

# Reducing Lumbopelvic Pain in Pregnant Women through the Combination of Technologies with Systemic Application of Photobiomodulation with Therapeutic Ultrasound-Case study

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## Abstract

Pregnancy is a unique period in a woman's life, marked by significant emotional and physical transformations. One of the most common complaints during pregnancy is low back pain, which affects between 50% and 90% of pregnant women and can compromise their quality of life. In view of this, this study investigated the effectiveness of combined laser and ultrasound therapy in relieving these pains and their complications, such as sleep quality, anxiety and depression, evaluating the effectiveness of a synergistic therapy of these resources. A patient in the 15th week of pregnancy underwent 10 sessions of combined therapy. Assessments were performed using the Visual Analog Scale for pain, the Pittsburgh Sleep Quality Index and the Hospital Anxiety and Depression scale. The results indicated a significant reduction in pain intensity after the first session. There was also an improvement in sleep quality and reductions in anxiety and depression levels, according to the HAD Scale. Combined laser and ultrasound therapy can be an effective, non-invasive, non-drug approach to pain relief and improving quality of life during pregnancy, providing benefits for both mother and baby.

**Keywords:** Laser; Photobiomodulation; Ultrasound; Pain; Low back pain; Pregnancy

## Introduction

The gestational period is unique in a woman's life, marked by a mix of feelings, where the mother bonds emotionally with herself and the fetus, making the child's existence increasingly real. Associated with the emotional changes, physical changes occur, especially in the musculoskeletal system, often related to the way in which the lumbar spine is stressed to the maximum, due to the growth of the uterus. There is a change in the mother's center of gravity that transfers force to the lumbar spine, causing stress in the lower back and pelvic girdle, resulting in compensatory postural changes, such as an increase in the already affected lumbar lordosis, which significantly alter the quality of life of pregnant women, even in uncomplicated pregnancies. These changes can impact both maternal and child health [1].

Highlighting the greatest impact during pregnancy, gestational pain, being a common condition, can cause significant physical disability and negatively influence the psychosocial aspect of pregnant women and their families. Lower back pain, located below the ribs and above the gluteal folds, can radiate to the legs [2]. However, pain in the pelvic girdle is felt between the posterior iliac crests and the gluteal folds, and can also radiate to the thighs and legs. When there is no clear distinction between these two types of pain, the term lumbopelvic pain is used, which affects between 50% and 90% of pregnant women, with a tendency to worsen as the pregnancy progresses [3].

Several types of interventions have been tested in clinical studies, reviews and recent research, of which relaxation [4], guided imagery [5], or mindfulness [6] and yoga [7], were the most commonly found. However, some studies have been carried out in a technological aspect for chronic pain, through therapeutic resources, and the synergistic use of laser and ultrasound, in a systemic action model [8]. Through the application of photobiomodulation and ultrasound therapy, there is an increase in ionic permeability promoted by ultrasound,

production of ATP via low-power laser, in addition to the balance of neurotransmitters, cellular regeneration and inflammatory modulation, which positively aids the functioning of the human body. These stimuli are conducted via afferent pathways to the brain, where there is regulation of intracranial pressure, muscle relaxation, sleep regulation and normalization of pain, allowing greater regulation of brain activity and the parasympathetic system [9].

Using the concept of systemic treatment, our aim is to evaluate the effects of the systemic action of laser and ultrasound, applied to the hands and feet, in relation to pain intensity, sleep quality, anxiety and depression index, generating possible gestational benefits and a new therapeutic possibility.

## Materials and Methods

### Study

Case study submitted for approval by the Research Ethics Committee of Santa Casa de Misericórdia de São Carlos Hospital, and approved by C.A.A.E.84719924.6.0000.8148. The patient signed the Free and Informed Consent Form, after clarifications about the

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study. The participant was not identified by name and if for any reason, at any time, any discomfort, physical or psychological/emotional, occurred, she could stop participating, without any charge. The patient began the intervention process after approval and authorization from the obstetrician responsible for the patient, who accompanied her throughout the process. The treatment was carried out individually and privately.

### Case Report

A 41-year-old cisgender woman with skin phototype 4 according to the Fitzpatrick scale [10]. The patient was invited to participate in the study. The patient was in the 15th week of pregnancy, characterized as the second trimester [11]. This is her first pregnancy, not a twin, planned, but classified as high-risk due to the low iron concentration and high rate of gestational pain. The patient is undergoing treatment with supplementation of acetylsalicylic acid, prednisone, vitamin C, vitamin E, and progesterone (Ultra Gestan), in addition to personalized manipulation with L-theanine, magnesium threonate, Crocus sativus, Passiflora, phosphatidylcholine, and huperzine. She also uses a second compound containing Bacopa monnieri, biotin, calcium pantothenate, zinc, methylcobalamin, and magnesium threolate.

### Questionnaires and scale

In the present study, the patient underwent Visual Analog Scale (VAS), Pittsburgh Sleep Quality Index, Hospital Anxiety and Depression Scale (HADs). The Visual Analog Scale was assessed to evaluate the chronic effect of the intervention (pre-treatment and after treatment – 10 sessions) and to evaluate the acute effect (pre-session and after session, of all sessions). The Pittsburgh Sleep Quality Index and HAD Scale assessments were performed only to evaluate the chronic effect of the intervention (pre-treatment and after treatment 10 sessions).

### Equipment and intervention protocol

A commercial device called RECUPERO®, developed by the São Carlos Physics Institute, University of São Paulo, by the Technical Support Laboratory (LAT), patent number BR102014007397-3 A2

and marketed by MMOptics, São Carlos, São Paulo, Brazil, was used. The device has a synergistic capacity for the application of Photobiomodulation with Therapeutic Ultrasound, including the formation of an “overlapping of therapeutic fields” [12].

The intervention was performed using the RECUPERO® equipment, totaling 10 sessions, with 2 sessions per week, for 5 weeks. The protocol used was the combined application of Photobiomodulation (through a low-power laser at a wavelength of 660nm) and therapeutic ultrasound (pulsed mode, frequency of 1MHz, intensity of 0.5w/cm<sup>2</sup>), being applied for 6 minutes on the palms of the hands (Thenar, Hypothenar and Palmar Aponeuroses region) and soles of the feet (midfoot), with irradiation of 36Joules per region, totaling 144Joules.

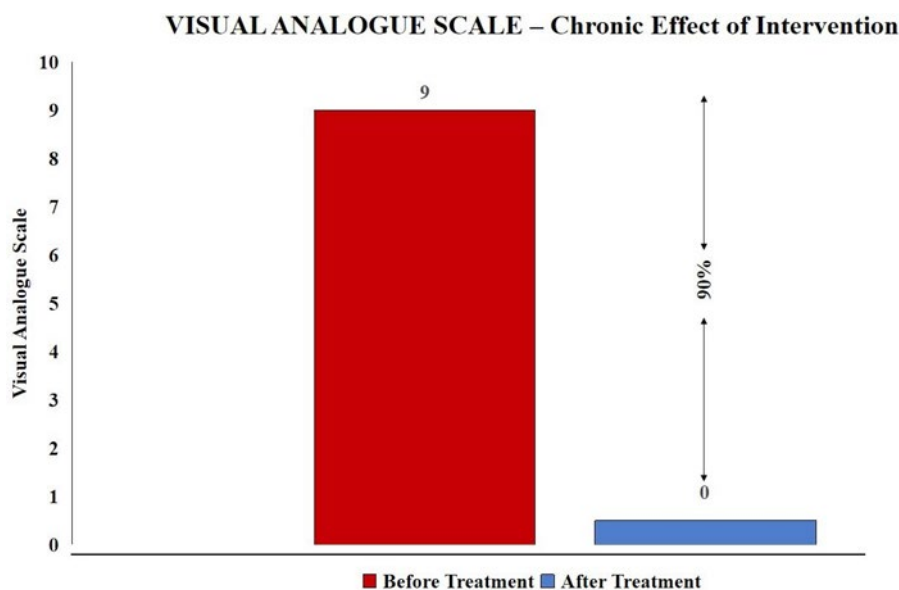
### Results

Figure 1 shows the result of the evaluation of the visual analogue scale (responsible for measuring pain), the reduction between the moments before treatment (scale value 9), in relation to after treatment (scale value 0), evaluating the chronic effect of the first session, obtaining a 100% improvement in chronic pain.

In Figure 2, using the Pittsburgh Sleep Quality Index, a reduction occurs between the Pre-treatment moments (scale value 10) in relation to the Post-treatment moments (scale value 1), evaluating the chronic effect of the first session with a percentage reduction of 90%.

In Figure 3, it was possible to observe for the HAD Anxiety Scale the reduction in values, from 13 (before treatment), to 5 (after treatment) and for the HAD Depression Scale the reduction in values from 11 (before treatment), to 7 (after treatment), providing a percentage difference of 61.54% and 36.36% (respectively).

Figure 4 shows the result of the evaluation of the visual analogue scale (responsible for measuring pain), in acute effects of pain. The data from the 10 proposed sessions were analyzed, obtaining in the first session the pre-treatment of 9 for the post-treatment of 0 (improvement of 100%), in the second session the pre-treatment of 6 for the post-treatment of 2 (improvement of 66.67%), in the third session the pre-treatment of 8 for the post-treatment of 0 (improvement of 100%), in



**Figure 1:** Comparison of the chronic effect of laser and ultrasound application in relation to the visual analogue scale in pre and post treatment during the weeks of gestation.

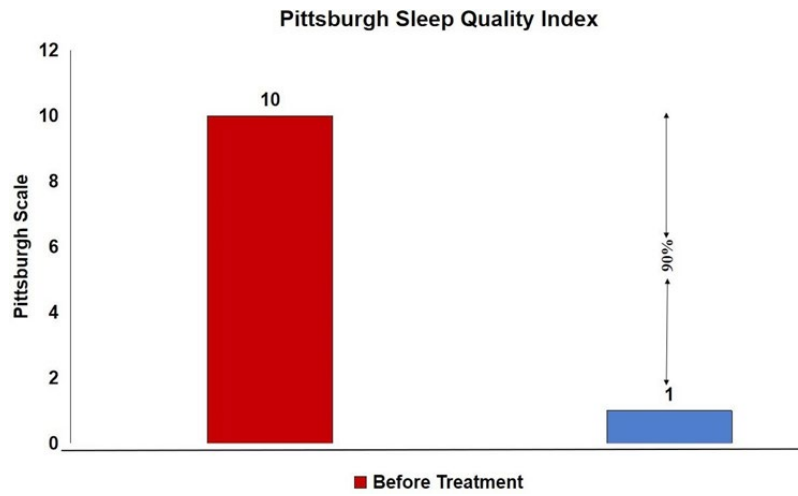


Figure 2: Comparison of the application of laser and ultrasound in relation to the pittsburgh sleep quality index in the gestational context.

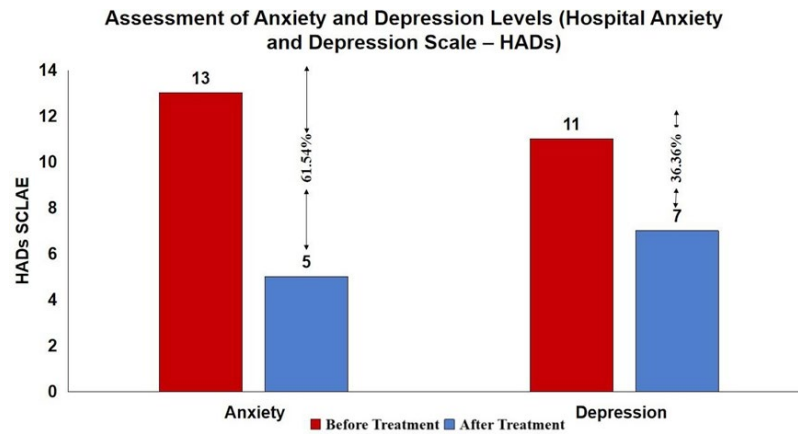


Figure 3: Comparison of the application of laser and ultrasound in relation to the HAD Scale for assessing the level of anxiety and depression in pregnant women.

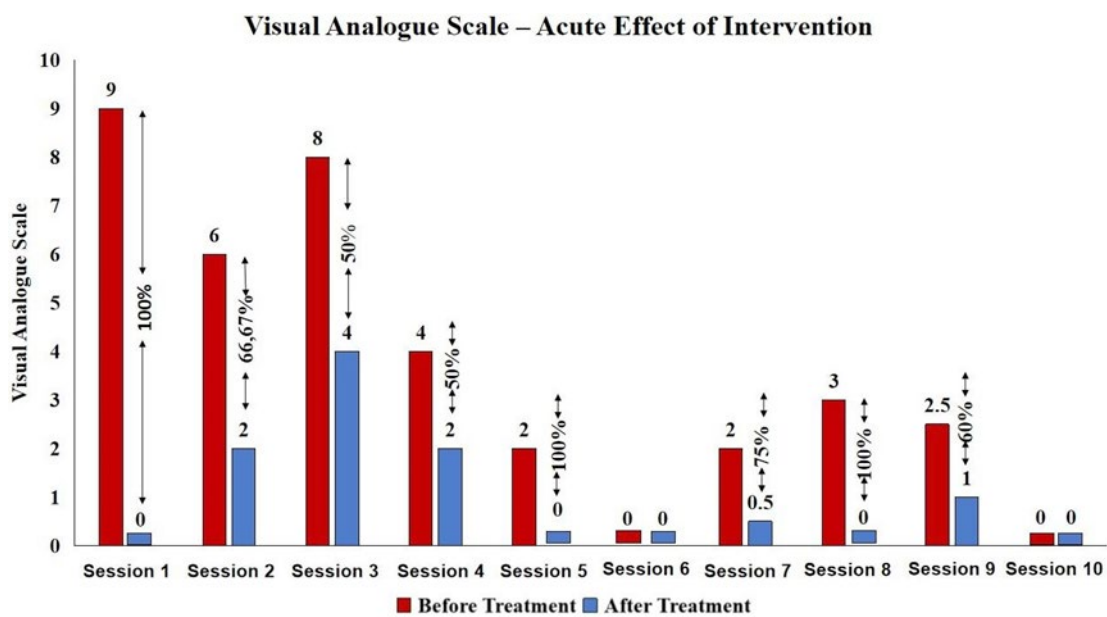


Figure 4: Comparison of the acute effect of the application of laser and ultrasound in relation to the Visual analogue Scale in the Pre and Post Treatment periods during the weeks of gestation.

the fourth session the pre-treatment of 4 for the post-treatment of 2 (improvement of 50%), in the fifth session the pre-treatment of 2 for the post-treatment of 0 (improvement of 100%), in the sixth session the pre-treatment of 0 for the post-treatment of 0, in the seventh session the pre-treatment of 2 for the post-treatment of 0.5 (improvement of 75%), in the eighth session the pre-treatment of 3 for the post-treatment of 0 (improvement of 100%), in the ninth session the pre-treatment of 2.5 for the post-treatment of 1 (improvement of 60%) and in the tenth session pre-treatment from 0 to post-treatment from 0.

## Discussion

Due to the importance and individualization of the gestational process in the life of women and their families, it is extremely important to support their needs during this period, especially in the musculoskeletal system, which is often related to postural changes and its stability, significantly affecting their work activities. Based on the results presented with synergistic laser and ultrasound therapy, it is possible to point out a significant percentage improvement in chronic and acute pain (Figure 1 and Figure 4), quality of sleep (Figure 2) and reduction in the index of anxiety and depression (Figure 3).

Photobiomodulation, through the application model on the palms of the hands and soles of the feet, allows for a differentiated action, which distances the systemic action from a punctual (local) application action. In a way, photobiomodulation occurs through the action of low-power lasers, as well as through the production of the wavelength that corresponds to 660nm (they are absorbed by structures that are easily penetrated by light, which is cytochrome C oxidase), having advantages, such as the reduction of edema and inflammatory processes, analgesic effects and production of ATP, thus allowing the restoration of homeostasis [12,13]. The ultrasound used in physiotherapy is a resource that emits mechanical waves, being them of high frequency, radiating energy through ultrasonic waves, thus observing thermal or non-thermal action [14]. With this in mind, with the increase in tissue temperature, there is an increase in membrane permeability, favoring vascularization, cytokine modulation and nerve conduction speed, increasing the nociceptive threshold, contributing to analgesic and anti-inflammatory effects [9]. Furthermore, through the cavitation process, changes occur in the permeability of ion channels, with a greater ionic transition of the concentration of Ca<sup>2+</sup>, Na<sup>+</sup> and K ions [15].

Our hypothesis comes from a new systemic therapy, the effects of which have been analyzed and measured in the treatment of diseases such as fibromyalgia and psoriatic arthritis [16]. Treatment with the application of laser and ultrasound to the palms of the hands and soles of the feet, initially only studied for these two rheumatic diseases, shows a new means for the application of synergistic action. Synergistic photobiomodulation and ultrasound applied to these regions have proven effective in providing greater conduction and absorption of these resources by nerve endings and peripheral circulation, through afferent pathways towards the central nervous system, with direct action through conduction in the vagus nerve (parasympathetic system) [17]. According to a study by Aquino Jr. et al, on fibromyalgia, the hypothesis is that instead of having acetylcholine degradation, due to the increase in the enzymatic production of acetylcholinesterase, modulation of the acetylcholine molecule itself occurs, reducing the degradation of the acetylcholine molecule, causing stimuli, both sonic and photonic, to reach the desired point, linked to the central nervous system [18,19]. Thus, it is observed that the systemic action acts positively in relation to the reduction in chronic (Figure 1) and acute (Figure 4) pain, and sleep quality (Figure 2). Furthermore, as a positive

cycle, over time, reductions in the levels of anxiety and depression are also observed (Figure 3). In the latter, a reduction in values from 13 to 5 is shown, in relation to anxiety and a reduction from 13 to 7, with a reduction of 61.54% and 36.36%, respectively.

The results obtained show that there was an overall improvement in the patient, with a positive evolution in the anxiety and depression symptoms, as well as in the pain represented on the visual analogue scale. In the analysis, it is possible to observe a positive picture of the therapy used, with a reduction in the factors that affect quality of life. In this context, the synergy of laser and ultrasound on the palms of the hands and soles of the feet can be an accessory mechanism for reducing pain, improving sleep and reducing anxiety and depression, with the aim of bringing the patient back to normal, possibly allowing a better quality of life during pregnancy.

## Conclusion

The impossibility of pharmacological and invasive action during pregnancy promotes the need for non-pharmacological action as an option, making it essential to seek effective therapeutic approaches that preserve the health of the mother and baby. In view of this, the synergistic use of combined laser and ultrasound therapy emerges as a new possibility, being a viable option for this case, due to the initial results presented, acting on chronic and acute pain, sleep quality, anxiety and depression rates, resulting in improved maternal and child quality of life.

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