

# Physiotherapists working in clinics have increased risk for new-onset spine disorders

## a 12-year population-based study

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### Abstract

Health care professionals are known to have a high risk for work-related musculoskeletal disorders. However, the information on the risk of new-onset spine-related musculoskeletal disorders (SRMDs) in health care professionals is insufficient. This study aimed to investigate new-onset spine disorder associations among physical, occupational, and pharmacy health care professionals working in different workplaces.

Taiwan's National Health Insurance Research Database for registered medical personnel claims from 2000 to 2011 was analyzed. An age- and sex-matched longitudinal cohort study of 7448 subjects (1682 physiotherapists, 1682 occupational therapists [OTs], and 3724 pharmacists) with or without new-onset spine disorders was conducted. The hazard ratios for the development of new-onset spine disorders were estimated among these 3 groups.

The overall percentage of new-onset SRMD for physiotherapists is 32.12. The median time from obtaining a registered license to developing SRMD is 1.94 years. The log-rank test showed that physiotherapists have the least possibility of having a SRMD-free rate ( $P < 0.0001$ ). The Cox model showed that physiotherapists have a higher risk of new-onset SRMD (hazard ratio: 1.65, 95% confidence interval: 1.48–1.84,  $P < 0.0001$ ) compared with OTs and pharmacists. Physiotherapists working in clinics have a 2.40-fold increased risk of developing SRMD (95% confidence interval: 1.97–2.92,  $P < 0.0001$ ) relative to OTs and pharmacists.

This may be the first study regarding new-onset SRMD in physiotherapists based on a powerful nationwide population-based database. We conclude that working in clinics is a potential risk for new-onset SRMD in physiotherapists. Therefore, we suggest that physiotherapists should pay more attention to this issue to prevent the development of spine disorders.

**Abbreviations:** HR = hazard ratio, NHIRD = National Health Insurance Research Database, OT = occupational therapist, PT = physiotherapist, SRMD = spine-related musculoskeletal disorder, WMSD = work-related musculoskeletal disorder.

**Keywords:** occupational therapists, pharmacists, physiotherapist, spine disorder, working place

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## 1. Introduction

Work-related musculoskeletal disorders (WMSDs) are known to be an important occupational problem among physiotherapists (PTs) and occupational therapists (OTs) during daily practice.<sup>[1–5]</sup> The major causes involving PTs are often in repetitive tasks of intense physical demands,<sup>[6]</sup> and the similar job settings are in OT practice.<sup>[4]</sup> Among WMSDs, pain disorders, such as lower back pain, were the most common problem, which was well documented among PTs and OTs.<sup>[3,6]</sup> However, on comparing between PTs and OTs focusing on spine disorders defined as intervertebral disc disorders, spondylolysis and spondylolisthesis in the whole spine areas were not established.

WMSDs usually lead to an increase in morbidity and health care costs and a reduction in quality of life and even lead to health care providers leaving the workplace. In addition to the characteristics of the work itself, patients' age and sex are risk factors for WMSDs.<sup>[6–9]</sup> A previous study indicated that WMSDs were related to working in specialized departments; for example, elderly care (12%), neurological rehabilitation (14%), and musculoskeletal outpatients (31%) are the 3 major clinical working places producing serious work-related injuries among PTs.<sup>[10]</sup> In addition, several studies have demonstrated the risk of musculoskeletal disorders among PTs, OTs, and other health care professionals<sup>[11,11–13]</sup>; the study design in most of those studies is a cross-sectional self-report survey in recalling injuries.<sup>[11,11,13]</sup> However, the potential recall bias should be taken into account

for improving the estimated risk of musculoskeletal disorders. Furthermore, the samples of those studies among PTs and OTs are small. Therefore, this study used the longitudinal cohort study based on the population-based nationwide database to evaluate the risk of musculoskeletal disorders, especially for spine-related musculoskeletal disorders (SRMDs).

To date, the information on the risk of new-onset SRMD in health care professionals is insufficient. The purpose of the current study was to investigate new-onset SRMD associations among PTs, OTs, and pharmacists working at medical centers, regional hospitals, local hospitals, and clinics from a population-based national database to understand the potential risk of new-onset SRMD. The results in this study could be served as prevention strategies of SRMDs in the foundational training programs among those high-risk groups.

## 2. Materials and methods

### 2.1. Database and patient identification

The National Health Insurance Research Database (NHIRD) based on Taiwan's National Health Insurance Program, which covers 99% of the population in Taiwan,<sup>[14]</sup> was used in this study. The NHIRD also has been published in various studies.<sup>[15]</sup> The registered medical personnel were also linked to this claims database according to working status, licensure date, working hospital level, specialty, and encrypted identification number. The NHIRD consists of unidentifiable secondary data that have been released to the public for research; thus, the exemption was waived by the Institutional Review Board at Chi-Mei Medical Center (IRB: 10307-E01).

The study subjects were all PTs, OTs, and pharmacists who were aged 18 to 65 years and who had initially obtained a registered license between January 1, 2000, and December 31, 2011, from the Registry of Medical Personnel. Pharmacists were used as the control group because they have similar lifestyle (fixed working hours) and medical knowledge, although they may develop low back pain due to varied physical workload.<sup>[16]</sup> PTs, OTs, and pharmacists followed the 1:1:2 age- and sex-matching scheme. In this 12-year study, all of the study subjects were followed up until they developed a SRMD or until December 31, 2011. A SRMD was identified by at least 3 outpatient service claims within 1 year or 1 hospitalization record based on the following International Classification of Diseases, Ninth Revision, Clinical Modification codes: 722, intervertebral disc disorders; 722.1, displacement of thoracic or lumbar intervertebral disc without myelopathy; 722.71, cervical region; 722.72, thoracic region; 722.11, thoracic intervertebral disc without myelopathy; 722.73, lumbar region; 723, other disorders of cervical region; 724, other and unspecified disorders of back; 724.1, pain in thoracic spine; 724.3, sciatica; 756.11, spondylolysis, lumbosacral region; and 756.12, spondylolisthesis. For identifying the new-onset SRMD, subjects who had a SRMD before the initial registered licensure date were excluded.

### 2.2. Statistical analyses

Descriptive statistics were used to present the baseline information among study groups with frequency and percentage for categorical variables, and mean  $\pm$  standard deviation or median (interquartile range [IQR]) for continuous variables. As prior studies have reported that age, sex, and working location are associated with WMSD among PTs and OTs,<sup>[6–10]</sup> we also selected these variables for estimating the interesting outcome,

SRMD. The difference between PTs, OTs, and pharmacists was compared using Pearson  $\chi^2$  test for categorical variables, such as age group, sex, working hospital level, and SRMD. In addition, the difference in the mean age was compared among these 3 groups with analysis of variance, and the difference of the time to SRMD among these 3 groups was compared using the Kruskal–Wallis test. Kaplan–Meier curves were plotted to describe the proportion of subjects who had a new-onset SRMD, and the risk difference between PTs, OTs, and pharmacists was compared by a log-rank test. A Cox proportional hazard regression was used to estimate the relative risks of SRMD. The hazard ratios (HRs) of SRMD were adjusted by age groups, sex, and working hospital level among the PTs, OTs, and the reference group, pharmacists. The initial sample size was determined by the number of registered PTs (N=6492), OTs (N=4196), and pharmacists (N=20,544) who were aged 18 to 65 years during the enrollment interval (2000–2011). After 1:1:2 age and sex matching, PTs (N=1862), OTs (N=1862), and pharmacists (N=3724) were selected. All statistical analyses used SAS 9.4 for Windows (SAS Institute, Inc, Cary, NC). Kaplan–Meier curves were plotted from STATA (version 12; Stata Corp, College Station, TX). The significance level was set at  $P$  values  $<0.05$ .

## 3. Results

Table 1 shows the baseline characteristics for PTs, OTs, and pharmacists. The mean age of the study subjects was  $24.93 \pm 3.12$  years; most of the study subjects were females (68.05%). Most of the PTs were employed in clinics (37.27%), and most of the OTs and pharmacists were working at metropolitan hospitals (37.06% for OTs and 37.70% for pharmacists). During the follow-up period (median follow-up=4.50 years), the incidence of SRMD in PTs (32.12%) was higher than in OTs (16.97%) and pharmacists (19.60%) ( $P<0.001$ ). The median time to SRMD for PTs was 1.94 years (IQR: 0.61–6.38); it was shorter compared with that for OTs (2.25 years, IQR: 0.76–4.31) and pharmacists (3.29 years, IQR: 1.41–5.57).

The Kaplan–Meier plot showed that PTs have a significantly higher risk of developing a SRMD than OTs and pharmacists (log-rank test:  $P<0.0001$ ; Fig. 1). For all of the study subjects, PTs and OTs had a 1.65-fold (95% confidence interval [CI]: 1.48–1.84) and 1.09-fold (95% CI: 0.95–1.24) increased risk for developing a SRMD compared with pharmacists. Focusing only on PTs and OTs, the risk of SRMD in PTs was increased by 1.43-fold in comparison with that in OTs. In addition, study subjects who were working at regional hospitals, local hospitals, and clinics had a significantly higher risk of developing a SRMD than if they worked at medical centers (Table 2).

In the analysis of the risk of developing a SRMD in different working hospital levels, the PTs also presented an increased risk at each working hospital level compared with pharmacists, especially compared with working at local hospitals (HR: 1.51; 95% CI: 1.25–1.81) and clinics (HR: 2.40; 95% CI: 1.97–2.92). However, only OTs working at clinics had a significantly higher risk of developing a SRMD in comparison with pharmacists (HR: 1.84; 95% CI: 1.40–2.43) (Table 3).

Increased age and females have a tendency of developing a SRMD and working in local community hospitals and clinics increases the risk of developing a SRMD in PTs (Table 4). The cumulative probability of not developing a SRMD for PTs only in medical centers, regional hospitals, local hospitals, and clinics was 79.39%, 66.37%, 52.13%, and 38.30% in the 12-year follow-up period, respectively (Fig. 2A). For OTs only at different

**Table 1****Baseline information for PT, OT, and pharmacist.**

	PT (N = 1862)	OT (N = 1862)	Pharmacist (N = 3724)	P value <sup>§</sup>
Age, mean $\pm$ SD	24.93 $\pm$ 3.12	24.93 $\pm$ 3.12	24.93 $\pm$ 3.12	0.998
Age				
$\leq$ 30	1735 (93.18)	1734 (93.13)	3473 (93.26)	1.000
31–40	113 (6.07)	114 (6.12)	223 (5.99)	
>40	14 (0.75)	14 (0.75)	28 (0.75)	
Sex				
Male	595 (31.95)	595 (31.95)	1190 (31.95)	1.000
Female	1267 (68.05)	1267 (68.05)	2534 (68.05)	
Working hospital level				
Medical center	172 (9.24)	429 (23.04)	895 (24.03)	<0.001
Regional hospitals	418 (22.45)	690 (37.06)	1255 (33.70)	
Local hospitals	578 (31.04)	509 (27.34)	940 (25.24)	
Clinics	694 (37.27)	234 (12.57)	634 (17.02)	
Outcome <sup>†</sup>				
SRMD				
Yes	598 (32.12)	316 (16.97)	730 (19.60)	<0.001
No	1264 (67.88)	1546 (83.03)	2994 (80.40)	
Time to SRMD, median (IQR)	1.94 (0.61–3.68)	2.25 (0.76–4.31)	3.29 (1.41–5.57)	<0.001

ANOVA = analysis of variance, IQR = interquartile range, OT = occupational therapist, PT = physiotherapist, SD = standard deviation, SRMD = spine-related musculoskeletal disorder.

<sup>§</sup> P-value is from Pearson  $\chi^2$  test for categorical variables and ANOVA or Kruskal–Wallis test for continuous variables.

<sup>†</sup> Overall follow-up year, median (IQR): 4.50 (1.86–7.92).

working levels, the cumulative probability of not developing SRMDs in medical centers, regional hospitals, local hospitals, and clinics was 80.52%, 77.02%, 65.82%, and 49.79% in the 12-year follow-up period, respectively (Fig. 2B).

#### 4. Discussion

To the best of our knowledge, the information of new-onset spine disorders in health care professions has not been well established. This is the first study to demonstrate that PTs are a higher risk group for developing new-onset SRMD, especially those PTs who work in clinics. This information will hopefully serve as a foundation for training programs that are planning prevention strategies for SRMDs for this high-risk group.

##### 4.1. Compared with occupational therapists and pharmacists, PTs are the highest risk group for developing new-onset spine disorder

It is well known that PTs and OTs are at a high risk for developing occupational musculoskeletal injuries, and low back pain is the most common problem among these injuries.<sup>[3,6]</sup> In the current study, spine disorders were defined as intervertebral disc disorders, spondylolysis, and spondylolisthesis in the cervical, thoracic, and lumbar areas. We further identified that PTs have a greater chance to develop new-onset SRMDs compared to other caregivers.

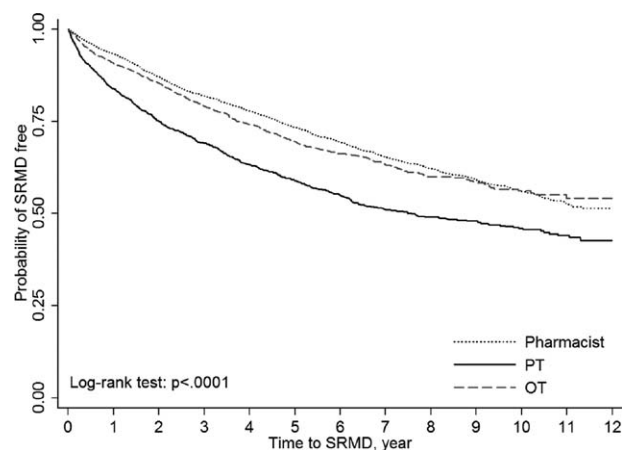
The possible mechanisms of injury may reflect the working characteristics of PTs, such as repetitive and labor-intensive tasks with directly contacting patients.<sup>[6,8]</sup> Hence, the increasing biomechanical load on the spine may be harmful to the spine structure through manual patient handling.<sup>[17,18]</sup>

In the current study, compared with pharmacists and OTs, PTs are most prone to develop SRMDs in a shorter working time interval of 1.94 years. The result, consistent with the Chartered Society of Physiotherapy, mentioned that PTs were at a higher risk of developing musculoskeletal injuries, particularly during the first 4 to 5 years of practice.<sup>[19]</sup> We suppose that the possible

reason of the shorter time to SRMD for Taiwanese PTs may be associated with the inexpensive and convenient national health insurance program. In this single-payment system, patients can easily seek health care; thus, PTs in Taiwan may treat more patients than PTs in other countries.

##### 4.2. Age has the tendency to be a protective factor for developing a new-onset SRMD

The average age of the PTs in the current study was approximately 24 years. Consistent with the previous studies, younger PTs have a greater chance of developing WMSDs.<sup>[6,9,20]</sup> However, in contrast to the studies of Tinubu et al<sup>[21]</sup> and King et al,<sup>[22]</sup> our study indicated that PTs in the age group of <30 years have a tendency to develop WMSDs. This may be because young PTs did not protect themselves from SRMDs



**Figure 1.** Time-to-event curves between PT, OT, and pharmacist for new diagnosis of spine-related musculoskeletal disorders. OT = occupational therapist, PT = physiotherapist, SRMD = spine-related musculoskeletal disorder.

**Table 2****Cox regression for risk of spine-related musculoskeletal disorder.**

	Crude HR (95% CI)	Adjusted HR (95% CI)	Adjusted HR for PT and OT (95% CI)
Pharmacist	1.00 (ref.)	1.00 (ref.)	
PT	1.89 (1.70–2.11)**	1.65 (1.48–1.84)**	1.43 (1.24–1.65)**
OT	1.01 (0.89–1.16)	1.09 (0.95–1.24)	1.00 (reference)
Age group			
≤30	1.00 (reference)	1.00 (reference)	1.00 (reference)
31–40	0.93 (0.77–1.14)	0.84 (0.69–1.03)	0.76 (0.57–1.01)
>40	0.86 (0.51–1.46)	0.72 (0.43–1.22)	0.32 (0.10–1.00)
Sex			
Male	1.00 (reference)	1.00 (reference)	1.00 (reference)
Female	0.99 (0.89–1.10)	1.03 (0.93–1.14)	0.94 (0.82–1.07)
Hospital level			
Medical center	1.00 (reference)	1.00 (reference)	1.00 (reference)
Regional hospitals	1.31 (1.09–1.56)*	1.26 (1.05–1.50)*	1.24 (0.94–1.63)
Local hospitals	2.28 (1.92–2.69)**	2.12 (1.79–2.51)**	2.22 (1.70–2.89)**
Clinics	2.91 (2.45–3.44)**	2.61 (2.20–3.10)**	3.42 (2.63–4.44)**

The model was adjusted for the above-listed variables. CI = confidence interval, HR = hazard ratio, OT = occupational therapist, PT = physiotherapist.

\*  $P < 0.05$ .

\*\*  $P < 0.001$ .

because of the limited professional experience, knowledge, and skill, which could make them ignore the safe working principles of the workstations.<sup>[6,9,20]</sup> As WMSDs occurred, a higher workload could be another explanation for the higher incidence of SRMDs in younger PTs.<sup>[9,20]</sup> Therefore, we propose that educating young PTs and OTs on protecting themselves to avoid SRMDs at work is a very important issue. Because our data collection was from a predominant number of younger PTs who were <30 years old (1735, 93.18%), the results may mainly reflect the situation of new-onset SRMD among young PTs during practice.

#### 4.3. Working in clinics is a potential risk for new-onset SRMDs for physiotherapists

As Chien et al showed, most of the PTs worked at clinics (2115 PTs, 34.49%), followed by metropolitan hospitals (1783 PTs, 29.08%), local community hospitals (1459 PTs, 23.79%), and medical centers (775 PTs, 12.64%) in 2012 in Taiwan.<sup>[23]</sup> In the current study, 37.2% of PTs work in clinics and 9.4% work in medical centers; these rates were consistent with those that Chien et al reported.<sup>[23]</sup> Therefore, our data actually reflected the distribution of PTs in Taiwan.

When considering the work place, health care professionals may suffer from a WMSD in their daily work routine. Several studies showed that WMSDs were related to working in specialized departments, such as orthopedics, pediatrics, and neurology, for PTs.<sup>[9,20]</sup> Our study further identified that the incidence rate of the new-onset SRMD among PTs who work in clinics is far higher (HR: 2.40, 95% CI: 1.97–2.92) than that

among PTs who work at other hospital levels. The cumulative probability of not developing a SRMD for PTs was also significantly lower if working in clinics. We consider that these etiologies may be related to the lowest ratio of the number of PTs to the number of hospital bed in clinics compared to that in the medical center.<sup>[23]</sup> Clinics may have no adequate equipment and less undergraduate students to undertake primary care. Therefore, we want to emphasize that the working place may affect the development of SRMDs and should be investigated. We also recommended a training program for PTs and OTs as a reminder that PTs and OTs in the working place could affect the risk of SRMD.

In the current study, we excluded patients who were diagnosed with preexisting spine disorders before obtaining a registered license. Therefore, this prospective association between SRMDs with risk factors allows the direction of the effect to be explored. Our results highlight the significant relationship of new-onset SRMDs with PTs and working in clinics, which may be a result of the environmental conditions of the workplace. Therefore, we recommend that young PTs should have a proper training to reduce the risk of new-onset SRMDs before entering the work place. This issue in the preventive medicine field of health professionals is worth exploring.

Especially, workplace setting was an important factor for improving the health promotion and disease prevention.<sup>[24–26]</sup> For reducing the risk of new-onset SRMDs, the organization should offer suitable tools or some compensation corporate sports activities<sup>[27]</sup> to protect PTs and OTs in their repeated activities. Furthermore, to prevent spinal disease, PTs and OTs should be encouraged to have more leisure time physical activity

**Table 3****Cox regression for risk of spine-related musculoskeletal disorder by different hospital level.**

	Medical center		Regional hospitals		Local hospitals		Clinics	
	No. of events	Adjusted HR (95% CI)	No. of events	Adjusted HR (95% CI)	No. of events	Adjusted HR (95% CI)	No. of events	Adjusted HR (95% CI)
Pharmacist	109 (12.18)	1.00 (reference)	202 (16.10)	1.00 (reference)	257 (27.34)	1.00 (reference)	162 (25.55)	1.00 (reference)
PT	23 (13.37)	1.02 (0.65–1.60)	82 (19.62)	1.14 (0.88–1.47)	202 (34.95)	1.51 (1.25–1.81)**	291 (41.93)	2.40 (1.97–2.92)**
OT	47 (10.96)	1.13 (0.80–1.60)	103 (14.93)	0.92 (0.72–1.16)	88 (17.29)	0.81 (0.63–1.03)	78 (33.33)	1.84 (1.40–2.43)**

The model was adjusted for the age and sex. CI = confidence interval, HR = hazard ratio, OT = occupational therapist, PT = physiotherapist.

\*\*  $P < 0.001$ .

**Table 4****Cox regression for risk of spine-related musculoskeletal disorder in PT only.**

	Crude HR (95% CI)	Adjusted HR (95% CI)
Age group		
≤30	1.00 (reference)	1.00 (reference)
31–40	0.84 (0.59–1.19)	0.74 (0.52–1.05)
>40	0.30 (0.07–1.18)	0.30 (0.07–1.20)
Sex		
Male	1.00 (reference)	1.00 (reference)
Female	1.08 (0.91–1.28)	1.05 (0.88–1.24)
Hospital level		
Medical center	1.00 (reference)	1.00 (reference)
Regional hospitals	1.48 (0.93–2.35)	1.50 (0.94–2.38)
Local hospitals	3.09 (2.01–4.75)**	3.14 (2.04–4.83)**
Clinics	4.22 (2.76–6.45)**	4.29 (2.80–6.56)**

The model was adjusted for the above-listed variables. CI = confidence interval, HR = hazard ratio, PT = physiotherapist.

\*\*  $P < 0.001$ .

for improving the health benefits.<sup>[28]</sup> These interventions from workplace or institution may improve the possible risk of occupational injury.

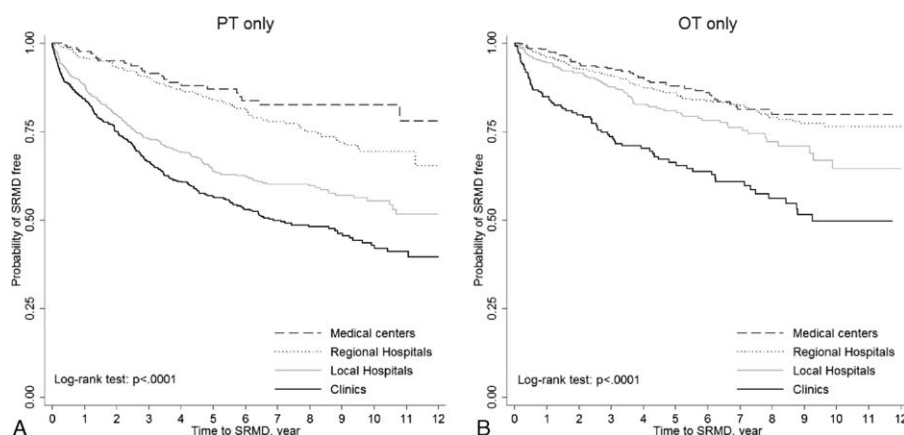
#### 4.4. Females have a tendency to develop new-onset SRMDs for physiotherapists

Several studies reported female predominance in the prevalence of musculoskeletal disorders among working population.<sup>[1,2,6,19]</sup> It may be because of the fact that females are physically weaker than males because of the relatively small size of their stomach muscle and weaker muscle strength, which places females at a relative disadvantage for lifting and transferring patients in daily practice.<sup>[8]</sup> Another important reason is that pregnancy induces changes in spinal posture and weakens the joint structure, which increases the risk for WMSDs.<sup>[8]</sup> However, our results showed that female PTs have a tendency of developing a SRMD, but not a significantly increased risk of developing a SRMD (Table 4).

#### 4.5. Limitations of the study

There are several limitations of our study that should be considered. First, because the diagnoses relied on the claims data

and the International Classification of Diseases, Ninth Revision, Clinical Modification diagnosis, some disease misclassifications may exist. Second, the incidence of new-onset SRMD in our study may be underestimated based on the reported information from insurance system because SRMD could be self-managed by PTs and OTs. Especially, health care professionals are less likely to seek care because of their ability to self-treat, recognize early injury symptoms, and access clinical colleagues.<sup>[29]</sup> A previous study also indicated that health professionals could self-treat pain using drug (57.7%),<sup>[30]</sup> and other studies reported that 7.7% to 23.8% of nurse/nursing students treated their WMSD based on the self-medication.<sup>[31,32]</sup> Therefore, the true outcome (new-onset spine disorder) could be underestimated because of underdiagnosis, undertreatment, and undiagnosed spine disorders in the claims data. Third, we did not evaluate pregnancy, body mass index, number of daily treated patients, hours worked per week, or academic degree, which may influence the development of SRMDs.<sup>[4]</sup> The lack of socioeconomic status information in this database may also affect the risk of SRMD estimation in PTs and OTs. Previous studies indicated that income inequality was relevant to health status and mortality.<sup>[33–35]</sup> As we know that low income may lead to poor health, the PTs and OTs may work a lot of hours for earning enough revenue for their life due to payment system. Thus, other potential contributors to our results may be undetected, and these indicators should be considered in the future research. However, despite these limitations, our study was based on a population-based matched cohort study to investigate new-onset SRMDs among PTs. Based on the population database, the large sample size and long duration of follow-up made it possible to examine the incidence and risk factors associated with SRMDs. Additionally, this study focused on the risk of SRMD among PTs because the previous study using a similar database demonstrated that PTs have the highest risk of musculoskeletal disorders among other medical professions,<sup>[12]</sup> although many studies show that nurses are also the higher risk group of WMSD.<sup>[11,21,36]</sup> For considering the comparable baseline on the similar working group, the OTs and pharmacists were selected. In the future research, we will explore the risk of WMSDs in the other medical professions with reasonable comparison. Especially, for different occupations, the plasticity of health with multidimensional influencing factors was totally different.<sup>[26]</sup> The impact of plasticity of health should be presented as an integrated view in the future study.



**Figure 2.** (A and B) Time-to-event curves of PT/OT in the different level of hospital for new diagnosis of spine-related musculoskeletal disorders. OT = occupational therapist, PT = physiotherapist, SRMD = spine-related musculoskeletal disorder.

## 5. Conclusions

In this study, among the health care professionals assessed, PTs, especially those working in clinics, had a significantly higher risk for developing new-onset SRMDs. These findings will hopefully serve as a foundation for future research on spine disorders for PTs.

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