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Incidence of low back pain and potential risk factors among pharmacists

A population-based cohort study in Taiwan

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Abstract

Low back pain (LBP) is one of the most common symptoms of work-related musculoskeletal disorders in pharmacists. This can impede the physical functions of the body and lead to incapacitation, resulting in significant social and economic burden. This study aimed to investigate the incidence and risk factors that correlate with LBP in Taiwanese pharmacists.

A retrospective cohort study was conducted among all registered pharmacists aged 20 to 40 years using the National Health Insurance Research Database (2000–2013) in Taiwan. The LBP diagnosis was confirmed with one episode of hospitalization or at least three claimed outpatient visits for LBP. Data on workplace characteristics as well as comorbidities were also collected for the analyses. A Cox proportional hazard regression was used to estimate the risk factors for LBP.

The incidence rate of LBP among pharmacists was 16.60% in this study. Older pharmacists (28.49%; $P < .01$) and those who worked at district hospitals (23.51%; $P < .01$) showed a higher proportion of LBP. Furthermore, after adjustment for selected potential confounding factors, female pharmacists [adjusted hazard ratio (aHR): 1.12, 95% confidence interval (95% CI): 1.01–1.24, $P = .0354$] and pharmacists with diabetes (aHR: 1.55; 95% CI: 1.20–2.01; $P = .0008$) and gout (aHR: 1.70; 95% CI: 1.37–2.09; $P < .0001$) had significantly higher risks of LBP.

In conclusion, age was positively correlated with LBP, and the workplace was an important factor in the development of LBP in pharmacists. We suggest that pharmacists who work in district hospitals should pay more attention to the development of LBP.

Abbreviations: CI = confidence interval, DM = diabetes mellitus, HR = hazard ratio, ICD-9-CM = International Classification of Diseases Ninth Revision Clinical Modification, LBP = low back pain, NHIRD = National Health Insurance Research Database, PER = registry for medical personnel.

Keywords: low back pain, musculoskeletal, occupational health problem, pharmacist

1. Introduction

Work-related musculoskeletal disorders (MSDs) are a commonly reported cause of pain. Low back pain (LBP) is one such disorder, which leads to morbidity and incapacitation resulting in significant social and economic costs.[1–4] LBP, characterized by pain of varying intensities and durations, is associated with suffering among workers and increased costs to employers, social insurance, and health care systems.[3,5–9] The incidence of LBP in the general population is between 50% and 80%.[3] LBP commonly affects men aged over 40 years and women aged between 50 and 60 years.[3,9,10] The etiology of LBP is multifactorial, so the identification of its causes is difficult.[3] The genesis of LBP is attributed to both individual and work-related risk factors. The most commonly individual risk factors include age, sex, body mass index, muscle imbalance, muscle strength, socioeconomic status, and the presence of comorbidities.[11,12] The most common work-related risk factors are combination of incorrect movements and postures caused by inadequate working environments or poorly designed equipment, as well as the ways in which work is organized and performed; for example, long hours of tedious and static work involving repetitive hand/wrist motions or the persistent and repeated lifting and transferring of goods and/or patients may be risk factors.[2,11,13]

LBP is commonly observed among health care professionals, and many studies have explored the incidence of this condition in

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The data that support the findings of this study are available from a third party, but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are available from the authors upon reasonable request and with permission of the third party.

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nurses, dentists, sonographers, and surgeons.[14–18] Some studies have used pharmacists as a reference group in the exploration of the risk ratio of MSDs among dentists, physiotherapists (PTs), and occupational therapists (OTs) [19–21]; however, the relationship between pharmacists and MSDs has been rarely investigated. A wide variety of causative factors, including the physical burden of work, ergonomics hazards, demographic factors, as well as psychosocial factors may be responsible for musculoskeletal symptoms in pharmacists working in hospitals.[22] The dispensing of a large volume of prescriptions as well as the requirement to identify potential drug–drug interactions or medication errors within a short space of time contributes to the work pressure that pharmacists experience. In addition, working in a standing position for long durations is a long-term challenge to the physical functions of the body. According to previous studies, LBP is one of the most common symptoms of MSDs in pharmacists[20]; therefore, it is important to understand the relationship between LBP and this group of health care workers. We therefore conducted a retrospective nationwide population-based cohort study to investigate the incidence, risk factors associated with demographic (individual) factors, and working environment with LBP in Taiwanese pharmacists using the National Health Insurance Research Database (NHIRD).

2. Methods

2.1. Data sources

The database of the registry for medical personnel (PER) from Taiwan's NHIRD was used for this study. Established on March 1, 1995, Taiwan's National Health Insurance is a single-payer compulsory social insurance program with an enrollment rate of 99.9% of the national population.[23] The NHIRD contains registration files and original claims data for reimbursement, which provides medical researchers with large amounts of data.

2.2. Definitions

This study was conducted among pharmacists working in diverse settings, including private drugstores, community clinics, district hospitals, area (regional) hospitals, and medical centers. A private drugstore is defined as place of business where pharmacists, according to the law, supervise and implement the provision of pharmaceutical care and the dispensing and supply of medication and medicinal products.[24] A community clinic is a place in which the outpatient service utilizes the services of physicians.[25] A district hospital is a place in which general outpatient and inpatient services are provided and the total number of ward beds is lower than 99. At least 1 pharmacist is allocated for every 50 ward beds and for every 100 prescriptions per day.[26] An area (regional) hospital a place that provides specialty outpatient and inpatient services with the number of ward beds $\geq$ 300. In addition to the functions of a hospital, it is also equipped with the functions of teaching residents and providing training to specialists. At least 1 pharmacist is allocated for every 50 ward beds and for every 80 prescriptions per day.[26] Finally, a medical center is defined as a place that provides specialty outpatient and inpatient services with the number of ward beds $\geq$500. In addition to the functions of a regional hospital, it also has multiple functions such as research and high-level medical operations. At least 1 pharmacist is allocated for every 40 ward beds and for every 70 prescriptions per day.[26]

2.3. Identification of study participants (pharmacists)

All registered pharmacists with professional licenses, between the ages of 20 and 40 years, were identified and selected as participants using the PER dataset (2000–2013). Using the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) data, the medical records of all the study participants were reviewed to check if a diagnosis of LBP was present (diagnostic codes: 721.3, 722.1, 724.02, 724.09, 724.2, 724.3, 724.5, 724.9). The definition of a diagnosis of LBP in our study was based on the ICD codes identified in a previous study.[27] To verify the diagnosis of LBP, 1 episode of hospitalization or at least 3 outpatient visits for LBP treatments had to be claimed by an individual patient. Exclusion criteria were age younger than 20 years or older than 40 years, professional pharmacy career commenced before 2000 (as the medical records or histories of these pharmacists could not be obtained through the database), patients with incomplete personal information such as that on sex and birth date, and patients with an LBP diagnosis before they started their professional careers as pharmacists. The study flow chart is shown in Figure 1.

The places in which the pharmacists practice, such as medical centers, regional hospitals, district hospitals, community clinics, and private drugstores, were evaluated. In addition, data on comorbidities such as diabetes mellitus (DM) (ICD-9-CM: 250), gout (ICD-9-CM: 274), underactive thyroid (ICD-9-CM: 244.9), and overweight and obesity (ICD-9-CM: 278.0 and v77.8) were recorded for evaluation as potential confounding factors.

2.4. Ethics statement

This study was conducted in accordance with the Declaration of Helsinki. The need for informed consent was waived because the NHIRD contains de-identified information. This waiver did not affect the right and welfare of the participants. The study was approved by Chi Mei Medical Center Institutional Review Board (IRB no. 10302-E01).

2.5. Statistical analysis

SAS 9.4 for Windows (SAS Institute, Cary, NC) was used for all the analyses. The significance level was set at .05 (2-tailed). The difference between pharmacists with and without LBP was compared using independent *t* tests and Pearson Chi-square tests for continuous variables and categorical variables, respectively. To estimate the potential risk factors for LBP among pharmacists, a Cox proportional hazard regression was used. The Kaplan–Meier plot was used to illustrate the trend of LBP incidence with a log-rank test to compare the differences in terms of the pharmacists' age, sex, and workplace type. Although all statistical analyses were conducted using SAS, the Kaplan–Meier curves were plotted using STATA (version 12; Stata Corp., College Station, TX).

3. Results

3.1. Incidence of LBP

Table 1 summarizes the pharmacists' baseline information. The mean age of the study pharmacist was 26.31 ± 4.05 years, female pharmacists accounted for 58.77%, and most of the pharmacists practiced in regional hospitals (29.42%). Among the 10,470

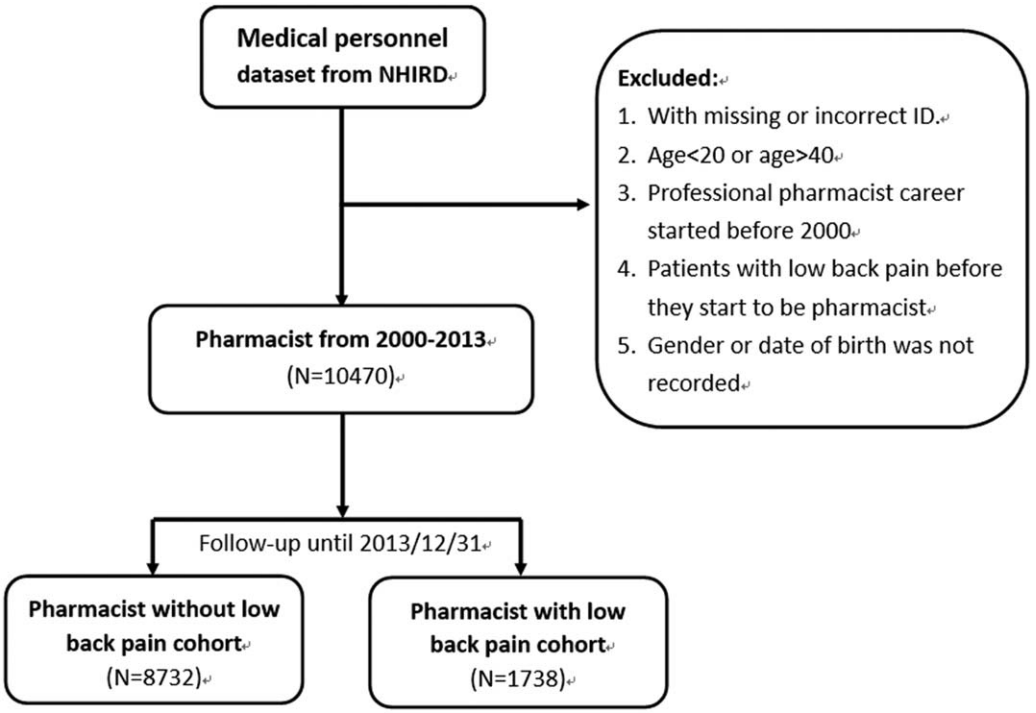

Figure 1. Study flow chart. NHIRD = National Health Insurance Research Database.

pharmacists, the incidence of LBP was 16.60% and the mean time to LBP development was 4.25 ± 3.21 years after the start of their careers as pharmacists.

Table 2 presents the comparative characteristics between pharmacists with and without LBP. The mean age of pharmacists with LBP was slightly higher than those without (27.08 ± 4.84 for LBP vs 26.16 ± 3.85 years for non-LBP, $P < .01$). Older pharmacists (aged at 36–40 years) showed a significantly higher rate of LBP (28.49%; $P < .01$). However, no gender differences were found in the development of LBP. Pharmacists practicing at district hospitals (23.51%) and community clinics (22.81%) had a significantly higher LBP incidence ($P < .01$). Pharmacists with

Table 1

Baseline information on the study pharmacists.

	Pharmacist (N = 10,470)
Age (mean ± SD)	26.31 ± 4.05
Age group, n (%)	
20~25 y	5273 (50.36)
26~30 y	3587 (34.26)
31~35 y	936 (8.94)
36~40 y	674 (6.44)
Sex, n (%)	
Male	4317 (41.23)
Female	6153 (58.77)
Workplace, n (%)	
Medical center	1979 (18.90)
Regional hospital	3080 (29.42)
District hospital	2097 (20.03)
Community clinic	1631 (15.58)
Private drugstore	1683 (16.07)
Comorbidity, n (%)	
Diabetes	173 (1.65)
Gout	293 (2.80)
Underactive thyroid	41 (0.39)
Obesity	53 (0.51)
LBP, n (%)	
Yes	1738 (16.60)
No	8732 (83.40)
Time to LBP development, yr (mean ± SD)	4.25 ± 3.21

LBP = low back pain, SD = standard deviation.

Table 2

The difference between pharmacists with LBP and those without.

	Non-LBP (N = 8732)	LBP (N = 1738)	*P*
Age (mean ± SD)	26.16 ± 3.85	27.08 ± 4.84	<.01*
Age group, n (%)			
20~25	4465 (84.68)	808 (15.32)	<.01†
26~30	3046 (84.92)	541 (15.08)	
31~35	739 (78.95)	197 (21.05)	
36~40	482 (71.51)	192 (28.49)	
Gender, n (%)			
Male	3607 (83.55)	710 (16.45)	0.72†
Female	5125 (83.29)	1028 (16.71)	
Working place, n (%)			
Medical center	1769 (89.39)	210 (10.61)	<.01†
Regional hospital	2654 (86.17)	426 (13.83)	
District hospital	1604 (76.49)	493 (23.51)	
Community clinic	1259 (77.19)	372 (22.81)	
Pharmacy	1446 (85.92)	237 (14.08)	
Comorbidity, n (%)			
Diabetes	108 (62.43)	65 (37.57)	<.01†
Gout	192 (65.53)	101 (34.47)	<.01†
Underactive thyroid	30 (73.17)	11 (26.83)	0.08†
Obesity	39 (73.58)	14 (26.41)	0.05†

* Independent *t* test was estimated from Satterthwaite approximate method, as the test of heterogeneity of variances was significant (*F*-value = 1.58, $P < .01$).
† Chi-square test.

Table 3

Crude and adjusted HRs of low back pain in pharmacists during the follow-up period.

	Crude HR (95% CI)	*P*	Adjusted HR (95% CI)	*P*
Age group				
20∼25 y	1.00	Ref.	1.00	Ref.
26∼30 y	0.94 (0.85–1.05)	.30	0.96 (0.86–1.08)	.59
31∼35 y	1.24 (1.06–1.45)	<.01	1.22 (1.04–1.43)	.02
36∼40 y	1.40 (1.19–1.64)	<.01	1.31 (1.11–1.56)	<.01
Sex				
Male	1.00	Ref.	1.00	Ref.
Female	1.02 (0.92–1.12)	.76	1.12 (1.01–1.24)	.04
Workplace				
Medical center	1.00	Ref.	1.00	Ref.
Regional hospital	1.38 (1.17–1.63)	<.01	1.38 (1.17–1.63)	<.01
District hospital	1.98 (1.69–2.33)	<.01	1.94 (1.65–2.29)	<.01
Community clinic	1.77 (1.50–2.10)	<.01	1.60 (1.35–1.91)	<.01
Private drugstore	1.33 (1.11–1.60)	<.01	1.24 (1.03–1.50)	.03
Comorbidity				
Diabetes	1.93 (1.51–2.48)	<.01	1.55 (1.20–2.01)	<.01
Gout	1.82 (1.49–2.22)	<.01	1.70 (1.37–2.09)	<.01
Underactive thyroid	1.39 (0.77–2.52)	.28	1.22 (0.67–2.22)	.52
Obesity	1.38 (0.82–2.34)	.23	1.09 (0.64–1.86)	.75

CI = confidence interval, HR = hazard ratio.

comorbidities such as diabetes (37.57%; $P<.01$) and gout (34.47%; $P<.01$) had a significantly higher incidence rate of LBP than participants without these conditions.

3.2. Risk factors of LBP

The Cox regression for LBP risk among the study participants is summarized in Table 3. After adjustment for selected potential confounding factors, female pharmacists had a 1.12-fold higher risk of LBP development than the male participants ($P=.04$), and pharmacists practicing at regional hospitals [adjust hazard ratio (aHR): 1.38; confidence interval (CI): 1.17–1.63; $P<.01$], district hospitals (aHR: 1.94; CI: 1.65–2.29; $P<.01$), community clinics (aHR: 1.60; CI: 1.35–1.91; $P<.01$), and private drugstores (aHR: 1.24; CI: 1.03–1.50; $P=.03$) had a significantly higher risk of LBP development than those working at medical centers. In addition, pharmacists with diabetes (aHR: 1.55; CI: 1.20–2.01; $P<.01$) and gout (aHR: 1.70; CI: 1.37–2.09; $P<.01$) had a higher risk of LBP development than those without diabetes and gout.

The trend of cumulative LBP incidence risk among age groups, gender, and working place is presented in Figure 2 with *P*-values indicating overall significance and the significance for each factor. Figure 2A indicates that different age groups showed a significant difference in the following period ($P<.01$). Pharmacists older than 31 years had a higher LBP risk than younger pharmacists (age≦30 years; Fig. 2A). However, the trend of cumulative LBP incidence showed no gender difference ($P=.76$; Fig. 2B). Figure 2C shows that the trend of LBP incidence between different working place settings was significantly different ($P<.01$). Pharmacists who worked at a medical center had a significantly lower risk of LBP development than those working at regional hospitals ($P<.01$), district hospitals ($P<.01$), community clinics ($P<.01$), and private drugstores ($P<.01$). In addition, pharmacists working at district hospitals or community clinics presented with the higher risk of LBP development than those working at medical centers, regional hospitals, and private drugstores (all $P<.05$).

4. Discussion

Pharmacists can be exposed to MSDs from activities that involve repetitive tasks, such as the performance of highly repetitive hand/wrist motions at the dispensing counter. Chronic injuries can occur over time due to the repeated overuse of specific body parts. Symptoms can develop in the affected part and, in addition, can also lead to recurring discomfort. LBP as an example of this and has been cited as a major reason for leave-taking.[13,28] Research in this area in the pharmacist population is scarce; therefore, the use of a nationwide population-based database to investigate the incidence and hazard of LBP among pharmacists can provide valuable insights into the provision of health care in this group of health care workers.

4.1. Incidence of LBP

The observed prevalence of LBP in this study was 16.60% (1738 LBP cases among 10,470 pharmacists), which although not the highest prevalence among the medical staff in the hospitals, should not be ignored. A 12-year population-based study of medical staff revealed that the incidence of spine-related MSDs (SRMDs; a symptom of LBP) of hospital pharmacists is 19.60%, which is between those for PTs (32.12%) and OTs (16.97%).[21] However, that study enrolled medical staff aged between 18 and 65 years, which covered a wider age range than our study, therefore its incidences were expected to be higher than the results of our study. Besides, higher incidences of LBP and/or SRMDs were also found in populations aged above 40 years in previously published studies.[13] The results of another cross-sectional study of MSDs on female general dentists and pharmacists shows that 91.60% of the female dentists and 87.70% of the female pharmacists reported at least 1 musculoskeletal symptom in the previous 12 months, indicating no significant difference in the incidences between the 2 professional categories (aOR = 1.2, 95% CI = .75–1.92).[20] Furthermore, the symptoms of LBP were found to have the greatest occurrence (53.10% vs 55.50%), indicating that LBP is the most frequently seen MSD.[20] Another

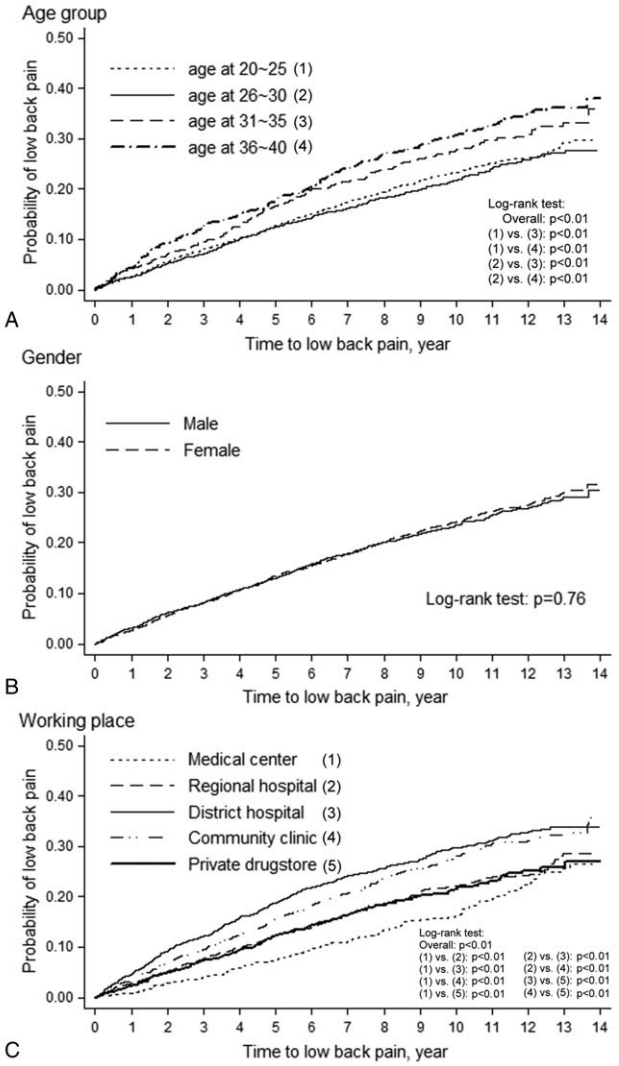

Figure 2. The trend of cumulative LBP incidence risk according to (A) age, (B) sex, and (C) workplace type.

study revealed that the mean time from obtaining a registered license to developing a SRMD is 1.41 to 5.57 years,[21] which is similar to our result of 4.25 years.

4.2. LBP risk factors associated with individual

Problems with any of the segments of the spine can lead to back pain. In some cases of back pain, its cause remains unclear.[29] In this study, we found that age is an important risk factor for LBP development, with older age showing an association with a higher incidence of LBP ($P < .01$) (Table 2). Older pharmacists (age group 36–40 years) showed a significantly higher risk of LBP development in the Kaplan–Meier analysis (Fig. 2A), similar to previous findings.[30] The incidence of chronic LBP was approximately 3 to 4 times higher in individuals older than 50 years than those aged 18 to 30 years. This may be related to the degeneration of articular processes after age 30 years.[30]

Female sex hormones play an important role in the etiology and pathophysiology of a variety of musculoskeletal degenerative diseases. The LBP incidence in postmenopausal women is higher than in males due to estrogen deficiency accelerated disc degeneration. A systematic literature review showed that the LBP prevalence ratio of female versus males in the four age groups (6–19 years; 20–50 years; mixed-age; and ≥50 years) was 1.36, 1.13, 1.19, and 1.28, respectively. It demonstrated that females had a higher prevalence of LBP across all age groups, especially in elderly group.[31] Female sex and older age were related to an increased risk of LBP even when the association between LBP and different vocational groups was examined.[32,33] In a randomized population-based study, female sex was a critical factor associated with the occurrence of LBP (female/male odds ratio = 1.46–1.65; $P < .01$).[34] Consistent with these studies, our study, after adjusting for confounding factors, found that female pharmacists had a 1.12-fold higher risk of developing LBP compared to their male counterparts ($P = .04$).

Comorbidities are also the associated LBP risk factors. Our study revealed that DM and gout were significantly associated with LBP in pharmacists and pharmacists with these comorbidities had a 1.55-fold and 1.7-fold higher risk of developing LBP, respectively, than those without these comorbidities. Although neuromusculoskeletal pain is a commonly observed problem in diabetes patients, there are few studies on the epidemiology of LBP in this population.[35] Chronic LBP (especially among those with severe pain) was shown to be associated with the patients with type 2 diabetes in a recent study.[36] High blood glucose levels alter the rate of fat metabolism, as commonly observed in diabetes patients, which can lead to pathoanatomical changes in the spine, such as early degeneration of the vertebrae, cartilage, and intervertebral discs. These changes can lead to the pain associated with musculoskeletal conditions, such as LBP.[36,37] Conversely, chronic pain has an adverse impact on health behaviors such as physical activity and diet, and negative lifestyle choices may also induce DM.[38] Therefore, the relationship between DM and LBP in pharmacists may not be as simple or direct as our study results indicate, and future studies with better designs are warranted.

Hyperuricemia manifesting as gout usually presents as pain in the large joints of the appendicular skeleton, which has been found to be correlated with comorbidities such as cardiovascular diseases, metabolic syndrome, and renal disease.[39–42] A study indicated that gout and serum urate levels were associated with chronic LBP.[43] The results of this study may explain the phenomena observed in our study: pharmacists with gout had a 1.70-fold higher risk of LBP development than those without. It suggested that increased uric acid levels may be of prime importance among the factors responsible for the aggravation of back pain or spinal gout.

4.3. LBP risk factors associated with working place

Previous studies have shown that working environments, long hours of tedious, and static work involving repetitive hand/wrist motions can be risk factors for LBP.[2,11,13] In this study, we found similar trends across the different hospital levels. Table 3 summarizes that pharmacists working in district hospitals had a higher risk of LBP than those working in regional hospitals or medical centers. For pharmacists working in district hospitals, at least 1 pharmacist is allocated to every 50 ward beds or for every 100 prescriptions per day and the burden of dispensing is at least 1.25-fold of that of the regional hospital, and 1.43-fold of the medical center.[26] Repetitiveness and long-term standing stress may be the potential risk of LBP among these workers.

Pharmacists working in private drugstores supervise and implement the provision of pharmaceutical care and the dispensing and supply of medication and medicinal products.[24] Due to the diversification of the work in the private drugstore, the probability of repeated dispensing and standing for a long time is lower than that of pharmacists who work in community clinics where the main duty is dispensing. Therefore, for pharmacists work in a private drugstore, the risk of LBP development is lower than that of pharmacists who work in clinics (aHR = 1.24 vs 1.60) (Table 3).

Work-related characteristics may cause a broad range of MSDs, particularly LBP, which can have a significant, negative impact on people's quality of life and work efficiency.[1,44,45] Environmental factors may, therefore, be targets for interventions aimed at reducing the risk of LBP among pharmacists. These include the installation of automated dispensing cabinets to reduce the dispensing workload, adjustment of medicine storage cabinets so that they are within reach, reducing the need to bend over or stand on tip toe to obtain medicines for prescriptions, the dispensing of complete packages (instead of packages in smaller quantities), and the use of ergonomic equipment[3,4] to reduce the MSDs.

4.4. Study limitations

This study has some limitations. First, there is the potential for a misclassification bias as a secondary data source was used and there may have been differences in the definition of LBP or the comorbidities based on the ICD-9-CM. Second, as detailed demographic data were not available, it is difficult to assess how well the sample corresponds to the study population. Third, data on physical examinations and instrumental measures for LBP were not collected for evaluation in the study; some studies have indicated that detailed measures for LBP that could affect muscle mechanics can be estimated from computed tomography scans.[46–48]

5. Conclusion

This is the first study to use a nationwide population-based database to investigate the LBP risk among pharmacists. We concluded that age and LBP development are positively correlated, while workplace and comorbidities of diabetes and gout are significant risk factors. Therefore, pharmacists who work at district hospitals should pay more attention to the development of LBP.

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