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Research article

The impact of the COVID-19 pandemic on catastrophic health expenditure in Greece

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Abstract: The measures implemented to combat the coronavirus disease 2019 (COVID-19) adversely affected both the Greek health system and the Greek population. This study aimed to investigate the influence of these measures on the catastrophic health expenditure (CHE) in Greece. The study used data from the household budget surveys (HBSs) of 2019, 2020 and 2021. Two-stage area sampling was applied in all three surveys, with stratification by geographic region and by degree of urbanization, and with samples of $n_{2019} = 6180$, $n_{2020} = 6256$ and $n_{2021} = 6053$. The analysis was based on the fit of two logistic regression models; the incidence of the CHE at the 10% and 25% thresholds was used as outcome variables. The increase in the incidence of the CHE at the 10% threshold during the pandemic was mainly due to the disruption of healthcare delivery, the increase in out-of-pocket (OOP) payments, income losses and the uneven distribution of healthcare resources across the country. Several occupational classes reported a higher CHE than manual workers. Moreover, the deterioration in health was found to contribute to the increase in the incidence of the CHE, while household size protected against the CHE. The latter was also true for the 25% threshold. The results indicated that the pandemic and the associated confinement measures negatively influenced the CHE in Greece.

Keywords: COVID-19; Greece; catastrophic health expenditure; out-of-pocket payments; disruption of healthcare delivery; income loss; uneven distribution of healthcare resources; deterioration in health

JEL Codes: I11

Abbreviations: National Organization for the Provision of Health Services (EOPYY); Regional Health Authorities (YPEs).

1. Introduction

The coronavirus disease 2019 (COVID-19) pandemic has caused unprecedented impacts on the population and healthcare services globally (Gupta et al., 2021; Ozoner et al., 2020). With respect to the population, such impacts included developments in the socioeconomic sphere (Nicola et al., 2020) that disrupted daily life, and high rates of non-COVID-19 and COVID-19 morbidity and mortality (Almufleh and Joseph, 2021; Gerotziafas et al., 2021); with respect to healthcare, they included a decrease in operations by health facilities, an increased cost of care, the avoidance of health facilities due to fear of COVID-19, a diversion of resources to manage COVID-19 and supply shortages (Dzianach et al., 2023).

At the onset of the pandemic, most countries, including Greece, prioritized essential healthcare services, and either cancelled or postponed non-urgent care (Webb et al., 2022). The restrictions implemented to curb the spread of the virus included temporarily closing or limiting access to healthcare facilities and services, reallocating healthcare resources and interrupting screening programs (Boulton, 2020). That is, during the pandemic, the provision of both preventive and curative health services was significantly limited for communicable and non-communicable diseases (NCDs) worldwide (World Health Organization, 2021c).

In this regard, the healthcare disruption caused by the COVID-19 measures negatively impacted the service coverage (World Health Organization, 2022a), thereby undermining the progress made toward achieving universal health coverage (UHC) (World Health Organization, 2021d). UHC is the goal of all people receiving the health services they need without risking financial hardship from unaffordable out-of-pocket (OOP) payments (Evans et al., 2013). OOP payments reflect the direct burden of healthcare costs that households bear at the time of using such services (OECD et al., 2017). That is, the implemented restrictions led to interruptions and delays in essential health services, which affected the service coverage, reduced income and increased OOP payments, thus undermining financial protection (World Health Organization; Regional Office for the Eastern Mediterranean, 2022). Financial risk protection (FRP) is a key component of UHC and is defined as the access to all quality health services needed without financial hardship; the basic concept of interest for FRP is the catastrophic health expenditure (CHE) (Saksena et al., 2014).

According to the basic approach, CHE occurs when a household's healthcare spending exceeds a certain threshold, usually either 10% or 25% of its household consumption (Wagstaff et al., 2018). Based on the capacity to pay (CTP) approach, healthcare expenditure is considered to be catastrophic when it exceeds 40% of the remaining income after subsistence needs have been met (Xu et al., 2003).

The basic approach is easy to understand and requires no further calculation. In addition, it is not dependent on a household's allocation decisions. However, it fails to distinguish between the poor and the rich, which is something that is addressed by the CTP approach (Hsu et al., 2018).

Because the basic approach has been adopted in the Sustainable Development Goal (SDG) 3.8.2 (World Health Organization, 2017), the statistics presented in the rest of this study are based on the total household expenditure.

Globally, in 2017, 996 million people spent more than 10% of their household budget on healthcare (World Health Organization, 2022b). Although CHE can occur in all countries at all levels of

socioeconomic development, it is more frequent and more severe in low- and middle-income countries (LMIC) (World Health Organization, 2008). This is not surprising because while government spending dominates in high-income countries (HIC) (70%), health spending in low-income countries (LIC) is primarily financed by external aid (29%) and OOP payments (44%) (World Health Organization, 2021a) (i.e., the main cause of catastrophic spending (Xu et al., 2015)). However, there are different reasons for why OOP payments differ between uninsured and insured patents. For the former, OOP payments arise from restricted access to healthcare services (Bustamante et al., 2014); for the latter, OOP payments arise from deductibles, coinsurance and limits (Cantwell, 1981).

On the other hand, the lack of prepayment mechanisms for risk pooling can also lead to catastrophic spending (Xu et al., 2005), because individuals face higher expenses when sick (World Health Organization, 2005).

Given the current circumstances, it is reasonable to question the extent to which the COVID-19 measures contributed to the CHE. However, due to a lack of data, a detailed and comprehensive assessment of the impact of COVID-19 on the CHE is precluded; a higher incidence, that is, a higher proportion of households whose OOP spending as a share of total (or non-subsistence) expenditure exceeding a chosen threshold resulting from the pandemic is probably, particularly among LMICs and lower-income households (World Health Organization, 2021b). This is possibly because (i) the provision of free-of-charge regular health services by the state may have been undermined as public health priorities mainly focused on the management of COVID-19 (Milionis et al., 2021) and (ii) in addition to its health effects, the pandemic also resulted in job and income losses (Dang and Nguyen, 2021), which are included among the factors influencing the CHE (Azzani et al., 2019); because job loss is often linked to a loss of health insurance, especially in Bismarck-type healthcare systems (although this is not the case in all healthcare systems), it is not surprising that unemployment is positively associated with OOP spending (Grigorakis et al., 2018), while families in the lowest income group paid a disproportionately larger share of family income for total OOP expenditure than all other income groups (Galbraith et al., 2005). However, because the study of CHE is an exercise focusing on expenditure, one should also note that the pandemic resulted in an economic crisis that combined the characteristics of both supply shocks and demand shocks (Baqaee and Farhi, 2021, w28346). In this sense, private household expenditure has been impacted by the pandemic (Choi et al., 2022).

Considering the 2008 financial crisis, which led to an increase in the CHE in Greece due to a significant downturn in the country's public health finances (Grigorakis et al., 2017; Grigorakis et al., 2016), i.e., from 14.64% in 2010 to 16.89% in 2016, as reported by the World Health Organization (2023a), it is important to examine the impact of the first two years of the pandemic; during this period, Greece implemented two lockdowns (from 23 March to 3 May 2020 and from 7 November 2020 to 15 May 2021) that triggered an economic shock, which were potentially more severe than the one previously mentioned in this paragraph (Papanikos, 2020). The disruption of the delivery of essential healthcare services during the pandemic (Tsimtsiou et al., 2021), in combination with the loss of income (OECD, 2020), the significant disruptions of consumer behavior (Theodoridis and Kavoura, 2021) and the characteristics of the healthcare system, paints a complicated picture that requires investigation.

To a large extent, the latter can be used to interpret the conditions under which the influence of the confinement measures may have contributed to the CHE. With regards to funding and provisions, Greece's healthcare system is a mixed public–private system, while both the Bismarck and the Beveridge models coexist in the public sector. It is administered by the Ministry of Health, while the

seven Regional Health Authorities (YPEs) coordinate healthcare services in their regions of responsibility under the Ministry's supervision. The delivery of healthcare in Greece is hospital-oriented, though several reform efforts between 2010 and 2022 attempted to enhance the role of primary healthcare. Primary healthcare (PHC) is provided by the public sector through health centers, regional medical offices, multipurpose regional medical offices, specialized regional medical offices, local medical offices, local health units and other units. Additionally, primary healthcare is provided by private-practice physicians contracted with the National Organization for the Provision of Health Services (EOPYY) (EOPYY was established in 2011 by merging four of the largest social security organizations, and EOPYY purchases primary and secondary healthcare services for its insured members from both public and private healthcare suppliers), private-practice physicians not contracted with EOPYY, and private diagnostics centers and laboratories. In addition, primary healthcare is provided through the outpatient departments of public and private hospitals. Hospital care is provided by public hospitals and by private hospitals and clinics.

In 2021 (the latest available data), total health expenditure (THE) amounted to EUR16,664.993 million. With regards to the financing schemes, EUR5,059.392 million (30% of THE) was from general government, EUR5,293.527 million (32% of THE) was from compulsory contributory health insurance schemes and EUR5,554.376 million (33% of THE) was from OOP payments (Hellenic Statistical Authority, 2023b). As one can see, the OOP payments were quite high; they contributed more to the THE than the other financing schemes. What is interesting is that the UHC index decreased in 2021 (77.19) compared with 2019 (79.46) (World Health Organization, 2023b).

Based on what was mentioned above, the conditions for the CHE to occur exist. What must be answered is whether the confinement measures contributed to the CHE. The need to study CHE during the COVID-19 pandemic (i.e., in a period in which socioeconomic development was hit hard (Liu et al., 2021b)), arises from the continuing need to understand several areas of health policy and systems to achieve the SDGs (Bennett et al., 2020). In this sense, the study attempted to investigate the CHE during the first two years of the COVID-19 pandemic in Greece and to compare the results with those from 2019.

2. Materials and methods

In this study, data from the Household Budget Surveys (HBSs) of 2019, 2020 and 2021 were used. The data are publicly available from the website of the Hellenic Statistical Authority (Hellenic Statistical Authority, 2023a).

Two-stage area sampling was applied in all three surveys. The primary units were the areas (one or more unified building blocks), and the ultimate sampling units selected in each sampling area were households. The samples were stratified in two levels (i.e., by the Nomenclature of Territorial Units for Statistics 2 (NUTS 2) and by the degree of urbanization). The sample size of HBS 2019 was $n = 6180$, that of HBS 2020 was $n = 6256$, and that of HBS 2021 was $n = 6053$ (Hellenic Statistical Authority, 2019, 2020, 2021).

To decide which approach to use for to study the CHE (i.e., the basic approach or the CTP approach), the income elasticity of health expenditure was calculated for 2019, 2020 and 2021, as well as for the pooled data (for the period of 2019–2021). According to O'Donnell et al. (2007), if health spending is income-elastic, non-food expenditure may be preferred for the denominator of the budget share to better detect catastrophic payments among the poor.

To calculate the elasticities, four two-part models (the first part was a logistic regression model, while the second part was a generalized linear model with a gamma family and log link) were fitted. Household health expenditure was used as the dependent variable in all four models. The variable "income" was used as the regressor for the 2019, 2020 and 2021 models. For the model applied to the pooled data (period: 2019–2021), the variable "year of survey" was also used as a regressor.

Elasticities were based on a calculation of the margins, and they were found to be $elasticity_{2019} = 0.645$, $elasticity_{2020} = 0.687$, $elasticity_{2021} = 0.638$ and $elasticity_{2019–2021} = 0.656$. Because household health expenditure was found to be income-inelastic (i.e., elasticities < 1), the basic approach was adopted for this analysis.

On the basis of the basic approach, the incidence (headcount: the proportion of households that suffered CHE), the intensity (overshoot: the average degree to which the share of health expenditure exceeded the threshold at which households suffered CHE), the concentration index of the incidence (which captures the distribution of CHE in relation to total household expenditure; it lies between −1 and 1), the concentration index of intensity (which captures the distribution of CHE in relation to total household expenditure; it lies between −1 and 1), the rank-weighted headcount (which considers the distribution of payments) and the rank-weighted overshoot (which considers the distribution of payments) of CHE (Wagstaff et al., 2011) were calculated for each year. The calculation of the aforementioned measures was based on the variables "health expenditure", "total household expenditure", "sample weight" and "household size". The analysis was performed with the ADePT 6.1 package (World Bank|DECRG).

In addition, two logistic regression models (i.e., one for the 10% threshold and one for the 25% threshold), were fitted to investigate whether the pandemic influenced the incidence of the CHE. A dichotomous variable with values of 0 (no catastrophic health spending) and 1 (catastrophic health spending) was used as the outcome variable, while the time period (before the pandemic: 2019 and 2 January 2020–24 February 2020; the first non-lockdown period during the pandemic: 2 March 2020–16 March 2020; the first lockdown period: 23 March 2020–27 April 2020; the second non-lockdown period during the pandemic: 4 May 2020–2 November 2020; the second lockdown period: 9 November 2020–10 May 2021; the third non-lockdown period during the pandemic: 17 May 2021–18 December 2021) was used as a potential predictor. The time variable was derived from the date of the data provided in the HBSs. The first and second lockdowns occurred on 23 March–3 May 2020 and 7 November 2020–15 May 2021, while the first COVID-19 case was diagnosed on 26 February 2020. Because the CHE depends on the dominance of OOP payments, income inequality and availability of healthcare (World Health Organization, 2008) at the macro-level, the potential predictors used in the analysis were selected on the basis of their proximity to the macro approach. Moreover, the age of the household's reference person (18–30, 31–40, 41–50, 51–60, 61–70, 71+), the total annual household income (continuous variable), the socioeconomic situation of the household's reference person (manual worker other than agriculture; non-manual worker other than agriculture; self-employed person, farmer or agricultural worker; unemployed; retired; other inactive) and household size (continuous variable) were used as potential predictors. Age was recoded as an ordinal variable because it was top-coded at 85+. The reason why age was used as an independent variable was that it constitutes a proxy for health status (Chernichovsky and Meesook, 1986). In addition, the geographic region of the household residence based on NUTS2 (Attica, North Aegean, South Aegean, Crete, Eastern Macedonia–Thrace, Central Macedonia, Western Macedonia, Epirus, Thessaly, Ionian Islands, Western Greece, Central Greece and Peloponnese) and the population density of the household's area

of residence (densely populated areas, at least 500 inhabitants per km^2; medium-density regions, 100–499 inhabitants per km^2; sparsely populated areas, fewer than 100 inhabitants per km^2) were used as potential predictors; the reason for this is that the geographic region constitutes a proxy for the availability of healthcare services (OECD, 2004), while population density is related to the delivery of healthcare and health outcomes (Vo et al., 2023). Because age and population density were ordinal variables, the Helmert contrast was used for this analysis. The Helmert contrast compares each category of an ordinal variable (except for the last) with the mean of the subsequent levels. Because the variables "lockdown period" and "region" were nominal variables, the indicator contrast was used for this analysis.

In the calculation of the headcount, overshoot, concentration indices, rank-weighted headcount and rank-weighted overshoot, and of elasticities (i.e., the four two-part models), the weights provided by the HBSs were used. For the models that used the pooled data (the two logistic regression models), the weights of each year were recalculated based on the following formula (Korn and Graubard, 1999):

$$weight = weight_{Year}(\frac{n_i}{n_i + n_j + n_k}) \quad (1)$$

where n_i, n_j and n_k were the sizes of the three samples, respectively (2019, 2020 and 2021).

Both logistic regression models' goodness of fit were assessed through the F-adjusted mean residual test (Archer and Lemeshow, 2006). Furthermore, the existence of specification errors was tested through the Link Test. The STATA 18 statistical software was used for this analysis. Specifically, the STATA commands "desmat" (Hendrickx, 1999), "svyset", "svy: twopm" (Belotti et al., 2015), "margins", "svy: logistic", "linktest" and "svylogitgof" (Archer and Lemeshow, 2006) were used. Because the command "svy" does not support the stepwise method, and because nominal potential predictors were used in this analysis, the backward elimination was applied.

3. Results

Based on the weighted data, the distribution of the age of the reference household member in the pooled dataset was as follows: 18–30 years old, 4.63%; 31–40 years old, 12.32%; 41–50 years old, 19.74%; 51–60 years old, 19.58%; 61–70 years old, 17.22%; and 71+ years old, 26.51%. The pooled sample was comprised of 32.05% females and 67.96% males. The geographic distribution of households in the same sample was as follows: Attica, 41.41%; Northern Aegean, 1.72%; Southern Aegean, 2.78%; Crete, 5.45%; Eastern Macedonia–Thrace, 5.04%; Central Macedonia, 16.41%; Western Macedonia, 2.93%; Epirus, 2.93%; Thessaly, 6.05%; Ionian Islands, 1.85%; Western Greece, 5.64%; Central Greece, 3.93%; and Peloponnese, 4.53%. In 2019, 2020, and 2021, the average annual total household expenditure was EUR17,204.5, EUR15,454.56, and EUR16,531.98, respectively. Meanwhile, the average annual health expenditure was EUR1,255.373, EUR1,271.078, and EUR1,379.163, respectively.

In 2019, the headcount at the 10% threshold was found to be 20.616%, while in 2020 and 2021, it was 23.252% and 26.455%, respectively (it increased by 12.785% between 2019 and 2020, and by 13.775% between 2020 and 2021). Additionally, the headcount at the 25% threshold increased during this period from 3.607% in 2019 to 4.333% in 2020 and 4.821% in 2021. Between 2019 and 2020, the overshoot at the 10% threshold increased by 18.369%, while between 2020 and 2021, it increased by 26.583% (the overshoot at the 25% threshold increased by 16.308% between 2019 and 2020, and by

3.704% between 2020 and 2021). Furthermore, in all three years, the rank-weighted headcount at both the 10% and the 25% thresholds was smaller than the headcount, meaning that the CHE was less frequent among the poor. In addition, the extent of excess health payments was lower among the poor because, in all three years, the rank-weighted overshoot at both thresholds was smaller than the overshoot (Table 1). The main conclusion based on what was mentioned above is that the incidence and the intensity of the CHE increased during the COVID-19 pandemic.

Table 1. Headcount and overshoot (2019, 2020, 2021).

Measure	2019 (%)	2020 (%)	2021 (%)
Headcount (10%)	20.616	23.252	26.455
Rank-weighted headcount (10%)	17.100	19.335	23.502
Headcount (25%)	3.607	4.333	4.821
Rank-weighted headcount (25%)	2.740	3.042	3.659
Overshoot (10%)	1.753	2.075	2.219
Rank-weighted overshoot (10%)	1.396	1.588	1.822
Overshoot (25%)	0.325	0.378	0.392
Rank-weighted overshoot (25%)	0.234	0.260	0.259

In 2019, the concentration index of the headcount at the 10% threshold was found to be equal to 0.171, while in 2020 and 2021, it was found to be 0.168 and 0.112, respectively. These findings indicated a greater tendency for the wealthy to exceed the payment threshold. The same was true for the concentration index at the 25% threshold, since it was found to be positive in all three years. Additionally, the concentration index of the overshoot at both the 10% and 25% thresholds was found to be positive in all three years, indicating that the average payment exceeding the threshold was greater among the wealthy. The concentration indices were found to be statistically significant at $\alpha = 0.01$, $\alpha = 0.05$ and $\alpha = 0.1$ (Table 2), indicating the existence of inequalities in the incidence and the intensity of the CHE in Greece. The inequality was higher at the 25% threshold. According to the findings regarding the concentration index of headcount at the 10% threshold, the inequality decreased during the COVID-19 pandemic.

Table 2. Concentration index of headcount and concentration index of overshoot (2019, 2020, 2021).

Measure	2019 (*p*-Value)	2020 (*p*-Value)	2021 (*p*-Value)
Concentration index of headcount (10%)	0.171 (<0.001)	0.168 (<0.001)	0.112 (<0.001)
Concentration index of headcount (25%)	0.240 (<0.001)	0.298 (<0.001)	0.241 (<0.001)
Concentration index of overshoot (10%)	0.204 (<0.001)	0.235 (<0.001)	0.179 (<0.001)
Concentration index of overshoot (25%)	0.281 (<0.001)	0.312 (<0.001)	0.340 (<0.001)

According to the logistic regression model, the CHE at the 10% threshold depended on the time period ($p < 0.001$), total annual household income ($p < 0.001$), socioeconomic situation of the household's reference person ($p < 0.001$), age of the household's reference person ($p < 0.001$), household size ($p < 0.001$), geographic region of the household's residence ($p < 0.001$) and the

population density of the household's residence area ($p < 0.001$). The interaction between the income and the time period was not found to be statistically significant ($p = 0.406$) and was excluded from the model. Specifically, all time periods except that between 04 May 2020 and 2 November 2020 were statistically significant compared with the period of 2019 and 2 January 2020–24 February 2020: 2 March 2020–16 March 2020 ($p = 0.004$, odds ratio (OR) = 1.554, 95% confidence interval (CI): 1.156–2.091); 23 March 2020–27 April 2020 ($p = 0.20$, OR = 1.273, 95% CI: 1.039–1.560); 9 November 2020–10 May 2021 ($p < 0.001$, OR = 1.290, 95% CI: 1.134–1.468); 17 May 2021–18 December 2021 ($p < 0.001$, OR = 1.263, 95% CI: 1.120–1.426). In the abovementioned time periods, the incidence of the CHE was higher than that of the period 2019 and 2 January 2020–24 February 2020. In addition, the incidence of the CHE was higher for households with a higher total annual income ($p < 0.001$, OR = 1.000006, 95% CI: 1.000003–1.000009). The same also held for the following: non-manual workers other than agriculture ($p < 0.001$, OR = 1.346, 95% CI: 1.149–1.576), retired ($p < 0.001$, OR = 1.512, 95% CI: 1.265–1.807) and other inactive ($p < 0.001$, OR = 2.132, 95% CI: 1.752–2.594). However, the incidence of the CHE was lower for households with more members ($p < 0.001$, OR = 0.891, 95% CI: 0.852–0.932). Moreover, the same was true for households with a younger reference person: (i) 18–30 vs. greater age: $p < 0.001$ (OR = 0.364, 95% CI: 0.269–0.0.492); (ii) 31–40 vs. greater age: $p < 0.001$ (OR = 0.601, 95% CI: 0.506–0.714); (iii) 41–50 vs. greater age: $p < 0.001$ (OR = 0.462, 95% CI: 0.397–0.538); (iv) 51–60 vs. greater age: $p < 0.001$ (OR = 0.470, 95% CI: 0.413–0.535); and (v) 61–70 vs. greater age: $p < 0.001$ (OR = 0.429, 95% CI: 0.386–0.477). Although the incidence of the CHE was higher for the region of Crete (Crete vs. Attica: $p < 0.004$, OR = 1.355, 95% CI: 1.104–1.662), it was lower for the regions of Epirus and Peloponnese: Epirus vs. Attica: $p < 0.002$ (OR = 0.637, 95% CI: 0.479–0.846) and Peloponnese vs. Attica: $p < 0.001$ (OR = 0.617, 95% CI: 0.497–0.767). In the same vein, the incidence of the CHE was lower for densely populated areas ($p = 0.001$, OR = 0.837, 95% CI: 0.754–0.929) and medium-density regions ($p < 0.001$, OR = 0.788, 95% CI: 0.693–0.896) (Table 3).

Table 3. Results of the logistic regression for the incidence of CHE (10%).

Variable (Main Effects)	OR	*P*	95% confidence interval	
Time period (overall)		<0.001		
Time period categories				
2 March 2020–16 March 2020	1.554	0.004	1.156	2.091
23 March 2020–27 April 2020 (lockdown)	1.273	0.020	1.039	1.560
4 May 2020–2 November 2020	1.068	0.301	0.943	1.208
9 November 2020–10 May 2021 (lockdown)	1.290	<0.001	1.134	1.468
17 May 2021–18 December 2021	1.263	<0.001	1.120	1.426
Income	1.000006	<0.001	1.000003	1.000009
Socioeconomic situation of the household's reference person (overall)		<0.001		
Socioeconomic situation of the household's reference person categories				
Non-manual worker other than agriculture	1.346	<0.001	1.149	1.576

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Variable (Main Effects)	OR	*P*	95% confidence interval	
Self-employed person, farmer or agricultural worker	1.167	0.079	0.982	1.386
Unemployed	1.015	0.913	0.782	1.317
Retired	1.512284	<0.001	1.265	1.807
Other inactive	2.131661	<0.001	1.751651	2.59411
Household size	0.891	<0.001	0.852	0.932
Region (overall)		<0.001		
Region categories				
North Aegean	0.873	0.348	0.656	1.160
South Aegean	0.999	0.992	0.769	1.297
Crete	1.355	0.004	1.104	1.662
Eastern Macedonia–Thrace	1.175	0.105	0.967	1.427
Central Macedonia	1.014	0.837	0.886	1.162
Western Macedonia	0.948	0.690	0.731	1.230
Epirus	0.637	0.002	0.479	0.846
Thessaly	1.024	0.815	0.838	1.252
Ionian Islands	0.796	0.271	0.530	1.195
Western Greece	0.928	0.410	0.778	1.108
Central Greece	0.922	0.576	0.693	1.226
Peloponnese	0.617	<0.001	0.497	0.767
Age (overall)		<0.001		
Age categories				
18–30 vs. greater age	0.364	<0.001	0.269	0.492
31–40 vs. greater age	0.601	<0.001	0.506	0.714
41–50 vs. greater age	0.462	<0.001	0.397	0.538
51–60 vs. greater age	0.470	<0.001	0.413	0.535
61–70 vs. greater age	0.429	<0.001	0.386	0.477
Population density (overall)		<0.001		
Population density categories				
Medium-density regions	0.837	0.001	0.754	0.929
Sparsely populated areas	0.788	<0.001	0.693	0.896
Constant	0.218	<0.001	0.179	0.265

According to the link test, the model did not suffer from a specification error ($p_{hat\text{-}square} = 0.831$). In addition, according to the F-adjusted mean residual test, the model had a good fit ($p = 0.908$).

Table 4. Results of the logistic regression for the incidence of CHE (25%).

Variable (Main Effects)	OR	*P*	95% confidence Interval	
Household size	0.854	0.001	0.779	0.938
Age (overall)		<0.001		
Age categories				
18–30 vs. greater age	0.297	0.008	0.121	0.727
31–40 vs. greater age	0.469	<0.001	0.324	0.678
41–50 vs. greater age	0.454	<0.001	0.340	0.605
51–60 vs. greater age	0.443	<0.001	0.346	0.566
61–70 vs. greater age	0.415	<0.001	0.346	0.498
Constant	0.051	<0.001	0.040	0.064

The CHE at the 25% threshold depended on age ($p < 0.001$) and household size ($p = 0.001$). Specifically, the incidence of the CHE was lower in households with a younger reference person: 18–

30 vs. greater age: $p = 0.008$ (OR = 0.297, 95% CI: 0.121–0.727); 31–40 vs. greater age: $p < 0.001$ (OR = 0.469, 95% CI: 0.324–0.678); 41–50 vs. greater age: $p = 0.001$ (OR = 0.454, 95% CI: 0.340–0.605); 51–60: $p < 0.001$ (OR = 0.443, 95% CI: 0.346–0.566); and 61–70 vs. greater age: $p < 0.001$ (OR = 0.415, 95% CI: 0.346–0.498). Additionally, the same was true for households with more members ($p = 0.001$, OR = 0.854, 95% CI: 0.779–0.938) (Table 4).

The interaction between the income and the time period was not statistically significant ($p = 0.203$) and was excluded from the model.

According to the link test, the model did not suffer from a specification error ($p_{hat\text{-}square} = 0.076$). In addition, according to the F-adjusted mean residual test, the model had a good fit ($p = 0.375$).

4. Discussion

According to the study's results, the measures implemented to combat COVID-19 increased the CHE in Greece; however, the inequality decreased. This was probably due to changes in the patterns of healthcare utilization (Zavras, 2022) and the lack of inequality in income loss (Zavras, 2021) during the pandemic.

According to the logistic model, the incidence of the CHE at the 10% threshold depended on the time period, total annual household income, the socioeconomic situation of the household's reference person, the age of the household's reference person, the household size, the geographic region of the household's residence and the population density of the household's area of residence.

Specifically, at the onset of the pandemic, during the first and second lockdowns, and during the period following the second lockdown, the incidence of the CHE increased compared with the period of 2019–24 February 2020. The influence of the time period was among other factors due to the disruption of healthcare that resulted in unmet healthcare needs. It is evident that during the pandemic, the unmet healthcare needs increased in Greece (European Commission, 2022). Unmet healthcare needs were positively associated with the worsening of health (Pappa et al., 2013), and they increased OOP payments (Choi and Jung, 2019). The CHE in Greece was mainly due to high OOP payments and weak prepayment mechanisms. Because of the low public coverage for pharmaceuticals and outpatient services, OOP payments were copayments for pharmaceuticals, direct payments for services outside the benefit package, and visits to private specialists and nursing care, while informal payments represented a high share of private payments. Furthermore, due to delays in healthcare because of the limits of doctors regarding the number of consultations reimbursed by EOPYY in an attempt to tackle the supply-induced demand, patients either sought an alternative provider or made an OOP payment for a consultation (OECD, 2021). In addition, as mentioned in the introduction, the prepayment mechanisms are weak (Kyriopoulos et al., 2021). Thus, the disruption of healthcare was a catalytic factor for the CHE during the pandemic; during the first and second waves, the state paid attention to the management of COVID-19 patients and most regular services provided by hospitals ceased, while the regular operations of PHC were suspended (Giannopoulou and Tsobanoglou, 2020). Specifically, hospitals revised their surgical case schedules to only accommodate emergency cases, while all elective surgeries in both public and private hospitals were deferred; oncology and emergency services remained operational. Non-emergency operations and afternoon outpatient appointments that had been suspended resumed as of May 4. Morning outpatient appointments resumed two weeks later. In addition, on 12 February 2021, elective surgeries and outpatient clinics in hospitals located in areas with a high epidemiological burden of COVID-19 were restricted by up to 80% and 50%, respectively

(Economou et al., 2020). The introduction of telemedicine and e-prescription services in early April and publicly reimbursed referrals of hospitalized patients from public hospitals to private clinics partly counterbalanced such restrictions for non-COVID-19 cases (Kondilis et al., 2021). The disruption of the delivery of healthcare is one of the reasons why OOP payments increased. This is true for people with pre-existing health conditions because the lockdown had a negative impact on their health (Michailidou et al., 2022), but also for those who developed either physical or mental health conditions during the lockdowns, as unmet needs may worsen health outcomes (Ko, 2016). For all providers, private payments increased by 3.9% in 2020 compared with 2019, while they increased by 5.7% in 2021 compared with 2020. In addition, for pharmacies, private payments increased by 16.6% in 2020 compared with 2019 and by 3.3% in 2021 compared with 2020. For hospitals, they increased by 4.1% in 2020 compared with 2019 and by 7.5% in 2021 compared with 2020. With respect to medical care, private payments increased by 10.9% in 2021 compared with 2020, while they decreased by 11% in 2020 compared with 2019 (Hellenic Statistical Authority, 2023b).

According to the results of this study, during the first and second lockdowns, the total annual household income decreased compared with the previous time periods, as confirmed in the literature (Cholezas, 2021; Marsellou, 2020). This finding, in combination with the increase in private health spending, explains the increase in the incidence of the CHE in Greece during the pandemic.

The influence of the household's reference person's socioeconomic situation confirmed the international literature, since it has been well documented that the risk of the CHE increases in lower occupational classes (Luo et al., 2023). To a large extent, this is due to the direct association between the occupation and their income (Preker and Langenbrunner, 2004). According to the results of the study, the categories found to be statistically significant were non-manual workers, retired and other inactive people. For the non-manual workers, the association was due to higher spending on health compared with manual workers, while for the retired and the other inactive people, it was due to a lower income.

The influence of household size was because larger households can share the economic risk of the CHE among a larger number of household members, which is equivalent to the greater affordability of family-based medical costs (Liu et al., 2021a).

Although the increased incidence of the CHE in older adults was due to reductions in income after retirement (Hori and Murata, 2019) and high OOP payments (Kim and Jacobson, 2022), the results of the study indicated that the influence of increased age was probably due to a deterioration in their health status and an increase in health conditions as age increases (Cutler, 2009).

The geographic region of the household's residence was statistically significant due to the uneven regional distribution of resources across the country, meaning that the availability of resources was responsible for the increased CHE. In addition, the higher concentration of health services and medical equipment in large cities compared with rural areas indicates the influence of the population density of the area of residence (Economou et al., 2017). Furthermore, residents of areas with a lower population density may face increased healthcare costs (Chen et al., 2023). The influence of health outcomes is an additional factor related to population density (Greenberg and Schneider, 2023).

The interpretation of the results for the 25% threshold was similar, even though only the household size and age were statistically significant. However, the non-significance of the remaining variables and the low incidence of the CHE at the 25% threshold probably meant that people did not receive (and did not pay for) the care they needed (Wagstaff et al., 2018).

However, assessing the validity of the data used in the study is outside the scope of this study, it should be noted that the probability of measurement errors related to issues such as the questions' structure and phrasing, the mode of data collection, the recall period, the number of items, etc., constitutes one of the study's limitations. However, although the existence of measurement errors in the context of the expenditure data derived from surveys is a known problem, the validity of the expenditure data from household surveys is difficult to judge (World Health Organization, 2011). Furthermore, due to the non-availability of health-related variables, such as the number of visits or hospitalizations, unmet healthcare needs, self-perceived health, and the existence of chronic physical and mental health issues (which may lead to economic consequences, such as increased healthcare costs, work absences and lower productivity (Tsangari et al., 2022)), one may argue that the interpretation of the results is somewhat arbitrary; however, it is evident that the CHE was associated with higher health care needs (Li et al., 2014). Thus, we may argue that the study provides a valid framework for the influence of the COVID-19 pandemic on the CHE in Greece.

5. Conclusions

Globally, the COVID-19 pandemic tested various health systems (Cooper, 2022). The Greek health system was not an exception (Moris and Schizas, 2020). The disrupted delivery of healthcare (Fragkiadakis and Tsatinian, 2023) in combination with a decrease in income (Zavras, 2021), an increase in OOP payments (Hellenic Statistical Authority, 2023b), the negative influence of the pandemic on the population's health (Poulakis and Poulakis, 2021) and the uneven regional distribution of health-related infrastructure and human resources (Gogos et al., 2022) were responsible for the increase in the incidence of CHE during the pandemic.

As mentioned in the introduction, CHE in Greece reflects, the coverage of healthcare to a large extent. UHC, with full access to high-quality healthcare services, cannot be achieved without evidence from research. Because research can provide answers to questions regarding improvements in health, well-being and development, as well as the way we can achieve UHC (World Health Organization, 2013), there is a need for research to inform how we can achieve the many goals of the health system, including, among others, expanding the coverage of healthcare services and enhancing people's financial protection (Peters, 2018).

Use of AI tools declaration

The authors declare they have not used Artificial Intelligence (AI) tools in the creation of this article.

Data availability statement

The data are publicly available from the website of the Hellenic Statistical Authority.

Conflict of interest

All authors declare no conflicts of interest in this paper.

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