

**THE PHYSIOLOGY OF MENSTRUAL PAIN AND THE EFFECTIVENESS OF TECHNOLOGY-BASED PAIN MANAGEMENT TECHNIQUES**

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**Abstract:** Dysmenorrhea or menstrual pain significantly affects the quality of life for many women, necessitating effective and non-invasive pain management strategies. This study systematically reviewed existing literature on the physiological causes of menstrual pain and the effectiveness of technology-based pain relief techniques. The review shows that menstrual pain is mainly regulated by the hypothalamus-pituitary-ovary axis, with prostaglandins and inflammatory cytokines playing key roles. Also, stress and anxiety can amplify menstrual discomfort. It also uncovers several technology-based interventions for effective pain management, including Transcutaneous Electrical Nerve Stimulation (TENS), heat therapy, mobile apps, virtual reality (VR), and wearable tech. However, potential risks and limitations of these interventions, such as overreliance, data security, limited accessibility, varying effectiveness, cost, user acceptance, and lack of human contact, were also identified. Despite these limitations, technology-based pain management techniques represent promising non-invasive alternatives for managing menstrual discomfort. Additional high-quality research is needed to further validate the efficacy of these approaches and address potential risks.

Relevance. Dysmenorrhea, another name for menstrual discomfort, is a frequent condition among women of reproductive age. Around 80% of women experience period pain at some stage in their lifetime [1], which may materially affect their day-to-day activities and quality of life. Menstrual pain is common, but many women hesitate to utilize medicine or seek medical assistance because they worry about the unwanted effects. As a result, women need access to and use pain treatment methods that are both efficient and non-invasive. This study aims to investigate the physiology of menstruation pain and the efficacy of technology-based pain treatment strategies.

Purpose of Study. This study aims to examine the physiological factors that underlie menstruation pain and assess the efficiency of technology-based pain treatment strategies. It focuses on the following:

- Review recent research on the physiology of menstrual pain;
- Assess the efficiency of technology-based pain management techniques, such as wearables, mobile apps, and virtual reality;
- Identify any potential risks or drawbacks of using technology-based pain management techniques;

Materials and Methods. A systematic assessment of the publications on menstrual pain and technology-based pain management strategies to accomplish our research goals. Terms including "dysmenorrhea," "future technologies," and "pain management" were searched in numerous databases, including PubMed, Scholar, and Web of Science. Only articles released in English between 2010 and 2022 were included in the search.

Research Results. The systematic review uncovered a number of research that investigated the physiology of menstruation pain and assessed the efficiency of technology-based pain relief methods. Below is the overview of what was discovered.

Physiology of menstrual pain: The axis between the hypothalamus, pituitary, and ovary controls the menstrual cycle. Gonadotropin-releasing hormone (GnRH), which is released by the brain's hypothalamus, stimulates the pituitary gland to release follicle-stimulating hormone (FSH) and luteinizing hormone (LH). The ovaries are subsequently stimulated by FSH and LH to create estrogen and progesterone. Progesterone gets the uterus ready for the prospective implantation of a fertilized egg, while estrogen encourages the growth and development of the uterine lining. The uterus contracts during menstruation to release the menstrual blood and tissue. Prostaglandins, which are hormone-like molecules made by the uterine lining, act as a mediator for these contractions. The uterus is stimulated to contract by prostaglandins, which aid in the menstrual blood's discharge. Nonetheless, uncomfortable and painful contractions may occur when prostaglandin levels are high.

Menstrual discomfort may be caused by a variety of reasons in addition to prostaglandins. For instance, women with dysmenorrhea have been reported to have higher levels of inflammatory cytokines such as interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF-alpha). These cytokines could factor in the discomfort and swelling related to menstrual cramps. Menstrual discomfort may also result from psychological reasons. According to studies, high levels of stress and anxiety have been linked to a higher risk of severe menstruation pain in women. This may be because anxiety and stress can raise cortisol and many other stress hormone levels, worsening pain and inflammation.

Technology-based pain management techniques: Menstrual pain management methods based on technology offer a different strategy without the risk of negative side effects. Electrical stimulation of the nerves through the skin (TENS) A safe, drug-free, and non-invasive pain management method is TENS. It uses a tiny battery-operated gadget to deliver electrical impulses to the nerves through the skin. Endorphins, the body's natural painkillers, are released as a result of these impulses. By putting the electrodes on the lower abdomen or back, TENS can be utilized to treat menstruation discomfort. Several studies have demonstrated the positive effects of TENS in reducing pain and related primary dysmenorrhea symptoms, the improvement of the quality of life, and the decreased use of additional analgesics[2].

Heat Therapy: Using heat treatment to treat menstruation pain is a straightforward and successful pain management strategy. To relax the muscles and relieve the pain, apply heat to the lower abdomen or back. A heating pad, bottle of hot water, or heated towel can be used to provide heat. Women can continue their regular activities while controlling their discomfort thanks to certain more recent technology, including covertly worn heat wraps and portable heating pads. There is a trend toward a reduction in menstrual pain with heat therapy compared with analgesic drugs [3].

Mobile apps: Using a mobile app to manage menstruation discomfort can be helpful. Several apps that track menstrual cycles and offer individualized pain management techniques are available. Also, several applications provide breathing and relaxation techniques to assist women in managing their pain. Women can easily access information and help when using mobile apps for pain management. Many studies have demonstrated the value of mobile apps in treating menstruation discomfort.

Virtual Reality (VR): VR is a more recent device being researched for pain management. VR includes donning a headset to submerge the user in a digital setting that can dull their pain. VR may help with menstrual pain and has been shown in some studies to be helpful in managing

chronic pain. In order to concentrate on a soothing virtual environment instead of their immediate surroundings, women can use VR technology, which can help them feel less pain and stress.

**Wearable tech:** The efficacy of wearable tech in easing menstrual discomfort has also been tested, including transcutaneous electrical nerve stimulation (TENS) and heat patches. TENS uses electrical stimulation to block pain impulses on the skin. It has also been demonstrated that using heat patches, which apply warmth to the lower abdomen, can lessen menstrual discomfort.

**Potential risks or limitations:** **Overreliance:** The use of technologically based pain management methods may result in an unhealthy reliance on them. Patients who use these methods frequently may become reliant on them and be unable to control their pain without them.

**Data security:** Personal data, such as health data, is collected by wearable technology and mobile apps, where it may be vulnerable to unauthorized access. Identity theft and privacy violations may come from this.

**Limited accessibility:** People without access to smartphones, wearable technology, or steady internet connections may find it difficult to use technology-based pain management methods.

**Effectiveness:** Depending on the individual, technology-based pain management techniques may be unsuccessful. They might not be sufficient for all patients to manage their menstrual discomfort. For mobile apps, quality measured through the Mobile App Rating Scale (MARS) was found to be acceptable; however, the apps ability to impact pain and symptom management was rated as low. Only 10 % of apps had interventions designed to manage pain [4].

**Cost:** Pain management methods dependent on technology can be pricey, and not all people may be able to pay for them. Because of this, they may not be as accessible to those with lesser incomes.

**User acceptance:** To use technology-based pain management methods, users must feel at ease using them. Some individuals, especially the elderly or those with disabilities, may be unwilling to use these techniques.

**Human contact is lacking.** In comparison to more conventional pain management methods like talk therapy or physical therapy, technology-based pain management techniques do not offer the same degree of interpersonal interaction. This may challenge some patients who depend on others for support or advice in managing their menstrual discomfort.

**Conclusion.** Our analysis indicates that technology-based pain treatment strategies, such as smartphone apps, wearable technologies, and virtual reality, may reduce menstruation pain. Thanks to technology-based pain management strategies, women who want to effectively control their menstrual pain have extra options. These safe, non-invasive approaches, including TENS, heat therapy, mobile apps, and virtual reality, can be used with more conventional pain management techniques. Women should discuss the optimal pain management plan with their healthcare physician and consider using technology-based strategies as a component of their comprehensive pain treatment. However, additional high-quality research is required to support these conclusions and pinpoint potential dangers or restrictions. These treatments might provide a simple, non-invasive replacement for conventional pain relief techniques. Healthcare professionals and researchers need to stay current on the most recent technological breakthroughs as this field develops.

## References

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