Research Article

Comparison of Differences of the Hand Area Anatomic and Anthropometric Parameters of the Isokinetic Muscle Functions of the Healthcare Workers Who Work in Different Units during the Covid-19 Pandemic Process

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Abstract

The hand grip strength of neurology physiotherapists working with neurological patients who have impaired control of agonist and antagonist muscles due to nerve injuries or accidents, and intensive care nurses and nursing staff working with second and third level immobile patients are at risk. Wrist grip level decreases over time in both professions; due to the damage to the anatomical structures of the wrist, for reasons such as positioning the patient, exercising, etc. Our aim in this study is to ensure that the aforementioned similar sub divisional health workers; to reveal the occupational difference rates between hand grip strength and forearm flexion extension strength losses. In our study, only male participants were included in the study in order to eliminate gender-related muscle strength differences. 20 male neurology physiotherapists and 20 male intensive care workers were determined as the research sample. Wrist circumference and Body Mass Index (BMI) of the groups were calculated for the anthropometric measurement evaluations in both groups included in the study. The wrist grip strength of both hands of the participants was evaluated with jamar dynamometer and flexion and extension strengths with an Electronic Push/Pull Dynamometer (EPPD). The data obtained were evaluated with SPSS22. In the analysis of the data, "Independent samples t" test was applied for parameters such as age, height, weight, and dominant hand preference, duration of work, flexion, extension and left jamar average values. "Mann Whitney U" test, one of the non-parametric tests, was applied for variables that do not show normal distribution. In the light of the data obtained as a result, there are statistically significant differences between the two groups for height, time spent in the profession/month and left hand extension values and right hand jamar average values in both occupational groups (P<0,05).

Keywords: Hand grip strength; Hand function; Flexion; Extension; Isokinetic health worker

Introduction

The hand is an important component of daily life, revealing the functionality of the upper extremities. The function used in almost all of the activities necessary for the daily life of the individual; it is the grasping function of the hand. Therefore, grip strength is accepted as the main criterion in evaluating the function of the upper extremity. [1]

Muscle group injuries and loss of function that greatly affect wrist and hand grip strength with its dramatic results; it reduces the quality of life of the person. [1]

The reduction in hand grip and muscle strength of employees in jobs using physical force has been demonstrated by studies. [2] Diseases that occur due to damage to muscles, tendons and surrounding structures due to the work done are named as "Occupational Musculoskeletal Disorders" (OMD). The incidence of OMD is quite high in industrialized societies and is generally disability; seen in the neck, upper extremities, hand, and wrist. The higher the incidence of OMD, the higher the cost it brings to the society. [3] Reasons such as repetitive flexion-extension movements, non-ergonomic working conditions and incorrect use of body biomechanics, rather than sharp movements such as lifting heavy loads in the working environment, can cause loss of hand and wrist movements and shoulder deformities. [4] In hand grip strength evaluations; It should be kept in mind that force generation has to be done together with neighboring structures affecting this area. It is a compact structure that contains the wrist, forearm muscle group tendons and various vessels and nerves [Figure 1].

A review of the literature reveals that healthcare workers who are in direct contact with patients, such as physiotherapists and intensive care workers are more common than musculoskeletal diseases. [5]

In a study conducted in 2008, it was reported that intensive care nurses and physiotherapists who work in close contact

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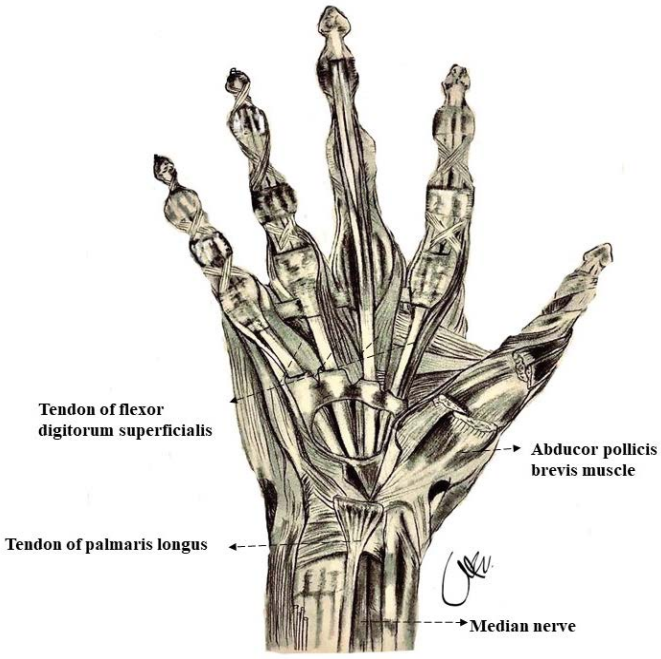

Figure 1: Structures passing through the deep layers of the right wrist (Drawing:Mehtap Erdogan).

with patients have a higher incidence of low back pain and musculoskeletal disease than doctors and dentists. Physiotherapists and intensive care workers are at risk in terms of hand grip strength and isokinetic muscle groups deformities due to long working hours, wrong body postures during work, heavy lifting while positioning and exercising severe patients, and repetitive isokinetic movements. [6]

In the literature, the comparison of nurses and intensive care personnel and physiotherapists with other occupational groups is quite high, but there is no comparison of deformity rates in these two occupations. In order to reveal this ratio, we aimed to compare the flexor and extensor group muscle deformity rate, which has an effect on hand grip strength and wrist biomechanics in the two professions.

Materials and Methods

The universe and sample of the research

The universe of our study has been determined as two different centers. The first group; Twenty male neurology service physiotherapists working in a private physiotherapy center were randomly selected. Second group; Kocaeli University Training and Research Hospital II and III. Randomly 20 male employees were determined from amongst the primary intensive care unit employees. The t distribution and t test were used to calculate the sample size. Before starting the study, the necessary ethics committee and chief physician permissions were obtained. Before the study, the measurements to be made for them and the instruments to be used in measurements were explained to the participants. Participants were provided with the necessary information to read and sign the volunteer consent form.

Collection of data

The data of the participants were recorded in the detailed measurement forms. Height and body weight measurements were recorded to calculate the BMI of the participants.

The time spent in the profession was also noted, as occupational deformity may differ depending on time. Wrist circumference of the participants was recorded by measuring both wrist circumference (right-left) with a tape measure with BMI. Edinburgh handedness inventory [7] test was applied to the participants to determine the dominant hand preferences of the cases included in our study [Table 1].

A data sheet was also created to record isokinetic measurements and jammer test results. Hand grip strength of the participants; It was measured with the Jamar Hydraulic Hand Dynamometer, recommended by the American Society of Hand Therapists (ASHT), whose reliability has been verified by many studies and accepted the gold standard in measurements [8] [Figure 2A]. Measurements were made in the standard sitting position recommended by the ASHT with the elbows in flexion, in the neutral wrist position and the shoulder in adduction [9,10] and the average of the three measurements obtained was calculated and recorded. It was used to measure the isokinetic (flexion/extansion) muscle strength Electronic Push/Pull Dynamometer (EPPD) of the subjects [Figure 2B]. EPPD measurements were also repeated three times for each wrist with one-minute intervals between them and the average value was recorded.

Statistical analysis

All statistical analyzes were performed using the SPSS statistical package version 22.0 for Windows (SPSS Inc., Chicago, IL, USA).

In the analysis of data showing normal distribution such as age, height, weight, dominant hand, time/month spent in the profession, right hand flexion, left hand extension, left hand jamar average, left hand flexion and left hand extension, the ‘’ Independent samples t ‘’ test was applied.

The “Mann Whitney U” test, one of the non-parametric tests, was applied for the BMI, right hand Wrist Circumference (WrC), left hand wrist circumference right Jamar average parameters, which are variables that do not show a normal distribution.

Values with $P \leq 0.05$ were considered statistically significant.

Table 1: Edinburgh handedness inventory. [7]

Questions	Left Hand (LH)	Right Hand (RH)
1.Writing	….	….
2.Drawing	….	….
3.Throwing	….	….
4.Scissors	….	….
5.Toothbrush	….	….
6.Knife (Whitout fork)	….	….
7.Spoon	….	….
8.Broom (Upper hand)	….	….
9. Striking match (match)	….	….
10.Openin box/lid	….	….

Note: Cumulative Total CT=LH+RH; Difference (D=RH–LH); Result (R=(D/CT) × 100)
(Interpretation: (Left Handed: R<-40) (Ambidextrous: -40 ≤ R ≤ +40) (Right Handed: R>+40))

Results

Our study was carried out on a total of 40 male healthcare workers in two different centers during the pandemic process.

The 40 participants included in the study were between the ages of 23 and 48, and all were men. The dominant hands of the participants were 95% right. The periods spent in the profession ranged from 12 months to 240 months in months. Sociodemographic values of the participants are shown in Table 2.

Considering the sociodemographic data of the cases in the study, the difference between the height ratios was found to be statistically significant with a standard deviation of 3.93. In addition, when the time spent in the profession of the participants is compared, the duration of the intensive care staff was found to be significantly higher ($p \leq .05$). For both professions, the dominant hand was determined as the right hand. There is no significant difference between body weights and BMIs.

The data of anthropometric measurements and isokinetic and isometric measurement results are shown in Table 3.

The average values of flexion and extension strength on the dominant hand side of both occupational groups were calculated. However, the extension strength ratios in non-dominant hands were found to be statistically significantly different ($p \leq .05$). Left wrist extension strength was found to be significantly lower in intensive care staff. This difference in non-dominant hands is important to us. When this value is compared with the time spent in the profession, it can be said that the wrist extension force, which is not dominant, that is, they do not use frequently, decreases depending on the duration of their work [Figure 3A].

Although the time spent by intensive care workers in our study is higher than physiotherapists; grip strengths in the dominant hand were found higher than physiotherapists [Figure 3B].

This situation can be interpreted as the forearm flexor muscles, which are frequently used by intensive care workers over time, increase the dominant wrist grip strength. Another possibility is that physiotherapists apply sharp, coercive and constantly repetitive movements with their dominant hands and wrist grip

Figure 2: A. Jamar hydraulic hand dynamometer, **B.** Electronic Push/Pull Dynamometer (EPPD).

Figure 3: A. Left hand extension ratios, **B.** Right hand jamar grip ratios.

Table 2: Sociodemographic values of the study group including Physiotherapists (PT) and Intensive Care units personnel (IC).

Study Group (M ± SD)	G (N=40)	PT (N=20)	IC (N=20)
Age(years)	33.07 ± 6	29.85	36.30
Height(cm)	176 ± 3.93	177.85	174.15
Weight(kg)	78.52 ± 7.91	77.55	79.50
Bmi	24.91 ± 0.97	24.55	25.27

(Note: Bold values have a significant meaning. ($p \leq .05$). G: Genaral; M: Mean; SD: Standart Deviation)

Table 3: Measurement data of the study group including Physiotherapists (PT) and Intensive Care units personnel (IC).

Study Group(M ± SD)	G (N=40)	PT (N=20)	IC(N=20)
Right Flx (kg)	12.73 ± 2.91	13.39	12.06
Right Ext (kg)	12.54 ± 2.40	12.91	12.18
Left Flx (kg)	13.00 ± 2.11	13.21	12.80
Left Ext (kg)	11.50 ± 2.57	12.41	10.60
Right Wrc (cm)	18.07 ± 0.88	17.95	18.20
Left Wrc (cm)	18.07 ± 0.88	17.95	18.20
Right Jamar M (kg)	27.59 ± 5.12	39.97	45.93
Left Jamar M (kg)	42.26 ± 6.76	38.59	42.35

(Note: Bold values have a significant meaning. ($p \leq .05$). G: Genaral; M: Mean; SD: Standard Deviation; WrC: Wrist Circumference)

forces in a shorter time; it can be interpreted as falling faster than other professions.

Discussion

It is known that anthropometric differences such as age, height, gender, forearm circumference, arm lengths play an important role among the factors affecting hand grip strength. These differences have been evaluated many times in the literature. [11] In our study, we aimed to evaluate the effects of occupations on the wrist grip and forearm flexion-extension values rather than anthropometric differences. For this reason, we evaluated the wrist grip and flexion-extension data, depending on the occupations of healthcare professionals with similar anthropometric characteristics and of the same gender.

In some studies, it has been shown that there is a relationship between the work that individuals deal with and their grip strength values. However, the results of these studies have contrasting results. [12,13] For example, in one of these studies, the wrist grip strength of desk workers was found to be lower than those of heavy-duty occupational groups. [12] Similarly, in our study, the dominant hand grip strengths of intensive care staff that have heavy tasks for forearm flexors such as in-bed movements and bed baths in immobile adult patients were found to be higher than physiotherapists. It is possible to say that the grip strength increases parallel to the hardly of the work. This situation supports the studies that argue that strengthening the forearm flexors by exercising also has a positive effect on grip strength.

In parallel with this, when looking at the literature, there are studies showing that grip strength also increases in direct proportion to the increase in forearm flexor muscle strength. [14-16] There are studies showing that it affects grip strength in sports that cause forearm flexor muscle group constrictions, such as tennis. [17]

There is no common result in the results of the studies investigating the relationship between grip strength and hand preference. For example, Crosby et al. in his work; compared the grip values of the participants' dominant and non-dominant hands and showed that the grip strength of the dominant hand was higher. [18] In our study, the dominant hand preference was right in both groups; on the other hand, grip strength was measured higher in intensive care staff according to the dominant hand preference. Compared to them, the grip strength was higher on the dominant hand side in both professions.

In a study conducted on athletes engaged in similar sports, it was revealed that the isokinetic concentration H/Q ratio was affected depending on the frequency of the muscle group being exercised. [19] Similarly, in our study, it was revealed that intensive care personnel from two groups working in a similar occupational group had a lower non-dominant hand extensor muscle strength compared to physiotherapists.

In many studies on grip strength, gender factor is an important limitation. [20] In order to eliminate this limitation, we conducted our study on the same gender. For this reason, there is no value to be eliminated in our study.

In a study [21] conducted on computer users who did not have any neuromuscular disease in 2014; median and ulnar nerve conduction velocity decreased in the dominant hand due to prolonged mouse use. Similarly in our study; we demonstrated that grip strength decreases with prolonged use of the forearm flexor and extensor group muscles that affect hand grip strength.

Conclusion

In our study, we compared the factors affecting the hand grip strength values of sub divisional healthcare workers.

As a result, in our study, we revealed the effects of hand grip strength and forearm flexor and extensor group muscle epidurans in different occupational groups on grip strength.

The result of our research works; confirms the hypothesis that force generation depends on the laws of physics. [22] The formation of force in a region and the rate of this force also depend on the surrounding structures, the muscle mass that creates the movement and the rate of use. When examining the strength ratio in a region, besides the anthropometric values; all muscle and joint groups that affect the examined cross-sectional area should also is examined.

Muscles that are exercised repetitively with similar movements weaken over time. Unused muscles can atrophy away if you're not active. This situation also damages other structures in the complex wrist area and the hand grip strength is reduced. Considering this situation, profession groups working with repetitive movements; Trainings should be given to exercise the muscles in the hand and hand area equally and intermittent short exercises programs should be included in occupational safety programs.

Competing Interests

The authors report no competing (commercial/academic) interests.

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