Ergonomi 5(3), 144 – 152, 2022
e-ISSN : 2651 - 4877

Ergonomics 5(3), 144 – 152, 2022
DOI: 10.33439/ergonomi.1150940

MUSCULOSKELETAL DISORDERS OF HAND IN HEALTHCARE WORKERS: A CROSS-SECTIONAL STUDY

İbrahim EYİ[1*], Banu Yeşim BÜYÜKAKINCI[2]

[1] İstanbul Aydın University, Department of Occupational Health and Safety
ORCID No: http://orcid.org/0000-0002-9604-6876
[2] Halic University, Faculty of Fine Arts
ORCID No: http://orcid.org/0000-0001-7597-4406

Keywords

Musculoskeletal disorders of hand
Healthcare workers
Ergonomics

Abstract

Musculoskeletal disorders (MSDs) of the hand negatively affect the hand's functionality and lead to long periods of sick leave. MSDs of hand are associated with work absences and productivity loss more than other Musculoskeletal disorders (MSDs). The study aimed to assess the discomfort of hands in healthcare workers (HWs) and the relationship between demographics and discomfort. 217 HWs selected randomly in the Trakya University Hospital from Dec. 2019 to Feb. 2020 participated in this cross-sectional study. The study was carried out through a questionnaire for sociodemographic characteristics and Cornell Hand Discomfort Questionnaires for MSDs. SPSS v.24.0 software was used to analyze the data. The most common discomfort scores were in the right-hand wrist (1.79), right-hand thumb joint, right-hand thumb (1.65), left-hand wrist (0.86), and left-hand (index, middle, half ring) (0.87), and left-hand thumb (0.80) areas respectively. Right-hand discomfort scores were relatively higher than left-hand. While an association was detected between the level of education, years of work, and MSDs of hand, there was no relation with gender, marital status, or profession. The findings from the study indicate MSDs of hand among HWs. Further research is recommended to detect the prevalence and prevention of MSDs of hand on HWs.

SAĞLIK ÇALIŞANLARINDA EL BÖLGESİ KAS İSKELET SİSTEMİ RAHATSIZLIKLARINA İLİŞKİN KESİTSEL BİR ÇALIŞMA

Anahtar Kelimeler

Sağlık Çalışanları
El bölgesi kas iskelet sistemi rahatsızlıkları
Ergonomi

Öz

El bölgesindeki kas iskelet sistemi rahatsızlıkları (KİSR-El) fonksiyonel kullanımı negatif etkilemekte ve uzun süren istirahatlerin alınmasına neden olabilmektedir. KİSR-El hastalık izinleri ile birlikte üretkenlik azalması ile de ilişkilendirilmektedir. Bu çalışmanın amacı sağlık çalışanlarında el bölgesindeki kas iskelet sistemi rahatsızlıklarını değerlendirmektir. Kesitsel tip çalışmaya Trakya Üniversitesi Hastanesindeki rastgele seçilen 217 sağlık çalışanı Aralık 2019 ve Şubat 2020 tarihleri arasında katılım sağlamışlardır. Sosyodemografik özellikler için tasarlanan anket ve KİSR-El için Cornell El Rahatsızlık Ölçeği ile çalışma verileri toplanmıştır. SPSS v.24.0 yazılımı verilerin analizi için kullanılmıştır. En fazla rahatsızlık ölçeği puanları sırasıyla sağ el bilek (1.79), sağ el başparmak eklemi (1.72), sağ el başparmak (1.65) ve sol el bilek (0.86), sol el (işaret, orta, yarım halka) (0.87) ve sol el başparmak (0.80) bölgelerinde bulunmuştur. Sağ el rahatsızlık ölçek puanları sol el puanlarına göre nispeten fazla tespit edilmiştir. Eğitim düzeyi, çalışma yılı ve KİSR-El arasında istatistiksel anlamlılık saptanırken, cinsiyet, medeni durum ve meslek ile ilişki tespit edilememiştir. Çalışmadan elde edilen bulgular sağlık çalışanlarında el bölgesindeki kas iskelet sistemi rahatsızlıklarına işaret etmektedir. Sağlık çalışanlarında KİSR-El yaygınlığının tespiti ve önlenmesi için daha fazla araştırma yapılması önerilmektedir.

Araştırma Makalesi		Research Article	
Başvuru Tarihi	: 14.08.2022	Submission Date	: 14.08.2022
Kabul Tarihi	: 31.10.2022	Accepted Date	: 31.10.2022

[*] Sorumlu yazar e-posta: ibrahimey@yahoo.com

1. Introduction

Occupational injuries such as MSDs affect almost every industry professional. Nevertheless, healthcare workers are injured more often than any other group. These occupational injuries may damage various body parts, including the head, hands, shoulder, eyes, spine, neck and feet. Hand injuries are especially common among healthcare workers involved in direct patient-handling activities. (Gyer et al., 2018). Systemic diseases also might affect hand function and cause disorders such as; limited joint mobility, Carpal Tunnel Syndrome, Dupuytren's Disease, Trigger finger/digit, Cubital tunnel syndrome, Hand weakness and Reduced dexterity (Zyluk & Puchalski, 2015).

Musculoskeletal disorders (MSDs) constitute a group of painful muscle, tendon, and nerve disorders. MSDs are associated with several related characteristics: repetitive movements, fixed or restricted body positions, concentrated force on small parts of the body (such as the hand or wrist), and a work pace that does not allow adequate recovery between such movements, exhaustive short-duration tasks, and lack of rest for muscular (OSH Fact Sheet, MacDonalds et al., 2018; Gallagher & Heberger, 2013; Simonsen et al., 2012).

Although It is well established that a heavy workload is a risk factor for musculoskeletal disorders (MSDs), high psychosocial work stressors also contribute to the frequency and intensity of MSDs (Lin et al.,2022). Hand and wrist diseases are among the most frequent musculoskeletal disorders (Oh et al., 2022).

Epidemiological research relates the beginning and severity of MSDs of hand or wrist with the repetitive, forceful hand-intensive tasks performance. MSDs of the hand and wrist constitute a great proportion of work-related illnesses and are related to relatively high medical costs and loss of work (Barr et al., 2004). MSDs include three types of injury: nerve injury, tendon injury, and muscle injury. The most common symptom that is associated with MSDs is pain. (OSH Fact Sheet).

Discomfort in the body often indicates a musculoskeletal injury that must be reduced in almost every situation and at any time. Efficiency and productivity are closely related to both comfort and discomfort. Achieving quality service depends on high job satisfaction, low absenteeism and most importantly, the employees' health. (Jansen et al., 2013). MSDs of the hand and wrist are associated with the longest absences from work and are, therefore, associated with greater lost productivity and wages than those of other anatomical regions (Barr et al., 2004).

On the other hand, efficiency and productivity in healthcare workers are achieved by providing quality care and service and protecting patients' health.

In healthcare workers, efficiency and productivity are achieved by providing quality care and service and protecting the health of healthcare workers (HWs) and patients (Jansen et al., 2013). Barr et al. (2004) expressed that the performance of repetitive and forceful hand-intensive tasks may induce musculoskeletal disorders via three pathways: (1) Central nervous system reorganization, (2) tissue compression/injury, and (3) reorganization of tissue (Barr et al., 2004).

Studies show that women, who make up the majority of healthcare workers, especially nurses, significantly have a higher risk for carpal tunnel syndrome than men. It is stated that more research is needed on hand disorders (Jansen et al., 2013).

Musculoskeletal disorders in the hands adversely affect the hand's functionality and may lead to long-term sick leave. Along with the biomedical and physical consequences of hand ailments/injuries, other potential determinants, such as work-related and psychosocial factors, also contribute to sick leave time, negatively affecting productivity (Opsteegh et al., 2009).

According to epidemiological studies, the onset of MSD in hand and the severity of the discomfort are associated with the demand for work requiring repetitive, intense and challenging performance. Psychosocial risk factors in the work environment and non-work exposures also support increased MSDs. MSD in hand is one of the causes of prolonged absence and is therefore associated with loss of productivity and increased cost compared to other anatomical areas of the body (Barr et al., 2004).

Evidence of muscular overload for healthcare staff performing intravenous push treatments and other tasks requiring hand usage was indicated by a high number of hand efforts combined with prolonged durations, thumb forces, and increased muscle activity with a lack of muscular rest (MacDonald et al., 2018).

Hand-related musculoskeletal disorders (MSD) have been increasing worldwide due to repeated and low-amplitude use over long periods (Eapen & Bhat, 2010).

While epidemiological studies define the relationship between risk factors and the prevalence and incidence of MSDs, they cannot tell us anything about the underlying pathophysiological mechanisms that lead to these disorders (Barr et al., 2004). That situation indicates a need for more detailed studies in this area. However, few studies have been conducted among healthcare workers internationally (Clari et al., 2021).

2. Objective

HWs have specific work, and Musculoskeletal Disorders are common among employees in the healthcare workplace. The study aimed to assess the discomfort of hands in healthcare workers and the relationship between some demographics and discomfort. To our knowledge, there has not been much research on hand discomfort in healthcare workers worldwide, and none in Türkiye.

3. Method

Study Design

This cross-sectional study involved 217 healthcare workers (a random sample of doctors and nurses) in the Republic of Türkiye Trakya University Hospital between Dec. 2019 and Feb. 2020. This work has been designed in line with STROBE checklist criteria.

The data were collected by interviewers who were provided 20 min pre-training (comprising the aim of the study, usage of questionnaires, and inclusion and exclusion criteria) for the study. A random sample of HWs (doctors and nurses) were recruited voluntarily and anonymously to participate in the research through written consent.

The physicians and nurses who worked in the hospital for at least one year were included in the study, and students and interns were excluded from the study.

The sample size was calculated via power analysis software, and after the data collection, the power analysis was done again to test (G-power 3.9.1). The number of samples for the study design was calculated as 193 (α=0.05, 1-β=0.80).

Data Collection Tools

Data were collected via the sociodemographic characteristics questionnaire and Cornell Hand Discomfort Questionnaire (CHDQ).

The first questionnaire of sociodemographic characteristics consisting of age, educational degree, marital status, year of study, and profession, was designed by researchers with literature.

The other questionnaire, Cornell Hand Discomfort Questionnaire, was used to analyze musculoskeletal symptoms and examines MSDs of the hand for a standing male or female worker with parts of the right and left hands, which is presented in Figure 1.

It consists of 3 sections, including (a) frequency [never (0), 1-2 times last week (1.5), 3-4 times (3.5) last week, once every day (5), and several times every day (10)], (b) discomfort [slightly, uncomfortable (1), moderately uncomfortable (2) and very uncomfortable (3)] and (c) interference in capability to perform requirements of work [not at all (1), slightly interfered (2) and substantially interfered (3)] [Figure 1].

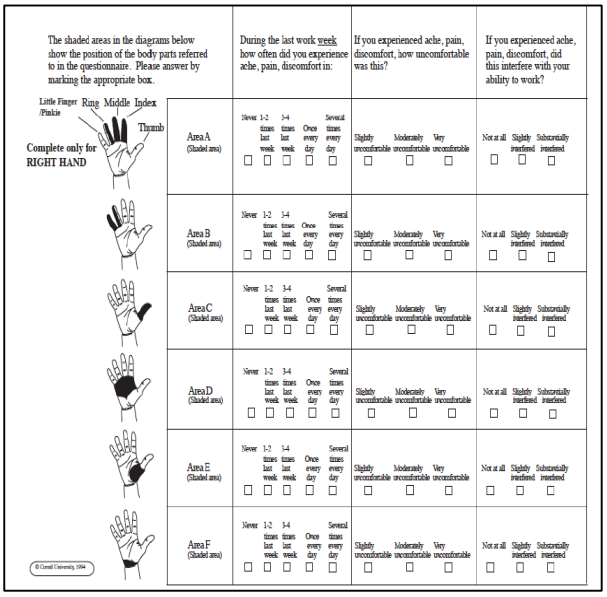

Figure 1. Cornell Hand Discomfort Questionnaire

(Cornell University, Ergonomics)

The CHDQ scores are analyzed by multiplying the scores of (a) frequency (0, 1.5, 3.5, 5, 10), (b) discomfort (1, 2, 3), and (c) interference (1, 2, 3). Erdinç et al. (2011) carried out the Turkish validation and reliability of CHDQ, and the total reliability (Cronbach's a) was 0.876.

Data Analysis

The data were analyzed by using the SPSS v.24.0 software package. Continuous variables were presented as means (±standard deviation) and categorical variables as absolute (n) and relative (%) frequencies.

The independent-sample t-test was used in case of no difference between the two groups, and if there was a difference between more than two groups, it was examined by one-way analysis of variance (One Way ANOVA). The Cronbach's alpha value is used for the scale's reliability (Table 1).

Table 1. Reliability of the Scale

Cornell Hand Discomfort Scale	Cronbach's Alpha
CHDQ Hand Frequency	0.931
CHDQ Hand Discomfort	0.956
CHDQ Hand Interference	0.945

Research Ethics

Ethical approval was granted from the Istanbul Aydın University Ethical Committee (30 Sept 2019,

Nu: 2019/14), and informed consent was taken from study participants.

4. Results and Discussion

The findings were handled with sociodemographics, the prevalence of MSDs of hand, and possible relation with characteristics.
The mean age of participants was 30.82, most of whom worked as nurses (64.1%) and females (61.3%).

Most of the HWs (63.6%) were married and had master's degrees (28.1%) and bachelor's degrees (53.9%). 67.7% of participants worked for 1-9 years (38.2%: 1-4 years, 29.5%: 5-9 years) (Table 2).

Table 2. Sociodemographic Characteristics

Variables		N	%
Gender	Male	84	38.7
	Female	133	61.3
Marital Status	Married	138	63.6
	Single	79	36.4
Level of Education	Highschool (HS)	10	4.6
	Associate Degree (AD)	21	9.7
	Bachelor Degree (BD)	117	53.9
	Master Degree (MD)	61	28.1
	Doctorate	8	3.7
Profession	Doctor	78	35.9
	Nurse	139	64.1
Working Years	1-4	83	38.2
	5-9	64	29.5
	10-14	38	17.5
	15-19	22	10.1
	20 and above	10	4.6

The discomfort scores were higher in the right-hand wrist (F) (1.79), right-hand thumb joint (E) (1.72), right-hand thumb (C) (1.65) and left-hand wrist (F) (0.86), left-hand A (index, middle, half ring) (0.87), and left-hand thumb (C) (0.80) areas respectively (Table 3), (Figure 2).

Sheikhzadeh et al. (2009) found that in a group of orthopedic hospital nurses, the prevalence of elbow disorders and hand/wrist disorders was 52% and 61%, respectively. Repetitive and prolonged use of the hands without muscular rest and forceful gripping contribute to an increased risk of MSDs (Sheikhzadeh et al., 2009; Hansson et al., 2009).

Table 3. Descriptive statistics of Cornell Hand Discomfort Questionnaire.

Variables	Mean	SD	Min.	Max
Right Hand A (index, middle, half ring)	1.03	3.757	0.0	40.0
Right Hand B (little finger, half ring)	0.90	3.698	0.0	40.0
Right Hand C (thumb)	1.65	5.515	0.0	40.0
Right Hand D (palm)	1.37	5.645	0.0	45.0
Right Hand E (thumb joint)	1.72	6.797	0.0	45.0
Right Hand F (wrist)	1.79	5.898	0.0	40.0
Left Hand A (index, middle, half ring)	0.86	3.868	0.0	40.0
Left Hand B (little finger, half ring)	0.50	2.369	0.0	21.0
Left Hand C (thumb)	0.80	3.779	0.0	40.0
Left Hand D (palm)	0.78	4.494	0.0	60.0
Left Hand E (thumb joint)	0.56	2.163	0.0	20.0
Left Hand F (wrist)	0.87	2.989	0.0	20.0

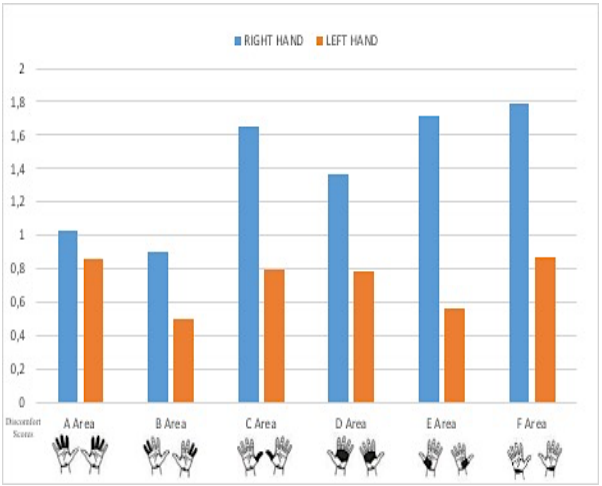

Figure 2. CHDQ Discomfort Scores

Right-hand discomfort scores were relatively higher than the left-hand subjects who participated in the study. Even though hand dominance was not questioned in the study, It is possible to say that most HWs used the right hand more for healthcare work requirements and medical equipment. On the other hand, the lowest discomfort scores in both the left hand (0.50) and right hand (0.90) were little fingers and half ring (B) [Table 4]. Sharan et al. (2014)

reported in their study that for the majority of the subjects, the right side of the hand was more commonly affected (61%) when compared to the left side of the hand and bilateral involvement. The common symptoms reported in their study during the examination were a pain in the thumb and forearm with associated burning, numbness, and tingling around the ulnar aspect of the hand with the stiffness of the wrist and hand. They also found a significant positive correlation between hand dominance and the occurrence of upper extremity MSDs (Sharan et al., 2014).

Table 4. Comparison of CHDQ Scores

Variables	Mean		Variables	Mean	p.
Right Hand A (index, middle, half ring)	1.03	>	Left Hand A (index, middle, half ring)	0.86	0.034
Right Hand B (little finger, half ring)	0.90	>	Left Hand B (little finger, half ring)	0.50	0.042
Right Hand C (thumb)	1.65	>	Left Hand C (thumb)	0.80	0.032
Right Hand D (palm)	1.37	>	Left Hand D (palm)	0.78	0.421
Right Hand E (thumb joint)	1.72	>	Left Hand E (thumb joint)	0.56	0.009
Right Hand F (wrist)	1.79	>	Left Hand F (wrist)	0.87	0.028

In the study of MacDonald et al. (2018), the healthcare staff working with syringes in the medical facility reported anecdotal complaints of musculoskeletal disorders. Common sources of complaints include repetitive laboratory work, mixing formula and intravenous, and donning gloves. Anecdotal complaints of thumb, hand, and arm pain were continuously reported. They expressed complaints regarding hospital injury reports and observations with risk assessments needed to examine hand tasks in the hospital (MacDonald et al., 2018).

While an association was detected between the level of education, years of work, and MSDs of hand for some parts, there was no relation with gender, marital status, and profession [Appendidx: Table 5].

HWs, who have high school degree/associate degree, had the highest hand discomfort scores for right hand A (index, middle, half ring), thumb (C), wrist (F) and left-hand thumb (C), thumb joint (E), wrist (F). HWs with master's and doctorate degrees had the lowest hand discomfort scores in the same hand areas [Appendix: Table 5]. HPs, who have high school degree/associate degree, had the highest hand discomfort scores for right hand A (index, middle, half ring), thumb (C), wrist (F) and left-hand thumb (C), thumb joint (E), wrist (F). HWs who have master's and doctorate degrees had the lowest hand discomfort scores in the same regions [Appendix: Table 5].

Alqahtani et al. (2022) found no association between MSDs of hand and sex, hand dominance, or type of practice (Alqahtani et al., 2022).

Ouni et.al., 2020 also reported that due to limited number of studies in this area in their country, there was no statistically significant difference in terms of Cornell regional and total pain scores by gender (Ouni et al., 2020). Barr et al., (2004) stated age alone does not appear to account for increased incidence of hand and wrist disorders in the absence of other risk factors, but aging is also increasing risk factor for MSDs (Barr et.al. 2004).

Women are more prone than men to the joint, tendon, and nerve-related problems, especially in the wrist and hand (Jansen et al., 2013). The current study did not find a statistically significant relation to gender, marital status, and profession with hand discomfort. That may be probably due to the study type, small sample size, and low complaint scores for hand discomfort. However, for carpal tunnel syndrome, the National Institutes of Health points out that women are three times more likely than men to have it. Although the explanation for the greater risk is not definite, it is claimed that fact can be due to the smaller size of women's carpal tunnel (Jansen et al., 2013).

Adams et al. (2013) reported a high wrist/hand pain prevalence in healthcare staff. The female gender is associated with an approximately twofold risk of reported Musculoskeletal pain (Adams et al., 2013).

Clari et al. indicated that traditionally, gender had not been considered an indicator of work-related MSDs but a confounding or modifying factor due to mixed exposure. Working women have an increased risk of work-related MSD, especially in the upper body musculoskeletal region. The most likely explanation for the increased risk of MSD in female workers may be physical, hormonal, and psychological differences (Clari et al., 2021).

Moreover, repetitive, comorbid medical conditions or past wrist trauma increase Carpal Tunnel Syndrome risk. The further risk factors of awkward or sustained Upper Extremity postures also contribute to hand/wrist tendinitis, strains, and sprains, which are the most common Upper Extremity musculoskeletal disorders (Barr et al., 2004). Ouni et al. (2020) stated that the relative physical disadvantages of women, as they have less muscle mass than men, suggest that this may affect the occurrence of musculoskeletal complaints more frequently. However, they also reported that men

were proportionally fewer than female nurses in their study; it was difficult to determine the impact of gender differences (Ouni et al., 2020). Upper Extremity MSDs have a higher prevalence and incidence in women, especially those who work in the service industries and who have psychosocial stress at work (Barr et. al. 2004).

Azma et al. (2015) found in their study on nurses that the lowest level of discomfort in the body was in the wrists. Musculoskeletal discomforts were mostly reported and localized in the neck, knee, back, and shoulder areas. Furthermore, the wrist and elbow had minimal discomfort (Azma et al., 2015). All muscles need to rest after a period of activity, and any muscle that is active for a prolonged period may pose an increased risk for MSDs (MacDonald et al., 2018). Additional opportunities to reduce risk, such as optimizing patient scheduling, the duration and timing of breaks while changing the order of tasks, may prove beneficial (Qin et al., 2014). The duration and timing of breaks are impacted by the level of force required to perform work tasks (Rogers, 1998; MacDonald et al., 2018).

Our study results indicated that HWs were at the highest risk of MSDs in their right and left (F) areas and were at the lowest risk in their (B) areas. Ou et al. (2021) showed that nursing professionals are at high risk of MSDs in their healthcare environment. The manual material handling risks for nurses varied by department. One hand handling of material mainly loads on elbows, hands, and wrists and found that high, medium, and workloads increase 5.75- 6 times for risk in the wrists and hands for MSDs (Ou et al., 2021).

That shows that health managers should give attention to related factors of risks with prioritization. Moreover, they should track hand discomfort injuries and take them into their assessment. In occupational training, they may consider risks expressed in the study, and they can arrange measures accordingly. Future detailed research may indicate differences in hand discomforts between healthcare professions.

It was suggested to understand the functional elements of patient handling (Ou et al., 2021) to reduce MSDs among healthcare workers.

All manual activities in healthcare workers, including transporting patients or equipment, repositioning patients, working in the work process with extremely awkward positions and postures, and heavy manual lifting with this distorted posture, are suggested as causes of MSD injuries in healthcare professionals (Ou et al., 2021). Performing hand tasks represented most of the workday for healthcare workers. Hand tasks mostly included handling, syringe, and pinch tasks, and the left forearm flexor muscles rested for only about 6% of the shift.

Levels of muscle activity in numerous tasks exceed suggested load limits. The duration and number of hand efforts, in combination with high muscle activity, and lack of muscular rest, provide evidence of muscular overload (MacDonald et al.,2018).

Smith et al. revealed that specific stressors might be associated with musculoskeletal disorders related to certain regions. They stated that the resulting musculoskeletal disorders and the stress felt may lead to difficulties in making decisions, excessive mental intensity, and ultimately discomfort in the neck region. In addition, they stated that a low level of control over the process in work activities and insufficient participation in decision-making processes might cause discomfort in the hand region, and inadequate social support may be related to elbow region disorders (Smith et al., 2006). Barr et al. (2004) stated that despite some variation and even disagreement among the studies, a causal relationship is apparent between prolonged exposure to repetitive and forceful hand-intensive tasks, highly repetitive hand-intensive tasks, vibration, psychosocial stress at work, and the development of Carpal Tunnel Syndrome or other hand/wrist of MSDs (Barr et al., 2004). In this respect, it is important to determine the presence of MSDs and their determinants in order to prevent the burden of work-related MSDs in the workplace (Ouni et al.,2020).

Findings and suggested risk reduction strategies can act as a guide for future evaluation of workplaces with hand demands (MacDonald et al., 2018). In this context, it should give special attention to the evaluation of prolonged restricted posture and repetitive movements, heavy weight bearing, strong grip, low temperatures, usage of vibrating tools, and the frequency, intensity, and duration of each task performed by healthcare workers (Clari et al.,2021).

Conclusion

According to study results, the right hand and left-hand wrist had the most discomfort in HWs. Right hands had more discomfort scores than all regions in the left hand, and some of the discomforts in the hand may relate to sociodemographic characteristics. Healthcare management of workers needs a comprehensive approach to deal with MSDs that requires focusing on physical hazards, psychosocial hazards, evidence-based causation models, and a multidimensional handling approach. It is advisable that provide breaks to rest and exercise. There are not many studies in the literature on healthcare workers using CHDQ for musculoskeletal hand discomfort. Therefore further

research may reveal hand discomfort and possible related factors in healthcare workers, especially for specific professions such as; surgeons and operating nurses.

6. Limitations of the Study

The study, which focuses on small groups, is pilot research due to the nature of the cross-sectional design. Moreover, health workers were not examined according to their different clinics, and the general health status of the participants and hand dominance were not questioned. The Cornell Hand Discomfort Questionnaire results were very low and showed not so much complaints. That may be because of the nature of the cross-sectional study and the selected population. However, the Healthcare Workers contributed significant input about their experiences. The study's findings may help healthcare workers and managers be better prepared for the risks of the working environment.

Conflict of Interest

There is nothing to declare as regards with conflict of interest.

References

Adams, S. R., Hacker, M. R., McKinney, J. L., Elkadry, E. A., & Rosenblatt, P. L. (2013). Musculoskeletal Pain in Gynecologic Surgeons. Journal of minimally invasive gynecology, 20(5), 656-660.

Alqahtani SM, Alzahrani MM, Bicknell R, Pichora D. (2022). Prevalence and Factors of Work-Related Musculoskeletal Disorders Among Hand Surgeons. World J Orthop 2022; 13(5): 465-471 [PMID: 35633751 DOI: 10.5312/wjo.v13.i5.465]

Azma K, Hosseini A, Safarian MH, Abedi M. (2015). Evaluation of The Relationship Between Musculoskeletal Discomforts and Occupational Stressors Among Nurses. N Am J Med Sci. 2015;7(7):322–7. https://doi.org/10.4103/1947-2714.161250.

Barr, A. E., Barbe, M. F., & Clark, B. D. (2004). Work-Related Musculoskeletal Disorders of The Hand and Wrist: Epidemiology, Pathophysiology, and Sensorimotor Changes. Journal of orthopaedic & sports physical therapy, 34(10), 610-627.

Clari, M., Godono, A., Garzaro, G., Voglino, G., Gualano, M. R., Migliaretti, G., ... & Dimonte, V. (2021). Prevalence of Musculoskeletal Disorders Among Perioperative Nurses: A Systematic Review and META-analysis. BMC musculoskeletal disorders, 22(1), 1-12.

Cornell University Ergonomics Web. http://ergo.human.cornell.edu/ahmsquest.html (Date of Access: 30.05.21).

Eapen, C., Kumar, B., & Bhat, A. K. (2010). Prevalence of Cumulative Trauma Disorders in Cell Phone Users. Journal of Musculoskeletal Research, 13, 137–145. https://doi.org/10.1142/S0218957710002545

Erdinc, O., Hot, K., & Ozkaya, M. (2011). Turkish Version of The Cornell Musculoskeletal Discomfort Questionnaire: cross-cultural adaptation and validation. Work, 39(3), 251-260. https://doi.org/10.3233/WOR-2011-1173

Gallagher, S., & Heberger, J. (2013). Examining the İnteraction of Force and Repetition of Musculoskeletal Disorder Risk. Human Factors: Journal of the Human Factors and Ergonomics Society, 55, 108–124.

Gyer, G., Michael, J., & Inklebarger, J. (2018). Occupational Hand Injuries: A Current Review of The Prevalence and Proposed Prevention Strategies For Physical Therapists and Similar Healthcare Professionals. Journal of integrative medicine, 16(2), 84-89.

Hansson, G., Nordander, C., Asterland, P., Ohlsson, K., Stromberg, U., Skerfving, S., & Rempel, D. (2000). Sensitivity of Trapezius Electromyography To Differences Between Work Tasks—Influence of Gap Definition and Normalisation Methods. Journal of Electromyography and Kinesiology, 10, 103–115.

Jansen, K., Luik, M., Reinvee, M., Viljasoo, V., Ereline, J., Gapeyeva, H., & Pääsuke, M. (2013). Hand Discomfort In Production Assembly Workers. Agronomy Research, 11(2), 407-412. 10.

Kim, H., Dropkin, J., Spaeth, K., Smith, F., & Moline, J. (2012). Patient Handling and Musculoskeletal Disorders Among Hospital Workers: Analysis of 7 Years of Institutional Workers' Compensation Claims Data. American journal of industrial medicine, 55 (8), 683-690. http://dx.doi.org/10.1002/ajim.22006

Lin, W. Y., Yang, C. L., Huang, W. P., Tseng, P. C., & Kuo, H. W. (2022). Moderating and Mediating Effects of Over-Commitment on the Association Between Effort–Reward Imbalance (ERI) with Upper Back and Hand/Wrist Disorders in Municipal Solid Waste Collectors. Journal of Pain Research, 15, 455.

MacDonald, V., & Keir, P. J. (2018). Assessment of Musculoskeletal Disorder Risk With Hand and Syringe Use in Chemotherapy Nurses and Pharmacy Assistants. IISE Transactions on Occupational Ergonomics and Human Factors, 6(3-4), 128-142.

Opsteegh, L., Reinders-Messelink, H. A., Schollier, D., Groothoff, J. W., Postema, K., Dijkstra, P. U., & Van der Sluis, C. K. (2009). Determinants of Return To Work in Patients With Hand Disorders and Hand Injuries. Journal of occupational rehabilitation, 19(3), 245-255.

OSH Answers Fact Sheets Work-related Musculoskeletal Disorders. https://www.ccohs.ca/oshanswers/diseases/rmirsi. (Date of Access: 30.05.21).

Oh, E., Kim, A., & Oh, Y. (2022). Research Trend of Korean Medicine for Musculoskeletal Disorders of the Hand and Wrist. Journal of Korean Medicine Rehabilitation, 32(1), 21-36.

Ou, Y. K., Liu, Y., Chang, Y. P., & Lee, B. O. (2021). Relationship Between Musculoskeletal Disorders and Work Performance of Nursing Staff: A Comparison of Hospital Nursing Departments. International Journal of Environmental Research and Public Health, 18(13), 7085. https://doi.org/10.3390/ijerph18137085

Ouni M, Elghali M, Abid N, Aroui H, Dabebbi F. (2020). Prevalence and Risk Factors of Musculoskeletal Disorders Among Tunisian Nurses. La Tunisie medicale. 2020;98(3):225-31

Qin, J., Lin, J., Faber, G., S., Buchholz, B., & Xu, X. (2014). Upper Extremity Kinematic and Kinetic Adaptations During A Fatiguing Repetitive Task. Journal of Electromyography and Kinesiology, 24, 404–411. doi: 10.1016/j.jelekin.2014.02.001

Rodgers, S. H. (1998). Predicting Ergonomically-Acceptable Highly Repetitive Tasks. In: Proceedings of the Silicon Valley Ergonomics Conference and Exposition, ErgoCon '98, San Jose, CA, May 3–6, 1998, pp. 3–11.

Sharan, D., Mohandoss, M., Ranganathan, R., & Jose, J. (2014). Musculoskeletal Disorders of The Upper Extremities Due To Extensive Usage of Hand Held Devices. Annals of Occupational and Environmental medicine, 26(1), 1-4.

Sheikhzadeh, A., Gore, C., Zuckerman, J. D., & Nordin, M. (2009). Perioperating Nurses and Technicians' Perceptions of Ergonomic Risk Factors in The Surgical Environment. Applied Ergonomics, 40, 833–839.

Simonsen, J., Arvidsson, I., & Nordander, C. (2012). Ergonomics in the Operating Room. Work, 41, 5644–5646.

Smith, D. R., Mihashi, M., Adachi, Y., Koga, H., & Ishitake, T. (2006). A Detailed Analysis of Musculoskeletal Disorder Risk Factors Among Japanese Nurses. Journal of safety research, 37(2), 195-200. https://doi.org/10.1016/j.jsr.2006.01.004

Zyluk, A., & Puchalski, P. (2015). Hand Disorders Associated With Diabetes: A Review. Acta Orthop Belg, 81(2), 191-196.

Appendix: Table 5. Sociodemographic characteristics **with CHDQ**

Variables	Gender		Sig.	Marital S.		Sig.	Graduate			Sig.	Profession		Sig.	Working Years				Sig.
	M	F	P	Mr.	Sn.	P	HS/ AD	BD	MD/ Doc.	P	Dr.	Nur.	P	1-4	5-9	10-14	15 and a.	P
RH. A (index, middle, h. ring) 	1.02	1.04	0.973	0.96	1.16	0.715	2.45	1.16	**0.18**	**0.017**	0.94	1.09	0.787	1.58	0.53	1.55	0.00	**0.107**
RH. B (l. finger, h. ring) 	0.71	1.03	0.539	0.90	0.91	0.996	1.18	1.19	0.30	0.258	0.49	1.14	0.215	1.08	0.27	2.21	**0.14**	**0.042**
RH. C (thumb) 	1.13	1.98	0.247	1.45	1.99	0.485	4.39	1.61	**0.48**	**0.004**	1.92	1.50	0.591	2.14	1.51	2.20	0.00	**0.270**
RH. D (palm) 	1.65	1.19	0.554	0.90	2.19	0.196	2.24	1.55	0.67	0.388	1.85	1.10	0.457	2.43	0.65	1.26	0.19	**0.146**
RH. E (thumb joint) 	2.00	1.54	0.629	1.41	2.27	0.371	2.90	2.02	0.67	0.247	2.04	1.54	0.605	2.54	0.70	3.00	0.11	**0.120**
RH. F (wrist) 	1.08	2.24	0.099	2.00	1.44	0.502	5.81	**1.66**	**0.22**	**0.000**	1.92	1.72	0.808	1.63	2.12	2.88	0.28	**0.302**
LH. A (index, middle, h. ring) 	0.88	0.85	0.957	0.79	0.97	0.749	1.44	1.21	0.00	0.079	0.69	0.95	0.639	1.37	0.82	0.47	0.05	**0.355**
LH. B (l.finger, h. ring) 	0.47	0.52	0.874	0.39	0.69	0.379	0.87	0.65	0.09	0.190	0.28	0.63	0.292	0.81	0.19	0.71	0.09	**0.291**
LH. C (thumb) 	0.49	1.00	0.341	0.65	1.06	0.442	2.05	0.93	**0.02**	**0.039**	0.73	0.84	0.836	1.11	0.65	1.07	0.00	**0.520**
LH. D (palm) 	0.59	0.90	0.618	0.53	1.22	0.283	0.94	1.20	0.00	0.209	0.97	0.68	0.647	1.57	0.23	0.64	0.00	**0.214**
LH. E (thumb joint) 	0.57	0.56	0.970	0.55	0.59	0.876	1.44	0.64	**0.04**	**0.010**	0.25	0.74	0.054	0.64	0.34	0.74	0.63	**0.785**
LH. F (wrist) 	0.77	0.93	0.711	1.05	0.56	0.180	3.13	0.78	**0.00**	**0.000**	0.51	1.07	0.190	0.86	0.73	1.29	0.67	**0.798**

Abbreviations: RH : Right Hand, LH : Left Hand, l.: little, h.: half, M: Married, Sn : Single, HS:High School, AD: Associate Degree, MD: Master Degree, Doc: Doctorate Dr: Doctor, Nur: Nurse, a: above, Sig: Significance (the P value ($p \leq 0.05$.) is accepted as statistically significant)