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USE OF PHOTOBIOMODULATION IN THE TREATMENT OF BREAST POSTPARTUM INTERCURRENCY: INTEGRATIVE REVIEW

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ABSTRACT

Objective: To analyze the evidence available in the literature about the use of photobiomodulation in the treatment of breast complications in the postpartum. **Method:** Integrative review of manuscripts in National Library of Medicine National Institutes of Health (PubMed), Web of Science, Latin American and Caribbean Health Sciences Literature (LILACS), Cumulative Index to Nursing and Allied Health Literature (CINAHL), EMBASE, and Scopus databases. Original articles written in Portuguese and English were included, analyzed according to the level of evidence and methodological quality. **Results:** The sample consisted of five articles. Based on the analysis of the results, three thematic categories were created: types of photobiomodulator used in breast complications, effects of photobiomodulators on healing of breast complications, and effects of photobiomodulators on reducing nipple pain. Both light-emitting diode (LED) and laser photobiomodulators were effective in the treatment of nipple trauma, as the application accelerated the healing process. Low-intensity laser therapy was found to be effective in treating nipple injuries in nursing mothers with pain, providing relief and prolonging exclusive breastfeeding. The single application laser protocol was not effective in reducing pain in women with damaged nipples. **Conclusion:** This study is an effort to mitigate existing gaps between nursing assistance and research, as it contributes to care based on evidence-based practice.

DESCRIPTORS: Breast feeding. Nursing. Enterostomal therapy. Low-level light therapy.

UTILIZAÇÃO DA FOTOBIOMODULAÇÃO NO TRATAMENTO DE INTERCORRÊNCIAS MAMÁRIAS PÓS-PARTO: REVISÃO INTEGRATIVA

RESUMO

Objetivo: Analisar as evidências disponíveis na literatura acerca da utilização da fotobiomodulação no tratamento de intercorrências mamárias pós-parto. **Método:** Revisão integrativa dos manuscritos nas bases de dados National Library of Medicine National Institutes of Health (PubMed), Web of Science, Literatura Latino-Americana e do Caribe em Ciências da Saúde (Lilacs), Cumulative Index to Nursing and Allied Health Literature (CINAHL), EMBASE e Scopus. Foram incluídos artigos originais redigidos em português e inglês, analisados de acordo com o nível de evidência e qualidade metodológica. **Resultados:** A amostra constituiu-se de cinco artigos. Com base na análise dos resultados, foram elaboradas três categorias temáticas: tipos de fotobiomodulador utilizados nas intercorrências mamárias, efeitos do fotobiomodulador na cicatrização das intercorrências mamárias e efeitos do fotobiomodulador na redução da dor mamilar. Tanto o fotobiomodulador de *light-emitting diode* (LED) quanto o de *laser* foram eficazes no tratamento dos traumas mamilares, pois a aplicação proporcionou aceleração do

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processo cicatricial. A terapia com *laser* de baixa intensidade foi considerada eficaz para tratar lesões mamilares em lactantes com dor, oferecendo alívio e prolongando o aleitamento materno exclusivo. O protocolo de *laser* de uma única aplicação não foi eficaz na redução da dor em mulheres com mamilos danificados. **Conclusão:** Este estudo buscou mitigar as lacunas existentes entre assistência e pesquisa em enfermagem, uma vez que contribui para o cuidado pautado na prática baseada em evidências.

DESCRITORES: Aleitamento materno. Enfermagem. Estomaterapia. Terapia com luz de baixa intensidade.

USO DE FOTOBIOMODULACIÓN EN EL TRATAMIENTO DE MAMA INTERMONEDA DESPUÉS DEL PARTO: REVISIÓN INTEGRATIVA

RESUMEN

Objetivo: Objetivo: analizar la evidencia disponible en la literatura sobre el uso de la fotobiomodulación en el tratamiento de las complicaciones mamarias después del parto. **Método:** revisión integradora de manuscritos en las bases de datos PubMed, Web of Science, LILACS, CINAHL, EMBASE y Scopus. Se incluyeron artículos originales escritos en portugués e inglés, analizados según nivel de evidencia y calidad metodológica. **Resultados:** la muestra estuvo compuesta por cinco artículos. Con base en el análisis de los resultados, se crearon tres categorías temáticas: tipos de fotobiomoduladores utilizados en las complicaciones mamarias, efectos de los fotobiomoduladores en la curación de las complicaciones mamarias y efectos de los fotobiomoduladores en la reducción del dolor en los pezones. Tanto el fotobiomodulador LED como el LÁSER resultaron efectivos en el tratamiento del trauma del pezón, ya que su aplicación aceleró el proceso de cicatrización. Se descubrió que la terapia con láser de baja intensidad es eficaz en el tratamiento de lesiones en los pezones en bebés con dolor, proporcionando alivio y prolongando la lactancia materna exclusiva. El protocolo LASER de aplicación única no fue efectivo para reducir el dolor en mujeres con pezones dañados. **Conclusión:** Este estudio buscó mitigar las brechas existentes entre el cuidado de enfermería y la investigación, ya que contribuye al cuidado basado en la práctica basada en la evidencias.

DESCRIPTORES: Lactancia materna. Enfermería. Estomaterapia. Terapia por luz de baja intensidad.

INTRODUCTION

Breast complications may appear between the first and tenth day postpartum, a period of adaptation to the breastfeeding process, whose regularity is still unstable[1].

These intercurrences negatively interfere with breastfeeding (BF), an isolated strategy that most prevents child morbidity and mortality since it promotes the physical, mental and psychic health of the infant and nursing mother[2,3]. Breast complications include breast engorgement, pain and nipple trauma (NT), mastitis, duct blockage and abscess[1].

Breast engorgement comes from three factors: congestion or increased vascularization of the breast, milk retention in the alveoli, and edema due to congestion and obstruction of lymphatic system drainage. Thus, the compression of the lactiferous ducts hinders or prevents milk output from the alveoli. Therefore, as there is no relief, milk production may be interrupted with subsequent reabsorption of the dammed milk, and the milk accumulated in the breast under pressure becomes more viscous. Hence the origin of the well-known term "hardened milk"[4].

About the pain in the nipples, it may be the result of strong sucking on the nipples and the areola. It is considered normal if the pain is of slight or moderate intensity. Still, it should not last longer than the first week, as injuries to the nipples resulting from inadequate positioning and latching are the most common causes of pain during breastfeeding[4].

NT produces discomfort and pain in the breastfeeding woman, impairs exclusive breastfeeding and contributes to encouraging the offer of another food to the infant, which can result in low milk production or even cease production, leading to early weaning[5]. It frequently occurs while still in the maternity ward or even within the first seven days postpartum, and, according to the literature, the prevalence ranges from 11 to 96%, with a mean frequency of 43.6 to 46.9%[6,7]. Depending on its extent and severity, NT healing time varies and can last from 24 hours to 28 days, on average, one or two weeks[6,8].

It should be noted that, in addition to the pain caused and the risk of weaning, NT is associated with maternal depression and anxiety. It is also a determining factor for puerperal mastitis, an initial inflammatory process resulting from breast engorgement. Afterward, bacterial proliferation occurs, especially in the presence of nipple trauma, and the process becomes infectious and may progress to more severe conditions, such as breast abscesses and sepsis[9].

In turn, breast abscess is an acute infectious process resulting from mastitis, forming "lodges", single or multiple, which can progress to breast tissue necrosis. In addition to intense pain, it can cause prostration and a significant drop in the woman's general condition. During treatment, BF can be temporarily suspended in the affected breast, with emptying done by manual, mechanical or electrical breast milk extraction[9].

Treating breast complications often involves the topical application of drugs that, in addition to presenting unsatisfactory results and complications, can often lead to interruption of breastfeeding during the treatment period and contribute to early weaning[10].

In a scenario that encourages BF[3,4], puerperal women still face difficulties in breastfeeding due to breast complications, despite the support of trained professionals and the use of traditional methods of breast treatment. Given the benefits of photobiomodulation, the following concern arose: what evidence is available in the literature regarding the use of photobiomodulation in treating breast complications?

Considering the above, this study aimed to analyze the evidence available in the literature about using photobiomodulation to treat breast complications.

METHOD

The integrative review was used as a methodology since it included the analysis of relevant research that supports decision-making and improvement of clinical practice based on the best evidence.[11,12].

Conducting this integrative review covered the six stages proposed by Mendes et al.12:elaboration of the research question, sampling or literature search of primary studies, data extraction, evaluation of primary/original studies, analysis and synthesis of results and presentation of the review. PRISMA recommendations were followed[13], and the protocol was registered in the Figshare repository under DOI number: 10.6084/m9.figshare.18426893.

Thus, the theme was identified, and the guiding question was formulated: what evidence is available in the literature about using photobiomodulation to treat breast complications?

The acronym PICO (an acronym for patient, intervention, comparison and outcomes) was used to construct the question above, in which patient (P) are postpartum women with breast complications, intervention (I) is photobiomodulation, comparison (C) does not apply, and outcomes (O) is the treatment of breast complications by health professionals[14].

As inclusion criteria, we used primary studies published in English, Portuguese and Spanish that answered the guiding question without a time frame. Review protocols, reviews, experience reports, case studies, editorials, letters to the editor, dissertations, theses and annals of events were excluded. The search for scientific articles took place on January 28, 2022, by the two reviewers.

The following databases were used to search for primary studies: National Library of Medicine National Institutes of Health (PubMed), Web of Science (WOS), *Literatura Latino-Americana e do Caribe em Ciências da Saúde* (LILACS), Cumulative Index to Nursing and Allied Health Literature (CINAHL), Biomedical Answer (EMBASE) and Scopus (Elsevier). For this purpose, the Medical Subject Headings (MeSH) controlled descriptors were used for the PubMed, WOS and Scopus databases; *Descritores em Ciências da Saúde* (DeCS) for LILACS, CINAHL databases; Subject Headings for the CINAHL base; and Emtree for the EMBASE base. The descriptors were interspersed with the Boolean operators "AND" and "OR". In this way, a single strategy adapted for each database listed was outlined.

The reference manager EndNote Web[15] (CLARIVATE) was used to manage references and verify duplicated studies. After excluding the identified duplications, the studies were exported to the Rayyan software, and the duplication identification process was performed again, excluding those identified. Then, the selection process of those studies that responded to the guiding question was started[16]. The first step was reading the titles and abstracts to select studies included in this review. In

the second stage, the studies were read in full. Both steps were carried out by blind analysis by two independent reviewers, and a third reviewer was contacted to resolve disagreements.

Fernandes' instrument[17] was used to extract information from the included studies and adapted to the study, adding the variable "country of development". The levels of evidence strength of the primary studies were classified according to the Polit and Beck design[18], and, for a critical evaluation of the methodological quality of the quantitative studies, the Guideline Critical Review Form for Quantitative Studies, developed by the McMaster University Occupational Therapy Evidence-Based Practice Research Group, was used[19].

RESULTS

The search path for articles can be viewed in the flowchart, as shown in Fig. 1. Afterwards, the synthesis of each study was carried out, as well as the analysis of the methodological quality and the assessment of the level of evidence of the included studies.

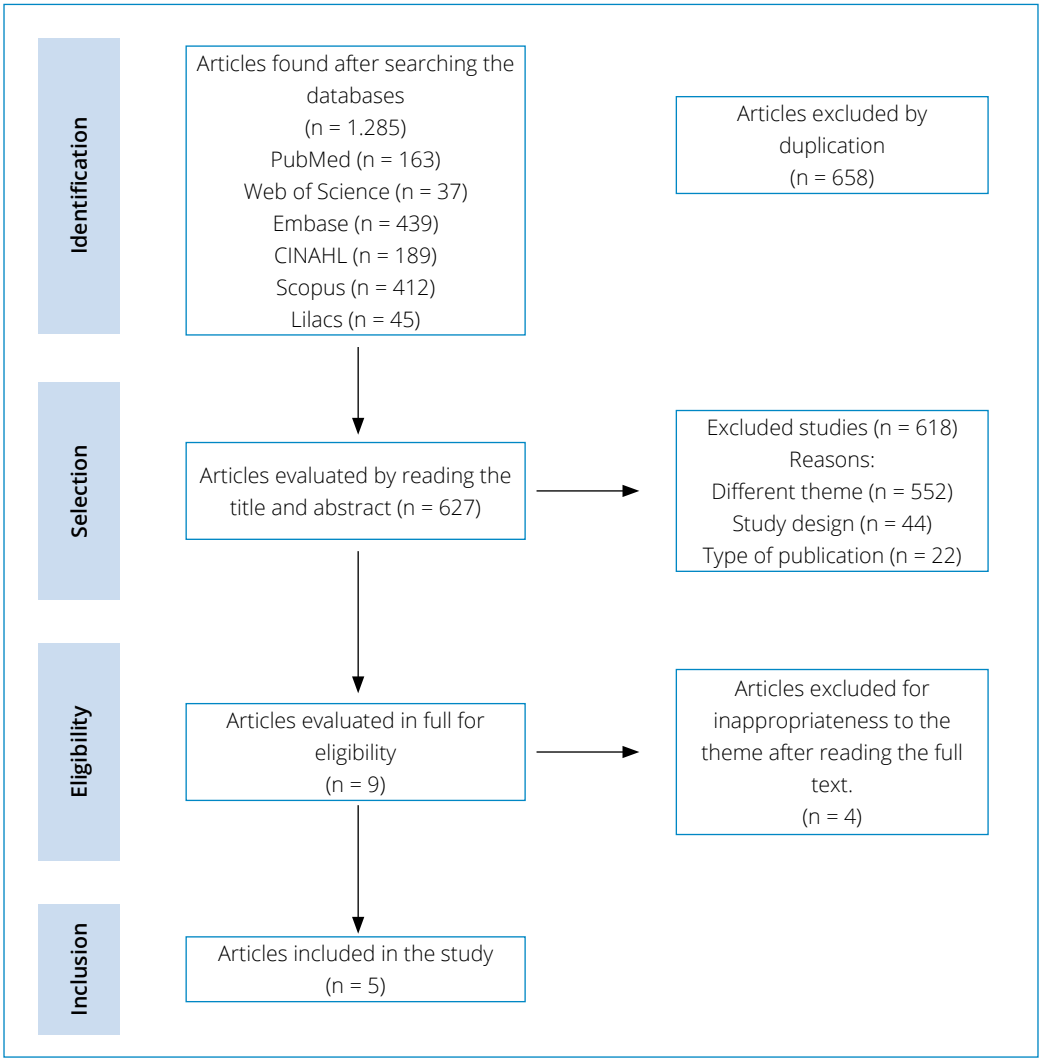

Figure 1. Flowchart of the study selection process.

PubMed: National Library of Medicine National Institutes of Health; Lilacs: *Literatura Latino-Americana e do Caribe em Ciências da Saúde*; CINAHL: Cumulative Index to Nursing and Allied Health Literature.

Source: Adapted from PRISMA flowchart[13].

Table 1 presents the description of the studies used in this review.

Table 1. Distribution of articles by authors, title, journal, year, language, type of study, country of publication/development and level of evidence. Alfenas, Minas Gerais, Brasil, 2022.

Authors	Title	Journal	Year	Language	Kind of study	Country of Publica-tion/ Development	Level of evidence
Araújo et al.[20] (E1)	*"Fotobiomodulação como uma nova abordagem para o tratamento de traumas mamilares: um estudo piloto, randomi-zado e controla-do"*	*Fisioterapia Brasil*	2013	Português	Pilot, randomized, controlled study	Brasil/Brasil	II
Camargo et al.[21] (E2)	"The effect of a single low-level laser irradiation on nipple pain in breastfeeding women: a randomized controlled trial"	*Lasers in Medical Science*	2020	Inglês	Double-blind randomized controlled trial	Inglaterra/Brasil	II
Coca et al.[22] (E3)	"Effectiveness of low-level laser therapy for relie-ving nipple pain in breastfeeding women: a triple-blind, randomized, controlled trial"	*Pain Management Nursing*	2016	Inglês	Clinical, triple-blind, randomized study	Estados Unidos da América/Brasil	II
Chaves et al.[23] (E4)	"LED phototherapy improves healing of nipple trauma: a pilot study."	*Photomedicine and Laser Surgery*	2012	Inglês	Pilot, randomized, controlled clinical study	Estados Unidos da América/Brasil	II
Nogueira et al.[24] (E5)	*"Laser de baixo nível: custo da terapia para trauma mamilar"*	*Revista Brasileira de Saúde Materno Infantil*	2021	Português	Randomized clinical trial	Brasil/Brasil	II

Of the five articles included in the integrative review, it was found that three were published in English and two in Portuguese. Among the countries of publication, two studies were published in Brazil, two in the United States of America and one in England. It should be noted that all research was carried out in Brazil. Concerning the journals, there was diversity, with one study being found in each of the following journals: *Fisioterapia Brasil, Lasers in Medical Science, Pain Management Nursing, Photomedicine* and *Laser Surgery and Revista Brasileira de Saúde Materno Infantil.* Regarding the profession of researchers, different domains were observed. Thus, the studies had the participation of the following professionals: three involved nurses, three were physiotherapists, and two were dentists. As for the involvement of doctors, engineers and psychologists, only one study contemplated the presence of these professionals.

Regarding the limitations presented in the articles included in the integrative review, the sample size predominated: a small number of participants in two studies. The non-exclusion of women with low pain intensity, the non-stratification of pain and the withdrawal of participants were also identified in the studies. As for the year the studies were carried out, there was diversity: two studies are more recent, published in the years 2020 and 2021, and the others occurred in 2012, 2013 and 2016.

According to design[18], all studies were identified as evidence level II, i.e., randomized clinical trials.

According to Table 2, concerning the analysis of methodological quality, the studies met most of the criteria of the instrument used.

Table 2. Analysis of the methodological quality of the included studies.

Critical review of quantitative studies		E1	E2	E3	E4	E5
Objective	Purpose clarity? (Yes/No)	Y	Y	Y	Y	Y
Literature	Was a review of the relevant literature carried out on this topic?	Y	Y	Y	Y	Y
Design	Design description (randomized clinical tri-al/cohort / single case / before and after / case-control / cross-sectional / case study / longitu-dinal)	Y	Y	Y	Y	Y
Sample	Sample described in detail (yes/no)	Y	Y	Y	Y	Y
	Justification for sample size presented (yes /no/not applicable)	Y	Y	Y	Y	Y
Outcomes	Reliable outcome measures (yes/no/not infor-med)	Y	Y	Y	Y	Y
	Valid outcome measures (yes /no/not infor-med)	Y	Y	Y	Y	Y
Intervention	Intervention described in detail (yes/no/not informed)	Y	Y	Y	Y	Y
	Contamination was avoided (yes/no /not in-formed/not applicable)	NI	NI	NI	NI	NI
	Simultaneous intervention was avoided (yes/no /not informed /not applicable)	NI	NI	NI	NI	NI
Results	Results reported in terms of statistical signifi-cance (yes/no/not informed /not applicable)	Y	Y	Y	Y	Y
	Appropriate analysis methods (yes/no /not in-formed)	Y	Y	Y	Y	Y
	Clinical importance was reported (yes/no/not informed)	Y	Y	Y	Y	Y
	Report of participants who dropped out of the study (yes/no)	N	N	Y	N	N
Conclusions and clinical implications	Conclusions consistent with the methods and results obtained (yes/no)	Y	Y	Y	Y	Y

N: no; NI: not informed; Y: yes. Source: adapted from Law et al.[19].

The studies met most of the criteria of the instrument used. Only the item "participants drop out of the study" was not informed in E1, E2, E4 and E5. The items "contamination was avoided" and "simultaneous intervention was avoided" were not reported in the five studies either.

After reading the results, three categories were created: types of photobiomodulation used in breast complications, effects of photobiomodulation on healing breast complications, and effects of photobiomodulation on reducing nipple pain.

DISCUSSION

Types of photobiomodulation used in the treatment of breast complications

In the included studies, it was observed that photobiomodulation is a resource that uses electromagnetic waves in the spectral range from red to near-infrared, which is applied to tissues employing low-power luminous devices, such as

light amplification by stimulated radiation (laser) and the light-emitting diode (LED)[22], being considered an innovative procedure of great utility in the treatment of fissure and nipple pain[21,22].

The first studies on photobiomodulation appeared approximately 50 years ago. In the 1960s and 70s, Eastern European, mainly Soviet and Hungarian doctors, actively developed laser biostimulation. The Hungarian Endre Mester presented the first reports of clinical applications of low-intensity laser therapy in 1966, who used ruby lasers to heal chronic ulcers of the lower limbs[25]. However, the helium-neon laser (HeNe) was the first commercially viable coherent light device widely used by several researchers in *in vitro* and *in vivo* studies.[26].

The effectiveness of the LED in the healing of nipple trauma was identified with a prototype emitting electromagnetic waves in the near-infrared spectral range, being an effective instrument for the clinical treatment of nipple injuries in puerperal women[22]. The effects of light on tissues depend on the light treatment parameters, mainly the wavelength (nm) and fluence (J/cm^2)[23].

By conducting a pilot, randomized, controlled study, researchers[23]observed that the intervention with LED phototherapy also had advantages, such as ease of application, cost × benefit and acceptance by breastfeeding women; however, LED as a light source differs in relation to the laser. LED therapy has a limited literary basis, distinguishing itself from laser for emitting polychromatic and non-coherent light[27].

LEDs are semiconductors that convert electric current into light energy and have been used as equipment that exert a therapeutic effect on tissues. There are no reports of side effects. Furthermore, these devices can be produced in a wide range of wavelengths, from ultraviolet, through the visible spectrum to infrared (247 to 1,300 nm). As for the cost, the LED has a lower price and the practicality of being organized in devices that illuminate larger surfaces, compared to the laser.[28].

As for the generation of light, in the LED, the light is produced by a mechanism of spontaneous emission of radiation, and in the laser, the emission of light is stimulated by a radioactive substance, such as helium-neon gases (HeNe), gallium arsenide (GaAs), gallium-aluminum arsenide (GaAsAl), among others. In LED, the conversion of an electric current into a spectrum of light by applying an electrical source is called electroluminescence[29].

Based on this distinction, the structural and functional differences between the two devices stem. Thus, three main properties differentiate the type of light resulting from an LED device from that produced by the laser or by ordinary light: monochromaticity, collimation and coherence[30].

Concerning monochromaticity, most of the generated light is grouped into a single wavelength and has a single color. This property, unlike sunlight, can be found in both LED and laser. Conversely, collimation concerns the distribution of rays and happens when all photons walk parallel in the same direction, as with the laser and not with the LED. Thus, the laser's light beam maintains the diameter from the origin to the end (non-diverging). The coherence of light, in turn, refers to how photons travel in space and time and occurs when waves of the same length are routed synchronously, as in the case of a laser. This last characteristic occurs to a lesser extent with LED-generated light. It does not happen with ordinary light since several waves are emitted asynchronously, each with a different frequency and wavelength[30].

Concerning the types of laser in the health area, there are two types: those with high intensity of irradiated light, which is generally more used in conservative surgical procedures, and Low-Level Laser Therapy (LLLT), which provides analgesia, healing, stimulation of tissue biomodulation and anti-inflammatory effect[31].

This type of treatment has been used by various health professionals, such as nurses, physiotherapists, dentists, speech therapists, and doctors, considering that each one works within limits defined by their professional bodies[21], corroborating, thus, the studies found in this review, whose authors transit between nurses, physiotherapists, doctors, engineers, dentists and psychologists, in their different contributions[20-23].

Concerning nursing, treatment with LLLT is duly regulated by the Federal Nursing Council (*Conselho Federal de Enfermagem-Cofen*) of Brazil; through Cofen opinion No. 13/2018[32], specific training is necessary so that the nurse can use photobiomodulation during the implementation of nursing care, which is also highlighted in the analyzed study[21]. The authors point out that the professional who applies photobiomodulation must have prior knowledge regarding the

operation and parameters of the laser, in addition to knowledge of physics, biophotonics, laser interaction and biological tissue and dosimetry and deepening in physiology and rehabilitation[21].

Effects of photobiomodulation on wound healing

Wound healing is a response to injury that begins after the loss of skin integrity, which occurs by replacing damaged tissue with living tissue, restoring its continuity. This healing process occurs through a new granulation tissue formation with a high density of blood, vessels and capillaries and epithelialization[33].

In the developed study[20], it was found that, after the intervention and application of photobiomodulation using LED, the participants' nipple injuries were initially classified as small and medium fissures. The percentage reduction in the size of nipple lesions was 54.5% in the control group and 74.1% in the experimental group. In the control group, 50% of the lesions evolved to complete healing, and the others reduced in size, changing from medium to small fissures. In the experimental group, the cure rate was 100%.

Tissue repair is favored by light in the spectral range from red to infrared. This benefit is a consequence of the physiological effects of light, including the stimulation of the synthesis of adenosine triphosphate (ATP) and growth factors, the increase in fibroblast proliferation and collagen production. The production of new ATP molecules occurs quickly after tissue radiation with light, favoring the metabolic activity of fibroblasts. Fibroblasts secrete fibronectin, proteoglycans and collagen fibers, especially type III. Subsequently, the remodeling and strengthening of the newly formed tissue occur, and the proportion of type I collagen increases in relation to type III collagen. The phototherapeutic stimulus favors the remodeling process and tensile strength development, justifying the better healing observed in the experimental group[20,34].

Acceleration of the healing process and pain control with LED stand out as a bio stimulator, presenting the biological results already described[35,36], corroborating the studies that evaluated the healing process when using the LED20,23. The same effects were found in laser treatment 37, which the findings of another study[22] can confirm by proving its effectiveness in treating nipple injuries and pain relief in nursing mothers.

Regarding the wavelength, the red laser is the most suitable for healing, as it acts on the most superficial layer of the tissue. In the study that evaluated the use of photobiomodulation in the recovery of pressure ulcers in diabetic humans using a red diode (685 nm) and a dose of 10 J/cm^2, there was a significant reduction in the size of the wound after the procedure, accompanied by an improvement in biochemical markers in the tissue regeneration[38].

The penetration of LLLT into the skin occurs more precisely in the mitochondrial membrane, increasing the proton rhythm and, consequently, the cellular energy level through biochemical and electrochemical changes in the mitochondrial membranes that help in the healing process. When there is some injury, these ATP levels are reduced. Still, biostimulation improves its synthesis, promoting increased nutrients and oxygen at the site, increasing tissue energy and, therefore, increasing cell division, enhancing the healing process[39,40].

Thus, effective healing may be related to inhibiting inflammatory processes in the wound and stimulating angiogenesis and fibroblast proliferation in specific radiatio[n41].

Such described processes can be identified in the study whose clinical efficacy of a LED phototherapy prototype in healing nipple trauma was proven in a pilot, randomized, controlled clinical study by identifying the success in healing nipple injuries in the participants of the experimental group when compared with those of the control group[23].

Furthermore, it was possible to identify the percentage reduction in the size of nipple lesions, 54.5% in the control group and 74.1% in the experimental group. The interventions carried out involved guidance and photobiomodulation. Both promoted a reduction in the size of nipple lesions, but significant results were found in the group in which the device was applied. The improvement observed in the control group was explained by the adherence to guidelines regarding breast care, as well as proper positioning and latching of the infant[20].

Because of the increasingly frequent use of this type of treatment, a randomized clinical trial measured the micro-costing of the application of local laser and intravascular laser irradiation of blood (ILIB) in treating nipple trauma and compared the most effective and efficient treatment alternatives. The control group received information regarding the proper management of breastfeeding; the local laser group, in addition to the guidelines, received local laser irradiation, punctual, with contact; and the ILIB group, apart from the guidelines, received the ILIB. It was possible to identify that, after three sessions, the average final cost was R$ 40.04 for the control group, R$ 53.55 for the local laser group and R$ 67.29 for the ILIB group. The ILIB group showed a more significant reduction in the area of the lesion but at a higher cost[33].

The average cost of the sessions that used photobiomodulation for the treatment of the local laser group and the ILIB group was higher when compared to that of the control group, which was only instructed regarding clinical management. The first session had a higher cost than the third, comparing the costs between sessions in the control group. This reduction may derive from educational actions aligned with technical, scientific and practical knowledge, well established in the first session, causing the professional to spend less time in other consultations[33].

Because this study does not address the treatment of ILIB, the cost comparison can be performed between the control group and the local laser group, which demonstrates that in the intervention with local laser (hard technology), the cost is relatively high when compared to the guidelines (soft-hard technologies). It is possible to infer that the longer the procedure, the higher the cost of each session[33].

The easy handling and good effects of tissue repair at any depth make the HeNe laser and the LED frequently used today[40].

Effects of photobiomodulation on pain reduction

Breast pain or discomfort was reported by approximately 80 to 96% of women in the first few weeks after childbirth, and 26% cited extreme or unbearable pain. Pain associated with trauma may be one of the precipitating factors for weaning[9].

LLLT is a non-invasive therapy in which light beams are absorbed by epithelial tissues, acting on biostimulation directly on mitochondria, causing them to produce more ATP and lower oxygen consumption. In addition to the already mentioned effects, it promotes the elevation of serotonin and endorphin levels and decreases those of prostaglandin and interleukin beta, reducing pain[39].

Like monochromaticity, coherence and collimation are laser-specific properties. Dosimetry, potency and time are just as relevant as they modulate the phototherapeutic device, which at low intensity provides analgesic effects[40].

Some of the main justifications for using light devices to modulate pain are the stimulation of local microcirculation and the changes induced in nociceptive afferents and the central nervous system. Light can cause increases in B-endorphin levels in spinal fluid and urinary excretion of glucocorticoids and serotonin. Decreased release of halogen substances, such as bradykinin, acetylcholine and prostaglandin-2, and a complex electrolyte-blocking mechanism of nerve fibers are proposed as theories to explain the effects induced by light therapy on pain control[20].

As for the wavelength, for analgesic, anti-inflammatory and anti-edematous action, infrared is indicated, as it has deeper absorption, acting directly on muscle and nervous tissue, and should be applied in all pain situations[42,43].

This analgesic effect is conferred due to the absorption of light beams by nociceptors by infrared electromagnetic waves between 780 and 910 nm[44].

Regarding the satisfactory reduction of pain, it was possible to observe that, in the continuous emission with infrared wavelength, after treatment for six consecutive weeks, with three sessions per week, on alternate days, totaling 18 sessions, both in the experimental group and in the group control, the mean reduction was 81.5 and 73.6%, respectively[20].

Anyway, the number of applications can be relevant to reach a satisfactory result or not. In women with damaged nipples, when compared to the control group, it was possible to identify that a single application's laser protocol was ineffective in reducing pain. Of the women who received the treatment, 31% perceived tingling and stinging sensation after laser application[21].

LLLT therapy, however, was considered adequate for treating nipple injuries in painful infants, providing relief and prolonging exclusive BF22. In a study, women received three applications for 0, 24 and 48 hours after the injury diagnosis. Thus, the intervention group experienced a reduction in pain intensity 24 hours after the first intervention and had lower pain levels than the control group[22].

A developed study[23] corroborates the results of another research 22 because it observed a reduction in the intensity of pain in the participants of the experimental group when compared to those in the control group when performing the intervention with LED phototherapy.

Thus, in addition to the tissue repair effect, the HeNe laser and the diode are the most requested, due to their anti-inflammatory and analgesic effects, by releasing natural endorphins[40].

CONCLUSION

The findings of this study showed the use of photobiomodulation by different health professionals, as well as the types applied in breast complications, their effects on wound healing and the reduction of nipple pain.

Thus, it was identified that both the LED photobiomodulation and the laser effectively treated nipple trauma, as the application accelerated the healing process. LLLT therapy was considered adequate for treating nipple injuries in painful nursing mothers, providing relief and prolonging exclusive BF. The single-application laser protocol was ineffective in reducing pain in women with damaged nipples; however, as evidenced by a few studies, further investigations must reinforce this statement.

The limitation found in carrying out this study was the need for more productions on this theme, mainly by nurses. These professionals should carry out and/or disseminate primary studies to contribute to relevant research and support and legitimize nursing care.

This study aims to mitigate the gaps between nursing care and research, as it contributes to evidence-based care practice using LLLT in treating breast complications.

AUTHORS' CONTRIBUTION

Substantive scientific and intellectual contributions to the study: Oliveira AG, Paraizo-Horvath CMS, Terra FS and Dázio EMR; **Concept and design:** Oliveira AG, Terra FS and Dázio EMR. **Collection, analysis and interpretation of data:** Oliveira AG, Paraizo-Horvath CMS, Terra FS and Dázio EMR; **Article writing:** Oliveira AG, Paraizo-Horvath CMS, Leite EPRC, Freitas PS, Terra FS and Dázio EMR; **Critical review:** Oliveira AG, Freitas PS, Terra FS and Dázio EMR; **Final approval:** Oliveira AG, Terra FS and Dázio EMR.

DATA STATEMENT AVAILABILITY

Data will be made available upon request.

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