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RESEARCH ARTICLE

RELATION BETWEEN NECK PAIN AND HAND FUNCTION IN PATIENTS WITH NON-SPECIFIC NECK PAIN

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ABSTRACT

Background: neck pain is one of the most common musculoskeletal disorders that affect quality of life. According to a lot of studies people which complain of non-specific neck pain reporting upper limb disabilities including hands. **Objective:** the main objective of the study was to find the correlation between non-specific neck pain and hand function. **Methodology:** 60 participants suffered from non-specific neck pain from both gender and 30 normal participants as a control group their ages ranged from 18 to 40 years old and their body mass index less than 30. Pain, Hand grip strength, endurance and pinch grip strength hand function were measured for both groups. **Results:** There was a significant effect of non-specific neck pain on the hand grip strength, endurance and pinch grip strength ($p = 0.03$).There was a negative significant correlation between short form McGill questionnaire and hand grip strength, endurance and pinch grip strength on both hands ($p=0.02, 0.0001$ and 0.0001) respectively. There was a positive significant correlation between brief Michigan hand outcomes questionnaire and hand grip strength and pinch grip strength on both hands ($p=0.0001$, 0.01) respectively. **Conclusion:** There is a correlation between NSNP and hand function. The proportional between hand grip strength, pinch grip strength, hand grip endurance with SF-MPQ was inverse and with brief MHQ was direct.

INTRODUCTION

Neck pain is one of the most commonly reported musculoskeletal disorders. The prevalence for neck pain varies between 16.7% and 75.1% in the general population (Fayez, 2014) and a survey of United Kingdom patients with mechanical neck pain found that 67% presented with associated upper limb symptoms without neurological deficit(Frank et al., 2005).There is a strong relationship between neck pain and upper limb disability(Feleus et al., 2008).Non-specific neck pain has also been shown to have a considerable impact on upper limb function (McLean et al., 2010) (Osborn et al., 2013).The mechanisms which cause neck pain and upper limb disability to coexist are not clear, but may relate to the mechanical attachment between the neck and the upper limb via skeletal, muscular and neural structures as repetitive movement of the upper limb increase the mechanical load to the neck which in turn provoke neck pain or create protective neck muscles spasm(Gorski & Schwartz, 2003) (Salah et al., 2017).

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Hands are used in a variety of situations, for performance of fine-motor skills or heavy work, and for interaction and communication with others (Engstrand, 2016)**.** The measurement of hand grip strength used to detect whole upper arm strength (Massy-westropp et al., 2011). Studies showed the impact of non-specific neck pain on upper limb function but did not specify hand function so, the aim of this study was to correlate between non-specific neck pain and hand function in patients with non-specific neck pain.

Purpose of the study

The primary purpose of the study was to determine the relation between non-specific neck pain and:

- Hand power grip strength in patients with NSNP.
- Hand power grip endurance in patients with NSNP.
- Hand pinch grip strength in patients with NSNP.

The secondary purpose was to detect the correlation between Brief Michigan Hand Outcomes Questionnaire and:

- Hand power grip strength in patients with NSNP.

- Hand power grip endurance in patients with NSNP.
- Hand pinch grip strength in patients with NSNP.

MATERIALS AND METHODES

Studydesign:Correlationdescriptivestudy.

Sample size calculation: Power analysis of the study revealed a sample size of 84 participants at the level of confidence 90%, margin of error 9% and response distribution 50%.

Patients' selection: The study conducted on ninety persons, sixty of them non-specific neck pain subjects and thirty normal individuals. The patients were selected from Outpatient Clinic of Faculty of physical therapy, Cairo University. Each participant signed the physical therapy faculty ethical committee approval.

Study groups

Participants were divided according to SF-MPQ into two groups:

- The study group (GI): 60 subjects with non-specific neck pain (34 male, 26 females).
- The control group (GII): 30 normal subjects (18 males, 12 females).

Inclusion criteria

1. Adults from both genders (18 -40years)(Fayez, 2014).
2. Subjects with body mass index less than 30(Massy-Westropp, Gill, Taylor, Bohannon, & Hill, 2011)(Al-asadi, 2018).

Exclusion criteria

Any participant suffered from one of these symptoms was excluded:

1. Having signs and symptoms of neurological disorders that cause nerve root compression.
2. Headache as a consequence of specific headache diagnosis.
3. Having a history of specific signs of malignancy, infection;
4. Having a history of trauma with or without proven structural disorders in the region of the neck, shoulder and head (e.g. whiplash);
5. Having signs and symptoms of cerebrovascular insufficiency.
6. Having a severe chronic disease of the locomotor system (e.g. polyarthritis, muscular disease (Tsakitzidis et al., 2009).
7. History of either orthopedic or neurologic diseases causing functional defect of the hand strength like: fracture, surgery of upper limb or hand, carpal tunnel syndrome, De Qurvain's syndrome or diabetes mellitus(Fayez, 2014).

Instrumentation

Baseline hydraulic Jamar hand dynamometer: The Jamar (Sammons Preston Incorporated, Bolingbrook, IL, USA) is small and portable with 1.5lb weight. The dial reads force in both kilograms and pounds, with markings at intervals of 2 kg or 5 lb, allowing assessment to the nearest 1 kg or 2.5 lb. It requires 3–4 pounds of force to make the indicator needle move (Oberts et al., 2011).

Figure 1. Jamar hydraulic dynamometer (Sammons Preston Incorporated, Bolingbrook, IL, USA)

The baseline hydraulic Jamar pinch gauge: The gauge (Vington, New York 10533, USA) has a red indicator needle, which remains at the maximum reading until reset and measures pinch force to 22.5 kg/50 lbs. in 0.5 kg increments (Jerosch-herold, 2013).

Figure 2. The baseline hydraulic Jamar pinch gauge (Vington, New York 10533, USA)

Arabic version of the short-form McGill Pain Questionnaire (SF-MPQ): The SF-MPQ consists of 11 sensory (sharp, shooting, etc.) and four affective (sickening, fearful, etc.) verbal descriptors. The patient is asked to rate the intensity of each descriptor on a scale from 0 to 3 (¼severe). Three pain scores are calculated: the sensory, the affective, and the total pain index. Patients also rate their present pain intensity on a 0–5 scale and a VAS. The total score between 0 to 65 , 0…no pain and 65 sever pain (Marco et al., 2008). (Abdrabou et al., 2016) made the validity of Arabic version of SF-MPQ .

Brief Michigan Hand outcomes Questionnaire (MHQ): The brief MHQ contains 12 items that address patient-perceived hand function, activities of daily living, pain, work performance, patient satisfaction, and aesthetics based on a 5-point Likert scale(Waljee, Kim, Burns, & Chung, 2011).

Procedure

- On approval to participate in the study, all subjects signed an informed consent form after receiving full information on the purpose of study, procedure, possible benefits, privacy and use of data, and their rights to withdraw from the study when even they want .All subjects were evaluated using the same procedures.
- Participants who met exclusion criteria were excluded.
- All personal information and measurement was gathered in data collection sheet.

Arabic version of the short-form McGill Pain Questionnaire (SF-MPQ): For measuring neck pain with Arabic form of short form McGill pain questionnaire the patient was asked to rate the intensity of each descriptor on a scale from 0 to 3. Patients also rated their present pain intensity on a 0–5 scale and a VAS. The total score between 0 to 65, 0…no pain and 65 sever pain. The score was calculated and recorded in data sheet.

Baseline hydraulic Jamar hand dynamometer for measuring hand power grip: For grip strength measurement, both hands were tested using the hydraulic Jamar dynamometers. The second handle position was used for all participants. All participants were seated on chair with back support and armrest the shoulder adducted 90° of elbow flexion, and the forearm in a neutral position. Participants naturally extended the wrist to approximately 30° extension during testing. The dynamometers were naturally positioned so participants could not see the readout while being tested, and no feedback given by the tester. The dominant hand was tested first for each participant. Subjects were instructed to squeeze maximally and hold until the contact force output could not be maintained while being timed with a stop watch to ascertain endurance Egwu et al., 2009). Grip strength was read in kilograms from the outside dial and the result recorded to the nearest 1 kg on the data entry form. Measurement was repeated in the non-dominant hand. Two further measurements were done for each hand alternating sides to give three readings in total for each side and the mean was taken.

Figure 3. Measuring hand grip strength while timing to measure hand grip endurance

The baseline hydraulic Jamar pinch gauge for measuring hand pinch grip strength: For measuring pinch strength, the gauge was placed between the thumb pad and the radial side of the middle phalanx of the index finger, while the thumb's IP-joint position was self-selected. Pinch strength was read in pounds from the outside dial and the result was recorded to the nearest 2.5 lb on the data entry form. Measurement was repeated in the non-dominant hand.

Figure 4. Measuring hand pinch grip strength

Brief Michigan Hand outcomes Questionnaire (MHQ) for functional assessment of hand function: For functional assessment of hand function with brief Michigan hand outcomes questionnaire, the therapist illustrated to the participant the purpose of the questionnaire. The therapist read the questions and asked the participants in Arabic form. The therapist should make sure that participants understood the question well. We started with the dominant hand then the non-dominant. The raw score for question (1, 2,3,4,8,9,11 and 12) was reversed in a process called reverse coding. The 12 raw scores were then added to give a maximum score of 60 and a minimum score of 12.The raw score was averaged. After averaging the items, the average score was then normalized to generate a score that is scaled from 0 (poorest function) to 100(ideal function).The score was normalized through this equation:

Normalization = 100 x (brief MHQ raw score – 1)/4.

The score was calculated and recorded in the data sheet.

Statistical Analysis

- Descriptive statistics of mean, standard deviation, frequencies and percentages were utilized in presenting the subjects demographic data.
- Unpaired t test was conducted for comparison of subjects' demographic, between both groups.
- Multivariate Analysis of Variance (MANOVA) was conducted for comparison of hand grip strength and endurance and pinch grip strength between both groups.
- Pearson correlation coefficient was conducted to investigate the correlation between SF-MPQ and MHQ with hand grip strength and endurance and

pinch grip strength. Variables with significant correlation with SF-MPQ and MHQ would be entered in multiple regression models.

- Multiple linear regressions were conducted to produce a formula to predict the values of hand grip strength and pinch grip strength from SF-MPQ and MHQ.
- The level of significance for all statistical tests was set at $p < 0.05$.
- All statistical tests were performed through the statistical package for social studies (SPSS) version 25 for windows. (IBM SPSS, Chicago, IL, USA).

RESULTS

There was a significant effect of non-specific neck pain on the hand grip strength, endurance and pinch grip strength (p = 0.03) on both hands (Figure 1, 2 and 3).

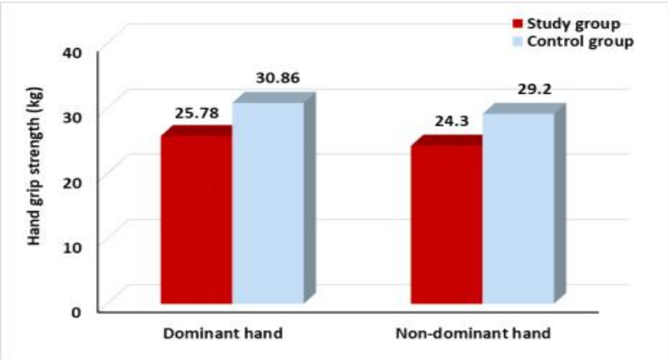

Figure 1. Mean hand grip strength of the study and control groups

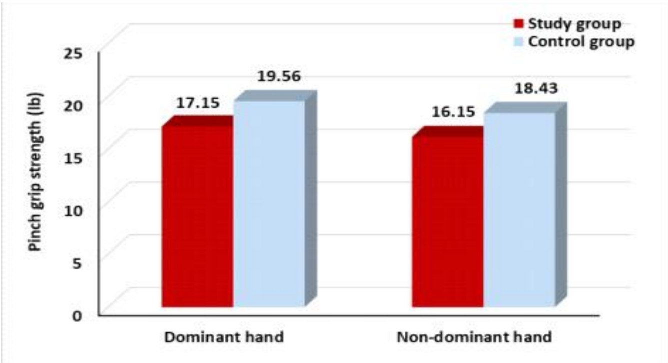

Figure 2. Mean pinch grip strength of the study and control groups

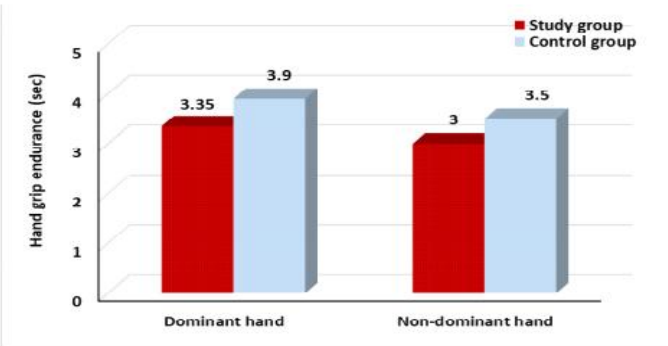

Figure 3. Mean hand grip endurance of the study and control groups

There was a negative significant correlation between SF-MPQ and hand grip strength, endurance and pinch grip strength on both hands (p=0.02, 0.0001and 0.0001) relatively (table 1, 2 and 3).

Table 1. Correlation between SF-MPQ and hand grip strength

	Hand grip strength (kg)	r value	p value	Sig
SF-MPQ	Dominant hand	-0.29	0.02	S
	Non-dominant hand	-0.28	0.02	S

r value: Pearson correlation coefficient p value: Probability value S: Significant

Table 2. Correlation between SF-MPQ and pinch grip strength

	Pinch grip strength (lb)	r value	p value	Sig
SF-MPQ	Dominant hand	-0.49	0.0001	S
	Non-dominant hand	-0.45	0.0001	S

r value: Pearson correlation coefficient
p value: Probability value
S: Significant

Table 3. Correlation between SF-MPQ and hand grip endurance

	Hand grip endurance (sec)	r value	p value	Sig
SF-MPQ	Dominant hand	-0.61	0.0001	S
	Non-dominant hand	-0.63	0.0001	S

r value: Pearson correlation coefficient
p value: Probability value
S: Significant

There was a positive significant correlation between brief MHQ and hand grip strength and pinch grip strength on both hands (p=0.0001, 0.01) relatively (Table 4 and 5).

Table 4. Correlation between MHQ and hand grip strength

	Hand grip strength (kg)	r value	p value	Sig
MHQ	Dominant hand	0.44	0.0001	S
	Non-dominant hand	0.46	0.0001	S

r value: Pearson correlation coefficient
p value: Probability value
S: Significant

Table 5. Correlation between MHQ and pinch grip strength

	Pinch grip strength (lb)	r value	p value	Sig
MHQ	Dominant hand	0.41	0.001	S
	Non-dominant hand	0.43	0.001	S

r value: Pearson correlation coefficient
p value: Probability value
S: Significant

SF-MPQ and MHQ can significantly predict the dominant hand grip strength (p = 0.001) and non-dominant hand grip (p=0.0001). SF-MPQ and MHQ can significantly predict the hand pinch grip strength and hand grip endurance (p=0.0001).

DISCUSSION

This study aim was to investigate the relation between non-specific neck pain and hand function in patients with non-specific neck pain. This study was conducted in the outpatient clinic of Faculty of Physical Therapy, Cairo University at the duration from October 2019 to February 2020. This study aim was to investigate the relation between non-specific neck pain and hand function in patients with non-specific neck pain. Study group contained sixty subjects with non-specific neck pain. Their mean ± SD age was 27.65 ± 6 years. Control group contained thirty normal subjects. Their mean ± SD age was 26.13 ± 5.46 years as age (peaked at 4th decade) (Fayez, 2014). BMI of the study group was 25.18 ± 2.6 kg/m² and in control group was 24.73 ± 2.77 kg/m², it was important that BMI was in normal range as hand grip correlated positively with BMI (Al-asadi, 2018) (Massy-Westropp et al., 2011). The current study revealed that non-specific neck pain has an effect on hand function of both hands as there was a significant difference in hand grip strength, pinch grip strength and hand grip endurance between study group and control group. The study findings also revealed that patients complain from non-specific neck pain reporting hand function problems as we found a negative significant correlation between SF-MPQ and hand grip strength. In addition we found a positive significant correlation between MHQ and hand grip strength in both hands while this did not support conclusions about causality. This present study finding agreed with (Egwu et al., 2009) who found that the grip strength decrease significantly in patients with spondylosis compared with those control group in dominant and non-dominant hand. They clarified that increased tissue pressure arising from degenerative changes compromises myoneural conduction velocity and tissue blood flow and oxygenation .These factors interfere with the ability of the nervous system to activate hand muscles.it also agreed with (Wollesen et al., 2020) who analyze the interaction between neck pain and hand grip strength using Standardized questionnaires [Neck Disability Index, Boston Carpal Tunnel Questionnaire] which were used to evaluate existing neck and/or wrist pain and found that neck disorders influence hand grip strength. They clarified their results as abnormality of sensory, motor and autonomic neurons found in neck pain lead to deficit in the quality of sensory information that generate motor output.

With the same concept in a systematic review (Sousa et al., 2019) found that lower limb muscle strength was significantly lower in patients with non-specific low back pain (LBP) compared with that of healthy controls. In terms of hip strength, there was moderate-quality evidence that patients with LBP have weaker hip abduction/extension strength when compared with that of healthy controls. When considering isokinetic knee strength, there was moderate-quality evidence that patients with LBP have weaker knee extension when compared with that of healthy controls. This present study finding disagreed with (Fayez, 2014) who investigated the correlation between neck pain and hand grip in dentists of Saudi Arabia. This study revealed that there was a significant positive correlation between neck pain and hand grip strength. As increase in intensity of neck pain lead to increase grip strength. (Fayez, 2014) clarified this findings as it may be attributed to abnormality of sensory motor integration found in neck pain lead to deficit in the quality of sensory information that generate motor output. Or, may be due to sensory hyper-excitability. This current study finding disagreed also with (Huysmans et al., 2008) They measured the grip strength in neck pain subjects and control group while carrying a 300g weight connected to (Futek, LSB200) dynamometer which measured forces applied to the object. They found that subjects with neck pain used significantly higher grip forces as compared to subjects without pain. After the initial lift object, all subject groups adapted to the lifting task by lowering their grip force level but grip force levels were still significantly higher in the subjects with pain. They clarified their findings as it may be due to sensory hyper excitability.

The study findings also revealed that patients complain from non-specific neck pain reporting hand function problems as we found a negative significant correlation between SF-MPQ and pinch grip strength of both hands while this did not support conclusions about causality. In addition we found a positive significant correlation between MHQ and pinch grip strength. This present study finding agreed with (Kaushik et al., 2014) who assessed pinch grip strength and neck disability in male hairdressers. Disability was measured by Neck Pain Disability Index and Pinch Strength was measured by pinch gauge. They found that awkward neck posture and repetitive work done by upper extremity exacerbates risk of disability in hairdressers with increase in age and experience addition there is also a decrease in pinch strength on the dominant hand. They clarified this finding was due to pain and cumulative trauma. The study findings also revealed that patients complain from non-specific neck pain reporting hand function problems as we found a negative significant correlation between SF-MPQ and hand grip endurance of both hands while this did not support conclusions about causality. This present study finding agreed with (Egwu et al., 2009) who found that the hand grip endurance decrease significantly in patients with spondylosis compared with those control group in dominant and non-dominant hand. They clarified that increased tissue pressure arising from degenerative changes compromises myoneural conduction velocity and tissue blood flow and oxygenation .These factors interfere with the ability of the nervous system to activate hand muscles. It also agreed with (Viikari-Juntura et al., 1988) who used a repetitive gripping test for the evaluation of neck and shoulder pain and disability.they found that low endurance was related to disability in neck and shoulder.

The current study also agreed with (Mairi, Klaber, Mac, & Gardiner, 2011) who investigated the relationship between neck pain and upper limb disability in patients with non-specific neck pain. This study demonstrated a strong positive pairwise correlation between baseline Northwick Park Neck Pain Questionnaire (NPQ) scores and baseline DASH scores. In addition, linear regression suggested that the severity of upper limb disability was predicted by NPQ score. Higher NPQ scores indicate increasing levels of neck pain and disability. Other studies agreed also with our findings and showed that there was a correlation between non-specific neck pain and upper limb disability (Panhale et al., 2017)(Osborn et al., 2013) (Gandhi, 2017). The mechanism of correlation between non-specific neck pain and hand function is not clear and there are some hypotheses that may explain this mechanism:

Firstly, the hand is mechanically connected to the neck and shoulder girdle via muscular and skeletal structures. Mechanical loading of the upper limbs may result in neck pain as a direct consequence of increasing the mechanical loading to the ligamentous and articular structures of the neck or by making protective muscle spasm (Gorski et al., 2003). This may make patients avoid using their hands.

Secondly, the hands are mechanically attached to the neck via a brachial plexus that extends from the neck to the upper limb. Recent studies claimed that the diffuse painful symptoms in the limbs such as those experienced in non-specific neck pain may result from relatively minor nerve injuries where there is no obvious change of nerve function (Greening & Lynn, 1998). Neurogenic neck pain may cause inflammation and increase in neural mechanosensitivity within and around the connective tissue structure of the cervical nerve roots (Lucas, 2001) (Dilley et al., 2003) (Greening et al., 2005). Upper limb function causes sliding and stretching of neural structures throughout the brachial plexus including the neck (Lucas, 2001) (Dilley et al., 2003). Stretching of inflamed and neural structures at the neck may lead to a neck pain response(Hall & Quintner, 1996) (Lucas, 2001). This may inhibit patients from using upper limbs. Finally, if patients inhibit the functional use of hands as a result of direct mechanical pain response this may cause physical deconditioning that may lead to reduced cardiovascular capacity, endurance and strength of muscles (Smeets et al., 2006). According to these findings we can predict hand grip strength, pinch grip strength and hand grip endurance of both hands from SF-MPQ and MHQ through a regression coefficient equation.

Limitations of the study

Psychosocial status and motivation may influence patients performance (e.g.: anxiety or stress) during assessing their pain. Furthermore, inability to quantify participant sleeping hours, work duration and level of exhaust that can also influence performance of the participants.

Conclusion

Based on the finding of the current study we can conclude that:

- Non-specific neck pain had an effect on hand function.
- There was a negative correlation between SF-MPQ and hand grip strength, pinch grip strength and hand grip endurance.
- There was a positive correlation between MHQ and hand grip strength, pinch grip strength and hand grip endurance.
- Hand grip strength, pinch grip strength and hand grip endurance in NSNP patients could be predicted from SF-MPQ and MHQ through regression coefficient equation as the higher SF-MPQ score indicates lower values in hand grip strength, pinch grip strength and hand grip endurance. On the other hand the higher MHQ score, the higher values in hand grip strength, pinch grip strength and hand grip endurance.

Clinical Implementations: The results of the present study can highlight the following clinical tips:

- Assessing hand function should be considered in patients with non-specific neck pain.
- Hand function exercise could be a part of treatment plan in patient with non-specific neck pain.

Recommendations: The effect of non-specific neck pain on hand function still needs further studies to explain and clarify this relation.

The present study gives rise to some additional research topics as follows:

- Further research was needed with using nerve conduction velocity as an assessment method to objectively exclude any case with radiculopathy.
- Further research was needed using the isokinetic device instead of jamar hand grip dynamometer and jamar pinch gauge to support our findings with another objective assessment tool.
- Studying the effect of postural correction exercise and stabilization training of cervical region on improving hand function in NSNP patients.

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