J Korean Med Sci. 2024 Jul 29;39(29):e214
https://doi.org/10.3346/jkms.2024.39.e214
eISSN 1598-6357·pISSN 1011-8934

JKMS

Original Article
Neuroscience

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# Healthcare Costs due to Dizziness/Vertigo in Korea: Analyses Using the Public Data of Health Insurance Review & Assessment Service

**Hyo-Jung Kim** [1], **Jae-Ryun Lee** [2], **Hyejin Lee** [3,4] and **Ji-Soo Kim** [5,6]

[1]Biomedical Research Institute, Seoul National University Bundang Hospital, Seongnam, Korea
[2]Department of Health Policy and Management, Seoul National University College of Medicine, Seoul, Korea
[3]Department of Family Medicine, Seoul National University Bundang Hospital, Seongnam, Korea
[4]Department of Family Medicine, College of Medicine, Seoul National University, Seoul, Korea
[5]Department of Neurology, College of Medicine, Seoul National University, Seoul, Korea
[6]Department of Neurology, Dizziness Center, Clinical Neuroscience Center, Seoul National University Bundang Hospital, Seongnam, Korea



**Received:** May 12, 2024
**Accepted:** Jun 11, 2024
**Published online:** Jun 27, 2024

**Address for Correspondence:**
**Ji-Soo Kim, MD, PhD**
Department of Neurology, Seoul National University Bundang Hospital, 82 Gumi-ro 173-beon-gil, Bundang-gu, Seongnam 13620, Republic of Korea.
Email: jisookim@snu.ac.kr

**Hyejin Lee, MD, PhD**
Department of Family Medicine, Seoul National University Bundang Hospital, 82 Gumi-ro 173-beon-gil, Bundang-gu, Seongnam 13620, Republic of Korea.
Email: jie2128@gmail.com



**ORCID iDs**
Hyo-Jung Kim
https://orcid.org/0000-0002-2027-6341
Jae-Ryun Lee
https://orcid.org/0000-0001-6776-3406
Hyejin Lee
https://orcid.org/0000-0001-5279-340X
Ji-Soo Kim
https://orcid.org/0000-0002-1508-2024

## ABSTRACT

**Background:** Dizziness/vertigo is one of the most common symptoms for which people seek healthcare. However, the healthcare expenditure attributable to dizziness/vertigo in South Korea remains poorly understood. We investigated the healthcare costs due to six major disorders causing dizziness/vertigo using claims data.
**Methods:** The healthcare costs were evaluated using all the claims data submitted to the Health Insurance Review and Assessment Service from January 1 to December 31, 2022. The six major vestibular disorders included for analysis were benign paroxysmal positional vertigo (BPPV), psychogenic/persistent postural perceptual dizziness (PPPD), vascular vertigo/dizziness (VVD), vestibular migraine (VM), Meniere's disease (MD), and vestibular neuritis (VN).
**Results:** During the 1-year study period, 4.1% of adults aged 20 or older visited hospitals due to dizziness/vertigo in South Korea. Compared to the general population, the patients with dizziness/vertigo were more often elderly, female, and residents of small towns. The total healthcare cost for the six major vestibular disorders was ₩547.8 billion (approximately $406.5 million). BPPV incurred the highest annual healthcare cost (₩183.5 billion, 33.5%), followed by VVD (₩158.8 billion, 29.0%), MD (₩82.2 billion, 15.0%), psychogenic/PPPD (₩60.3 billion, 11.0%), VN (₩32.9 billion, 6.0%), and VM (₩30.1 billion, 5.5%). The mean healthcare cost per hospital visit due to dizziness/vertigo was ₩96,524 (95% confidence interval, ₩96,194–₩96,855), 30% higher than the average (₩73,948) of the overall healthcare cost per hospital visit over the same period.
**Conclusion:** Owing to higher healthcare costs for dizziness/vertigo and increased prevalence of dizziness/vertigo in the aged population, healthcare costs due to dizziness/vertigo will increase rapidly in South Korea. Thus, a guideline for cost-effective management of dizziness/vertigo should be established to reduce the healthcare costs due to these common symptoms.

**Keywords:** Dizziness; Vertigo; Health Care Economics; Insurance; Healthcare Costs; Health Policy

**Disclosure**

Dr. Ji-Soo Kim serves as an Associate Editor of *Frontiers in Neuro-otology* and on the editorial boards of the *Journal of Clinical Neurology*, *Frontiers in Neuro-ophthalmology*, *Journal of Neuro-ophthalmology*, and *Journal of Vestibular Research*, *Journal of Neurology and Medicine*. The other authors have nothing to disclose.

**Author Contributions**

Conceptualization: Kim JS. Data curation: Lee H. Formal analysis: Lee JR, Lee H. Investigation: Kim HJ, Lee JR, Lee H, Kim JS. Methodology: Lee H. Visualization: Kim HJ. Writing - original draft: Kim HJ. Writing - review & editing: Kim JS, Lee H.

## INTRODUCTION

Dizziness/vertigo is one of the major reasons leading to hospital visits, with a 1-year prevalence of 20–30%.[1-3] Although numerous disorders may cause dizziness/vertigo, more than 80% of cases are ascribed to six major disorders, include benign paroxysmal positional vertigo (BPPV), psychogenic/persistent postural perceptual dizziness (PPPD), vascular vertigo/dizziness (VVD), vestibular migraine (VM), Meniere's disease (MD), and vestibular neuritis (VN).[4]

Dizziness/vertigo imposes a significant social and economic burden. In the USA, the annual healthcare expenditures for patients with dizziness/vertigo were estimated at $48.1 billion from 2007 to 2015.[5] In a recent study, the annual payments due to three episodic vestibular disorders (MD, VM, and BPPV) were calculated at about $151 billion, which was $60 billion more than those for the normal population.[6] In Ontario, Canada, the estimated hospital cost for dizziness is approximately C$31 million annually.[7] In Germany, patients with dizziness spend €818 more than those without dizziness during 1 year.[8] Thus, even though the healthcare costs due to dizziness/vertigo differ significantly among countries, research has consistently shown that patients with dizziness/vertigo spend more than those without this condition. However, research on healthcare costs due to dizziness/vertigo in the entire population at the national level is sparse. Dizziness/vertigo occurs across all age groups but is more prevalent in the aged population.[4] According to the World Population Ageing 2022, the life expectancy reached 72.8 years in 2019, an increase of almost 9 years since 1990. Accordingly, the global average life expectancy is projected to be 77.2 years in 2050.[9] The proportion of people aged 65 or more is expected to rapidly increase from 10% in 2022 to 16% by 2050 worldwide.[9] Thus, the number of patients with dizziness/vertigo is expected to increase, and predicting healthcare costs due to dizziness/vertigo is essential to establish healthcare policies for the future.

In South Korea, the government manages health insurance on a national basis, and all the claim data are collected by the Health Insurance Review and Assessment Service (HIRA). A major advantage of this data source lies in the inclusion of the entire population.[10,11]

This study aimed to evaluate the healthcare costs for six major diseases causing dizziness/vertigo, which include BPPV, psychogenic/PPPD, VVD, VM, MD, and VN, using public data from HIRA in South Korea.

## METHODS

### Study design, setting, and population

This retrospective cross-sectional study included all individuals diagnosed with BPPV, PPPD, VVD, VM, MD, or VN for dizziness/vertigo in 2022. The primary endpoint of our study was direct healthcare costs due to dizziness/vertigo, and the secondary endpoints were 1) the differences in direct healthcare costs and healthcare services among the diseases, and 2) differences in healthcare costs according to income level.

Our study used the claims data collected by HIRA from January 1 to December 31, 2022. South Korea has mandatory national health insurance, and 97% of Koreans are covered by the national health insurance. The government pays for the healthcare expenses using


https://doi.org/10.3346/jkms.2024.39.e214

taxes for the other 3% of people who are unable to pay for their health insurance premiums through Medical Aid.[12] Since HIRA gathers all the claims data from both national health insurance beneficiaries and Medical Aid recipients, almost all the information on healthcare utilization and diagnosis is available in South Korea.

The six disorders were defined using the codes adopted by the 7th edition of the Korean Standard Classification of Diseases, the Korean version of the 10th edition of the International Standard Classification of Diseases. BPPV (H81.1), MD (H81.0), and VN (H81.2) were defined only by the disease code. In contrast, psychogenic/PPPD was defined when the codes for psychiatric disorders (depressive episode [F32], recurrent depressive disorder [F33], or other anxiety disorders [F41]) were co-registered with the codes for disorders of vestibular function (H81) or dizziness and giddiness (R42). Likewise, VVD (cerebrovascular disorders [I60–I69]) and VM (migraine [G43]) were defined when the disease code was registered along with the codes H81 or R42.

## Variables

The age and sex of the patients were defined using the claims data. The patients' income was classified into 5 levels according to the insurance premiums, and the lowest level was for the Medical Aid recipients. We calculated the Charlson comorbidity index (CCI), which is an indicator of disease burden that predicts the risk of death, for each disorder.[13] The CCI considers 17 categories of concurrent conditions (age, myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular accident or transient ischemic attack, dementia, chronic obstructive pulmonary disease, connective tissue disease, peptic ulcer disease, liver disease, diabetes mellitus, hemiplegia, chronic kidney disease, solid tumor, leukemia, lymphoma, AIDS) to estimate a patient's 10-year survival.[14,15] The index assigns weights to each condition based on its impact on mortality.[16] Hospitalization was defined when a patient was hospitalized at least once in 2022. Healthcare utilization was assessed using the numbers of outpatient days, hospitalization days, and emergency room visit days based on the claims data. For each category of healthcare utilization, we calculated the healthcare costs.

## Statistical analyses

The baseline characteristics of the general population and the patients with dizziness/vertigo were presented as means with standard deviations, or numbers with percentages (**Table 1**). When a person visited the hospital multiple times, each visit was counted separately. Thus, **Table 2** was presented on a per-case basis, not on a per-person basis. The total healthcare cost was presented in terms of mean and 95% confidence intervals (CIs), and the mean healthcare cost was calculated by dividing the total healthcare cost by the number of patients with dizziness/vertigo. Any differences in healthcare costs among the income quintiles were analyzed using the two-tailed Student's *t*-test. The significance level was defined as a two-tailed $P$ value < 0.05, and the SAS Enterprise guide 7.15 (SAS Institute, Cary, NC, USA) was used for all analyses.

## Ethics statement

This study was reviewed and approved by the Institutional Review Board (IRB) of the Seoul National University Bundang Hospital (X-2309-850-901). No informed consent was required from patients due to the nature of public data from HIRA.


https://doi.org/10.3346/jkms.2024.39.e214

**Table 1.** Overall characteristics of the study populations

| Characteristics | Total population (N = 43,881,520) | Patients with dizziness (N = 1,805,159) | *P* value |
|---|---|---|---|
| Age, yr | 50.1 ± 14.4 | 59.9 ± 17.0 | < 0.001 |
| Sex | | | < 0.001 |
| Male | 21,781,644 (49.64) | 608,557 (33.71) | |
| Female | 22,099,876 (50.36) | 1,196,602 (66.29) | |
| Income | | | < 0.001 |
| 1st quintile (lowest) | 1,350,451 (3.08) | 106,943 (5.92) | |
| 2nd quintile | 9,271,246 (21.13) | 372,264 (20.62) | |
| 3rd quintile | 8,812,117 (20.08) | 318,578 (17.65) | |
| 4th quintile | 10,732,716 (24.46) | 400,698 (22.20) | |
| 5th quintile (highest) | 13,714,990 (31.25) | 606,676 (33.61) | |
| Residence area | | | < 0.001 |
| Big cities | 30,803,861 (70.20) | 1,158,616 (64.18) | |
| Small towns | 13,077,659 (29.80) | 646,543 (35.82) | |
| CCI | | | < 0.001 |
| 0 | 2,5583,393 (58.30) | 584,503 (32.38) | |
| 1 | 8,430,425 (19.21) | 414,298 (22.95) | |
| ≥ 2 | 9,867,702 (22.49) | 806,358 (44.67) | |

Values are presented as number (%) or mean ± standard deviation.
CCI = Charlson comorbidity index.

**Table 2.** Characteristics of study population by disease

| Characteristics | Overall (5,675,424, 100%) | BPPV (1,608,488, 28.34%) | MD (1,494,782, 26.34%) | Psychogenic/ PPPD (1,075,233, 18.95%) | VVD (91,158, 16.06%) | VM (362,384, 6.39%) | VN (222,956, 3.93%) | *P* |
|---|---|---|---|---|---|---|---|---|
| Age, yr | 62.9 ± 16.2 | 60.4 ± 15.9 | 61.1 ± 16.6 | 64.4 ± 16.0 | 71.5 ± 11.9 | 56.3 ± 17.1 | 60.2 ± 15.8 | < 0.001 |
| Sex | | | | | | | | < 0.001 |
| Male | 1,910,590 (33.66) | 460,081 (28.60) | 514,859 (34.44) | 345,489 (32.13) | 411,755 (45.17) | 97,272 (26.84) | 81,134 (36.39) | |
| Female | 3,764,834 (66.34) | 1,148,407 (71.40) | 979,923 (65.56) | 729,744 (67.87) | 499,826 (54.83) | 265,112 (73.16) | 141,822 (63.61) | |
| Income | | | | | | | | < 0.001 |
| 1st quintile (lowest) | 508,858 (8.97) | 96,293 (5.99) | 105,242 (7.04) | 155,435 (14.46) | 112,274 (12.32) | 27,437 (7.57) | 12,177 (5.46) | |
| 2nd quintile | 1,142,848 (20.14) | 327,473 (20.36) | 308,183 (20.62) | 214,426 (19.94) | 168,683 (18.50) | 78,621 (21.70) | 45,462 (20.39) | |
| 3rd quintile | 950,074 (16.74) | 277,101 (17.23) | 262,760 (17.58) | 169,399 (15.75) | 135,935 (14.91) | 66,799 (18.43) | 38,080 (17.08) | |
| 4th quintile | 1,205,263 (21.24) | 352,507 (21.92) | 330,479 (22.11) | 209,029 (19.44) | 183,294 (20.11) | 80,012 (22.08) | 49,942 (22.40) | |
| 5th quintile (highest) | 1,868,381 (32.92) | 555,114 (34.51) | 488,118 (32.65) | 326,944 (30.41) | 311,395 (34.16) | 109,515 (30.22) | 77,295 (34.67) | |
| Residence area | | | | | | | | < 0.001 |
| Big cities | 3,510,767 (61.86) | 1,062,941 (66.08) | 918,200 (61.43) | 652,197 (60.66) | 503,429 (55.23) | 224,886 (62.06) | 149,114 (66.88) | |
| Small towns | 2,164,657 (38.14) | 545,547 (33.92) | 576,582 (38.57) | 423,036 (39.34) | 408,152 (44.77) | 137,498 (37.94) | 73,842 (33.12) | |
| CCI | | | | | | | | < 0.001 |
| 0 | 1,444,238 (25.45) | 519,492 (32.30) | 410,064 (27.43) | 260,354 (24.21) | 65,506 (7.19) | 117,034 (32.30) | 71,788 (32.20) | |
| 1 | 1,263,303 (22.26) | 378,651 (23.54) | 350,156 (23.43) | 233,962 (21.76) | 159,416 (17.49) | 87,632 (24.18) | 53,486 (23.99) | |
| ≥ 2 | 2,967,883 (52.29) | 710,345 (44.16) | 734,562 (49.14) | 580,917 (54.03) | 686,659 (75.33) | 157,718 (43.52) | 97,682 (43.81) | |
| Admissions | 102,076 (1.80) | 30,628 (1.90) | 9,398 (0.63) | 7,036 (0.65) | 36,632 (4.02) | 6,609 (1.82) | 11,773 (5.28) | < 0.001 |
| Emergency room visits | 41,240 (0.73) | 16,320 (1.01) | 2,952 (0.20) | 1,930 (0.18) | 12,752 (1.40) | 894 (0.25) | 6,392 (2.87) | < 0.001 |
| Healthcare utilization | 1.07 ± 1.01 | 1.05 ± 0.80 | 1.03 ± 0.58 | 1.03 ± 0.68 | 1.22 ± 1.89 | 1.06 ± 0.81 | 1.16 ± 1.10 | < 0.001 |
| Outpatient days | 1.00 ± 0.06 | 1.00 ± 0.03 | 1.00 ± 0.03 | 1.00 ± 0.10 | 1.00 ± 0.06 | 1.00 ± 0.04 | 1.00 ± 0.04 | |
| Hospitalization days | 5.14 ± 6.32 | 3.84 ± 5.04 | 5.40 ± 5.90 | 5.71 ± 6.82 | 6.56 ± 7.69 | 4.42 ± 4.93 | 3.98 ± 3.78 | |
| Emergency room visit days | 3.73 ± 5.63 | 2.35 ± 3.58 | 3.06 ± 4.56 | 3.90 ± 6.32 | 5.94 ± 7.86 | 3.06 ± 3.79 | 3.18 ± 3.17 | |

Values are presented as number (%) or mean ± standard deviation.
BPPV = benign paroxysmal positional vertigo, MD = Meniere's disease, PPPD = persistent postural perceptual dizziness, VVD = vascular vertigo/dizziness, VM = vestibular migraine, VN = vestibular neuritis, CCI = Charlson comorbidity index.


https://doi.org/10.3346/jkms.2024.39.e214

## RESULTS

In 2022, 4.1% (n = 1,805,159) of 43,881,520 adults aged 20 or more visited hospitals due to the six major diseases causing dizziness/vertigo in South Korea. Compared to the general population, patients with dizziness/vertigo were more often female, elderly, and residents of small towns (**Table 1**, **Figs. 1-3**). The patients with dizziness/vertigo showed a higher proportion of CCI scores ≥ 2, lowest income (first quintile), and highest income (fifth quintile) than the general population (**Table 1**).

There were 5,675,424 hospital visits due to these diseases. BPPV (28.34%) was the most common diagnosis, followed by MD (26.34%), psychogenic/PPPD (18.95%), VVD (16.06%), and VN (3.93%). **Table 2** shows the characteristics of each disorder. VN accounted for the highest proportions of admissions (5.28%) and emergency room visits (2.87%), while MD corresponded to the lowest proportions (admission = 0.63%, emergency room visit = 0.20%).

In 2022, the total population registered in the national health insurance system was 51.41 million in South Korea, and the annual healthcare costs were summed at ₩83.4668 trillion (approximately $62 billion). Thus, the annual healthcare cost per person was ₩1,623,967, and the average healthcare cost per outpatient visit or admission day was ₩73,948.[17] The annual healthcare costs for the six major vestibular disorders were ₩547.8 billion (approximately $406.5 million) in 2022. The vestibular disorder with the highest healthcare

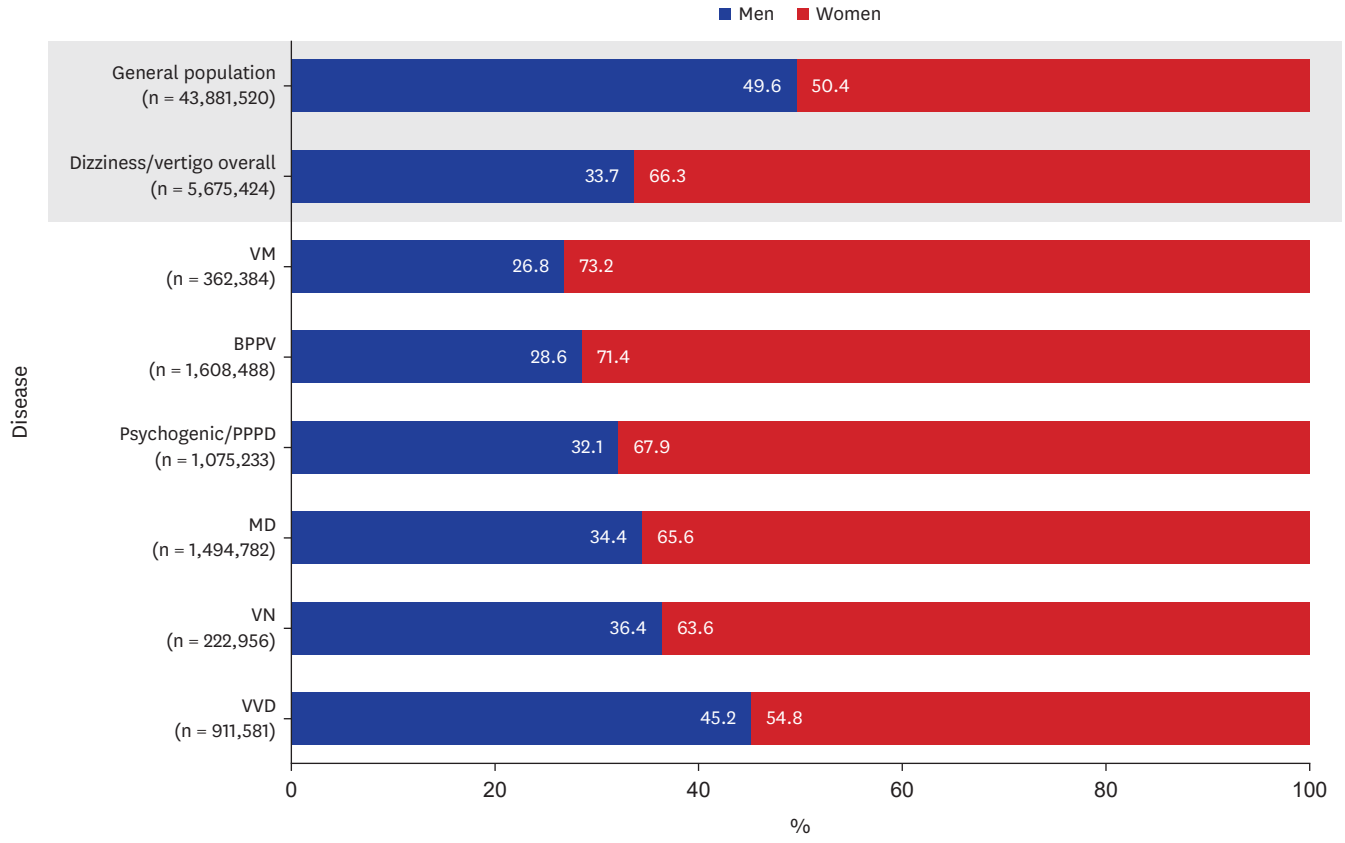


**Fig. 1.** Distribution of sex by disease. Likewise dizziness/vertigo overall, the six major diseases causing dizziness/vertigo showed a female predominance ($P < 0.001$).
VM = vestibular migraine, BPPV = benign paroxysmal positional vertigo, PPPD = persistent postural perceptual dizziness, MD = Meniere's disease, VN = vestibular neuritis, VVD = vascular vertigo/dizziness.


https://doi.org/10.3346/jkms.2024.39.e214

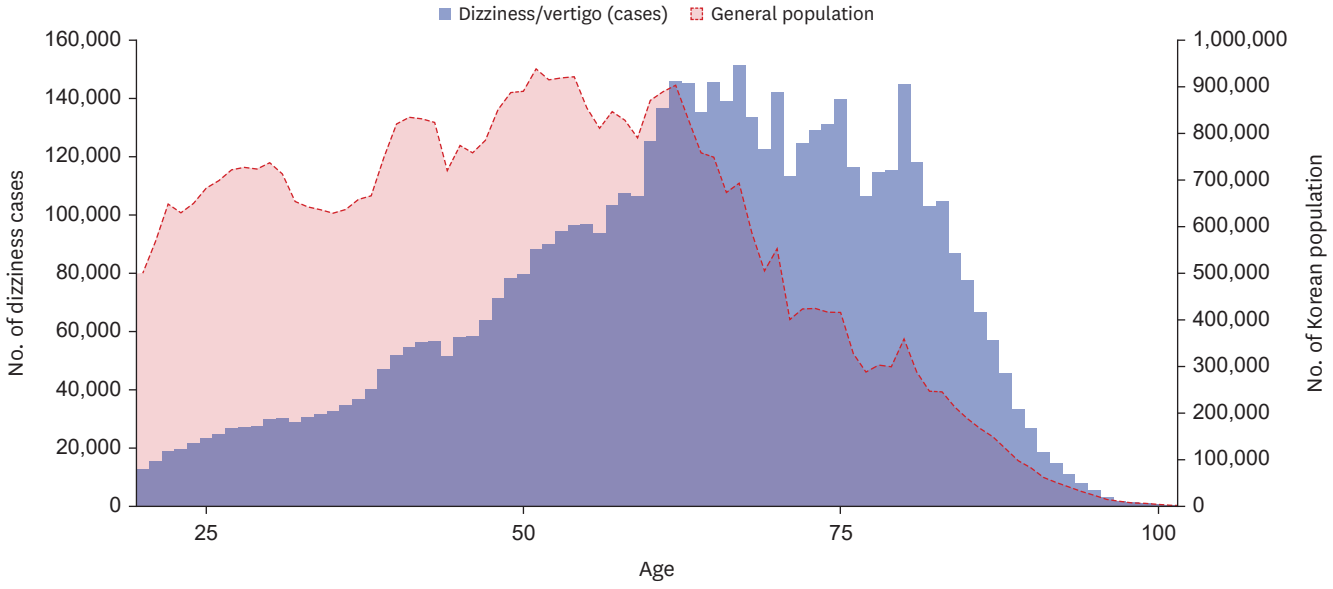


**Fig. 2.** Distribution of age in general population and patients with dizziness/vertigo. The patients with dizziness/vertigo are more likely to be older than the general population.

costs was BPPV (₩183.5 billion), followed by VVD (₩158.8 billion), MD (₩82.2 billion), psychogenic/PPPD (₩60.3 billion), VN (₩32.9 billion), and VM (₩30.1 billion, **Fig. 4**). In contrast, the healthcare costs per each case were highest for VVD (₩174,254), followed by VN (₩147,536), BPPV (₩114,051), VM (₩83,174), psychogenic/PPPD (₩56,037), and MD (₩55,012, **Fig. 4**).

The mean direct cost incurred by dizziness/vertigo per hospital visit or admission day was ₩96,524 (CI, ₩96,194–₩96,855), which was 31% more than that spent for other conditions (₩73,948).

We estimated the number of hospital visits due to dizziness/vertigo in South Korea in 2050. According to the data from the Korean Statistical Information Service (KOSIS), the general population aged over 20 years is expected to decrease by approximately 4.3% (n = 41,998,545) in 2050, but the elderly (over 65 years) will increase by 99% (n = 18,907,853) compared to those in 2022. The prevalence of dizziness/vertigo increases with age, and more dramatically in those over 60 (**Supplementary Fig. 1**). When the age-specific prevalence of dizziness/vertigo found in this study is applied to the population data in 2050 estimated from the KOSIS, the number of hospital visits due to dizziness/vertigo will increase by 32.3%.

## DISCUSSION

This study assessed, for the first time, the healthcare costs due to dizziness/vertigo using public data for the entire population of South Korea.

First, about 4.1% of the total population aged 20 or more visited hospitals due to dizziness/vertigo during the study period of one year. In a survey performed on a randomly selected 2,064 people aged 18–64 years in London in 1998, 23.3% (n = 480) had experienced dizziness during the past month, and 46.9% (225/480) of them reported some degree of handicap


https://doi.org/10.3346/jkms.2024.39.e214

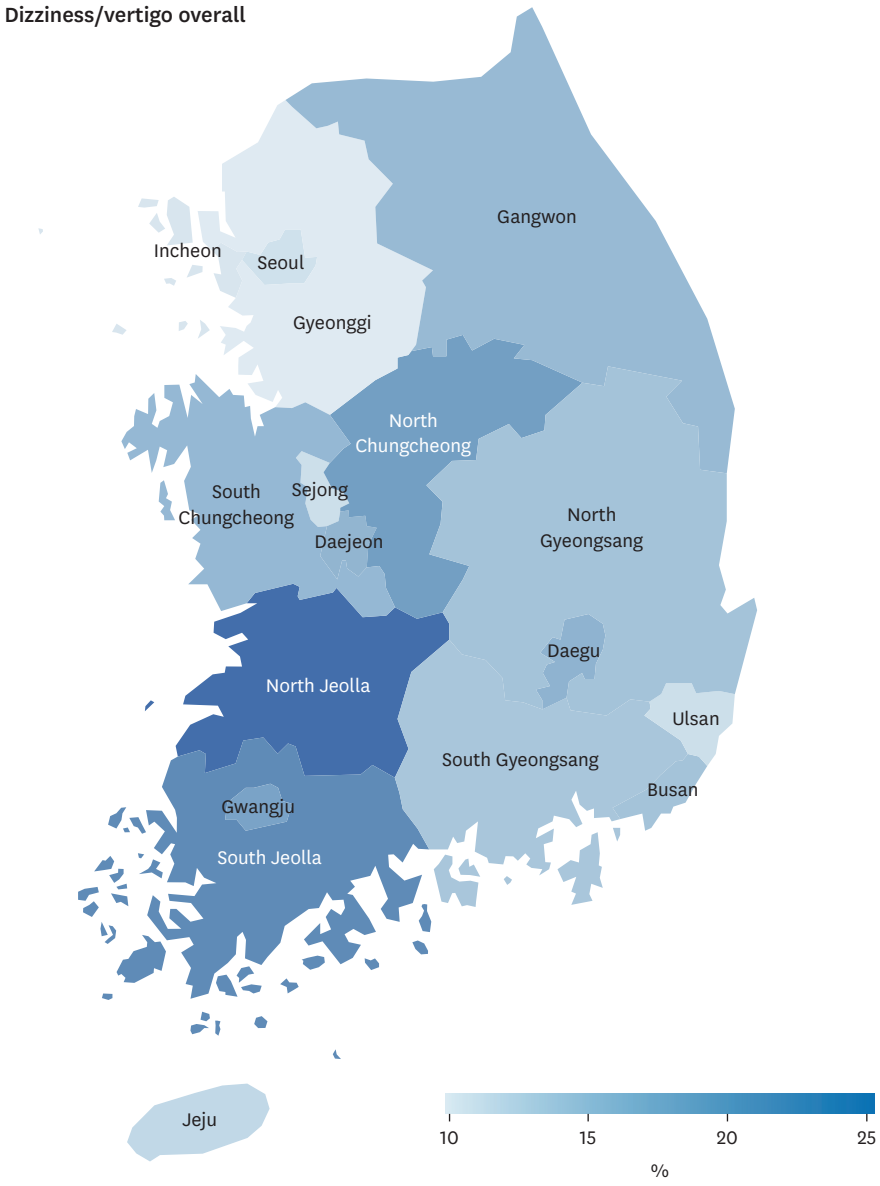


**Fig. 3.** Heat map of the proportion of patients with dizziness/vertigo relative to the population in 17 regions of South Korea. The proportion of dizzy patients are higher in the rural areas with small towns while it is lower in the large cities and their nearby areas.

due to dizziness. Finally, a quarter (55/225) of those handicapped by dizziness sought any form of healthcare.[18] Thus, approximately 2.1% (55/2,064) of the population appears to have received medical treatments due to dizziness/vertigo according to that study. According to another study using data from the German National Health Interview Survey 2023, 22.9% of the general population aged 18 years or more experienced dizziness/vertigo during the last 12 months, and 1.8% required medical consultation because of dizziness/vertigo.[19] In our study, the proportion of patients with hospital visits due to dizziness/vertigo was somewhat higher than that reported in the previous studies. This may have reflected the relatively easier accessibility of the healthcare system in South Korea than in other countries.[20]


https://doi.org/10.3346/jkms.2024.39.e214

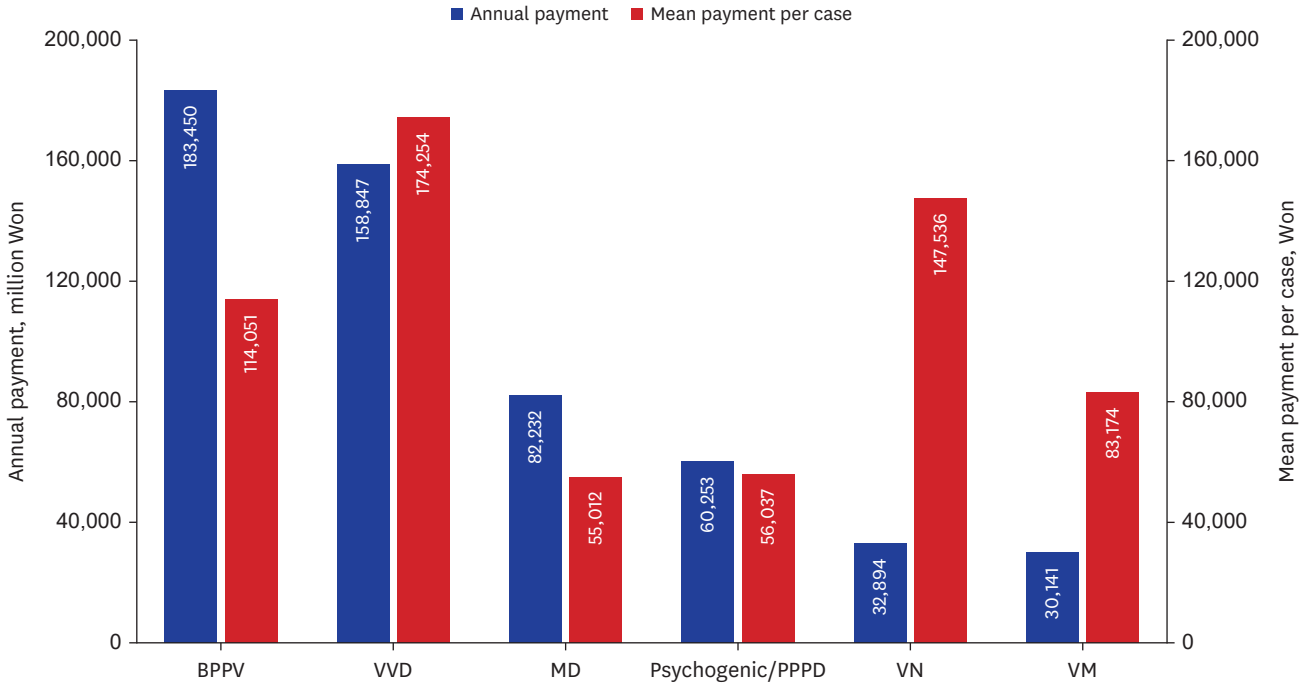


**Fig. 4.** Total healthcare costs and mean payments per hospital visit in Korean Won. The disease with the highest total healthcare cost is BPPV, followed by VVD, MD, psychogenic/PPPD, VN, and VM. The average payment per each hospital visits for the six major diseases causing dizziness/vertigo was ₩96,524 (confidence interval, ₩96,194–₩96,855). The disease with the highest healthcare cost per hospital visit is VVD, followed by VN, BPPV, VM, psychogenic/BPPV, and MD.
BPPV = benign paroxysmal positional vertigo, VVD = vascular vertigo/dizziness, MD = Meniere's disease, PPPD = persistent postural perceptual dizziness, VM = vestibular migraine, VN = vestibular neuritis.

In this study, the proportion of dizzy patients was higher in those residing in small towns than in the general population (**Fig. 3**). Recently, the population has been decreasing, and the residents are mostly older adults in the small towns in South Korea. Since the prevalence of dizziness/vertigo is higher in older adults, the higher proportion of dizzy patients may be explained by the aged population in the small towns. The proportion of dizzy patients was also higher in the population with high or low income levels. It is conceivable that the population with a high income level is more likely to visit hospitals when they experience dizziness/vertigo. However, the population with a low income level also showed a higher proportion of dizzy patients. Previous studies have also shown that those with lower income levels more commonly report subjective dizziness.[21,22] In addition, since people with low incomes can receive healthcare at a very low cost in South Korea, more hospital visits could have been made even in the low-income group.

The CCI is a widely used method of estimating the risk of death from comorbid diseases as a predictor of long-term prognosis and survival. In this study, patients with dizziness had higher CCI scores than the general population (52.3% vs. 22.5%). This contradicts the result of a previous study, in which the CCI scores were mostly 0, not different from those of the controls.[6] When calculating the CCI, the patient's age, sex, and comorbid conditions (myocardial infarction, congestive heart failure, peripheral vascular disease, etc.) are considered.[23] A previous study performed in the USA analyzed the claim data from private insurance subscribers aged 0 to 64. Therefore, elderly patients were not included. On the other hand, our data included the entire population, and thus many older adults over 65 years of age were included. Thus, it seems reasonable that our patients had higher CCI scores,


https://doi.org/10.3346/jkms.2024.39.e214

where one point is added for every ten years after 50 years old (< 50 years: 0 points, 50–59 years: +1 point, 60–69 years: +2 points, 70–79 years: +3 points, ≥ 80 years: +4 points).[15,23]

The patients with VN had the second-highest healthcare costs per case, next to VVD. Although VN is a peripheral disorder with spontaneous resolution, the high healthcare costs reflect improper clinical practice for the diagnosis and management of this disorder.[24] In addition, the patients with VN showed the highest admission rate with a mean admission day of 4.0 days. In the future, the proportion of the aged population will increase, and the healthcare costs for dizziness/vertigo will inevitably increase. As was demonstrated in this study, managing dizziness/vertigo incurs more healthcare costs than other diseases. Thus, guidelines for cost-effective management of dizziness/vertigo should be established to reduce the healthcare costs due to these common symptoms.

This study had several limitations. First, this study only analyzed the data from the six major diseases that cause dizziness/vertigo. According to a previous study, the six disorders covered in this study account for 80% of all dizziness/vertigo. The remaining 20% of diseases that cause dizziness/vertigo include neurodegenerative disorders, tumors, and hereditary diseases, which require more healthcare costs for diagnosis and treatments. Therefore, the direct healthcare costs calculated in this study may have been underestimated. Second, the data analyzed in this study did not include the healthcare costs uncovered by the national insurance. Especially, the high-income patients may have been subjected to the tests with a high cost, such as magnetic resonance imaging, which is not covered by the national insurance for peripheral vestibular disorders.

## SUPPLEMENTARY MATERIAL

### Supplementary Fig. 1

Ratio of hospital visits due to dizziness/vertigo by age. The prevalence of dizziness/vertigo was calculated by (the number of cases of dizziness/vertigo/the number of populations). The lowest ratio was observed in those aged 20–24 years. The ratio rapidly increases in those aged 60 or more. In the population aged 75 or more, 9.7% of the population visit the hospital due to dizziness/vertigo.

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