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ORIGINAL ARTICLE

Association Between Neck and Wrist Pain with Hand Grip Strength and Demographic Factors Among Workers of a Petroleum Products Distribution Company in Sabzevar City

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ABSTRACT

Background: The prevalence of neck and wrist pain is mainly related to ergonomic risk factors, affecting the work ability of petroleum workers. This study aimed to analyze the association between neck and wrist/hand pain with hand grip strength and to investigate the effects of factors (age, work experience, BMI, neck and wrist/hand pain, anthropometric dimensions of the hand) on hand grip strength among workers.

Methods: A cross-sectional study was conducted in a petroleum products distribution company among 180 workers. The Standardized Nordic Questionnaire was used to evaluate existing neck and wrist/hand pain. The anthropometric factors of the hand were measured directly using a tape measure. Hand grip strength was measured using a SAEHAN SH® 5001 hydraulic handheld dynamometer; the SAEHAN Hydraulic Pinch Gauge (SH5005) was used for pinch grip strength. Statistical analysis tests including the Chi-square test, Independent T-test, Pearson correlation coefficient, One-way analysis of variance, and linear regressions were carried out using SPSS version 26. The level of significance was set at $P \leq 0.05$.

Results: The results of the study showed that the prevalence of neck pain and hand/wrist pain among workers was 39.44% and 27.22%, respectively. The average grip and pinch strength of the dominant hand was lower in workers who had neck pain than in those who did not have neck pain, but the difference was not significant. There was a significant difference between hand length and hand width in relation to hand grip strength (HGS) and pinch grip strength (PGS). There was no significant relationship between hand grip strength and the variables of BMI and work experience. Linear regression analysis showed that hand length and hand width explained 14.5% of the variance in hand grip strength ($F(2, 176) = 14.885$, $p = .000$, $R^2 = 0.145$).

Conclusion: The findings showed that there was no substantial link between neck and wrist/hand pain and the strength of hand grip and pinch grip. However, larger hand length and width were significantly correlated with stronger hand grip strength.

KEYWORDS: *Manual handling, Hand drip strength, Musculoskeletal disorders, Neck pain, Wrist pain*

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INTRODUCTION

Musculoskeletal disorders (MSDs) are the most prevalent health issue faced by workers and rank as the fourth primary cause of disability globally [1]. MSDs are one of the most important health problems worldwide, with significant socio-economic consequences. These disorders have affected almost a third of the world's population and are among the leading causes of chronic disability, sick leave, reduced work productivity, and diminished quality of life for humans [2]. Neck and lower back disorders are very common among office workers [3]. Several risk factors for MSDs among workers are known, including individual, work-related, and psychosocial factors [4]. Ranasinghe et al. have stated that occupational risk factors such as improper posture, detrimental work practices, habitual computer usage, excessive workload, and insufficient social support are substantially correlated with the incidence of MSDs in the workforce [5].

Manual material handling (MMH) occurs in various workplaces, such as the industrial, manufacturing, and service sectors. MMH is a risk factor for worker health. The association between MMH activity and the occurrence of MSDs of the upper limb has been demonstrated in the literature [6]. Typically, performing MMH requires considerable manual skill. Repetitive movements of the hand and arm, or the application of significant force using the hand and arm, are among its main characteristics [7].

Manual dexterity, an important component of upper limb function, is necessary for individuals to perform daily tasks [8]. Globally, neck pain is among the most common MSDs, with its one-year prevalence among young adults reported between 42% and 67% [9]. Neck and hand/wrist pain are upper limb disorders that can influence hand grip strength (HGS). Gripping and applying force in manual work are among the most important hand functions during occupational activities [10]. The force required to grasp a tool should be proportional to an individual's physical capability. If the work environment is not ergonomically designed, the wrists and forearms of manual workers may gradually suffer from MSDs, such as tendinitis and carpal tunnel syndrome (CTS) [11]. When task demands vary, force, torque requirements, and load distribution which influence the posture of the worker's body, especially the wrist must be considered [12]. Repetitive activities, awkward postures, and the aging process are contributing factors to neck injuries among workers [13]. When the required hand grip force is disproportionate to an individual's capability, and the workplace is poorly designed from an ergonomic perspective, the forearm and wrist may develop MSDs such as tendinitis and CTS [11, 14]. Age, sex, and genetic and anthropometric factors play a role in CTS. Repetitive activities, excessive force, sustained exertion, and vibration are considered significant hazardous factors [13].

HGS is one of the most important parameters in hand muscle function, encompassing both clinical and ergonomic aspects. Factors influencing HGS include age, sex, body mass index (BMI), occupation, leisure activities, upper limb muscle strength, nutritional status, arthritis, other disorders, and reduced cognition [15, 16]. There are two types of grips: power grip and pinch grip. The power grip is used to apply high force, whereas the pinch grip is employed in precise and delicate tasks [17]. Research indicates that the weakest HGS is observed in individuals with high BMI under the age of 30 and over the age of 70, while the strongest HGS is found in those with high BMI aged between 30 and 70 [18]. The primary purpose of HGS assessment is that it serves as a valuable tool for evaluating upper limb function, designing manual tools, assessing treatment effectiveness, and promoting development [10]. Various studies have shown that HGS in the non-dominant hand is significantly lower in women and tends to decline with age [19, 20]. Additionally, individuals aged 35–49 represent a more abundant demographic compared to those aged 20–30, while the lowest prevalence is observed in individuals over 60 years of age [18, 21].

The reason behind degenerative disk and pathological conditions, including osteoporosis with rheumatoid arthritis among people over 65 years old, is that their HGS is reduced [22]. In performing precise and repetitive manual tasks, often found in the manufacturing industry, many workers are forced to endure non-neutral neck positions and subsequently increased neck muscle tension, which may cause cervical nerve root compression, as well as neck pain and headaches [23]. HGS is very important in evaluating hand and upper limb performance [24]. Workers who carry out manual activities in petroleum product distribution companies like many activities that are conducted in industrial work environments experience repetitive manual tasks with non-ergonomic positions of the wrist and neck daily, which can lead to neck, shoulder, and back pain, as well as CTS [25].

Wollesen et al. stated that workers with neck pain showed lower HGS compared to those without neck pain [10]. Findings of a study indicated an association between neck pain and MSDs, which further diminishes HGS [26]. Age and sex significantly influence the severity of neck and wrist pain and HGS, with younger individuals and females often reporting higher pain levels [10]. Müller et al. have expressed that the continuous alterations in current work settings, in conjunction with a considerable workforce engaged in the manual movement of loads, have driven both employers and researchers to show greater cognizance regarding the health implications and outcomes of manual load handling for employees in their work environments [6]. In oil and gas workers, neck and wrist pain prevalence is related to ergonomic risk factors, affecting overall productivity and work ability [27].

Considering the high importance of HGS in performing tasks among company employees and the prevalence of MSDs, this study was carried out to answer the following research questions:

1. Is there a correlation between hand grip strength and neck or wrist/hand discomfort in manual material handling and office employees?
2. What factors (such as age, work experience, BMI, neck pain, wrist/hand pain, and hand measurements) have the greatest impact on variations in hand grip strength among manual material handling and office workers?

MATERIALS AND METHODS

Participants

The oil depot located in the east of the country is considered one of the most important oil product storage depots. It covers an area of about 10 hectares and includes 15 reservoirs with a nominal capacity of 97 million liters. It has 6 platforms and 10 automatic loading lines, with a loading capacity of 15,000 liters per minute. Approximately one million six hundred and fifty thousand liters of products are distributed daily, and approximately 615 million liters are distributed annually by 97 tankers. The total number of office workers was 80, and 110 workers performed manual handling operations. The inclusion criteria were all employees who were engaged in the office department and MMH and had at least one year of work experience. The number of female workers in this industry was very small, so all the participants were male. In this industry, occupational medical examinations were conducted for all employees every year. Therefore, with the approval of the occupational medicine doctor, the exclusion criteria included workers with neuromuscular disability, surgical history of median nerve release, tendon lesion of the thumb or hand, previous fracture of the neck and hand/wrist, and any prior history of neck and hand/wrist injury [26]. The three female employees did not want to participate in the study. Also, seven male workers did not meet the inclusion criteria and were not included in the study. According to the inclusion and exclusion criteria, 180 workers were eligible to participate in this study. All the participants were right-hand dominant. Before testing, they read and signed the informed consent form. The study was approved by the Ethics Committee of Sabzevar University of Medical Sciences (ethics code: IR.MEDSAB.REC.1401.008). Neck pain and wrist/hand pain were assessed using the Nordic Musculoskeletal Questionnaire (NMQ), the validity and reliability of which have been confirmed by experts. The test/retest reliability of the NMQ is approximately 0.8. Its sensitivity and specificity are between 66%–92% and 71%–88%, respectively [29, 30]. The anthropometric dimensions of the hand were measured in three dimensions hand length, hand width, and palm width directly using a tape measure [31].

Research tools

A SAEHAN SH® 5001 hydraulic handheld dynamometer was used to perform the HGS test, which has a holding needle that retains the highest reading until reset for easy and convenient strength recording [32]. This device can display forces in two scales: pounds and kilograms. In the present study, all data were recorded in kilograms. It provides an adjustable handle to accommodate different hand sizes, allowing researchers to quantify grip strength for objects of varying sizes. Most of the participants preferred to choose the 2nd position to perform the test [33]. The SAEHAN Hydraulic Pinch Gauge (SH5005) was used for PGS testing by measuring the key pinch. PGS was also measured in kilograms [32].

Procedure

HGS and PGS were measured in a comfortable sitting position on a chair without arm support for each participant. To familiarize the participants with the testing procedures, practice trials were given before the beginning of the tests. The position of the shoulders was adducted and neutrally rotated, the forearm was bent at a 90-degree angle, and the position of the arm and wrist was neutral. Each participant performed the test three times, and the average was recorded in kilograms. Measurements were taken for both the dominant and non-dominant hands. A rest period of one minute between trials was given to minimize

Table 1. Demographic characteristics of participants

Variable	Job	M	SD
Age (year)	Office	41.80	6.46
	MMH	41.30	6.29
	Total	41.49	6.34
BMI (kg/m^2)	Office	25.80	2.90
	MMH	26.09	3.38
	Total	25.98	3.19
Work Experience (year)	Office	16.25	6.85
	MMH	16.31	6.56
	Total	16.29	6.65

Note: M= mean; SD= standard deviation; kg= kilogram.

Table 2. Prevalence of neck and wrist/hand pain

		Neck pain N(%)		Hand/wrist pain N(%)	
		Yes	No	Yes	No
Job	Office	25 (35.7)	45 (64.3)	17 (24.3)	53 (75.7)
	MMH	46 (41.8)	64 (58.2)	32 (29.1)	78 (70.9)
	Total	71 (39.44)	109 (60.56)	49 (27.22)	131 (72.73)

fatigue effects [34]. For key pinch strength, the pinch dynamometer was held between the radial side of the proximal phalanx of the index finger and the tip of the thumb [35]. During the PGS test, the dynamometer was held by the researcher, not the participant. The duration of applying pressure in each test was 3–5 seconds. The test was conducted for all participants between 10:00 and 11:50 AM..

Statistical analysis

All data were collected from the sheet, and the results of the measurements were entered into the SPSS program. For descriptive analysis, the mean (M) and standard deviation (SD) were reported. The Chi-square test was used to compare the categorical variables and to test for associations between MSDs and selected risk factors within the two groups. Independent t-tests were used to compare mean differences in HGS and PGS between the two groups, and the Pearson correlation coefficient was used to analyze associations between continuous variables. One-way analysis of variance (ANOVA) was applied to compare the intensity of neck and wrist/hand pain with HGS across different age groups. Stepwise linear regressions were conducted to determine the factors associated with HGS and PGS (age, work experience, and BMI), where HGS and PGS were the dependent variables and neck and wrist/hand pain were the independent variables. The p-values were reported, and the level of significance was set at ≤ 0.05.

RESULTS

A total of 180 employees participated in this study; of this number, 70 were employees of the office department and 110 were employees responsible for manual handling operations. The average age and work experience of the employees in this study were 41.49 and 16.29 years, respectively. The results of the independent samples test showed that there was no significant difference between the demographic variables of age, BMI, and work experience in the two groups of office (N = 70) and MMH (N = 110) employees. The descriptive statistics of these variables are shown in Table 1.

The prevalence of pain in the neck and wrist/hand wrist area in office workers was lower than that in workers who were responsible for MMH. The results are presented in Table 2.

The mean and standard deviation of HGS and PGS for office and MMH employees are presented in Table 2. The results showed that the average HGS and PGS are higher in MMH employees than in office employees. The results of the Chi-square test showed that there were no significant differences in neck pain (p-value = 0.128) and hand/wrist pain (p-value = 0.099) between office and MMH workers. The results of the independent t-test showed a significant difference in the average HGS between office and MMH employees. However, this difference in PGS was not significant between office and MMH employees (Table 3).

In this study, the average grip strength of the dominant hand (42.13 kg) was lower in workers who had neck pain than in workers who did not have neck pain (43.44 kg). The results of the Chi-square test showed that this

Table 3. Mean and standard deviation of HGS and PGS in participants

	Job	M	SD	t	df	Sig. (2-tailed)
HGS_R	Office	40.48	12.57	-2.568	178	.011
	MMH	44.73	9.53	-2.417	118.635	.017
	Total	43.08	10.98			
HGS_L	Office	38.54	13.35	-2.750	178	.007
	MMH	43.25	9.60	-2.561	114.078	.012
	Total	41.42	11.41			
PGS_R	Office	7.85	3.07	.148	178	.883
	MMH	7.79	2.77	.144	136.063	.885
	Total	7.81	2.88			
PGS_L	Office	7.79	2.77	-.507	178	.613
	MMH	8.01	2.72	-.505	145.205	.615
	Total	7.92	2.74			

Note: Results of the independent t-test, M= mean; SD= standard deviation; MMH: manual material handling; HGS=hand grip strength; PGS=pinch grip strength; R=right; L=left

Table 4. Mean and standard deviation of the anthropometric dimensions of hands in participants

	Job	**M**	**SD**	**t**	**df**	**Sig. (2-tailed)**
Hand width	Office	8.46	1.13	-2.762	178	.006
	MMH	8.80	.51	-2.383	87.539	.019
	Total	8.67	.82			
Hand length	Office	18.46	.88	-1.048	178	.296
	MMH	18.61	.96	-1.068	156.181	.287
	Total	18.55	.93			
Palm width	Office	10.72	.51	-2.230	178	.027
	MMH	10.93	.63	-2.339	168.317	.021
	Total	10.85	.60			

Note: Results of the independent t-test, M= mean; SD= standard deviation

difference was not significant (p = 0.259). Additionally, the average PGS of the dominant hand (7.88 kg) was lower in workers who had neck pain than in workers who did not have neck pain (8.03 kg). The results of the Chi-square test indicated that this difference was not significant (p = 0.127).

The average HGS of the dominant hand (42.19 kg) was lower in workers who had wrist/hand pain than in workers who did not have wrist/hand pain (43.25 kg). The results of the Chi-square test showed that this difference was not significant (p = 0.246). Additionally, the average PGS of the dominant hand (7.75 kg) was lower in workers who had wrist/hand pain than in workers who did not have wrist/hand pain (8.12 kg). The results of the Chi-square test indicated that this difference was not significant (p = 0.097).
The mean and standard deviation of the anthropometric dimensions of the hand for office and MMH workers are presented in Table 4. The results of the independent t-test showed that there was a significant difference between the dimensions of hand width and palm width in the two groups.

The mean and standard deviation of HGS and PGS in different age groups are shown in Table 5. The age group of 36 to 40 years had the highest HGS and PGS compared to other age groups. The results of the one-way analysis of variance test showed that there were no significant differences in HGS and PGS among workers in different age groups. Additionally, the results of this test indicated that there were no significant differences in HGS and PGS with respect to the variables of BMI and work experience.

The association between hand-dominant anthropometric dimensions and the HGS and PGS of the workers was investigated using ANOVA. The results showed a significant difference between the studied anthropometric dimensions and the HGS and PGS of the workers. The results are presented in Table 6.

Using Pearson's correlation test, the relationship between demographic variables (age, work experience, and BMI) and the HGS and PGS of the workers was investigated. A significant association was found between BMI and both HGS and PGS. The results are shown in Table 7.

The results of Spearman's correlation test showed that

Table 5. Mean and standard deviation of HGS and PGS in employees, classified by age groups

Age (years)		HGS_R	HGS_L	PGS_R	PGS_L	Sum of Squares	df	M Square	F	Sig.
30-35 (N=29)	M	43.79	41.37	7.84	8.28	817.60	5	163.52	1.36	.238
	SD	12.83	13.75	2.91	2.82	20779.17	174	119.42		
36-40 (N=62)	M	43.81	42.40	7.81	7.83	885.40	5	177.08	1.37	.236
	SD	10.72	11.08	2.93	2.92	22419.47	174	128.84		
41-45 (N=45)	M	44.81	43.37	8.15	8.36	30.45	5	6.09	.72	.606
	SD	8.81	9.45	2.96	2.80	1462.99	174	8.40		
46-50 (N=25)	M	40.33	38.66	7.92	7.68	31.47	5	6.29	.834	.527
	SD	11.28	10.91	3.06	2.43	1312.75	174	7.54		
51-55 (N=15)	M	37.67	35.89	6.53	6.97	817.60	5	163.52	1.36	.238
	SD	13.75	14.05	1.81	1.98	20779.17	174	119.42		
56-60 (N=4)	M	44.45	42.52	7.93	7.03	885.40	5	177.08	1.37	.236
	SD	3.29	5.02	3.67	2.83	22419.47	174	128.84		

Note: Results of the analysis of variance test (ANOVA), HGS=Handgrip strength; PGS=Pinch grip strength; R=Right; L=Left

Table 6. Association between HGS and PGS with dominant hand anthropometric dimensions in employees

	Sum of Squares	df	M Square	F	Sig.
HGS_R* Palm width	13755.320	104	132.263	1.265	.141
	1306.400	1	1306.400	12.495	.001
	12448.920	103	120.863	1.156	.255
PGS_R * Palm width	1007.632	104	9.689	1.496	.033
	49.661	1	49.661	7.667	.007
	957.970	103	9.301	1.436	.050
HGS_R * Hand width	14905.436	96	155.265	1.926	.001
	1928.593	1	1928.593	23.922	.000
	12976.843	95	136.598	1.694	.007
PGS_R * Hand width	976.401	96	10.171	1.633	.011
	44.480	1	44.480	7.140	.009
	931.921	95	9.810	1.575	.018
HGS_R* Hand length	17528.694	123	142.510	1.962	.003
	2357.539	1	2357.539	32.453	.000
	15171.154	122	124.354	1.712	.013
PGS_R * Hand length	1069.513	123	8.695	1.149	.284
	115.548	1	115.548	15.263	.000
	953.965	122	7.819	1.033	.455

Note: Results of the analysis of variance test (ANOVA), HGS=Handgrip strength; PGS=Pinch grip strength; R=Right

Table 7. Correlation between HGS and PGS with demographic variables in employees

Variables	Age	BMI	Work history	HGS_R	HGS_L	PGS_R	PGS_L
Age (years)	1						
BMI (kg/m^2)	.110	1					
Work history (years)	.739**	.210**	1				
HGS_R	-.122	.172*	-.116	1			
HGS_L	-.109	.151*	-.091	.903**	1		
PGS_R	-.055	.177**	-.004	.571**	.578**	1	
PGS_L	-.098	.131*	-.112	.503**	.535**	.780**	1

**. Correlation is significant at the 0.01 level (1-tailed)

*. Correlation is significant at the 0.05 level (1-tailed).

Note: Results of Pearson's correlation test, BMI: body mass index; kg= kilogram; HGS=hand grip strength; PGS=pinch grip strength; R=right; L=left

there was no significant relationship between pain in the neck and wrist/hand areas and the HGS and PGS of the workers (p>0.05).

A stepwise linear regression was applied to identify predictors and variables associated with HGS and PGS. A model that included age, BMI, and work experience as confounding variables and the anthropometric dimensions of the hand (hand width, hand length, and palm width), neck pain, and wrist/hand pain as

Table 8. Summary of linear regression model for factors associated with hand-grip and pinch-grip strength

VARIABLE	HGS		PGS	
	β	**t(*p*)**	**β**	**t(*p*)**
BMI	-	-	0.145	2.021 (0.045)
HAND LENGTH	0.253	3.342 (0.001)	0.261	3.632 (0.000)
HAND WIDTH	0.201	2.647 (0.009)	-	-
R^2 AND P-VALUE OF THE MODEL	R^2	*p*	R^2	*p*
	0.145	0.000	0.098	0.000

Note: Results of linear regression test, BMI; body mass index, HGS=hand grip strength, PGS=pinch grip strength

independent variables, with HGS as the dependent variable, was examined. Age, work experience, palm width, neck pain, and wrist/hand pain were excluded, and the remaining variables hand length and hand width explained 14.5% of the variance in handgrip strength ($F(2, 176) = 14.885$, $p = .000$, $R^2 = 0.145$) (Table 8).

For PGS, the same model used for HGS was applied. After analysis, age, work experience, hand width, palm width, neck pain, and wrist/hand pain were excluded, and the remaining variables—BMI and hand length—explained 9.8% of the variance in PGS ($F(2, 177) = 9.635$, $p = .000$, $R^2 = 0.098$) (Table 8). All models were tested for collinearity, and no effects of collinearity were found in either model.

DISCUSSION

The current study investigated the association between neck pain and wrist/hand pain with HGS among MMH and office workers. A weak but significant association was found between some variables. The results may indicate that hand length and hand width are related and contribute to stronger HGS, and that BMI and hand length are related and contribute to stronger PGS.

The findings revealed that the prevalence of neck and wrist/hand pain in workers was 39.44% and 27.22%, respectively. The prevalence of neck and wrist/hand disorders was reported to be higher in MMH workers than in office workers, but the difference was not significant. The prevalence of neck and wrist/hand disorders among MMH workers in an automotive manufacturing company was reported as 16.8% and 15.4%, respectively [36]. The relationship between MMH operations and pain in the hands and arms has been demonstrated in the German workforce [6]. The prevalence of neck and wrist/hand disorders among office employees at a university of medical sciences was reported as 55.2% and 24%, respectively [37].

The industry had good working conditions regarding ergonomics, including proper ergonomic equipment, workstations, training on ergonomic principles, and work–rest regimes, as well as favorable employee age and work experience. Therefore, the prevalence of neck and wrist disorders in the present study is different from that in previous studies among MMH workers and office workers. Russo et al. [38] reported that MMH workers, particularly in the forestry industry, and other workers who experienced physically demanding repetitive tasks had significantly lower HGS than those who conducted non-manual activities, which is not consistent with the results of the present study.

The results of several studies have shown higher HGS in manual workers than in those performing non-manual tasks [39–41], which confirms the findings of this study. Various causes can be proposed, one of which is continuous repetitive movements while facing harmful physical factors that can aggravate the impact on the musculoskeletal system and gradually reduce grip strength in workers [42]. Given the contradictory findings observed in past studies, it is recommended that further studies be conducted using appropriate methodology.

The results show that there is a significant relationship between HGS, PGS, and BMI. Gholamian et al. [43] investigated the factors affecting HGS and found a significant relationship between BMI and HGS, which aligns with the results of the present study. However, Choudhary et al. [44] reported that BMI does not affect the grip strength of restaurant workers, which is inconsistent with the results of the present study. This difference may be due to variations in the populations studied [43].

No significant correlation between age and HGS was observed. Frederiksen et al. [20] indicated that HGS decreases from the age of 50 onwards. Furthermore, HGS is higher in the age group of 35 to 49 years than in the age group of 20 to 34 years and is lowest in the age group over 65 years [19, 21, 45], which is not consistent with the results of the present study. However, the findings of Habibi et al. [46] showed no significant association between age and HGS. These discrepancies appear to be due to differences in demographic and lifestyle characteristics, as well as job specifications of the participants.

The results showed a significant association between the grip strength of the dominant hand and the non-dominant hand. Jarit P. [47] indicated that there is no significant correlation between the grip strength of the dominant hand and the non-dominant hand, which is not consistent with the present study. The average grip strength of the dominant hand was greater than that of the non-dominant hand, which aligns with the results of Bansal et al. [48].

The findings showed a significant relationship between HGS and PGS and the anthropometric dimensions of the hand. Moreover, MacDermid et al. [49] stated that a positive association was observed between the anthropometric dimensions of the hand and grip strength. Another study revealed that the palm width dimension had the greatest relationship with grip strength [39], and there was a direct relationship between grip strength and hand dimensions [50].

There was no significant relationship between neck pain and hand/wrist pain and HGS and PGS. Additionally, according to the findings of extensive studies, a significant correlation between neck pain and grip strength has been reported [10, 51, 52], which does not support the findings of the present study. Factors such as conducting a cross-sectional study, the lack of a control group, relatively favorable ergonomic conditions in this industry, and possibly not utilizing pain assessment tools for various body areas instead of the Nordic questionnaire might have contributed to the absence of a relationship between neck and wrist/hand pain and grip strength in this research.

LIMITATIONS

The main limitation of this study was its cross-sectional nature, which makes it challenging to generalize the findings to other sectors. Additionally, the research did not have the capacity to compare HGS and PGS across genders. In occupations with varying work demands and risk factors, if the prevalence of neck and wrist/hand pain is substantial, a reduction in HGS and PGS may be anticipated after several years. Despite the limited number of studies in this area, it is advisable to conduct longitudinal prospective research involving a substantial number of male and female participants across various industries with different types of occupations.

CONCLUSION

In summary, our results showed no significant correlation between neck and wrist/hand pain with HGS and PGS in office and MMH workers. The present study demonstrated a relationship between hand length and hand width measurements and HGS. The results indicated that hand length and width were associated with enhanced HGS, while BMI and hand length were linked to increased PGS. Furthermore, the findings revealed that the occurrence of neck and wrist/hand disorders is notable among workers involved in manual handling tasks.

Consequently, it is recommended that the occupational health and safety management system in this sector implement appropriate ergonomic interventions for workstations involving repetitive tasks and manual handling. Additionally, employees should be encouraged to adopt behaviors that reduce neck pain and lower the risk of wrist/hand issues. The application of broad ergonomic measures at workstations can help mitigate the decline of HGS associated with age and gender.

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CONFLICT OF INTEREST

The authors declare no competing interests.

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