Chronic pain and use of analgesics in the elderly: a nationwide population-based study

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Abstract

Introduction: Chronic pain may cause many comorbidities in the elderly; however, nationwide data about this issue remain insufficient. We conducted this study to address the data gap. 
Material and methods: We identified geriatric participants (≥ 65 years) with chronic pain between 2000 and 2013 from the Taiwan National Health Insurance Research Database. The causes of chronic pain and use of analgesics between two sexes and among three age subgroups were compared.
Results: A total of 21,018 participants were identified with the mean age (standard deviation) of 72.7 years (5.6) and the female percentage of 50.8%. The prevalence of chronic pain in the elderly was 21.5%, and it was higher in the females than males. The proportions of each age subgroup were 65–74 (66.8%), 75–84 (29.4%), and ≥ 85 years (3.8%). Common causes of chronic pain were osteoarthritis (21.9%), spinal disorders (19.0%), peripheral vascular diseases (12.4%), and osteoporosis (11.4%). Non-steroidal anti-inflammatory drugs were the most common medication, followed by acetaminophen and opioids. The most commonly used opioid was morphine. The use of opioids increased with age.
Conclusions: This study delineated the causes of chronic pain and use of analgesics in a geriatric population, which may help further studies about this issue in the future.

Key words: acetaminophen, chronic pain, elderly, geriatric, non-steroidal anti-inflammatory drugs.

Introduction

Aging is an important issue in public health worldwide. In the United States, the population aged 65 and over is projected to reach 83.7 mil-
lion in 2050, which is almost double the number in 2012 [1]. Taiwan is one of the most rapidly aging countries in the world [2, 3]. In 2013, the geriatric population was 13.3% in Taiwan; however, it will rapidly grow to 20% by 2025 [2, 3]. The growing geriatric population will contribute to a serious burden on the health care system because the elderly use more medical resources than their younger counterparts due to their multiple and complex comorbidities [3–11]. The statistics from the Taiwan National Health Insurance demonstrated that the geriatric population contributed to 38.5% of the total expenditures in 2015, and the proportion is still growing [12].

Chronic pain in the elderly is defined as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage, for persons who are age ≥ 65 years with pain for greater than 3 months” [13]. Chronic pain may cause impaired activities of daily living, depression, deconditioning, polypharmacy, and cognitive decline in the elderly, which may further contribute to the poor quality of life in the affected elderly and increased burdens of caregiver and medical health system [13, 14]. Understanding the causes of chronic pain, treatments in the geriatric population, and subsequent interventions, is crucial. However, nationwide data about this issue are insufficient, so this study was conducted to fill the data gap.

Material and methods

Data sources

For this study we used the Longitudinal Health Insurance Database 2000 (LHID2000), which contains 1,000,000 beneficiaries registered in the year 2000 randomly selected from the original National Health Insurance Research Database (NHIRD) [15]. No significant difference is found in the sex distribution between the LHID 2000 and NHIRD. The Taiwan NHIRD, which covers nearly 100% of the population’s healthcare data, is one of the most comprehensive databases in the world [16].

Study design, setting, and participants

We conducted this nationwide population-based study by identifying all the geriatric participants (≥ 65 years) with chronic pain between January 1, 2000 and December 31, 2013 from the LHID 2000 (Figure 1). Demographic variables including age, sex, and living areas, causes of chronic pain, other comorbidities, and use of analgesics were included in the analysis. We compared causes of chronic pain and use of analgesics between two sexes and among three age subgroups (65–74, 75–84, and ≥ 85 years).

Definitions of variables

Given the lack of direct data about chronic pain in the NHIRD, we defined subjects with chronic pain as the participants who have used either acetaminophen, non-steroidal anti-inflammatory drugs (NSAIDs; excluding aspirin), or opioids for at least 3 months. The standardized tools for pain assessment commonly used in Taiwan were the visual analog scale, numeric rating scale, and face rating scale. The causes of chronic pain were defined as follows: osteoarthritis (International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM): 715), spinal disorders (ICD-9-CM: 756.11, 756.12, 720-725, 737.1-737.4), peripheral vascular diseases (ICD-9-CM: 440.0-440.2), and cancer (ICD-9-CM: 140-208.9). The use of analgesics was defined as follows: acetaminophen (ICD-9-CM: 904.1), non-steroidal anti-inflammatory drugs (NSAIDs; excluding aspirin) (ICD-9-CM: 904.2), or opioids (ICD-9-CM: 904.3).

Figure 1. Flowchart of this study. NHIRD, National Health Insurance Research Database

NSAID – non-steroidal anti-inflammatory drug.
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443.8-444.9), osteoporosis (ICD-9-CM: 733.0), malignancy (ICD-9-CM: 140-208), gout (ICD-9-CM: 274), headache (ICD-9-CM: 307.81, 784.0, 346), diabetic neuropathy (ICD-9-CM: 250.6, 357.2), rheumatoid arthritis (ICD-9-CM: 714), pressure ulcer (ICD-9-CM: 707), and herpes zoster (ICD-9-CM: 053). The other comorbidities were defined as follows: hypertension (ICD-9-CM: 401–405), diabetes (ICD-9-CM: 250), stroke (ICD-9-CM: 430-438), coronary artery disease (ICD-9-CM: 410-414), chronic obstructive pulmonary disease (ICD-9-CM: 490-496), renal diseases (ICD-9-CM: 580-593), hyperlipidemia (ICD-9-CM: 272), liver diseases (ICD-9-CM: 570-576), dementia (ICD-9-CM: 290, 291.2, 292.82, 294.1), and depression (ICD-9-CM: 300.4). The participants who had the diagnosis of causes of chronic pain and comorbidities in at least one hospitalization or three out-patient clinics were defined as having the disease.

Ethical statements

This study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board at Chi-Mei Medical Center. Considering that the data in the LHID2000 are unidentifiable and secondary data released to the public for research, informed consent was waived. The waiver does not affect the rights and welfare of the participants.

Statistical analysis

We used SAS 9.4 for Windows (SAS Institute, Cary, NC, USA) for all statistical analyses. Pearson chi-square tests were used for categorical variables (i.e., age subgroup, sex, causes of chronic pain, other comorbidities, living areas, and pain killers in Tables I–IV), and the independent t test was used for continuous variables (i.e., age in Table I). The significance level was set at \( p < 0.05 \) (two-tailed).

Results

Comparison of causes of chronic pain between the two sexes

A total of 21,018 participants were identified in this study (Figure 1, Table I). The mean age ± standard deviation was 72.7 ±5.6 years, and the female percentage was 50.8%. The prevalence of chronic pain in the elderly was 21.5%, and it was higher in the females than in the male population (23.6% vs. 19.7%; Figure 2). The age of 65–74 years was the largest subgroup (66.8%), followed by 75–84 years (29.4%). The common causes of chronic pain were osteoarthritis (21.9%), spinal disorders (19.0%), peripheral vascular diseases (12.4%), osteoporosis (11.4%), malignancy (7.2%), gout (4.4%), headache (3.8%), diabetic neuropathy (1.7%), rheumatoid arthritis (1.6%), pressure ulcer (1.3%), and herpes zoster (0.6%). In the comparison of causes of chronic pain between the two sexes, the female participants had a higher percentage of osteoarthritis (23.2% vs. 20.5%), spinal disorders (19.9% vs. 18.2%), osteoporosis (17.3% vs. 5.3%), diabetic neuropathy (2.1% vs. 1.4%), and rheumatoid arthritis (2.0% vs. 1.2%) than the male participants. The female participants with chronic pain had higher prevalence of hypertension (53.8% vs. 50.0%), diabetes (25.4% vs. 19.9%), and hyperlipidemia (9.8% vs. 7.4%) than their male counterparts. Depression was diagnosed in only 0.2% of the total participants. Nearly half of the participants lived in North Taiwan (47.0%), followed by those who lived in South Taiwan (30.5%).

Comparison of causes of chronic pain between age subgroups

A comparison of the causes of chronic pain among age subgroups showed that peripheral vascular diseases, osteoporosis, and pressure ulcer increased with advancing age (Table II). The prevalence of comorbidities with stroke, coronary artery disease, chronic obstructive pulmonary disease, renal diseases, and dementia was higher in the older subgroup than in the younger subgroup.

Comparison of pain killers between the two sexes and age subgroups

NSAIDs were the most commonly used analgesics (89.1%), followed by acetaminophen (77.5%) and opioids (10.2%; Table III). Pethidine was the most commonly used opioid (6.6%). The percentage of male participants who used opioids was higher than that of female participants (11.9% vs. 8.5%). With advancing age, more participants used opioids as analgesics (65–74 years: 9.8% vs. 75–84 years: 10.6% vs. ≥85 years: 13.4%).

Discussion

This study showed that musculoskeletal and rheumatic disease disorders were the most common causes of chronic pain in the elderly; this finding was consistent with the results of previous studies [13, 17, 18]. Osteoarthritis, a common joint disorder in the world, is one of the most common causes of pain and disability in the geriatric population [18–21]. The greatest risk factor for osteoarthritis is old age, and other risk factors are joint injury, obesity, genetics, anatomical factors, and female sex [19, 22]. The most common joint affected is the knee, followed by the hip and hands [19]. Spinal disorders encompass a broad spectrum of pathologies including congenital, de-
Table I. Comparison of causes of chronic pain in the elderly between two sexes

| Variables                        | Female n = 10677 | Male n = 10341 | P-value*          |
|----------------------------------|------------------|----------------|-------------------|
| Age (mean ± SD)                  | 72.6 ± 5.9       | 72.8 ± 5.4     | 0.009             |
| Age subgroup, n (%)              |                  |                |                   |
| 65–74 years                      | 14048 (66.9)     | 6909 (66.8)    | 0.046             |
| 75–84 years                      | 6172 (29.0)      | 3072 (29.7)    |                   |
| ≥ 85 years                       | 798 (3.8)        | 360 (3.5)      |                   |
| Causes of chronic pain†:         |                  |                |                   |
| Osteoarthritis                   | 2477 (23.2)      | 2121 (20.5)    | < 0.001           |
| Spinal disorders                 | 2120 (19.9)      | 1882 (18.2)    | 0.002             |
| Peripheral vascular diseases     | 1166 (10.9)      | 1430 (13.8)    | < 0.001           |
| Osteoporosis                     | 1851 (17.3)      | 543 (5.3)      | < 0.001           |
| Malignancy                       | 594 (5.6)        | 910 (8.8)      | < 0.001           |
| Gout                             | 227 (2.1)        | 687 (6.6)      | < 0.001           |
| Headache                         | 429 (4.0)        | 363 (3.5)      | 0.053             |
| Diabetic neuropathy              | 221 (2.1)        | 144 (1.4)      | < 0.001           |
| Rheumatoid arthritis             | 214 (2.0)        | 123 (1.2)      | < 0.001           |
| Pressure ulcer                   | 120 (1.1)        | 161 (1.6)      | 0.006             |
| Herpes zoster                    | 48 (0.5)         | 77 (0.7)       | 0.005             |
| Other comorbidities‡:            |                  |                |                   |
| Hypertension                     | 5744 (53.8)      | 5173 (50.0)    | < 0.001           |
| Diabetes                         | 2708 (25.4)      | 2061 (19.9)    | < 0.001           |
| Stroke                           | 1745 (16.3)      | 2136 (20.7)    | < 0.001           |
| Coronary artery disease          | 1689 (15.8)      | 1853 (17.9)    | < 0.001           |
| Chronic obstructive pulmonary disease | 772 (7.2)   | 1768 (17.1)    | < 0.001           |
| Renal diseases                   | 1040 (9.7)       | 1283 (12.4)    | < 0.001           |
| Hyperlipidemia                   | 1045 (9.8)       | 768 (7.4)      | < 0.001           |
| Liver diseases                   | 860 (8.1)        | 903 (8.7)      | 0.077             |
| Dementia                         | 438 (4.1)        | 448 (4.3)      | 0.407             |
| Depression                       | 16 (0.2)         | 20 (0.2)       | 0.445             |
| Living areas:                    |                  |                |                   |
| North                            | 4836 (45.3)      | 5032 (48.7)    | < 0.001           |
| Center                           | 2055 (19.3)      | 1908 (18.5)    |                   |
| South                            | 3406 (31.9)      | 3005 (29.1)    |                   |
| East                             | 380 (3.6)        | 396 (3.8)      |                   |

Data are presented as number (percentage) or mean ± SD. SD – standard deviation. *Comparison between female and male participants. †Participant may have multiple causes of chronic pain. ‡Participant may have multiple comorbidities.

velopmental, degenerative, traumatic, infectious, inflammatory, and neoplastic disorders [23]. Aging will lead to an increasing burden of spinal disorders on the health care system [23]. In the report in the United States, when the elderly comprised 17% of the population, they were responsible for
Table II. Comparison of causes of chronic pain in the elderly among three age subgroups

| Variables                      | Total n = 21018 | 65–74 n = 14048 | 75–84 n = 6172 | ≥ 85 n = 798 | P-value*  |
|--------------------------------|----------------|-----------------|----------------|-------------|-----------|
| Female                         | 10677 (50.8)   | 7139 (50.8)     | 3100 (50.2)    | 438 (54.9)  | 0.046     |
| Male                           | 10341 (49.2)   | 6909 (49.2)     | 3072 (49.8)    | 360 (45.1)  |           |
| Causes of chronic pain†:       |                |                 |                |             |           |
| Osteoarthritis                 | 4598 (21.9)    | 3247 (23.1)     | 1217 (19.7)    | 134 (16.8)  | < 0.001   |
| Spinal disorders               | 4002 (19.0)    | 2803 (20.0)     | 1107 (17.9)    | 92 (11.5)   | < 0.001   |
| Peripheral vascular diseases   | 2596 (12.4)    | 1585 (11.3)     | 894 (14.5)     | 117 (14.7)  | < 0.001   |
| Osteoporosis                   | 2394 (11.4)    | 1480 (10.5)     | 798 (12.9)     | 116 (14.5)  | < 0.001   |
| Malignancy                     | 1504 (7.2)     | 1023 (7.3)      | 439 (7.1)      | 42 (5.3)    | 0.098     |
| Gout                           | 914 (4.4)      | 627 (4.5)       | 261 (4.2)      | 26 (3.3)    | 0.230     |
| Headache                       | 792 (3.8)      | 596 (4.2)       | 171 (2.8)      | 25 (3.1)    | < 0.001   |
| Diabetic neuropathy            | 365 (1.7)      | 271 (1.9)       | 84 (1.4)       | 10 (1.3)    | 0.010     |
| Rheumatoid arthritis           | 337 (1.6)      | 246 (1.8)       | 88 (1.4)       | 3 (0.4)     | 0.005     |
| Pressure ulcer                 | 281 (1.3)      | 149 (1.1)       | 111 (1.8)      | 21 (2.6)    | < 0.001   |
| Herpes zoster                  | 125 (0.6)      | 79 (0.6)        | 43 (0.7)       | 3 (0.4)     | 0.372     |
| Other comorbidities‡:          |                |                 |                |             |           |
| Hypertension                   | 10917 (51.9)   | 7291 (51.9)     | 3237 (52.5)    | 389 (48.8)  | 0.142     |
| Diabetes                       | 4769 (22.7)    | 3419 (24.3)     | 1224 (19.8)    | 126 (15.8)  | < 0.001   |
| Stroke                         | 3881 (18.5)    | 2345 (16.7)     | 1338 (21.7)    | 198 (24.8)  | < 0.001   |
| Coronary artery disease        | 3542 (16.9)    | 2238 (15.9)     | 1155 (18.7)    | 149 (18.7)  | < 0.001   |
| Chronic obstructive pulmonary disease | 2540 (12.1) | 1399 (10.0) | 987 (16.0) | 154 (19.3) | < 0.001 |
| Renal diseases                 | 2323 (11.1)    | 1494 (10.6)     | 721 (11.7)     | 108 (13.5)  | 0.007     |
| Hyperlipidemia                 | 1813 (8.6)     | 1393 (9.9)      | 404 (6.6)      | 16 (2.0)    | < 0.001   |
| Liver diseases                 | 1763 (8.4)     | 1275 (9.1)      | 444 (7.2)      | 44 (5.5)    | < 0.001   |
| Dementia                       | 886 (4.2)      | 434 (3.1)       | 366 (5.9)      | 86 (10.8)   | < 0.001   |
| Depression                     | 36 (0.2)       | 26 (0.2)        | 9 (0.2)        | 1 (0.1)     | 0.783     |
| Living areas:                  |                |                 |                |             |           |
| North                          | 9868 (47.0)    | 6436 (45.8)     | 3020 (48.9)    | 412 (51.6)  | < 0.001   |
| Center                         | 3963 (18.9)    | 2696 (19.2)     | 1137 (18.4)    | 130 (16.3)  |           |
| South                          | 6411 (30.5)    | 4398 (31.3)     | 1788 (29.0)    | 225 (28.2)  |           |
| East                           | 776 (3.7)      | 518 (3.7)       | 227 (3.7)      | 31 (3.9)    |           |

Data are presented as number (percentage). *Comparison among three age subgroups. †Participant may have multiple causes of chronic pain. ‡Participant may have multiple comorbidities.

Table III. Comparison of pain killers in the elderly with chronic pain between two sexes*

| Variables      | Total n = 21018 | Female n = 10677 | Male n = 10341 | P-value†  |
|----------------|----------------|-----------------|---------------|-----------|
| Acetaminophen  | 16288 (77.5)   | 8236 (77.1)     | 8052 (77.9)   | 0.207     |
| NSAIIDs        | 18718 (89.1)   | 9554 (89.5)     | 9164 (88.6)   | 0.045     |
| Opioids:       | 2136 (10.2)    | 909 (8.5)       | 1227 (11.9)   | < 0.001   |
| Morphine       | 1072 (5.1)     | 440 (4.1)       | 632 (6.1)     | < 0.001   |
| Fentanyl       | 454 (2.2)      | 182 (1.7)       | 272 (2.6)     | < 0.001   |
| Pethidine      | 1383 (6.6)     | 593 (5.6)       | 790 (7.6)     | < 0.001   |

Data are presented as number (percentage). *Participant may use multiple types of pain killers. NSAIIDs – non-steroid anti-inflammatory drugs. †Comparison between female and male participants.
Table IV. Comparison of pain killers in the elderly with chronic pain among age subgroups

| Variables     | Total  | 65–74  | 75–84  | ≥ 85   | P-value† |
|---------------|--------|--------|--------|--------|----------|
| Acetaminophen | 16288  (77.5) | 10949 (77.9) | 4725 (76.6) | 614 (76.9) | 0.088    |
| NSAIDs        | 18718 (89.1) | 12590 (89.6) | 5450 (88.3) | 678 (85.0) | < 0.001  |
| Opioids:      |        |        |        |        |          |
| Morphine      | 2136 (10.2)  | 1376 (9.8)   | 653 (10.6)   | 107 (13.4) | 0.002    |
| Fentanyl      | 454 (2.2)    | 327 (2.3)    | 115 (1.9)    | 12 (1.5)   | 0.048    |
| Pethidine     | 1383 (6.6)   | 873 (6.2)    | 441 (7.2)    | 69 (8.7)   | 0.003    |

Data are presented as number (percentage). *Participant may use multiple types of pain killers. †Comparison among three age subgroups. NSAIDs – non-steroid anti-inflammatory drugs.

nearly half of all hospitalization for low back conditions [19]. Osteoporosis is a common disorder associated with a large burden of morbidity and mortality in the elderly [24]. In addition to pain and disability, osteoporosis may cause morbidity, fragility fractures, and increased risk of mortality [24]. Peripheral vascular diseases are chronic arterial occlusive diseases of the lower extremities [25]. Peripheral vascular diseases may cause intermittent claudication with pain or weakness during walking, which may be relieved with rest [25]. Victims with peripheral vascular diseases have increased risk for coronary artery disease, stroke, and subsequent all-cause mortality, cardiovascular mortality, and cardiovascular events [25]. Aging is a high risk factor for malignancy, with the geriatric population accounting for 60% of newly diagnosed malignancies and 70% of all cancer deaths in the United States [26, 27]. The common malignancies in the elderly are lung, colon, stomach, liver, prostate, and breast cancers [28].

In this study, the female participants demonstrated a higher prevalence of osteoarthritis, spinal disorders, osteoporosis, diabetic neuropathy, and rheumatoid arthritis as the causes of chronic pain than the male participants. Many studies revealed a difference in response to pain between the two sexes [29]. Women have more pain sensitivity and risk for pain than men [29]. In addition, differences in pharmacological and non-pharmacological pain interventions in the two sexes were observed [29]. However, these differences depend on the etiology, treatment, and characteristics of the provider [29]. Osteoarthritis is more common in women than in men [30]. Joint anatomy, kinematics, previous joint injury, and hormonal influences may play important roles [30]. Women always receive treatment for osteoarthritis in more advanced stages and have more debilitating pain than their male counterparts [30]. The prevalence of spinal disorders also suggests a sex difference. A study in 2015 showed that spondylosis and low back pain are more prevalent in women than in men (7.8% vs. 3.3% and 76.2% vs. 73.9%, respectively) [31]. This study revealed that female participants have a higher prevalence of diabetic neuropathy as chronic pain than male participants. A study recruiting 1705 patients with type 2 diabetes in 2010 reported that the prevalence of diabetic neuropathy was 78.8% without a sex difference [32]. Men may develop diabetic neuropathy earlier than women [32, 33]. However, the pain sensation is not equal to the development of diabetic neuropathy. In addition, the data were gathered from general adults and not from a geriatric population [32, 33]; therefore, further studies are required to confirm the results of this study. Rheumatoid arthritis is more common in women than in men [34]. The incidence of rheumatoid arthritis in women is four to five times higher than that in men below the age of 50 years, but the women/men ratio is about 2 above 60–70 years [34].

The prevalence of most diseases is high in the elderly. However, only peripheral vascular diseases, osteoporosis, and pressure ulcer as the causes of chronic pain increased with age in this study. The possible explanation is that we identified the participants with chronic pain in this study. The participants who had the diseases but no diagnosis of “chronic pain” were not analyzed. Pain is a subjective sensation, and it may not be expressed completely in the elderly with advancing age.
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The prevalence of chronic pain in the elderly was 21.5%, and it was higher in the female population than in the male population. The major causes of chronic pain were osteoarthritis, spinal disorders, peripheral vascular diseases, osteoporosis, and malignancy. The female participants had higher incidence of osteoarthritis, spinal disorders, osteoporosis, diabetic neuropathy, and rheumatoid arthritis as the cause of chronic pain than the male participants. NSAIDs were the most commonly used analgesics, and the use of opioids increased with advancing age. This study provided a general picture of chronic pain in the elderly, which may help subsequent studies on this issue in the future.

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Conflict of interest

The authors declare no conflict of interest.

References

1. Ortman JM, Velkoff VA, Hogan H. An aging nation: the older population in the United States. Washington, DC: US Census Bureau; 2014. Accessed from http://www.census.gov/prod/2014pubs/p25-1140.pdf on November 4, 2017.

2. National development council, department of executive, Taiwan. Population Projections for R.O.C. (Taiwan): 2016–2060. Accessed from http://www.ndc.gov.tw/en/cp.aspx?n=2E5DCB04C64512CC&m=002ABF0E676F4DB8 on November 4, 2017.

3. Ke YT, Peng AC, Shu YM, et al. Emergency geriatric assessment: a novel comprehensive screen tool for geriatric patients in the emergency department. Am J Emerg Med 2016; 36: 143-6.

4. Huang CC, Chen WL, Hsu CC, et al. Elderly and nonelderly use of a dedicated ambulance corps’ emergency medical services in Taiwan. Biomed Res Int 2016; 2016: 1506436.

5. Huang CC, Tsai KT, Weng SF, et al. Chronic osteomyelitis increases long-term mortality risk in the elderly: a nationwide population-based cohort study. BMC Geriatr 2016; 16: 72.

6. Wu CI, Huang CC, Weng SF, et al. Septic arthritis significantly increased the long-term mortality in geriatric patients. BMC Geriatr 2017; 17: 178.

7. Chung MH, Chu FY, Yang TM, et al. Hypotension, bed-ridden, leukocytosis, thrombocytopenia and elevated serum creatinine predict mortality in geriatric patients with fever. Geriatr Gerontol Int 2015; 15: 834-9.

8. Huang CC, Weng SF, Tsai KT, et al. Long-term mortality risk after hyperglycemic crisis episodes in geriatric patients with diabetes: a national population-based cohort study. Diabetes Care 2015; 38: 746-51.

9. Chung MH, Huang CC, Yong SC, et al. Geriatric fever score: a new decision rule for geriatric care. PLoS One 2014; 9: e110927.

10. Huang CC, Chien TW, Su SB, et al. Infection, absent tachycardia, cancer history, and severe comar are independent mortality predictors in geriatric patients with hyperglycemic crises. Diabetes Care 2013; 36: e151-2.

11. Pobrotyn P, Suslo R, Witzczak J, Rypicz I, Drobnik J. An analysis of the costs of treating aged patients in a large clinical hospital in Poland under the pressure of recent demographic trends. Arch Med Sci 2019 doi:10.5114/ams.2018.1506436.

12. National Health Insurance Administration, Ministry of Health and Welfare, Taiwan. The National Health Insurance Statistics, 2015. Accessed from http://www.nhi.gov.tw/english/Content_List.aspx?m=7080F5F6752E7B9E&topn=616B97F80DF2C3614 on September 5, 2017.

13. Kaye AD, Baluch A, Scott JT. Pain management in the elderly population: a review. Ochsner J 2010; 10: 179-87.

14. Mędrycka-Dąbrowska WA, Dąbrowski S, Basiański A, Plich D. Perception of barriers to postoperative pain management in elderly patients in Polish hospitals with and without a “Hospital Without Pain” Certificate – a multi-center study. Arch Med Sci 2016; 12: 808-18.
15. National Health Insurance Research Database. Data subsets. Accessed from http://nhird.nhri.org.tw/en/Data_Subsets.html#S3 on November 5, 2017.

16. National Health Insurance Research Database. Background. Accessed from http://nhird.nhri.org.tw/en/index.html on November 5, 2017.

17. Reid MC, Eccleston C, Pillemer K. Management of chronic pain in older adults. BMJ 2015; 350: h332.

18. Kozak-Szkopek E, Broczek K, Slusarczyk P et al. Prevalence of chronic pain in the elderly Polish population – results of the PolSenior study. Arch Med Sci 2017; 13: 1197-206.

19. Shane AA, Loeser RF. Why is osteoarthritis an age-related disease? Best Pract Res Clin Rheumatol 2010; 24: 15-26.

20. Arden N, Nevitt MC. Osteoarthritis: epidemiology. Best Pract Res Clin Rheumatol 2006; 20: 3-25.

21. Lawrence RC, Felson DT, Helmick CG, et al. Estimates of the prevalence of arthritis and other rheumatic conditions in the United States. Part II. Arthritis Rheum 2008; 58: 26-35.

22. Silverwood V, Blagojevic-Bucknall M, Jinks C, Jordan JL, Protheroe J, Jordan KP. Current evidence on risk factors for knee osteoarthritis in older adults: a systematic review and meta-analysis. Osteoarthritis Cartilage 2015; 23: S7-15.

23. Waldrop R, Cheng J, Devin C, McGirt M, Fehlings M, Berken S. The burden of spinal disorders in the elderly. Neurosurgery 2015; 77: S46-50.

24. Liberman D, Cheung A. A practical approach to osteoporosis management in the geriatric population. Can Geriatr J 2015; 18: 29-34.

25. Aronow WS. Peripheral arterial disease in the elderly. Clin Interv Aging 2007; 2: 645-54.

26. Berger NA, Savvides R, Kourkian SM, et al. Cancer in the elderly. Trans Am Clin Climatol Assoc 2006; 117: 147-56.

27. Ries LAG, Eisner MP, Kosary CL, et al. Cancer Statistics Review, 1973–1998. National Institute of Health. NIH publication 00-2789.

28. Hansen J. Common cancers in the elderly. Drugs Aging 1998; 13: 467-78.

29. Bartley EJ, Fillingim RB. Sex differences in pain: a brief review of clinical and experimental findings. Br J Anaesth 2013; 111: 52-8.

30. Hamel SL, Alexander RA. Knee osteoarthritis in women. Curr Rev Musculoskelet Med 2013; 6: 182-7.

31. Alshami AM. Prevalence of spinal disorders and their relationships with age and gender. Saudi Med J 2015; 36: 725-30.

32. Kamovtov ZA, Parapunova RA, Georgieva RT. Earlier development of diabetic neuropathy in men than in women with type 2 diabetes mellitus. Gend Med 2010; 7: 600-15.

33. Aaberg ML, Burch DM, Hud ZR, Zacharias MP. Gender differences in the onset of diabetic neuropathy. J Diabetes Complications 2008; 22: 83-87.

34. Kvien TK, Uhlig T, Ødegård S, Helberg MS. Epidemiological aspects of rheumatoid arthritis: the sex ratio. Ann N Y Acad Sci 2006; 1069: 212-22.

35. Victor K. Properly assessing pain in the elderly. Accessed from http://www.modernmedicine.com/modern-medicine/content/properly-assessing-pain-elderly on November 7, 2017.

36. Abdulla A, Adams N, Bone M, et al.; British Geriatric Society. Guidance on the management of pain in older people. Age Ageing 2013; 42: 11-57.

37. American Geriatrics Society Panel on Pharmacological Management of Persistent Pain in Older Persons. Pharmacological management of persistent pain in older persons. J Am Geriatr Soc 2009; 57: 1331-46.

38. Kang KH, Kuo LF, Cheng IC, Chang CS, Tsay WI. Trends in major opioid analgesic consumption in Taiwan, 2002-2014. J Formos Med Assoc 2017; 116: 529-35.

39. Cheng IC, Chang CS, Tsay WI. Long-term usage of narcotic analgesics by chronic intractable noncancer pain patients in Taiwan from 2003 to 2012. J Formos Med Assoc 2016; 115: 773-8.