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Does the educational level of women influence hand grip and pinch strength in carpal tunnel syndrome?

Rodrigo Núñez-Cortés[a,b], Carlos Cruz-Montecinos[a,c,d,*], Marcela Andrea Antúnez-Riveros[e], Sofía Pérez-Alenda[d]

[a] Laboratory of Clinical Biomechanics, Department of Physical Therapy, Faculty of Medicine, University of Chile, Santiago, Chile
[b] Service of Physical Therapy, Hospital Clínico La Florida, Santiago, Chile
[c] Biomechanics and Kinesiology Laboratory, Service of Physical Therapy, San José Hospital, Santiago, Chile
[d] Department of Physiotherapy, University of Valencia, Valencia, Spain
[e] Department of Education in Health Sciences, Faculty of Medicine, University of Chile, Santiago, Chile

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ABSTRACT

Background: Grip and pinch strength are relevant functional variables for various activities of daily life and are related to the quality of life of patients with carpal tunnel syndrome (CTS).
Objective: The main aim was to analyze the relationship between grip and pinch strength and the educational level in women with CTS.
Study design: Cross-sectional study.
Methods: Thirty-one female patients with CTS awaiting surgery were assigned to the low education group if they only had primary education level (completed or not) and the high education group for those having higher education level. The assessments included: grip strength, pinch strength, Visual Analogue Scale, Quick DASH Questionnaire, Pain Catastrophizing Scale and the Tampa scale of kinesiophobia.
Results: A statistically significant difference was obtained for grip strength ($p = 0.027$), pinch strength ($p = 0.002$) and catastrophizing ($p = 0.038$) between the two groups. No significant differences were observed for the other variables studied ($p < 0.05$). Grip strength was not related to individual factors: type of work, age, body mass index.
Conclusion: CTS patients with a low educational level exhibited reduced grip and pinch strength and more catastrophic thinking. Future studies should investigate the mechanisms involved in the loss of strength in patients with lower educational levels.

Introduction

Carpal tunnel syndrome (CTS) is a compressive peripheral neuropathy, characterized by pain, a tingling sensation and paraesthesia over the skin territory of the median nerve [1], symptoms modulated by psychosocial factors (i.e. catastrophizing) [2–4] and commonly associated with a decreased grip and pinch strength [5,6], which overall leads to a functional deterioration of the upper extremity [6]. Grip and pinch strength are relevant functional variables for various everyday activities [7] and have been considered a physical measure of recovery to assess the results of surgery in several studies [8]. Grip strength has been described to be related to self-reporting variables on the physical and functional health status of the upper limb in patients with CTS [9] and is considered a predictor for returning to work [10] and of satisfaction after undergoing surgery. [11] Both grip and pinch strength have been shown to be related to the quality of life in patients with CTS [12].

Loss of strength in patients with CTS has been associated with different factors, such as median nerve conduction impairment [13] or structural changes in the carpal tunnel [14]. In a healthy subject, grip strength has been reported to be related to individual factors such as age [15], however, in patients with CTS no such relationship has been observed [5]. Body mass index (BMI) and type of work have also not been shown to be associated with loss of strength in CTS patients [5], so this may be related to other factors.

Socio-demographic factors such as educational level have been shown to be related to loss of grip strength in healthy adult populations [16]. Disuse of the upper limb associated with fear-avoidance beliefs has also been associated with the loss of grip strength experienced by patients with pain in the upper extremity [17] and this type of behavior

* Corresponding author at: Faculty of Medicine, University of Chile, Avenida Independencia 1027, Independencia, Región Metropolitana, Santiago, Chile.
E-mail address: carloscruz@uchile.cl (C. Cruz-Montecinos).

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has been shown to be related to the patient's educational level [18].

On the other hand, it has been suggested that people with low educational levels have less knowledge about their health condition [19] and are more likely to develop negative pain-related beliefs and maladaptive coping strategies [20]. Moreover, a low level of education acts as a risk factor for adverse outcomes related to pain [21] and a higher educational level has been shown to be associated with less pain and disability in diseases affecting the hand (i.e. rheumatoid arthritis) [22].

Hypothesis

Although a relationship has been established between the educational level and pain and functionality in hand and wrist pathologies [22], this condition has not been studied in patients with CTS and it is unknown whether the educational level also affects the loss of grip strength experienced by patients. The main aim of our study was to compare grip and lateral pinch strength between lower and higher educational CTS patients. A secondary aim was to compare differences in pain, functionality, and psychosocial factors such as catastrophizing, kinesiophobia and individual factors such as age, BMI, and type of work. The null hypothesis of this study was that there were no differences between patients with lower and high educational levels. We assume that patients with CTS and lower educational levels have reduced grip and pinch strength, as well as greater catastrophic thinking. (Fig. 1).

Methods

Participants and design

An observational cross-sectional study was performed in 31 women with carpal tunnel syndrome awaiting surgery. The severe medical diagnosis of CTS was made by a specialized hand surgeon based on two criteria: when persistent symptoms did not respond to conservative treatment and when patients had severe electrophysiological disorders [23]. Patients were selected consecutively one week prior to their admission to open carpal tunnel release surgery for CTS at the La Florida Clinical Hospital from June to November 2017. Inclusion criteria were: female patients, over 18 years of age, severe CTS medical diagnosis, duration of symptoms for more than one year, awaiting surgery, acceptance to participate in the study [24]. Exclusion criteria were: inability to understand instructions, non-controlled mental health pathology, cognitive problems, and previous surgery in the upper limb. Subjects were assigned to the low education group (n = 14) if they had primary education (completed or not) and to the higher education group (n = 17) if they had secondary education, with vocational education and with completed university studies. Participants provided informed consent following an explanation of the study aims and procedures. The Ethical Committee of our institution approved all the procedures, which were performed in accordance with the principles of the Declaration of Helsinki of the World Medical Association and its revision in 2013.

The sample size calculation was determined using the G*Power 3.1 software and was based on pilot measurements, considering a 5-kilo difference in grip strength, a significance level of 0.05 and a statistical power of 80% for the comparison of two means. Predicting a percentage of drop-outs of 20%, the minimum sample size needed to perform our study was 14 subjects per group.

Outcome measure

The grip strength of the symptomatic hand was measured using a Jamar dynamometer (Preston, Clifton, NJ) in the second handle position and the lateral pinch strength was measured using a pinch meter (Preston, Clifton, NJ) [25], both following the recommendations of the American Society of Hand Therapists [26]. The participant was instructed to squeeze the device as hard as possible; five trials were performed with a 10-second rest between attempts. The lowest and highest values were eliminated and the average of the remaining 3 trials was recorded [6].

The self-report assessments included: Perception of pain using the Visual Analogue Scale (VAS), a valid and reliable measure for the evaluation of pain [27] and widely used in patients with CTS [28,29]; Functional Assessment using the shortened version of the Disability of Arm, Shoulder, and Hand Questionnaire (QuickDASH), a validated measure to assess the specific disability of the upper extremity [30,31]; Catastrophic thinking as a response to pain using the Pain Catastrophizing Scale (PCS) [32] and fear of movement using the Tampa scale of kinesiophobia (TSK-11) [33]. Both are valid and reliable measures used to assess the influence of psychosocial factors in patients with CTS [4]. The subject's individual factors included duration of symptoms, type of work (desk/non-desk), BMI and age, and were collected through an interview process. All evaluations were conducted by an evaluator blinded to the group allocation by educational level.

Statistical analyses

The Shapiro-Wilk test was used in the statistical analysis to verify the normalcy of the data; all data were distributed normally and were expressed using the mean and standard deviation. The comparison between groups was made with the T-test for the quantitative variables and Chi-square for the categorical variables. A multivariate analysis with ANOVA was used to determine the interaction between grip strength, educational level and individual factors of the subject: duration of symptoms, type of work (desk/non-desk) [34], BMI and age.

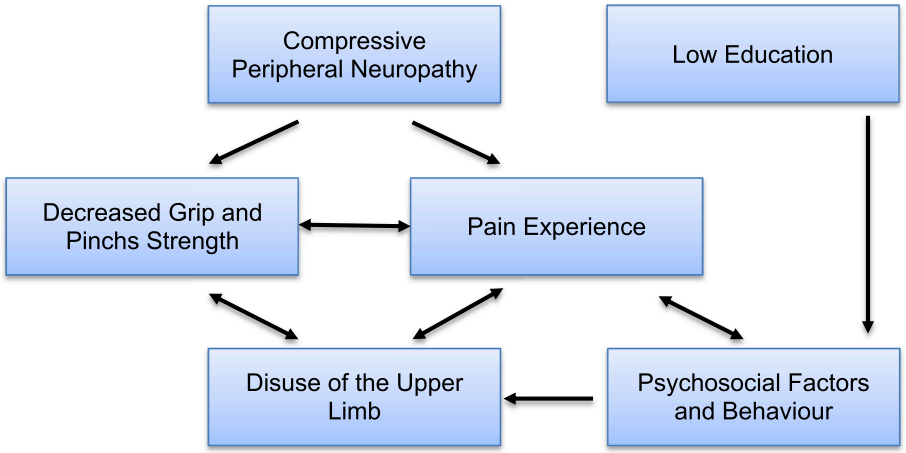

Fig. 1. Hypothesis.

Table 1
Baseline characterization of patients.

	All Subjects (n = 31)	Low education (n = 14)	High education (n = 17)	p-value
Age (years)	53.9 ± 13.7	57.2 ± 8.2	54.8 ± 10.5	0.492
BMI (kg/m^2)	30.9 ± 5.7	32.2 ± 4.1	29.5 ± 3.4	0.060
Duration of CTS (years)	3.1 ± 1.9	2.9 ± 1.6	3.1 ± 2.3	0.684
Type of work activity (%)				
Desk-based	7 (22.6%)	2 (14.3%)	5 (29.4%)	
Non-desk-based	24 (77.4%)	12 (85.7%)	12 (70.5%)	0.412

Abbreviations: BMI, Body Mass Index; CTS, Carpal Tunnel Syndrome.
Values are mean ± SD unless otherwise indicated.

Statistical significance was established at $p < 0.05$. All the data were analysed in SPSS Version 22.0 (IBM Corporation, Armonk, NY).

Results

A total of 31 subjects made up the sample, 14 assigned to the low education group and 17 to the higher education group. Table 1 shows the socio-demographic characteristics of the subjects (n = 31) and Fig. 2 represents the flow diagram of the participants.

A statistically significant difference was obtained for grip and pinch strength between the two groups, being greater in subjects with higher education, with $p = 0.027$ and $p = 0.002$ respectively (Table 2). For a multivariate analysis with ANOVA, there was no interaction ($p > 0.05$) when comparing strength with the subject's individual factors: duration of symptoms, type of work (desktop/non-desktop), BMI and age.

For secondary variables, there was a significant difference in the catastrophizing scale, with $p = 0.038$, being higher in lower education subjects compared to higher education subjects (Table 2). No significant differences were observed in pain, upper limb functionality or kinesiophobia ($p > 0.05$). There were no drop-outs or any participants with missing data for the variables of interest.

Discussion

These results confirm our hypothesis that there is a difference in grip and pinch strength between patients based on higher and lower educational levels. In our sample, patients with lower educational levels showed lower grip and pinch strength than expected.

Our results are similar to those observed in previous studies in healthy population. Rantanen et al. [35] also found a relationship between educational level and grip strength in healthy middle-aged women, arguing that these differences could be explained by the working conditions associated with the different social status of each subject. A lower educational level is generally related to lower income and this socioeconomic deprivation is associated with a worse state of health [36]. In addition, subjects with lower income and shorter duration of education are more likely to have performed manual labor and are more likely to have injuries that affect upper limb functionality as measured by QuickDASH scores [37]. The increased likelihood of labor performance or injury could be explained by the lifestyles required by these conditions [37] and the low work adaptability in a lower social status [38]. Other studies have also found a relationship between QuickDASH scores and the educational level [39]. However, in our study we found no differences in functionality between subjects with low and high levels of education. In addition, the type of work (desk/not desk) was not related to strength. We believe that for this reason, the loss of strength found in our population could be more related to psychosocial variables such as catastrophic thinking.

Psychosocial factors such as catastrophizing [2–4] have been shown to be modulators of symptoms in CTS patients, and it has been suggested that patients with a low level of education are more likely to develop this type of negative thinking related to pain and maladaptive coping strategies [20]. Alizadehkhaiyat et al. [17] also suggest that the loss of strength in patients with tennis elbow may be related to the patient's beliefs and disuse of the limb. These results guide us to consider that the disuse of the upper limb in CTS patients could be related patient's beliefs about possible mechanisms of pain and preferences of daily activities.

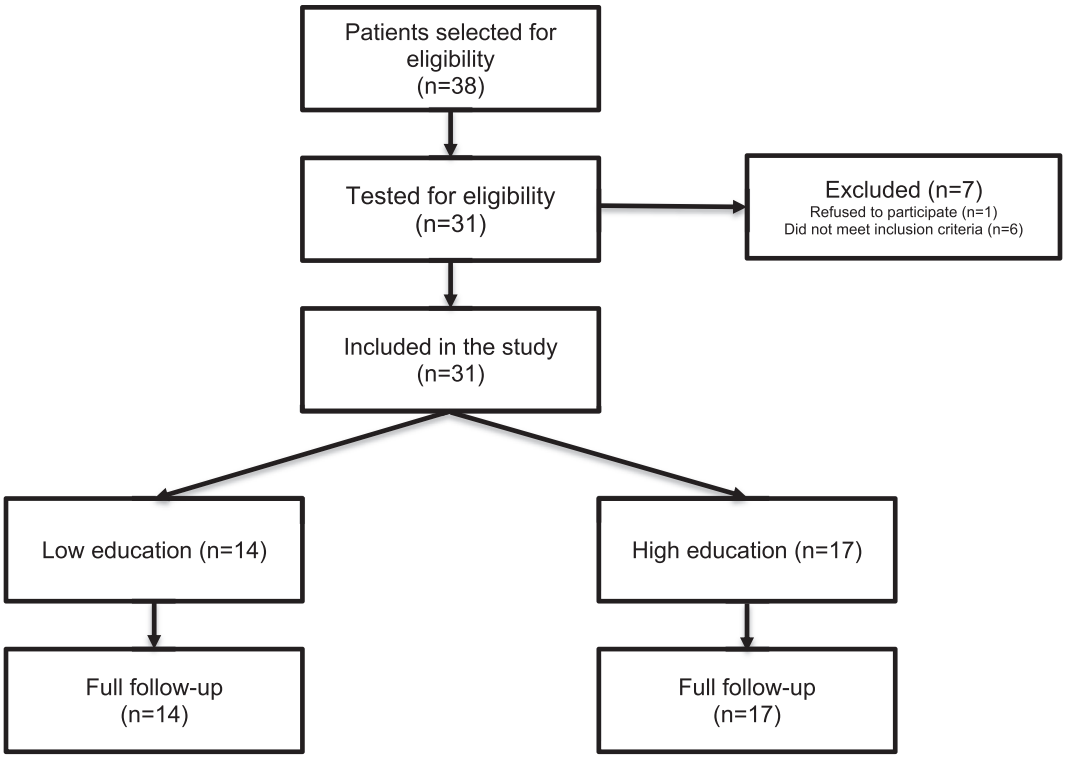

Fig. 2. Patient flow diagram.

Table 2
Comparison between groups.

	Low education (n = 14)	High education (n = 17)	Difference [95% CI]	P Value
Grip strength (kg)	13.4 ± 6.7	19.1 ± 6.8	5.7 [0.7 to 10.7]	0.027*
Pinch strength (kg)	3.6 ± 1.6	5.4 ± 1.3	1.8 [0.8 to 2.9]	0.002**
VAS (0–100 mm)	77.1 ± 21.2	58.1 ± 24.6	13.0 [−4.1 to 30.1]	0.130
Quick DASH (0–100%)	64.9 ± 19.5	59.9 ± 11.6	5.0 [−6.5 to 16.6]	0.381
PCS (0–52 points)	36.4 ± 14.1	26.1 ± 12.3	10.3 [0.6 to 19.9]	0.038*
TSK-11 (0–44 points)	34.1 ± 8.1	30.5 ± 6.8	3.4 [−1.9 to 8.9]	0.194

Data are expressed as mean ± standard deviation.
Abbreviations: CI, Confidence Interval; VAS, Visual Analogue Scale; DASH, Disabilities of the Arm; Shoulder, and Hand Questionnaire; PCS, Pain Catastrophizing Scale; TSK-11, Tampa Scale of Kinesiophobia.
*Statistically-significant difference ($p < 0.05$); **Statistically-significant difference ($p < 0.01$).

The results of our study should be interpreted with caution, as cross-sectional studies do not allow for establishing a causal relationship between the studied variables. One limitation of our study is that only female patients were included; furthermore, the subjects were only categorized according to the type of work (desk/non-desk), without considering the level of physical activity or the level of economic income as has been examined in other studies. Subjects additionally represent a local reality based on Chile's educational model, so the results cannot be extrapolated to the entire population. Another limitation is that the calculation of the sample size was made to detect differences in the hand grip and pinch strength, which could explain why there was no difference in pain and functionality between the groups.

Conclusion

For our study population, patients with CTS with a low educational level exhibited a reduced grip and pinch strength and more catastrophic thinking. It is advisable to identify the educational level of patients and develop education and counselling strategies to reduce negative beliefs in patients with lower educational levels. Future studies should deepen our understanding of causes of loss of strength in subjects with a lower educational level associated with variables including lifestyle or socioeconomic status.

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Declaration of Competing Interest

The authors have no conflict of interest to declare. No financial support was provided for this research.

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