South Korea's healthcare expenditure: a comprehensive study of public and private spending across health conditions, demographics, and payer types (2011–2020)

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Summary

Background South Korea has witnessed a rapid increase in health expenditure, reaching USD 135 billion in 2021 and accounting for 9.3% of its GDP, surpassing the OECD average. Despite achieving universal health coverage, significant gaps remain in service coverage, leading to high out-of-pocket (OOP) expenses that expose households to financial burdens.

Methods This study examines healthcare spending in South Korea from 2011 to 2020 using national datasets, focusing on expenditures across two primary payer categories: public insurance and OOP payments. Data were stratified by health condition, age group, sex, type of care, and income level. A combination of the National Health Insurance (NHI) dataset and the Korea Health Panel Survey (KHPS) was used to estimate total health expenditures, with multiple imputation methods applied to address data gaps.

Findings Healthcare expenditure in South Korea rose significantly from $45.6 billion in 2011 to $76.9 billion in 2020, placing an increasing economic burden on the system. Public health insurance spending grew at an annual rate of 5.1%, while OOP expenses rose by 5.0% for covered services and 6.7% for uncovered services. Despite a shift toward greater public funding—with public expenditure comprising 64.4% of total spending in 2020—OOP payments still accounted for 35.6%, remaining above the OECD average. Individuals aged 60 and above contributed to 51.3% of total expenditures. Gender disparities emerged, especially in high-cost areas like obstetrics and gynecology, where women incurred higher OOP costs. Additionally, uncovered services experienced significant spending growth across all income levels, with major cost contributors including musculoskeletal disorders, urinary tract disorders, and chronic diseases such as hypertension and diabetes.

Interpretation This study highlights the need for targeted healthcare policies in South Korea to address rising costs and persistent inequalities. High OOP expenses disproportionately impact vulnerable groups, especially women and the elderly, while uncovered medical costs are growing across income levels, straining households. Conditions like musculoskeletal disorders, hypertension, and diabetes, along with gender-specific costs such as obstetric care, emphasize access inequities. Uncovered OOP expenses are rising faster than covered services, particularly among older adults. Addressing these issues requires policies to ease financial burdens and ensure equitable healthcare access.

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Keywords: Healthcare expenditure; Out-of-pocket (OOP) payments; National health insurance (NHI); Korea health panel survey (KHPS); Aging population; Health conditions/diseases

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Research in context

Evidence before this study

Previous research in South Korea has largely concentrated on out-of-pocket (OOP) spending within specific populations, including low-income individuals, cancer patients, and the elderly with chronic conditions. These studies typically focused on expenditure trends before and after the implementation of OOP costs or targeted age demographics, particularly among the elderly and low-income sectors. However, a comprehensive analysis that integrates healthcare spending across all payers—combining both public and private expenditures and stratifying OOP into covered and uncovered services—has yet to be conducted. This gap limits the existing evidence available to guide healthcare financing decisions in South Korea.

Added value of this study

This study addresses a significant gap in existing research by providing a comprehensive analysis of healthcare expenditures by payer, encompassing both public and private sectors. Unlike prior studies that often target specific demographics or health conditions, this research is the first to examine healthcare spending across all payers, health conditions, income, age, sex, while also stratifying OOP

spending into covered and uncovered services. By highlighting critical trends and gaps, these findings offer policymakers essential insights to manage rising healthcare costs and promote the sustainability of the healthcare system.

Implications of all the available evidence

The findings of this study highlight alarming trends in healthcare expenditure in South Korea, revealing significant disparities in spending patterns across different demographics, including age, gender, and income levels. Despite the expansion of public insurance, OOP payments remain persistently high, particularly for vulnerable populations such as women and low-income groups. These results underscore the urgent need for policy interventions aimed at reducing financial inequalities and improving healthcare access. The study found that health spending growth was highest for musculoskeletal disorders and urinary tract infections, suggesting the need to prevent and streamline care for these two health issues. Overall, these findings advocate for a re-evaluation of existing healthcare financing strategies to ensure a more equitable and effective healthcare system.

Introduction

Korea's health expenditure is rising at the fastest rate among OECD countries, reaching USD 135 billion in 2021 (USD $4190 per capita), and, representing 9.3% of South Korea's gross domestic product (GDP).[1] This marks an acceleration from 5.9% of GDP in 2011 to 8.3% in 2020. In contrast, the OECD average trend shows that the pandemic-induced slowdown, with a 0.7% increase from 2019 to 2021. Korea's healthcare expenditure growth rate from 2011 to 2020 exceeded the 5–7% typical of high-income countries and more closely resembled the 6–9% growth seen in lower-middle-income countries.[2] Despite this rapid increase, Korea's health expenditure was slightly below the OECD average of 9.8% in 2020 but exceeded it in 2022 at 9.7%. From 2011 to 2020, adjusted for inflation, South Korea's health expenditure consistently grew over 10% annually, with stable public and private shares and a marked reduction in out-of-pocket (OOP) spending in 2020 (Supplementary Fig. S1). Health expenditure as a percentage of GDP increased by 50% over this period—five times the OECD average increase of 10%.[3–5]

South Korea's public healthcare system includes Medical Aid, which supports low-income individuals with essential medical services, and National Health Insurance (NHI), funded by beneficiary contributions, which covers the broader population.[6,7] Although South Korea achieved universal health coverage in 1989,

service coverage gaps persist. Medical Aid covers only about 3% of the population, while the majority rely on NHI, which has limited benefits.[8,9] Private health expenditure accounts for over 40% of total healthcare spending, restricting access to healthcare services for many.[7,10,11] Due to these limitations, supplementary private health insurance has gained popularity, with a subscription rate of 78.6% in 2020. The share of private insurance in health expenditure has increased from 3.9% in 2008 to 9.7% in 2020, though data on expenditure trends and reimbursement levels for private insurance remains limited.[12] Efforts to expand NHI coverage have contributed to a decrease in OOP payments from 37.1% in 2008 to 29.1% in 2021,[13] though nearly 30% of expenditures remain OOP, exposing households to potential financial strain.[14]

The public sector's contribution to South Korea's healthcare spending remains relatively low. Significant healthcare coverage reforms in 2017 aimed to expand essential service coverage, regulate previously uncovered services, and lower the cost-sharing threshold to protect against catastrophic health expenses.[15] Since the expansion, the government's share in healthcare spending increased from 59.0% in 2008 to 64.8% in 2021; however, this remains below the 2019 OECD average of 74.0%.[4] South Korea has one of the highest financial burdens on patients among OECD countries, with OOP costs covering 35.2% of health expenditure in

2021. This OOP share resembles that of upper-middle- and lower-middle-income countries (20–30% and 30–40%, respectively), in contrast to the 10–20% OOP typical in high-income countries.[16]

While studies in the United States and other OECD countries have analyzed healthcare spending by payer and program across different contexts, including geographic stratification,[17] health conditions,[18] health service delivery schemes,[19,20] similar comprehensive studies are lacking in South Korea. Existing research from South Korea often focuses on specific groups, such as low-income individuals[21] or cancer patients,[22,23] and limited age groups or health conditions,[24] without a full analysis of healthcare spending by payer type. Consequently, there is a need for a more extensive investigation into spending trends, particularly within the private sector and OOP payments, to better inform healthcare financing decisions.

This study aims to address this gap by analyzing South Korea's healthcare spending from 2011 to 2020, focusing on public insurance and OOP payments. Data are stratified by health condition, age, sex, type of care, and income level (inferred from insurance premiums). The analysis identifies spending patterns across different care types, health conditions, and sociodemographic factors. These insights are essential for addressing inefficiencies and unnecessary expenses in healthcare, ultimately supporting policy reforms that enhance the value and equity of healthcare services in Korea. This comprehensive analysis, integrating both public and private healthcare expenditures, makes a novel contribution to the research literature.

Methods
Data sources
Healthcare expenditure in Korea includes public spending via the National Health Insurance (NHI) program and private OOP payments that are reflected in data from the Korea Health Panel Survey (KHPS). OOP payments can be divided into statutory copayments for covered services (thereafter, OOP1) and costs for uncovered services (thereafter, OOP2). Private insurance covers some discretionary spending that are coded here as OOP. Since data on payments made by private insurers are not publicly accessible, a portion of what we refer to as OOP spending is, in fact, reimbursed for these policyholders. The analysis focuses on total healthcare expenditure, excluding spending on medical goods and non-durable items, which are classified as personal health expenditures rather than current healthcare expenditures.[25]

Healthcare data derived from NHIS claims includes both primary and secondary diagnoses; however, this analysis considers only the primary diagnosis. Long-term care costs in nursing homes and home healthcare were excluded due to their absence from NHIS data, but costs in long-term care hospitals were included to account for this particular aspect of care.

The study uses two primary datasets including i) NHI dataset for the public insurance claims; ii) KHPS for OOP payments from 2011 to 2020 as shown in Fig. 1. Introduced in 1977, NHI is compulsory, covering 99.7% of the population and capturing all claims data. KHPS, introduced by the National Health Insurance Service and the Korea Institute for Health and Social Affairs, samples about 8000 households, including 14,000 individuals nationwide.[26] The survey records annual public and private healthcare expenses, including NHI benefits, statutory copayments (OOP1), and payments for uncovered services (OOP2). Its representativeness is ensured through a two-stage stratified random cluster sampling method and efforts to minimize information loss and recall bias, such as triangulating health insurance data with receipt verification.[27] The study includes all KHPS samples, excluding observations with missing values, which are addressed through imputation.

The analysis stratifies healthcare spending by three payer types (public health insurance, OOP1 and OOP2), four service types (outpatient, inpatient, emergency and pharmacy), sex (M/F), age (8 age groups including 0–9 years, 10–19 years, 20–29 years, ..., over 80 years), and 34 health conditions aligned with KHPS disease categories and the Korean Standard Classification of Diseases (KCD) (Supplement B).[28]

Addressing data gaps and adjusting for imperfect data
This study addresses gaps in NHI data regarding uncovered medical care expenditures by supplementing it with KHPS data, which includes information on uncovered medical expenses (OOP2) not captured in the NHI system. KHPS provides annual records of public health expenditure and OOP costs across service types, sex, age, income, and health conditions. Samples for public health insurance, OOP1, and OOP2 expenditures are analyzed in KHPS.

Supplementary Table S1 reveals variable missingness within KHPS data from 2011 to 2020, ranging from 10% to 40%. While response rates for total OOP expenditures are high (80–90%), they are lower for both OOP1 and OOP2 (60–70%). Public expenditure data, sourced from NHIS, shows higher completeness. Missing data is more prevalent in OOP2 due to unretained receipts by respondents, varying by payer type and service category, with emergency services showing higher missingness. Given these inconsistencies, data from 2008 to 2010 were excluded due to ambiguous OOP categorization, focusing the analysis on data from 2011 onward.

To handle missing data, the study assesses the Missing At Random (MAR) assumption (Supplementary Appendix A) by analyzing differences between groups
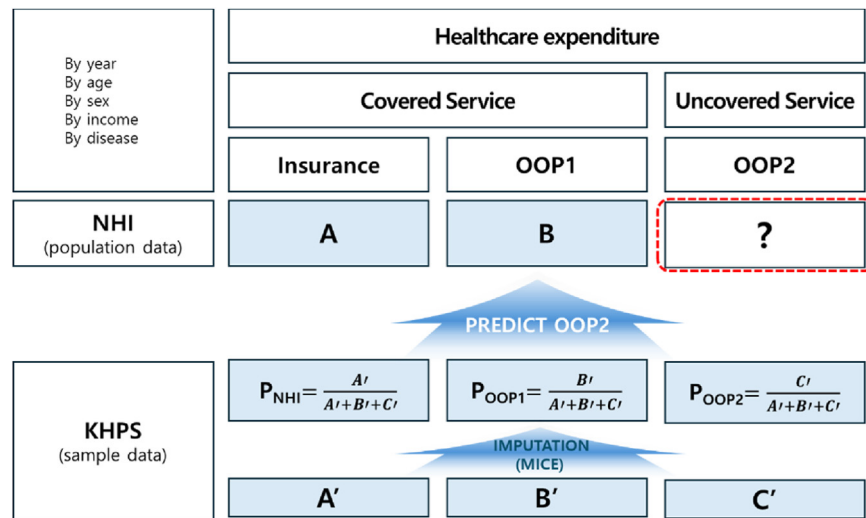
Fig. 1: Overview of estimating healthcare expenditure with NHI and KHPS data. Source: Created by authors.

with and without missing data. Missing data was flagged with a binary variable, allowing for logistic regression to examine its association with other variables. While it is impossible to definitively confirm if missing data falls under the Missing At Random (MAR) or Not Missing At Random (NMAR) categories,[29,30] the patterns observed in this study suggest that the missing data may not be systematically related to the amounts unreported. Specifically, many omissions stemmed from respondents forgetting to collect receipts, implying that the missing data likely lacks a systematic bias associated with specific expenditure amounts. Therefore, treating the data as MAR seems reasonable for the purposes of this analysis.

In summary, the study applies Iterative Proportional Fitting (IPF) and MICE to address missing data. IPF maintains consistency across marginal distributions even with incomplete KHPS records by iteratively updating estimates until they match known totals. The combined use of IPF and MICE ensures robust handling of diverse missing data patterns, enhancing the accuracy of the analysis.

Estimating healthcare expenditures

Assuming data is MAR (See Supplementary A), we impute missing expenditures for uncovered healthcare (OOP2) using data from the KHPS and NHIS. Fig. 1 demonstrates an overview of the method for estimating healthcare expenditure using NHIS (population data) and KHPS (sample data), breaking down costs into covered services (public insurance and OOP1) and uncovered services (OOP2), with formulas for predicting OOP2 based on the other components, using MICE under the MAR assumption.

MICE is chosen for its ability to handle complex missing data patterns by accounting for variable interdependence and generating multiple imputed datasets to improve analysis reliability. This study applied an outcome-sensitive imputation approach, refining the imputation process based on key outcome-related variables, which enhances predictive accuracy and reduces bias from missing data, ensuring more robust conclusions.[31–33] Specifically, MICE handles missing values in OOP2 data through linear regression, leveraging variables such as year, age, income, disease type, and health insurance type as predictors. These variables were selected based on their theoretical relevance to the OOP2 and their potential influence on the missing data mechanism. This approach ensures that the imputed values for OOP2 are based on the observed relationships between these variables. To adequately reflect the uncertainty associated with missing data, we generate 20 imputed datasets. Negative or implausible imputed values are corrected: for instance, public health insurance expenditures are replaced with the average for that disease code, and missing statutory copayments are adjusted using the sum of known total payments (OOP1 + OOP2) or recalculated from total payments in Stata version 17.0. Financial figures are presented in both Korean Won and US Dollars, using the exchange rate from the World Bank's WDI for the respective year.[34]

The KHPS provides expenditure across five categories: income, sex, age, types of payers, and types of services. This granularity enables the calculation of the proportions of covered expenditures ($P_{NHI} + P_{OOP1}$) to uncovered expenditures (P_{OOP2}) for each demographic segment, or 'cell'. We apply the covered/uncovered ratio derived from the KHPS data to the broader NHI dataset to accurately estimate the missing OOP2 values.

Trend analysis

The trend analysis spans from 2011 to 2020, focusing on periods with significant changes in annual expenditures for various health conditions. We identify the top 10 disease categories by expenditure and calculated annual growth rates by payer type, health condition, income, age, and sex. Both nominal and adjusted annualized growth rates are shown in Supplementary Table S2. The annualized rate reflects year-over-year spending changes without inflation adjustment, while the population-adjusted rate recalculates 2011 spending in 2020's price levels. The iterative proportional fitting algorithm adjusted for differences in gender, age, and income distribution, enhancing comparability.[35]

Role of the funding source

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. The authors had full access to all study data and take responsibility for the integrity and accuracy of the analysis. They are accountable for the content and have approved the submission for publication.

Results

The total sample contained 12.5 billion unique insurance claims, including 7.2 billion outpatient visits, 86.8 million inpatient services, 86.8 million emergency department (ED) visits, and about 5.1 billion pharmaceutical prescriptions over a 10-year period (Supplementary Table S3). A total of 52.9 million (26.5 million males and 26.4 million females) and 50.9 million patients (25.5 million males and 25.4 females) are included in our study in 2020 and 2011, respectively (Supplementary Table S4). The data reflects 91.6% of health care spending between 2011 and 2020. The analysis does not include dental health care (5.6% of total health care spending) and Chinese medicine expenditures (3.4%).

Total health care spending by payer across time

Total health care spending increased from an estimated USD $45.6 billion ($1884.7 per person) in 2011 (3.6% of gross domestic product [GDP]) to an estimated USD $76.9 billion ($3324.8 per person) in 2020 (4.7% of GDP) shown in Fig. 2 (Supplementary Table S6). Health care spending was estimated to have increased between 2011 and 2020 at an adjusted annualized rate of 5.4% on average; 5.1% for public health insurance, 6.0% for OOP1 and 6.7% for OOP2, after adjusting for changes in population size, inflation, and age groups (Fig. 2a). Between 2019 and 2020, the annual growth rate significantly decelerated due to COVID-19, registering at 0.2% for inflation unadjusted growth and −0.3% for inflation adjusted growth shown in Fig. 2a.

In 2020, public health expenditure accounted for USD $49.5 billion ($2142.1 per person) or 64.4% of total spending, USD $27.4 billion ($1183.1 per person) or 35.6% by OOP payments (19.1% by OOP1 and 16.5% by OOP2) as shown in Supplementary Table S6. The proportion of public health expenditure slightly increased by about one percentage point from the decade's average. Specifically, OOP payments for covered services (OOP1) accounted for 19.1% (USD $14.7 billion, $635.3 per person) of the total healthcare spending, whereas payments for uncovered services (OOP2) represented 16.5% (USD $12.7 billion, $547.8 per person). There has been a downward trend in OOP2 spending over the past decade, reflecting the country's efforts to broaden healthcare coverage.

Over the decade, outpatient services accounted for the highest amount of expenditure, averaging 42.9% (USD $26.2 billion) with a slight uptrend, followed by pharmacy (23.9%, USD $14.6 billion), inpatient services (23.5%, USD $14.3 billion), and ER (9.7%, USD $5.9 billion) (Supplementary Table S6). In 2020, spending was distributed as follows: 38.2% (USD $18.9 billion) on outpatient care, 25.8% (USD $12.8 billion) on inpatient services, and 11.5% (USD $5.7 billion) on emergency services, with 24.5% (USD $12.1 billion) of pharmacy expenditures covered by public insurance. OOP payments accounted for 53.6% (USD $14.6 billion) of outpatient, 20.3% (USD $5.6 billion) of inpatient, 6.8% (USD $1.9 billion) of emergency services, and 19.3% (USD $5.3 billion) of pharmacy costs.

Total health care spending by payer, sex and age in 2020

Fig. 2b highlights the payer–and service-specific total healthcare spending patterns across different age groups for both men and women. Total expenditure declines after age 69 because there are fewer people in their 70s than in their 60s although per capita spending is not reduced with advancing age. In 2020, there is a transition to greater proportion of public insurance and emergency expenditures with increased age especially over 60 years of age. In 2020, individuals aged 60 and above, who made up 23.7% of the total population, were responsible for $39.4 billion ($4543.7 per person), representing 51.3% of the total healthcare expenditure as shown in Supplementary Table S7. In 2011, individuals aged 60 and above constituted only 15.6% of the total population, highlighting a notable demographic shift over time. Since 2011, this shift has contributed to the 113.2% increase from $18.5 billion ($3115.9 per person).

Women's total healthcare spending is generally higher than that of men (USD $35.5 billion, $3365.4 per person), representing 53.8% (USD $41.3 billion, $3290.6 per person) of the overall total healthcare expenditure in 2020 (Supplementary Table S7). This disparity is especially pronounced in the peak fertility age range of 30–39 years, where women's spending, including OOP and public expenditures, comprises
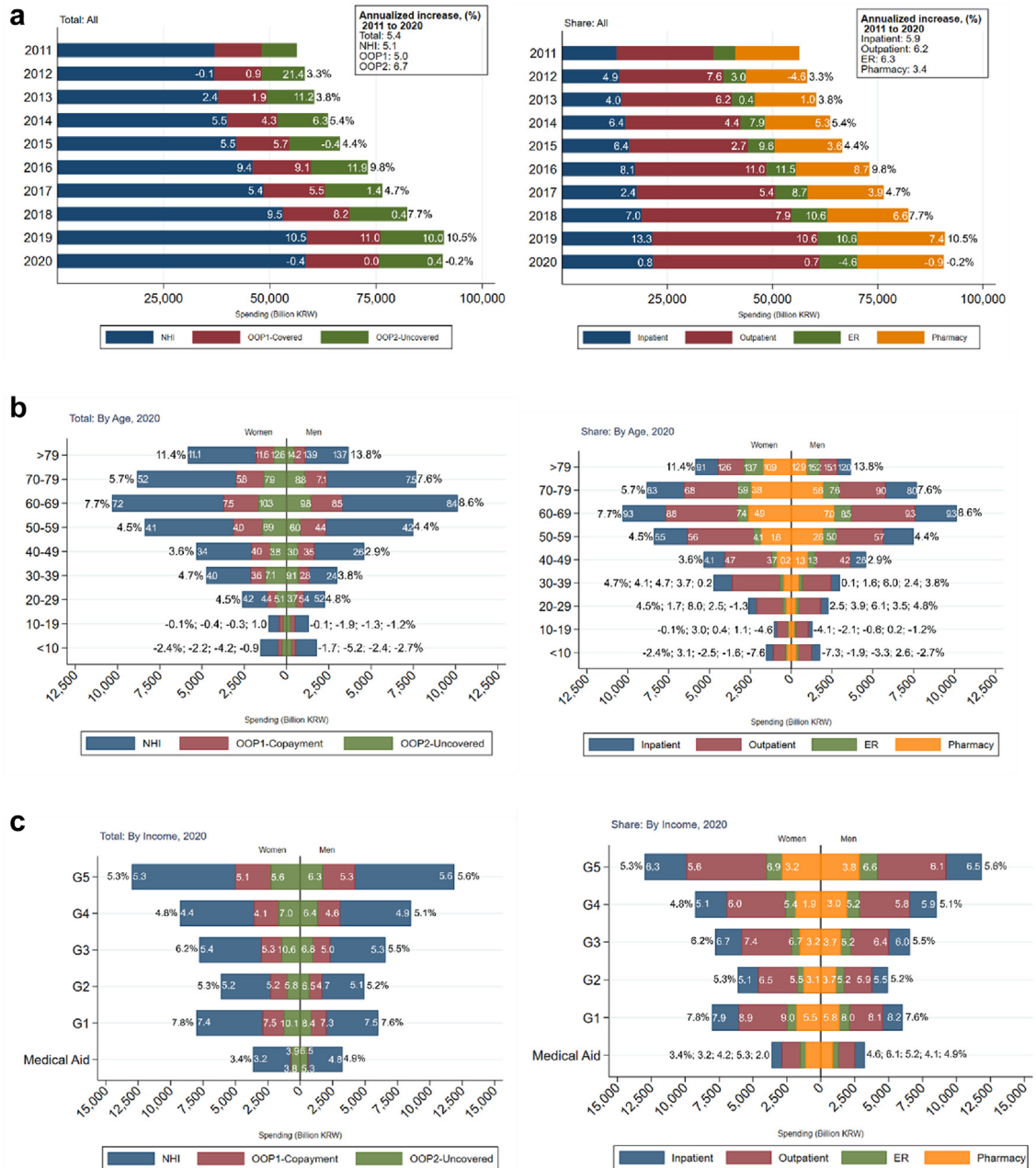
Fig. 2: (a) Total healthcare spending by payer 2011–2020. *The annualized rate from 2011 to 2020 adjusts for inflation. The number inside each bar indicates inflation adjusted growth in spending from each of the payer and service categories from the prior year. The percentage next to each bar indicates inflation adjusted total growth in spending from the prior year; (b) Payer- and Service-specific Healthcare spending by Age and Sex in 2020. *The numbers indicate annualized growth rate of total, NHI, OOP1, OOP2 spending and total, inpatient, outpatient, ER, pharmacy spending in each age group from 2011 to 2020 adjusted for inflation; (c) Payer- and Service-specific Total Healthcare Spending by Income and Sex in 2020, respectively in order. *The numbers indicate annualized growth rate of total, NHI, OOP1, OOP2 spending and total, inpatient, outpatient, ER, pharmacy spending in each income group from 2011 to 2020 adjusted for inflation.

61.3% (USD $4.0 billion, $3052.7 per person) of the total for this demographic, exceeding that of their male counterparts (USD $2.5 billion, $2494.7 per person).

Similarly, in the over-80 age group, women's total spending (USD $5.0 billion, $5135.3 per person) significantly surpasses that of men (USD $3.1 billion,

$6271.7 per person); although on a per capita basis, expenditure for men appears to be higher than that for women. The annual growth rate of total spending is higher for men, particularly among those aged above 80 (Supplementary Table S7). The higher total medical expenditure for women appears to be due to the significantly higher number of women survivors aged over 80, reflecting their relatively higher life expectancy. For the under-19 age groups, men's total healthcare spending (USD $2.6 billion, $1905.6 per person) is about 18.7% higher than that of women with similar trends for per capita expenditures (USD $2.2 billion, $1675.0 per person).

Fig. 2b/Supplementary Table S7 reveals that women in general pays higher OOP2 per capita and lower public insurance expenses compared to males. For both sexes over 80 years old, public insurance spending peaks, consisting of 69.0% for females (USD $3.4 billion, $3541.5 per person) and 69.8% for males (USD $2.2 billion, $4375.1 per person), reflecting the aging population's increasing need for healthcare services. The lowest public share was for the 30–39 age group at 55.7% for males (USD $1.4 billion, $770.6 per person) and 55.3% for females (USD $2.2 billion, $928.4 per person), although per capita expenses for women for this age group was far greater than of males. In contrast, OOP spending followed an inverse pattern, with the highest rates in the 20–39 age groups ($4.8 billion USD, $1128.5 per person) and the lowest for those aged 60 and above ($13.0 billion USD, $1498.3per person), with OOP2 spending decreasing further with age.

Healthcare expenditure by service type shows variation across different age groups and sex, with each demographic favoring certain services. For the younger demographic, there was a noticeable trend toward higher healthcare expenses via outpatient services (Supplementary Table S8). Among men, when examining outpatient service usage by age group, those aged 20–29 had the highest rate of outpatient visits at 58.7%, followed by those aged 30–39 (58.2%) and 10–19 (57.6%). For inpatient services, the highest proportion was observed in the under-10 age group at 29.2%. This suggests that children and infants require more intensive care, leading to a greater use of inpatient services. In emergency services, individuals over 80 showed a significantly higher proportion at 22.0%, in stark contrast to other age groups which were below 10%. In the realm of pharmacy usage, the 50–60 age bracket showed the highest proportion at 26.1%.

Health care spending by payer, sex and income in 2020
There is a clear gradient in healthcare spending across income groups, with the highest income group

incurring the highest healthcare expenditure for both genders (Fig. 2c/Supplementary Table S9). The highest income group incurs the most healthcare spending for both public insurance and OOP spending due to its ability to access a wider range of healthcare services, often of a higher quality with the ability to opt for elective services with additional OOP spending. The wealthiest group had the highest share of OOP spending (29.5% of the total OOP, $7.9 billion, $1241.2 per person) compared to those receiving Medical Aid, representing the lowest income bracket, with the least amount of healthcare spending and the smallest OOP contribution (4.5%, $1.2 billion, $1262.7 per person) as shown in Supplementary Table S9. This group's healthcare expenses are primarily covered by public assistance programs, reflecting the socioeconomic barriers and reliance on subsidized healthcare. Women in the wealthiest group ($4.2 billion, $1310.2 per person) had a higher proportion of healthcare spending compared to men ($3.6 billion, $1168.1 per person), especially for OOP payments.

The data analysis further reveals that healthcare spending also varies by type of service. Higher income groups have a greater proportion of spending in pharmacies (28.3%, USD $4.8. billion) and outpatient services (28.1%, USD $9.3 billion), whereas Medical Aid recipients may utilize more emergency room (ER) services (9.5%, USD $0.7 billion) and pharmacies (9.9%, USD $1.7 billion USD), possibly due to lack of access to stable sources of primary health care. The lowest income group experienced the highest annualized growth in healthcare spending of 7.6% for male and 7.8% for female while the Medical Aid group incurred the lowest growth of 4.9% for male and 3.4% for female. OOP2 (uncovered services) expenses grew the fastest across all income levels, regardless of income groups.

Health care spending by payer and health condition in 2020
Examining healthcare expenditure across 34 common diseases (Supplement B for KCD codes), shows significant variations in the total spending in large part due to variations in the overall number of cases for each disease. Fig. 3/Supplementary Table S10 demonstrates the top 10 health conditions with the highest spending in 2020, which accounted for 41.7% of spending. Among the top 10, the health condition that had the highest proportion of public health expenditure was breast cancer (75.2%, USD $0.9 billion, $10,770.4 per person), followed by pneumonia bronchitis (72.2%, USD $1.1 billion, $816.5 per person). For OOP payments, the highest was women's OBGYN health conditions (43.7%, USD $1.0 billion, $1034.9 per person), followed by musculoskeletal disorders (41.6%, USD $4.4 billion, $934.6 per person). Outside of the top 10, the highest OOP share was thyroid
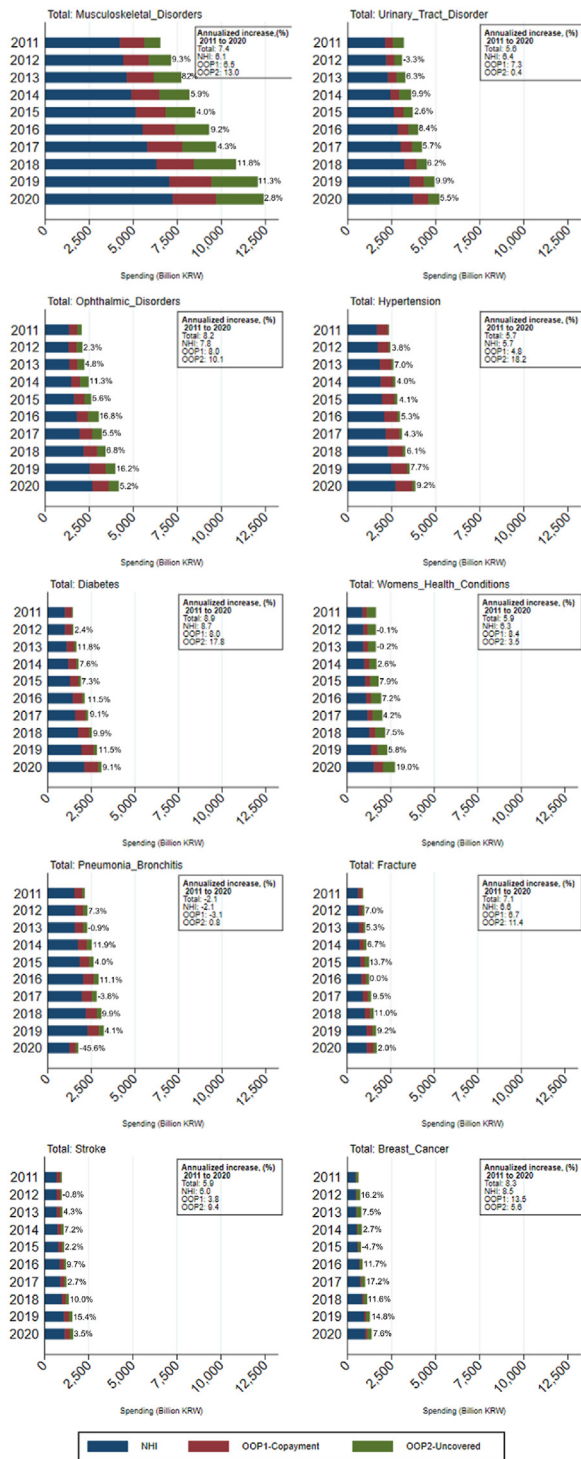
Fig. 3: Top 10 payer-specific healthcare expenditure by diseases in 2020. *The adjusted annualized rate from 2011 to 2020 adjusts for inflation. The percentage left on each bar indicates inflation adjusted growth in spending from the prior year. **The decrease in pneumonia cases in 2020 can be attributed to the COVID-19 lockdown measures and classification of COVID-19 related cases.

cancer with 45.3% with 31.7% for uncovered services with more than three-fourth are spent by women. Among the 10 health conditions, urinary tract disorder (65.6%, USD $2.9 billion) had the highest proportion of health care spending on outpatient visits; fracture (44.4%, USD $0.6 billion) had the highest proportion of health care spending on inpatient care; and stroke (50.2%, USD $0.7 billion) had the highest proportion of spending on emergency visits.

Fig. 4 shows that while the top five health conditions with the highest spending in 2020 were consistent across different payer types, the specific expenditures varied. Musculoskeletal disorders were the leading expense for all payer types, with public insurance spending $6.1 billion, and OOP1, OOP2 payments at $2.1 billion, $2.2 billion, respectively. Urinary tract disorders ($4.3 billion), hypertension ($3.2 billion), and ophthalmic ($3.5 billion) consistently appeared among the top expenditures. OBGYN health conditions incurred significant OOP expenses, particularly with OOP2. Breast cancer was a notable expense under OOP2, potentially due to non-covered medications and treatments, even though it was ranked 10th and 17th in public and OOP1 expenditures. Covered services have set fees, limiting price discretion by providers, but OOP2, covering non-fixed fee services, can lead to higher expenses for certain conditions compared to covered services.

Fig. 5 demonstrates 10 health conditions with the highest spending by sex and payer, as well as across age groups in 2020 (Supplementary Table S11). OOP expenditure contributed significantly to healthcare spending for OBGYN (43.7%), musculoskeletal disorders (41.6%), ophthalmic disorders (36.0%), with public insurance playing a more prominent role for those aged 60 years and older. OOP payments were relatively consistent across age groups. Musculoskeletal disorders saw more private financing in individuals younger than 60 years, and spending was higher in women between the ages of 40 and 70, likely due to conditions like osteoporosis. Hypertension and diabetes spending increased in later life, predominantly covered by public insurance. OOP spending on OBGYN services was significantly higher among women aged 30–39, showing the steepest annual increase in expenditure compared to any other age group. In addition, for breast cancer, although PHI and OOP1 is relatively lower, OOP for uncovered services remains high at the top 5. The data indicates a gender disparity in spending patterns, with certain conditions like OBGYN, thyroid cancer, and breast cancer attracting higher spending in women, while older men incurred more expenses, especially after the age of 50.

The health condition with the largest annual increase in total population and inflation-adjusted medical

expenses from 2011 to 2020 was dizziness, with a 12.6% increase and total expenditures of $201.9 million in 2020 as shown in Supplementary Table S15. This surge in expenses is attributed to the increasing aging population and introduction of the NHI coverage expansion policy in the past decade, which allowed reimbursement for MRI scans for conditions like dizziness that previously fell outside reimbursable criteria.[36] This list was followed by fever of unknown origin, with a 9.8% increase and gallstones & cholecystitis, with a 9.4% increase.

Breast cancer showed the highest annual growth rate in OOP1 from 2011 to 2020 (Supplementary Table S15), with an estimated annual increase of 13.5%, followed by thyroid cancer, dizziness, gallstone, headache, lung cancer, and myocardial infraction. Pulmonary fibrosis showed the highest annual growth in OOP2, with an annual increase of 19.8%, followed by fever, hypertension, diabetes, COPD and musculoskeletal disorders. The growth rate for OOP2 expenses consistently surpassed that of NHI or OOP1 for several health issues, including musculoskeletal and ophthalmic disorders, hypertension, diabetes, fractures, and stroke. Conversely, for conditions like urinary tract infections, OBGYN, and pneumonia/bronchitis, the increase in OOP2 spending was minimal compared to the annual rises in NHI and OOP1 costs.

Discussion

This study examines healthcare expenditure trends in South Korea from 2011 to 2020, revealing significant increases in both public and private spending across various demographics and health conditions. Total healthcare expenditure surged from $45.6 billion in 2011 to $76.9 billion in 2020, underscoring the growing economic burden of health services. Public health insurance spending grew annually by 5.1%, while OOP spending increased by 5.0% for OOP1 and 6.7% for OOP2. The impact of the COVID-19 pandemic is evident, as spending growth slowed in 2019 and 2020. South Korea's healthcare financing has shifted towards greater public funding, with public health expenditure rising to 64.4% in 2020 and a corresponding decrease in OOP payments. However, despite the expansion of NHI coverage since 2017, public healthcare coverage remains below the OECD average of 74.0%, with OOP payments accounting for 35.6% of total spending.

The study highlights significant disparities in healthcare spending across different demographics in South Korea, underscoring the need for targeted policy interventions. In 2020, individuals aged 60 and above accounted for 51.3% of total healthcare expenditures, emphasizing the urgent requirement for enhanced senior healthcare support. In contrast, spending on children under 10 has declined, suggesting a potential shift in resource allocation. Additionally, there are marked gender disparities, where women face considerable OOP costs for services not covered by insurance, such as ultrasounds for breast and thyroid cancer. This disparity calls for gender-sensitive policies to alleviate the financial burden on women.

Gender-specific issues extend to musculoskeletal disorders, which disproportionately affect older women due to factors like osteoporosis and hormonal changes.[37–39] Musculoskeletal conditions account for approximately 14% of total healthcare expenditures in Korea, and this financial burden is growing rapidly as aging population and their prevalence are projected to increase significantly in the coming decades.[40,41] This deviation from the typical gendered division of labor raises questions about the social determinants of women's health service utilization, suggesting a need for further investigation into how osteoporosis and fractures influence these costs in Korea.

Income and disease groups also reveal inequities in healthcare spending. While higher-income individuals incur the largest overall costs, the lowest-income group has experienced the highest annual spending growth,
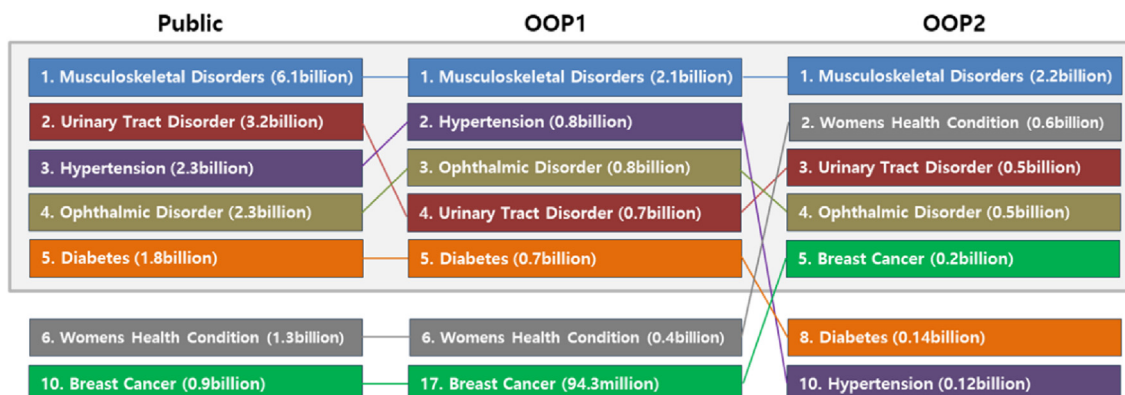

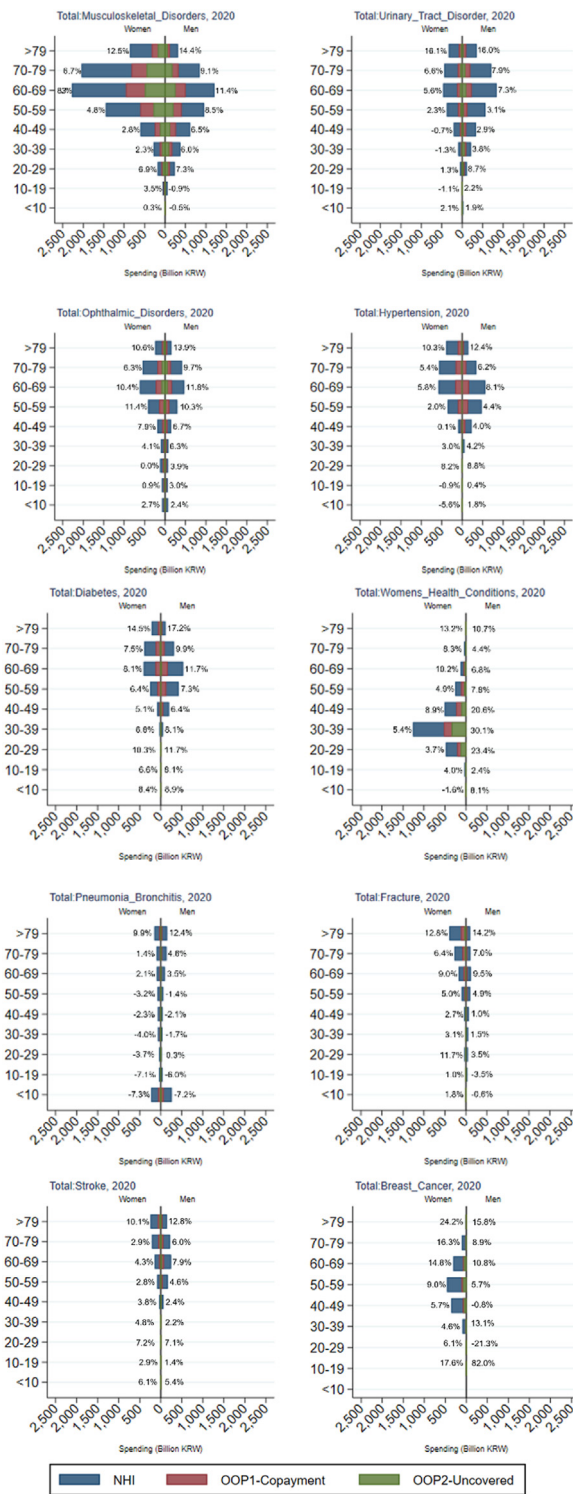*Fig. 4:* Estimated health care spending by payer and type of care in 2020.

Fig. 5: Top 10 health conditions with the highest spending by sex and payer and across age groups in 2020. *The percentage next to each bar indicates annualized growth rate of total spending specific to each condition from 2011 to 2020 adjusts for inflation in each age group.

pointing to persistent healthcare access challenges. Uncovered service costs have surged across all income levels, particularly for conditions like musculoskeletal disorders, ophthalmic disorders, hypertension, diabetes, fractures, and strokes. Additionally, we observe an increase in urinary tract infections among older men, likely linked to prostate health issues such as benign prostatic hyperplasia and prostate cancer.[42] Preventive strategies, including early screening and lifestyle adjustments, could potentially reduce these costs.[43,44] Furthermore, the rise in cases related to dizziness may reflect supply-driven demand, possibly due to the recent financial incentives for diagnostic imaging. Physician ownership of radiology facilities may encourage self-referral for tests, raising concerns about unnecessary procedures and inflated costs. Addressing these issues may require closer examination of ownership patterns and stricter regulations to curb conflicts of interest in the healthcare system.

This study faced several limitations. First, merging KHPS and NHI data presents challenges due to different scope, sampling methods, and data collection techniques, which can affect sample representation and data compatibility such as difficulties in aligning the sample data with the population data. Second, discrepancies in disease classification between KHPS and NHI create inconsistencies in health condition recording. Third, the income level measure, used as a proxy for insurance levels, does not match traditional income quintile classifications due to differences in categorization and population sizes between datasets. Fourth, limited data points from the KHPS constrained the analysis of PHI expenditure, preventing a comprehensive assessment of its role in indemnifying some of these OOP payments. Fifth, emergency room visit data could not be detailed by specific diseases. Sixth, pharmacy-related OOP expenses not covered by insurance were not recorded in the KHPS data and thus excluded from the analysis. Lastly, the study excludes the impact of the COVID-19 pandemic to focus on long-term healthcare expenditure trends.

Our study not only tracks South Korea's healthcare expenditure but also explores its financing mechanisms, pinpointing the key factors driving spending increases and the spending disparities among different demographic groups. This analysis provides a foundation for informed policy-making, advocating for a balanced approach to healthcare financing that combines public insurance and OOP payments to ensure comprehensive coverage and protect households from financial difficulties, particularly for women and lower-income groups. Future research should continue to explore these areas, providing insights that can guide

policymakers in creating a more equitable and efficient healthcare system.

References
1 *South Korea: spending on health per capita.* Statista; 2022.
2 World Health Organization. *Tracking universal health coverage: 2023 global monitoring report.* World Health Organization; 2023.
3 Ministry of Health and Welfare. *Korean national health accounts in 2021.* 2022.
4 OECD. *OECD health statistics 2022.* 2022.
5 Zhao L, et al. *Korea's transition to a high-income economy.* 2023.
6 Choi JW, Park EC, Chun SY, Han KT, Han E, Kim TH. Health care utilization and costs among medical-aid enrollees, the poor not enrolled in medical-aid, and the near poor in South Korea. *Int J Equity Health.* 2015;14:128.
7 Yoo KJ, Lee Y, Lee S, et al. The road to recovery: impact of COVID-19 on healthcare utilization in South Korea in 2016–2022 using an interrupted time-series analysis. *Lancet Reg Health Western Pac.* 2023;41.
8 Lee H, Park H, Lee J. *Statistical yearbook of poverty 2019, KIHASA.* 2019.
9 Yoo KJ, Kwon S, Choi Y, Bishai DM. Systematic assessment of South Korea's capabilities to control COVID-19. *Health Policy.* 2021;125(5):568–576.
10 Eun SJ. Evaluating the effects of the 2017 National Health Insurance coverage expansion on amenable mortality and its disparities between areas in South Korea using Bayesian structural time-series models. *Soc Sci Med.* 2024;344:116574.
11 Lee T-J. *Paying out of pocket for health care in Korea: change in catastrophic and poverty impact over a decade.* 2011. Available at: http://ebookbrowse.com/rp254-takemijournal1-lee-pdf-d57080924.
12 Lee H. Factors and trends associated with purchasing multiple private health insurances in Korea. *J Korea Contents Assoc.* 2022;22(1):601–610.
13 Park E. Moon jae-in Government's plan for benefit expansion in national health insurance. *Health Policy Mang.* 2017;27(3):191~198.
14 van Doorslaer E, O'Donnell O, Rannan-Eliya RP, et al. Catastrophic payments for health care in Asia. *Health Econ.* 2007;16(11):1159–1184.
15 Park S. Medical service utilization and out-of-pocket spending among near-poor National Health Insurance members in South Korea. *BMC Health Serv Res.* 2021;21(1):886.
16 World Bank Group. *High-performance health financing for universal health coverage: driving sustainable, inclusive growth in the 21st century.* World Bank; 2019.
17 Lassman D, Sisko AM, Catlin A, et al. Health spending by state 1991–2014: measuring per capita spending by payers and programs. *Health Aff.* 2017;36(7):1318–1327.
18 Dieleman JL, Cao J, Chapin A, et al. US health care spending by payer and health condition, 1996-2016. *JAMA.* 2020;323(9):863–884.
19 Martin AB, Hartman M, Lassman D, Catlin A, National Health Expenditure Accounts Team. National health care spending in 2019: steady growth for the fourth consecutive year. *Health Aff.* 2020;40(1):14–24.
20 Poisal JA, Truffer C, Smith S, et al. Health spending projections through 2016: modest changes obscure Part D's impact. *Health Aff.* 2007;26(Supplement 2):w242–w253.
21 Ruger JP, Kim H-J. Out-of-Pocket healthcare spending by the poor and chronically Ill in the Republic of Korea. *Am J Public Health.* 2007;97(5):804–811.
22 You CH, Kang S, Kwon YD, Choi JH. Time trend of out-of-pocket expenditure among cancer inpatients: evidence from Korean tertiary hospitals. *Asian Pac J Cancer Prev.* 2013;14(11):6985–6989.
23 Kim S, Kwon S. Impact of the policy of expanding benefit coverage for cancer patients on catastrophic health expenditure across different income groups in South Korea. *Soc Sci Med.* 2015;138:241–247.
24 Park E-J, et al. Out-of-pocket medication expenditure burden of elderly Koreans with chronic conditions. *Int J Gerontol.* 2015;9(3):166–171.
25 OECD. *Health spending definition*; 2023. Available from: https://data.oecd.org/healthres/health-spending.htm.
26 KHPS. *Korea health panel survey*; 2023. Available from: https://www.khp.re.kr:444/web/introduction/greetings.do.
27 Jung H, Lee J. Estimating the effectiveness of national health insurance in covering catastrophic health expenditure: evidence from South Korea. *PLoS One.* 2021;16(8):e0255677.
28 KCD. *Korean standard classfication of diseases and causes of death*; 2022. Available from: http://kssc.kostat.go.kr/ksscNew_web/ekssc/common/selectIntroduce.do?part=2&top_menu=102&bbsId=icd_s&categoryNameCode=802&categoryMenu=001.

29 Galasso V, et al. *Gender differences in COVID-19 related attitudes and behavior: evidence from a panel survey in eight OECD countries*. National Bureau of Economic Research; 2020.

30 Goldberg SB, Bolt DM, Davidson RJ. Data missing not at random in mobile health research: assessment of the problem and a case for sensitivity analyses. *J Med Internet Res*. 2021;23(6): e26749.

31 Van Buuren S, Groothuis-Oudshoorn K. mice: multivariate imputation by chained equations in R. *J Stat Software*. 2011;45: 1–67.

32 Van Buuren S, Oudshoorn K. *Flexible multivariate imputation by MICE*. Leiden: TNO; 1999.

33 Kontopantelis E, White IR, Sperrin M, Buchan I. Outcome-sensitive multiple imputation: a simulation study. *BMC Med Res Methodol*. 2017;17:1–13.

34 World Bank. *World development indicators*. The World Bank; 2022. . Accessed June 21, 2024.

35 Kolenikov S. Calibrating survey data using iterative proportional fitting (raking). *STATA J*. 2014;14(1):22–59.

36 HIRA. *Brain, cerebral vessels, and cervical vessels Magnetic Resonance Imaging (MRI) reimbursement criteria*; 2023. Available from: https://www.hira.or.kr/rc/insu/insuadtcrtr/InsuAdtCrtrPopup.do?mtgHmeDd=20230717&sno=1&mtgMtrRegSno=0001.

37 Liu S, Wang B, Fan S, Wang Y, Zhan Y, Ye D. Global burden of musculoskeletal disorders and attributable factors in 204 countries and territories: a secondary analysis of the Global Burden of Disease 2019 study. *BMJ Open*. 2022;12(6):e062183.

38 Chen N, Fong DYT, Wong JYH. Secular trends in musculoskeletal rehabilitation needs in 191 countries and territories from 1990 to 2019. *JAMA Netw Open*. 2022;5(1):e2144198.

39 International Association for the Study of Pain. *Global burden of musculoskeletal conditions*. Washington, DC: International Association for the Study of Pain; 2021 [cited 2024 Oct 18]. Available from: https://www.iasp-pain.org/resources/fact-sheets/global-burden-of-musculoskeletal-conditions.

40 Major ME, Clabault H, Goupil A. Work-related musculoskeletal disorders interventions in a seasonal work context: a scoping review of sex and gender considerations. In: *Congress of the international ergonomics association*. Cham: Springer; 2021.

41 Chen Ningjing, Fong Daniel Yee Tak, Wong Janet Yuen Ha. Health and economic outcomes associated with musculoskeletal disorders attributable to high body mass index in 192 countries and territories in 2019. *JAMA Netw Open*. 2023;6(1):e2250674.

42 National Institute of Diabetes and Digestive and Kidney Diseases. Urinary tract infections in adults. National Institute of diabetes and digestive and kidney diseases, U.S. Department of Health and Human Services. www.niddk.nih.gov/health-information/urologic-diseases/urinary-tract-infections-utis. Accessed October 9, 2024.

43 Kim Hyo-Jung, Lee JO, Choi JY, Kim JS. Etiologic distribution of dizziness and vertigo in a referral-based dizziness clinic in South Korea. *J Neurol*. 2020;267(8):2252–2259.

44 Lam Justin H, Pickles K, Stanaway FF, Bell KJL. Why clinicians overtest: development of a thematic framework. *BMC Health Serv Res*. 2020;20:1–11.