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Association of Psychometric Indices and Normal Electrodiagnostic Studies in Referral for Suspected Carpal Tunnel Syndrome

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Abstract. *Background/Aim: The aim of this study was to investigate psychometric indices and their association with electrodiagnostic studies (EDX). Patients and Methods: A total of 100 patients referred for EDX testing of the upper limbs were prospectively enrolled. Demographic data, laboratory test results, referral physician specialty, main symptom, WHODAS 2.0-12 item version, Hospital Anxiety and Depression Scale (HADS), Boston Carpal Tunnel Questionnaire (BCTQ) and a Numeric Rating Scale (NRS) indicating the extent of their discomfort were collected. Results: Normal EDX results were elicited from 56% of patients. Only the presence of numbness in the right hand, pain in the left hand and older age were significantly associated with an abnormal EDX result. The more depressed and anxious the patients were, the more they scored on psychometric scales. Conclusion: The large prevalence of normal EDX studies raises the issue of unnecessary referrals. A proportion of patients are referred only according to their reported symptoms. Psychological factors affect the way a person expresses physical discomfort, leading to unnecessary EDX referrals and inevitably with normal results.*

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Nerve conduction studies and needle electromyography (EMG) are invaluable electrodiagnostic (EDX) tools in the diagnosis of neuromuscular disorders. EDX studies are considered an extension of the clinical examination (1) but not a substitute for careful history-taking and physical examination. Several studies have reported the issue of a high prevalence of normal results from EDX studies, ranging from 35% to 69% of cases (2-12). The appropriateness of the request for EDX has already been addressed, focusing mainly on the source of the referrals, whether the referring physician is a general practitioner or a specialist, a neurologist or an orthopedic (12) and even more so when the referring neurologist is a neuromuscular expert or a non-neuromuscular neurologist (7). Some studies suggest that when referrals are issued by specialists, they are more appropriate and the initial suspicion is confirmed to a greater extent than when issued by general practitioners (2, 13, 14), while other studies suggest that the referral source is not significantly related to the EDX outcome (3-5, 10, 15). The above findings are inconclusive and contradictive and may lead to decisions which prevent general practitioners from referring patients for EDX studies (7, 14).

In all relevant published studies, a high proportion of non-diagnostic, but symptomatic referrals, such as numbness, pain and weakness, are mentioned, ranging from 30% to 68% (2, 4, 5, 10-12, 15), a rate similar to that of normal EDX results. Therefore, a symptomatic referral may indicate the difficulty of the referring physician to correlate symptoms to diseases.

Considering all the above, referral and outcome may depend on the specialty of the referring physician and on the symptoms reported by patients. These factors alone cannot account for all of the negative EDX results. Symptoms such as numbness and pain are subjective and cannot be measured. They are usually chronic and persistent, affecting the quality of life but are nevertheless regarded as evidence of a medical condition. This may sometimes indicate a misinterpretation of symptoms in the context of an anxiety disorder, as recently discussed by Meuret *et al.* (16). Subjective neurological symptoms can simply co-exist as comorbid physical symptoms with mood or anxiety disorders, or they may be the only manifestations of a psychosomatic syndrome (17). Psychological comorbidity is frequently overlooked in medical care of patients suffering from chronic diseases (18, 19). It is therefore generally accepted that any physical symptom is not just a reflection of somatic pathology but a cue. Psychological factors play a major role in symptom reporting (20). Nevertheless, as far as we are aware, the psychological factors of patients that may influence the decision for EDX referral and EDX result have not been addressed.

Furthermore, there are significant sex differences regarding referrals. Women almost always comprise a significantly larger proportion of referrals for EDX tests compared to men (53-67%) (2, 4, 6, 7, 10-15, 21) but this has also not yet been addressed and interpreted. The facts that women generally suffer from somatic complaints significantly more than men, tend to report their symptoms at higher rates and consequently utilize more medical services have been reported in representative health surveys (22, 23) but never specifically for symptoms indicating neuromuscular diseases.

Bearing the above in mind, this study was designed to investigate psychological factors related to normal findings in EDX studies.

Patients and Methods

Study design. A prospective study was carried out at an outpatient EDX service in the Athens area in the period between January and April 2019. All patients were referred to the EMG Laboratory by any type of physician who treated patients with neuromuscular disorders.

Study population. The study population consisting of 100 consecutive patients referred to the EMG Laboratory for upper-limb symptoms, such as numbness, pain, weakness and muscle atrophy and a referral diagnosis either of carpal tunnel syndrome (CTS) or a descriptive diagnosis that implied CTS. Outpatients represented 100% of the sample. Patients participated on a voluntary basis after giving their informed consent. The sample was representative of the population referred to the EMG Laboratory throughout the whole year in terms of gender, age and origin of referral.

Demographic and clinical data. The following data were collected: Personal data [age, gender, body mass index (BMI), handedness, employment], laboratory test results associated with abnormal EDX results: thyroid-stimulating hormone (TSH), haemoglobin A1c (HbA1c), B12, folic acid, vitamin D, referral physician specialty, referral diagnosis, main symptom (pain, numbness, atrophy, weakness, other *e.g.* tremor).

Self-reported questionnaires. Patients were asked to complete World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0; 12-item version) (24), Hospital Anxiety and Depression Scale (HADS) (25), Boston Carpal Tunnel Questionnaire (BCTQ) (26) and a Numeric Rating Scale.

WHODAS 2.0-12-item. WHODAS 2.0 is a self-rated health questionnaire, direct derivative of International Classification of Functioning, Disability and Health and is applicable to any health condition (27). The WHODAS 2.0 was developed in order to assess behavioral limitations and restrictions to participation experienced by an individual, independently from a medical diagnosis. WHODAS 2.0-12 item has excellent psychometric properties (28), is easy to use and score, and is available on the public domain in self-report, proxy, and telephone-based versions that can be administered in around 5-10 min. WHODAS 2.0 assesses perceived disability associated with the health condition in the 30 days preceding its application. This instrument is divided into six domains: i) Cognition; ii) mobility; iii) self-care; iv) inter-personal relationships; v) activities of daily living; and vi) participation. Scoring is based on 'item-response-theory'. It takes into account multiple levels of difficulty for each WHODAS 2.0 item. It takes the coding for each item response as "none", "mild", "moderate", "severe" and "extreme" separately, and then uses an algorithm to determine the summary score by differentially weighting the items and the levels of severity. The SPSS algorithm is available from WHO. WHODAS 2.0 generates an overall score ranging from 0 (no disability) to 100 (full disability). A disability score of 25% or greater was considered here to indicate disability (0-4% no disability, 5-24% mild, 25-49% moderate, 50-95% severe and 96-100% complete disability)(24).

HADS. This scale was developed by Zigmond and Snaith in 1983 (29) and validated in the Greek language in 2008 (25). Its purpose is to provide clinicians with an acceptable, reliable, valid and easy to use practical tool for identifying and quantifying depression and anxiety. The HADS is a self-report rating scale of 14 items on a 4-point Likert scale (range of 0-3). It is designed to measure anxiety and depression (seven items for each subscale, HADS-A and HADS-D). The total score is the sum of the 14 items, and for each subscale, the score is the sum of the respective seven items (ranging from 0-21). A score of 0 to 7 for either subscale is regarded as being in the normal range, a score of 11 or higher indicating probable presence of mood disorder, and a score of 8 to 10 being suggestive of the presence of the respective state (30). HADS has demonstrated reliability and validity when used to assess medical patients, and gives clinically meaningful results as a psychological screening tool; furthermore, HADS scores predict psychosocial and possibly also physical outcome (31).

BCTQ. BCTQ is a self-administered questionnaire developed by Levine *et al.* (32) for the assessment of severity of symptoms and functional status of patients with CTS. The Greek version has been validated as a reliable screening tool in patients with suspected CTS

(26). The Symptom Severity Scale subscale includes 11 items assessing pain, paresthesia, numbness, weakness, nocturnal symptoms, and overall functional status. The Functional Status Scale subscale includes eight items assessing hand function during common daily activities. Each item is scored on a 5-point scale, from 1 (no symptoms/no difficulty) to 5 (worst symptoms/cannot perform any activity). The overall scores are measured as the mean of the scores for the individual items. The overall scores were calculated as the mean of the scores for all items.

NRS. The NRS is any scale which renders a quantitative symbolization of a symptom and it is most commonly is used to assess pain. The NRS is a subjective measure in which individuals rate their pain on an eleven-point numerical scale. The scale is composed of 0 (no pain at all) to 10 (worst imaginable pain). The literature shows that NRSs provide sufficient discriminative power for chronic pain patients to describe their pain intensity. The benefits of the NRS are that it is validated, and is quick and easy to use. Disadvantages of the NRS is that it attempts to assign a single number to the symptom experience. It also suffers from the ceiling effect in that if a value of "10" is chosen and the symptom worsens, the patient has no way to express this change. NRSs have been reported to be sensitive to change and correlate well with other pain intensity measures (33). In our study, patients were asked to rate their discomfort due to their symptoms (numbness, pain) with a number from 0 (no annoyance at all) to 10 (maximum degree of discomfort, interfering with daily activities and quality of life).

EDX studies. EDX studies were performed for each patient by two neurologists with expertise in neuromuscular disorders and electrophysiology. EDX examination was performed using a Neuropack MEB-9400 EMG instrument, (Nihon Kohden Corp., Tokyo, Japan) and the examination protocol included motor and sensory nerve conduction velocity (NCV) bilaterally, using surface stimulating and recording electrodes, F-wave analysis for one ulnar nerve and concentric needle EMG sampling of muscles innervated by the C5 to T1 spinal roots in patients with suspected radiculopathy. Motor NCV included median and ulnar nerves (recording from *abductor pollicis brevis* and *abductor digiti minimi* muscles) and second lumbrical-interosseous distal motor latency comparison test. Sensory NCV included sensory action potential amplitude, latency and velocity of median, ulnar, radial and sural nerve (in cases of suspected neuropathy). EDX study was judged as normal or abnormal based on standardized EDX criteria (34). The Canterbury severity scale for CTS was used to assess the EDX result for suspected CTS, ranging from 0 (normal EDX) study to 6 (extremely severe CTS) (35).

Statistical analysis. Statistical analysis was performed using the Statistical Package for Social Science (SPSS Inc., version 24.0 for Windows; IBM, Armonk, NY, USA). Descriptive statistics are given as the mean and standard deviation, frequency and percentage. Statistical comparisons between different groups were performed using the chi-square test (or exact test) for binary outcomes, and Student's *t*-test or Mann-Whitney *U*-test for continuous variables as appropriate. Correlations between variables were tested by the use of Pearson's test. A *p*-value of less than 0.05 was considered significant.

This study was approved by the local Ethics Committee of our Institution (EΔB20/15.01.2019) and followed the principles of the Helsinki Declaration and its later amendments (36). Informed consent was obtained from all participants.

Results

During the study period, 100 consecutive patients were included in the study, 78 women and 22 men. The mean age was 55 years, ranging between 21 and 84 years; 90% of the patients were right-handed. The mean BMI was 27.6 kg/m^2, with a range of 17.9-44.9 kg/m^2. The demographic, biochemical and psychometric characteristics of the study population are presented in detail in Table I.

In 50% of cases, the referral diagnosis was descriptive (pain, numbness, muscle weakness, causalgia, or tingling), in 50% the referral diagnosis was CTS,

Sixty-nine referrals originated from orthopedics, 23 from neurologists, seven from internists and one from a neurosurgeon. Of the total 100 EDX studies, results of 56% were normal. Orthopedic referrals resulted in normal findings in 38/69 cases (56%), for neurologist referrals normal results were found in 14/23 cases (60%), and other specialist referrals showed normal EDX studies in 4/8 cases (50%). There was no statistical difference in pathological results among physician referrals.

The most commonly reported symptom was numbness, both for men and women. Women reported numbness in the right hand more often than men. The second most frequently reported symptom was pain, occurring in almost half of all cases compared to numbness. Weakness was a complaint in many fewer cases and other symptoms were only scarcely reported. Apart from reported numbness in the right hand, we did not observe a significant difference between men and women for any other symptom (Table II).

Although more women were referred, there was no difference in the percentage of abnormal EDX studies between men and women, nor was there a gender difference in severity of EDX result. Normal EDX studies were found in 44/78 (56%) of women and in 12/22 (55%) of men (p=0.876). No statistically significant difference was found between men and women with respect to age, BMI, employment, handedness, biochemical markers, referral source, reported symptom such as numbness, with the exception of RH numbness as mentioned before, pain, weakness, atrophy or other. A statistically significant difference was found only between the two groups with respect to WHODAS 2.0-12 item (p<0.001) and HADS-D scale (p=0.027), reflecting psychometric differences between sexes (Table I). No gender differences in patient scale (NRS) and BCTQ were detected. The reported symptoms, as described by men and women, are presented in Table II.

Except for age (p=0.002) and employment (p=0.038), two factors that are invariably interconnected, all other factors, namely gender, BMI, handedness, referral source, biochemical

Table I. *Comparison of demographic, biochemical and psychometric characteristics between sexes.*

Characteristic	Women (n=78)	Men (n=22)	*p*-Value
Age, years			
Mean±SD	54.45±12.515	58.64±15.289	0.411
BMI, kg/m2			
Mean±SD	27.38±5.727	28.37±4.481	0.237
Handedness (%)			
Right	69 (88.5%)	20 (91%)	0.79
Left	2 (2.5%)	1 (4.5%)	
Unknown	7 (9%)	1 (4.5%)	
Employment, n (%)			
Retired	38 (49%)	15 (68.2%)	0.249
Employed	32 (41%)	6 (27.3%)	
Housework	6 (8%)	0 (0%)	
Student	1 (1%)	0 (0%)	
Unknown	1 (1%)	1 (4.5%)	
Referring physician, n (%)			
Neurologist	16 (20.5%)	7 (32%)	0.407
Orthopedic	55 (70.5%)	14 (63.5%)	
Other	7 (9.0%)	1 (4.5%)	
TSH, μIU/ml			
Mean±SD	2.35±1.34	2.23±0.90	0.162
HbA1c, %			
Mean±SD	5.398±0.63	5.324±0.043	0.344
Vitamin B12, pg/ml			
Mean±SD	409.93±180.325	446.65±150.05	0.562
Folic acid, ng/ml			
Mean±SD	9.83±6.86	8.073±4.078	0.094
Vitamin D, ng/ml			
Mean±SD	27.37±8.6	14.89±7.044	0.492
NRS scale			
Mean±SD	5.3±2.784	4.31±2.798	0.206
WHODAS			
Mean±SD	19.14±14.17	8.03±7.54	**<0.001**
HADS-Anxiety			
Mean±SD	6.11±3.4	5.29±2.498	0.585
HADS-Depression			
Mean±SD	6.78±3.45	3.29±2.138	**0.027**
BCTQ			
Mean±SD	1.63±0.61	1.49±0.66	0.399
Severity Scale			
Mean±SD	2.56±2.913	2.59±2.46	0.966

BCTQ: Boston Carpal Tunnel Questionnaire; BMI: body mass index; HADS: Hospital Anxiety and Depression Scale; HbA1c: hemoglobin A1c; NRS: Numeric Rating Scale; TSH: thyroid-stimulating hormone; WHODAS: World Health Organization Disability Assessment Schedule 2.0 12-item version. Statistically significant *p*-values are shown in bold.

markers, psychometric indexes and BCTQ were not associated with EDX results ($p>0.05$). Depending on the reported symptom, only right-hand numbness ($p=0.001$) and left-hand pain ($p=0.004$) were related to EDX results. Severity, as measured by the Canterbury severity scale, was age-related, as expected, since abnormal results were also found to be age-related. Severity was not associated with psychometric factors (r=0.246, $p=0.014$). Table III summarizes the associations between factors and EDX results and their statistical significance.

Table II. *Frequency distribution of reported symptoms by sex.*

Hand	Symptom	Women (n=78)	Men (n=22)	*p*-Value
Right	Pain	23 (29.5%)	5 (23%)	0.602
	Numbness	54 (69%)	10 (46%)	**0.048**
	Weakness	9 (11.5%)	3 (14%)	0.723
	Atrophy	2 (2.5%)	0 (0%)	0.448
	Other	8 (10%)	1 (4.5%)	0.679
Left	Pain	20 (25%)	9 (41%)	0.189
	Numbness	50 (64%)	13 (59%)	0.803
	Weakness	7 (9%)	1 (4.5%)	0.681
	Atrophy	2 (2.5%)	0 (0%)	0.448
	Other	4 (5%)	1 (4.5%)	0.912

Statistically significant *p*-values are shown in bold.

Although none of the psychometric indices were associated with EDX results nor correlated with EDX severity scale, they were correlated with the result of self-reporting questionnaires: NRS scale with WHODAS (r=0.352, $p=0.001$) and BCTQ marginally with HADS-A (r=0.494, $p=0.052$), and to a lesser extent but indicatively with HADS-D (r=0.445, $p=0.084$) (Table IV).

Discussion

In this study, normal EDX results were found in 56% of patients. The EDX result was only associated with age, employment, right hand numbness and left-hand pain. Psychometric indices were not correlated with EDX results but did affect the result of self-reporting questionnaires, BCTQ and NRS scale.

The present study provides a new insight in EDX tests, regarding the referral and examination result, aiming to investigate psychometric characteristics of the referred population. The aforementioned large number of normal EDX results are viewed through the prism of a psychosomatic disorder.

The results of our study confirmed other investigators' findings regarding high percentages of normal EDX studies. According to our findings, there was no statistically significant association between referral from different specialties (orthopedics *vs.* neurologists or other) and EDX outcome, as already described by previous authors (3-5, 10, 15). On the other hand, there are studies in the literature that came to the opposite conclusion (2, 12, 13). This discrepancy might reflect different patient population selection across studies (inpatient *vs.* outpatient) and the magnitude of selected data, ranging from 100 cases (13) to over 3,000 (2, 14), or different EMG laboratory settings such as tertiary hospitals (7, 13, 15), community-based EMG laboratory (3, 14), Institutes of Neurophysiology (4), and private outpatient clinics (12).

Table III. *Factors associated with the result of electrodiagnostic studies (EDX).*

Factor	EDX result		
	Normal	Abnormal	*p*-Value
Gender, n (%)			
Female	44/78 (56%)	34/78 (44%)	0.876
Age, years			
Mean±SD	51.89±14.081	59.8±10.593	**0.002**
BMI, kg/m^2			
Mean±SD	26.89±5.4452	28.49±5.427	0.148
Handedness, n (%)			
Right	52/89 (58%)	37/89 (42%)	0.289
Left	2/3 (67%)	1/3 (23%)	
Unknown	3/8 (37.5%)	5/8 (42.5%)	
Employment, n (%)			
Retired	23/53 (43%)	30/53 (57%)	**0.038**
Employed	26/38 (68%)	12/38 (32%)	
Housework	5/6 (83%)	1 (7%)	
Student	1/1 (100%)	0/1 (0%)	
Unknown	1/2 (50%)	1/20 (50%)	
Referring physician, n (%)			
Neurologist	14/23 (61%)	9/23 (39%)	0.417
Orthopedic	38/69 (55%)	31/69 (45%)	
Other	4/8 (50%)	4/8 (50%)	
TSH, μIU/ml			
Mean±SD	2.4194±1.33094	2.2042±1.16374	0.430
HbA1c, %			
Mean±SD	5.450±0.6359	5.296±0.5407	0.257
Vitamin B12, pg/ml			
Mean±SD	425.66±155.859	410.71±193.130	0.718
Folic acid, ng/ml			
Mean±SD	10.230±7.2819	8.639±5.2577	0.313
Vitamin D, ng/ml			
Mean±SD	25.31±10.441	25.09±8.696	0.935
NRS scale			
Mean±SD	5.22±3.091	4.97±2.408	0.69
WHODAS			
Mean±SD	16.03±13.7	17.5±13.9	0.68
HADS-Anxiety			
Mean±SD	6.27±3.16	4.6±2.4	0.61
HADS-Depression			
Mean±SD	5.73±3.95	4.2±1.3	0.61
BCTQ			
Mean±SD	1.65±0.64	1.53±0.60	0.335
Right hand, n (%)			
Pain	17/56 (30%)	11/44 (25%)	0.655
Numbness	28/56 (50%)	36/44 (81%)	**0.001**
Weakness	5/56 (9%)	7/44 (16%)	0.358
Atrophy	0/56 (0%)	2/44 (4.5%)	0.191
Other	7/56 (12.5%)	2/44 (4.5%)	0.292
Left hand			
Pain	23/56 (41%)	6/44 (14%)	**0.004**
Numbness	33/56 (59%)	30/44 (68%)	0.406
Weakness	3/56 (5%)	5/44 (11%)	0.295
Atrophy	0/56 (0%)	2/44 (4.5%)	0.191
Other	4/56 (7%)	1/44 (2.25%)	0.381

BCTQ: Boston Carpal Tunnel Questionnaire; BMI: body mass index; HADS: Hospital Anxiety and Depression Scale; HbA1c: hemoglobin A1c; NRS: Numeric Rating Scale; TSH: thyroid-stimulating hormone; WHODAS: World Health Organization Disability Assessment Schedule 2.0 12-item version. Statistically significant *p*-values are shown in bold.

Table IV. *Correlations among psychometric indices, questionnaires and severity grade in electrodiagnostic studies.*

Variable	Pearson's correlation coefficient (ϱ)	*p*-Value
BCTQ *vs*. HADS-Anxiety	0.494	0.052
BCTQ *vs*. HADS-Depression	0.445	0.084
NRS scale *vs*. WHODAS	0.352	**0.001**
Severity scale *vs*. HADS-Anxiety	–0.318	0.231
Severity scale *vs*. HADS-Depression	–0.266	0.319
Severity scale *vs*. WHODAS	0.170	0.873

BCTQ: Boston Carpal Tunnel Questionnaire; HADS: Hospital Anxiety and Depression Scale; NRS: Numeric Rating Scale; WHODAS: World Health Organization Disability Assessment Schedule 2.0 12-item version. Statistically significant *p*-values are shown in bold.

The reported symptoms and their association with EDX outcome were evaluated. Our findings agree with those of other investigators, namely that numbness is the most common complaint followed by pain. Women and men reported symptoms at the same rate, with an exception of right-hand numbness, which was more frequently reported by women. This finding might reflect more engagement of women in handcraft jobs and house working. In this study, only numbness in the right hand was strongly related to a positive EDX result, while pain was not, confirming a similar finding by other researchers (3, 4).

Women constituted a significant proportion of the data sample (78%). The possibility of a woman being referred for upper-limb EDX studies is 3.5-fold greater than that of a man. Comparing the two study populations, men and women, we found that they did not differ in any factor other than the WHODAS 2.0 scale and HADS-D scale. This phenomenon of women being referred more often than men was reported in almost all relevant studies (2, 4, 6, 7, 10-15, 21). Gender as a factor associated with EDX results has only been assessed once, by Lo *et al*. (3), who interestingly found that female sex had a negative predictive value for a positive EDX result. They assumed that female patients or the referral physician may have a greater awareness for CTS or that females may more often experience musculoskeletal-related symptoms that mimic CTS. In our study, female gender was not statistically significant related to EDX results, a finding that supports the above interpretation of women's greater awareness and preoccupation with subjective symptoms, leading them to more referrals compared to men.

Most studies that dealt with negative EDX results focused on the fact that EDX might be normal despite an underlying disease, due to factors related to EDX testing itself. They suggest that in some cases, there may be a neurological disease that EDX fails to detect due to the limited sensitivity of the test, as in cases of radiculopathy, where only sensory

roots are damaged and cannot be assessed through standard EDX studies (12). In some other cases, there may be an underlying musculoskeletal disorder that may presents such as a neurogenic one and, even after extensive physical examination, the two conditions cannot be distinguished, leading to an EDX referral with negative results (8, 37). Another important issue regarding the EDX result is the skill of the electromyographer and the time devoted for each patient (13).

In the present study, we suggest that EDX might be normal because there is no underlying somatic disease, although the reported symptoms might imply a neuromuscular disease. We assume that other factors, not neurological or musculoskeletal, compel patients to seek medical advice. Complaints such as numbness or pain alone are not necessarily related to a disease. The lack of severity or specificity of the patient's complaint appears to be a common cause for negative EDX results (21). Furthermore, referring physicians, either because of lack of time for a good physical examination and a good medical history, or because of lack of experience and knowledge of EDX restrictions, refer patients based exclusively on their complaints without clear indication of a specific disease (7).

Our study has certain limitations. The study population was marginal (100 patients) but nevertheless is representative, as patients examined in the same EMG Laboratory by the same physicians throughout the year had a similar percentage of normal EDX results and representation of sexes. Another issue is that our study was limited to outpatients referred for upper-limb EMG. The reason for this is that these requests are the most common and tend to be normal more often. Furthermore, the cross-sectional data presented in this study do not allow causality to be determined. Follow-up longitudinal studies are needed to clarify whether numbness and pain are symptoms of psychological distress or alternatively, reflect the chronic presence of undiagnosed and persistent symptoms which may cause anxiety and depression.

Conclusion

Physical complaints do not always imply physical disease. Our study suggests that psychological factors may give rise to subjective symptoms, such as numbness and pain, mimicking neuromuscular disorders. They affect clinical scales but are not associated with the final EDX result which is necessary for a diagnosis. This results in a large number of unnecessary referrals and consequently in inconclusive reports. We suggest that a physician should always bear in mind that psychological factors might affect a patient's perception of their body, leading to complaints that reflect more a psychosomatic disorder rather than neuromuscular disease.

Conflicts of Interest

The Authors declare no conflicts of interest in regard to this study.

Authors' Contributions

MP: Data collection, data analysis, and article drafting. GT: Article drafting and editing. IC: Data collection. MB: Data analysis. LP: Data analysis. CV: Article editing. IM: Data analysis, statistical analysis, and article editing.

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