

Work-related musculoskeletal disorders among physical therapists in Taiwan

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Abstract

Work-related musculoskeletal disorders (WMSD) refer to musculoskeletal injuries caused by the occupation. Physical therapists (PTs) suffer from a high risk of WMSD despite their extensive knowledge in ergonomics and injury prevention. This study aims to discover the incidence and prevalence of WMSD among PTs using Taiwan's nationwide claims database. The trend of annual patients seeking rehabilitation and the prevalence of WMSD among PTs were presented. The age- and gender-specific incidence of WMSD were also calculated. The prevalence of WMSD in PTs varied from 6.1% to 75.2%, and the incidence ranged from 6.1 to 29.1 per 100 person-years during 1997 and 2012. For those aged ≤ 30 years, the incidence was higher in females than males (incidence rate ratio = 1.08, 95% confidence interval [CI]: 1.02–1.14, $P = .011$), whereas for those aged from 31 to 40 years, females had lower incidence of WMSD than males (incidence rate ratio = 0.88, 95% CI: 0.80–0.96, $P = .007$). The patients/PTs ratio was higher (270.56–337.74) in 1998 and 2004 to 2007 and became stable (245.93–252.82) in 2008 to 2012, correlating with a rise in the WMSD prevalence in 1999 to 2007 and a steady prevalence after 2008 (63.5%–66.3%) in PTs. In conclusion, the risk of WMSD among PTs was positively correlated to the frequency of patients seeking rehabilitation service. In addition, age and gender were important risk factors for developing WMSD among PTs.

Abbreviations: BMI = body mass index, CI = confidence interval, ICD-9-CM = International Classification of Diseases, Ninth Revision, Clinical Modification, IRR = incidence rate ratio, NHI = National Health Insurance, NHIRD = National Health Insurance Research Database, PTs = physical therapists, PYs = person-years, WMSD = work-related musculoskeletal disorders.

Keywords: healthcare utilization, physical therapists (PTs), work-related musculoskeletal disorders (WMSD)

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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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1. Introduction

Work-related musculoskeletal disorders (WMSD) refer to musculoskeletal injuries induced or aggravated by work or the environment where the work is carried out. Risk factors for WMSD include heavy physical load or psychosocial stress, smoking, a higher body mass index (BMI), and the presence of comorbidities (pain, arthritis, and rheumatism).^[1–3] Excessive repetition, awkward postures, and heavy lifting are common biomechanical risk factors causing WMSD.^[1]

Although physical therapists (PTs) have extensive knowledge in ergonomics and injury prevention, their risk of WMSD remains high.^[4–7] Several studies have investigated the prevalence of WMSD in PTs. In Kuwait, the 1-year prevalence of WMSD was 47.6% in PTs, most commonly affecting the low back (32%), neck (21%), and upper back (13%).^[8] In Nigeria, the 1-year prevalence was 91.3%; low back (69.8%), and neck (34.1%) were the main involved areas. The female gender and a lower BMI were two major risk factors for WMSD.^[4] In Izmir, Turkey, the lifetime prevalence of WMSD in PTs was 85%; low back (26%), hand-wrist (18%), shoulders (14%), and neck (12%) were the most vulnerable, and transferring the patients was the leading maneuver to cause its occurrence (15%).^[9] In Israel, the lifetime prevalence of WMSD was 83%, occurring most commonly in the lower back (80%).^[10] In Greek, the lifetime prevalence of WMSD in PTs was 89%.^[11] Fewer studies had addressed the incidence of WMSD in PTs. Two studies in the USA showed the 1-year incidence of WMSD ranged from 16.9 to 20.7 injuries per 100 full-time workers among PTs.^[12,13] Another study showed the 3-year incidence of WMSD in older and

younger PTs were 19.6 and 21.4 injuries per 100 full-time workers, respectively.^[14] Despite the difference in methodology and the numbers reported, these studies did highlight the universality of WMSD in PTs.

WMSD imposes a significant direct cost burden on healthcare systems and accounts for an even greater indirect loss in productivity. WMSD had substantial effects on PTs both at home and at work, leading to changes in career plans and reduction in clinical longevity.^[15] One study has shown that every one out of 6 PTs had to adjust their workload or even left the profession as a result of WMSD.^[16]

Although several cross-sectional surveys have reported the prevalence of WMSD in PTs, the longitudinal data are rare regarding how the prevalence has evolved. In this study, we undertook an analysis based on Taiwan's nationwide claims database to investigate the prevalence and incidence of WMSD in PTs. Specifically, it attempted to answer the following questions:

1. whether the numbers of PTs and patients seeking rehabilitation service affect the trends of WMSD prevalence in PTs; and
2. whether the incidence and prevalence vary between genders and among different age groups of PTs.

2. Materials and methods

2.1. Data sources

Taiwan's single-payer National Health Insurance (NHI) system began in 1995, covering more than 99% of Taiwan's population. For research purposes, the system's claims data were released as the National Health Insurance Research Database (NHIRD), and Taiwan's National Health Research Institutes continued to maintain the database. The NHIRD used the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) code to document all the registration records of diseases. The NHIRD contained encrypted patient identification numbers, gender, date of birth, dates of admission and discharge, and detailed medical expenditure. To avoid the possibility of ethical violation, all the personal identification has been encrypted to secure the privacy and confidentiality of the individuals. Thus, the institutional review board of Chi Mei Medical Center approved the exemption (IRB No.: 10302-E01, issued date at 2014/2/26).

2.2. Study population and definitions

The Registry of Medical Personnel, a subset database of the NHIRD, was used in this study. All the registered PTs aged 18 to 65 years who initially obtained a registered license between January 1, 1997 and December 31, 2012 were selected from the Registry of Medical Personnel. These subjects were our study population, and they were screened for all the diagnosed diseases. Those who developed WMSD were identified either by at least 3 outpatient service claims or 1 hospitalization claim within 1 year using ICD-9-CM. In this study, the diagnosis of WMSD was based on the ICD-9-CM, including disorders of peripheral nerves (ICD-9-CM: 353–355, excluding 353.5 and 353.6); osteoarthritis other than spine (ICD-9-CM: 715), unspecified arthropathies or arthritis (ICD-9-CM: 716.40–716.99), knee or other joint disorders (ICD-9-CM: 717–719); spinal disorders (ICD-9-CM: 721–724); soft tissue disorders (ICD-9-CM: 726–729); and sprains and strains of joints and muscles (ICD-9-CM: 840.00–848.9). To identify the cases with new-onset WMSD,

subjects who had WMSD before the initial registered licensure date were excluded.

2.3. Statistical analysis

All statistical analyses were conducted using SAS (version 9.4, SAS Institute Inc., Cary, NC). The baseline information (age, gender, the presence of WMSD, and the types of WMSD) was presented as frequency with percentage. To estimate the distribution difference between PTs with WMSD and those without in age and gender, Pearson Chi-Squared was used. The annual prevalence of WMSD was calculated using the number of the PTs with the diagnosis of WMSD divided by the total registered PTs each year. For estimating the incidence rate of WMSD, the person-years (PYs) of each PT were calculated from the date of registered license to December 31 of each year, and the annual incidence rate was calculated by the number of PTs with newly diagnosed WMSD (cases) each year divided by the total PYs of all the registered PTs at the same year. The linear trend test was used to estimate the patient/PT ratio between 1998 and 2012. In addition, the age- and gender-specific incidence rates of WMSD were also calculated. The Poisson regression model was used to estimate the incidence rate ratio (IRR) with 95% confidence interval (CI) of gender difference. Statistical significance was set at P values $< .05$.

3. Results

The target population consisted of 8988 PTs (3302 males and 5696 females). There were more females (63.30%) than male PTs (36.70%). Table 1 presents the baseline demographic data of all PTs. Their mean age was 26.31 ± 4.91 years, and 6647 (73.87%) were younger than 30 years old. Of them, 7092 (78.82%) had ever had WMSD during the study period. The distribution of age and gender between PTs with WMSD and those without were also presented. PTs who aged older than 30 years-old had significant higher WMSD than those without WMSD ($P < .0001$). The 3 most common types of WMSD were soft tissue injury (66.99%), spinal disorders (59.1%), and sprains and strains (56.8%). In contrast, arthropathy (8.06%) and disorders of peripheral nerves (12.60%) were less common (Table 1).

3.1. Prevalence and incidence of WMSD in PTs

Table 2 presents the annual prevalence and incidence of WMSD in PTs from 1997 to 2012. The prevalence of WMSD in PTs ranged from 6.1% to 9.6% in 1997 to 1998, surged suddenly to 34.8% in 1999, peaked at 75.2% in 2007, and then remained steady (63.5%–66.3%) after 2008. The incidence of WMSD ranged from 6.1 to 29.1 per 100 PYs during 1997 to 2012. The highest incidence rates appeared in 1999 to 2000 (28.7–29.1 per 100 PYs), and then the incidence rate started to decline and became steadier after 2008 (6.4–9.3 per 100 PYs).

3.2. The trend of patients seeking rehabilitation versus the number of registered PTs

To understand whether the prevalence of WMSD in PTs was correlated with the workload of PTs, we presented the trend of patients who received rehabilitation and the numbers of registered PTs during the years 1998 and 2012 (Fig. 1). The numbers of the patients increased from 758,164 (year 1998) to

Table 1
The baseline demographic information of all physical therapists (PTs) of Taiwan from 1997 to 2012.

	PT (N = 8998)	Without WMSD (N = 1906)	With WMSD (N = 7092)	P value
Age, n (%) [*]				
<30	6647 (73.87%)	1566 (82.16)	5081 (71.64)	<.0001
30–39	2006 (22.29%)	286 (15.01)	1720 (24.25)	
40–49	251 (2.79%)	43 (2.26)	208 (2.93)	
≥50	94 (1.04%)	11 (0.58)	83 (1.17)	
Gender, n (%)				
Male	3302 (36.70%)	730 (38.30)	2572 (36.27)	.1019
Female	5696 (63.30%)	1176 (61.70)	4520 (63.73)	
WMSD types, n (%)				
Disorders of peripheral nerves	1134 (12.60%)			
Osteoarthritis (other than spine)	1357 (15.08%)			
Unspecified arthropathies or arthritis	725 (8.06%)			
Knee or other joint disorders	2173 (24.15%)			
Spinal disorder	5318 (59.10%)			
Soft tissues disorders	6028 (66.99%)			
Sprains and strains of joints and muscles	5111 (56.80%)			

^{*} Mean of age (mean ± SD): 26.31 ± 4.91 years.

^{*} There are 7092 patients with WMSD (78.82%) and 1906 patients without WMSD (21.18%).

PT = physical therapist, WMSD = work-related musculoskeletal disorders.

1,540,964 (year 2012), whereas those of PTs rose from 2296 to 6253 at the same time. The patients/PTs ratio was higher (>300) in 1998 and 2004 to 2007, and it was lower (245.93–252.82) in 2008 to 2012. The patient/PT ratio presented a significantly decreased trend ($P = .037$).

3.3. Gender- and age-specific incidence rates of WMSD in PTs

Table 3 listed the gender-specific incidences of WMSD in PTs at different age groups. Compared with other age groups, PTs aged ≤30 years had the highest incidence of WMSD (48.26 per 100 PYs) in both males and females. For those aged ≤30 years, the incidence was higher in females than males (IRR = 1.08, 95% CI: 1.02–1.14, $P = .011$). However, for those aged 31 to 40 years,

females had lower incidence of WMSD than males (IRR = 0.88, 95% CI: 0.80–0.96, $P = .007$).

4. Discussion

The main findings of this study include:

1. WMSD is common in Taiwanese PTs, and the prevalence showed a similar trend with the ratios of patients/PTs;
2. the incidence rate of WMSD in PTs fluctuated year by year in the range of 6 and 17 per 100 PYs;
3. the effect of gender on the incidence of WMSD differ among the age groups; and
4. the most common types of WMSD included soft tissue injury, spinal injury, and muscle sprain/strains.

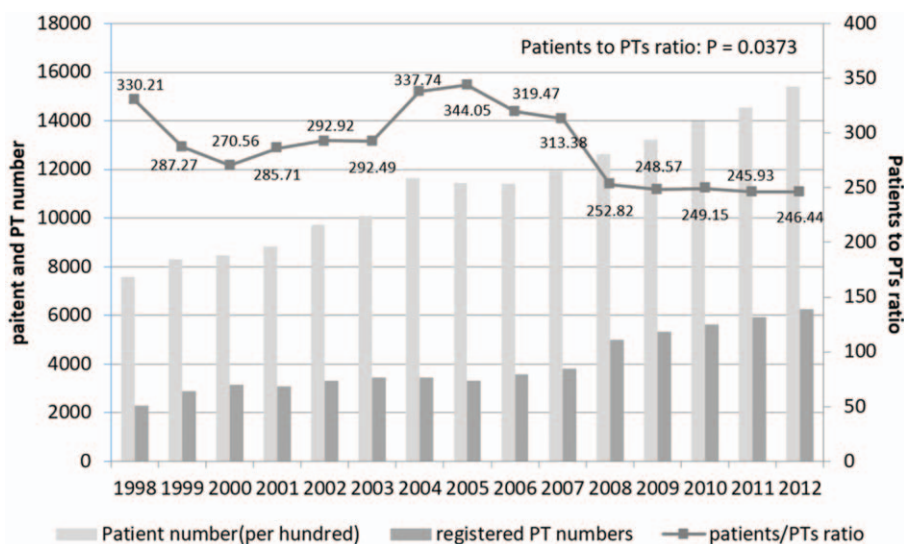


Figure 1. The trend of patients seeking rehabilitation service, registered physical therapists (PTs), and the patients to PTs ratio from 1998 to 2012. PT = physical therapist.

Table 2**The incidence and prevalence of work-related musculoskeletal disorders (WMSD) in physical therapists of Taiwan from 1997 to 2012.**

Year	Total population	New WMSD cases	Total WMSD cases	Incidence rate per 100 person-years	Prevalence per 100 persons
1997	1491	91	91	6.1	6.1
1998	2296	163	220	7.1	9.6
1999	2895	841	1008	29.1	34.8
2000	3136	900	1621	28.7	51.7
2001	3089	554	1798	17.9	58.2
2002	3318	476	1972	14.3	59.4
2003	3446	413	2256	12.0	65.5
2004	3447	390	2421	11.3	70.2
2005	3328	330	2501	9.9	75.2
2006	3568	373	2569	10.5	72.0
2007	3808	419	2845	11.0	74.7
2008	5003	461	3179	9.2	63.5
2009	5323	495	3496	9.3	65.7
2010	5613	500	3696	8.9	65.8
2011	5918	471	3918	8.0	66.2
2012	6253	398	4146	6.4	66.3

WMSD = work-related musculoskeletal disorders.

4.1. The prevalence and incidence of WMSD

Our study demonstrated that the overall prevalence of WMSD during 1997 to 2012 was 78.82%, which was in the middle of those reported in the literature (32%–91.3%).^[4,8–10,16–19] The year-by-year data showed the prevalence accelerated since 1999, peaked (75.2%) in 2007, and became steadier (63.5%–66.3%) during 2008 to 2012. We believed that the launch of the NHI program in 1995 increased the utilization of rehabilitation resources.^[20] In 2008, the number of practicing PTs was increased by 31.38% (from 3808 to 5003, Table 2), whereas the utilization of rehabilitation resources was up by 5.95% only (from 119,300 to 126,400, Fig. 1) in the same year. Heavier workload (indicated by a higher patient-to-PT ratio) increased the risk of WMSD in PTs, leading to rising prevalence during 1999 to 2007. In contrast, a more favorable patient-to-PT ratio (245–252) since 2008 indicated improved workload for PTs, and the prevalence of WMSD became lower at the same time.

In this study, the annual incidence of WMSD in PTs fluctuated between 6.1 and 29.1 per 100 PYs. A drastic change in the incidence rates in 1999 to 2000 was probably related to the “Chi Chi” earthquake on September 21, 1999, which led to 2415 people killed and 11,305 injured in Taiwan. Although the patients to PTs ratio in 1999 to 2000 was lower compared to 1998, the earthquake survivors required much more rehabilitation services, increasing the workload of PTs and leading to a surge of WMSD incidence in PTs. The incidence of WMSD progressively declined since 2001 and remained stable after 2008. Due to great fluctuations in the incidence throughout the years,

our data were difficult to compare with 2 other US studies, which showed the 1-year incidence ranged from 16.9 to 20.7 per 100 PYs.^[12,13] However, our data indicated that both the prevalence and incidence of WMSD could be affected by the change in the healthcare system and the occurrence of catastrophic events. Therefore, it may be essential to collect and analyze the long-term data when researching the WMSD issue in PTs.

4.2. The effect of age and gender on the incidence of WMSD

We found that PTs under age 30 had the highest incidence of WMSD among all age groups. Junior PTs have heavier clinical loading and less experience in maintaining proper body mechanisms at work and in self-treatment, putting them at a higher risk of WMSD than senior PTs.^[21] Senior PTs aged ≥ 50 in this study had a lower incidence of WMSD than junior PTs aged ≤ 30 . It was probably because senior PTs often serve as supervisors or teachers and have a less physical challenge at work. Despite this, age-related physical change contributes to WMSD, and 1 study showed that senior PTs might have worse pain symptoms when they developed WMSD.^[14]

In line with other studies,^[22,23] we found a higher incidence of WMSD in females PTs under 30 years old. Compared with men, women have lower cardiopulmonary fitness, less muscle strength, and shorter muscular endurance. Besides, female PTs under age 30 were usually in their childbearing years. Pregnant women gain weight and undergo multiple hormonal and biomechanical

Table 3**Averaged age-specific incidence of work-related musculoskeletal disorders (WMSD) in physical therapists of Taiwan during years 1997 to 2012.**

Age	Number of WMSD (percentage)			Incidence per 100 person-years			F/M incidence rate (95% CI)	
	Male	Female	Total	Male	Female	Total	IRR of F/M	P value
≤ 30	1684 (65.47)	3397 (75.15)	5081 (71.64)	23.22	25.04	48.26	1.08 (1.02–1.14)	.011
31–40	783 (30.44)	937 (20.73)	1720 (24.25)	17.32	15.20	32.52	0.88 (0.80–0.96)	.007
41–50	85 (3.30)	123 (2.72)	208 (2.93)	11.04	12.51	23.55	1.13 (0.86–1.49)	.374
≥ 50	20 (0.78)	63 (1.39)	83 (1.17)	14.18	16.45	30.63	1.16 (0.70–1.92)	.564

CI = confidence interval, F/M = female/male, IRR = incidence rate ratio, WMSD = work-related musculoskeletal disorders.

alterations, including straining of the axial skeleton and pelvis and increased laxity of peripheral joints.^[24] These changes may impact the musculoskeletal system and increase the risk of WMSD in young female PTs. On the other hand, male PTs aged 30 to 40 had a higher incidence of WMSD than female PTs of the same age group. In males, the decline of joint flexibility started since age 30 seconds, which is earlier than females (since age 50 seconds).^[25] This gender-specific physiological change might render the male PTs liable to WMSD when they reach 30 to 40 years old.

4.3. The types of WMSD

In this study, the most and third most common types of WMSD in PTs were soft tissue injury as well as sprains and strains, respectively (Table 1). Soft tissue injury refers to the inflammatory change in muscles, ligaments, fascia, synovium, tendon, and bursa; sprains are caused by overextension or tear of a ligament; strains are caused by prolonged, repetitive movement of a muscle. Manual therapy, which requires repetitive thrust and non-thrust manipulation techniques, might be responsible for these 2 injuries in PTs. Other maneuvers contributing to these 2 injuries in PTs included lifting/transferring training, standing training, mat exercises, gait training, and posture adjustment.^[4,7] These treatment behaviors required PTs to assist the patients in positioning, stabilization, and movements all the time, so PTs with improper body biomechanics, muscle overuse, and poor soft flexibility were susceptible to these injuries.

The second most common type of WMSD in this study was spinal disorders, that is, spondylosis and herniation of the intervertebral disc in the cervical and lumbar regions. Working in a standing position puts mechanical stress on the spine and causes spinal problems in PTs.^[8,10,21,23,26] A recent study in Taiwan also demonstrate that PTs have a 2.40 fold increased risk of developing spinal-related musculoskeletal disorders compared to occupational therapists and pharmacists.^[27]

Arthropathy or arthritis is also a common cause of WMSD in PTs. Standing and performing manual therapy increases the risk of osteoarthritis in the knees and finger joints in later life. One study showed that 10% to 20% of PTs developed osteoarthritis of the knee at age 65.^[28] Neuropathy was a less common cause of WMSD. Repetitive wrist movement during manual therapy may lead to carpal tunnel syndrome in PTs,^[29] while long-term standing caused lumbar radiculopathies.^[30]

4.4. Limitations

Our study has limitations. First, this study was based on the claims database, and the diagnoses of WMSD relied on the correct coding of the ICD-9-CM. Therefore, the possibility of disease misclassifications (i.e., the types of WMSD in PTs) may exist. Second, the prevalence and incidence of WMSD may be under-estimated because WMSD could be self-managed by PTs without seeking medical help. Third, due to the limitation of the claims database, we could not evaluate the effect of some potential factors on WMSD, including BMI, smoking, and psychosocial stress, which were known risk factors for WMSDs.^[13] In addition, sociocultural, and socioeconomic differences among cities of Taiwan may affect the results, but they were not standardized and mapped in this study.^[31] Fourth, fewer PTs were aged ≥ 50 years in this study. It was because physical therapy is a new territory of medicine in Taiwan: the first

department of physical therapy was established in 1967, with the second one in 1985. As a result, the impact of WMSD on the elderly PTs may be difficult to evaluate in this study.

5. Conclusions

The risk of WMSD among PTs was positively correlated to the frequency of patients seeking rehabilitation service in Taiwan. In addition, female PTs aged below 30 years had a higher risk of WMSD. In December 2021, Taiwan's Ministry of Labor had issued an amendment to the Regulations of the Labor Health Protection, mandating the enterprise to hire healthcare staff to help laborers with WMSD. We hope that our study could promote the awareness of WMSD in PTs. Therefore, the hospital managers should regularly monitor the patients to PTs ratio to avoid overload of PTs. Young PTs should be aware of the risk of WMSD and use behavior-modification strategies and ergonomic equipment to avoid WMSD. The hospital managers and the association of physical therapists should hold more educational programs to reduce the risk of WMSD in young PTs.

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References

- [1] da Costa BR, Vieira ER. Risk factors for work-related musculoskeletal disorders: a systematic review of recent longitudinal studies. *Am J Ind Med* 2010;53:285–323.
- [2] Assuncao AA, Abreu MNS. Factor associated with self-reported work-related musculoskeletal disorders in Brazilian adults. *Rev Saude Publica* 2017;51(suppl):1–10.
- [3] Cole DC, Ibrahim S, Shannon HS. Predictors of work-related repetitive strain injuries in a population cohort. *Am J Public Health* 2005;95:1233–7.
- [4] Adegoke BO, Akodu AK, Oyeyemi AL. Work-related musculoskeletal disorders among Nigerian physiotherapists. *BMC Musculoskelet Disord* 2008;9:1–9.
- [5] Girbig M, Deckert S, Kopkow C, et al. Work-related complaints and diseases of physical therapists - protocol for the establishment of a "Physical Therapist Cohort" (PTC) in Germany. *J Occup Med Toxicol* 2013;8:1–8.
- [6] Khairy WA, Bekhet AH, Sayed B, Elmetwally SE, Elsayed AM, Jahan AM. Prevalence, profile, and response to work-related musculoskeletal disorders among Egyptian physiotherapists. *Open Access Maced J Med Sci* 2019;7:1692–9.

- [7] Passier L, McPhail S. Work related musculoskeletal disorders amongst therapists in physically demanding roles: qualitative analysis of risk factors and strategies for prevention. *BMC Musculoskelet Disord* 2011;12:1–9.
- [8] Alrwayeh HN, Alshatti TA, Aljadi SH, Fares M, Alshamire MM, Alwazan SS. Prevalence, characteristics, and impacts of work-related musculoskeletal disorders: a survey among physical therapists in the State of Kuwait. *BMC Musculoskelet Disord* 2010;11:1–11.
- [9] Salik Y, Ozcan A. Work-related musculoskeletal disorders: a survey of physical therapists in Izmir-Turkey. *BMC Musculoskelet Disord* 2004;5:1–7.
- [10] Rozenfeld V, Ribak J, Danziger J, Tsamir J, Carmeli E. Prevalence, risk factors and preventive strategies in work-related musculoskeletal disorders among Israeli physical therapists. *Physiother Res Int* 2010;15:176–84.
- [11] Anyfantis ID, Biska A. Musculoskeletal disorders among Greek physiotherapists: traditional and emerging risk factors. *Saf Health Work* 2018;9:314–8.
- [12] Campo M, Weiser S, Koenig KL, Nordin M. Work-related musculoskeletal disorders in physical therapists: a prospective cohort study with 1-year follow-up. *Phys Ther* 2008;88:608–19.
- [13] Darragh AR, Huddleston W, King P. Work-related musculoskeletal injuries and disorders among occupational and physical therapists. *Am J Occup Ther* 2009;63:351–62.
- [14] King P, Huddleston W, Darragh AR. Work-related musculoskeletal disorders and injuries: differences among older and younger occupational and physical therapists. *J Occup Rehabil* 2009;19:274–83.
- [15] Campo M, Darragh AR. Impact of work-related pain on physical therapists and occupational therapists. *Phys Ther* 2010;90:905–20.
- [16] Cromie JE, Robertson VJ, Best MO. Work-related musculoskeletal disorders in physical therapists: prevalence, severity, risks, and responses. *Phys Ther* 2000;80:336–51.
- [17] Bork BE, Cook TM, Rosecrance JC, et al. Work-related musculoskeletal disorders among physical therapists. *Phys Ther* 1996;76:827–35.
- [18] Holder NL, Clark HA, DiBlasio JM, et al. Cause, prevalence, and response to occupational musculoskeletal injuries reported by physical therapists and physical therapist assistants. *Phys Ther* 1999;79:642–52.
- [19] West DJ, Gardner D. Occupational injuries of physiotherapists in North and Central Queensland. *Aust J Physiother* 2001;47:179–86.
- [20] Chen L, Yip W, Chang MC, et al. The effects of Taiwan's National Health Insurance on access and health status of the elderly. *Health Econ* 2007;16:223–42.
- [21] Vieira ER, Schneider P, Guidera C, Gadotti IC, Brunt D. Work-related musculoskeletal disorders among physical therapists: a systematic review. *J Back Musculoskelet Rehabil* 2016;29:417–28.
- [22] Brown WJ, McLaughlin D, Leung J, et al. Physical activity and all-cause mortality in older women and men. *Br J Sports Med* 2012;46:664–8.
- [23] Campo MA, Weiser S, Koenig KL. Job strain in physical therapists. *Phys Ther* 2009;89:946–56.
- [24] Marnach ML, Ramin KD, Ramsey PS, Song SW, Stensland JJ, An KN. Characterization of the relationship between joint laxity and maternal hormones in pregnancy. *Obstet Gynecol* 2003;101:331–5.
- [25] Swain DP. American College of Sports Medicine. American College of Sports Medicine. ACSM's resource manual for Guidelines for exercise testing and prescription 7th ed. Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins; 2014.
- [26] Rahimi F, Kazemi K, Zahednejad S, Lopez-Lopez D, Calvo-Lobo C. Prevalence of work-related musculoskeletal disorders in Iranian physical therapists: a cross-sectional study. *J Manipulative Physiol Ther* 2018; 41:503–7.
- [27] Liao JC, Ho CH, Chiu HY, et al. Physiotherapists working in clinics have increased risk for new-onset spine disorders: a 12-year population-based study. *Medicine (Baltimore)* 2016;95:e4405.
- [28] Plotnikoff R, Karunamuni N, Lytyyak E, et al. Osteoarthritis prevalence and modifiable factors: a population study. *BMC Public Health* 2015; 15:1–10.
- [29] Conolly WB, McKessar JH. Carpal tunnel syndrome—can it be a work related condition? *Aust Fam Physician* 2009;38:684–6.
- [30] Hartvigsen J, Hancock MJ, Kongsted A, et al. What low back pain is and why we need to pay attention. *Lancet* 2018;391:2356–67.
- [31] Bayramlar OF, Ezirmik E, Issever H, Bayramlar Z. Standardization of the numbers of work accidents, occupational diseases and mortality rates according to social security institution's 2010-2015 years data based upon cities. *J Instanb Fac Med* 2019;82:29–39.