



Catastrophic household expenditure associated with out-of-pocket payments for dental healthcare in Spain

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Abstract

Objective To estimate the prevalence of catastrophic health expenditure due to dental healthcare (CHED) in Spain, quantify its intensity and examine the related sociodemographic household characteristics.

Methods Data from the Spanish Household Budget Survey, which addresses more than 20,000 households each year for the period 2008–2015 were included, and the methodology proposed by Wagstaff and van Doorslaer was followed. The prevalence (number of households that devote more than a certain threshold of their income to such payments) and intensity (amount that exceeds a certain percentage of income) were estimated. Ordered logistic regression models were estimated to analyse the sociodemographic factors associated with the prevalence of catastrophic payments.

Results The prevalence and intensity remained stable during the period under analysis. In terms of prevalence, a mean proportion of 7.36% of the population dedicated, in terms of intensity, more than 10% of their resources to dental care payments [mean: €292.75 per year (SD €2144.14)] and 2.05% dedicated more than 40% [mean: €143.02 per year (SD €1726.42)]. This represents 36.32% and 51.34% (for the thresholds of 10% and 40%) of the total catastrophic expenditure derived from out-of-pocket payments for dental healthcare in Spain.

Conclusion This study shows that a significant proportion of catastrophic healthcare payments correspond to dental services. Being male, aged over 40 years, unattached (single, separated, divorced or widowed), having a low level of education, a low household income, being unemployed and living in an urban area are all associated with a greater risk of CHED. This finding highlights the need to establish policies aimed at increasing dental care coverage to mitigate related financial burdens on a large part of the Spanish population.

Keywords Out-of-pocket payments · Dental healthcare · Catastrophic · Spain

JEL Classification I110 · I180

Introduction

The Spanish National Health System (SNHS) is one of the most robust public health systems in the world, as evidenced

by its twelfth place in the world ranking of health systems in 2015 [1]. The SNHS guarantees universal health protection coverage to citizens regardless of their employment, economic or demographic circumstances [2]. The SNHS

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is essentially financed through general taxes: 94.5% from the resources of the central and regional administrations, 3.4% from special schemes for public-sector employees and 2.1% from payroll deductions and employers' contributions. Although there are also contributions through user co-payments for medications or prostheses, their quantity is residual [3]. The breadth of coverage is set out in the service portfolio established by the Ministry of Health and the Autonomous Communities of Spain, which are responsible for providing regional health services and are thus able to extend the range of services under their own authority [4].

Although the SNHS offers a wide range of services and despite the fact that oral diseases are highly prevalent worldwide, specific dental care for adults in Spain is limited to extractions and treatment for abscesses and trauma. All other dental needs must be satisfied in the private market. This treatment gap represents a significant economic health burden and diminishes the quality of life of those affected [5]. All other dental needs must be satisfied in the private market. In 2010, these deficiencies in access to dental treatment led to an average health loss in Spain ranging from 22 to 213 years per 100,000 people in terms of disability-adjusted life years. The global figure in this respect was 224 years per 100,000 people. Worldwide, dental treatment costs ranked third amongst all types of healthcare, second only to that for diabetes and cardiovascular disease, with cancer in sixth place [6]. Some of Spain's Autonomous Communities unilaterally offer dental care programmes, such as the child dental care programmes partly subsidised by the National Ministry of Health, or specific programmes aimed at persons with disabilities [7].

Spain is one of the European Union countries with the lowest level of dental coverage, with the SNHS covering only 1% of the total cost of this service in 2016, and so most treatment is acquired in the private sector. This is in stark contrast to other European countries, such as Germany, which provides the widest-ranging services and covers as much as 68% of the cost of oral health services, followed by Croatia (61%), Slovakia (56%) and Slovenia (51%). Approximately 30% of the total cost of dental care in Europe is covered by government initiatives or compulsory insurance schemes [8].

Acquiring health services frequently involves families making monetary disbursements, in the form of fees, co-payments, taxes or other contributory alternatives [9], which can generate significant financial tensions in households [10, 11]. Out-of-pocket payment (OOPs) are defined as financially catastrophic when they exceed a given percentage (threshold) of household income, for example, 10%, 20%, 30% or 40% [12]. There is a large body of literature on the financial impacts of payments for access and use of health services worldwide. Two studies have analysed the catastrophic effects of out-of-pocket payments (OOPs) on health in 59 [13] and 89 [11] countries, revealing prevalence values ranging from 0.01% in France to 10% in Vietnam [13], and

of 3.1%, 1.8% and 0.66% for low-, middle- and high-income countries, respectively [11]. A recent systematic review of 133 countries found that the mean worldwide prevalence was 11.7% in 2010, reporting that 808 million people had incurred catastrophic healthcare payments [14]. Catastrophic expenditure on health services has been measured for specific illnesses, such as cardiovascular disease and diabetes [15], cancer [15, 16], HIV [17], chronic illnesses [18] and other diseases [19].

However, the prevalence of catastrophic expenditure on oral health care has received scant attention in the literature. Amongst the few studies that have been conducted in this respect, one examined a sample of schoolchildren in public schools in Mexico [20] and found that households lacking dental care insurance and whose children had the poorest oral health were faced with the highest OOPs. Another, conducted in the United States, reported that, in 2015, expanding dental care coverage to more than 33 million persons aged over 55 years would mitigate the enormous differences currently observed in the uptake of dental care and the related spending between those with and without health insurance in this age group [21]. Finally, a study in Iran found high levels of inequality, reporting that persons with a higher income and with health insurance were more likely to use oral health services [22, 23].

In Spain, 14.08% of the population in 2014 had little or no access to dental care, for economic reasons, whilst 70.02% had private access to such services, and 15.90% had no need for oral health care [24]. The mean annual household private expenditure on oral health was €435, a similar amount to that spent on glasses, orthopaedics and hearing aids [25]. To the best of our knowledge, no previous studies have been conducted to analyse the catastrophic effect of OOPs on oral health in Spain. Accordingly, the aim of the present work is to analyse the prevalence and intensity of catastrophic health expenditure on dental care (CHED) in Spain during the period 2008–2015 and to examine the sociodemographic characteristics of the population considered.

Methods

The study data considered were those published by the Spanish Household Budget Survey (SHBS) for the period 2008–2015 [26]. This survey consists of an annual questionnaire administered to more than 20,000 households, which collects sociodemographic and economic information on standards of living, income and occupation (of the head of the household), as well as the distribution of consumer spending. The households included in the sample are changed every 2 years or less, and so the SHBS is not a panel dataset. The classification used to measure these expenses is the Classification of Individual Consumption

by Purpose (COICOP), which comprises different categories of goods and services on which a household's financial resources are spent. The sixth category contains data on families' healthcare expenditure. Within this category, a specific subgroup is labelled "dental services", which is the key variable in the present study and which we refer to as OOPs for dental care.

In addition, we used the variable of equivalised household incomes. To this end, and following the literature [27], we calculated the number of equivalised household members, using the modified OECD scale, which assigns a value of 1 to the first household member, 0.5 to each household member aged over 13 years (14 or more), and 0.3 to each member aged 13 years or less [28]. Finally, we divided the total household income by the number of equivalised household members to obtain the equivalised household income. Monthly household income was then converted to annual household income.

The next step was to estimate the prevalence and intensity of CHED. The methodology used is that proposed by Wagstaff and van Doorslaer [27], which is widely recognised in the literature. Following this methodology, we defined a dummy variable E_i , which takes the value of 1 when the OOPs_{*i*} of household *i*, as a proportion of equivalent household income *i* (y_i) exceeds the normative threshold used (z_{cat}), that is, $(\text{OOPs}_i/y_i) > z_{\text{cat}}$, and 0 otherwise. Therefore, a household's expenditure is defined as catastrophic when its OOPs for dental care exceed the stated threshold. The number of households in a catastrophic situation or rate of households exposed to catastrophic expenditure due to healthcare OOPs (H_{cat}), denominated prevalence, is defined as follows:

$$H_{\text{cat}} = \frac{1}{N} \sum_{i=1}^n E_i = \bar{x}_E, \quad (1)$$

where N is the sample size, and \bar{x}_E is the mean sample of E_i . In a complementary way, we define the intensity of CHED as the mean catastrophic gap of households due to dental payments (O_i), and it is estimated as the difference between the OOPs financed by the household and the normative threshold used (z_{cat}) multiplied by the equivalised household income, that is, $\text{OOPs} - z_{\text{cat}} * y_i$ si $E_i = 1$, or 0 otherwise (i.e., the catastrophic gap is the difference between the total OOP financed by the household and the normative threshold corresponding to each household, but valued in euros). The expression is described in the following equation:

$$O_{\text{cat}} = \frac{1}{n} \sum_{i=1}^n O_i = \bar{x}_{\text{AO}}. \quad (2)$$

Consequently, the total catastrophic gap due to OOPs for dental care (GO_i) is defined as follows:

$$GO_{\text{cat}} = \sum_{i=1}^n O_i. \quad (3)$$

Whilst prevalence (H_{cat}) measures the number of households that devote more than a specific normative threshold of their equivalised income to OOPs for dental care, intensity (O_i) measures how far the expenditure exceeds the particular normative threshold. In the present study, we use the normative thresholds most commonly cited in the literature (z_{cat}), namely 10%, 20%, 30% and 40%.

To analyse the sociodemographic factors associated with the profiles of prevalence of CHED, we estimated eight ordered logistic regression models (one for each year during the period 2008–2015). This approach was determined by the ordinal nature of the dependent variable. To this end, we used the rate of catastrophic expenditure by households due to dental care OOPs (H_{cat}) as the dependent variable ($y_i = 1$, if the OOPs on dental care do not exceed 10% of household equivalised income; $y_i = 2$, if they exceed 10% of household equivalised income but not 20%; $y_i = 3$, if they exceed 20% of household equivalised income but not 30%; $y_i = 4$, if they exceed 30% of household equivalised income but not 40%; $y_i = 5$, if they exceed 40% of household equivalised income, with $i = 1, \dots, n$, where n is each of the households comprising the sample). To reflect this association, the marginal effects on the set of variables included in the analysis were estimated.

In the set of explanatory variables, we include those recommended in the literature and employ the categories established for each one [11, 15, 29–33]. The sociodemographic variables incorporated into the model were (the reference category is indicated by *): gender (male; female*); age (below 40 years*; between 40 and 65 years; over 85 years); marital status (married*; single; widowed, separated/divorced); educational level (low * (primary education unfinished, finished or equivalent); medium (compulsory secondary education/higher secondary education/intermediate level vocational training); high (university education or equivalent); employment situation (employed*; unemployed; pensioner or retired; other situations (homemaker, students, others); monthly household income (less than €1200*; between €1200 and €2500; more than €2500); per capita GDP in the autonomous community of residence (low *; medium; high); and finally, place of residence (rural*; urban). The methodology proposed by Williams [34] (using the Stata command `gologit2`) was used to estimate our models. This methodology identifies collinear predictors, eliminates them automatically and allows us to estimate three cases of the generalised models to be fitted: the proportional odds/parallel-lines model, the partial proportional odds model and the logistic regression model.

Finally, we checked for the presence of a concentration of CHED in a population of wealthier individuals and in one of less well-off individuals, by calculating the Concentration Index (CI). This index reveals the existence (or otherwise) of inequality in the distribution of individuals at risk of CHED, with regard to their socioeconomic status [35, 36]. When the value of the CI is close to zero, this means there is no socioeconomic-related inequality underlying the distribution of CHED; if the value is negative, this indicates a high concentration of CHED amongst poorer individuals; finally, positive values suggest that CHED is present amongst the wealthier population [37]. The general formulation of CI is

$$CI = 1 - 2 \int_0^1 L(p) dp. \quad (4)$$

For the purpose of our research, this index can be expressed more accurately according to Eq. 5. This equation shows that the value of the CI is equal to the covariance between the value of the CHED (y_i) and the relative ranking of individuals according to their income level (R_i) divided by the average of the CHED measure (μ):

$$CI(y) = \frac{2}{\mu} \text{cov}(y_i, R_i). \quad (5)$$

The index ranges from -1 to 1 (i.e. $-1 \leq CI \leq 1$, or $y' - 1 \leq CI \leq 1 - y'$, where y' is the mean of y , and y is the variable CHED).

As the results obtained are intrinsically similar, the present study only includes the results obtained for the marginal effects and the concentration index for 2008, 2011 and 2015.

All calculations were conducted using the statistical software Stata 16.0 (StataCorp LP, College Station, TX).

Results

Table 1 shows the sociodemographic information obtained for 2008. Our findings show that in 72.66% of cases, the head of the household was male, that 44.74% of the sample were aged 40–64 years, and that 60.62% were married. The most common levels of education were medium (43.97%) and low (30.21%). By economic status, six out of ten main breadwinners were in employment (62.28%), followed by those who were pensioners or retired (28.04%). Just over four in ten households had a monthly income below €1200 (41.24%). Nearly a third lived in Autonomous Communities (regions) with a low per capita GDP (31.02%) and a similar number (29.02%) lived in regions with a medium level of per capita GDP. 84.67% of households lived in urban areas.

The sample yielded similar patterns of behaviour across the different thresholds, although certain variations were

observed for some thresholds in the variables for age below 40 years, age 40–65 years, married and separated/divorced, employment situation and retired/pensioner and for monthly household income.

Tables 2 and 3 show the sociodemographic characteristics of the samples for 2011 and 2015. The frequencies are similarly distributed in each year, with the following minor differences. In 2011, there were more unemployed heads of household and so the weight of employment was lower. In 2015, there were fewer households with a male breadwinner and the age of the head of the household was lower. Fewer heads of household were married, and more were separated/divorced. A smaller percentage of households reported a low level of education (vs. medium–high level). Finally, more households had a monthly income of less than €1200.

Table 4 shows the results for CHED in Spanish households. In 2008, the prevalence of CHED was 7.74%. In other words, this percentage of households dedicated more than 10% of their income to OOPs for dental care, with an intensity illustrated by the mean annual catastrophic gap of €306.25 (SD €2480.31). Both measures decrease as the normative thresholds increase. Thus, 2.26% of households devoted over 40% of their income to OOPs for dental care, with a mean annual catastrophic intensity of €164.12 (€2064.06). In overall terms, at the national level, the intensity represented by the annual catastrophic gap resulting from devoting more than 10% of household income to OOPs for dental care was €4800.74 million (0.43% of GDP). This amount fell to €2472.15 million (0.22% of GDP) for the 40% threshold. In consequence, 36.32%, 41.19%, 46.08% and 51.34% of the overall prevalence of CHED in Spain for the thresholds of 10%, 20%, 30% and 40%, respectively, corresponded to payment for dental care. This pattern remained fundamentally unchanged from 2009 to 2015.

Table 5 shows the marginal effects derived from the ordered logistic regression for 2008, with all effects revealing statistically significant parameters. For all the thresholds above 10%, the results are similar, but differ from those for the threshold below 10%. For the 40% threshold, the factors increasing the likelihood of financial catastrophe due to OOPs for dental care include being male, being aged over 40 years (0.68 percentage points for age 40–65 and 0.35 percentage points for age over 65 years, with respect to the reference category: age less than 40), being single, separated/divorced or widowed (0.26, 2.25 and 0.20 percentage points, respectively, with respect to the reference category: married status), having a low level of education, being unemployed and being a pensioner (1.21 and 0.35 percentage points, respectively, with respect to the reference category, being employed), having a monthly income of less than €1200, and living in an urban area

Table 1 Descriptive statistics of the sociodemographic variables of households in Spain based on the percentage of resources they dedicate to dental care payments

	Total	Threshold < 10%	10% ≤ Thresh- old < 20%	20% ≤ Thresh- old < 30%	30% ≤ Thresh- old < 40%	Threshold ≥ 40%
<i>Gender</i>						
Male	72.66%	72.70%	76.64%	66.54%	63.61%	71.21%
Female	27.34%	27.30%	23.36%	33.46%	36.39%	28.79%
<i>Age of head of household (years)</i>						
Less than 40	27.05%	27.54%	19.32%	12.65%	12.78%	15.49%
40–64	44.74%	44.47%	52.12%	50.10%	45.34%	50.88%
More than 65	28.21%	27.99%	28.56%	37.25%	41.88%	33.63%
<i>Marital status</i>						
Married	60.62%	60.45%	71.98%	60.52%	64.02%	53.92%
Single	19.61%	19.87%	13.22%	12.46%	12.52%	17.92%
Separated/divorced	7.03%	6.94%	5.41%	11.30%	2.13%	15.61%
Widowed	12.74%	12.74%	9.39%	15.72%	21.33%	12.55%
<i>Educational level</i>						
Low level (primary school incomplete, primary or equivalent)	30.21%	30.11%	31.37%	33.36%	34.13%	32.93%
Middle level (secondary school/middle level professional)	43.97%	43.84%	46.35%	47.95%	44.93%	46.66%
University degree or equivalent (university degree or equivalent)	25.82%	26.05%	22.28%	18.69%	20.94%	20.41%
<i>Activity status</i>						
Employed	62.28%	62.59%	59.07%	53.61%	44.79%	55.07%
Unemployed	4.73%	4.69%	7.93%	5.38%	2.54%	2.87%
Receiving earnings-related pension	28.04%	27.73%	29.67%	36.00%	46.22%	39.00%
Other situations (homecare, student, etc.)	4.95%	4.99%	3.33%	5.01%	6.45%	3.06%
<i>Household monthly income</i>						
Low level (less than €1200)	41.24%	40.84%	45.93%	48.10%	45.72%	61.42%
Middle level (€1200–€2500)	42.42%	42.60%	40.60%	38.16%	44.87%	32.96%
High level (more than €2500)	16.34%	16.56%	13.47%	13.74%	9.41%	5.62%
<i>GDP per capita</i>						
Low	31.02%	31.11%	31.22%	26.51%	30.57%	27.39%
Middle	29.02%	29.07%	27.86%	25.38%	19.83%	33.38%
High	39.96%	39.82%	40.92%	48.11%	49.60%	39.23%
<i>Place of residence urban (ref. rural)</i>						
Rural	15.33%	15.37%	15.06%	16.56%	17.99%	9.36%
Urban	84.67%	84.63%	84.94%	83.44%	82.01%	90.64%
<i>N</i>	22,021	21,051	440	211	84	235

Year 2008

(0.82 percentage points with respect to living in a rural area), as well as living in a region where per capita GDP is medium or high (0.73 and 0.58 percentage points, respectively, with respect to living in a region where per capita GDP is low).

Tables 6 and 7 describe the marginal effects obtained but with reference to the 2011 and 2015 waves of the survey, respectively. The amounts and patterns of behaviour are very similar to those for the 2008 wave.

Table 8 shows the CI estimated for the three years addressed in this study, and Figs. 1, 2 and 3 illustrate the concentration curves obtained for these years. In all three years, the CI was significant at 1%. In every case, the sign is negative, which indicates the existence of a CHED concentration amongst the poorer population; at higher levels of equivalent income per household, the probability of CHED concentration decreases.

Table 2 Descriptive statistics of the sociodemographic variables of households in Spain based on the percentage of resources they dedicate to dental care payments

	Total	Threshold < 10%	10% ≤ Thresh- old < 20%	20% ≤ Thresh- old < 30%	30% ≤ Thresh- old < 40%	Threshold ≥ 40%
<i>Gender</i>						
Male	69.28%	68.96%	73.50%	71.55%	70.49%	76.38%
Female	30.72%	31.04%	26.50%	28.45%	29.51%	23.62%
<i>Age of head of household (years)</i>						
Less than 40	25.60%	26.34%	18.72%	18.30%	12.01%	9.50%
40–64	45.57%	44.89%	56.55%	50.45%	58.23%	52.84%
More than 65	28.83%	28.77%	24.73%	31.25%	29.76%	37.66%
<i>Marital status</i>						
Married	57.32%	56.55%	67.99%	64.25%	64.22%	70.99%
Single	21.21%	21.67%	15.41%	20.67%	10.44%	12.23%
Separated/divorced	12.50%	12.70%	8.53%	9.02%	16.42%	10.26%
Widowed	8.97%	9.08%	8.07%	6.06%	8.92%	6.52%
<i>Educational level</i>						
Low level (primary school incomplete, primary or equivalent)	20.99%	21.15%	14.43%	20.50%	20.18%	25.09%
Middle level (secondary school/middle level professional)	50.16%	49.86%	57.76%	49.15%	49.07%	53.23%
University degree or equivalent (university degree or equivalent)	28.85%	28.99%	27.81%	30.35%	30.75%	21.68%
<i>Activity status</i>						
Employed	57.58%	57.61%	61.38%	58.27%	51.19%	50.63%
Unemployed	8.86%	8.85%	11.13%	5.03%	11.75%	7.11%
Receiving earnings-related pension	27.74%	27.58%	23.55%	33.04%	34.43%	37.60%
Other situations (homecare, student, etc.)	5.82%	5.96%	3.94%	3.66%	2.63%	4.66%
<i>Household monthly income</i>						
Low level (less than €1200)	44.67%	44.79%	43.10%	46.96%	40.50%	41.14%
Middle level (€1200–€2500)	40.24%	39.99%	42.57%	43.39%	41.12%	46.68%
High level (more than €2500)	15.09%	15.22%	14.33%	9.65%	18.38%	12.18%
<i>GDP per capita</i>						
Low	31.26%	31.33%	31.25%	33.14%	27.03%	27.57%
Middle	28.79%	28.85%	27.97%	29.07%	27.28%	27.80%
High	39.95%	39.82%	40.78%	37.79%	45.69%	44.63%
<i>Place of residence urban (ref. rural)</i>						
Rural	14.91%	14.84%	12.85%	17.49%	20.49%	18.37%
Urban	85.09%	85.16%	87.15%	82.51%	79.51%	81.63%
<i>N</i>	21,625	20,056	710	275	165	419

Year 2011

Discussion

To the best of our knowledge, this is the first study to quantify CHED in Spain and also the first to analyse the sociodemographic factors associated with the likelihood of suffering financial catastrophe as a result of such payments.

Our findings regarding the sociodemographic profile and the likelihood of catastrophic financial expenditure are consistent with the literature in this respect [38]. However, the statistical sign obtained for the sex and age of the head of

household differs according to the type of health expenditure [39–41] and the study period analysed [42]. Focussing on expenditure on dental care, our finding that male gender and being aged over 40 years increase the risk of CHED is in line with previous research conducted in Iran [32, 33]. With respect to marital status, we find that any arrangement involving living alone increases the risk of CHED. This, too, is in line with results from Iran [32, 33], although another study concluded that marital status was not statistically significant [40].

Table 3 Descriptive statistics of the sociodemographic variables of households in Spain based on the percentage of resources they dedicate to dental care payments

	Total	Threshold < 10%	10% ≤ Thresh- old < 20%	20% ≤ Thresh- old < 30%	30% ≤ Thresh- old < 40%	Threshold ≥ 40%
<i>Gender</i>						
Male	66.25%	66.08%	68.24%	75.72%	73.37%	66.31%
Female	33.75%	33.92%	31.76%	24.28%	26.63%	33.69%
<i>Age of head of household (years)</i>						
Less than 40	21.37%	21.69%	20.22%	14.64%	6.86%	8.65%
40–64	47.34%	47.28%	49.07%	50.28%	57.57%	42.38%
More than 65	31.29%	31.03%	30.71%	35.08%	35.57%	48.97%
<i>Marital status</i>						
Married	54.02%	53.81%	59.75%	65.55%	56.43%	50.77%
Single	22.85%	23.06%	22.05%	19.78%	11.18%	14.32%
Separated/divorced	10.21%	10.19%	8.82%	8.52%	10.54%	16.07%
Widowed	12.92%	12.94%	9.38%	6.15%	21.85%	18.84%
<i>Educational level</i>						
Low level (primary school incomplete, primary or equivalent)	19.80%	19.84%	14.88%	20.01%	23.66%	24.26%
Middle level (secondary school/middle level professional)	48.82%	48.61%	52.58%	46.41%	51.58%	58.71%
University degree or equivalent (university degree or equivalent)	31.38%	31.55%	32.54%	33.58%	24.76%	17.03%
<i>Activity status</i>						
Employed	56.78%	57.22%	56.17%	47.39%	43.87%	34.08%
Unemployed	8.24%	8.28%	6.89%	10.35%	1.58%	8.48%
Receiving earnings-related pension	29.22%	28.77%	31.72%	39.08%	46.64%	47.03%
Other situations (homecare, student, etc.)	5.76%	5.73%	5.22%	3.18%	7.91%	10.41%
<i>Household monthly income</i>						
Low level (less than €1200)	46.54%	46.38%	46.82%	44.24%	44.19%	61.77%
Middle level (€1200–€2500)	39.98%	40.01%	39.24%	42.40%	48.17%	33.55%
High level (more than €2500)	13.48%	13.61%	13.94%	13.36%	7.64%	4.68%
<i>GDP per capita</i>						
Low	31.54%	31.69%	29.27%	30.82%	23.95%	27.60%
Middle	28.60%	28.46%	31.56%	31.39%	40.58%	28.10%
High	39.86%	39.85%	39.17%	37.79%	35.47%	44.30%
<i>Place of residence urban (ref. rural)</i>						
Rural	14.37%	14.41%	12.86%	17.51%	9.89%	13.17%
Urban	85.63%	85.59%	87.14%	82.49%	90.11%	86.83%
<i>N</i>	22,054	21,000	472	194	124	264

Year 2015

Education and household income both play an important role in CHED. In each case, low levels increase the risk of CHED whilst high levels insulate households from this financial burden. This finding is corroborated by the literature [30–33]. In consequence, the diminished economic status provoked by unemployment compromises household finances and heightens the risk of CHED, as reported in several previous studies [30, 42, 43]. Finally, the place of residence is directly relevant to the risk of CHED: persons who live in urban areas and/or where GDP

per capita is high are at greater risk in this respect, as has also been observed in other countries [13, 30, 32, 33].

The CI results obtained highlight the existence of a pro-poor inequality in CHED in Spain, in line with the inequality for unmet dental care needs in Iran [23], but contrary to that for dental care utilisation in the same country [22, 23], where the inequality is pro-rich in both rural and urban areas, and in most provinces [22], especially in the north west [23]. In Spain, the concentration of CHED is similar

Table 4 Prevalence, intensity and total gap of financial catastrophism due to out-of-pocket payments for dental care in Spain (€)

		10%	20%	30%	40%
2008	Rate of catastrophic payments for dental care (H_{cat})	7.74%	4.43%	2.99%	2.26%
	Mean gap of households' catastrophic payments (SD) (O_{cat})	306.25 (2480.31)	238.10 (2320.26)	194.88 (2183.70)	164.12 (2064.06)
	Total gap of catastrophic payments in Spain (GO_{cat})	4,800,743,302.00	3,703,941,537.00	2,984,917,868.00	2,472,147,908.00
	% total gap/GDP in Spain	0.43%	0.33%	0.27%	0.22%
	% prevalence of OOPs for dental care with respect to total OOPs for healthcare	36.32%	41.19%	46.08%	51.34%
2009	Rate of catastrophic payments for dental care (H_{cat})	7.33%	4.11%	2.80%	2.05%
	Mean gap of households' catastrophic payments (SD) (O_{cat})	294.10 (2340.38)	227.93 (2166.50)	186.61 (2015.50)	157.15 (1881.63)
	Total gap of catastrophic payments in Spain (GO_{cat})	4,818,302,508.00	3,730,227,218.00	3,062,553,720.00	2,590,644,287.00
	% total gap/GDP in Spain	0.45%	0.35%	0.29%	0.24%
	% prevalence of OOPs for dental care with respect to total OOPs for healthcare	37.10%	42.61%	48.60%	51.22%
2010	Rate of catastrophic payments for dental care (H_{cat})	7.68%	4.21%	2.85%	2.07%
	Mean gap of households' catastrophic payments (SD) (O_{cat})	274.53 (2322.34)	207.64 (2170.48)	167.09 (2044.17)	138.90 (1935.27)
	Total gap of catastrophic payments in Spain (GO_{cat})	4,678,550,166.00	3,555,909,873.00	2,875,695,860.00	2,407,331,879.00
	% Total Gap/GDP in Spain	0.44%	0.33%	0.27%	0.22%
	% Prevalence of OOPs for dental care with respect to total OOPs for healthcare	37.41%	42.37%	47.62%	51.45%
2011	Rate of catastrophic payments for dental care (H_{cat})	7.25%	3.97%	2.70%	1.93%
	Mean gap of households' catastrophic payments (SD) (O_{cat})	259.75 (2063.58)	194.03 (1900.56)	153.36 (1765.97)	125.18 (1651.99)
	Total Gap of catastrophic payments in Spain (GO_{cat})	4,246,887,795.00	3,108,567,293.00	2,416,233,188.00	1,947,540,003.00
	% total gap/GDP in Spain	0.40%	0.29%	0.23%	0.18%
	% Prevalence of OOPs for dental care with respect to total OOPs for healthcare	37.12%	41.23%	47.63%	51.15%
2012	Rate of catastrophic payments for dental care (H_{cat})	7.01%	4.01%	2.72%	1.94%
	Mean gap of households' catastrophic payments (SD) (O_{cat})	248.86 (1889.01)	185.77 (1729.73)	147.60 (1600.98)	121.43 (1491.98)
	Total gap of catastrophic payments in Spain (GO_{cat})	4,512,205,961.00	3,387,199,959.00	2,721,042,393.00	2,273,142,214.00
	% total gap/GDP in Spain	0.44%	0.33%	0.26%	0.22%
	% prevalence of OOPs for dental care with respect to total OOPs for healthcare	35.95%	41.50%	46.46%	50.00%
2013	Rate of catastrophic payments for dental care (H_{cat})	7.32%	4.07%	2.68%	1.96%
	Mean gap of households' catastrophic payments (SD) (O_{cat})	242.98 (1902.57)	180.82 (1743.04)	142.74 (1612.26)	116.63 (1501.77)
	Total Gap of catastrophic payments in Spain (GO_{cat})	3,804,337,361.00	2,796,481,146.00	2,194,567,498.00	1,786,896,298.00
	% total gap/GDP in Spain	0.37%	0.27%	0.22%	0.18%
	% prevalence of OOPs for dental care with respect to total OOPs for healthcare	36.30%	41.84%	46.89%	50.23%
2014	Rate of catastrophic payments for dental care (H_{cat})	7.04%	3.96%	2.56%	1.93%
	Mean gap of households' catastrophic payments (SD) (O_{cat})	264.08 (2007.41)	199.64 (1842.33)	161.05 (1705.30)	134.34 (1587.30)
	Total Gap of catastrophic payments in Spain (GO_{cat})	4,793,535,473.00	3,651,880,107.00	2,970,055,191.00	2,492,694,966.00
	% total gap/GDP in Spain	0.46%	0.35%	0.29%	0.24%
	% prevalence of OOPs for dental care with respect to total OOPs for healthcare	35.47%	41.35%	45.71%	50.00%
2015	Rate of catastrophic payments for dental care (H_{cat})	7.55%	4.33%	3.04%	2.30%
	Mean gap of households' catastrophic payments (SD) (O_{cat})	292.75 (2147.55)	220.81 (1969.54)	175.52 (1822.18)	143.02 (1697.36)
	Total Gap of catastrophic payments in Spain (GO_{cat})	4,807,279,059.00	3,567,313,599.00	2,791,487,421.00	2,250,669,193.00
	% total gap/GDP in Spain	0.45%	0.33%	0.26%	0.21%
	% prevalence of OOPs for dental care with respect to total OOPs for healthcare	37.04%	42.96%	49.81%	53.52%

Period 2008–2015

H_{cat} is the prevalence, defined as the proportion of households that dedicate more of the monthly equivalent household income than the threshold value to out-of-pocket payments for dental care

O_{cat} is the intensity, defined as the average amount exceeding the threshold of annually equivalent household income (€) spent on dental healthcare

GO_{cat} is the intensity, defined as the global amount exceeding the threshold of annually equivalent household income (€) spent on dental healthcare

SD standard deviation, $OOPs$ out-of-pocket payments for dental care

to that of the catastrophic expenditure inherent to long-term care services [43].

Oral health is a major global health problem. Despite these diseases typically being preventable, half of the world's population suffer some type of oral disease, with a growing prevalence in low- and middle-income countries [5]. In the OECD countries, mean household expenditure on oral health represents 55% of total expenses, and 20% of medical expenses [6].

In Spain, one of every three children suffers from tooth decay in early childhood, and 14% continue to present caries at the age of 12; at 15 years, 35% of adolescents from families with a high socioeconomic status currently have or have had tooth decay problems, with this percentage rising to 50% in families with a low socioeconomic status [44]. In the 35–44-year age group, 11% of individuals with a low socioeconomic status require dental extraction, compared to 1.8% of those with a high socioeconomic status. Only around half of Spanish citizens (46% in 2017) attend the dentist on a yearly basis. This percentage rises to 65% in higher income groups, compared to 35% in lower income groups. In any event, oral health represents a significant financial burden for one of every four households, in general, and for 28.9% of low-income households, in particular [45].

According to our results, entirely funding dental healthcare for households would require an annual disbursement of €4800 million, or €2400 million to fund the threshold above 40%. This would entail a public-sector spending increase of approximately 6.5% or 3.24%, respectively, in health expenditure, which amounted to €74150 million in 2017 [46].

Undoubtedly, the perception of oral health services as a luxury rather than a necessity [6] complicates access to this care in the private market. A study conducted in Hong Kong found that the role of traditional Chinese medicine, individuals' beliefs and family influence all have an effect on oral health and on access to dental services [47], whilst a study in the United States reported that patients with lower levels of income and resources, lower levels of education, poorer general health and those in older age groups use dental health services with significantly less frequency and would continue to do so even if dental health coverage were increased within public health programmes [21].

This study presents certain limitations. First, we were unable to consider the different waves of the survey as a panel dataset, because the households included in the survey are changed every 24 months, which restricted our econometric analysis of the data. The second limitation concerns the nature of the information provided by the households in terms of expenditure inherent to dental health care: we had no information on the type and/or severity of the dental-related problem, the duration of treatment or the drugs or prosthetics prescribed. Finally, we also lacked information

on the possible existence of private health insurance for households, which would have enabled us to analyse the results from another perspective. Nonetheless, to our knowledge, the present study is the first to examine and quantify the financial impact of OOPs by families for dental care within the Spanish health system.

Policy implications

There is general consensus on the need to design policies aimed at increasing dental care coverage to mitigate inequalities in access to oral health services and in their use [22, 23]. Studies have highlighted that if dental care is not included in the portfolio of public health services, it is almost impossible to attend to the real needs of oral-dental pathologies and associated diseases [6]. Integrating such services into primary care would considerably reduce the financial burden of OOPs for dental care on households [48]. In Hong Kong, for example, health promotion programmes have greatly alleviated oral health problems [47].

The design of new policies should be carried out in two ways, focussing both on prevention and on healthcare attention. In terms of prevention, programmes to promote awareness of dental care issues are essential to limit the appearance of related diseases. In health care, legislators should seek to provide financial protection for persons in situations of vulnerability and in need of dental attention, taking into account the catastrophic spending profiles identified in the present study. Furthermore, the portfolio of dental services available within the SNHS should be expanded, albeit gradually, prioritising persons with more severe needs and those requiring long-term treatment. A third objective must be to shorten the waiting lists for dental health services in Spain, which are still unacceptably long (whilst addressing the additional demand that would arise from expanding the dental services portfolio).

Conclusions

The findings we present show that the OOPs inherent to dental care in Spain constitute an important financial burden for certain population segments, and reflect the existence of a pro-poor inequity in terms of the concentration of CHED. The factors that increase the risk of CHED are male gender, age over 40 years, being single, separated, divorced or widowed, having a low level of education, having a low household income, being unemployed, living in an urban area, and living in a region with a relatively high level of GDP per capita. An expansion of SNHS health coverage for dental services would reduce the risk of CHED by financially protecting families, enabling them to address dental needs.

Future lines of research should be undertaken to extend our knowledge about the uptake and financing of dental healthcare.

Table 5 Marginal effects of the sociodemographic factors of households in Spain associated with financial catastrophism derived from out-of-pocket payments for dental care in Spain

	Threshold < 10%		10% ≤ Threshold < 20%		20% ≤ Threshold < 30%		30% ≤ Threshold < 40%		Threshold > 40%	
	dy/dx	p value	dy/dx	p value	dy/dx	p value	dy/dx	p value	dy/dx	p value
Female (ref. male)	-0.87	0.000	0.26	0.000	0.34	0.000	0.82	0.000	-0.55	0.000
Age (ref. age < 40)										
40–65	-2.30	0.000	0.61	0.000	0.63	0.000	0.38	0.000	0.68	0.000
More than 65	-2.16	0.000	0.12	0.000	0.92	0.000	0.77	0.000	0.35	0.000
Marital status (ref. married status)										
Single	1.85	0.000	-1.31	0.000	-0.37	0.000	-0.42	0.000	0.26	0.000
Separated/divorced	0.42	0.000	-1.07	0.000	0.30	0.000	-1.90	0.000	2.25	0.000
Widowed	1.58	0.000	-1.06	0.000	-0.27	0.000	-0.45	0.000	0.20	0.000
Educational level [ref. low (primary school incomplete, primary or equivalent)]										
Middle (secondary school/middle level professional)	-0.64	0.000	0.16	0.000	0.21	0.000	0.22	0.000	-0.05	0.000
University degree or equivalent (university degree or equivalent)	-0.13	0.000	0.11	0.000	-0.23	0.000	0.85	0.000	-0.60	0.000
Activity status (ref. employed)										
Unemployed	-0.58	0.000	1.19	0.000	0.34	0.000	0.26	0.000	-1.21	0.000
Receiving earnings-related pension	-0.38	0.000	0.15	0.000	-0.04	0.000	-0.08	0.000	0.35	0.000
Other situations (homecare, student, etc.)	1.55	0.000	-0.31	0.000	-0.53	0.000	-0.72	0.000	0.00	0.000
Household monthly income [ref. low (less than €1200)]										
Middle (€1200–€2500)	1.47	0.000	-0.58	0.000	-0.23	0.000	0.22	0.000	-0.88	0.000
High (more than €2500)	3.01	0.000	-0.88	0.000	-0.19	0.000	-0.25	0.000	-1.68	0.000
GDP per capita (ref. low)										
Middle	-0.19	0.000	0.03	0.00%	0.05	0.00%	-0.61	0.000	0.73	0.000
High	-0.94	0.000	0.30	0.00%	0.46	0.00%	-0.40	0.000	0.58	0.000
Place of residence urban (ref. rural)	-0.47	0.000	0.12	0.00%	-0.02	0.00%	-0.27	0.000	0.83	0.000
N	22,021									
LR χ^2 ($H_0: \beta_1 = \beta_2 = \dots = \beta_k$)	112,675.10									
Prob > χ^2	0.000									
Pseudo R ²	0.0141									
Classification percentage	95.60%									

Year 2008

dy/dx: marginal effect, expressed in percentage points. 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 overall p value was estimated for the complete variables age, marital status, educational level, activity status, household monthly income and GDP per capita. The p value obtained in all cases was =0.000

Table 6 Marginal effects of the sociodemographic factors of households in Spain associated with financial catastrophism derived from out-of-pocket payments for dental care in Spain

	Threshold < 10%			10% ≤ Threshold < 20%			20% ≤ Threshold < 30%			30% ≤ Threshold < 40%			Threshold > 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
Female (ref. male)	-0.21	0.000	0.000	0.01	0.000	0.000	0.32	0.000	0.000	-0.02	0.000	0.000	-0.10	0.000	0.000
Age (ref. age < 40)															
40-65	-0.38	0.000	0.000	1.33	0.000	0.000	0.49	0.000	0.000	0.65	0.000	0.000	1.29	0.000	0.000
More than 65	-0.35	0.000	0.000	1.62	0.000	0.000	0.17	0.000	0.000	0.60	0.000	0.000	1.14	0.000	0.000
Marital status (ref. married status)															
Single	2.84	0.000	0.000	-1.63	0.000	0.000	-0.11	0.000	0.000	-0.32	0.000	0.000	-0.78	0.000	0.000
Separated/divorced	3.11	0.000	0.000	-1.37	0.000	0.000	-0.10	0.000	0.000	0.63	0.000	0.000	-0.71	0.000	0.000
Widowed	2.68	0.000	0.000	-1.32	0.000	0.000	-0.85	0.000	0.000	-0.15	0.000	0.000	-1.15	0.000	0.000
Educational level [ref. low (primary school incomplete, primary or equivalent)]															
Middle (secondary school/middle level professional)	-1.58	0.000	0.000	1.38	0.000	0.000	0.02	0.000	0.000	0.12	0.000	0.000	0.06	0.000	0.000
University degree or equivalent (university degree or equivalent)	-1.47	0.000	0.000	1.10	0.000	0.000	0.42	0.000	0.000	0.29	0.000	0.000	0.34	0.000	0.000
Activity status (ref. employed)															
Unemployed	-0.22	0.000	0.000	0.58	0.000	0.000	-0.70	0.000	0.000	0.45	0.000	0.000	-0.11	0.000	0.000
Receiving earnings-related pension	0.13	0.000	0.000	-1.07	0.000	0.000	0.30	0.000	0.000	0.13	0.000	0.000	0.51	0.000	0.000
Other situations (homecare, student, etc.)	1.67	0.000	0.000	-0.98	0.000	0.000	-0.06	0.000	0.000	-1.07	0.000	0.000	0.45	0.000	0.000
Household monthly income [ref. low (less than €1200)]															
Middle (€1200-€2500)	0.12	0.000	0.000	-0.26	0.000	0.000	-0.14	0.000	0.000	0.20	0.000	0.000	0.09	0.000	0.000
High (more than €2500)	2.25	0.000	0.000	-0.90	0.000	0.000	-1.05	0.000	0.000	0.23	0.000	0.000	-0.53	0.000	0.000
GDP per capita (ref. low)															
Middle	0.01	0.000	0.000	0.00	0.00%	0.00%	-0.06	0.00%	0.00%	0.02	0.000	0.000	0.03	0.000	0.000
High	-0.76	0.000	0.000	0.01	0.00%	0.00%	-0.08	0.00%	0.00%	0.21	0.000	0.000	0.58	0.000	0.000
Educational level [ref. low (primary school incomplete, primary or equivalent)]	0.52	0.000	0.000	0.61	0.00%	0.00%	-0.25	0.00%	0.00%	-0.44	0.000	0.000	-0.44	0.000	0.000
N	21,625														
LR χ^2 ($H_0: \beta_1 = \beta_2 = \dots = \beta_k$)	144,177.92														
Prob > χ^2	0.000														
Pseudo R^2	0.0119														
Classification percentage	92.74%														

Year 2011

dy/dx: marginal effect, expressed in percentage points. 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 overall p value was estimated for the complete variables age, marital status, educational level, activity status, household monthly income, and GDP per capita. The p value obtained in all cases was = 0.000

Table 7 Marginal effects of the sociodemographic factors of households in Spain associated with financial catastrophism derived from out-of-pocket payments for dental care in Spain

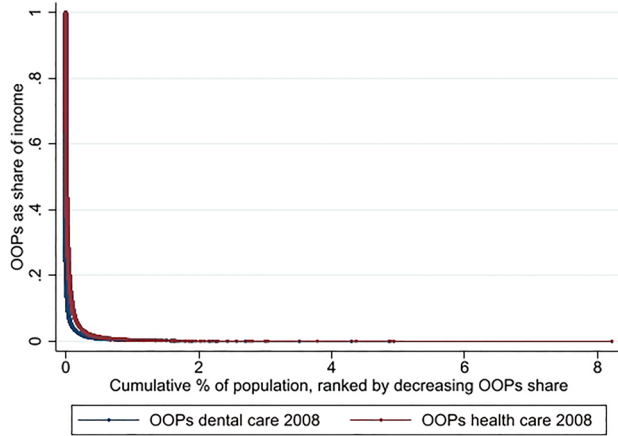
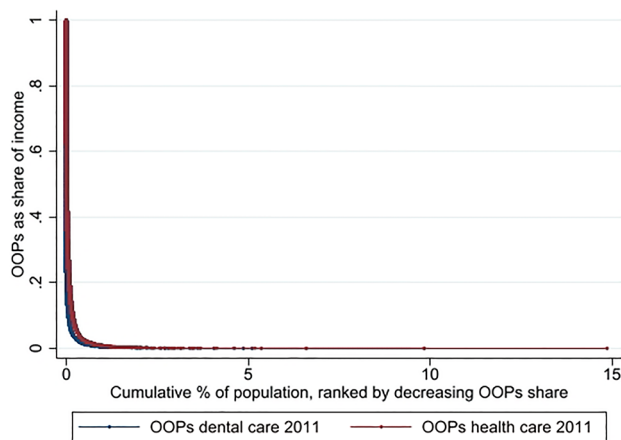
	Threshold < 10%		10% ≤ Threshold < 20%		20% ≤ Threshold < 30%		30% ≤ Threshold < 40%		Threshold > 40%	
	dy/dx	SD	dy/dx	SD	dy/dx	SD	dy/dx	SD	dy/dx	SD
Female (ref. male)	0.47	0.000	0.27	0.000	0.21	0.000	0.000	0.000	-0.46	0.000
Age (ref. age < 40)										
40–65	-1.17	0.000	0.07	0.000	0.41	0.000	0.000	0.000	0.76	0.000
More than 65	-0.10	0.000	-0.25	0.000	0.40	0.000	0.000	0.000	0.07	0.000
Marital status (ref. married status)										
Single	0.89	0.000	-0.44	0.000	-0.02	0.000	0.000	0.000	-0.32	0.000
Separated/divorced	0.35	0.000	-0.72	0.000	-0.52	0.000	0.000	0.000	0.00	0.000
Widowed	1.50	0.000	-1.13	0.000	-1.07	0.000	0.000	0.000	0.59	0.000
Educational level [ref. low (primary school incomplete, primary or equivalent)]										
Middle (secondary school/middle level professional)	-1.33	0.000	0.82	0.000	0.09	0.000	0.000	0.000	0.00	0.000
University degree or equivalent (university degree or equivalent)	-1.22	0.000	1.05	0.000	0.29	0.000	0.000	0.000	0.13	0.000
Activity status (ref. employed)										
Unemployed	-0.02	0.000	-0.03	0.000	0.16	0.000	0.463	0.463	-0.72	0.000
Receiving earnings-related pension	-2.80	0.000	0.78	0.000	0.37	0.000	0.000	0.000	0.55	0.000
Other situations (homecare, student, etc.)	-3.22	0.000	1.21	0.000	0.47	0.000	0.000	0.000	0.23	0.000
Household monthly income [ref. low (less than €1200)]										
Middle (€1200–€2500)	0.70	0.000	-0.24	0.000	0.05	0.000	0.000	0.000	-0.03	0.000
High (more than €2500)	1.79	0.000	-0.05	0.000	0.03	0.000	0.000	0.000	-0.33	0.000
GDP per capita (ref. low)										
Middle	-0.83	0.000	0.22	0.000	0.10	0.000	0.000	0.000	0.45	0.000
High	-0.54	0.000	-0.08	0.000	0.04	0.000	0.000	0.000	0.03	0.000
Educational level [ref. low (primary school incomplete, primary or equivalent)]	-0.57	0.000	0.28	0.000	-0.20	0.000	0.000	0.000	0.47	0.000
N	22,054									
LR χ^2 ($H_0: \beta_1 = \beta_2 = \dots = \beta_k$)	90,715.12									
Prob > χ^2	0.000									
Pseudo R^2	0.01									
Classification percentage	95.22%									

Year 2015

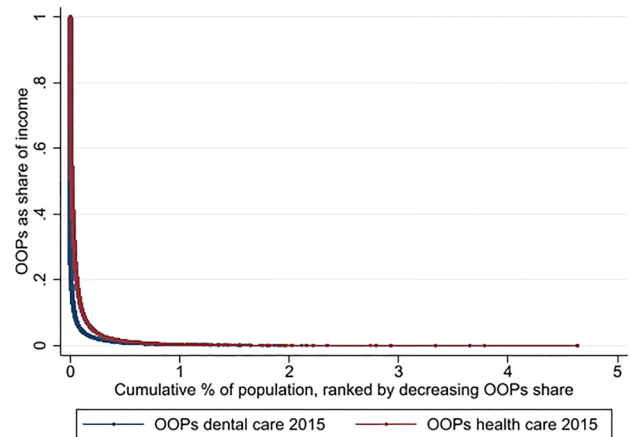
dy/dx: marginal effect, expressed in percentage points. Includes the slope of the calculated parameter; SD: standard deviation; p value: corresponds to the test of individual significance of the corresponding parameter; LR: corresponds to the test of overall significance of all the slopes in the model; the overall p value was estimated for the complete variables age, marital status, educational level, activity status, household monthly income, and GDP per capita. The p value obtained in all cases was = 0.000

Table 8 Concentration Index of out-of-pocket payments for dental care in Spain

Year	CI	<i>p</i> value
2008	- 0.1050	0.000
2011	- 0.0708	0.000
2015	- 0.1003	0.000

**Fig. 1** Dental care payments budget share vs. cumulative percent of households ranked by decreasing budget share. Year 2008**Fig. 2** Dental care payments budget share vs. cumulative percent of households ranked by decreasing budget share. Year 2011

An area of priority attention would be to estimate the effect of treating secondary pathologies attributed to primary oral-dental pathologies that are currently untreated due to the lack of public health cover. This is important because poor oral health is known to increase the risk of infections spreading to the bloodstream, and may provoke tumours or stomach problems [6]. At present, there is no oral health cover during pregnancy or for children's first teeth [49]. It would be useful to standardise oral healthcare cover across all of Spain's autonomous communities and to regularly monitor and assess

**Fig. 3** Dental care payments budget share vs. cumulative percent of households ranked by decreasing budget share. Year 2015

public dental care services, progressively introducing measures to provide dental healthcare for specific groups, such as children and pregnant women.

Author contributions SLL and RPR carried out the data preparation and the statistical analysis. MOO and FES have contributed to write the manuscript. All the authors have read and agreed to the published version of the manuscript.

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Declarations

Transparency declaration The corresponding author, on behalf of all the co-authors, vouches for the accuracy, transparency and honesty of the data and information contained in the study, declares that no relevant information has been omitted and that all discrepancies between the authors have been adequately resolved and described.

Conflict of interest The authors declare they have no conflict of interest.

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