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ORIGINAL PAPER

Catastrophic long-term care expenditure: associated socio-demographic and economic factors

Raúl del Pozo-Rubio[1,5] · Román Mínguez-Salido[2] · Isabel Pardo-García[3,5] · Francisco Escribano-Sotos[4,5]

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Abstract

Objective An increasing number of persons across the world require long-term care (LTC). In Spain, access to LTC involves individuals incurring out-of-pocket (OOP) expenditure. There is a large body of literature on the incidence of catastrophic OOP payments in access and participation in health systems, but not in the field of LTC nor the determinants of these expenses. Our aim was to analyse the socio-demographic and economic factors associated with different levels of catastrophic LTC expenditure in the form of private out-of-pocket payments among dependent persons in Spain.

Materials and methods The study used the Spanish Disability and Dependency Survey (SDDS) conducted by the Spanish National Statistics Institute to obtain the socioeconomic, demographic and health profiles. The households were classified into those below the poverty threshold and those above the threshold of catastrophe, using measures of impoverishment and catastrophe. We estimated two logistic regression models, one binary (impoverishment) and one ordinal (catastrophe).

Results The results show that OOP expenditure on LTC increases the probability of impoverishment by 18.90%. The factors associated with higher probability of experiencing catastrophe were age, being single, widowed or separated, lower levels of household income and education, higher level of dependence and living in an autonomous community with lower per capita income.

Conclusions These findings highlight the need to include exemptions or insurance in the design of LTC policies to protect dependent persons from the risk of financial burden.

Keywords Catastrophic · Long-term care · Out-of pocket · Dependence

JEL Classification G38 · I38 · J14

Introduction

Population ageing influences the design and implementation of social and healthcare policies. The proportion of people aged 65 or over in the EU28 Member States is expected to

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✉ Isabel Pardo-García
isabel.pardo@uclm.es

Raúl del Pozo-Rubio
raul.delpozo@uclm.es

Román Mínguez-Salido
roman.minguez@uclm.es

Francisco Escribano-Sotos
francisco.esotos@uclm.es

[1] Department of Economics and Finance, University of Castilla-La Mancha, Avda, Los Alfares, 44, 16071 Cuenca, Spain

[2] Department of Public Economy, Statistics and Economic Policy, University of Castilla-La Mancha, Avda, Los Alfares, 44, 16071 Cuenca, Spain

[3] Department of Public Economy, Statistics and Economic Policy, University of Castilla-La Mancha, Plaza de la Universidad, s/n, 02071 Albacete, Spain

[4] Department of Economics and Finance, University of Castilla-La Mancha, Plaza de la Universidad, s/n, 02071 Albacete, Spain

[5] Research Group Economy, Food and Society, University of Castilla-La Mancha, Ciudad Real, Spain

increase from 18.00% in 2015 to 28.00% in 2060; the population aged 80 or over will grow from 5.00 to 12.00%, with this segment being as large as that of the young population (aged 0–19) [1]. Indeed, the demographic old-age dependency ratio (defined as people aged 65 or above relative to those aged 15–64) is expected to increase from 27.80 to 50.10% in the above-mentioned period.

As people age, diseases such as heart disease, stroke, chronic respiratory disorders, cancer and dementia appear, illnesses become chronic and multiple pathologies emerge [2]. These new health scenarios lead to new needs that require specific attention beyond the scope of health systems [1], such as so-called long-term care (LTC), which attend to the needs of individuals who are unable to independently perform the basic daily life activities [3].

The number of persons requiring LTC varies substantially between countries, with percentages ranging from 5.00% of the population aged between 65 and 74 years in high-income countries to 50.00% in low- and middle-income countries [2–4]. The demand for LTC is predicted to grow in the future, increasing from 4.00% in 2010 to 10.00% in 2050 in the population aged over 80 years [4]. In Spain, 2.60% of the population (1.2 million) in 2017 was dependent and 7 of every 10 dependent persons were aged over 65 years and more than 50.00% were over the age of 80 [5, 6]. Population ageing and the associated need for LTC will increase public expenditure on LTC. Moreover, in 2014, LTC accounted for 1.50% of GDP on average across the OECD, varying from more than 3.00% of GDP in the Netherlands, Finland or Sweden to less than 1.00% in Spain or the United States [7].

Universal Health Coverage is one of the 13 health targets among the Sustainable Development Goals established by the World Health Organization to be achieved by 2030 [8]. However, in most cases, access to healthcare and LTC systems is associated with out-of-pocket (OOP) payments, either through fee payments, co-payments for healthcare, for LTC services, drugs, etc., [8], which have an economic impact on families. When OOP expenditure associated with health services or provision of LTC exceeds a certain threshold of household income [9], the financial burden may become significant and may result in catastrophic healthcare expenditure (CHE) (40.00% is the threshold typically used). In this sense, a recent systematic review concluded that when formal fees are introduced, protection against catastrophic healthcare payments is needed for the most vulnerable groups [10].

There are numerous studies on the incidence of catastrophic OOP expenditure associated with healthcare payments in Asian countries, as well as others conducted in African, Latin American and European countries. In Asian countries, the incidence of catastrophic OOP payments ranges from 0.21 to 34.15% [11]. Studies in African countries (the Middle East and North Africa [12] and Kenya [13]) reveal catastrophism rates of between 7.00 and 13.00%, while in Latin American countries [14] and Brazil [15] the rate is between 1.00 and 25.00%. In European countries, two recent studies were conducted in Portugal [16] and Greece [17], and the catastrophic spending rate varied from 5.03 to 9.75%.

The studies conducted by Xu et al. [18, 19] analysed the effect of OOP payments on health systems in 59 and 89 countries, respectively, finding that the difference in catastrophic expenditure rates across the countries analysed was related to income level. The CHE rate ranged from 0.01% in France or 0.03% in Germany to over 10.00% in countries such as Brazil or Vietnam [18]. Specifically, the average catastrophic expenditure rates vary between 3.10, 1.80 and 0.66% for low, middle and high-income countries, respectively [19]. Besides income, other determining factors of catastrophism were identified as the existence of health services requiring copayments, the lack of insurance schemes and households' limited capacity to pay [18].

As well as copayments for access to healthcare systems, there also exist costs related to illnesses (illness treatments, medical costs, non-medical costs and time costs [20]) which are paid for by the individuals and/or families [21]. The catastrophic impact of OOP payments has also been analysed in specific diseases such as cardiovascular diseases [22], HIV [23], rare diseases [24], non-communicable diseases [25] or cancer [26].

Furthermore, due to their financial vulnerability and greater likelihood of incurring CHE, certain population groups have been studied, such as older adults [27], persons with chronic diseases [28, 29], older adults with chronic diseases [30, 31] and persons with disabilities [32, 33]. The determining factor for incurring catastrophic healthcare expenditure is being aged over 65 years [16, 17]. Among the group of older adults with chronic conditions, the variables that explain the differences in catastrophic spending rates are household size and per capita income, which present an indirect association, and having members aged more than 65 years or having members with two or more chronic diseases, with these two variables presenting a direct relationship [30]. Moreover, having a disability or an occupational disability are also risk factors for CHE [16]. Finally, although living in low- and middle-income countries increases the probability of incurring catastrophic payments [19], regardless of other factors, in high-income countries older adults in lower-income percentiles show greater likelihood of incurring catastrophic expenses [31].

Despite the existence of widespread literature on the economic impacts of OOP on healthcare and the determining factors, to the best of our knowledge, few studies have analysed the financial consequences of the cost of LTC. Specifically, across the OECD, it has been found that the cost of LTC may be high and especially difficult for lower-income

groups and/or those with intensive care needs to address [34]. In Spain, out-of-pocket expenditure associated with long-term care (OOP-LTC) in 2012 reached a mean total of €303.64, €412.12 and €661.62 per month for the lowest to the highest levels of dependence (levels I, II and III), corresponding to 31.85%, 44.83% and 64.95% of household income, respectively [35]. Another study quantifies catastrophic long-term care expenditure (C-LTC-E), and reveals that the percentage of households devoting more than 40.00% of their income to funding dependent care benefits grows as care needs increase [36].

Our study makes various contributions to the empirical knowledge on OOP-LTC; it quantifies the economic impact of OOP-LTC on households and analyses the financial burden of OOP-LTC, taking different income thresholds into account; it quantifies the findings according to level of dependence and analyses the factors associated with OOP-LTC.

Summarising, older adults incur catastrophic expenses and high financial burden due to healthcare and LTC consumption [31], but there is limited knowledge of the effects of OOP-LTC and the determining factors of this expenditure. Thus, the aim of our study is to investigate the determinants that drive Spanish households with dependent persons into situations of impoverishment and financial catastrophe, after making OOP-LTC payments, considering different thresholds and quantifying their impact.

Materials and methods

The Spanish Disability and Dependency Survey (SDDS) conducted by the Spanish National Statistics Institute [37] was used to obtain the socioeconomic, demographic and health profiles and the characteristics of the environments of people with disabilities in Spain. The survey examines a representative sample of persons with disabilities at national and regional level. Specifically, we used the households section of the SDDS. In a first stage, 96,000 households with 260,000 individuals were selected. In a second stage, 22,795 persons with disabilities were identified and interviewed in-depth. The SDDS considers any individual over the age of 6 years to have a disability if he/she has a significant limitation to performing at least one of 44 selected activities. This limitation must have been present for more than a year and must originate from an impairment. The methodology of the survey assigns weights to each item so as to extrapolate the findings to the population with disabilities in Spain. Apart from information related to disabilities, impairments and limitations, it also contains information on the income and financial situation of persons with disabilities, a variable required to calculate the OOP payment corresponding to each dependent person.

Among the excluded variables are: conditions of the home and accessibility; characteristics of the persons providing care; social networks and contacts; discrimination; private household expenditure related to disability and general health; other variables related to the persons with a disability, such as kinship (with the head of the household and with persons with a disability), country of birth, nationality and recognised disability ($\geq 33.00\%$).

We included a disability measure, using levels of dependence defined in the Dependency Act (Act 39/2006 of 14th December on Promotion of Personal Autonomy and Assistance for Persons in a Situations of Dependency; henceforth DA) [38]. The DA defined three levels of dependence: mild (level I), moderate (level II) and severe (level III).

The households were classified into those below the poverty threshold and those above the threshold of catastrophe, using the measures of impoverishment and catastrophe defined by Wagstaff and Van Doorslaer [9]. The impoverishment rate refers to the number of households whose equivalent income is below the so-called poverty threshold. The poverty threshold is defined as a certain level of income, which in this study was established as 60.00% of the mean equivalent household income in Spain. The poverty threshold for 2012 was calculated to be €7,166.00/year, i.e., €597.17/month.

OOP payments for long-term care can also represent a catastrophic expenditure for households if they generate a decline in the standard of living of individuals or households now, or in the future [39, 40]. The catastrophe threshold has been defined as a certain percentage of income which households must devote to making the corresponding OOP payment for dependent care, in such a way that when a household has to make a payment above the regulatory percentage, this household's expenditure is classified as catastrophic. Five thresholds were set (less than 10.00%, between 10.00 and 20.00%, between 20.00 and 30.00%, between 30.00 and 40.00% and more than 40.00%) to determine whether individuals' expenditure is over that level, and hence their living conditions may be impaired.

To calculate OOP payments associated with LTC, the cost of the service that dependent people receive was calculated as well as the OOP-LTC of each type of benefit (Supplementary material) [35].

In accordance with the aim of the current study, we ran two logistic regression models, one binary (impoverishment) and the other ordinal (catastrophe), due to the binary and ordinal nature of the dependent variables, respectively. Firstly, the pre- and post-payment poverty headcount as measure of impoverishment was used as the dependent variable ($yi = 1$, if the person with dependence is situated below the poverty threshold with or without having made copayments for dependent care, $yi = 0$ otherwise; with $i = 1,..,n$, where n is the number of individuals in the sample). In the

case of the catastrophe measure, we used the catastrophic payment headcount as the dependent variable (yi = 1, if co-payment for dependent care does not exceed 10.00% of household income; yi = 2, if it exceeds 10.00% of household income and does not exceed 20.00%; yi = 3 if it exceeds 20.00% of household income and does not exceed 30.00%; yi = 4, if it exceeds 30.00% of household income and does not exceed 40.00%; yi = 5 if it exceeds 40.00% of household income, with $i = 1,..,n$, where n is the number of individuals in the sample). The specification of the models is as follows [41]:

$$y^* = -X'\beta + \varepsilon, \tag{1}$$

where y^* is not observed, X represents a matrix of explanatory variables, β is a vector of the parameters and ε is the standard error following logistic probability distribution. In addition, for the binary model:

$$\begin{aligned} y = 0 &\leftrightarrow y^* \leqslant \theta \\ y = 1 &\leftrightarrow y^* > \theta. \end{aligned} \tag{2}$$

And for the ordinal model:

$$\begin{aligned} y = 1 &\leftrightarrow y^* \leqslant \theta_1 \\ y = 2 &\leftrightarrow \theta_1 < y^* \leqslant \theta_2 \\ y = 3 &\leftrightarrow \theta_2 < y^* \leqslant \theta_3 \\ y = 4 &\leftrightarrow \theta_3 < y^* \leqslant \theta_4 \\ y = 5 &\leftrightarrow y^* \geqslant \theta_4, \end{aligned} \tag{3}$$

where θ refers to the parameter assigned to each category or order in both dependent variables: impoverishment and catastrophe.

These models can assess the socio-demographic characteristics, level of dependence and place of residence of persons with dependence whose parameters are statistically significant, and which are therefore associated with the corresponding dependent variables adjusted for the rest of features. Marginal effects were estimated on all the variables.

An alternative for the binary logit, when the main objective of the model is to evaluate the marginal effects of the covariates, is the linear probability model (LPM) given by the following equation (Wooldridge [42], pp. 562):

$$\Pr\left(y_i = 1/x_i\right) = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \cdots + \beta_k x_{ki}. \tag{4}$$

This model can be estimated consistently by ordinary least squares (OLS) although; given that the distribution of y is Bernoulli, there will be heteroscedasticity in the errors. Nevertheless, the standard errors can be fitted consistently using the White correction and can be used for inference purposes [43] empirical results of the estimation of LPM are included in the Supplementary material.

The explanatory variables (matrix X) were selected from the literature, essentially socio-demographic characteristics [11, 17, 19, 27, 31]. The socio-demographic characteristics are (the model reference variable is indicated by *): gender (male; female*); age (below 65*; 65–74; 75–84; 85–94; over 95); marital status (married*; single; widowed; separated/divorced); educational level (very low level*: illiterate/primary school incomplete; low level: primary or equivalent; medium level: secondary school/medium level professional; high level: university degree or equivalent); household income (less than 500€*; 500–1000 €; 1000–1500 €; 1500–2000 €; more than 2000 €); level of dependence with interactions with co-payment (level I*; level II; level III); per capita GDP of autonomous community (low per capita GDP *; medium per capita GDP; high per capita GDP).

The statistical program Stata 13.0 (StataCorp LP, College Station, TX) was used to perform the analyses described [44, 45].

Results

As can be seen in the study population data in Table 1, 32.15% are female, mean age is 78.86 years (DT: 18.92), the predominant marital status types are widowed (42.06%) and married (39.74%), and the most common educational level is basic (primary or equivalent and lower, 90.72%). A total of 34.63% and 38.94% of the sample are recognised as having level II and III dependence, respectively. The majority of persons receive a pension (84.08%) and 36.02% and 33.85% of the population live in low and medium per capita GDP autonomous communities, respectively.

The characteristics of the populations that are impoverished and non-impoverished due to OOP-LTC payment—are similar, except in educational level and per capita income in the autonomous community of residence. In the first case, 94.27% of those who are impoverished have primary level education or equivalent or a lower educational level, while in the case of non-impoverishment this proportions falls to 85.90%. In the second case, 43.15% of the sample who are impoverished live in a low per capita GDP autonomous community (22.39% high GDP per capita autonomous community), while in the non-impoverishment sample the proportion living in a low per capita GDP autonomous community is 26.40% (40.58% high per capita GDP autonomous community).

In the case of catastrophic expenditure, the pattern is similar for all the variables and below 40.00% thresholds, while for the 40.00% threshold, the most significant effect is in educational level and level of per capita income in the region of residence. Level of dependence also exhibits disparities in behaviour. In the below 40.00% thresholds, level I is predominant (41.63% for the below 10.00% threshold; 40.51% for the below 20.00% threshold; 61.14% for

Table 1 Socio-demographic data of the sample, divided by values of impoverishment and catastrophe

		Impoverishment measure		Catastrophe measure (threshold)				
	Total	Non-impoverishment	Impoverishment	< 10%	10–20%	20–30%	30–40%	> 40%
Gender								
Male	32.15%	32.60%	31.82%	34.52%	35.20%	33.77%	30.50%	30.53%
Female	67.85%	67.40%	68.18%	65.48%	64.80%	66.23%	69.50%	69.47%
Age [mean (SD) range]	72.86 (18.92) 6-104	71.63 (20.38) 6-102	73.78 (17.70) 6–104	68.57 (20.38) 6–102	71.62 (20.84) 6–101	72.30 (18.26) 7–102	72.54 (19.33) 6–102	74.74 (17.76) 6–104
Household monthly income (mean SD)	1441.09 (1066.78)	2162.04 (1242.23)	907.13 (409.75)	2832.34 (1592.76)	2233.07 (1020.23)	1430.19 (676.00)	1196.87 (471.15)	887.07 (392.82)
Marital status								
Single	15.97%	17.33%	14.97%	15.32%	16.89%	13.26%	22.56%	15.10%
Married	39.74%	38.24%	40.86%	49.74%	44.56%	48.96%	30.27%	34.89%
Widowed	42.06%	42.05%	42.07%	32.18%	36.65%	35.51%	46.07%	47.58%
Separated/ divorced	2.22%	2.38%	2.10%	2.76%	1.91%	2.27%	1.10%	2.42%
Educational level								
Illiterate or primary school incomplete	60.32%	51.93%	66.52%	47.63%	52.65%	58.99%	62.04%	66.10%
Primary or equivalent	30.40%	33.97%	27.75%	33.85%	35.06%	31.85%	28.20%	28.24%
Secondary school/ middle level professional	4.94%	6.89%	3.50%	8.84%	6.29%	6.39%	4.14%	3.15%
University degree or equivalent	4.34%	7.20%	2.23%	9.68%	5.99%	2.76%	5.62%	2.51%
Employment status								
Employed	1.94%	3.16%	1.05%	5.76%	2.66%	1.97%	1.08%	0.85%
Unemployed	1.15%	0.94%	1.30%	1.13%	1.39%	2.01%	0.93%	0.86%
Receiving earnings-related pension	84.08%	85.42%	83.09%	82.71%	83.96%	80.41%	86.50%	85.11%
Other situations	12.83%	10.48%	14.55%	10.40%	11.99%	15.61%	11.49%	13.18%
Level of dependence								
Level I	34.63%	35.93%	33.67%	41.63%	40.51%	61.14%	50.67%	17.84%
Level II	38.94%	38.99%	38.91%	53.14%	29.28%	19.79%	40.50%	43.30%
Level III	26.43%	25.08%	27.42%	5.23%	30.21%	19.07%	8.83%	38.87%
Per capita GDP								
Low level	36.02%	26.40%	43.15%	34.61%	16.42%	28.65%	47.54%	41.04%
Medium level	33.85%	33.02%	34.46%	25.79%	35.76%	33.89%	29.19%	36.95%
High level	30.13%	40.58%	22.39%	39.59%	47.81%	37.45%	23.27%	22.01%
n	6523	2657	3868	886	793	978	856	3010

the below 30.00% threshold; 50.67% for the below 40.00% threshold) while for the 40.00% threshold, the higher levels of dependence (levels II and III) have a greater weight in the overall sample (43.30% and 38.87%, respectively).

Table 2 shows the marginal effects derived from the binary logistic regression for the impoverishment variable. All the effects, including those related to the interactions yielded statistically significant parameters. First, making OOP-LTC payments increases the risk of impoverishment by 18.90%, regardless of the amount to be paid. As regards the socio-demographic determinants, it can be seen that the probability of impoverishment increases with age; with being male; being single, widowed or separated/divorced (2.00%, 3.00% and 5.70%, respectively) and with being unemployed, which increases the risk by 17.30%. In contrast, a higher educational level (secondary school/middle level professional: -10.50%; university degree or equivalent: − 16.40%), being employed (− 1.60%), and having a higher income level (− 18.90% for more than €1,500.00 per month), diminish the probability of impoverishment.

Table S3 shows the alternative LPM estimated by OLS for the impoverishment variable. The results are very similar (in sign and value) than those obtained with binary logit model. It is important to highlight that robust standard errors are almost equal to the usual OLS standard error. This fact robustifies the results of OLS inference (Supplementary material).

Table 3 shows the effect of the interactions of OOP-LTC and the variables of level of dependence and per capita income in the autonomous community of residence. As a reference, for a mildly dependent person (level I), resident in a low per capita GDP community, the probability of impoverishment is 18.90%. If the level of dependence is moderate (level II), and depending on whether the individual lives in an autonomous community with low or medium per capita GDP, the probability increases to 22.10% and 23.20%, respectively. This percentage declines to 20.80% in the case of autonomous communities with high per capita GDP. In the case of severe dependence (level III), the proportions rise to 26.70% and 27.80% in communities with low and medium per capita GDP, respectively, and decrease to 25.40%, in the cases of high per capita GDP communities.

Table 4 shows the marginal effects of the explanatory variables associated with the different catastrophe thresholds. It can be seen that for the thresholds below 40%, the results are similar to those with no probability of impoverishment, while for those who spend more than 40.00% of their income on long-term care and are at risk of catastrophic expenditure, the results are similar for those at risk of impoverishment. It is worth noting that the parameters in this case are also statistically significant.

In thresholds below 40,00%, being female, older aged, being married, low and medium levels of education and

Table 2 Marginal effects for the binary logistic regression model performed for the impoverishment measure

	dy/d*x*	SD	*p* value
OOP-LTC payment	18.90%	0.00	0.00
Male (ref. female)	1.00%	0.00	0.00
Age (ref. age < 65)			
65–74	3.30%	0.00	0.00
75–84	2.50%	0.00	0.00
85–94	1.30%	0.00	0.00
> 95	− 4.70%	0.00	0.00
Marital status (ref. married)			
Single	2.00%	0.00	0.00
Widow	3.00%	0.00	0.00
Separated/divorced	5.70%	0.02	0.00
Educational level (ref. illiterate or primary school incomplete)			
Primary or equivalent	− 4.80%	0.00	0.00
Secondary school/middle level professional	− 10.50%	0.01	0.00
University degree or equivalent	− 16.40%	0.01	0.00
Activity status (ref. receiving earnings-related pension)			
Employed	− 1.60%	0.00	0.00
Unemployed	17.30%	0.00	0.00
Other situations	5.20%	0.00	0.00
Monthly € household income (ref. <500)			
500.00–1000.00	44.20%	0.00	0.00
1000.00–1500.00	13.50%	0.00	0.00
1500.00–2000.00	− 18.90%	0.00	0.00
> 2000.00			0.00
Level of dependence (ref. Level I)			
Level II	2.90%	0.00	0.00
Level III	3.30%	0.00	0.00
Interaction level of dependence and OOP-LTC payment (ref. Level I)			
Level II	3.20%	0.00	0.00
Level III	7.80%	0.00	0.00
Per capita GDP (ref. autonomous communities with low per capita GDP)			
Medium per capita GDP	− 6.70%	0.00	0.00
High per capita GDP	− 14.30%	0.00	0.00
Interaction per capita GDP and OOP-LTC payment (ref. autonomous communities with low per capita GDP)			
Medium per capita GDP	1.10%	0.00	0.00
High per capita GDP	− 1.30%	0.00	0.00
N	6523		
LR χ^2 (H_0: $\beta_1 = \beta_2 = \ldots = \beta_k$)	1,002,436		
Prob > χ^2	0.00		
Pseudo R^2	0.35		

dy/d*x*: marginal effect. Includes the slope of the calculated parameter

SD standard deviation

p value: corresponds to the test of individual significance of the corresponding parameter

LR: corresponds to the test of overall significance of all the slopes in the model

Table 3 Overall marginal effects for level of dependence and per capita income in the autonomous community of residence, including the effect of interactions

	Level I	Level II	Level III
Low per capita GDP	18.90%	22.10%	26.70%
Medium per capita GDP	20.00%	23.20%	27.80%
High GDP per capita	17.60%	20.80%	25.40%

Calculation of interactions:

$$\frac{\partial Impoverishmentmeasure}{\partial OOP-LTC} = \beta_1 xOOP - LTC + \beta_2 xOOP - LTCxlevelII + \beta_3 xOOP - LTCxlevelIII + \beta_4 xOOP - LTCxmiddleGDPpercapita + \beta_5 xOOP - LTCxhighGDPpercapita$$

different income levels increase the probability of the OOP-LTC payment being higher than the corresponding threshold, versus reference category. However, the trend is diametrically opposed in the 40.00% threshold, where again being male, older aged, marital status other than married, having a higher level of dependence, living in a community with lower per capita GDP, and having a lower level of income increase the probability of OOP-LTC payments exceeding 40.00% of personal resources with respect to the reference category.

Discussion

To the best of our knowledge, this is the first work to identify the factors associated (size and sign) with impoverishment and catastrophic expenditure resulting from OOP-LTC payment in Spain.

The impoverishment model reflects the probability of individuals' income being below the minimum level required to cover expenditure on basic necessities as a result of long-term care payments, while the catastrophe model analyses the different percentages of income (thresholds) devoted to long-term care. When this percentage increases (over 40.00%), the risk of catastrophic payments and associated factors are similar to the risk of impoverishment.

Most similar studies have focused on healthcare expenditures for individuals with chronic diseases [28, 29] or disabilities [30, 32, 33] or on the area of LTC, on the difficulty of funding the costs derived from "being unable to perform daily life activities on a permanent (vs. temporary) basics" [38], for lower income level groups [34].

First, it can be seen that the mere fact of having to make OOP-LTC payments increases the probability of impoverishment by 18.90%. Our findings are consistent with those of previous studies, which reveal that the likelihood of incurring catastrophic expenditure is 1.17–1.34 times higher for households with disabled members than households without disabled members (threshold of 10.00% − 40.00%, respectively) [32], and 7.52 times higher if there are persons with chronic diseases in the household [28]. A further study found that in households with a person with a disability or a person with an occupational disability, the probability of incurring catastrophic expenses is between 1.14 and 1.41 times higher than in households without a person with disability or a person with occupational disability, respectively [16].

A direct consequence of this probability of impoverishment is that users desist from receiving in-kind services versus cash benefits, within the Spanish LTC System [32]. Since choosing in-kind services (residential care, day or night care or home help) requires higher OOP payments [35], users may opt for cash benefits (in which the State transfers a financial income to the user). Thus, OOP-LTC payment represents a reduction of income, which may lead to situations where beneficiaries' basic needs are unsatisfied [46, 47].

It can be observed that the higher the level of dependence, the greater is the financial burden, since the dependent person's care needs increase [32] and the OOP payments are higher [35]. Thus, by extension, the probability of impoverishment in a situation of fragile health increases. The more intensive the care required, the greater is the probability of the cost being three times higher than the mean income of a dependent person [34].

If we add the autonomous community of residence in terms of per capita GDP to the severity of dependence, it can be seen that for persons with a higher level of dependence and living in a community with low or medium per capita GDP the risk of impoverishment is very high (26.70% and 27.80%, respectively). This coincides with the findings of previous studies. For example, in countries in transition or Latin American countries (although not all), living in middle-income countries and countries with a significant level of OOP payment, the probability of impoverishment increases [18]. This finding for middle-income countries is controversial because a different study has shown a negative relation with incidence of catastrophic healthcare expenditure [19], similar to that for high-income countries [11], reducing the probability of incurring catastrophic expenses in both cases. It is worth noting that the duration of OOP payment is important, given that the greater the time horizon, the more the effect of risk of catastrophic expenditure increases [31], as happens with LTC. This would explain why, in Spain, the financial burden associated with high per capita GDP autonomous communities is no lower than in the low and medium per capita GDP regions, which reflects that C-LTC-E has an impact in all Spanish autonomous communities.

Among the socio-demographic factors in our study related to risk of impoverishment, we find being male, being over 65 years of age and any marital status other than married. This is consistent with the findings in the literature, where

Table 4 Marginal effects for the ordinal logistic regression model performed for the catastrophe measure, according to threshold

	Threshold														
	< 10%			10–20%			20–30%			30–40%			> 40%		
	dy/dx	SD	*p* value	dy/dx	SD	*p* value	dy/dx	SD	*p* value	dy/dx	SD	*p* value	dy/dx	SD	*p* value
Male (ref. female)	−0.60%	0.00	0.00	−0.10%	0.00	0.00	−4.00%	0.00	0.00	−0.20%	0.00	0.00	1.20%	0.00	0.00
Age (ref. age < 65)															
65–74	0.10%	0.00	0.03	0.00%	0.00	0.03	0.00%	0.00	0.03	0.00%	0.00	0.03	−0.10%	0.00	0.03
75–84	0.50%	0.00	0.00	0.10%	0.00	0.00	0.30%	0.00	0.00	0.10%	0.00	0.00	−1.00%	0.00	0.00
85–94	0.10%	0.00	0.09	0.00%	0.00	0.09	0.00%	0.00	0.09	0.00%	0.00	0.09	0.00%	0.00	0.09
> 95	−0.40%	0.00	0.00	−0.10%	0.00	0.00	−0.30%	0.00	0.00	−0.10%	0.00	0.00	0.80%	0.00	0.00
Marital status (ref. married)															
Single	−4.80%	0.00	0.00	−0.90%	0.00	0.00	−3.20%	0.00	0.00	−1.30%	0.00	0.00	10.10%	0.00	0.00
Widow	−5.40%	0.00	0.00	−1.00%	0.00	0.00	−3.60%	0.00	0.00	−1.40%	0.00	0.00	11.30%	0.00	0.00
Separated/divorced	−4.10%	0.00	0.00	−0.70%	0.00	0.00	−2.70%	0.00	0.00	−1.10%	0.00	0.00	8.60%	0.00	0.00
Educational level (ref. illiterate or primary school incomplete)															
Primary or equivalent	0.10%	0.00	0.00	0.00%	0.00	0.00	0.10%	0.00	0.00	0.00%	0.00	0.00	−0.20%	0.00	0.00
Secondary school/middle level professional	0.90%	0.00	0.00	0.20%	0.00	0.00	6.00%	0.00	0.00	0.30%	0.00	0.00	−2.00%	0.00	0.00
University degree or equivalent	−0.60%	0.00	0.00	−0.10%	0.00	0.00	−0.40%	0.00	0.00	−0.20%	0.00	0.00	1.20%	0.00	0.00
Employment status (ref. receiving earnings-related pension)															
Employed	0.80%	0.00	0.00	1.00%	0.00	0.00	0.50%	0.00	0.00	0.20%	0.00	0.00	−1.70%	0.00	0.00
Unemployed	1.50%	0.00	0.00	0.30%	0.00	0.00	1.00%	0.00	0.00	0.40%	0.00	0.00	−3.10%	0.00	0.00
Other situations	−1.70%	0.00	0.00	−0.30%	0.00	0.00	−1.20%	0.00	0.00	−0.50%	0.00	0.00	3.60%	0.00	0.00
Monthly € household income (ref. < 500.00)															
500.00–1000.00	11.20%	0.00	0.00	2.00%	0.00	0.00	7.40%	0.00	0.00	2.90%	0.00	0.00	−0.234	0.00	0.00
1000.00–1500.00	15.80%	0.00	0.00	2.80%	0.00	0.00	10.40%	0.00	0.00	4.10%	0.00	0.00	−0.330	0.00	0.00
1500.00–2000.00	41.00%	0.00	0.00	7.20%	0.00	0.00	27.00%	0.00	0.00	10.80%	0.00	0.00	−0.860	0.00	0.00
> 2000.00	47.20%	0.00	0.00	8.30%	0.00	0.00	31.10%	0.00	0.00	12.40%	0.00	0.00	−0.989	0.00	0.00
Level of dependence (ref. Level I)															
Level II	−8.30%	0.00	0.00	−1.50%	0.00	0.00	−5.50%	0.00	0.00	−2.20%	0.00	0.00	0.175	0.00	0.00
Level III	−20.60%	0.00	0.00	−3.60%	0.00	0.00	−13.60%	0.00	0.00	−5.40%	0.00	0.00	0.431	0.00	0.00
Per capita GDP (ref. autonomous communities with low per capita GDP)															
Medium per capita GDP	−33.00%	0.00	0.00	−0.60%	0.00	0.00	−21.60%	0.00	0.00	−9.00%	0.00	0.00	0.069	0.00	0.00
High per capita GDP	−5.00%	0.00	0.00	−0.10%	0.00	0.00	-0.30%	0.00	0.00	−0.10%	0.00	0.00	0.010	0.00	0.00

Table 4 (continued)

	Threshold														
	< 10%			10–20%			20–30%			30–40%			> 40%		
	dy/dx	SD	p value	dy/dx	SD	p value	dy/dx	SD	p value	dy/dx	SD	p value	dy/dx	SD	p value
n	6523														
LR χ^2 (H_0: $\beta_1 = \beta_2 = \ldots = \beta_k$)	2,531,269														
Prob > χ^2	0.00														
Pseudo R^2	0.42														

dy/dx: marginal effect. Includes the slope of the calculated parameter

SD: standard deviation

P value: corresponds to the test of individual significance of the corresponding parameter

LR: corresponds to the test of overall significance of all the slopes in the model

the effect of gender is ambiguous depending on the country where the study is conducted, [17, 27, 28, 31] or when the study was conducted [16]. Hence, there are no clear conclusions about the effect of gender. Being aged 65 years or older is a significant factor in the risk of financial catastrophe, although there is no clearly defined pattern: while Xu et al. [19] found that being over 65 years of age is a determinant in middle-income countries, other studies have found an odds ratio of 2.10 when the head of the household is aged over 65 years [32] or that the probability increases by 1.00% compared to a younger population [16], demonstrating that this variable represents a higher financial risk. However, the study by Choi et al. [28] shows that age has little impact (odds ratio of 1.06 for ages between 60 and 79 years compared to ages between 20 and 39 years). Finally, little attention has been paid to marital status in the literature, although there exists one study showing a statistically non-significant effect [27].

A higher level of household income, higher level of education and being employed are protective factors against financial risk in all the studies we analysed [11, 16, 17, 27, 28, 32]. Dependent persons with higher income present a lower risk of impoverishment, while the likelihood of impoverishment increases by 44.00% in dependent persons with lower incomes. These results coincide with the previous literature on 13 OECD countries, where the higher income population are able to pay for LTC for moderate needs without the risk of descent into poverty, while as these needs become more severe, it becomes increasingly difficult to meet the OOP payments for individuals with lower incomes [34].

In the case of educational level, findings are inconclusive. There is one study analysing copayment according to type of illness where the education variable generates coefficients of different signs: while for cancer the association is negative, in line with our results, for diabetes mellitus or cardiovascular diseases the relationship is positive, that is, the higher the educational level, the greater is the probability of incurring catastrophic expenditure [31].

Although it is well-known that LPM does not guarantee to get probabilities in unit interval, nevertheless if the target of the research is to evaluate the marginal effects, LPM specification can provide an alternative way to compare with the usual logit estimates. Moreover, this model does not need any particular assumption about the distribution of the errors to get consistent estimates of the marginal effects [43] and can be used to check the robustness of the marginal effects fitted with the logit or probit alternatives. Said that, marginal effects in LPM are constant for the whole range of the covariates and should be carefully interpreted for extreme values of any continuous covariate [42]. In our case, as was previously explained in the section of results, the marginal effects estimated either with binary logit model or LPM are quite similar.

This study has certain limitations. The first is that due to lack of data, copayments are not based on actual figures, but are estimated based on the distribution of benefits in each autonomous community as published in 2011 [48]. Another limitation is that to calculate the economic capacity, and subsequently, the copayment for LTC services, we have only considered income but not households' wealth because SDDS-08 provides no information on family assets. Finally, while the 2008 Spanish Disability and Dependency Survey has been used to obtain the sociodemographic characteristics of the dependent population, the computation of the copayment for LTC services is based on the 2012 Dependency Act. However, results should not be significantly affected by this gap in the timing of the data since the evolution in disability prevalence tends to remain relatively unchanged over time [49]. For instance, while Spanish data shows that the disability prevalence was 6.20% in 1999 and 6.50% in 2008, the prevalence of dependence only increased from 4.40 to 5.10% in the same period [50].

Our findings suggest that legislators might include the aim of protecting dependent persons from the risk of financial burden in the design of their LTC policies, by means of possible measures for particular profiles and/or certain income levels, in order to avoid these households crossing the poverty threshold. Among these characteristics, as risk factors for C-LTC-E, we find being aged over 65 years (70.00% of the dependent population [6]); any marital status other than married, which reduces the possibility of a person being able to cover care for the dependent person by means of informal care; or persons with lower financial resources or lower educational level. Among the persons with lower resources, the situation of those who do not work is particularly delicate, with their risk of impoverishment increasing by 18.90% compared to the employed.

In short, our results suggest that it would be advisable for persons with LTC needs to be given access to the services they require. The financial burden for individuals with particular profiles should be reduced, so they can bear the costs of formal services. In this sense, complementary systems or alternative OOP-LTC schemes could be considered, such as the use of other financial instruments involving liquidation of assets or insurance or social welfare programmes.

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Compliance with ethical standards

Conflict of interest The authors of this manuscript have no conflicts of interest.

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