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ARTICLE

Musculoskeletal Disorders in COVID-19 Surveillance Staff Members: An Analysis of Prevalence, Risk Factors, and Coping Strategies

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Abstract

Aims/Background During the coronavirus disease 2019 (COVID-19) pandemic, the COVID-19 surveillance staff members experienced an increased risk for musculoskeletal disorders. Thus, it is necessary to further investigate the causal factors stemming from COVID-19 surveillance work, especially nucleic acid testing, and establish their relationship with work-related musculoskeletal disorders (WMSDs) by building upon the previous research. This study aimed to determine the prevalence of WMSDs and the major risks faced by the COVID-19 surveillance staff members.

Methods This cross-sectional study was conducted in May 2022. The Quick Exposure Check (QEC), Nordic Musculoskeletal Questionnaire (NMQ), and Maslach Burnout Inventory (MBI) were used to evaluate ergonomic factors, musculoskeletal symptoms and pressure among 131 COVID-19 surveillance staff members in four hospitals in South-central Henan Province. Additionally, data regarding the coping strategies adopted by the respondents for lowing the risk of developing WMSDs were collected using a self-report questionnaire.

Results The QEC results showed that the back, neck, and should/arm of the COVID-19 surveillance staff members bore high ergonomic loads, while the wrist suffered a medium load. The neck (75.6%), shoulder (66.4%), upper back (58%), and wrist (55.7%) were at higher risk for musculoskeletal disorder. Most of the respondents claimed a low sense of achievement (124, 94.7%) and slightly less than half of them had endured emotional exhaustion at work (61, 46.6%). Prolonged period of maintaining the same posture at work, awkward bending or twisting of back side, task repetition and so on were the perceived job risk factors precipitating WMSDs among the participants in this study. The top three coping strategies for lowering the risk of WMSDs included adjusting the plinth/bed height (49.6%), utilizing different parts of the body at work (47.3%), and taking short breaks when required (33.6%).

Conclusion Prolonged large-scale nucleic acid detection can aggravate the musculoskeletal injuries of the neck, shoulder, upper back, and wrist in COVID-19 surveillance staff members. Prevention measures for musculoskeletal injuries factors must be in place to deter such incidence at work.

Key words: work-related musculoskeletal disorders; ergonomics; COVID-19 surveillance staff members; COVID-19

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Introduction

Manual handling of patients, which is the leading cause of work-related musculoskeletal disorders (WMSDs), is required in the jobs of a few types of healthcare practitioners. The occurrence of WMSDs diminish workers' retention and effective

working hours, as well as increase management difficulty, making it the leading occupational health problem that affects workers the most (Tang et al, 2022). A polish study found out that 85% of nurses suffered pain at more than one body location (Rypicz et al, 2020). In a different study, it was found that 27.49% of the Brazilian nurses reported WMSDs in the lower back, 25.09% in upper back, and 20.62% in the neck (Valim et al, 2024).

The occurrence of WMSDs is mainly caused by works requiring force, high load acting at one body part, asymmetric load, frequent lifting, incorrect posture, and special conditions of the workers. The workers' height, weight, body shape, and disease status, such as spasms, spinal injury, and postoperative placement of drainage tube and venous catheter have been reported to increase the risk of WMSDs (Kgakge et al, 2021). The less-than-ideal internal organization of hospital and a lack of relevant auxiliary equipment are two environmental factors that contribute to the occurrence of WMSDs (Wiggermann et al, 2024). An unfavorable hospital environment would restrict the movement and positioning of nursing operations. For example, nurses in the intensive care unit who need to adjust monitors fixed at high position are prone to WMSDs. Other factors of WMSDs also include repetitive tasks, long working hours, work shifts, which were defined as work that is not fixed day shifts, short intervals for rest, and lack of training. Psychosocial factors may also contribute to the occurrence of WMSDs, including high perceived workload, time pressure, low sense of job control, low job satisfaction, and work-family conflict (Muthelo et al, 2023).

Recent studies have reinforced the relationship between influencing factors and the occurrence of musculoskeletal disorders in nursing workers (Wiggermann et al, 2024; Muthelo et al, 2023). However, the emergence of the coronavirus disease 2019 (COVID-19) has led to the integration of the nucleic acid detection works as part of the medical staff's works. Nucleic acid detection of the novel coronavirus is the preferred method for diagnosis, since whole-gene sequencing is costly and the technically demanding. A large number of medical personnels who perform nucleic acid testing are subjected to a high-intensity workload (Qu, 2022), a common risk factor for WMSDs. Thus, there is a need to investigate the causal factors stemming from the COVID-19 surveillance works, especially nucleic acid testing, and validate their relationship with WMSDs by build upon previous research.

Since the outbreak of COVID-19, A total of 9214 billion person-times of nucleic acid testing were carried out in China. By the end of March 2022, a total of 12,500 medical and healthcare institutions in China had joined forces in delivering nucleic acid testing as part of the COVID-19 deterrence efforts. Up to 144,700 technicians were engaged in the works of nucleic acid testing, contributing to specimen collection of more than 48.85 million tubes/day. Theoretically speaking, 10-in-1 or 20-in-1 mixed mining detection allows for screening up to 490 million or 980 million cases per day (Zuo, 2022). However, the association of WMSDs with workload, mental health, and degree of difficulty in performing tasks among COVID-19 surveillance staff members remains unknown. Moreover, studies on multifaceted evaluation of the needs of COVID-19 surveillance staff members and the factors affecting WMSDs in this particular healthcare workforce have rarely been reported.

Therefore, an evaluation is required to determine whether the repetitive work of COVID-19 surveillance staff members has implications for musculoskeletal damage. The objective of the current study was to survey a sample of COVID-19 surveillance staff members in South-central of Henan Province in China about the occurrence of WMSDs, as well as the effect of ergonomic, environmental, and mental factors on the injury.

Methods

Aim

This study aimed to investigate the prevalence of WMSDs and the major ergonomic risks of COVID-19 surveillance staff members. Three problem statements for this research are as follows:

(1) What is the degree and nature of WMSDs in the workers included in the study?

(2) What is the major ergonomic risk faced by this sample?

(3) Do the respondents know the measures to prevent WMSDs and the coping strategies for lowering the risk of developing WMSDs?

Study Design

The present study utilized a cross-sectional analytical design to examine the prevalence of WMSDs and the major ergonomic risks faced by the COVID-19 surveillance staff members.

Procedure

During a COVID-19 epidemic outbreak in May 2022, a survey was conducted on the prevalence, work-related risk factors, and coping strategies of WMSDs among staff members engaged in nucleic acid testing in four hospitals in South-central Henan Province. These institutions were selected on the typicality and availability of respondents.

Firstly, an information sheet describing the survey was given to all potential participants for acquiring their consent to partake in the survey. Then, the Quick Exposure Check (QEC) was used to identify the adverse ergonomic factors of staff members engaged in nucleic acid testing. The surveyors recorded the posture and movement frequency of each body part of the survey respondents during a 10-to-20-minute observation. Simultaneously, another surveyor also carried out an on-site observation of the respondents' posture and movement frequency. Once the observation results were saturated, the increase in observation samples was halted.

At last, a questionnaire was used to collect information such as demographic and occupational health data, including age, height, weight, working tenure, marital and child delivery status, and gender. Nordic Musculoskeletal Questionnaire (NMQ) and Maslach Burnout Inventory (MBI) were used to assess the respondents' work-related musculoskeletal injury and mental burnout. A self-report questionnaire was utilized to gather data concerning work-related risk factors including workload, work environment and organizational managements, as well as coping strategies used to reduce these risk factors.

Instruments

Established by the British Health and Safety Executive Committee (HSE), the QEC is a simple and fast method to evaluate the COVID-19 surveillance staff members' response to ergonomic load. It includes nine observation items that assess force, lifting and carrying heavy loads, repetitive movements, awkward posture, duration of exposure, as well as environmental and psychosocial factors that increase the staff members' risk for WMSDs (Hossain et al, 2018). The ergonomic load score allows for partial and total risk quantification (David et al, 2008; Li and Buckle, 1999). A higher score indicates a greater ergonomic load (Li and Buckle, 1999).

The NMQ is a widely used tool for evaluating WMSDs worldwide. There are 36 questions about the pain. Pain assessment of the neck, shoulder, lower back, elbow, wrist, finger, leg, knee, and ankle provides relevant data for evaluating the prevalence of WMSDs in different populations (Heidari et al, 2018).

The MBI, which was translated and revised by Li and Liu (2000), can accurately and objectively reflect the pressure borne by the caregivers. This scale can accurately and objectively reflect the work-related stress experienced by the caregivers (Poghosyan et al, 2009). The scale contains 22 items and consists of 3 subscales: (1) Emotional exhaustion (EE), which contains nine items, is a subscale for evaluating the emotional response, with a score range of 0–54; (2) Depersonalization (DP), which encompasses five items, is a subscale for evaluating the attitude of the service personnel, with a score range of 0–30; (3) Personal achievement (PA), which entails eight items, is used for self-evaluation by the caregivers regarding their works, with a score range of 0–48 (Poghosyan et al, 2009). A 7-point Likert scale, ranging from 0 (never) to 6 (every day), was used in scoring every item (Li and Liu, 2000). Surpassing the critical score by a score of any one of the subscales was recognized as an indication for mild fatigue level (Li and Liu, 2000). If the scores of any two subscales exceeded the critical score, moderate fatigue level was considered, whereas severe fatigue level was implied by the scores of all three subscales exceeding the critical score (Poghosyan et al, 2009). Higher scores in the emotional exhaustion subscale and depersonalization subscale, as well as lower scores of the personal achievement subscale, indicate a higher level of occupational burnout (Poghosyan et al, 2009). In this study, the Cronbach's α coefficients were 0.85 for emotional exhaustion, 0.78 for depersonalization, and 0.83 for personal achievement.

Data Collection

Data were collected in May 2022. Convenience sampling was applied in this study. After two days of training on the research instruments applied in this study, the surveyors and the researchers first carried out a preliminary experiment. By the end of May 2022, the researchers collected the questionnaires from the respondents and performed data analysis. During the observation, two surveyors collected data from six randomly selected respondents until the results were saturated. In the survey, out of the 161 questionnaires distributed, 143 were returned and collected, yielding a response rate of 88.8%. However, data from the 91.6% (131) of the

returned questionnaire were used in the data analyses, while the remaining (12) were excluded due to incomplete data. The responses to certain questions were transformed into ordinal variables to facilitate data analysis.

Data Analyses

Means, standard deviations, and percentages were used to summarize the data in this paper. SPSS version 21.0 software (IBM Corp., Chicago, IL, USA) was used to analyze the data. Descriptive statistics of demographic data, WMSDs and job burnout are presented in this paper. The frequency of WMSDs occurrence or the counts for qualitative variables, and the arithmetic means with standard deviations for the quantitative variables, were computed. The associations between WMSDs and the variables were analyzed using Pearson's chi-square test. p-value < 0.05 is considered statistically significant.

Results

Descriptive Statistics

The demographic characteristics of 131 workers who participated in nucleic acid testing in the hospitals located in South-central region of Henan, were as follows: the mean age of the respondents was 31.61 $\pm$ 6.086 years; 75.6% (99) of the sample had attained an educational level of bachelor degree, 51.9% (68) had been working for 4–10 years, 7.6% (10) were involved in physical exercises, only 8.4% (11) were involved in strength exercise, and 22.1% (29) in flexibility exercise (Table 1). Table 2 depicts that the respondents demonstrated moderate fatigue at the work. Among the job burnout scores, emotional exhaustion at work (46.6%) stood out to be the most prevalent form of burnout. The majority of the respondents reported severe lack of personal achievement at work (124, 94.7%), with a mean score of 19.42 (SD = 8.92). In this scale, a lower score means a higher level of job burnout.

Table 3 presents the extent of ergonomic load on the musculoskeletal parts of COVID-19 surveillance staff members. The median back score is 26, shoulder/arm is 36, and hand is 30. Among all the body regions, the back, neck, and shoulder/arm recorded a high ergonomic load, while the wrist experienced a rather medium load. The level of load on the limbs was related to the height of the chair and the intensity of light which the staff members are exposed to. There were high pressure and work rhythm, as the work rhythm score is 4 and pressure score is 16.

Prevalence of WMSDs

A high percentage of the respondents suffered from musculoskeletal diseases of the neck (99, 75.6%), shoulder (87, 66.4%), upper back (76, 58%), wrist/hand (73, 55.7%), ankle/feet (61, 46.6%), and knee (60, 45.8%) (Table 4).

The Relationship between Risk Factors and WMSDs

Prolonged periods of maintaining the same posture at work, awkward bending or twisting of back side, task repetition and so on were perceived as the most potent job risk factors precipitating WMSDs among the respondents surveyed in this study

Table 1. Demographic characteristics of the respondents (n = 131).

Characteristics		n	Percentage (%)
Gender	Male	3	2.3
	Female	128	97.7
Age	20–29 years	49	37.4
	30–39 years	71	54.2
	40–49 years	8	6.1
	50 years and above	3	2.3
Education	College degree	28	21.4
	Bachelor degree	99	75.6
	Graduate degree and above	4	3.1
BMI (kg/m^2)	≤18.4	23	17.6
	18.5–23.9	77	58.8
	24–27.9	17	13.0
	≥28	14	10.7
Job tenure (years)	<3	24	18.3
	4–10	68	51.9
	>10	39	29.8
Marital status	Unmarried	48	36.6
	Married	81	61.8
	Separated	1	1
	Divorced	1	1
Child delivery	Yes	70	53.4
	Spontaneous labor	37	52.9
	Cesarean	33	47.1
	No	61	46.6
Number of children	0	61	46.6
	1	39	29.8
	2	29	22.1
	3	2	1.5
Physical exercise	Never	35	26.7
	Occasionally (once a month)	63	48.1
	Sometimes (once a week)	23	17.6
	Often (at least twice a week)	10	7.6
Regular exercise (multiple choice)	Aerobic exercise	87	66.4
	Strength exercise	11	8.4
	Flexibility exercise	29	22.1

BMI, Body mass index.

(Table 5). Separately, emotional exhaustion was found to be highly correlated with WMSDs among the respondents (Table 6).

Table 2. Analysis of job burnout among the respondents (n = 131).

Dimension	Score	Mild		Moderate		Serve	
		n	%	*n*	%	*n*	%
Emotional exhaustion (EE)	19.81 ± 8.41	29	22.1	41	31.3	61	46.6
Depersonalization (DP)	14.66 ± 4.62	118	90.1	9	6.9	4	3.1
Personal achievement (PA)	19.42 ± 8.92	124	94.7	6	4.6	1	0.8
Dimension	Score	None	Mild		Moderate		Serve	
Professional burnout	53.89 ± 18.66	1 (0.8)	26	19.8	93	71	11	8.4

Table 3. Interpretation of the Quick Exposure Check scores.

Quick Exposure Check scores on various body area									Total scores
Back	Shoulder/Arm	Wrist/Hand	Limbs	Neck	Drive	Vibration	Work rhythm	Pressure	
26	36	30	36	18	1	1	4	16	168

Coping Strategies Adopted by the COVID-19 Surveillance Staff Members

The present study revealed that the top three coping strategies for reducing the risk of WMSDs were adjusting the plinth/bed height (49.6%), utilizing different parts of the body (47.3%), and taking short breaks when required (33.6%). WMSDs were diagnosed in 27.5% of the respondents (Table 7), although the self-reported rates of WMSDs seemed to be higher (Table 4). Thirty-six respondents claimed that they used traditional Chinese medicine plaster (86.1%), physical exercise (80.6%), and Chinese-styled massage (72.2%) for relieving physical discomfort caused by WMSDs in the past (Table 7).

Discussion

Musculoskeletal Loads Endured by the COVID-19 Surveillance Staff Members

Nucleic acid detection represents the key approach used to realize the "dynamic clearing of COVID-19 cases" in China (Zuo, 2022). Large-scale nucleic acid testing is conducted immediately in a population, where a COVID-19 outbreak erupts, providing a quick avenue to decipher the transmission route in the communities so as to deter and control an epidemic outbreak (Zuo, 2022). Before COVID-19 pandemic, collection of throat swabs has been adopted as part of the testing procedure given the deteriorating pollution in urban areas and the rising occurrence of respiratory diseases. However, it is challenging to integrate the throat swab collection procedure into the 15-minute nucleic acid detection protocol due to the high costs involved. Thus, to control the budgets, low-cost manpower plays a vital role in nucleic acid detection. At the observation site, nucleic acid detection can be rapidly executed in an average of 5 seconds per person. Nucleic acid measurement is a form of static procedure involving mostly the back and the neck. Twisting and bending of the back side is a series of body movements involved in taking an oral swab,

Table 4. Prevalence of work-related musculoskeletal disorders at different body regions (*n* = 131).

Body region	Occurrence of WMSDs in 12 months	WMSDs affects normal life	Frequency of medical consultation	Occurrence of WMSDs in 7 days
Neck	99 (75.6)	41 (31.3)	35 (26.7)	67 (51.1)
Shoulder	87 (66.4)	33 (25.2)	15 (11.5)	53 (40.5)
Upper back	76 (58)	20 (15.3)	9 (6.9)	36 (27.5)
Elbow	27 (20.6)	9 (6.9)	2 (1.5)	11 (8.4)
Wrists/Hand	73 (55.7)	25 (19.1)	9 (6.9)	25 (19.1)
Lower back	55 (42)	19 (14.5)	9 (6.9)	32 (24.4)
Hips/Thighs	35 (26.7)	18 (13.7)	8 (6.1)	18 (13.7)
Knees	60 (45.8)	21 (16)	18 (13.7)	37 (28.2)
Ankles/Feet	61 (46.6)	20 (15.3)	15 (11.5)	32 (24.4)

WMSDs, work-related musculoskeletal disorders.

throwing cotton swabs, and taking cotton swabs, with the back bending at 10–30 degrees during each detection. Due to task repetition, the staff members commonly experienced high-level job fatigue, a low sense of personal achievement at work, and a high load on shoulders and wrists.

Neck and Shoulder/Arm

The most common injury sites were the neck, shoulder, and upper back. The prevalence rates of WMSDs affecting the neck, shoulder and upper back were 51.1%, 40.5% and 27.5%, respectively, in the past 7 days, and the rates were 75.5%, 66.4% and 58%, respectively, in 12 months. These rates were higher than the prevalence rates for the neck and shoulder (66.2% and 43.4%) during anesthesiology evaluation and intensive care by surgical nurses, as reported by Rypicz et al (2020). The discrepancy could in part be due to nucleic acid detection imposing high injury risk on the cervical spine and shoulder. Static load-bearing during prolonged standing may also inflict injury of the musculoskeletal system.

In our observation, the large-scale nucleic acid detection primarily refers to the temporary outdoor detection, performed by the COVID-19 surveillance staff members in their protective clothing, who were conducting detection sitting down, or visiting every house in the neighborhood by walking. During nucleic acid detection, the ergonomic load on a person's neck and shoulder was high. Since the height of the chairs on which the tested person and the COVID-19 surveillance staff member sit is the same, the tester needs to bend their neck and back by more than 15 degrees while taking a look at the tested person's throat, especially under dim-light condition. Always placing the arms in front of the chest is a medium-level risk factor for shoulder diseases. It is necessary to note that the nucleic acid detection process involves the use of a 50-centimeter-wide table for placing cotton swabs and solvent tubes, which necessitates leaning forward and arm stretching of the COVID-19 surveillance staff member while performing their duties. Prolonged stretching the arms at more than 25 cm away from the trunk, without any supports, is also a risk factor for causing shoulder/arm WMSDs.

Table 5. Association of work-related risk factors with diseases of neck, shoulder, upper back and wrists (n = 131).

Work-related risk factor	Neck		Shoulder		Upper back		Wrists/Hand	
	WMSDs	No WMSDs	WMSDs	No WMSDs	WMSDs	No WMSDs	WMSDs	No WMSDs
1. For prolonged periods of maintaining the same posture at work								
Yes	78 (79.6)	20 (20.4)	72 (73.5)	26 (26.5)	63 (64.3)	35 (35.7)	60 (61.2)	38 (38.8)
No	21 (63.6)	12 (36.4)	15 (45.5)	18 (54.5)	13 (39.4)	20 (60.6)	13 (39.4)	20 (60.6)
χ^2	3.404		8.686		6.280		4.769	
p	0.065		0.003		0.012		0.029	
2. Task repetition								
Yes	70 (78.7)	19 (21.3)	66 (74.2)	23 (25.8)	59 (66.3)	30 (33.7)	57 (64.0)	32 (36.0)
No	29 (69.0)	13 (31.0)	21 (50.0)	21 (50.0)	17 (40.5)	25 (59.5)	16 (38.1)	26 (61.9)
χ^2	1.426		7.465		7.807		7.788	
p	0.232		0.006		0.005		0.005	
3. Awkward bending or twisting of back side								
Yes	67 (80.7)	16 (19.3)	61 (73.5)	22 (26.5)	52 (62.7)	31 (37.3)	54 (65.1)	29 (34.9)
No	32 (66.7)	16 (33.3)	26 (54.2)	22 (45.8)	24 (50.0)	24 (50.0)	19 (39.6)	29 (60.4)
χ^2	3.255		5.093		1.998		8.001	
p	0.071		0.024		0.157		0.005	
4. Not having enough rest or breaks at work								
Yes	61 (85.9)	10 (14.1)	57 (80.3)	14 (19.7)	46 (64.8)	25 (35.2)	49 (69.0)	22 (31.0)
No	38 (63.3)	22 (36.7)	30 (50.0)	30 (50.0)	30 (50.0)	30 (50.0)	24 (40.0)	36 (60.0)
χ^2	8.983		13.368		2.920		11.096	
p	0.003		0.001		0.087		0.001	
5. Problems in work scheduling (overtime, irregular shifts, extended length of workday)								
Yes	60 (84.5)	11 (15.5)	55 (77.5)	16 (22.5)	46 (64.8)	25 (35.2)	47 (66.2)	24 (33.8)
No	39 (65)	21 (35)	32 (53.3)	28 (46.7)	30 (50.0)	30 (50.0)	26 (43.3)	34 (56.7)
χ^2	6.703		8.489		2.92		6.890	
p	0.010		0.004		0.087		0.009	
6. Working with confused or agitated patients								
Yes	59 (84.3)	11 (15.7)	56 (80.0)	14 (20.0)	45 (64.3)	25 (35.7)	47 (67.1)	23 (32.9)
No	40 (65.6)	21 (34.4)	31 (50.8)	30 (49.2)	31 (50.8)	30 (49.2)	26 (42.6)	35 (57.4)
χ^2	6.182		12.442		2.427		7.943	
p	0.013		0.001		0.119		0.005	
7. Handling of an overwhelmingly excessive number of patients in one work shift								
Yes	61 (87.1)	9 (12.9)	53 (75.7)	17 (24.3)	45 (64.3)	25 (35.7)	51 (72.9)	19 (27.1)
No	38 (62.3)	23 (37.7)	34 (55.7)	27 (44.3)	31 (50.8)	30 (49.2)	22 (36.1)	39 (63.9)
χ^2	10.902		5.831		2.427		17.883	
p	0.001		0.016		0.119		0.001	
8. Unanticipated sudden movement or fall of patient								
Yes	53 (88.3)	7 (11.7)	46 (76.7)	14 (23.3)	41 (68.3)	19 (31.7)	40 (66.7)	20 (33.3)
No	46 (64.8)	25 (35.2)	41 (57.7)	30 (42.3)	35 (49.3)	36 (50.7)	33 (46.5)	38 (53.5)
χ^2	9.765		5.219		4.839		5.372	
p	0.002		0.022		0.028		0.020	

Table 5. Continued.

Work-related risk factor	Neck		Shoulder		Upper back		Wrists/Hand	
	WMSDs	No WMSDs	WMSDs	No WMSDs	WMSDs	No WMSDs	WMSDs	No WMSDs
9. Lifting or transferring dependent patients								
Yes	45 (84.9)	8 (15.1)	36 (67.9)	17 (32.1)	33 (62.3)	20 (37.7)	37 (69.8)	16 (30.2)
No	54 (69.2)	24 (30.8)	51 (65.4)	27 (34.6)	43 (55.1)	35 (44.9)	36 (46.2)	42 (53.8)
χ^2	4.200		0.091		0.660		7.159	
p	0.040		0.763		0.417		0.007	
10. Working while injured								
Yes	45 (91.8)	4 (8.2)	42 (85.7)	7 (14.3)	37 (75.5)	12 (24.5)	36 (73.5)	13 (26.5)
No	54 (65.9)	28 (34.1)	45 (54.9)	37 (45.1)	39 (47.6)	43 (53.4)	37 (45.1)	45 (54.9)
χ^2	11.217		13.075		9.837		9.990	
p	0.001		0.001		0.002		0.002	
11. Working on the brink of physical limits								
Yes	43 (89.6)	5 (10.4)	44 (91.7)	4 (8.3)	33 (68.8)	15 (31.3)	40 (83.3)	8 (16.7)
No	56 (67.5)	27 (32.5)	43 (51.8)	40 (48.2)	43 (51.8)	40 (48.2)	33 (39.8)	50 (60.2)
χ^2	8.056		21.661		3.584		23.405	
p	0.005		0.000		0.058		0.001	
12. Inadequate training on injury prevention								
Yes	38 (90.5)	4 (9.5)	40 (95.2)	2 (4.8)	29 (69.0)	13 (31.0)	29 (69.0)	13 (31.0)
No	61 (68.5)	28 (31.5)	47 (52.8)	42 (47.2)	47 (52.8)	42 (47.2)	44 (49.4)	45 (50.6)
χ^2	7.438		23.029		3.089		4.447	
p	0.006		0.001		0.079		0.035	
13. Reaching or working away from your body								
Yes	31 (88.6)	4 (11.4)	29 (82.9)	6 (17.1)	27 (77.1)	8 (22.9)	29 (82.9)	6 (17.1)
No	68 (70.8)	28 (29.2)	58 (60.4)	38 (39.6)	49 (51.0)	47 (49.0)	44 (45.8)	52 (54.2)
χ^2	4.372		5.790		7.174		14.250	
p	0.037		0.016		0.007		0.001	
14. Working in awkward and cramped positions								
Yes	22 (88.0)	3 (12.0)	23 (92.0)	2 (8.0)	18 (72.0)	7 (28.0)	23 (92.0)	2 (8.0)
No	77 (72.6)	29 (27.4)	64 (60.4)	42 (39.6)	58 (54.7)	48 (45.3)	50 (47.2)	56 (52.8)
χ^2	2.585		9.069		2.481		16.478	
p	0.108		0.003		0.115		0.001	
15. Enough equipment for lifting and transporting patients								
Yes, useful	47 (68.1)	22 (31.9)	38 (55.1)	31 (44.9)	34 (49.3)	35 (50.7)	35 (50.7)	34 (49.3)
Yes, not useful	23 (92.0)	2 (8.0)	23 (92.0)	2 (8.0)	17 (68.0)	8 (32.0)	16 (64.0)	9 (36.0)
No	29 (78.4)	8 (21.6)	26 (70.3)	11 (29.7)	25 (67.6)	12 (32.4)	22 (59.5)	15 (40.5)
χ^2	5.891		11.563		4.573		1.602	
p	0.053		0.003		0.102		0.449	

The pressure exerted on the neck and back muscles is proportional to the head flexion angle (Lv et al, 2018). Constant lowering of the head or forward bending of the neck will make the cervical spine lose its natural curve, cause the neck to

Table 6. Association between emotional exhaustion and work-related musculoskeletal disorders (n = 131).

Emotional exhaustion (EE)	Neck (n = 99)		Shoulder (n = 87)		Upper back (n = 76)		Wrists/Hand (n = 73)	
	WMSDs	No WMSDs	WMSDs	No WMSDs	WMSDs	No WMSDs	WMSDs	No WMSDs
Mild	23	6	22	7	22	7	22	7
Moderate	35	6	33	8	27	14	30	11
Severe	41	20	32	29	27	34	21	40
χ^2	4.659		10.127		9.563		21.040	
p	0.097		0.006		0.008		0.000	

WMSDs, work-related musculoskeletal disorders.

bear additional pressure, and clog the blood vessels and nerves in the intervertebral disk backlog of blood vessels and nerves long-term, leading to cervical spondylosis (Peng et al, 2021).

Wrist

In this study, the prevalence rates of wrist WMSDs in the past 7 days and 12 months were 19.1% and 55.7%. These rates were higher than the prevalence rates of 41.9% reported by Rypicz et al (2020). Nucleic acid detection necessitates precise hand movement, requiring twisting of the wrist to take, revolve, break, and discard the cotton swab, as well as open and screw in the reagent bottle. Repetitive movements of fingers and wrists are also critical risk factors for carpal tunnel syndrome (CTS), a syndrome which is more common in manual workers (Wright and Atkinson, 2019). Furthermore, CTS is more common in women as their carpal tunnels are usually smaller than men's (Wright and Atkinson, 2019). The quick finger movements of the COVID-19 surveillance staff member at the wrist flexion position result in increased pressure in the carpal tunnel. This repeated movement causes edema, proliferation, or fibrosis of the synovium and tendon, reducing the volume of the carpal tunnel and increasing median nerve pressure. Thus, it is recommended to include physical examination of the wrist in the daily physical examination for COVID-19 surveillance staff members by conducting electromyogram examination for facilitating diagnosis and treatment.

Based on the self-reported assessments, the COVID-19 surveillance staff members dedicated more than 4 hours in nucleic acid detection—a long working duration in the same posture that is unfavorable for back health. Reducing the working time to less than 4 hours and having breaks can help alleviate musculoskeletal injury. This study provides comprehensive data concerning the ergonomic loads on neck, back and wrist among COVID-19 surveillance staff members, offering invaluable insights into the improved designs of working schedule and environment setting in the future.

Table 7. Coping strategies shared by the respondents for reducing the risk of work-related musculoskeletal disorders (n = 131).

Strategies	n	Percentage
1. I adjust plinth/bed height so that I can stretch and change posture.	65	49.6
2. I use different part of my body to facilitate the nursing procedure.	62	47.3
3. I pause regularly so that I can stretch and change posture.	44	33.6
4. I call for assistance while handling a heavy patient.	39	29.8
5. I select and use techniques/procedures that will not aggravate or provoke my discomfort.	24	18.3
6. I modify the patient's position/my position.	20	15.3
7. I stop a treatment if it causes or aggravate my discomfort.	14	10.7
8. I modify my nursing procedure in order to avoid stressing an injury.	13	9.9
9. I do warm-up and stretching before performing my nursing duties.	13	9.9
10. After diagnosed musculoskeletal disease, I utilize treatment strategies, as follows:	36	27.5
10.1 Chinese medicine plaster	31	86.1
10.2 Physical exercise	29	80.6
10.3 Chinese-styled massage	26	72.2
10.4 Acupuncture moxibustion	16	44.4
10.5 Painkillers	13	36.3
10.6 Blocking treatment (inject appropriate amounts of glucocorticoids and narcotic drugs into the pain site, so as to play an anti-inflammatory and analgesic effect)	3	8.3

The Prevalence of Musculoskeletal Disorders and Their Correlation with Risk Factors

In the present study, workers suffered severe neck, shoulder, and upper back diseases, which are caused by the deterioration of musculoskeletal diseases in these body parts owing to high muscle load exerted during the work of nucleic acid detection. Working environment where the detection was carried out, workloads of healthcare personnel and any non-ergonomic positions employed in nucleic acid detection were investigated. Our results showed that the extent or frequency of these factors is correlated with the occurrence of WMSDs (Table 7). These results align with those reported by Abdollahi et al (2020) and Muthelo et al (2023). Factors such as overtime or long working hours in handling or moving heavy objects also were found to increase the possibility of WMSDs occurrence. During work, the COVID-19 surveillance staff members are required to follow the same protocols and thus assume the same postures for an extended period. In some cases, due to low light intensity and considerable chair's height difference, the staff members are forced to twist their back in an uncomfortable manner. The location and strength of the light source in the nucleic acid detection site, the height difference between the eye of the staff members and the patient's mouth, the distance between the staff members and the tested persons, the design of the cotton swab, sampling of the cotton swab and the mechanical assistance for collection are factors that should be considered in further studies to reduce the ergonomic load on the staff members' muscle.

An importation finding of the study was that emotional exhaustion is highly correlated with WMSDs among the respondents. The high levels of emotional ex-

haustion are associated with the presence of diseases (Valim et al, 2024). This is because the emotional exhaustion affects the respondents' response to the factors that induce WMSDs. Therefore, it is important to reduce the incidence of job burnout and WMSDs from the angle of human resource management and working environment management through a pre-emptive identification of the inducing factors.

Prevalence of Musculoskeletal Disorders and the Coping Strategies Adopted by the COVID-19 Surveillance Staff Members

The COVID-19 surveillance staff members surveyed in the present study reported that they rarely changed their working posture, did warm-up, modified the nursing procedures, or took breaks during work to reduce the risk of musculoskeletal injury. Furthermore, our study unveiled that very few people from the respondent sample had engaged themselves in physical exercises such as those that are conducive to body flexibility and strength.

A previous study demonstrated that combining anti-resistance exercise for shoulder and aerobic exercise had a significant impact on the pathogenesis of neck-shoulder disease (Voet et al, 2019). Based on an effective evaluation, Ezzatvar et al (2020) proposed a targeted intervention on work-related injury of the neck and shoulder muscles to prevent neck pain. Taken together, it is imperative to adopt more preventive measures against WMSDs occurrence, improve work schedules, and conduct more trainings.

Permitting family members to accompany tested person during nucleic acid detection is actually a protective factor against WMSDs. In fact, the family can assist with the detection work, thus reducing the occurrence of WMSDs among the COVID-19 surveillance staff members. According to the staff members, traditional Chinese medicine plaster and massage moxibustion were used to alleviate the discomfort of the body. While applied to the acupunture points, moxibustion generates significant thermal energy, infrared thermal radiation, and therapeutic effects (Huang et al, 2020). Traditional Chinese medicine plaster can dredge the meridians and collaterals through the dispersing effect of acupoints, thereby alleviating musculoskeletal injury (Xu et al, 2019). The medicinal materials used in the plaster, such as Acniti Radix, Caryophylli Flos, Cinnamomi Cortex, etc, have a repertoire of beneficial effects, such as relieving detumescence and pain, promoting blood circulation and removing blood stasis, warming the meridians and collaterals, and improving patients' pain and other symptoms (Li et al, 2023). Separately, massage can stimulate the mechanical receptors through squeezing, swinging, rotating, and joints sliding, thus inhibiting the pain receptors, reducing the release of pain factors from the spinal cord and brain stem, and raising the pain threshold of patients (Gräf et al, 2022). The amalgamation of massage with rehabilitation exercise can expand the range of shoulder joint's motions, benefiting the patients with musculoskeletal pain (Skillgate et al, 2020). These prior studies provide ample evidence that traditional Chinese medicine can be integrated into WMSD prevention and control training.

Limitations of the Present Study

Due to time constraint and the limited availability of detection sites where this study can be conducted, we were only able to recruit a sample of 131 COVID-19 surveillance staff members. The sample had very few males and elderly respondents, thus presenting a potential source of data bias. Nevertheless, such demographic distribution was consistent with the actual recruited staff in nucleic acid detection unit during the COVID-19 pandemic. Thus, further studies should consider merging the COVID-19 surveillance staff members and the employed staff of the hospital to expand the sample size. It is important to note that the COVID-19 surveillance staff members surveyed in this study were mainly selected from among the part-time medical staff working in hospital, and none of them had expertise knowledge in nucleic acid testing. The Health Commission of Henan Province announced that activities of nucleic acid detection would be put under normal regulation, rolling out rules to specifically recruit personnel specialized in nucleic acid testing and integrating bidding system in the process for acquiring nucleic acid testing materials and appliances in 2022 (Li, 2022). Given the persistent role of nucleic acid detection on COVID-19 screening even in the coming future, its influence as a profession on the musculoskeletal health of the relevant healthcare personnel remains an interesting research subject in future.

The self-report questionnaire employed in this study might result in reporting biases with regard to the incidence of musculoskeletal disorders, because the pain perception and tolerance of every person is different. Such biases can be reduced if myoelectric data are integrated for auxiliary judgment of the occurrence of musculoskeletal diseases; this approach would be attempted in the follow-up investigations.

Conclusion

Prolonged nucleic acid detection work can aggravate the musculoskeletal injury of the neck, shoulder, upper back, and wrist among the COVID-19 surveillance staff members. The current results provide invaluable insights for the management authorities to improve the work conditions so as to reduce the adverse effect of WMSDs on the health of COVID-19 surveillance staff members.

Key Points

- Among the COVID-19 surveillance staff members, their back, neck, and shoulder/arm endure high ergonomic load, as opposed to the wrist that experiences a medium load.
- Prolonged large-scale nucleic acid detection activity can aggravate the musculoskeletal injuries of the neck, shoulder, upper back, and wrist among the staff members.
- The top three coping strategies for lowering the risk of WMSDs include adjusting the plinth/bed height, utilizing different parts of the body, and taking short breaks when required.
- The COVID-19 surveillance staff members exhibit inadequate understanding of work pressure and musculoskeletal injury, which is one of the factors resulting in musculoskeletal injury.

Availability of Data and Materials

All data included in this study are available upon request by contact with the corresponding author.

Author Contributions

HYZ, YYL contributed to the conception and design of this study. YLiu and YLuo performed the statistical analysis. HYZ wrote the manuscript. All authors contributed to important editorial changes in the manuscript. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

Ethical approval for this study was obtained from Medical Ethics Committee of Xuchang University (decree code: 2024012). After being informed of the procedures, the participants were asked to provide informed consent prior to their participation in the survey. The anonymity and confidentiality of the respondents' data and identity were guaranteed. The study was carried out in accordance with the ethical guidelines outlined in the Declaration of Helsinki.

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Conflict of Interest

The authors declare no conflict of interest.

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