Prevalence of common causes of neuropathic pain in Korea: population-based observational study

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Abstract
Objective: To investigate the prevalence of complex regional pain syndrome (CRPS), post-herpetic neuralgia (PHN), trigeminal neuralgia (TN), and diabetic neuropathy (DN), common causes of neuropathic pain encountered in pain clinics.

Methods: We investigated the period prevalence rate of CRPS, PHN, TN, and DN using data from a Korean national electronic database from 2009 to 2013.

Results: The prevalence of CRPS decreased slightly throughout the study period, while the prevalence of PHN increased from 2009 to 2013. The prevalence of TN was reduced over the same period. The prevalence of DN increased from 2009 to 2012 but decreased in 2013. All four neuropathic diseases were more prevalent in individuals aged over 70 years. The prevalence of CRPS, PHN, and TN were more common in women than in men, but DN showed no gender difference.

Conclusion: While the prevalence of CRPS and TN has decreased in Korea, that of PHN and DN has increased. With the exception of DN, the neuropathic diseases were more prevalent in women. Further studies are necessary to investigate the risk factors and socioeconomic burden for each disease, and national efforts are essential to limit the development of these preventable neuropathic diseases.

Keywords
Prevalence, complex regional pain syndrome, post-herpetic neuralgia, trigeminal neuralgia, diabetic neuropathy, neuropathic pain

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Introduction

Neuropathic pain typically persists for several years or even decades, does not respond to conventional analgesic treatment such as non-steroidal anti-inflammatory drugs and opioids, and debilitates the quality of life of the patient. It is important to evaluate the epidemiology of neuropathic pain in the general population to determine its socio-economic burden.

Several studies have examined the prevalence of neuropathic pain. Bouhassira et al. reported that the prevalence of chronic pain with neuropathic characteristics was 6.9% in the general population in France according to a postal survey. In Brazil, the prevalence of chronic pain with neuropathic characteristics was reported to be 10% in the municipality of São Luís. According to Gajria et al., the prevalence of diagnosis associated with chronic neuropathic pain was 13 per 1000 in one region of London, United Kingdom. To date, however, little has been reported on the prevalence of chronic neuropathic pain attributable to a specific condition such as complex regional pain syndrome (CRPS), post-herpetic neuralgia (PHN), trigeminal neuralgia (TN), or diabetic neuropathy (DN). Although its mechanism has not been clearly described, several studies have defined CRPS as a neuropathic pain state. We therefore investigated the prevalence of CRPS as part of neuropathic pain.

Hecke et al. reported the prevalence of PHN (3.9–42.0/100,000 person years [PY]), TN (12.6–28.9/100,000 PY), and painful diabetic neuropathy (15.3–72.3/100,000PY). Sandroni et al. reported that the incidence and prevalence rate of CRPS type 1 in 1990 in Olmsted County were 5.46/100,000 and 20.57/100,000, respectively, and that the female-to-male ratio was 4:1. McDonald et al. reported that the lifetime prevalence of PHN and TN was 0.7/1000 in the London area. Savettieri et al. reported that the prevalence of DN with somatic symptoms was 3 per 1000 people in two Sicilian municipalities according to a door-to-door survey. Mueller et al. reported that the lifetime prevalence of TN was estimated to be 0.3%.

These previous studies were limited to specific regions within a country during a defined study period. Given the regional variability in age and sex ratio within a country, nationwide data are essential to evaluate the effects of a disease on society. Koopman et al. reported an incidence rate of TN (12.6/100,000 PY) in The Netherlands in 2009, while Hall et al. reported an incidence rate of PHN (3.4/1,000 PY) in the UK general population. These studies were not population-based, however, but were instead based on primary care records, and clear diagnostic criteria may not have been used. Other studies by Mueller et al. and Schwaiger et al. used clear diagnostic criteria and face-to-face interviews to collect data.

In recent years, many countries have implemented the use of electronic medical records systems, thus enabling nationwide epidemiologic research. In Korea, all citizens have been covered by the National Health Insurance Service (NHIS) since 1989, and the Health Insurance Review and Assessment Service (HIRA) under NHIS has computerized all medical records since 2005. It is therefore possible to investigate the incidence or prevalence of specific diseases and their yearly change in Korea.

Because few studies to date have reported the nation-wide annual prevalence of rare neuropathic diseases, we sought to investigate the prevalence of CRPS, PHN, TN, and DN using HIRA data and to determine whether the prevalence of these rare neuropathic diseases changed from 2009 to 2013 in Korea.

Materials and methods

Ethical statement and informed consent

This study was approved by the institutional review board (IRB) of Bucheon
St. Mary’s Hospital of the Catholic University of Korea (no. HIRB00E92001). The need for informed consent was waived by the IRB because this study used existing data that were in the public domain.

**Data source**

Demographic data including age and sex are collected by the NHIS according to an individual’s Korean identification (ID) number. All medical procedures including diagnosis, physical and laboratory examination, treatment, prescription, nursing procedures, and hospitalization are also reported in the HIRA computerized database by Korean ID number.

Population data from 2009 to 2013 were used in this study and were obtained from the National Statistical Office of South Korea (http://kosis.kr).

**Case definition**

Patients with CRPS, PHN, TN, and DN were identified by searching the data using the International Classification of Disease 9th revision code (ICD-9) and the relevant domestic HIRA codes for CRPS (M890 for CPRS type 1, G564 for CRPS type 2), PHN (G530), TN (G500), and DN (G590 for diabetic mononeuropathy, G632 for diabetic poly-neuropathy). For CRPS, cases of CRPS type 1 and CRPS type 2 were taken together, while cases of diabetic mononeuropathy and diabetic poly-neuropathy were taken together for DN.

The prevalence rate was calculated by dividing the number of cases of CRPS, PHN, TN, and DN by the population for a given year and multiplying by 100,000. In the present study, prevalence rate is expressed as cases per 100,000 persons.

Given that variability in population factors such as gender proportion and age throughout the study period may have affected the number of cases identified, we standardized the prevalence rate to the population in 2009 to determine whether there were changes over time in the prevalence of neuropathic disease.

**Statistical analysis**

All variables were described by number or percentage. Standardization was performed for comparison by year, gender, and age using a direct method. The standardized rate was calculated using the population of 2009 as a standard population. Statistical analyses were performed using SAS 9.4 (SAS Institute, Inc, Cary, NC).

Statistical analysis in our study was supported by consultation with the Medical Statistical Office of the Catholic Research Coordinating Center (https://cmccrc.cmcnu.or.kr/).

**Results**

The prevalence of CRPS showed a trend towards a gradual reduction over time, from 32.8 per 100,000 in 2009 to 26.3 per 100,000 in 2013. Prevalence was highest for the age group 70 to 79 years from 2009 to 2012 in both males and females, but was highest in the age group ≥80 years in 2013 among males. CRPS was more prevalent in women than in men (ratio 1:1.2, Table 1).

The prevalence of PHN increased from 161.5 per 100,000 in 2009 to 224.6 per 100,000 in 2013. Prevalence was highest for the age group 70 to 79 years in both males and females, but was highest in the age group ≥80 years in 2013 among males. CRPS was more prevalent overall in women (ratio 1:1.7, Table 2).

The prevalence of TN decreased slightly from 81.8 per 100,000 in 2009 to 76.8 per 100,000 in 2013. Prevalence was highest for the age group 70 to 79 years in men and ≥80 years in women, and was more prevalent overall in women (ratio 1:2.2, Table 3).

The prevalence of DN increased from 80.7 per 100,000 in 2009 to 124.7 per
Table 1. Standardized prevalence of CRPS in Korea 2009–2013.

| Age group (y) | 2013 Cases | Standardized prevalence | 2012 Cases | Standardized prevalence | 2011 Cases | Standardized prevalence | 2010 Cases | Standardized prevalence | 2009 Cases | Population | Prevalence |
|---------------|------------|-------------------------|------------|-------------------------|------------|-------------------------|------------|-------------------------|------------|------------|------------|
| Men           |            |                        |            |                         |            |                         |            |                         |            |            |            |
| Total         | 6,533      | 23.4                   | 6,471      | 24.0                    | 6,345      | 24.2                    | 6,601      | 25.9                    | 7,429      | 24,929,939 | 29.8       |
| <10           | 9          | 0.4                    | 9          | 0.4                     | 8          | 0.3                     | 16         | 0.6                     | 47         | 2,553,592  | 1.8        |
| 10–19         | 83         | 2.5                    | 73         | 2.2                     | 74         | 2.1                     | 126        | 3.5                     | 187        | 3,599,148  | 5.2        |
| 20–29         | 480        | 13.9                   | 467        | 13.5                    | 516        | 14.7                    | 496        | 13.9                    | 507        | 3,636,509  | 13.9       |
| 30–39         | 510        | 12.5                   | 528        | 12.7                    | 528        | 12.5                    | 619        | 14.5                    | 607        | 4,269,498  | 14.2       |
| 40–49         | 831        | 18.3                   | 917        | 20.3                    | 891        | 19.7                    | 930        | 20.6                    | 1,045      | 4,439,164  | 23.5       |
| 50–59         | 1,406      | 34.8                   | 1,417      | 36.2                    | 1,295      | 34.3                    | 1,340      | 37.8                    | 1,517      | 3,261,648  | 46.5       |
| 60–69         | 1,543      | 71.4                   | 1,618      | 77.7                    | 1,626      | 80.5                    | 1,712      | 85.6                    | 2,065      | 1,920,187  | 107.5      |
| 70–79         | 1,423      | 109.5                  | 1,287      | 103.3                   | 1,239      | 108.0                   | 1,191      | 111.2                   | 1,294      | 997,027    | 129.8      |
| >80           | 406        | 114.5                  | 322        | 98.9                    | 317        | 105.9                   | 309        | 109.4                   | 296        | 253,166    | 116.9      |
| Women         |            |                        |            |                         |            |                         |            |                         |            |            |            |
| Total         | 8,103      | 29.2                   | 7,736      | 28.6                    | 7,641      | 29.1                    | 8,187      | 32.2                    | 8,879      | 24,843,206 | 35.7       |
| <10           | 3          | 0.1                    | 3          | 0.1                     | 7          | 0.3                     | 16         | 0.7                     | 39         | 2,369,377  | 1.6        |
| 10–19         | 69         | 2.3                    | 58         | 1.9                     | 62         | 2.0                     | 83         | 2.6                     | 141        | 3,212,502  | 4.4        |
| 20–29         | 204        | 6.5                    | 213        | 6.7                     | 221        | 6.8                     | 298        | 9.0                     | 342        | 3,391,753  | 10.1       |
| 30–39         | 482        | 12.3                   | 455        | 11.4                    | 485        | 12.0                    | 575        | 14.0                    | 644        | 4,102,035  | 15.7       |
| 40–49         | 861        | 19.7                   | 906        | 20.9                    | 983        | 22.7                    | 1,020      | 27.8                    | 1,393      | 4,290,331  | 32.5       |
| 50–59         | 1,897      | 47.6                   | 1,912      | 49.3                    | 1,801      | 48.0                    | 1,924      | 54.6                    | 2,134      | 3,246,429  | 65.7       |
| 60–69         | 1,854      | 80.2                   | 1,819      | 81.0                    | 1,846      | 84.0                    | 1,870      | 85.3                    | 1,993      | 2,127,305  | 93.7       |
| 70–79         | 2,171      | 122.4                  | 1,899      | 110.1                   | 1,736      | 106.9                   | 1,762      | 113.8                   | 1,769      | 1,480,410  | 119.5      |
| >80           | 744        | 88.8                   | 615        | 78.4                    | 619        | 84.5                    | 601        | 87.1                    | 548        | 623,064    | 88.0       |
| Total         | 14,636     | 26.3                   | 14,207     | 26.3                    | 13,986     | 26.6                    | 14,788     | 29.0                    | 16,308     | 49,773,145 | 32.8       |

Note: Standard population was that in 2009. Prevalence is cases per 100,000.
Table 2. Standardized prevalence of PHN in Korea 2009–2013.

| Age group (y) | 2013 Cases | Standardized prevalence | 2012 Cases | Standardized prevalence | 2011 Cases | Standardized prevalence | 2010 Cases | Standardized prevalence | 2009 Cases | Population | Prevalence |
|---------------|------------|-------------------------|------------|-------------------------|------------|-------------------------|------------|-------------------------|------------|------------|------------|
| Men           |            |                         |            |                         |            |                         |            |                         |            |            |            |
| Total         | 48,519     | 168.2                   | 44,712     | 160.4                   | 39,116     | 145.7                   | 34,383     | 132.3                   | 30,688     | 24,929,939 | 123.1      |
| <10           | 45         | 1.9                     | 30         | 1.2                     | 42         | 1.7                     | 35         | 1.4                     | 43         | 2,553,592  | 1.7        |
| 10–19         | 475        | 14.5                    | 508        | 15.0                    | 442        | 12.6                    | 407        | 11.3                    | 405        | 3,599,148  | 11.3       |
| 20–29         | 1,254      | 36.3                    | 1,366      | 39.5                    | 1,164      | 33.3                    | 1,102      | 30.9                    | 1,022      | 3,636,509  | 28.1       |
| 30–39         | 3,069      | 75.0                    | 2,834      | 68.1                    | 2,518      | 59.8                    | 2,345      | 54.9                    | 2,142      | 4,269,498  | 50.2       |
| 40–49         | 5,274      | 116.1                   | 5,001      | 110.9                   | 4,445      | 98.4                    | 4,113      | 91.1                    | 3,682      | 4,439,164  | 82.9       |
| 50–59         | 10,327     | 255.5                   | 9,360      | 239.0                   | 8,153      | 216.0                   | 6,783      | 191.4                   | 5,934      | 3,261,648  | 181.9      |
| 60–69         | 12,515     | 579.4                   | 11,767     | 564.7                   | 10,585     | 524.0                   | 9,381      | 469.2                   | 8,518      | 1,920,187  | 443.6      |
| 70–79         | 12,651     | 973.6                   | 11,384     | 913.4                   | 9,696      | 845.3                   | 8,304      | 775.6                   | 7,340      | 997,027    | 736.2      |
| ≥80           | 3,524      | 994.1                   | 3,079      | 946.0                   | 2,543      | 849.4                   | 2,267      | 802.8                   | 1,973      | 253,166    | 779.3      |
| Women         |            |                         |            |                         |            |                         |            |                         |            |            |            |
| Total         | 79,138     | 281.2                   | 74,678     | 272.9                   | 64,461     | 242.9                   | 56,323     | 219.2                   | 49,701     | 24,843,206 | 200.1      |
| <10           | 39         | 1.7                     | 43         | 1.9                     | 41         | 1.8                     | 52         | 2.3                     | 41         | 2,369,377  | 1.7        |
| 10–19         | 475        | 16.0                    | 486        | 15.9                    | 480        | 15.2                    | 400        | 12.4                    | 342        | 3,212,502  | 10.6       |
| 20–29         | 1,723      | 54.9                    | 1,821      | 57.5                    | 1,631      | 50.5                    | 1,451      | 44.0                    | 1,345      | 3,391,753  | 39.7       |
| 30–39         | 3,829      | 97.6                    | 3,660      | 91.4                    | 3,058      | 75.6                    | 2,856      | 69.7                    | 2,490      | 4,102,035  | 60.7       |
| 40–49         | 7,742      | 176.8                   | 7,659      | 176.8                   | 6,679      | 154.3                   | 6,221      | 143.6                   | 5,691      | 4,290,331  | 132.6      |
| 50–59         | 19,690     | 494.2                   | 18,643     | 481.0                   | 15,972     | 425.5                   | 13,246     | 375.9                   | 11,245     | 3,246,429  | 346.4      |
| 60–69         | 19,404     | 839.1                   | 18,402     | 819.7                   | 16,298     | 741.8                   | 14,515     | 662.2                   | 13,110     | 2,127,305  | 616.3      |
| 70–79         | 19,671     | 1109.3                  | 18,085     | 1049.0                  | 15,209     | 936.4                   | 13,216     | 853.9                   | 11,759     | 1,480,410  | 794.3      |
| ≥80           | 7,429      | 886.7                   | 6,775      | 863.8                   | 5,788      | 789.8                   | 5,039      | 729.9                   | 4,182      | 623,064    | 671.2      |
| Total         | 127,657    | 224.6                   | 119,390    | 216.5                   | 103,577    | 194.2                   | 90,706     | 175.6                   | 80,389     | 49,773,145 | 161.5      |

Note: Standard population was that in 2009. Prevalence is cases per 100,000.
Table 3. Standardized prevalence of TN in Korea 2009–2013.

| Age group (y) | 2013 Cases | Standardized prevalence | 2012 Cases | Standardized prevalence | 2011 Cases | Standardized prevalence | 2010 Cases | Standardized prevalence | 2009 Cases | Population | Prevalence |
|---------------|------------|-------------------------|------------|-------------------------|------------|-------------------------|------------|-------------------------|------------|------------|------------|
| Men           |            |                         |            |                         |            |                         |            |                         |            |            |            |
| Total         | 13,239     | 47.8                    | 13,472     | 50.0                    | 13,458     | 51.2                    | 13,412     | 52.2                    | 12,895     | 24,929,939 | 51.7       |
| <10           | 18         | 0.8                     | 17         | 0.7                     | 20         | 0.8                     | 18         | 0.7                     | 25         | 2,553,592  | 1.0        |
| 10–19         | 290        | 8.9                     | 301        | 8.9                     | 334        | 9.5                     | 353        | 9.8                     | 356        | 3,599,148  | 9.9        |
| 20–29         | 779        | 22.6                    | 790        | 22.8                    | 885        | 25.3                    | 922        | 25.9                    | 840        | 3,636,509  | 23.1       |
| 30–39         | 1,642      | 40.1                    | 1,732      | 41.6                    | 1,777      | 42.2                    | 1,677      | 39.2                    | 1,744      | 4,269,498  | 40.8       |
| 40–49         | 2,191      | 48.3                    | 2,360      | 52.3                    | 2,413      | 53.4                    | 2,464      | 54.6                    | 2,378      | 4,439,164  | 53.6       |
| 50–59         | 2,837      | 70.2                    | 2,813      | 71.8                    | 2,735      | 72.5                    | 2,691      | 75.9                    | 2,583      | 3,261,648  | 79.2       |
| 60–69         | 2,579      | 119.4                   | 2,718      | 130.4                   | 2,612      | 129.3                   | 2,720      | 136.0                   | 2,660      | 1,920,187  | 138.5      |
| 70–79         | 2,465      | 189.7                   | 2,386      | 191.4                   | 2,304      | 200.9                   | 2,169      | 202.6                   | 1,953      | 997,027    | 195.9      |
| ≥80           | 609        | 171.8                   | 554        | 170.2                   | 540        | 180.4                   | 548        | 194.1                   | 510        | 253,166    | 201.4      |
| Women         |            |                         |            |                         |            |                         |            |                         |            |            |            |
| Total         | 28,857     | 105.9                   | 30,086     | 113.3                   | 29,757     | 114.2                   | 28,635     | 112.4                   | 27,801     | 24,843,206 | 111.9      |
| <10           | 23         | 1.0                     | 29         | 1.3                     | 23         | 1.0                     | 19         | 0.8                     | 31         | 2,369,377  | 1.3        |
| 10–19         | 462        | 15.6                    | 576        | 18.8                    | 612        | 19.3                    | 540        | 16.7                    | 587        | 3,212,502  | 18.3       |
| 20–29         | 1,388      | 44.2                    | 1,551      | 49.0                    | 1,636      | 50.7                    | 1,630      | 49.4                    | 1,714      | 3,391,753  | 50.5       |
| 30–39         | 2,850      | 72.6                    | 3,212      | 80.2                    | 3,285      | 81.2                    | 3,132      | 76.4                    | 3,271      | 4,102,035  | 79.7       |
| 40–49         | 4,718      | 107.7                   | 5,050      | 116.7                   | 5,315      | 122.8                   | 5,155      | 119.0                   | 5,037      | 4,290,331  | 117.4      |
| 50–59         | 7,083      | 177.8                   | 7,139      | 184.2                   | 6,871      | 183.0                   | 6,412      | 182.0                   | 5,983      | 3,246,429  | 184.3      |
| 60–69         | 5,630      | 243.5                   | 5,941      | 264.6                   | 5,739      | 261.2                   | 5,788      | 264.1                   | 5,542      | 2,127,305  | 260.5      |
| 70–79         | 5,230      | 294.9                   | 5,213      | 302.4                   | 4,889      | 301.0                   | 4,765      | 307.9                   | 4,495      | 1,480,410  | 303.6      |
| ≥80           | 1,830      | 218.4                   | 1,842      | 234.9                   | 1,715      | 234.0                   | 1,525      | 200.9                   | 1,466      | 623,064    | 235.3      |
| Total         | 42,096     | 76.8                    | 43,558     | 81.6                    | 43,215     | 82.7                    | 42,047     | 82.3                    | 40,696     | 49,773,145 | 81.8       |

Note: Standard population was that in 2009. Prevalence is cases per 100,000.
100,000 in 2012, and subsequently decreased slightly to 115.3 per 100,000 in 2013. Prevalence was highest for the age group 70 to 79, and no gender difference was observed (ratio 1:1.0, Table 4).

Discussion

In the present study, we report the standardized prevalence rates of CRPS, PHN, TN, and DN over a 5-year period in Korea. Our study is the first to report the prevalence of four rare neuropathic diseases and their change by year in a single-ethnic Asian country with a population over 50 million.

CRPS usually occurs from trauma, is extremely painful, and is associated with a particularly poor quality of life as well as extensive health-care and societal costs.18 Few studies to date have reported the prevalence of CRPS, however. Because CRPS type 1 and CRPS type 2 were considered together in our study, direct comparison with other studies may be difficult, although the prevalence of CRPS type 1 in our raw data was 17.8/100,000 in 2013, which was comparable to that reported by Sandroni et al.9 (20.57/100,000).

The prevalence of CRPS in Korea decreased slightly throughout the study period. Given that few studies to date have examined the change in prevalence or incidence of CRPS over time, the cause of this reduction is difficult to identify. As trauma is the main cause of CRPS, a reduced occurrence of trauma might be one reason for this reduction, although we were unable to obtain national statistics on trauma to verify this.

PHN is the most common complication of herpes zoster (HZ). Although several studies have examined the incidence of herpes zoster and PHN, few have reported on the prevalence of PHN. McDonald et al.10 reported that the lifetime prevalence of PHN was 0.7/1000. Direct comparison with our data was not possible, however, because they investigated lifetime prevalence while we examined prevalence within a specified period of time.

Our findings show that the prevalence of PHN has increased persistently from 2009 to 2013. We consider the increasing age of the population in Korea to be the main reason for this observation. PHN can be prevented by vaccination to reduce the incidence of HZ11 and better management of acute HZ,19 meaning that primary physicians and health policy makers should strongly recommend HZ vaccination to older individuals and provide active treatment for acute HZ.

TN is a unilateral painful disorder characterized by brief electric shock-like pain with abrupt onset and termination in the distribution area of the trigeminal nerve.20 McDonald et al.10 reported that the lifetime prevalence of TN was 0.7/1000 in the London area using data from a General Practice Linkage Scheme with the National Hospital for Neurology and Neurosurgery. Sjaastad and Bakketeig21 reported two cases of TN among 1838 parishioners in the age group 18 to 64 years using a face-to-face questionnaire. Using a self-assessment questionnaire and face-to-face interviews with clear diagnostic criteria, Mueller et al.12 reported that the estimated lifetime prevalence of TN in Essen city, Germany was 0.3%. Tallawy et al.22 reported that the prevalence of TN was 28/100,000 in people aged >37 years in Al Quseir City, Red Sea Governorate, Egypt using a door-to-door survey. In our study, the prevalence of TN was 51/100,000, although we examined the prevalence for a defined period of time while McDonald et al.10 and Mueller et al.12 investigated lifetime prevalence. While Tallawy et al. and Sjaastad and Bakketeig implemented an age limit in their study population, we included patients of all ages. In the study of Mueller et al.,12 7 of 10 patients with TN were women, resulting in an estimated male-to-female ratio of 1:2.3, which

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| Age group (y) | 2013 Cases | 2013 Standardized prevalence | 2012 Cases | 2012 Standardized prevalence | 2011 Cases | 2011 Standardized prevalence | 2010 Cases | 2010 Standardized prevalence | 2009 Cases | 2009 Population | 2009 Prevalence |
|--------------|------------|-------------------------------|------------|-------------------------------|------------|-------------------------------|------------|-------------------------------|------------|----------------|-----------------|
| Males        |            |                               |            |                               |            |                               |            |                               |            |                 |                 |
| Total        | 33,288     | 116.6                         | 34,462     | 124.9                         | 25,908     | 96.6                          | 21,287     | 82.7                          | 20,104     | 24,929,939     | 80.6            |
| <10          | 3          | 0.1                           | 1          | 0.0                           | 1          | 0.0                           | 0          | 0                            | 1          | 2,553,592      |                 |
| 10–19        | 72         | 2.2                           | 47         | 1.4                           | 33         | 0.9                           | 20         | 0.6                           | 23         | 3,599,148      | 0.6             |
| 20–29        | 161        | 4.7                           | 160        | 4.6                           | 119        | 3.4                           | 89         | 2.5                           | 90         | 3,636,509      | 2.5             |
| 30–39        | 975        | 23.8                          | 981        | 23.6                          | 702        | 16.7                          | 588        | 13.8                          | 558        | 4,269,498      | 13.1            |
| 40–49        | 3,673      | 80.9                          | 4,127      | 91.5                          | 2,972      | 65.8                          | 2,516      | 55.7                          | 2,526       | 4,439,164      | 56.9            |
| 50–59        | 9,335      | 231.0                         | 9,950      | 254.1                         | 6,990      | 185.2                         | 5,529      | 156                          | 5,181       | 3,261,648      | 158.8           |
| 60–69        | 10,650     | 493.0                         | 11,110     | 533.2                         | 8,857      | 438.5                         | 7,584      | 379.3                         | 7,185       | 1,920,187      | 374.2           |
| 70–79        | 7,914      | 609.0                         | 7,725      | 619.8                         | 5,654      | 492.9                         | 4,564      | 426.3                         | 4,241       | 997,027        | 425.4           |
| ≥80          | 1,581      | 446.0                         | 1,486      | 456.5                         | 1,085      | 362.4                         | 905        | 320.5                         | 779         | 253,166        | 307.7           |
| Females      |            |                               |            |                               |            |                               |            |                               |            |                 |                 |
| Total        | 31,862     | 114.0                         | 33,645     | 124.4                         | 25,473     | 96.5                          | 21,206     | 83.5                          | 20,056     | 24,843,206     | 80.7            |
| <10          | 4          | 0.2                           | 4          | 0.2                           | 0          | 0.0                           | 0          | 0                            | 0          | 2,369,377      |                 |
| 10–19        | 58         | 2.0                           | 36         | 1.2                           | 26         | 0.8                           | 20         | 0.6                           | 21         | 3,212,502      | 0.7             |
| 20–29        | 134        | 4.3                           | 150        | 4.7                           | 101        | 3.1                           | 120        | 3.6                           | 121        | 3,391,753      | 3.6             |
| 30–39        | 533        | 13.6                          | 578        | 14.4                          | 451        | 11.2                          | 401        | 9.8                           | 425        | 4,102,035      | 10.4            |
| 40–49        | 2,068      | 47.2                          | 2,282      | 52.8                          | 1,918      | 44.3                          | 1,814      | 41.9                          | 1,772       | 4,290,331      | 41.3            |
| 50–59        | 6,736      | 169.1                         | 7,461      | 192.5                         | 5,724      | 152.5                         | 4,636      | 131.6                         | 4,419       | 3,246,429      | 136.1           |
| 60–69        | 9,896      | 427.9                         | 10,869     | 484.2                         | 8,214      | 373.9                         | 6,899      | 314.8                         | 6,728       | 2,127,305      | 316.3           |
| 70–79        | 10,539     | 594.3                         | 10,613     | 615.6                         | 7,578      | 466.6                         | 6,263      | 404.6                         | 5,717       | 1,480,410      | 386.2           |
| ≥80          | 2,875      | 343.2                         | 2,761      | 352.0                         | 1,973      | 269.2                         | 1,600      | 231.8                         | 1,289       | 623,064        | 206.9           |
| Total        | 65,150     | 115.3                         | 68,107     | 124.7                         | 51,381     | 96.6                          | 42,493     | 83.1                          | 40,160     | 49,773,145     | 80.7            |

Note: Standard population was that in 2009. Prevalence is cases per 100,000.
was similar to that in our study. The differences between our study and those reported previously may be explained by differences in methodology, ethnicity, and proportion of older individuals in the general population.

Several studies have reported on the prevalence of neuropathy in a diabetic population.\textsuperscript{23,24} However, there are few reports of the prevalence of DN in the general population. McDonald et al.\textsuperscript{10} reported that the lifetime prevalence of diabetic polyneuropathy was 2 per 1000 persons in an unselected urban population. Savettieri et al.\textsuperscript{11} reported that the prevalence of diabetic neuropathy with somatic symptoms was 3 per 1000 persons in two Sicilian municipalities according to a door-to-door survey. In our study, the prevalence of DN was 80.7 to 115.3/100,000 lower than that reported in the previous studies. As for TN, these differences can be explained by differences between our study and those reported previously.

The prevalence of DN increased from 2009 to 2012 and was highest in the group aged 70 to 79 years, with no gender difference. An increasing diabetic population in Korea is considered the main reason for this increased prevalence. DN can be prevented by reducing the incidence of diabetes or improving glucose control in patients that have diabetes,\textsuperscript{25} indicating that both individual and social efforts are required.

A limitation of our study is its reliance on diagnosis codes in a computerized database instead of on medical records that include symptoms and signs; cases that were misdiagnosed or over-diagnosed could therefore not be eliminated. Moreover, variability caused by changes in diagnostic criteria could not be accounted for. Furthermore, we used period prevalence because HIRA data were collected year by year. Other studies used point prevalence or life-time prevalence, meaning that direct comparison was difficult.

Our findings show that, despite a reduction in the prevalence of CRPS and TN during the study period, the prevalence of PHN and DN was increased. Preventive methods to reduce PHN and DN are therefore warranted in clinical practice.

In conclusion, we reported the period prevalence and change in prevalence for four neuropathic diseases. Further studies are necessary to investigate the risk factors and socioeconomic burden associated with each disease.

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The authors declare that there is no conflict of interest.

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