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# RESEARCH ARTICLE

## EFFECT OF COGNITIVE BEHAVIORAL THERAPY ON CHRONIC LOW BACK PAIN WITH SENSITIZATION

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**ABSTRACT**

***Background*:** Chronic low back pain (CLBP) is a debilitating condition that persists despite the lack of tissue damage and an effective management is still lacking. CLBP is a multifactorial disorder comprising psychosocial factors like pain catastrophization, fear avoidance and central sensitization. ***Objectives*:** to investigate the effect of Cognitive Behavioural Therapy on CLBP patients with Central sensitization. ***Methods*:** This randomized clinical study was conducted *on* thirty patients of both genders having chronic low back pain with central sensitization, their age ranged from 20-37years old. The 30 patients were divided into two groups. The first group received Cognitive Behavioural Therapy comprising of one session neurophysiology education, one biofeedback relaxation session and three sessions comprising functional training exercises. The second group received conventional physiotherapy treatment comprising 12 sessions of TENS and core strengthening exercises over the course of 4 weeks. ***Results*:** The results of this study showed a significant improvement in pain intensity according to the NPRS of 30.02% in the CBT group while only 5.82% in the conventional physiotherapy group. ***Conclusion*:** Cognitive Behavioural Therapy has a significant effect on chronic low back pain, disability and fear avoidance behavior related to its central sensitivity aspects which are neglected by conventional treatment physiotherapy. Larger studies are required to establish the best feasible treatment protocol.

## INTRODUCTION

Chronic low back pain (CLBP) is very prevalent and one of the top leading causes of disability in the Arab world and worldwide (Mokdad, 2014; Murray, 2012; Rapoport, 2004). Despite research on finding the best treatment approach and the wide range of techniques and methods, low back pain was ranked as the second cause of "years of life living with disability" in the Arab world in 2010 and remains among the top ten leading causes of disability among men and women in the Arab world with increasing rates of "disability adjusted life years" from 2.4% to 3.9% among male individuals ,and from 2.3% to 3.8% among female individuals between 1990 and 2010 In middle income Arab countries, Egypt being one of them (Mokdad, 2014). Recent research has shown that CLBP is a multifactorial disorder comprising factors like pain catastrophization, fear avoidance and central sensitization (Iles, 2008) (Goossens, 2007; Zale, 2015). Central sensitization has been defined as "An amplification of neural signaling within the central nervous system that elicits pain hypersensitivity" (Woolf, 2011) and "increased responsiveness of nociceptive neurons in the central nervous system to their normal or subthreshold afferent input" (Merskey, 1994). Maladaptive behavior, false beliefs and misinformation regarding the cause of the pain are all contributing factors to the chronicity of LBP (Vlaeyen, 2000; Leeuw, 2007). Central sensitization has been attributed to cortical reorganization and amplification of the somatosensory representation of the back causing increased pain and further contributing to the maladaptive behavior and beliefs (Di Pietro, 2013; Lotze, 2007; O'Sullivan, 2005).

Cognitive behavioral treatment has been an important intervention for psychological disorders for decades and recently has gained a lot of interest as an intervention for chronic pain in general and CLBP in specific(Ehde, 2014) (Sveinsdottir, 2012). Neurophysiology education is a targeted approach toward false beliefs and information and has been recommended by the American Physical Therapy Association clinical practice guidelines on low back pain (Clarke, 2011) (Louw, 2011). Electromyography (EMG) biofeedback has been used to help CLBP patients learn to regulate their physiological responses to daily stressors and better adhere to psychological pain treatments (Schwartz, 2003; Glombiewski, 2016). Combining cognitive and behavioral treatments through neurophysiological education and electromyography (EMG) biofeedback will maximize the benefit to the CLBP patient with sensitization (Glombiewski, 2016).

## MATERIALS AND METHODS

Thirty patients of both sexes suffering from chronic low back pain were recruited from Cairo university outpatient clinic, teaching hospitals and private outpatient clinics to participate in this study; they will be selected according to the following criteria.

Inclusion Criteria

- Age ranged from 20-40 years old.
- All patients experienced low back pain for at least 3 months.

- All patients scored above or equal 40 in the Central Sensitization Inventory (CSI) (Neblett, 2013; Neblett, 2015; Neblett, 2016; De Pauw, 2015).
- All patients signed consent before the study.
- All patients were not taking analgesics during the time of the study.
- All patients scored 3 or above on the Numerical Pain Rating Scale.
- All patients were screened to exclude serious spinal pathologies by MRI and diagnosed as CLBP.
- Exclusion Criteria:
- Patients were excluded if they had taken pain medications on the day of the assessment.
- Patient who had serious spinal pathologies, such as fractures, tumors or inflammatory diseases, such as ankylosing spondylitis, narrowing of spinal canal and other conditions or severe cardiorespiratory diseases.
- Uncontrolled mental health condition that prevents successful compliance.

**Instrumentation**

**Evaluation tools and equipment**

***Surface Electromyography (SEMG):*** Surface electromyography (Noraxon Telemyo DTS) was used to measure the electrical activity of the multifidi during full flexion using the concept of the flexion relaxation phenomenon. "A flexion relaxation (FR) phenomenon, in which the lumbar muscles relax completely during maximum voluntary flexion (MVF), is seen in most normal pain-free subjects, but is often absent in CLBP patients"(Randy Neblett, 2013). Pain, self-reported disability and fear of re-injury which are all contributing factors to CLBP and central sensitization have all been linked to deficits in the flexion relaxation phenomenon, and improvements have been correlated with improvements in pain, fear avoidance beliefs and self-efficacy(Mayer TG N. R., 2009)(Watson PJ, 1997)(Ahern DK, 1988).

**Procedures**

The study protocol was explained in details for every patient before the initial assessment. A complete history and neurological examination were taken for all patients. A written informed consent was signed by each patient before participation in the study as an agreement to be included in the present study. This study was reviewed and was approved by the Ethics Committee of Faculty of Physical therapy, Cairo University.

**Evaluation procedure**

Full neurological assessment was done followed by central sensitivity assessment (CSI). Patients were included according to the scoring or otherwise excluded. Pain, disability and fear avoidance were assessed using the Numerical Pain Rating Scale (NPRS), Oswestry Disability index (ODI) and Fear Avoidance Beliefs Questionnaire (FABQ) respectively.

**Test procedures**

A standard methodology was used for electrode placement and SEMG measurement. The skin was cleaned with alcohol and silver-silver chloride electrodes from Noraxon (1 cm. in diameter and spaced 2 cm. apart) were placed vertically on the left and right multifidi muscles above the posterior superior iliac spine, approximately 2 cm. from the midline. Patients and control subjects were given standardized instructions for data collection, which have been fully documented elsewhere. Three SEMG measures were collected: a 10-second standing mean; the maximum SEMG during the flexion movement; approximately 2 seconds of mean SEMG during maximum voluntary flexion; the maximum SEMG during re-extension; and approximately 10 seconds of mean SEMG during standing, following recovery from re-extension. A root mean square (RMS) rectified SEMG signal was monitored and displayed in real time to the experimenter, while being recorded by an SEMG biofeedback system (Noraxon, Arizona). A frequency response of 20–500 Hz and an averaging factor of 5 seconds for signal smoothing were used during recording. Microvolt (μV) levels from the left and right side electrodes were averaged to obtain a single mean SEMG μV number.

**Treatment procedure**

**I. Cognitive Behavioral Therapy Group**

***Pain Education:*** Following assessment a one on one session was given comprising education cognitively targeting false ideas and beliefs on the nature of pain, differentiating nociception due to a painful stimulus and the transition of such a stimulus to a centrally sensitized experience due to misinformation, maladaptive behavior and fear avoidance. Upon completion of the session assessment using the NPQ was done to assess the understanding of the patient and further address any shortcomings in future exercise sessions. The educational information was presented verbally (explanation by the therapist) and visually using the Retrain Pain slideshow (https://www.retrainpain.org/) (pictures and diagrams on computer).

***SEMG Biofeedback relaxation:*** Another SEMG recording of the Flexion Relaxation phenomenon was done upon completion of the educational session and a SEMG biofeedback session was given to help the patient regain their sense of control over their body and function.

***Conventional physiotherapy:*** A program comprising electrical modalities and strengthening exercises as the control group.

**II. Conventional physiotherapy Group**

***Transcutaneous Electrical Neuromuscular Stimulation (TENS):*** TENS was delivered using dual channel portable electrical stimulation units with two leads and four carbon-cloth electrodes. TENS waveform was balanced asymmetrical at 125Hz frequency. Pulse duration was variable based on intensity, however ranged between 16 and 360 microseconds. To control for positional intolerance during the intervention, participants were given the option of being reclined, prone, or side lying with appropriate pillow support. However, the selected body position for TENS was maintained across all sessions. Electrode placement paralleled clinical application, in that electrodes were immediately above and below the spinal level corresponding to pain complaint. Participants were instructed to verbalize when a "strong, but tolerable and not painful" stimulus was experienced, which should correspond

**General characteristics of the subjects: Table (1)**

**Table 1. Descriptive statistics and t-test for comparing the mean age, weight, height and BMI of the study and control groups**

| | Study group | Control group | MD | t- value | p-value | Sign |
|---|---|---|---|---|---|---|
| | $\bar{X}$ ±SD | $\bar{X}$ ±SD | | | | |
| Age (years) | 22.46 ± 3.11 | 22.53 ± 4.15 | -0.07 | -0.05 | 0.96 | NS |
| Weight (kg) | 65.66 ± 7.33 | 67.4 ± 4.32 | -1.74 | -0.78 | 0.43 | NS |
| Height (cm) | 164.73 ± 9.6 | 167.53 ± 8.81 | -2.8 | -0.83 | 0.41 | NS |
| BMI (kg/m²) | 24.24 ± 2.44 | 24.12 ± 2.16 | 0.12 | 0.14 | 0.88 | NS |

x̄: mean SD: Standard deviation MD: mean difference
t value: Unpaired t value p value: Probability value NS: Non significant

**Results of pain pre and post the study**

**Table 2. Mean NRS pre and post treatment of the study and control groups**

| NRS | Pre | Post | MD | % of change | P-value | Sig |
|---|---|---|---|---|---|---|
| | $\bar{X}$ ±SD | $\bar{X}$ ±SD | | | | |
| Study group | 6.86 ± 1.92 | 4.8 ± 1.97 | 2.06 | 30.02 | 0.0001 | S |
| Control group | 6.8± 1.56 | 6.33 ± 1.58 | 0.47 | 6.91 | 0.24 | NS |
| MD | 0.06 | -1.53 | | | | |
| P-value | 0.91 | 0.02 | | | | |
| Sig | NS | S | | | | |

**Results of disability pre and post the study**

**Table 3. Mean ODI pre and post treatment of the study and control groups**

| ODI (%) | Pre | Post | MD | % of change | P-value | Sig |
|---|---|---|---|---|---|---|
| | $\bar{X}$ ±SD | $\bar{X}$ ±SD | | | | |
| Study group | 35.13 ± 2.09 | 23.13 ± 6.2 | 12 | 34.15 | 0.0001 | S |
| Control group | 35.86± 1.45 | 34.8 ± 8.31 | 1.06 | 2.95 | 0.58 | NS |
| MD | -0.73 | -11.67 | | | | |
| P-value | 0.27 | 0.0001 | | | | |
| Sig | NS | S | | | | |

**Results of fear avoidance beliefs pre and post the study**

**Table 4. Mean FABQ pre and post treatment of the study and control groups**

| FABQ | Pre | Post | MD | % of change | P-value | Sig |
|---|---|---|---|---|---|---|
| | $\bar{X}$ ±SD | $\bar{X}$ ±SD | | | | |
| Study group | 39.33 ± 4.62 | 27.6 ± 8.06 | 11.73 | 29.82 | 0.0001 | S |
| Control group | 37.2± 3.42 | 35.8 ± 4.82 | 1.4 | 3.76 | 0.3 | NS |
| MD | 2.13 | -8.2 | | | | |
| P-value | 0.16 | 0.002 | | | | |
| Sig | NS | S | | | | |

with a 70/100 stimulus intensity (0 equal to “no sensation” and 100 equal to “intolerable sensation”). At the same time, an additional stop rule was in place to ensure TENS did not evoke a motor stimulus. Once channel intensity surpassed 15mA, the physical therapist palpated lumbar paraspinals in the region of the electrodes. If motor activation was detected, channel intensity was decreased by 10% as has been previously used in TENS effect studies. Once stimulus intensity was set, TENS remained on for 20 minutes. (Corey Simona, 2015)

***Ultrasonic Therapy (U.S.):*** A treatment duration of 3-5 minutes depending on the size of the area being treated using continuous U.S.

***Strengthening exercises:*** Bridging back exercise was used for strengthening of the back extensor musculature including erector spinae muscles.

**Statistical analysis:** The data obtained from all thirty patients were statistically analyzed for comparison between before and after treatment results. The statistical package of social studies (SPSS, version 9) was used for data processing using the P-value≤ 0.05 as a level of significance.

## RESULTS

The purpose of the present study was to find out the effect of CBT on chronic low back pain patients with central sensitivity, Data obtained from thirty patients before and after the study, regarding pain, disability, fear avoidance and EMG activity were statistically analyzed and compared in the following tables.

## DISCUSSION

The current study was conducted to explore the effect of cognitive behavioral therapy on chronic low back pain with central sensitivity. Thirty patients of both sexes (19 females & 11 males), aging (20-37 years old), were included and divided randomly into two groups. All patients were subjected to full clinical examination before and after treatment including

**Results of EMG amplitudes of the lumbar multifidi pre and post the study**

**Table 5. Mean EMG amplitude of right multifidus pre and post treatment of the study and control groups**

| EMG amplitude of right multifidus (µV) | Pre | Post | MD | % of change | P-value | Sig |
|---|---|---|---|---|---|---|
| | $\bar{X}$±SD | $\bar{X}$±SD | | | | |
| Study group | 11.93 ± 3.53 | 5.8 ± 1.93 | 6.13 | 51.38 | 0.0001 | S |
| Control group | 11.26± 2.05 | 10.53 ± 1.55 | 0.73 | 6.48 | 0.35 | NS |
| MD | 0.67 | -4.73 | | | | |
| P-value | 0.53 | 0.0001 | | | | |
| Sig | NS | S | | | | |

**Table 6. Mean EMG amplitude of left multifidus pre and post treatment of the study and control groups**

| EMG amplitude of left multifidus (µV) | Pre | Post | MD | % of change | P-value | Sig |
|---|---|---|---|---|---|---|
| | $\bar{X}$±SD | $\bar{X}$±SD | | | | |
| Study group | 11.13 ± 1.76 | 5.73 ± 1.53 | 5.4 | 48.51 | 0.0001 | S |
| Control group | 11.86± 1.4 | 11.26 ± 1.66 | 0.6 | 5.05 | 0.11 | NS |
| MD | -0.73 | -5.53 | | | | |
| P-value | 0.21 | 0.0001 | | | | |
| Sig | NS | S | | | | |

surface EMG, NPRS, ODI and FABQ. The study group (G1) received cognitive behavioral therapy (Neurophysiology education and EMG biofeedback) at rate of two one on one education sessions and one EMG biofeedback session, while the control group (G2) received selected conventional physical therapy program including (Ultrasound, TENS, back and abdominal strengthening). Our findings suggest that Cognitive behavioral therapy has a significant effect on chronic low back pain, disability and fear avoidance behavior related to its central sensitivity aspects which are neglected by conventional treatment physiotherapy. Our findings show a significant change in pain (30.02% compared to 6.91%), disability (34.15% compared to 2.95%) and fear avoidance beliefs (29.82% compared to 3.76%) in patients with chronic low back pain with central sensitivity after cognitive behavioral therapy compared to conventional treatment. This significant change may be due to a more focused approach targeting maladaptive thoughts and behavior, engaging the patient in their treatment rather than a hierarchical method of delivering treatment through applications and orders. The change could also be explained by including a targeted group in the study, which were only included if they had a 40 or more score in the Central Sensitivity Inventory. In a randomized controlled clinical trial in Bergen university by (Vibe Fersum *et al.,* 2013) significant improvements were shown in disability (ODI), pain (NPRS) and Fear avoidance beliefs (FABQ) using a person-centered classification-based cognitive behavioral therapy approach comprising an education session and functional exercises. Improvements were shown immediately post treatment as well as 12 months post treatment. In the CINS trial it was shown that a brief educational session followed by a behavioral modification session was effective in improving anxiety, stress and disability as a secondary outcome in chronic low back pain (Harris *et al.,* 2017), while (Louw *et al.,* 2011) in a systematic review showed that a single neurophysiological education (NE) session improved pain and disability outcomes in a group or one on one methods and in group according to another (Lee *et al.,* 2015). In a more recent systematic review, the effect of neurophysiology education (NPE) on chronic low back pain and disability was small to moderate immediately and in follow up post three months from treatment (Tegner *et al.,* 2018), similar results were shown in a systematic review for the" American College of Physicians Clinical Practice Guideline" on the effect of biofeedback and cognitive behavioral therapy, which showed low to moderate evidence (Chou *et al.,* 2017). Although both agree on the difficulty of extracting evidence due to the limitations and heterogeneity of the RCTs. Significant correlation between pain-related fear of movement and dynamic flexion EMG was present in a study by (Geisser *et al.,* 2005) on seventy six subjects, unlike our study which showed nonsignificant correlation between the two variables.

## Conclusion

Cognitive Behavioral Therapy is an effective rehabilitative method that improves pain, disability and fear avoidance in chronic low back pain patients.

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