Is psychological distress associated with carpal tunnel syndrome symptoms and nerve conduction study findings? A case–control study from Syria

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Abstract

Background: Carpal tunnel syndrome (CTS) is a common entrapment neuropathy of the median nerve at the wrist which causes severe symptoms. However, psychological aspects can affect patients' perception of this pain and can cause similar pain in some instances. This study aims to determine the association between symptoms severity, functional status, and nerve conduction studies (NCS) of adult patients with CTS and their anger, anxiety, and depression status.

Methods: This case–control study was conducted in clinics in Damascus, Syria. Controls were frequency matched by gender and age from a general clinic. Interviews based on questionnaires were used that included the Boston Carpal Tunnel Questionnaire (BCTQ-A), Hospital Anxiety and Depression Scale (HADS), Dimensions of Anger Reactions Scale-5 (DAR-5), and NCS.

Results: Overall, 242 patients (121 cases) were included in this study. Cases with CTS had significantly higher anxiety and depression when compared to controls, but not higher anger. Cases with higher anxiety, depression, and anger had significantly more CTS symptoms and less functional status. Anxiety was also higher in cases with normal NCS in the case group. When using regression, anxiety and depression remained significantly associated with having CTS.

Conclusion: Anxiety and depression are more prominent with CTS. Furthermore, having anxiety and depression were associated with more CTS symptoms in the hand. Having anger was also associated with more CTS symptoms among cases. These findings emphasize the importance of psychological aspects when having hand pain or CTS symptoms as these patients might have these symptoms despite having normal NCS.

KEYWORDS
anger, carpal tunnel syndrome, functional disability, nerve conduction studies, psychological status, symptom severity
INTRODUCTION

Carpal tunnel syndrome (CTS) is a common entrapment neuropathy of the median nerve at the wrist (Demino & Fowler, 2021). Much as the name implies, the median nerve is compressed when entering the carpal tunnel as it travels beneath the transverse carpal ligament (Bhatt et al., 2015). Though the underlying cause of the compression can be idiopathic, it can be attributable to a number of different factors such as malpositioning of the wrist, any condition that leads to an excess fluid within the body that leads to an increased volume in the tunnel, and masses that could occupy the volume of the tunnel (Genova et al., 2020).

The nerve damage from the compression produces sensory symptoms, such as numbness, tingling, and pain within the hand. As the disease progresses, soft tissue injury occurs, and disabling motor symptoms such as reduction of grip strength become apparent. This impairment may progress into thenar atrophy in advanced cases (Bhatt et al., 2015; Genova et al., 2020; McCallum et al., 2019).

These symptoms mostly aggravate at night and have a huge negative impact on the ability to work and perform daily activities leading to increased morbidity and inability to attend work (Demino & Fowler, 2021; Genova et al., 2020; McCallum et al., 2019). They can also affect patients’ quality of life and cause a deteriorating in mental health (Jerosch-Herold et al., 2017; McCallum et al., 2019). Moreover, psychological distress itself can intensify symptom perception, or even produce subjective symptoms resembling CTS (McCallum et al., 2019; Papadopoulou et al., 2021). The prevalence of anxiety and depression in CTS patients is 28.7% and 37.6%, respectively, which is higher than the general population (Filho et al., 2020; McCallum et al., 2019). In addition, the prevalence of CTS is higher among women, usually after their sixth decade of age (Basiri & Katirji, 2015). It is speculated that decreased estrogen antinociceptive effect caused by the decreased estrogen concentrations is the reason behind the increased likeliness of anxiety and depression in women (Filho et al., 2020).

Since psychological distress affects CTS symptoms, diagnosis workup and treatment program, it is important to assess the presence of an association between them as it could affect patients’ outcomes. The more symptomatic the patients are, the higher they scored in anxiety and depression scales even before having a confirmed CTS by electric studies (McCallum et al., 2019). There is still considerable controversy surrounding the association between psychological status and nerve conduction studies (NCS) (Papadopoulou et al., 2021). To our knowledge, there is a lack of studies discussing anger’s effect on CTS symptoms and NCS. However, some studies included the association with anxiety and other psychological aspects. The aim of this study is to broaden current knowledge of the association between psychological status such as anger and anxiety and the severity of CTS symptoms along with NCS. This is the first study to include anger in CTS psychological factors’ assessment.

It is noteworthy to mention that we undertook this study in Syria that has been in war for ten years. Therefore, by taking into account the effects of war environment on mental health, our study provides special insights on CTS in war time. As high prevalence of mental health disorders was found in Syria, particularly during war and COVID-19 (Levine et al., 1993), we speculated that they both might have indirectly led to an increase of CTS symptoms as well. This is a case–control study that aims to determine the association between symptoms severity, functional status, and NCS of adult patients with CTS and their anger, anxiety, and depression status. This is the first study to explore into CTS in Syria and its association with mental health during the war and COVID-19.

METHODS

2.1 Study design

This case–control study was conducted at a neurophysiology outpatient clinic and general outpatient clinics at Al-Assad teaching hospital in Damascus, Syria. This study was conducted from December 2020 to June 2021. Interviews based on questionnaires were used to collect data after applying the inclusion and exclusion criteria for both, the cases or the controls. The interviewers were trained to facilitate data collection and explain any vague information in the questionnaires to overcome any educational or cultural barrier that might have prevented proper understanding.

2.2 Study population

Cases were at least 18 years old, able to give informed consent, and were diagnosed with CTS by a combination of clinical features, physical examination, and NCS findings. We excluded cases that had either a neuropathy other than CTS, such as ulnar neuropathy, or previous CTS surgery during the last year. Cases were frequency matched with a control group by gender and age (not more than ten years range). Controls were selected from the general outpatient clinics at Al-Assad University Hospital provided that they had no history of previous or current nerve entrapments and did not need neurology symptoms or referrals. We excluded any case or control who had conditions causing chronic pain other than the pain from CTS in the case group.

2.3 Questionnaires

Questionnaires included demographics such as gender, age, educational level, work, marital status, number of children, along with handedness and shisha or cigarette smoking.

The evaluation of patients with suggestive CTS symptoms was made through taking a detailed history of their condition, performing a clinical examination, which includes Phalen and Tinel tests, and finally confirming the diagnosis by conducting NCS.

CTS symptoms severity was assessed by asking cases to complete the Arabic version of Boston Carpal Tunnel Questionnaire (BCTQ-A).
Boston Carpal Tunnel Questionnaire (BCTQ) is a self-report questionnaire that records symptom severity and functional status in CTS patients (Levine et al., 1993). It represents CTS severity in the last two weeks and consists of two scales; the first one is the symptom severity scale (SSS) that has 11 items that cover six domains include: pain, numbness, nocturnal symptoms, paraesthesia, weakness, and functional status. Its score ranges from 1 to 5, which is the most severe. The second one is the functional status scale (FSS) that has 8 functional activities that are commonly affected by CTS (difficulty in writing, buttoning clothes, opening jars, holding a book, gripping a telephone handle, performing household chores, carrying grocery bags, bathing, and dressing). The scores also range from 1 to 5 that represent not being able to perform the activity at all (Alanazy et al., 2019). Since many patients were illiterate, we had to change the question asking about difficulties of writing or holding a book while reading to difficulties of using cutlery during their meals or holding their plate while eating, respectively.

The Hospital Anxiety and Depression Scale (HADS) was also used which is a brief, clinically meaningful scale that screens for the levels of anxiety and depression in clinics. The limitation of this version is that it does not have somatic symptoms of depression to reduce the effect of the current medical condition(s) on the scores. It consists of two subscales and scores can predict the psychosocial and physical outcomes. HADS has 14 items as anxiety and depression have seven items each. Each item is scored on a four-point scale ranging from 0 to 3 and the maximum score for each subscale is 21. Scores that range from 0 to 7 are considered normal while 8–10 are considered borderline, and 11–20 are considered as anxiety or depression cases (Terkawi et al., 2017; Zigmond & Snith, 1983).

Dimensions of Anger Reactions Scale-5 (DAR-5) is used to assess problematic anger. It is a mini screening measure of anger reactions for the past four weeks. It assesses the frequency, intensity, and duration of anger, antagonism toward others, and social relations interference. Scores of each item range from 1 (None or almost none of the time) to 5 (All or almost all of the time). Total scores above 12 are considered problematic anger (Forbes et al., 2014; Kakaje et al., 2021).

NCS: Median distal motor latency (DML) and median sensory NCS (between the wrist and digit, between the wrist and palm) are of the best NCS tests to evaluate CTS according to a literature review of the American Association of Neuromuscular and Electrodiagnostic Medicine (AANEM) (Basiri & Katirji, 2015). Of these tests, DML and distal sensory latency (DSL) are the most popular ones, so that we used them along with other tests such as sensory nerve conduction velocity (NCV) and amplitude in order to increase the sensitivity and specificity of our tests. The sensory conduction study was performed by placing an active electrode on the index at a distance of 13–14 cm from a stimulator in the middle of the wrist. We also stimulated the median nerve at the palm. The motor conduction study was done by placing an active electrode on the belly of the abductor pollicis brevis (APB) muscle. We stimulated the median nerve at the wrist at a distance of 4-6 cm from the active electrode.

Neurophysiological grading of CTS was done based on the study of Bland (2000) and Jerosch-Herold et al. (2017):

- Grade 0: normal (absence of abnormal neurophysiological findings)
- Grade 1: very mild (NCV from index to wrist < 50 m/s and ≥ 40 m/s, DML from wrist to abductor pollicis brevis [APB] > 4.0 ms)
- Grade 2: mild (NCV from index to wrist < 40 m/s, DML [APB] < 4.5 ms)
- Grade 3: moderate (DML [APB] > 4.5 ms and < 6.5 ms with normal index finger sensory nerve action potential [SNAP])
- Grade 4: severe (DML [APB] > 4.5 ms and < 6.5 ms with absent index [SNAP])
- Grade 5: very severe (DML [APB] > 6.5 ms)
- Grade 6: extremely severe (motor nerve action potential [MNAP] [APB] < 0.2 mV)

2.4 Definitions

The classification of clinical symptoms such as numbness, tingling, or pain depended on the location where the patient experiences these symptoms. It comprised 4 categories: classic, probable, possible, and unlikely, which represent the following patterns of symptoms: two of three fingers (thumb, index, and long) without the involvement of the palm or hand dorsum, two of three fingers (thumb, index, and long) and the palm but no confinement to the ulnar side, one of three fingers (thumb, index, and long), and none of three fingers, respectively (Basiri & Katirji, 2015; Radwan et al., 2018).

Tinel’s test result is considered positive if patients display CTS symptoms while the examiner is percussing the median nerve over the carpal tunnel (Basiri & Katirji, 2015; Genova et al., 2020). In comparison, the result of Phalen’s maneuver, by which patients flex the wrist vertically, is described as positive if the patient experiences symptoms in the distribution of the median nerve (Basiri & Katirji, 2015; Genova et al., 2020).

Education was categorized according to their years to: illiterate, which means he did not finish year 6 at school or has not entered school altogether, elementary if he finished year 6, primary if he finished year 9, and secondary if he finished year 12.

2.5 Statistical analysis

Statistical analysis was performed using the Statistical Package for Social Science (SPSS 25). Descriptive statistics were stated as the mean and standard deviation, frequency and percentage. Chi-square test (or Fisher’s exact test) were performed for comparing categorical data and Student’s t-test or one-way analysis of variance (ANOVA) were used for continuous variables as appropriate. Pearson's correlations were used to evaluate relationships between variables. A p-value of less than .05 was considered significant. Linear forward regression was also used for multivariable analysis of numeric variables (the scores) on significant factors.
伦理

研究得到了达马斯库斯大学医学院当地伦理委员会的批准。

结果

共242名患者参与了这项研究，121名病例和121名对照。每组各有96名女性和25名男性。两组的平均年龄为43.95 ± 13.38岁（病例组）和43.12 ± 13.19岁（对照组）。两组在平均年龄上的差异不大，因为按性别和年龄匹配了组间频率。大多数患者在两组中都是右手（93.4%在病例组，86%在对照组）。教育水平的主导水平是小学（26.4%在病例组）和大学教育（32.2%在对照组）。家庭主妇在CTS患者中占61.2%（与对照组的41.3%相比）。表1中列出了人口统计变量。

症状模式百分比，如描述的CTS患者：经典（18.2%），可能存在（65.3%），可能存在（6.6%），和不太可能（9.9%）。根据BCTQ-A SSS的结果，患者被分类为无症状（1.7%），轻度（41.3%），中度（34.7%），重度（20.7%），和非常重度（1.7%）。数据也根据BCTQ-A功能状态量表分类为无症状（13.2%），轻度（33.9%），中度（31.1%），重度（15.7%），和非常重度（4.1%）。最后，57（47.1%）的CTS患者具有阳性Tinel征，45（37.2%）具有阳性Phalen征。

在病例组中，未发现左右手在电生理检查上的差异，除了感觉中神经的幅度外。值得注意的是，两手中性结果的百分比为31.4%。表2

在两组中，焦虑和抑郁得分存在显著差异。然而，愤怒的得分为显著差异。两个组的DAR-5得分为12以上。焦虑和抑郁得分为正常或轻度的百分比在对照组中更高（焦虑74.4%，抑郁83.4%）。焦虑和抑郁的严重得分为病例组中更常见（HADS）。心理因素及其与CTS的关联在表3中总结。

正常电生理检查的患者有最高的焦虑平均值。进行单因素ANOVA时，组间差异仅在左手有统计学显著性。然而，该差异仅存在于正常和中等组之后使用后向检验（表4）。

在焦虑和抑郁得分的电生理检查中，左、右手的NCS之间存在显著的负相关性，而抑郁得分的电生理检查中无显著相关性（表5）。电生理检查、HADS、DAR-5、NCV和DML之间的相关性在表6中列出。

当使用向前线性回归来预测焦虑得分时，教育程度和工作状况，对照组在控制焦虑得分方面作为分类变量使用。表1

| 分类 | 案例（121） | 对照（121） | p值 |
|------|-----------|-----------|-----|
| 年龄，岁 | 43.95 ± 13.38 | 43.12 ± 13.19 | .629* |
| 性别 | | | |
| 女性（%） | 96 (79.3) | 96 (79.3) | | |
| 男性（%） | 25 (20.7) | 25 (20.7) | | |
| 主导手 | | | |
| 右手（%） | 113 (93.4) | 104 (86) | .057** |
| 左手（%） | 8 (6.6) | 17 (14) | | |
| 教育 | | | |
| 未受教育（%） | 25 (20.7) | 5 (4.1) | <.001** |
| 小学（%） | 32 (26.4) | 25 (20.7) | | |
| 初中（%） | 24 (19.8) | 31 (25.6) | | |
| 高中（%） | 20 (16.5) | 17 (14) | | |
| 大学（%） | 20 (16.5) | 39 (32.2) | | |
| 硕士和博士（%） | 0 (0) | 4 (3.3) | | |
| 工作 | | | |
| 无业（%） | 11 (9.1) | 14 (11.6) | .004** |
| 家庭主妇（%） | 74 (61.2) | 50 (41.3) | | |
| 农民（%） | 5 (4.1) | 1 (0.8) | | |
| 教师（%） | 4 (3.3) | 10 (8.3) | | |
| 员工（%） | 14 (11.6) | 20 (16.5) | | |
| 家庭主管家（%） | 1 (0.8) | 0 (0) | | |
| 手术和油漆工（%） | 1 (0.8) | 9 (7.4) | | |
| 卫生保健（%） | 4 (3.3) | 3 (2.5) | | |
| 店主（%） | 1 (0.8) | 7 (5.8) | | |
| 员工（%） | 4 (3.3) | 6 (5) | | |
| 司机（%） | 2 (1.7) | 1 (0.8) | | |
| 婚姻状况 | | | |
| 单身（%） | 14 (11.6) | 25 (20.7) | .211** |
| 已婚（%） | 104 (86) | 92 (76) | | |
| 离婚（%） | 2 (1.7) | 2 (1.7) | | |
| 离婚（%） | 1 (0.8) | 2 (1.7) | | |
| 子女人数 | | | |
| 平均 ± SD | 4.32 ± 3.1 | 2.88 ± 2.68 | <.001* |
| 吸烟 | | | |
| 是（%） | 28 (23.1) | 27 (22.3) | .878* |
| 否（%） | 93 (76.9) | 94 (77.7) | | |
| 钩吻 | | | |
| 是（%） | 14 (11.6) | 18 (14.9) | .448** |
| 否（%） | 107 (88.4) | 103 (85.1) | | |

*Student's t-test. **Chi-square test (or Fisher’s exact test).
TABLE 2  Comparison of nerve conduction studies between right and left hands

|                          | Left       | Right      | p-Value |
|--------------------------|------------|------------|---------|
| Distal sensory latency   | 3.2 ± 0.58 | 3.3 ± 0.70 | .400*   |
| Sensory nerve amplitude  | 40.35 ± 21.52 | 34.84 ± 2.70 | .049*   |
| Sensory nerve conduction velocity | 44 ± 6.56 | 43 ± 7.13 | .267*   |
| Distal motor latency     | 3.92 ± 0.95 | 4.0 ± 0.94 | .580*   |
| Motor nerve amplitude    | 11.22 ± 4  | 11.29 ± 6  | .924*   |

**Abbreviations:** DAR-5, Dimensions of Anger Reactions Scale-5; HADS, Hospital Anxiety and Depression Scale.

<sup>*</sup>Student’s t-test.

<sup>**</sup>Chi-square test (or Fisher’s exact test).

TABLE 3  Comparison of psychological factors between cases and controls

|                          | Cases       | Controls    | p-value |
|--------------------------|------------|------------|---------|
| HADS-anxiety             | 10.12 ± 5.22 | 7.55 ± 4.77 | <.001*   |
| HADS-depression          | 9.59 ± 5.25 | 6.95 ± 3.78 | <.001*   |
| DAR-5 anger              | 13.97 ± 5.56 | 12.76 ± 4.53 | .065*   |
| HADS-anxiety grading     | Normal (%)  | 46 (38)    | 68 (56.2) | .010** |
|                          | Mild (%)    | 20 (16.5)  | 22 (18.2) |   |
|                          | Moderate (%)| 27 (22.3)  | 17 (14)   |   |
|                          | Severe (%)  | 28 (23.1)  | 14 (11.6) |   |
| HADS-depression grading  | Normal (%)  | 43 (35.5)  | 69 (57)   | <.001** |
|                          | Mild (%)    | 27 (22.3)  | 32 (26.4) |   |
|                          | Moderate (%)| 25 (20.7)  | 16 (13.2) |   |
|                          | Severe (%)  | 26 (21.5)  | 4 (3.3)   |   |

<sup>Abbreviations:** DAR-5, Dimensions of Anger Reactions Scale-5; HADS, Hospital Anxiety and Depression Scale.
<sup>*Independent t-test was used.
<sup>**Chi-square test was used.

TABLE 4  Factors associated with the result of nerve conduction study

|                          | Anxiety       | Depression     |
|--------------------------|---------------|----------------|
| Mean left hand EDX grading ± SD | 13.47 ± 4.50 | 11.89 ± 5.12 |
| Very mild                | 9.97 ± 5.49   | 9.80 ± 5.0     |
| Mild                     | 9.60 ± 4.30   | 8.20 ± 5.15    |
| Moderate                 | 8.53 ± 4.47   | 8.40 ± 6.03    |
| Very severe              | 7 ± 1.41      | 6 ± 7.07       |
| p-value                  | .039*         | .193*          |

Mean right hand EDX grading ± SD

|                          | Anxiety       | Depression     |
|--------------------------|---------------|----------------|
| Normal                   | 12.16 ± 4.40  | 10.42 ± 5.54   |
| Very mild                | 10.10 ± 5.53  | 9.61 ± 4.94    |
| Mild                     | 9.86 ± 5.25   | 11.07 ± 5.39   |
| Moderate                 | 8.61 ± 4.03   | 6.56 ± 3.91    |
| Very severe              | 7 ± 0.82      | 11.25 ± 7.41   |
| p-value                  | .186*         | .078*          |

<sup>Abbreviations:** EDX: electrodiagnostic; HADS, Hospital Anxiety and Depression Scale.
<sup>*One-way ANOVA test.

TABLE 5  Correlations between psychological factors and EDX findings

| Variables                  | r (Spearman correlation) |
|----------------------------|--------------------------|
| HADS-anxiety vs. left EDX  | −.277                    |
| HADS-anxiety vs. right EDX | −.240                    |
| HADS-depression vs. left EDX | −.152                  |
| HADS-depression vs. right EDX | −.084               |

<sup>Abbreviations:** EDX, electrodiagnostic; HADS, Hospital Anxiety and Depression Scale.

significant with p < .001 and R² of 6.2% and work with p = .004 and R² of 9.4%. When using the same methods to regress depression score, case–control was significant with p < .001 and R² of 7.8%, work with p = .004 and R² of 10.9%, and education with p = .022 and R² of 12.9%. However, when using the same method to regress anger, only work was significant with p = .025 and R² of 1.7%.

4 | DISCUSSION

This study found a strong association between CTS symptoms severity along with functional status and anxiety, depression, and anger. In regard to anger, this study surprisingly revealed that both cases and controls have problematic anger, and no significant difference between them was found. Furthermore, there was no correlation between anger and NCS. However, regarding anxiety and depression, controls have more normal and milder anxiety and depression when compared to cases of CTS who had more severe anxiety and depression. Anxiety was correlated with milder NCS as it had an inverse correlation with
TABLE 6 Correlations between psychological factors, BCTQ questionnaire, and nerve conduction study

| Variables                      | r (Pearson correlation) | p-Value |
|--------------------------------|-------------------------|---------|
| BCTQ SSS vs. HADS-anxiety      | 0.295                   | .001    |
| BCTQ SSS vs. HADS-depression   | 0.287                   | .001    |
| BCTQ SSS vs. DAR-5 anger       | 0.284                   | .002    |
| BCTQ FSS vs. HADS-anxiety      | 0.297                   | .001    |
| BCTQ FSS vs. HADS-depression   | 0.293                   | .001    |
| BCTQ FSS vs. DAR-5 anger       | 0.181                   | .047    |
| HADS-anxiety vs. left sensory NCV | 0.246               | .008    |
| HADS-anxiety vs. left DML      | -0.186                  | .044    |
| HADS-depression vs. left sensory NCV | 0.192              | .038    |
| HADS-depression vs. left DML   | -0.171                  | .066    |
| DAR-5 anger vs. left sensory NCV | 0.150                 | .107    |
| DAR-5 anger vs. left DML       | -0.083                  | .373    |
| HADS-anxiety vs. right sensory NCV | 0.183                | .052    |
| HADS-anxiety vs. right DML     | -0.206                  | .029    |
| HADS-depression vs. right sensory NCV | 0.071               | .455    |
| HADS-depression vs. right DML  | -0.102                  | .284    |
| DAR-5 anger vs. right sensory NCV | 0.121                | .201    |
| DAR-5 anger vs. right DML      | -0.107                  | .258    |

Nerve conductive study was conducted in only case group. Significant values were in bold font.

Abbreviations: BCTQ FSS, Boston Carpal Tunnel Questionnaire Function Status Scale; BCTQ SSS, Boston Carpal Tunnel Questionnaire symptom Severity Scale; DAR-5, dimensions of anger reaction 5; DML, distal motor latency; HADS, Hospital Anxiety and Depression Scale; NCV, nerve conduction velocity.

DML in both hands and a positive correlation with sensory NCV in the left hand only. On the other hand, depression had a weak correlation with NCS as it does not relate to DML, and its positive correlation with sensory NCV was only significant to left hands.

This study confirms previous findings (Beleckas et al., 2018; Filho et al., 2020; Moghadam-Ahmadi et al., 2017) that anxiety and depression were more prevalent in CTS patients, but this finding should be interpreted with caution as these studies used different tools other than HADS to either calculate or estimate the percentage of patients with CTS. To the best of our knowledge, there are no studies in the literature that explore the association of self-reported anger with symptom severity and functional status in patients with CTS. Our study reveals that both case and control groups have problematic anger, which may be attributable to the traumatic war environment in Syria (Kakaje et al., 2021). There were significant positive correlations between anger and both symptom severity and functional status in our study. In general, the association between pain and anger was highly reported in previous studies. Anger exacerbates pain intensity in both, chronic and acute conditions (Estlander et al., 2008; Greenwood et al., 2003), and vice versa was true as a systematic review stated that patients experiencing chronic pain reported higher degrees of anger in comparison to controls (Somer et al., 2019). This supports our findings where anger was highly associated with NCS in both hands and pain intensity scores in all case groups.

The inverse association between anxiety and EDX findings for both right and left hands in terms of general grading. This correlation demonstrates the association between the high grade of anxiety and the low grade of EDX.

Although it is believed that having more severe symptoms is associated with a greater underlying pathophysiology, this is mostly not true with pain (Nunez et al., 2010) since many studies demonstrate that psychological distress act synergistically on pathophysiology at a personal level, and there is a positive correlation between this distress and CTS, as well (Mansfield et al., 2018). Since association does not mean causation, the limitation of our study is that it does not investigate whether CTS causes psychological distress or vice versa is true.

There was an inverse association between anxiety and EDX findings for both right and left hands in terms of general grading. This correlation demonstrates the association between the high grade of anxiety and the low grade of EDX.

The inverse association between anxiety and DML indicates that anxiety is more associated with normal to mild electrodiagnostic CTS grades than moderate to severe grades. The positive correlation between anxiety and sensory NCV in the left hand also supports the mentioned association. This is consistent with other case-control study’s results that found patients with only CTS symptoms without electrodiagnostic (EDX) conformation had the highest mean of HADS anxiety score. However, this study reported that patients with normal EDX have also the highest HADS depression score in contrast to our study, in which depression was not significantly correlated with NCS in case positive anxiety and depression were found (Khan et al., 2017; Papadopoulou et al., 2021).

Psychological factors were related to clinical scales but not EDX results in other research studies (Khan et al., 2017; Papadopoulou et al., 2021). The specific correlation between anxiety and the left hand may shed light on the psychometric origin of these symptoms. While CTS is known to be most prominent in the dominant hand, this phenomenon may be explained by the idea that symptoms in the left hand may be due to the anxiety itself rather than median nerve injury.

Psychological support should be offered for CTS patients with mild NCS in case positive anxiety and depression were found (Khan et al., 2017).

Research on anger’s relationship with CTS lags far behind studying that of anxiety and depression with CTS. To the best of our knowledge, there are no studies in the literature that explore the association of self-reported anger with symptom severity and functional status in patients with CTS. Our study reveals that both case and control groups have problematic anger, which may be attributable to the traumatic war environment in Syria (Kakaje et al., 2021). There were significant positive correlations between anger and both symptom severity and functional status in our study. In general, the association between pain and anger was highly reported in previous studies. Anger exacerbates pain intensity in both, chronic and acute conditions (Estlander et al., 2008; Greenwood et al., 2003), and vice versa was true as a systematic review stated that patients experiencing chronic pain reported higher degrees of anger in comparison to controls (Somer et al., 2019). This supports our findings where anger was highly associated with NCS in both hands and pain intensity scores in all case groups.

et al. (2018) who states that only CTS symptoms severity is associated with depression and anxiety. Shin et al. (2018) also interestingly reports that depression lessened following the improvement of CTS symptoms. Our study disagrees with Moghadam-Ahmadi et al.’s (2017) and Papadopoulou et al.’s (2021) study findings disproving the association, too.

This study confirms previous findings (Beleckas et al., 2018; Filho et al., 2020; Moghadam-Ahmadi et al., 2017) that anxiety and depression were more prevalent in CTS patients, but this finding should be interpreted with caution as these studies used different tools other than HADS to either calculate or estimate the percentage of patients with CTS. To the best of our knowledge, there are no studies in the literature that explore the association of self-reported anger with symptom severity and functional status in patients with CTS. Our study reveals that both case and control groups have problematic anger, which may be attributable to the traumatic war environment in Syria (Kakaje et al., 2021). There were significant positive correlations between anger and both symptom severity and functional status in our study. In general, the association between pain and anger was highly reported in previous studies. Anger exacerbates pain intensity in both, chronic and acute conditions (Estlander et al., 2008; Greenwood et al., 2003), and vice versa was true as a systematic review stated that patients experiencing chronic pain reported higher degrees of anger in comparison to controls (Somer et al., 2019). This suggests that CTS patients often experience both physical and psychological distress, which may interact synergistically at a personal level.

Although it is believed that having more severe symptoms is associated with a greater underlying pathophysiology, this is mostly not true with pain (Nunez et al., 2010) since many studies demonstrate that psychological distress act synergistically on pathophysiology at a personal level, and there is a positive correlation between this distress and CTS, as well (Mansfield et al., 2018). Since association does not mean causation, the limitation of our study is that it does not investigate whether CTS causes psychological distress or vice versa is true.

There was an inverse association between anxiety and EDX findings for both right and left hands in terms of general grading. This correlation demonstrates the association between the high grade of anxiety and the low grade of EDX.

The inverse association between anxiety and DML indicates that anxiety is more associated with normal to mild electrodiagnostic CTS grades than moderate to severe grades. The positive correlation between anxiety and sensory NCV in the left hand also supports the mentioned association. This is consistent with other case-control study’s results that found patients with only CTS symptoms without electrodiagnostic (EDX) conformation had the highest mean of HADS anxiety score. However, this study reported that patients with normal EDX have also the highest HADS depression score in contrast to our study, in which depression was not significantly correlated with NCS in case positive anxiety and depression were found (Khan et al., 2017; Papadopoulou et al., 2021).

Psychological factors were related to clinical scales but not EDX results in other research studies (Khan et al., 2017; Papadopoulou et al., 2021). The specific correlation between anxiety and the left hand may shed light on the psychometric origin of these symptoms. While CTS is known to be most prominent in the dominant hand, this phenomenon may be explained by the idea that symptoms in the left hand may be due to the anxiety itself rather than median nerve injury.

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study provides new insight into anger as its association with CTS is never studied before. Our study did not come with any limitations. The questionnaires of assessing psychological status cannot substitute clinical diagnosis by medical professionals. Having other factors such as work and education could also affect the results. Finally, a larger sample size could also help determine the differences between the groups, which was not feasible in our study.

In conclusion, this is the first study in Syria about CTS and its association with mental health. There was a strong association between psychological aspects of anger, anxiety, and depression and symptoms severity and functional status of CTS patients. Having CTS symptoms with normal NCS was associated with higher anxiety and depression score. These findings may suggest that being in the war with major distress such as COVID-19 might indirectly increase CTS symptoms. These findings emphasize the importance of psychological aspects when having hand pain or CTS symptoms. Further studies are needed to evaluate the association between anger and CTS symptoms.

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CONFLICT OF INTEREST
The authors declare no conflict of interest.

AUTHOR CONTRIBUTION
Aya Alsharif: Conceptualization; data curation; formal analysis; investigation; methodology; project administration; resources; software; validation; original draft; writing – review and editing. Aya Al Habbal: Conceptualization; data curation; formal analysis; investigation; methodology; project administration; resources; software; validation; original draft; writing – review and editing. Yaman Daaboul: Software; resources; conceptualization; project administration; supervision; validation. Lama Al Hawat: Software; investigation; project administration. Osama Al Habbal: Software; investigation; project administration. Ameer Kakaje: Conceptualization; formal analysis; methodology; project administration; supervision; resources; validation; original draft; writing – review and editing.

DATA AVAILABILITY STATEMENT
Data will be made available upon reasonable request.

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REFERENCES
Alanazy, M. H., Alaboudi, M., Almaari, A., Alhumayyid, Z., Albulaihe, H., & Muaqil, T. (2019). Translation and validation of the Arabic version of the Boston carpal tunnel syndrome questionnaire. Neurosciences (Riyadh, Saudi Arabia), 24(4), 296–301.
Basiri, K., & Katriji, B. (2015). Practical approach to electrodiagnosis of the carpal tunnel syndrome: A review. Advanced Biomedical Research, 4, 50. https://doi.org/10.4103/2277-9175.151552
Beleckas, C. M., Wright, M., Prather, H., Chamberlain, A., Guattary, J., & Calfee, R. P. (2018). Relative prevalence of anxiety and depression in patients with upper extremity conditions. The Journal of Hand Surgery, 43(6), 571, e1–e8. https://doi.org/10.1016/j.jhsa.2017.12.006
Bhatt, N., Sheth, M., & Vyas, N. (2015). Relationship of electrodiagnostic findings with severity of symptoms and function in subjects with carpal tunnel syndrome. International Journal of Therapies and Rehabilitation Research, 4, 18. https://doi.org/10.5455/ijtr.00000053
Bland, J. D. P. (2000). A neurophysiological grading scale for carpal tunnel syndrome. Muscle & Nerve, 23(8), 1280–1283.
Demino, C., & Fowler, J. R. (2021). The sensitivity and specificity of nerve conduction studies for diagnosis of carpal tunnel syndrome: A systematic review. Hand, 16(2), 174–178. https://doi.org/10.1177/1558944719855442
Estlander, A. M., Knaster, P., Karlsson, H., Kaprio, J., & Kalso, E. (2008). Pain intensity influences the relationship between anger management style and depression. Pain, 140(2), 387–392. https://doi.org/10.1016/j.pain.2008.09.015
Filho, H. R., Pedroso, F. L. C., Bueno, F. B., Paiva, V. G. N., Oliveira, E. F., & Rocha, M. A. (2020). Prevalence of anxiety and depression symptoms in people with carpal tunnel syndrome. Revista Brasileira de Ortopedia, 55(4), 438–444.
Forbes, D., Alkemade, N., Mitchell, D., Elhai, J. D., McHugh, T., Bates, G., Novaco, R. W., Bryant, R., & Lewis, V. (2014). Utility of the Dimensions of Anger Reactions-5 (DAR-5) scale as a brief anger measure. Depression and Anxiety, 31(2), 166–173. https://doi.org/10.1002/dan.22148
Genova, A., Dix, O., Saefan, A., Thakur, M., & Hassan, A. (2020). Carpal tunnel syndrome: A review of literature. Cureus, 12(3), e7333.
Greenwood, K. A., Thurston, R., Rumble, M., Waters, S. J., & Keefe, F. J. (2003). Anger and persistent pain: Current status and future directions. Pain, 103(1-2), 1–5. https://doi.org/10.1016/S0304-3959(03)00132-5
Jerosch-Herold, C., Houghton, J., Blake, J., Shaikh, A., Wilson, E. C. F., & Shepstone, L. (2017). Association of psychological distress, quality of life and costs with carpal tunnel syndrome severity: A cross-sectional analysis of the PALMS cohort. BMJ Open, 7(11), e017732. https://doi.org/10.1136/bmjopen-2017-017732
Kakaje, A., Alsamara, K., & Forbes, D. (2021). Assessment of problematic anger using an Arabic adaptation of the Dimensions of Anger Reactions Scale-5 (DAR-5). Journal of Affective Disorders Reports, 4, 100128. https://doi.org/10.1016/j.jadr.2021.100128
Khan, F., Shethna, A., Ramesh, S., Sandhya, K., & Paul, R. (2017). Subjective symptoms of carpal tunnel syndrome correlate more with psychological factors than electrophysiological severity. Annals of the Indian Academy of Neurology, 20(1), 69–72. https://doi.org/10.4103/0972-2327.199909
Levine, D. W., Simmons, B. P., Koris, M. J., Daltroy, L. H., Hohl, G. G., Fossel, A. H., & Katz, J. N. (1993). A self-administered questionnaire for the assessment of severity of symptoms and functional status in carpal tunnel syndrome. The Journal of Bone & Joint Surgery, 75(11), 1585–1592. https://doi.org/10.2106/00004623-199311000-00002
Levine, D. W., Simmons, B. P., Koris, M. J., Daltroy, L. H., Hohl, G. G., Fossel, A. H., & Katz, J. N. (1993). A self-administered questionnaire for the assessment of severity of symptoms and functional status in carpal tunnel syndrome. The Journal of Bone & Joint Surgery, 75(11), 1585–1592. https://doi.org/10.2106/00004623-199311000-00002
Mansfield, M., Thacker, M., & Sandford, F. (2018). Psychosocial risk factors and the association with carpal tunnel syndrome: A systematic review. Hand, 13(5), 501–508. https://doi.org/10.1002/brb3.17736398
McCallum, L. M., Damsms, N. A., Sarrigianinis, P. G., & Zis, P. (2019). Anxiety and depression in patients with suspected carpal tunnel syndrome – A case controlled study. Brain and Behavior, 9(7), e01342. https://doi.org/10.1002/brb3.1342
Moghadam-Ahmadi, A., Bidaki, R., Sarhadi, T. S., Vakilian, A., & Razavi, A. (2017). Prevalence of depression and anxiety in patients with carpal tunnel syndrome Rafsanjan, Iran 2014. Journal of Mazandaran University of Medical Sciences, 27, 64–73.
Nunez, F., Vranceanu, A.-M., & Ring, D. (2010). Determinants of pain in patients with carpal tunnel syndrome. Clinical Orthopaedics and Related Research, 468(12), 3328–3332. https://doi.org/10.1007/s11999-010-1551-x

Papadopoulou, M., Tsivgoulis, G., Chatzi, I., Palaiodimou, L., Bregianni, M., Voumournakis, K., & Michopoulos, I. (2021). Association of psychometric indices and normal electrodiagnostic studies in referral for suspected carpal tunnel syndrome. In Vivo, 35(3), 1791–1797.

Radwan, S., Hamo, K., & Zayed, A. (2018). A 67-year-old woman with bilateral hand numbness. Cleveland Clinic Journal of Medicine, 85, 200–208.

Shin, Y. H., Yoon, J. O., Kim, Y. K., & Kim, J. K. (2018). Psychological status is associated with symptom severity in patients with carpal tunnel syndrome. The Journal of Hand Surgery, 43(5), 484.e1–e8. https://doi.org/10.1016/j.jhjsa.2017.10.031

Sommer, I., Lukic, N., Rössler, W., & Ettlin, D. A. (2019). Measuring anger in patients experiencing chronic pain – A systematic review. Journal of Psychosomatic Research, 125, 109778. https://doi.org/10.1016/j.jpsychores.2019.109778

Sun, P. O., Walbeehm, E. T., Selles, R. W., Jansen, M. C., Slijper, H. P., Ulrich, D. J. O., & Porsius, J. T. & Hand-Wrist Study Group. (2019). Influence of illness perceptions, psychological distress and pain catastrophizing on self-reported symptom severity and functional status in patients with carpal tunnel syndrome. Journal of Psychosomatic Research, 126, 109820. https://doi.org/10.1016/j.jpsychires.2019.109820

Terkawi, A. S., Tsang, S., AlKahtani, G. J., Al-Mousa, S. H., Al Musaed, S., AlZo-rai, U. S., Alasfar, E. M., Doais, K. S., Abdulrahman, A., & Altirkawi, K. A. (2017). Development and validation of Arabic version of the Hospital Anxiety and Depression Scale. Saudi Journal of Anaesthesia, 11(5), S11–S18. https://doi.org/10.4103/sja.SJA_43_17

Zigmond, A. S., & Snaith, R. P. (1983). The hospital anxiety and depression scale. Acta Psychiatrica Scandinavica, 67(6), 361–370. https://doi.org/10.1111/j.1600-0447.1983.tb09716.x

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