Preplanned Studies

Epidemiological Data of Work-Related Musculoskeletal Disorders — China, 2018–2020

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Summary

What is already known about this topic?

In recent decades, work-related musculoskeletal disorders (WMSDs) have become increasingly prominent and have become an important issue that is of universal concern and an urgent need to be solved in all countries of the world.

What is added by this report?

The top three industries or occupational groups with the highest standardized prevalence rate of WMSDs were flight attendants, medical staff, and vegetable greenhouses in that order. Women workers were 1.5 times more likely to suffer from WMSDs than men workers.

What are the implications for public health practice?

This study has found the prevalence and distribution characteristics of WMSDs in key industries in China. It is urgent to draw up relevant measures to prevent and control occupational populations with WMSDs.

With the development of science and technology and the process of industrialization, the working conditions of workers have changed greatly. During their work, workers frequently undergo local muscle tension such as repetitive operation, poor working posture, excessive force load, continuous muscle tension, vibration contact, and other health effects caused by adverse working conditions. Work-related musculoskeletal disorders (WMSDs) caused by adverse ergonomics are becoming increasingly prominent. As early as 2002, the International Labor Organization (ILO) added WMSDs in the international list of occupational diseases and refined it in the latest edition of occupational diseases catalogue approved in 2010, including seven categories and an open clause (*1*). Currently, WMSDs are not included in the list of statutory occupational diseases in China. Rather, it is only perceived as work-related diseases, so there is no legal basis for preventing and controlling WMSDs among occupational groups. In 2019, China put forward in the Healthy China Action (2019–2030) that the prevention and control of WMSDs should be included in the national health action goal. Therefore, a large sample of people in key industries in different regions of China were investigated and studied to determine the prevalence and distribution characteristics of WMSDs in key industries of China and explore related epidemiological characteristics.

The scope of this study covers seven regions of North, East, Central, South, Southwest, Northwest and Northeast China. Selection of key industries is based on representative industries closely related to WMSDs, i.e., involving 15 industries such as automobile manufacturing, footwear industry, biological medicine manufacturing, electronic equipment manufacturing, ship and related equipment manufacturing, petrochemical industry, construction industry, furniture manufacturing, coal mining and cleaning industry, animal husbandry, medical staff, automobile 4S shops, vegetable greenhouses, civil aviation flight attendants, and toy manufacturing. In this study, a cluster sampling method was adopted, and all workers on duty who met the inclusion criteria were selected as research objects from the representative enterprises in the key industries and above areas. The inclusion criteria was workers with more than one year's service, and the exclusion criteria was congenital spinal deformity and non-WMSD patients due to trauma, infectious diseases, and malignant tumors.

In the study, the epidemiological cross-sectional survey method and the electronic questionnaire system of Chinese version of musculoskeletal disorders questionnaire were used to investigate the prevalence of WMSDs among occupational groups in key industries in different regions of China. This electronic questionnaire system was based on Nordic

Musculoskeletal Questionnaires (NMQ) (*2*), and after proper modification, the adapted NMQ proved to have good reliability and validity for use for Chinese occupational groups. The criteria of the US National Institute for Occupational Safety and Health (NIOSH) for musculoskeletal injury was used to determine WMSDs (*3*). The survey was conducted by an investigator using face-to-face survey on N respondents, and the respondents answered questions online by mobile phone or by tablet after scanning Quick Response (QR) codes. Up to now, 57,501 valid questionnaires have been received, and the effective rate of questionnaires was 100%. There were 37,240 male workers and 20,261 female workers. The age of the investigated population was (32.3±9.2) years and the length of service was (7.5±7.2) years.

The standardized prevalence rate of WMSDs among the population in key industries in China was 41.2% (all patients suffering from WMSDS at any position are regarded as one patient). The standardized prevalence rate of WMSDs varied from 7.3% to 24.8%. The 3 parts with the highest prevalence were the neck (24.8%), shoulders (20.8%), and lower back (16.8%). Female workers had 1.5 times the risk of WMSDs compared to male workers. A significant difference in the prevalence of WMSDs was observed between different age groups and different working age groups (*P*<0.05). The prevalence rate of WMSDs increased gradually and decreased with age, and the highest prevalence rate was between 35 and 45 years old. The prevalence of WMSDs increased with increased length of service. Regular physical exercise could reduce the risk of suffering from WMSDs. The risk of neck, shoulders, and lower back of people with different demographic characteristics was shown in Table 1.

The results showed statistical differences in the prevalence of WMSDs among occupational groups in different industries (*P*<0.05). The standardized prevalence rate of WMSDs in various industries from high to low was: flight attendants (55.7%), medical staff (54.2%), vegetable greenhouse (50.7%), toy manufacturing (49.0%), biopharmaceutical manufacturing (48.4%), automobile manufacturing (43.5%), electronic equipment manufacturing (40.4%), shipbuilding and related equipment manufacturing (40.1%), animal husbandry (39.7%), 4S automobile store (38.6%), coal mining and cleaning industry (38.4%), footwear industry (34.2%), furniture manufacturing (28.5%), construction industry (23.4%), and petrochemical industry (11.5%)

(Table 2).

In this study, 56.5%–88.7% of the occupational population chose the pain scores for the neck, shoulders, upper back, lower back (waist), elbow, wrist/hand, hip/thigh, knee, ankle/foot, etc., as 0, which means no pain occurred. Therefore, this study used 10–90 percentile to express the distribution of pain scores. The results demonstrated that the pain scores of female workers were higher than those of male workers except for elbow and knee, which were statistically significant (*P*<0.05). The pain scores of different age groups, different working age groups, smoking history, and physical exercise habits were statistically significant (*P*<0.05) (Table 3).

DISCUSSION

The epidemiological characteristics of WMSDs in key industries in China from January 2018 to June 2020 were investigated in this study. On the basis of data published last year (*4*), this paper continues to expand the sample size, reaching data of nearly 60,000 people, which is the largest population survey on WMSDs in China so far. The results of this study showed that the prevalence rate of WMSDs in any body part was 41.2%, and the most common parts were neck, shoulders, and lower back. The risk of WMSDs among female workers was 1.5 times that of male workers. With increases in age, the prevalence rate of WMSDs increased gradually and then decreased. A study on the burden of 354 diseases in 195 countries and regions demonstrated that from 1990 to 2017, lower back pain was the first disease leading to years lived with disability (YLD), and the prevalence rate of musculoskeletal disorders, lower back pain, and neck pain was 38.4% (36.4% to 40.2%), 30.0% (27.9% to 31.9%), and 44.4% (41.9% to 47.0%), respectively (*5*). According to the data, in 2017, the spot prevalence rate of neck pain in women was higher than that in men, although the results were not significant at *P*=0.05. It was also found that the prevalence rate of pain in the neck increased up to age 70–74 years and then decreased (*6*), which was similar to the results obtained from this study.

The results showed that biopharmaceutical manufacturing, vegetable greenhouses, medical personnel, civil aviation flight attendants, toy manufacturing, automobile manufacturing, and shipbuilding and related equipment manufacturing were industries or occupational groups with high prevalence rate of WMSDs exceeding 40%.

TABLE 1. WMSD prevalence and risk for different demographic groups among key industries or occupational groups in China, 2018–2020.

Characteristic	Number	Any body part			Neck		Shoulders		Lower back	
		No. of cases	Rate, %	OR (95%CI)	No. of cases	OR (95%CI)	No. of cases	OR (95%CI)	No. of cases	OR (95%CI)
Gender										
Male	37,240	14,057	37.7	1	7,774	1	6,419	1	5,514	1
Female	20,261	9,612	47.4	1.5 (1.4–1.5)*	6,713	1.9 (1.8–2.0)*	5,647	1.9 (1.8–1.9)*	3,935	1.4 (1.3–1.5)*
Age (years)										
<25	12,085	4,426	36.6	1	2,389	1	2,027	1	1,462	1
25–	26,139	11,196	42.8	1.3 (1.2–1.4)*	6,967	1.5 (1.4–1.6)*	5,741	1.4 (1.3–1.5)*	4,577	1.5 (1.4–1.6)*
35–	12,301	5,294	43.0	1.3 (1.2–1.4)*	3,486	1.6 (1.5–1.7)*	2,888	1.5 (1.4–1.6)*	2,238	1.6 (1.5–1.7)*
45–	5,802	2,271	39.1	1.1 (1.0–1.2)*	1,385	1.2 (1.2–1.4)*	1,187	1.3 (1.2–1.4)*	964	1.4 (1.3–1.6)*
55–	1,174	482	41.1	1.2 (1.1–1.4)*	260	1.2 (1.0–1.3)	223	1.2 (1.0–1.4)*	208	1.6 (1.3–1.8)*
Working age (years)										
<2	16,061	5,498	34.2	1	2,955	1	2,536	1	1,886	1
2–	12,072	4,989	41.3	1.3 (1.3–1.4)*	3,011	1.5 (1.4–1.6)*	2,509	1.4 (1.3–1.5)*	1,857	1.4 (1.3–1.5)*
4–	7,299	3,106	42.6	1.4 (1.3–1.5)*	1,966	1.6 (1.5–1.7)*	1,654	1.6 (1.5–1.7)*	1,292	1.6 (1.5–1.7)*
6–	9,717	4,361	44.9	1.6 (1.5–1.6)*	2,805	1.8 (1.7–1.9)*	2,302	1.7 (1.6–1.8)*	1,853	1.8 (1.7–1.9)*
8–	12,352	5,715	46.3	1.7 (1.6–1.7)*	3,750	1.9 (1.8–2.0)*	3,065	1.8 (1.7–1.9)*	2,561	2.0 (1.8–2.1)*
Education										
Junior high school	15,369	5,543	36.1	1	3,230	1	2,815	1	2,225	1
Senior high school	21,901	8,636	39.4	1.2 (1.1–1.2)*	4,990	1.1 (1.1–1.2)*	4,174	1.1 (1.0–1.1)	3,399	1.1 (1.0–1.2)*
University degree	19,231	8,949	46.5	1.5 (1.5–1.6)*	5,841	1.6 (1.6–1.7)*	4,729	1.5 (1.4–1.5)*	3,626	1.4 (1.3–1.5)*
Graduate degree	1,000	541	54.1	2.1 (1.8–2.4)*	426	2.8 (2.4–3.2)*	348	2.4 (2.1–2.7)*	199	1.5 (1.2–1.7)*
BMI										
<18.5	6,006	2,459	40.9	1	1,487	1	1,217	1	908	1
18.5–	39,328	16,130	41.0	1.0 (0.9–1.1)	9,973	1.0 (0.9–1.1)	8,389	1.1 (0.9–1.1)	6,414	1.1 (1.0–1.2)*
25–	12,167	5,080	41.8	1.0 (1.0–1.1)	3,027	1.0 (0.9–1.1)	2,460	1.0 (0.9–1.1)	2,127	1.2 (1.1–1.3)*
Smoking										
No	36,527	15,496	42.4	1	9,895	1	8,227	1	6,074	1
Occasionally	10,111	3,616	35.8	0.8 (0.7–0.8)	2,049	0.7 (0.6–0.7)*	1,708	0.7 (0.6–0.7)*	1,453	0.8 (0.8–0.9)*
Frequently	10,863	4,557	41.9	1.0 (0.9–1.0)	2,543	0.8 (0.8–0.9)*	2,131	0.8 (0.8–0.9)*	1,922	1.1 (1.0–1.1)
Sporting										
No	17,947	7,859	43.8	1	4,772	1	4,038	1	3,375	1
Occasionally	32,797	13,272	40.5	0.9 (0.8–0.9)*	8,147	0.9 (0.8–0.9)*	6,749	0.9 (0.8–0.9)*	5,116	0.8 (0.7–0.8)*
Frequently	6,757	2,538	37.6	0.8 (0.7–0.8)*	1,568	0.8 (0.8–0.9)*	1,279	0.8 (0.7–0.8)*	958	0.7 (0.6–0.7)*

Abbreviations: WMSDs=work-related musculoskeletal disorders; BMI=body mass index.
* $P<0.05$.

TABLE 2. Prevalence of WMSDs in key industries or occupational groups in China, 2018–2020.

Industry	Number (n)	Any body part			Neck			Shoulders			Upper back			Lower back			Elbows			Wrists/Hands			Hips/Thighs			Knees			Ankles/Feet		
		n	P_i	P_i'	n	P_i	P_i'	n	P_i	P_i'	n	P_i	P_i'	n	P_i	P_i'	n	P_i	P_i'	n	P_i	P_i'	n	P_i	P_i'	n	P_i	P_i'	n	P_i	P_i'
Total	57,501	23,669	41.2	40.9	14,487	25.2	24.8	12,066	21.0	20.8	8,399	14.6	14.2	9,449	16.4	16.8	4,169	7.3	7.3	7,553	13.1	12.9	6,065	10.5	10.6	6,184	10.8	11.0	8,002	13.9	12.8
Automobile manufacturing	21,560	8,969	41.6	43.5	5,047	23.4	25.2	4,214	19.5	20.6	3,148	14.6	15.3	3,460	16.0	18.1	1,571	7.3	7.3	3,210	14.9	14.0	2,219	10.3	11.1	2,584	12.0	12.3	3,883	18.0	16.8
Electronic equipment manufacturing	8,116	3,158	38.9	40.4	2,060	25.4	25.2	1,758	21.7	22.4	1,156	14.2	14.2	1,129	13.9	13.9	515	6.3	6.4	889	11.0	10.9	701	8.6	8.4	572	7.0	8.1	800	9.9	10.9
Footwear industry	7,106	2,616	36.8	34.2	1,701	23.9	21.6	1,368	19.3	17.9	846	11.9	11.5	943	13.3	12.4	507	7.1	7.1	1,058	14.9	14.4	603	8.5	8.5	524	7.4	7.0	595	8.4	8.2
Medical staff	6,766	3,794	56.1	54.2	2,749	40.6	39.7	2,224	32.9	32.5	1,490	22.0	21.9	1,712	25.3	24.5	462	6.8	7.6	782	11.6	12.1	1,126	16.6	16.2	922	13.6	14.0	1,072	15.8	15.0
Furniture manufacturing	4,471	1,320	29.5	28.5	701	15.7	15.0	623	13.9	13.7	481	10.8	10.6	459	10.3	9.9	410	9.2	9.0	556	12.4	12.1	429	9.6	9.6	418	9.3	9.6	612	13.7	12.9
Shipbuilding and related equipment manufacturing	3,488	1,432	41.1	40.1	787	22.6	21.6	672	19.3	18.8	491	14.1	13.5	658	18.9	18.4	326	9.3	8.9	452	13.0	12.3	418	12.0	11.7	488	14.0	13.0	413	11.8	11.5
Coal mining and cleaning industry	1,500	586	39.1	38.4	362	24.1	23.7	311	20.7	20.2	223	14.9	13.0	259	17.3	15.6	133	8.9	7.6	168	11.2	10.2	188	12.5	11.6	244	16.3	15.0	200	13.3	0.1
Construction industry	1,379	332	24.1	23.4	134	9.7	9.5	147	10.7	10.5	102	7.4	7.1	165	12.0	11.6	55	4.0	3.9	89	6.5	5.9	63	4.6	4.6	50	3.6	3.5	63	4.6	4.5
Flight attendants	1,356	696	51.3	55.7	504	37.2	38.2	387	28.5	33.7	203	15.0	20.1	275	20.3	88.4	52	3.8	4.8	98	7.2	7.0	121	8.9	10.0	143	10.5	11.7	156	11.5	11.2
4S automobile store[11]	544	177	32.5	38.6	88	16.2	23.1	78	14.3	16.8	70	12.9	15.4	92	16.9	23.2	27	5.0	8.5	50	9.2	14.5	47	8.6	12.3	50	9.2	15.2	61	11.2	16.2
Toy manufacturing	333	167	50.2	49.0	119	35.7	34.2	116	34.8	31.6	84	25.2	24.2	91	27.3	25.3	71	21.3	20.1	97	29.1	28.3	55	16.5	14.9	63	18.9	18.9	64	19.2	19.4
Animal husbandry	246	96	39.0	39.7	62	25.2	27.3	41	16.7	17.7	20	8.1	8.6	64	26.0	27.1	19	7.7	8.3	47	19.1	20.6	23	9.3	10.1	35	14.2	14.2	15	6.1	6.3
Biopharmaceutical manufacturing	243	157	64.6	48.4	110	45.3	34.1	77	31.7	24.7	65	26.7	20.9	53	21.8	17.7	13	5.3	5.0	34	14.0	88.4	36	14.8	11.3	29	11.9	9.2	52	21.4	18.0
Vegetable greenhouse	243	147	60.5	50.7	51	21.0	18.7	43	17.7	15.0	16	6.6	4.5	79	32.5	27.1	5	2.1	1.5	16	6.6	4.2	30	12.3	10.3	57	23.5	16.6	13	5.3	3.7
Petrochemical industry	150	22	14.7	11.5	12	8.0	7.0	7	4.7	3.5	4	2.7	1.6	10	6.7	6.5	3	2.0	1.4	7	4.7	2.7	6	4.0	4.5	5	3.3	1.9	3	2.0	1.4
Chi-square test		1,336.7			992.4			1,525.7			550.4																				
P value		0			0			0			0																				

Note: P_i: Actual prevalence rate, P_i': Standardized prevalence rate.
Abbreviation: WMSDs=work-related musculoskeletal disorders.

TABLE 3. Analysis of pain scores of WMSDs with different demographic characteristics in China, 2018–2020.

Characteristic	Neck M (Q10, Q90)	Neck Z/χ²	Shoulders M (Q10, Q90)	Shoulders Z/χ²	Upper back M (Q10, Q90)	Upper back Z/χ²	Lower back M (Q10, Q90)	Lower back Z/χ²	Elbows M (Q10, Q90)	Elbows Z/χ²	Wrists/Hands M (Q10, Q90)	Wrists/Hands Z/χ²	Hips/Thighs M (Q10, Q90)	Hips/Thighs Z/χ²	Knees M (Q10, Q90)	Knees Z/χ²	Ankles/Feet M (Q10, Q90)	Ankles/Feet Z/χ²
Gender																		
Male	0(0, 6)	−40.5**	0(0, 6)	−37.8**	0(0, 5)	−16.9**	0(0, 6)	−15.8**	0(0, 2)	−0.7	0(0, 5)	−6.0**	0(0, 5)	−10.6**	0(0, 5)	−9.1	0(0, 6)	−10.9**
Female	3(0, 7)		0(0, 6)		0(0, 6)		0(0, 6)		0(0, 3)		0(0, 5)		0(0, 5)		0(0, 5)		0(0, 5)	
Age (years)																		
<25	0(0, 6)		0(0, 5)		0(0, 5)		0(0, 5)		0(0, 0)		0(0, 5)		0(0, 4)		0(0, 4)		0(0, 6)	
25–	0(0, 6)		0(0, 6)		0(0, 6)		0(0, 6)		0(0, 2)		0(0, 5)		0(0, 5)		0(0, 5)		0(0, 6)	
35–	0(0, 6)	888.4**	0(0, 6)	619.5**	0(0, 6)	287.3**	0(0, 6)	684.8**	0(0, 4)	97.7**	0(0, 5)	38.3**	0(0, 5)	152.5**	0(0, 5)	182.4**	0(0, 5)	262.3**
45–	0(0, 6)		0(0, 6)		0(0, 5)		0(0, 5)		0(0, 4)		0(0, 5)		0(0, 4)		0(0, 5)		0(0, 4)	
55–	0(0, 6)		0(0, 6)		0(0, 5)		0(0, 5)		0(0, 1)		0(0, 4)		0(0, 4)		0(0, 5)		0(0, 4)	
Working age (years)																		
<2	0(0, 6)		0(0, 5)		0(0, 5)		0(0, 5)		0(0, 0)		0(0, 5)		0(0, 4)		0(0, 4)		0(0, 5)	
2–	0(0, 6)		0(0, 6)		0(0, 5)		0(0, 6)		0(0, 3)		0(0, 5)		0(0, 5)		0(0, 5)		0(0, 5)	
4–	0(0, 6)	1740.3**	0(0, 6)	1225.6**	0(0, 6)	667.1**	0(0, 6)	1300.8**	0(0, 2)	86.9**	0(0, 5)	36.5**	0(0, 5)	343.5**	0(0, 5)	664.9**	0(0, 5)	102.2**
6–	0(0, 7)		0(0, 6)		0(0, 6)		0(0, 6)		0(0, 3)		0(0, 5)		0(0, 5)		0(0, 5)		0(0, 6)	
8–	2(0, 7)		0(0, 6)		0(0, 6)		0(0, 6)		0(0, 4)		0(0, 5)		0(0, 5)		0(0, 6)		0(0, 6)	
BMI																		
<18.5	0(0, 6)		0(0, 6)		0(0, 5)		0(0, 6)		0(0, 1)		0(0, 5)		0(0, 5)		0(0, 5)		0(0, 5)	
18.5–	0(0, 6)	6.4*	0(0, 6)	10.3**	0(0, 5)	15.5*	0(0, 6)	76.6**	0(0, 3)	8.4	0(0, 5)	2.5	0(0, 5)	3.6	0(0, 5)	49.2**	0(0, 5)	49.7**
25–	0(0, 6)		0(0, 6)		0(0, 6		0(0, 6)		0(0, 3)		0(0, 5)		0(0, 5)		0(0, 5)		0(0, 6)	
Smoking																		
No	0(0, 6)		0(0, 6)		0(0, 5)		0(0, 6)		0(0, 2)		0(0, 5)		0(0, 5)		0(0, 5)		0(0, 5)	
Occasionally	0(0, 6)	421.9**	0(0, 6)	327.2**	0(0, 5)	102.3**	0(0, 5)	214.1**	0(0, 2)	38.3**	0(0, 5)	53.0**	0(0, 4)	62.9**	0(0, 5)	104.9**	0(0, 5)	268.6**
Frequently	0(0, 6)		0(0, 6)		0(0, 6)		0(0, 6)		0(0, 4)		0(0, 5)		0(0, 5)		0(0, 5)		0(0, 6)	
Sporting																		
No	0(0, 7)		0(0, 6)		0(0, 6)		0(0, 6)		0(0, 3)		0(0, 5)		0(0, 5)		0(0, 5)		0(0, 6)	
Occasionally	0(0, 6)	26.6**	0(0, 6)	39.8**	0(0, 5)	56.7**	0(0, 6)	128.5**	0(0, 2)	10.9**	0(0, 5)	84.4**	0(0, 5)	41.5**	0(0, 5)	28.4**	0(0, 5)	72.0**
Frequently	0(0, 6)		0(0, 6)		0(0, 5)		0(0, 6)		0(0, 1)		0(0, 5)		0(0, 4)		0(0, 5)		0(0, 5)	

Abbreviations: WMSDs=work-related musculoskeletal disorders; BMI=body mass index.
* P<0.05.
** P<0.01.

Differences in the occurrence position of WMSDs depended on features of occupational activities. WMSDs of shipbuilding and related equipment manufacturing industry, construction industry, coal mining and cleaning industry, civil aviation flight attendants, automobile 4S shops, automobile manufacturing industry, petrochemical industry, and medical personnel were mainly concentrated in the neck, shoulders, and lower back. WMSDs in electronic equipment manufacturing and biopharmaceutical manufacturing occurred mainly in the upper back, and WMSDs in the furniture manufacturing industry occurred mainly in the ankles. However, in toy manufacturing, animal husbandry, and footwear industry, WMSDs not only occurred in the neck and shoulders but also the wrist. WMSDs occurred in the knees of vegetable greenhouse workers except for the lower back and neck. The disparity in results may be related to differences in affected parts, labor intensity, working conditions, and working methods. The prevalence rate of WMSDs in vegetable greenhouse workers was very high, which exceeded that of most workers in industrial and mining enterprises.

The pain scores in many parts of the female population were higher than those of the male population, which might be related to the fact that women were more sensitive to pain than men and were more willing to report pain (7). This study also found that the pain scores of those with BMI above 25, those who smoke, and those without physical exercise were higher than those of the corresponding low-dose groups. A prospective population study investigated the relationship between chronic pain and lifestyle factors and a correlation was found between pain and lifestyle such as smoking and infrequent physical exercise (8).

The study was subject to some limitations. First, research objects came from workers of 15 industries in China and some key industries related to WMSDs were not investigated, so the generalizability of the results was limited. Second, because of the nature of cross-sectional studies, making causal inference between risk factors and WMSDs was impossible. Finally, because the questionnaire survey was used in this study and the time period of the questionnaire survey was limited to past year, the resulting reporting bias and recall bias could influence the results.

In conclusion, the prevalence rate of WMSDs in key industries or occupations in China was relatively high. The most affected body parts were in the neck, shoulders, and lower back, and the results showed increases with increasing age and length of service. Women were more likely to suffer from WMSDs than men. The top three industries or occupational groups with the highest prevalence of WMSDs were pharmaceutical manufacturing, vegetable greenhouses, and medical staff. As a result, it is necessary to strengthen the publicity and education of ergonomics knowledge and improve the awareness of the occupational population on the basis of this study of WMSDs to promote effective intervention and control measures among the occupational population in order to reduce the impact of WMSDs. WMSDs in key industries should also be considered to be included in China's list of statutory occupational diseases.

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