 years (35.0%).

The $IC_{h/wk}$ (unadjusted) were 17.74 (95% confidence interval: 13.85-21.63) in the group of subjects without CI versus 32.15 (95% confidence interval: 27.11-37.20) in the subjects with CI. By gender, men with CI received more $IC_{h/wk}$ (35.05; 95% confidence interval: 26.27-43.82) than men without CI (20.96; 95% confidence interval: 13.48-28.43), and women with CI received more $IC_{h/wk}$ (30.05; 95% confidence interval: 23.92-36.18) than women without CI (16.03; 95% confidence interval: 11.52-20.53).

Other sociodemographic and clinical characteristics of the participants with and without CI were similar, with the exception of hearing and vision, the diagnosis of osteoporosis and the diagnosis of emphysema/asthma/COPD (Table 1). A high percentage of subjects with CI had hearing (72.1%) and vision (70.8%) problems.

For the purpose of finding the best control and/or fit variables to estimate $IC_{h/wk}$ derived from CI, we calculated the mean $IC_{h/wk}$ in subjects with CI and the difference of the means between different characteristics (Table 2) and simple linear regression models using the variables eligible for the final model (Table 3). The main difference between the mean $IC_{h/wk}$ of subjects with CI versus subjects without CI as cohabitation of the secondary caregiver with the subject, presence of hearing or vision problems, arthritis, and walker-assisted locomotion. In addition, receiving formal care by at-home nurses also increased the number of $IC_{h/wk}$ and domestic help decreases it. In simple linear regression analysis, the greater percentage of variability in $IC_{h/wk}$ for the control variables of the final analysis was explained by the hearing problems (9.2%) and vision problems (6.4%) variables. Furthermore, subjects who used walker-assisted locomotion increases hours of $IC_{h/wk}$ and women receives less.

The final model (Table 4) was the most parsimonious model, but the estimated effects of $IC_{h/wk}$ are not significantly different in the models with the full set of controls. Model explained 30.5% of the variation in the log of $IC_{h/wk}$. It was calculated using the following control variables: hearing problems, walker use, wheelchair use, at-home nursing care, and domestic service. We observed that hearing problems, walker

use, wheelchair use and at-home nursing care increases $IC_{h/wk}$. However, this effect is reversed for domestic service. The explanatory variable of primary interest in the model, cognitive impairment, showed an important positive association but wheelchair variable showed the most positive association supposing the major increment in $IC_{h/wk}$.

After retransforming the log of $IC_{h/wk}$ into $IC_{h/wk}$, we estimated the increase of $IC_{h/wk}$ in subjects with CI and the cost of these hours when the service was provided by a company or by a private party in Spain in euros per year (Table 5).

Discussion

This study provides a comprehensive estimate of the excess costs associated with informal care to elderly with CI. CI is a complex disease that affects many people (about 40 percent in our sample) and increase informal caregiving time in 282,61 annual hours with a cost of 3956.54 or 1978.27€ depending on the service provider (companies or individuals respectively). This means that it is important from a political and social point of view to identify the associated factors and their costs in order to palliate them as much as possible.

Informal care is one of the indirect costs of CI. There are many other direct and indirect costs, but it is fundamental to mitigate informal care. Informal care occasions substantial costs to caregivers in terms of unemployment and loss of working hours (Bolin et al. 2008), aside from originating health problems and considerably increasing costs to the health care system (Etters et al. 2008; Meredith B. Lilly 2007). Furthermore, it has been shown that the unpaid caregiver time is a sensitive measure of change in cognitive decline (Clipp & Moore 1995).

The objective of this study was to estimate the cost of $IC_{h/wk}$ in subjects with CI residing at home in a rural area of Spain. Thus, since the informal caregiving hours, which we used to estimate costs, are correlated with the severity of CI, our estimates may be biased if we do not control adequately. The factors associated with $IC_{h/wk}$ were evaluated by bivariate and multivariate analysis. We found that the hearing problems, walker-assisted locomotion, wheelchair-assisted locomotion, at-home nursing care and domestic service were the best control variables for predicting the informal caregiving time of CI subjects and therefore to fit the model.

We found in the final model that the adjustment variable of formal at-home nursing care increased $IC_{h/wk}$. This is not so much because this service is an aid to the patient as a sign of the seriousness of the patient's comorbidities. Longitudinal study presents that medical formal services decrease informal care time in the first years but the amount of informal care became more stable controlling functional status and supporting our findings (Li 2005). Final model also shows that $IC_{h/wk}$ was negatively associate with domestic service and seems to be a substitute for home help. Similar results have been found in other studies (Arksey & Glendinning 2007; Hammar T 2008; Kadushin 2004).

In parallel to the primary study objective, we found that CI increases with age and is associated with a larger number of comorbidities as well as hearing and vision problems. In the literature we found studies that suport it (Bernstein & Remsburg 2007; Spijker et al. 2008).

On the other hand, the measurement of informal care in economic evaluations of health is problematic. Two main methods are used: the recall method, which consists of collecting information about the time dedicated to informal care during the week prior to the interview, and the diary, which involves recording the time dedicated to informal care support during a 24-hour period. The diary method is the gold standard. Van den Berg and Spauweb (van den Berg & Spauwen 2006) have demonstrated that the recall method is valid whenever the $IC_{h/wk}$ may have been overestimated. In the present study, we used the recall method and the correction measures detailed in Methods.

Our sample was a cohort representative of a sparsely populated geographic area (province of Cuenca) with an aging population that is strongly dependent. The estimates presented may be similar to other countries with comparable socioeconomic and demographic circumstances, such as Italy, Portugal, Greece, and France, as well as other Spanish provinces. The differences that may exist with urban areas in Spain are not large because few social services (from either public institutions or companies) were being offered to support informal caregivers when the study was made. Since Spanish law 39/2006, of 14 December, on the promotion of personal independence and care for people in situations of dependence came into effect, informal caregivers are beginning to receive assistance.

This study has some limitations. The sample size limited the potential number of covariates that could be included simultaneously in the models. In addition, we estimated the cost of subjects with CI without detailing the intensity of the CI; high-grade CI could greatly increase costs. On the other hand in the results of this study shown the mean of cognitive impairment. The prevalence of CI in our study population cannot be taken as a reference for the prevalence in the general population more than 64 years old due to the inclusion criteria, among other reasons.

One study found, estimated informal care as the sum of more components than informal caregiving hours. This may be a lack on our analysis and a subestimation of informal care. However, the study concludes that caregiving time are one of the largest components of this costs and provides estimates similar to those of our study (Moore et al. 2001).

One study shows that home care can be a cost-effective substitute for residential care even when informal caregiver time is determined with cost at replacement wage (Chappell et al. 2004). We believe that our results are in the same direction. In conclusion, the care of older people with CI is a problem that can be better managed if we know the real costs of mitigating the impact on the caregiver. In our case, the cost

ranged from 1447.5 to 5348.45 € a year, depending on whether the cost is calculated based on the services provided by companies or individuals.

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References

- Arksey H and Glendinning C (2007) Choice in the context of informal care-giving. *Health Soc Care Community* 15(2) 165-175.
- Berecki-Gisolf J, Lucke J, Hockey R and Dobson A (2008) Transitions into informal caregiving and out of paid employment of women in their 50s. *Soc Sci Med* 67(1) 122-127.
- Bernstein AB and Remsburg RE (2007) Estimated Prevalence of People With Cognitive Impairment: Results From Nationally Representative Community and Institutional Surveys. *Gerontologist* 47(3) 350-354.
- Bolin K, Lindgren B and Lundborg P (2008) Your next of kin or your own career? Caring and working among the 50+ of Europe. *J Health Econ* 27(3) 718-738.
- Bulati M, Pellicano M, Vasto S and Colonna-Romano G (2008) Understanding ageing: Biomedical and bioengineering approaches, the immunologic view. *Immun Ageing* 5 9.
- Carpenter GI, Hastie CL, Morris JN, Fries BE and Ankri J (2006) Measuring change in activities of daily living in nursing home residents with moderate to severe cognitive impairment. *BMC Geriatr* 6 7.
- Carpenter I, Gambassi G, Topinkova E, Schroll M, Finne-Soveri H, Henrard JC, Garms-Homolova V, Jonsson P, Frijters D, Ljunggren G, Sorbye LW, Wagner C, Onder G, Pedone C and Bernabei R (2004) Community care in Europe. The Aged in Home Care project (AdHOC). *Aging Clin Exp Res* 16(4) 259-269.
- Clipp EC and Moore MJ (1995) Caregiver time use: an outcome measure in clinical trial research on Alzheimer's disease. *Clin Pharmacol Ther* 58(2) 228-236.
- Crews DE and Zavotka S (2006) Aging, disability, and frailty: implications for universal design. *J Physiol Anthropol* 25(1) 113-118.
- Chappell NL, Dlitt BH, Hollander MJ, Miller JA and McWilliam C (2004) Comparative Costs of Home Care and Residential Care. *Gerontologist* 44(3) 389-400.
- Ernst RL and Hay JW (1994) The US economic and social costs of Alzheimer's disease revisited. *Am J Public Health* 84(8) 1261-1264.

- Etters L, Goodall D and Harrison BE (2008) Caregiver burden among dementia patient caregivers: a review of the literature. *J Am Acad Nurse Pract* 20(8) 423-428.
- Glick HA DJ, Sonnad SS, Polsky D (2007) Analyzing cost. IN *Economic Evaluation Trials*. Oxford: Oxford University Press, pp. 90-113.
- Hammar T RP, Perälä ML (2008) Home-care clients' need for help, and use and costs of services. *Eur J Ageing*(5) 147-160.
- Hansebo G, Kihlgren M, Ljunggren G and Winblad B (1998) Staff views on the Resident Assessment Instrument, RAI/MDS, in nursing homes, and the use of the Cognitive Performance Scale, CPS, in different levels of care in Stockholm, Sweden. *J Adv Nurs* 28(3) 642-653.
- Hawes C, Morris JN, Phillips CD, Mor V, Fries BE and Nonemaker S (1995) Reliability estimates for the Minimum Data Set for nursing home resident assessment and care screening (MDS). *Gerontologist* 35(2) 172-178.
- Hirdes JP, Fries BE, Morris JN, Ikegami N, Zimmerman D, Dalby DM, Aliaga P, Hammer S and Jones R (2004) Home care quality indicators (HCQIs) based on the MDS-HC. *Gerontologist* 44(5) 665-679.
- Jonsson L (2004) Economic evidence in dementia: a review. *Eur J Health Econ* 5 Suppl 1 S30-35.
- Kadushin G (2004) Home health care utilization: a review of the research for social work. *Health Soc Work* 29(3) 219-244.
- Koopmanschap MA, van Exel JN, van den Berg B and Brouwer WB (2008) An overview of methods and applications to value informal care in economic evaluations of healthcare. *Pharmacoeconomics* 26(4) 269-280.
- Langa KM, Chernew ME, Kabeto MU, Herzog AR, Ofstedal MB, Willis RJ, Wallace RB, Mucha LM, Straus WL and Fendrick AM (2001) National estimates of the quantity and cost of informal caregiving for the elderly with dementia. *J Gen Intern Med* 16(11) 770-778.
- Li LW (2005) Longitudinal Changes in the Amount of Informal Care Among Publicly Paid Home Care Recipients. *Gerontologist* 45(4) 465-473.
- Mahoney FI and Barthel DW (1965) Functional Evaluation: the Barthel Index. *Md State Med J* 14 61-65.

- Manning WG (1998) The logged dependent variable, heteroscedasticity, and the retransformation problem. *J Health Econ* 17(3) 283-295.
- Manning WG and Mullahy J (2001) Estimating log models: to transform or not to transform? *J Health Econ* 20(4) 461-494.
- Mathers C BT, Ma-Fat D. (2008) The global burden of disease: 2004 update. : World Health Organization.
- Meredith B. Lilly ALPCC (2007) Labor Market Work and Home Care's Unpaid Caregivers: A Systematic Review of Labor Force Participation Rates, Predictors of Labor Market Withdrawal, and Hours of Work. *Milbank Quarterly* 85(4) 641-690.
- Moise P SM, Um MY. OECD (2004) Dementia Care in 9 OECD Countries: A Comparative Analyses.: Organisation for Economic Co-operation and Development (OECD).
- Moore MJ, Zhu CW and Clipp EC (2001) Informal costs of dementia care: Estimates from the National Longitudinal Caregiver Study. *Journals of Gerontology - Series B Psychological Sciences and Social Sciences* 56(4).
- Morris JN, Fries BE, Mehr DR, Hawes C, Phillips C, Mor V and Lipsitz LA (1994) MDS Cognitive Performance Scale. *J Gerontol* 49(4) M174-182.
- Morris JN, Fries BE, Steel K, Ikegami N, Bernabei R, Carpenter GI, Gilgen R, Hirdes JP and Topinkova E (1997) Comprehensive clinical assessment in community setting: applicability of the MDS-HC. *J Am Geriatr Soc* 45(8) 1017-1024.
- Moya Martinez P, Escribano Sotos F, Pardo Garcia I, Notario Pacheco B, Alfaro Orozco C and Martinez Vicaino V (2009) [Costs associated to informal caregiving hours for older people living in rural communities [Spain].]. *Gac Sanit*.
- Nordberg G, von Strauss E, Kareholt I, Johansson L and Wimo A (2005) The amount of informal and formal care among non-demented and demented elderly persons-results from a Swedish population-based study. *Int J Geriatr Psychiatry* 20(9) 862-871.
- Novoa AM, Juarez O and Nebot M (2008) [Review of the effectiveness of cognitive interventions in preventing cognitive deterioration in healthy elderly individuals.]. *Gac Sanit* 22(5) 474-482.

Paquay L, De Lepeleire J, Schoenmakers B, Ylief M, Fontaine O and Buntinx F (2007) Comparison of the diagnostic accuracy of the Cognitive Performance Scale (Minimum Data Set) and the Mini-Mental State Exam for the detection of cognitive impairment in nursing home residents. *Int J Geriatr Psychiatry* 22(4) 286-293.

Pfeiffer E (1975) A short portable mental status questionnaire for the assessment of organic brain deficit in elderly patients. *J Am Geriatr Soc* 23(10) 433-441.

Sorbye LW, Garms-Homolova V, Henrard JC, Jonsson PV, Fialova D, Topinkova E and Gambassi G (2009) Shaping home care in Europe: The contribution of the Aged in Home Care project. *Maturitas* 62(3) 235-242.

Spijker A, Vernooij-Dassen M, Vasse E, Adang E, Wollersheim H, Grol R and Verhey F (2008) Effectiveness of nonpharmacological interventions in delaying the institutionalization of patients with dementia: a meta-analysis. *J Am Geriatr Soc* 56(6) 1116-1128.

van den Berg B, Brouwer WB and Koopmanschap MA (2004) Economic valuation of informal care. An overview of methods and applications. *Eur J Health Econ* 5(1) 36-45.

van den Berg B and Spauwen P (2006) Measurement of informal care: an empirical study into the valid measurement of time spent on informal caregiving. *Health Econ* 15(5) 447-460.

van der Steen JT, Volicer L, Gerritsen DL, Kruse RL, Ribbe MW and Mehr DR (2006) Defining severe dementia with the Minimum Data Set. *Int J Geriatr Psychiatry* 21(11) 1099-1106.

Wimo A, Winblad B and Jönsson L (2007) An estimate of the total worldwide societal costs of dementia in 2005. *Alzheimer's and Dementia* 3(2) 81-91.

Table 1. Descriptive analysis of the sample of patients over 64 years with and without cognitive impairment (n=242).

		No cognitive impairment n (%)	Cognitive impairment n (%)	p*
Gender	Women	96 (63.6)	55 (36.4)	0.245
	Men	51 (56.0)	40 (44.0)	
Age (years)	64-75	39 (65.0)	21 (35.0)	0.051
	75-85	79 (65.3)	42 (34.7)	
	+85	29 (47.5)	32 (52.5)	
Marital status	Widow(er)	51 (53.7)	44 (46.3)	0.046
	Married	90 (67.7)	43 (32.3)	
	Unmarried	5 (38.5)	8 (61.5)	
Education	Elementary school	27 (75.0)	9 (25.0)	0.058
	No schooling	120 (58.3)	86 (41.7)	
Primary caregiver	Lives with subject	119 (58.3)	85 (41.7)	0.059
	Son /daughter /son-in-law /daughter-in-law	67 (56.8)	51 (43.2)	0.218
	Spouse	69 (67.6)	33 (32.4)	0.061
	Other relatives /friends /neighbors	11 (50.0)	11 (50.0)	0.279
Secondary caregiver	Lives with subject	136 (62.1)	83 (37.9)	0.194
	Son /daughter /son-in-law /daughter-in-law	142 (61.5)	89 (38.5)	0.288
	Spouse	2 (40.0)	3 (60.0)	0.337
	Other relatives /friends /neighbors	3 (50.0)	3 (50.0)	0.585
Hearing	Adequate or minimal difficulty	128 (73.6)	46 (26.4)	<0.001

	In special situations / severely altered	19 (27.9)	49 (72.1)	
Vision	Adequate or minimally altered	121 (79.1)	32 (20.9)	<0.001
	Moderately to seriously altered	26 (29.2)	63 (70.8)	
Comorbidities	Congestive heart failure	17 (56.7)	13 (43.3)	0.625
	Coronary artery disease	5 (38.5)	8 (61.5)	0.091
	Hypertension	109 (6.0)	64 (37.0)	0.245
	Cardiac arrhythmias	19 (57.6)	14 (42.4)	0.688
	Parkinsonism	10 (58.8)	7 (41.2)	0.866
	Arthritis	28 (59.6)	19 (40.4)	0.855
	Osteoporosis	42 (76.4)	13 (23.6)	0.007
	Cancer	5 (41.7)	7 (58.3)	0.165
	Diabetes	37 (59.7)	25 (40.3)	0.842
	Emphysema /asthma /COPD	32 (84.2)	6 (15.8)	0.001
	Renal failure	11 (55.0)	9 (45.0)	0.583
	Hyper or hypothyroidism	4 (50.0)	4 (50.0)	0.527
Locomotion aid	Cane	61 (69.3)	27 (30.7)	0.039
	Walker	40 (58.8)	28 (41.2)	0.702
	Wheelchair	9 (42.9)	12 (57.1)	0.079
Formal care	House-aid	44 (71.0)	18 (29.0)	0.052
	At-home nurses	36 (72.0)	14 (28.0)	0.063
	Domestic service	10 (50.0)	10 (50.0)	0.312

* 95% significance according to the Pearson Chi-square test.

Table 2. Differences in mean hours of informal care given to subjects over 64 years with cognitive impairment (n=95)

		Mean (n)	Difference of means	Typical error	p*
Gender	Men	35.05 (40)	4.99	5.15	0.367
	Women	30.05 (55)			
Education	Yes	31.29 (86)	-9.15	8.68	0.713
	No	40.44 (9)			
PC lives with subject	Yes	32.80 (85)	4.80	8.74	0.899
	No	28.00 (9)			
SC lives with subject	Yes	29.20 (83)	-24.97	7.60	0.037
	No	54.18 (11)			
Hearing	Adequate / minimal difficulty	26.93 (46)	-10.12	5.00	0.004
	In special situations / severely altered	37.06 (49)			
Vision	Adequate / minimally altered	24.87 (32)	-10.98	5.28	0.016
	Moderately to seriously altered	35.85 (6)			
<i>Disease diagnoses</i>					
Congestive heart failure	Yes	29.76 (13)	-2.76	7.43	0.727
	No	32.53 (82)			
Coronary artery disease	Yes	26.87 (8)	-5.76	9.18	0.874
	No	32.64 (87)			
Hypertension	Yes	33.76 (64)	4.92	5.42	0.491
	No	28.83 (31)			
Cardiac arrhythmias	Yes	34.71 (14)	2.99	7.20	0.593
	No	31.71 (81)			

Parkinsonism	Yes	44.85 (7)	13.70	9.67	0.163
	No	31.14 (88)			
Arthritis	Yes	34.84 (19)	3.35	6.37	0.003
	No	31.48 (76)			
Osteoporosis	Yes	24.92 (13)	-8.38	7.38	0.145
	No	33.30 (82)			
Cancer ^a	Yes	51.85 (7)	21.26	9.53	0.065
	No	30.59 (88)			
Diabetes	Yes	36.64 (25)	6.08	5.76	0.434
	No	30.55 (70)			
Emphysema /asthma /COPD	Yes	27.83 (6)	-4.61	10.49	0.838
	No	32.44 (89)			
Renal failure	Yes	39.88 (9)	8.54	8.68	0.592
	No	31.34 (86)			
Thyroid disease	Yes	41.25 (4)	9.49	12.68	0.392
	No	31.75 (91)			
<i>Locomotion aids</i>					
Cane-assisted locomotion	Yes	27.37 (27)	-6.68	5.62	0.223
	No	34.05 (68)			
Walker-assisted locomotion	Yes	40.89 (28)	12.38	5.45	<0.001
	No	28.50 (67)			
Wheelchair-assisted locomotion	Yes	44.25 (12)	13.84	7.55	0.279
	No	30.40 (83)			
<i>Formal support</i>					
House-aid	Yes	27.11 (18)	-6.22	6.48	0.140
	No	33.33 (77)			
At-home nurses	Yes	52.14 (14)	23.43	6.78	0.038
	No	28.70 (81)			
Domestic service	Yes	18.70 (10)	-15.04	8.18	0.058

	No	33.74 (85)			
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PC: primary caregiver; SC: secondary caregiver.

* The p value is applicable to calculations of the differences between means and the logarithm of weekly hours of informal care.

^a In the last 5 years and not including skin cancer.

Table 3. Simple linear regression models of the logarithm of (ln) weekly hours of informal care

	Standardized beta	R square	Corrected R square	p
Cognitive impairment	0.371	0.138	0.134	<0.001
Women	-0.133	0.018	0.014	0.039
Unmarried	0.004	0.000	-0.004	0.948
Married	0.018	0.000	-0.004	0.786
Widow	-0.020	0.000	-0.004	0.759
Education	-0.107	0.012	0.007	0.096
PC lives with subject	-0.053	0.003	-0.001	0.412
PC son /daughter /son-in- law /daughter-in-law	0.045	0.002	-0.002	0.486
PC spouse	-0.021	0.000	-0.004	0.744
SC lives with subject	0.115	0.013	0.009	0.076
SC son /daughter /son-in- law /daughter-in-law	0.147	0.021	0.017	0.023
SC spouse	0.125	0.016	0.012	0.052
Hearing deficit	0.310	0.096	0.092	<0.001
Vision deficit	0.261	0.068	0.064	<0.001
Congestive heart failure	-0.007	0.000	-0.004	0.917
Coronary artery disease	0.074	0.005	0.001	0.254
Hypertension	-0.001	0.000	-0.004	0.982
Cardiac arrhythmias	0.107	0.011	0.007	0.098
Parkinsonism	0.084	0.007	0.003	0.192
Arthritis	0.076	0.006	0.002	0.239
Osteoporosis	-0.158	0.025	0.021	0.014
Cancer	0.124	0.015	0.011	0.054
Diabetes	0.100	0.010	0.006	0.121
Emphysema /asthma	-0.001	0.000	-0.004	0.988

/COPD				
Renal failure	0.075	0.006	0.001	0.247
Thyroid disease	-0.004	0.000	-0.004	0.952
Cane-assisted locomotion	-0.186	0.035	0.031	0.004
Walker-assisted locomotion	0.183	0.033	0.029	0.004
Wheelchair-assisted locomotion	0.264	0.070	0.066	<0.001
House-aid	-0.139	0.019	0.015	0.031
At-home nurses	0.148	0.022	0.018	0.022
Domestic service	-0.114	0.013	0.009	0.076

PC: primary caregiver; SC: secondary caregiver.

Table 4. Final regression model with the dependent variables (ln) of weekly hours of informal care.

	B	95% confidence interval		p
Cognitive impairment	0.54	0.32	0.76	<0.01
Hearing deficit	0.38	0.14	0.62	<0.01
Walker-assisted locomotion	0.44	0.22	0.66	<0.01
Wheelchair-assisted locomotion	0.93	0.57	1.29	<0.01
At-home nurses	0.43	0.19	0.68	<0.01
Domestic service	-0.46	-0.82	-0.10	0.01
Constant	2.31	2.15	2.47	<0.01
R square	0.322			
Corrected R square	0.305			

Table 5. Increase in the hours and costs of informal care derived from cognitive impairment

	Mean	95% confidence interval	
Annual hours (hours/year)	282.61	206.79	382.03
Company cost (euros/year)	3956.54	2895.00	5348.45
Personal cost (euros/year)	1978.27	1447.50	2674.23