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Clinical Research Article

Household catastrophic health expenditure related to pain in Korea

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ABSTRACT

Background: The data related to pain and catastrophic health expenditure (CHE) needed to be further explored. This study aims to understand the relationship between pain and CHE.

Methods: Using cross-sectional analysis of 4-year data (2015–2018) from the Korea Health Panel, the prevalence of CHE and adjusted odds ratio (AOR) by pain type were confirmed.

Results: Among participants (n = 46,597), the prevalence of pain and severe pain were 24.2% and 1.1%, respectively. The use of medical services in emergency rooms, hospitalizations, and outpatients increased in the order of pain-free, pain, and severe pain ($P < 0.001$). Prevalence of household CHE was 3.3% *vs.* 11.1% *vs.* 25.9%, ($P < 0.001$). The AOR of CHE was 1.5 (95% confidence interval [CI], 1.4–1.7) for pain and 3.1 (95% CI, 2.5–3.9) for severe pain. Household capacity to pay per year was lower and lower in the order of pain-free, pain, and severe pain ($25,094 *vs.* $17,965 *vs.* $14,056, $P < 0.001$). Also, the household out-of-pocket expenditure per year was higher and higher in the order of pain-free, pain, and severe pain ($1,649, $1,870, $2,331, $P < 0.001$).

Conclusions: It can be inferred that pain is one of the mechanisms of poverty. Positivist healthcare policies for the prevention and management of pain should be sought.

Keywords: Big Data; Catastrophic Health Expenditure; Comorbidity; Cross-Sectional Studies; Health Expenditures; Insurance; Pain; Policy; Poverty; Prevalence.

INTRODUCTION

Knowledge of the relationship between pain and catastrophic health expenditure (CHE) appears to be sparse so far. The impact of health status on the household economy has long been an essential issue in the health and social sectors. In Korea, universal and inclusive medical care has been emphasized for proper health for all people and all regions. To this end, health policies are being developed to ensure adequate health. When, where, and to whom to allocate limited healthcare resources is essential

for healthcare efficiency. Therefore, more study is needed on the potential for impoverishing people with health problems, especially pain. Exploration of health and CHE is being attempted to understand the mechanisms leading to poverty. Therefore, this study began by asking questions about which is the most vulnerable population for pain, how much health care is used in cases of pain, and whether there is an association between pain and CHE even after controlling for various multidimensional characteristics of pain.

People with pain used more healthcare [1–3]. Pain

causes discomfort to people and brings physical problems and mental burdens. It affects the healthcare system and economic issues and is broadly linked to ineffective social production [4]. Chronic pain, which persists for more than 3 months or recurs, can become a disease in itself or appear secondary to other diseases [5]. The International Association for the Study of Pain defines pain as an unpleasant sensory and emotional experience associated with or similar to actual or potential tissue damage [6]. Estimates of pain prevalence vary widely, even in studies of the same population. As a result of meta-analysis, the estimated pain prevalence in 2017 showed a wide range from 8.7% to 64.4% [7]. The prevalence of pain in adults in the United States was 20.5% [8], in Japan, it was 17.5%–40.2% [9,10], and it was 29.8% for Koreans [11]. However, when making cross-cultural comparisons, it should be noted that definitions and questions are different.

In Korea, universal medical coverage is provided through the National Health Insurance (NHI) System. However, the proportion of households with CHE due to high out-of-pocket (OOP) expenditure is relatively higher: Korea = 36% *vs*. OECD average = 19% [12,13]. There is no single accepted definition of CHE. Some studies evaluate CHE in relation to budget share [14,15], while others evaluate CHE in relation to capacity to pay (household expenditure minus food spending) [16]. Nonetheless, all measures can often negatively impact other living standards when households spend a large portion of their budget on healthcare [17]. Loan income was significantly higher in households with CHE than households without, and all consumption categories except medical consumption were low, suggesting that households with CHE may have to reduce their consumption of all other items [18]. When the cost of illness is high, households have adopted unsustainable strategies such as disposing of assets. It was a process of struggle to overcome poverty for these people [14].

The purpose of this study is to determine an independent relationship between pain and CHE. CHE was defined as a case where household OOP expenditure was 40% or more of household capacity to pay, which is calculated by subtracting food spending from household expenditures [16]. To this end, the major hypothesis of this study was that the prevalence of CHE would be higher in the presence of pain. In the process of verifying the major hypothesis, the sub-hypotheses of this study are as follows: First, the prevalence of pain would be higher in the vulnerable population; second, when there is pain, the amount of medical use such as over-the-counter (OTC)

medicines, emergency room visits, hospitalization, and outpatient visits would be high; and third, when there is pain, annual household capacity to pay would be low, and annual OOP expenditure would be high. The author hopes that this study can be used as basic data for the need for pain prevention and management, and that some evidence of the mechanism of pain and poverty can be added.

MATERIALS AND METHODS

1. Design

This is a cross-sectional study to find the relationship between pain and CHE using the long format data of the Korea Health Panel (KHP, Version 1.7.3) for 4 years from 2015 to 2018.

2. Data and ethics

The 1st KHP is a government-approved statistical survey under the Statistics Act. A consortium of the NHI Corporation and the Korea Institute for Health and Social Affairs (KIHASA) has been involved in joint investigation since 2008. The 1st KHP used the 2005 registration census as an extraction framework to maintain national representation. Its purpose is to provide information for medical use and cost, and to improve medical responsiveness, accessibility, and efficiency policy. In 2008, about 8,000 households and all of their household members were surveyed using proportional stratified two-stage cluster sampling. To overcome participant dropouts, such as death and refusal to be surveyed, an additional 2,500 households were selected and surveyed in 2012. For the additional sample in 2012, the 2010 registration census was used as a sampling frame.

This study complied with ethical study guidelines, and the data used in this study were officially transferred, after the author submitted the study proposal, to the KIHASA, a data management institution. The data is not personally identifiable and has been approved by the IRB (KIHASA No: 2022-017).

3. Survey method of KHP

Surveyors visited households and collected data through face-to-face interviews. For the subjects' memory bias on medical use and medical expenditure, standardized household health account books were provided to par-

ticipants, and training was given on how to use them. When the survey participants visited hospitals/clinics or pharmacies, they promptly recorded the reason for the visit and the amount received in the household health account book. Therefore, KHP is examining unknown co-payment and non-insured data from the NHI, and based on this, it identifies the OOP expenditure of Koreans.

4. Participants in this study

Pain variable, a representative explanatory variable, was not investigated in 2014, and the food cost required to calculate capacity to pay has been investigated since 2013. Therefore, this study extracted 69,476 people from the long format panel for 4 years from 2015 to 2018. Among them, there were 54,495 participants after excluding participants under the age of 19 (n = 14,981), and 52,166 participants after excluding the no response to pain variable (n = 2,329). Afterward, for the homogeneity of study participants, 46,597 people were finally selected after excluding the registered disabled (n = 3,660), those on public assistance, and other benefit recipients (n = 1,909), which are representative vulnerable groups.

5. Study variables

1) Pain

KHP measured quality of life with 5 items: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. This is equivalent to the 3-Level Version of the European Quality of Life 5 Dimensions developed (EQ-5D-3L) by the EuroQol Group [19]. Among these, the question regarding pain was, "How do you feel about your pain or discomfort today?" In response, participants chose one of three responses: (1) I have no pain or discomfort, (2) I have moderate pain or discomfort, and (3) I have extreme pain or discomfort. In this study, 'no pain or discomfort' was 'pain-free', 'moderate pain or discomfort' was 'pain', and 'severe pain or discomfort' was defined as 'severe pain'.

2) Household capacity to pay

KHP investigated the monthly household living expenses, excluding savings for the past year. The household's capacity to pay was defined as a household's non-subsistence spending or the non-subsistence effective income of the household. Household subsistence spending is the minimum requirement to maintain basic life. This was

calculated in the following two ways. First, when subsistence spending was smaller than spending for household food, calculated by subtracting subsistence spending from total household expenditure. Second, it was defined as total household expenditure minus food expenditure when food expenditure was less than subsistence spending [16]. In this study, food expenditure was calculated after excluding eating-out expenditure and all amounts were recalculated per year. A poverty line is used in the analysis as subsistence spending. This poverty line is defined as the food expenditure of the household whose food expenditure share of total household expenditure is at the 45th–55th percentile in the country. Also, considering the economic scale of households, the household equivalence scale is used rather than the actual household size [16]. In this study, the household's capacity to pay was calculated by calculating the poverty line in the same way suggested.

$$ctp_h = \exp_h - se_h \quad if\ se_h <= food_h$$
$$ctp_h = \exp_h - food_h \quad if\ se_h > food_h$$
$$se = pl*eqsize_h$$
$$pl = [(\Sigma\ W_h * eqfood_h)/W_h]\ where\ food45 < foodexp_h < food55$$
$$eqfood_h = foodexp_h/eqsize_h$$
$$foodexp_h = food_h/exp_h$$
$$eqsize_h = hhsize_h^{0.56}$$

$_h$ = household, eq = equivalent
ctp_h = household capacity to pay
se = subsistence expenditure, pl = poverty line
W_h = total household expenditure, $foodexp$ = food expenditure
exp = expenditure, $hhsize$ = household size

3) Household OOP expenditure

Household OOP expenditure was defined as the medical expenses paid by a household when receiving medical services as defined by the World Health Organization [16]. In this study, the household OOP expenditure is the cost each household paid for an emergency, outpatient treatment, hospitalization, and pharmaceutical expenditure due to services. It is the sum of copayments with NHI and uncovered medical expenditure. Indirect medical expenditures are excluded from OOP expenditures.

4) Indirect healthcare expenditure

In this study, indirect health expenditure was analyzed, such as transportation costs for medical use, purchase of non-prescription drugs such as oriental medicine or medical equipment, and long-term care service cost. These costs are not included in household OOP expendi-

tures.

5) Household CHE

Household CHE was defined as a case where household OOP expenditure was equal to or greater than 40% of the household capacity to pay. When households spend a large portion of their capacity to pay on OOP expenditure, they may reduce the purchase of other goods and services [17]. Therefore, household capacity to pay is defined as the economic power of a household to purchase a particular good or service, excluding expenditures such as essential food for subsistence [20]. Often the choice of this threshold is arbitrary, but two commonly used standards are 10% of total income or 40% of household capacity to pay [21]. In this study, the prevalence of CHE in the households of participants who were pain-free, had pain, and had severe pain was compared.

$Cata_h = 1$ if $OOP_h / ctp_h \geq 0.4$
$Cata_h = 0$ if $OOP_h / ctp_h < 0.4$

$Cata_h$ = Household catastrophic health expenditure

6) Covariates

In order to understand the influence of pain on CHE, multidimensional characteristic variables of pain were input as covariates. The variables used as covariates were age, gender, survey year, number of household members, family type, and educational background to determine sociodemographic characteristics.

Economic characteristic variables included economic activity, private health insurance benefits, and household income quintile. Household income depends on the number of people in the household. Therefore, the KHP divides the number of household members by the square root to find the equivalent household size and then classifies household income into grades 1 to 5 [22].

Health-related variables were the number of comorbidities, OTC medications taken for more than 3 months, and medical use variables: emergency room use, hospitalization experience, and outpatient visits.

6. Data analysis

To identify the multidimensional characteristics of pain, the sociodemographic characteristics, economic characteristics, comorbidities, and medical use characteristics of the participants were identified through descriptive statistics, chi-square test, ANOVA, and ANCOVA.

In this study, household capacity to pay was household expenditure minus food spending. According to the method proposed [16], when household OOP expenditure is 40% or more of household capacity to pay, the definition of household CHE is met. The prevalence of CHE by pain type was identified through cross-tabulation.

The relationship between pain and household OOP expenditure and pain and indirect medical expenditure, such as transportation costs for healthcare use, purchase of oriental medicine or medical equipment, and long-term care service cost, was confirmed after all possible variables related to pain were input as covariates.

The influence of pain and severe pain on CHE prevalence was identified through an adjusted odds ratio (AOR). Considered multicollinearity among independent variables, namely gender, age, family type, college entrance, household income quintile, and comorbidities, were input into the model and controlled. In addition, by stratifying the participants by gender, the AOR of household CHE for pain and severe pain was examined.

All analyses were performed using SAS 9.4 (SAS Institute) after excluding missing values for each variable. It was a two-sided statistical test, and it was considered statistically significant when the P value was less than 0.05. The KRW was changed to the USD based on the exchange rate on July 1, 2015 (1 USD = 1,115.50 KRW).

RESULTS

1. Prevalence of pain by sociodemographic characteristics

Among the study participants (n = 46,597), prevalence of pain was 24.2%, and prevalence of severe pain was 1.1%. The ages of pain and severe pain participants were 63.1 years and 69.8 years, respectively, which were higher than those of pain-free participants (47.9 years) ($P < 0.001$). The average number of household members was 3.3 persons among pain-free participant, compared to 2.7 persons and 2.4 persons in the pain and severe pain participants, respectively ($P < 0.001$). The prevalence of pain and severe pain in single-person household participants was 46.0% and 2.9%, respectively, which was higher than the prevalence of pain and severe pain in all participants, which were 24.2% and 1.1%, respectively ($P < 0.001$). In the 1st household income quintile, the prevalence of pain and severe pain were 49.9% and 4.2%, respectively. In the 5th quintile of the highest household income level, the prevalence of pain and severe pain were 15.3% and

0.4%, respectively, lower than the prevalence of all participants ($P < 0.001$). Other demographic characteristics variables included survey year ($P = 0.049$), age group ($P < 0.001$), college entrance or higher academic background ($P < 0.001$), economic activity ($P < 0.001$), and receiving private health insurance ($P < 0.001$) showed significant differences by the pain characteristics of the participants (**Table 1**).

2. Amount of medical use by pain type

The amount of medical use increased with the level of

Table 1. Prevalence of pain-free, pain, and severe pain by sociodemographic characteristics

Characteristics	Pain-free	Pain	Severe pain	X^2 or F	P value
Total participants	34,803 (74.7)	11,268 (24.2)	526 (1.1)		
Age (yr)	47.9 ± 0.09	63.1 ± 0.15	69.8 ± 0.69	4,283.2	< 0.001
Gender				694.69	< 0.001
Men	16,845 (80.5)	3,936 (18.8)	141 (0.7)		
Women	17,958 (69.9)	7,332 (28.6)	385 (1.5)		
Survey year				12.65	0.049
2015	8,991 (75.0)	2,848 (23.7)	156 (1.3)		
2016	8,660 (75.1)	2,756 (23.9)	122 (1.1)		
2017	8,650 (74.9)	2,769 (24.0)	132 (1.1)		
2018	8,502 (73.9)	2,895 (25.2)	116 (1.0)		
Age quartile group				7,212.85	< 0.001
Q1 ≤ 38	10,300 (92.5)	813 (7.3)	22 (0.2)		
Q2 ≤ 50	9,762 (86.3)	1,525 (13.5)	29 (0.3)		
Q3 ≤ 64	8,812 (73.9)	3,028 (25.4)	90 (0.8)		
Q4 > 65	5,929 (48.5)	5,902 (48.3)	385 (3.2)		
Household members	3.3 ± 0.01	2.7 ± 0.01	2.4 ± 0.05	1,261.64	< 0.001
Family formation[a]				1,394.72	< 0.001
Single	1,983 (51.1)	1,786 (46.0)	114 (2.9)		
Nuclear	29,832 (77.6)	8,271 (21.5)	343 (0.9)		
Extended	2,988 (70.0)	1,211 (28.4)	69 (1.6)		
College entrance				3,174.65	< 0.001
No	18,020 (65.3)	9,109 (33.0)	469 (1.7)		
Yes or more	16,783 (88.3)	2,159 (11.4)	57 (0.3)		
Economic activity				836.66	< 0.001
Yes	23,091 (78.9)	6,027 (20.6)	162 (0.6)		
No	11,712 (67.6)	5,241 (30.3)	364 (2.1)		
Quintile of household income[b]				3,660.12	< 0.001
1st (Lowest)	2,332 (45.9)	2,539 (49.9)	213 (4.2)		
2	5,281 (65.6)	2,657 (33.0)	113 (1.4)		
3	7,912 (77.4)	2,225 (21.8)	89 (0.9)		
4	9,294 (81.5)	2,038 (17.9)	66 (0.6)		
5th (The best)	9,984 (84.3)	1,809 (15.3)	45 (0.4)		
Received private insurance[c]				44.45	< 0.001
Yes	2,471 (70.0)	1,007 (28.5)	51 (1.5)		
No	32,332 (75.1)	10,261 (23.8)	475 (1.1)		

Values are presented as number (prevalence) or mean ± standard error.
[a]A type in which one person forms a household; a nuclear family: a couple or parents and children; an extended family; a form of living with other family members/other than the nuclear family. [b]Household income quintile was the equivalized household size by the square root of the household members. [c]Refers to the case of receiving insurance benefits after subscribing to private insurance.

Table 2. Pain type and medical utilization rate: over-the-counter drugs, emergency room, hospitalization, and outpatient use

Characteristics	Pain-free	Pain	Severe pain	F or X^2	P value
Total participants	34,803 (100.0)	11,268 (100.0)	526 (100.0)		
Number of comorbidities[a]	1.3 ± 0.01	3.2 ± 0.01	4.4 ± 0.08	–79.36	< 0.001
Taking OTC drugs[b]	3,282 (9.4)	1,830 (16.2)	107 (20.3)	441.67	< 0.001
Emergency room use	2,493 (7.2)	1,322 (11.7)	102 (19.4)	314.19	< 0.001
Hospitalization	3,430 (9.9)	2,336 (20.7)	211 (40.1)	1,254.69	< 0.001
Outpatient visit	29,591 (85.0)	10,899 (96.7)	519 (98.7)	1,161.53	< 0.001

Values are presented as number (%) or mean ± standard error.
OTC: over-the-counter.
[a]Age, gender, survey year, number of household members, family type, college admission, economic activity, household income quintile, and received private health insurance were input as covariates for ANCOVA. [b]It refers to the use of OTC drugs for more than 3 months per year.

pain: OTC drug use for more than 3 months for those who were pain free, had pain, and had severe pain was 9.4%, 16.2%, and 20.3%, respectively; emergency room use was 7.2%, 11.7%, and 19.4%, respectively; hospitalization was 9.9%, 20.7%, and 40.1%, respectively; and outpatient visits were 85.0%, 96.7%, and 98.7%, respectively (**Table 2**).

3. Household capacity to pay, OOP expenditure, and prevalence of household CHE

Pain-free participants had a household capacity to pay approximately $25,736 per year, whereas pain and severe pain participants had household capacity to pay $18,345 and $14,269, respectively ($P < 0.001$). Household OOP expenditure was about $1,649 for pain-free participants, while for participants with pain and severe pain were $1,870 and $2,331, respectively ($P = 0.001$). When household CHE was defined as household OOP expenditure exceeding household capacity to pay by 40% or more, it was found in 3.3% in pain-free participants, whereas it was higher at 11.1% and 25.9% in pain and severe pain participants ($P < 0.001$). In addition, the difference in the component of indirect healthcare expenditures was confirmed. For instance, transportation costs for healthcare use for those who were pain-free, had pain, and had severe pain were $38, $40, and $113, respectively ($P = 0.001$). In the same way, the purchase of oriental medicine and medical equipment was $178, $201, and $221, respectively ($P < 0.001$). Long-term care service cost was $52, $84, and $286, respectively ($P < 0.001$). In other words, when there was pain and when the intensity of pain increased, indirect healthcare expenditures were found to be higher, suggesting that pain is a factor affecting household finances (**Table 3**).

4. Relationship between pain and severe pain and household CHE

In all participants with household CHP (n = 2,546), the AOR of household CHE was 1.5 (95% confidence interval [CI], 1.4–1.7) for pain, and 3.1 (95% CI, 2.5–3.9) for severe pain, respectively. In men, AOR was 1.6 (95% CI, 1.4–1.9) and AOR 2.6 (95% CI, 1.5–4.0), respectively. In women, AOR was 1.5 (95% CI, 1.3–1.7) and AOR 2.9 (95% CI, 2.3–3.8), respectively. Even after controlling for all possible confounding variables, this study found that pain and severe pain were associated with CHE (**Table 4**).

DISCUSSION

The mechanism of household poverty is not simple, but it will be affected by two axes: income and expenditure. On the other hand, the health level of an individual has an effect on household finances. When it has a serious impact, this is defined as CHE. When integrating the study results so far, there is no perfect method to determine the CHE of a household [20]. Household CHE was defined as when, after dividing household solvency, as the denominator, by household OOP expenditure, as the numerator, the result expenses exceed 40% [16]. As far as the author knows, there are not many positivist studies on how pain affects household finances, and, that impact being assumed, how much it affects income or expenses, and what portion of the population experiences CHE as a result of pain. Therefore, this study attempted to explore the major hypothesis that CHE would be high when pain is present in participants. Its purpose was to identify medical expenses that are fatal to household finances in those with pain and severe pain.

The major hypothesis of this study, that the prevalence

Table 3. Household capacity to pay, household out-of-pocket expenditure, and prevalence of household catastrophic health expenditure

Characteristics	Pain-free (n = 34,803)	Pain (n = 11,268)	Severe pain (n = 526)	F or X²	P value
Household capacity to pay[a]	25,736 ± 78.30	18,345 ± 137.61	14,269 ± 636.9	1,203.33	< 0.001
Household OOP expenditure[b]	1,649 ± 11.22	1,870 ± 20.74	2,331 ± 89.68	60.5	< 0.001
Transportation costs for healthcare use[c]	38 ± 2.57	40 ± 4.74	113 ± 20.52	6.55	0.001
Purchase oriental medicine or medical equipment[c]	178 ± 2.93	201 ± 5.42	221 ± 23.43	7.53	0.001
Long-term care service cost[c]	52 ± 4.28	84 ± 7.91	286 ± 34.18	25.99	< 0.001
Prevalence of household CHE[d]	1,103 (3.3)	1,252 (11.1)	136 (25.9)	1,503.27	< 0.001

Values are presented as mean ± standard error or number (%).

OOP: out-of-pocket, CHE: catastrophic health expenditure.

[a]The household's capacity to pay is defined as a household's non-subsistence spending or the non-subsistence effective income of the household. [b]OOP expenditure represents the participant's annual uninsured costs and copayment; All possible pain characteristics: age, gender, survey year, number of household members, family type, college admission, economic activity, household income quintile, received private health insurance, comorbidities, taking health functional drugs, emergency room, hospitalization, and outpatient visit were input as covariates for ANCOVA. [c]Indirect healthcare expenditures, which are not included in household OOP expenditure; The variable input as a covariate in ANCOVA was the same as OOP expenditure. [d]Household CHE was defined as a case where household OOP expenditure was 40% or more of household capacity to pay.

of CHE would be higher in the presence of pain, was supported. In this study, the prevalence of CHE was 3.3% in pain-free participants, whereas it increased to 11.1% and 25.9% in pain and severe pain participants, respectively ($P < 0.001$). In 2012, Korea's CHE was reported to be 3.0% [20]. Also, the AOR of CHE was 1.4 (95% CI, 1.3–1.5) for pain and 2.0 (95% CI, 1.6–2.6) for severe pain. In a study using KHP data from 2011 to 2013, 4.5% of Korean households experienced CHE [23]. These different rates of CHE could be due to rising healthcare costs or changes in income levels. Other possible factors include sociodemographic characteristics, analysis exclusion criteria, and threshold criteria for CHE discrimination being different. Therefore, it is necessary to find implications between groups within each individual study rather than using a cross-cultural comparison of CHE. In addition, various alternatives to mitigate CHE, such as expansion of medical coverage, income preservation, and multilateral measures for prevention and health promotion will have to be different according to the healthcare system of each country.

The second sub-hypothesis of this study, that people with pain will use more healthcare, was supported. The amount of medical use increased in the order of pain-free, pain, and severe pain: OTC drug use for more than 3 months (9.4% *vs.* 16.2% *vs.* and 20.3%, $P < 0.001$), emergency room use (7.2% *vs*. 11.7% *vs*. 19.4%, $P < 0.001$), hospitalization (9.9% *vs*. 20.7% *vs*. 40.1%, $P < 0.001$). One way to reduce the household burden due to medical use is to reduce the household's OOP expenditure [1–3,24]. The medical coverage rate from NHI has steadily improved. However, public funds account for 60.8% of Korea's current medical expenditures, which is significantly lower than the average of OECD member countries (74.0%) [25]. In addition, the prevalence of households experiencing CHE is higher in Korea [12,13]. Nevertheless, the NHI is struggling with financial shortages, and therefore, the NHI is operated sustainably through strict price controls by medical providers. On the other hand, private insurance is expanding as a niche market for consumers who want high-quality healthcare services and high medical coverage rates. As such, the rise in NHI coverage has now become a health issue that requires to consider the financial status of NHI with private insurance.

The third sub-hypothesis of this study, household OOP expenditure would be higher and household capacity to pay would be lower in participants with pain, was also supported. Pain-free participants had a household capacity to pay of approximately $25,736 per year, whereas participants with pain and severe pain had capacities

Table 4. Impact of pain and severe pain on catastrophic health expenditure by multiple logistic regression model

Characteristics	Presence of household catastrophic health expenditure					
	Model I[a] (n = 2,491 *vs.* 44,106)		Men[b] (n = 1,012 *vs.* 19,909)		Women[b] (n = 1,533 *vs.* 25,675)	
	AOR (95% CI)	*P* value	AOR (95% CI)	*P* value	AOR (95% CI)	*P* value
Pain-free	Ref.		Ref.		Ref.	
Pain	1.5 (1.4–1.7)	0.045	1.6 (1.4–1.9)	0.133	1.5 (1.3–1.7)	0.100
Severe pain	3.1 (2.5–3.9)	< 0.001	2.6 (1.5–4.0)	< 0.001	2.9 (2.3–3.8)	< 0.001

AOR: adjusted odds ratio, CI: confidence interval.
[a]Considering multicollinearity among independent variables, gender, age, family type, college entrance, household income quintile, and comorbidities were input into the model and controlled. [b]Considering multicollinearity among independent variables, age, family type, college entrance, household income quintile, and comorbidities were input into the model and controlled.

of $18,345 and $14,269, respectively (*P* < 0.001). Household OOP expenditure increased in the order of pain-free, pain, and severe pain ($1,649 *vs.* $1,870 *vs.* $2,331, *P* = 0.001). Unnecessary expenditure was a risk factor for chronic pain management [3]. Primary care appointments for chronic pain in the UK cost around £69 million, and prescription pain medications cost £5 million per year [26]. All indirect medical costs: transportation, costs, purchase of oriental medicine or medical equipment, and long-term care service cost analyzed in this study increased in the order of pain-free, pain, and severe pain. Therefore, it was implied that when there is pain, the household's CHE are higher and the household's ability to pay is lower, so there is a possibility of falling into poverty.

Meanwhile, income, one of the pillars of household financial stability, should also be reviewed. In recent years, household income inequality has become more prominent, and during the COVID-19 pandemic, financial turmoil has been aggravated throughout society [27,28]. This means that within limited income resources, an increase in medical expenditure can inevitably have negative effects, such as lowering other living standards [17]. Therefore, it is possible that pain, a continuous increase in OOP expenditure, high household CHE, and declining income will lead to poverty. Participants with pain had a lower household capacity to pay and higher OOP expenditure. The household's capacity to pay is defined as the non-subsistence effective income of the household [16]. Therefore, it can be inferred that the effect of pain on household finances affects both income and expenditure. Due to the circular relationship between poverty and health levels, the quality of life of individuals who suffer will become increasingly impoverished. In addition, as time goes by, the burden on the national health budget will inevitably increase.

As a result of a preceding meta-analysis, the estimate of

pain prevalence in 2017 showed a wide range from 8.7% to 64.4% [7], including 20.5% of adults in the United States [8], and 17.5% of adults in Japan [9,10]. Therefore, it was suggested that it is difficult to compare the prevalence of chronic pain cross-sectionally with different data sets. This is because the results will differ depending on the age, investigation method, and definition of pain. However, in the analysis of the stratified data in each study, it is possible to identify in the study results that the trend is consistent. Factors highly associated with pain include older age, lower educational attainment, and lower household income. Therefore, the first sub-hypothesis of this study, that the prevalence of pain was higher in vulnerable people, was supported.

Among various measures to reduce the household burden due to medical use, the transition from unhealthy to healthy is probably the most classic yet innovative alternative. What is crucially important is to maintain and promote the health of each individual, and measures such as early detection, management, and rehabilitation will be needed. In the process of preparing these strategic alternatives, empirical evidence is important. For example, the number of comorbidities (1.3 *vs.* 3.2 *vs.* and 4.4, *P* < 0.001) increased in the order of pain-free, pain, and severe pain. From previous studies, inductively, we can see that chronic disease management is meaningful for pain management. Then, early prevention of pain should also be emphasized. Subjects with chronic diseases had greater financial difficulties than those without [29]. Household members suffering from chronic diseases are a major factor influencing economic bankruptcy, and subjects suffering from chronic diseases have greater financial difficulties than those without [30,31].

The limitations of this study are as follows. First, the pain variable in this study asked about today's pain, so it cannot be concluded to be chronic pain. Chronic pain is pain that lasts longer than 3 months or recurs, and

can become a disease in itself or appear secondary to another disease [5]. Based on this definition, it is possible that the pain in this study was a mixture of chronic and acute symptoms and its own disease. Therefore, it is necessary to understand the differences in each data set when comparing it with other studies. Second, income or capacity to pay is used as the value of the denominator in household CHE. However, this value varies greatly depending on the number of people in the household. In fact, in this study, there was a difference in the number of household members between those who were pain-free, had pain, and had severe pain (3.3 *vs*. 2.7 *vs*. 2.4 persons, $P < 0.001$). However, there are different approaches, such as use or non-use of the various methods of equivalizing the number of household members. Therefore, care should be taken in interpreting absolute figures when comparing studies. Third, although the KHP data is longitudinal data, this study pooled data from 2015 to 2018 and conducted a cross-sectional analysis. Therefore, the temporal trend of financial indicators related to pain was not presented in this study. In future studies, it will be necessary to closely understand the income, capacity to pay, and trends in medical expenses of people with pain. In addition, it is necessary to further study the need for pain management through the production of evidence of impoverishment due to pain. Also, pain and CHE cannot be interpreted as cause and effect.

In conclusion, pain is a health problem strongly associated with CHE in households. Therefore, it suggests that interest in the financial characteristics of pain is necessary for the well-being of individuals in the population and in terms of medical experts' understanding of pain. In addition, in terms of the efficiency of national medical spending, policy development for pain management can be proposed, and at that time, it can be expected that this study will be able to provide some evidence.

DATA AVAILABILITY

The datasets supporting the findings of this study are not publicly available due to personal information protective policy and technical limitations.

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CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

AUTHOR CONTRIBUTIONS

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REFERENCES

1. Breivik H, Collett B, Ventafridda V, Cohen R, Gallacher D. Survey of chronic pain in Europe: prevalence, impact on daily life, and treatment. Eur J Pain 2006; 10: 287-333.

2. Blyth FM, March LM, Brnabic AJ, Cousins MJ. Chronic pain and frequent use of health care. Pain 2004; 111: 51-8.

3. Gatchel RJ, McGeary DD, McGeary CA, Lippe B. Interdisciplinary chronic pain management: past, present, and future. Am Psychol 2014; 69: 119-30.

4. Şentürk İA, Şentürk E, Üstün I, Gökçedağ A, Yıldırım NP, İçen NK. High-impact chronic pain: evaluation of risk factors and predictors. Korean J Pain 2023; 36: 84-97.

5. Treede RD, Rief W, Barke A, Aziz Q, Bennett MI, Benoliel R, et al. Chronic pain as a symptom or a disease: the IASP Classification of Chronic Pain for the International Classification of Diseases (ICD-11). Pain 2019; 160: 19-27.

6. Raja SN, Carr DB, Cohen M, Finnerup NB, Flor H, Gibson S, et al. The revised International Association for the Study of Pain definition of pain: concepts, challenges, and compromises. Pain 2020; 161: 1976-82.

7. Steingrímsdóttir ÓA, Landmark T, Macfarlane GJ, Nielsen CS. Defining chronic pain in epidemiologi-

cal studies: a systematic review and meta-analysis. Pain 2017; 158: 2092-107.

8. Yong RJ, Mullins PM, Bhattacharyya N. Prevalence of chronic pain among adults in the United States. Pain 2022; 163: e328-e32.

9. Sakakibara T, Wang Z, Paholpak P, Kosuwon W, Oo M, Kasai Y. A comparison of chronic pain prevalence in Japan, Thailand, and myanmar. Pain Physician 2013; 16: 603-8.

10. Imai R, Imaoka M, Nakao H, Hida M, Tazaki F, Omizu T, et al. Association between chronic pain and pre-frailty in Japanese community-dwelling older adults: a cross-sectional study. PLoS One 2020; 15: e0236111. Erratum in: PLoS One 2021; 16: e0261597.

11. Shin SM. Prevalence and trends of pain associated with chronic diseases and personal out-of-pocket medical expenditures in Korea. Korean J Pain 2017; 30: 142-50.

12. OECD. Health at a glance 2013: OECD indicators. OECD Publishing. 2013.

13. Woo KS, Shin YJ. The effect of catastrophic health expenditure on household economy: focusing on financial coping and poverty. Health Soc Welf Rev 2015; 35: 166-98.

14. Russell S. The economic burden of illness for households in developing countries: a review of studies focusing on malaria, tuberculosis, and human immunodeficiency virus/acquired immunodeficiency syndrome. Am J Trop Med Hyg 2004; 71(2 Suppl): 147-55.

15. Pradhan M, Prescott N. Social risk management options for medical care in Indonesia. Health Econ 2002; 11: 431-46.

16. Xu K, World Health Organization. Distribution of health payments and catastrophic expenditures methodology [Internet]. World Health Organization; 2005. Available at: https://apps.who.int/iris/handle/10665/69030

17. O'Donnell O, van Doorslaer E, Wagstaff, A, Lindelow M. Analyzing health equity using household survey data: a guide to techniques and their implementation [Internet]. The World Bank; 2008. Available at: https://books.google.co.kr/books?hl=ko&lr=&id=8krsjfKv2vgC&oi=fnd&pg=PR3&dq=Analyzing+health+equity+using+household+survey+data:+A+guide+to+techniques+and+their+implementation.+&ots=Rx530Wd6dR&sig=4WyLmdHnJ0nv1tpCFAMjIfLF4RA#v=onepage&q=Analyzing%20health%20equity%20using%20household%20survey%20data%3A%20A%20guide%20to%20techniques%20and%20their%20implementation.&f=false

18. Kim Y, Yang B. Relationship between catastrophic health expenditures and household incomes and expenditure patterns in South Korea. Health Policy 2011; 100: 239-46.

19. EuroQol. EQ-5D instrument [Internet]. EuroQol Research Foundation; 2014. https://euroqol.org/eq-5d-instruments/

20. Xu K, Evans DB, Carrin G, Aguilar-Rivera AM, Musgrove P, Evans T. Protecting households from catastrophic health spending. Health Aff (Millwood) 2007; 26: 972-83.

21. Chuma J, Maina T. Catastrophic health care spending and impoverishment in Kenya. BMC Health Serv Res 2012; 12: 413.

22. Korea Institute for Health and Social Affairs. Korea Health Pannel Survey [Internet]. Korea Institute for Health and Social Affairs; 2022. Available at: https://www.khp.re.kr:444/

23. Kang SH, Ju YJ, Yoon HJ, Lee SA, Kim W, Park EC. The relationship between catastrophic health expenditure and health-related quality of life. Int J Equity Health 2018; 17: 166.

24. Somkotra T, Lagrada LP. Which households are at risk of catastrophic health spending: experience in Thailand after universal coverage. Health Aff (Millwood) 2009; 28: w467-78.

25. Kim SK. OECD 'last place' in health insurance coverage rate..."In Korea, health care austerity policy is a disaster". Rapportian. 2023 Jan 19. Available at: https://m.rapportian.com/news/articleView.html?idxno=156697

26. Donaldson LM. 150 years of the annual report of the Chief Medical Officer: on the state of public health 2008. London: Department of Health; 2009.

27. Jhuremalani A, Potter R, Lushington K, Lowies B. COVID-19: financial well-being of older Australians in times of crisis. Australas J Ageing 2022; 41: 440-7.

28. Ruiz Estrada MA, Koutronas E, Lee M. Stagpression: the economic and financial impact of the COVID-19 pandemic. Contemporary Economics 2021; 15: 19-33.

29. Kusi A, Hansen KS, Asante FA, Enemark U. Does the National Health Insurance Scheme provide financial protection to households in Ghana? BMC Health Serv Res 2015; 15: 331.

30. Anbari Z, Mohammadbeigi A, Mohammadsalehi N, Ebrazeh A. Health expenditure and catastrophic costs for inpatient- and out-patient care in Iran. Int J

Prev Med 2014; 5: 1023-8.
31. Counts CJ, Skordis-Worrall J. Recognizing the importance of chronic disease in driving healthcare expenditure in Tanzania: analysis of panel data from 1991 to 2010. Health Policy Plan 2016; 31: 434-43.