



# Dysmenorrhea Reliever and Posture Support Belt with a Combination of Heat and Vibration Therapy

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**Abstract :** Menstrual cramps (Primary Dysmenorrhea) are cramping pains in the lower abdomen just before and during a woman's menstrual cycle. Menstrual cramps don't cause medical complications, but they can interfere with school, work and social activities. The goal of this project is to provide pain treatment to individuals suffering from the pain caused due to their menstrual cycle in three ways: heat therapy, vibration therapy, and posture support with the help of a 3-in-1 belt that can be worn on the abdomen and lower back. The main idea of the project is to improve the blood flow to the abdomen region of the body.

**IndexTerms - Primary dysmenorrhea, menstrual cramps, heat therapy, vibration therapy, posture support, blood flow**

## I. INTRODUCTION

Dysmenorrhea occurs soon before or during menstruation, is a painful or cramping sensation in the lower abdomen that is frequently accompanied by other biological symptoms including exhaustion, perspiration, headaches, nausea, vomiting, and diarrhoea [2]. A majority of adolescents suffer from primary dysmenorrhea. As many as 90% of adolescent females and above 50% of menstruating women worldwide report suffering from it, with 10–20% of them describing their hurt as severe and distressing [3]. In a survey conducted by BMC Women's Health (2020), it was observed that the majority of women undergo abdominal and back pain during their menstrual cycle [4]. In contrast to other symptoms, abdominal pain is seen to be the most prevalent. Despite the fact that primary dysmenorrhea is not a life-threatening disorder, it can nonetheless have a negative impact on a woman's quality of life and, in extreme circumstances, can result in disability and decreased productivity at work [5].

### A. Heat Therapy

Heat has long been a home remedy for menstrual cramps. The buildup of lactic acid in a particular body region is the most common cause of muscle pain. The application of heat provides relief because it basically regulates the blood flow, pumping more blood to the affected region. This causes the removal of any stored and undesirable lactic acid components, thereby reducing or eliminating the pain [6]. Mild menstrual cramps can be relieved by placing a heating pad or hot water bottle on one's lower back or abdomen, but the desired temperature cannot be retained for a long time. In this project, we aim to provide heat therapy to the abdomen.

### B.Vibration Therapy

Vibration therapy works by stimulating muscles and ligaments to stimulate blood circulation, which helps reduce pain and inflammation, promote immunological response, and improve joint strength and flexibility, among other things. Furthermore, the vibrations operate as a sensory distraction, blocking pain signals that are continually travelling via the body's nerve endings to the brain. The effect of vibration on chronic backache was studied and it was inferred that vibration, moderate or fast percussions or deep pressure on painful spots of the back are pain relievers in dysmenorrhea. A research on self-treatment patterns of young girls for dysmenorrhea management showed that they use vibration therapy (massage) to decrease their pain [7]. In this project, we aim to provide vibration therapy to the lower back.

### C. Posture Support

Another essential component included in this project is a posture supporting belt. Apart from menstrual cramps, proper posture improves spine health; sitting and standing with proper alignment improve blood flow, can keep nerves and blood vessels healthy and support muscles, ligaments and tendons [5]. People who practise good posture regularly are less likely to have back pain. The posture supporting belt helps provide relief not only for women suffering from menstrual cramps but also for physically challenged, aged people and professionals working long hours. Devices like a simple orthopaedic lumbo-sacral corset are widely available for daily use.

## II. EXISTING DEVICES

There are several products available in the market for heat therapy and vibration therapy separately, they are used for different applications of pain relief. However, the combination of these is not easily available in a single device that aims to provide adequate amounts of the two therapies simultaneously to the user.

### A. Heating:

A heating pad may be used to relieve aches and pains and minimize muscle and joint stiffness. This is one method of delivering thermotherapy or heat therapy. You may boost blood flow to the damaged location and help your blood vessels expand by applying heat there. Heat also activates sensory receptors in the human body, calms irritable nerve endings, and boosts blood flow to the wounded area. Heat treatment offers a rapid reduction in muscular tension while boosting tissue extensibility and eliminating any unwanted substances [6].

#### 1. Basic Orthopedic Heat Belt:

This instrument provides dry heat treatment, which is recommended for relieving orthopaedic discomfort. It has a power cord and a temperature controller which the user may use to adjust the heat level to suit his or her needs. This heat belt not only provides excellent pain relief, but it's also helpful for people who are less resistant to extremely cold conditions. The device can produce a maximum temperature of 80°C and consumes 55W [8].



Figure 1: Basic Orthopedic Heat Belt

#### 2. Nua Heating Patches:

The key ingredient of the Nua heating patch is iron powder. When iron comes in contact with the oxygen in the atmosphere, it oxidises and emits heat. It is air-activated and releases heat on its own. The patches can emit heat for up to 8 hours. However, these patches cannot be reused or recharged [9].



Figure 2: NUA Heating pad

### B. Vibration/Massage:

Vibration is the propagation of elastic waves producing deformations and tensions on a continuous medium. The vibratory movement created is similar to repeated massage movements around an equilibrium position. Vibration belts can increase circulation and has a plausible effect on chronic back pain [10].

### 1. Vibroshaper Slimming Vibration Belt

The belt can reduce body fat by burning the fat thereby increasing the metabolic rate of the body. It is also said to reverse the signs of ageing as it contains more Antioxidants [11].



Figure 4: Vibro Shaper Slimming Belt

### 2. Electrical Nerve Stimulation Pulse Massager Digital Massage Machine

The muscle stimulator sends powerful electrical pulses through the central nervous system, effectively blocking pain receptors the same way a strong painkiller would work. There are 4 adhesive gel pads that can easily be placed around the joints. Pads are reusable as many as 60-80 times [12].



Figure 5: Electrical Nerve Stimulation Pulse Massager Digital Massage Machine

### C. Posture Support:

Injuries, neck and back pain, and headaches can all be averted by maintaining good posture throughout the day. One may train and strengthen the muscles that support one's spine by wearing a posture corrector for a few hours each day and integrating activities that focus on good posture in workouts. [13]. There are various posture correctors available in the market. An example is given below:



Figure 6: Posture Corrector with Adjustable Straps

## III. METHODOLOGY

Vibration is the propagation of elastic waves producing deformations and tensions on a continuous medium. The vibratory movement created is similar to repeated massage movements around an equilibrium position. Vibration belts can increase circulation and has a plausible effect on chronic back pain [10].

### A. Heating belt:

The heating device is made of six TEC1-12706 Thermoelectric Peltiers. Thermoelectric uses electrical energy to circulate heat between two sides that serve as a hot reservoir and a cold reservoir [14].

A thermoelectric device is made of solid-state semiconductors that can convert a voltage input into a temperature difference that can be utilised for cooling or heating. It has the ability to generate DC electrical power when a temperature differential is applied [15].

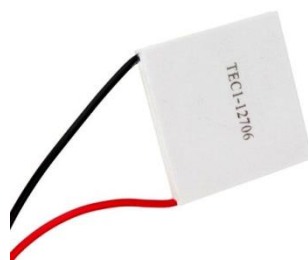


Figure 7: TEC1-12706 Thermoelectric Peltier

There are two operational modes.

A. Cooling mode

B. Heating mode

Peltier cooling reduces the TEC cold side's temperature when the current flows through semiconductor elements. The heating mode reverses the polarity of the current. The previously hot side starts to cool and the cooler side now acts as the hot surface [16].

In this project, the patch is heated to 42°C using the heating operational mode to deliver a suitable quantity of heat to the lower abdomen. Polyester PU, polyester cotton, and 2mm foam are the materials used to cover and insulate the heating patch. This insulation lowers the temperature by 2-3°C while also shielding the user from changes in heat or current. The L293D drivers connect the heating patch to a suitable microcontroller, which regulates the amount of heat delivered and enables the user to turn the device on and off as needed.



Figure 8: Heating belt

### B. Vibration belt:

The vibration patch consists of sixteen coin-type micro vibration motors to produce the required levels of vibration when connected to a microcontroller. These are embedded within a belt made of polyester PU and polyester cotton which is interconnected to the rest of the device using velcros. The coin-type micro vibration motors, also known as shaftless or pancake vibrator motors, are typically in diameters between 8 and 12 mm. Pancake motors are small and practical.



Figure 9: Micro Vibration Motors

These coin-type micro vibration motors are arranged so that four motors are linked together within a single small patch, which is then linked to three other similar vibration motor patches and positioned in a velcro belt. These patches are powered by batteries which are placed in pouches on the belt and are controlled by the microcontroller through L293D Driver.



Figure 10: Vibration Belt

### C. Posture support belt:

The additional belt, the posture belt, is designed and composed of materials like Spandex, Eva, Nylon and Polyester to provide back support while performing daily activities.

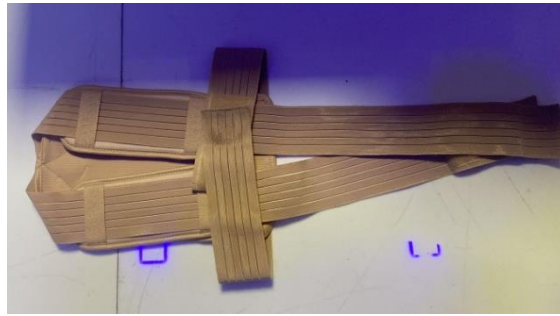


Figure 11: Posture support belt

The mid-back muscles are meant to receive the most relaxation and support from the posture support belt's unique construction. Correct spine alignment strengthens the surrounding muscles and enhances blood flow [5]. These considerations went into the design of the posture belt in Figure 11. Two metal rods on either side of the spine make up the belt's back area, which helps the wearer keep an upright posture while engaging in any activity. The user is shielded from any harm by the soft material covering the metal rods. Softer material is used at the belt's area at the shoulders (cushioning). One elastic belt wraps around the waist, and shoulder belts extend from the flat metal rod piece above the shoulders, over the back, and back to the waist using velcro fasteners on all four ends of the belt. This kind of belt usage ensures that the user is always going to maintain an upright posture, maximising their benefits.

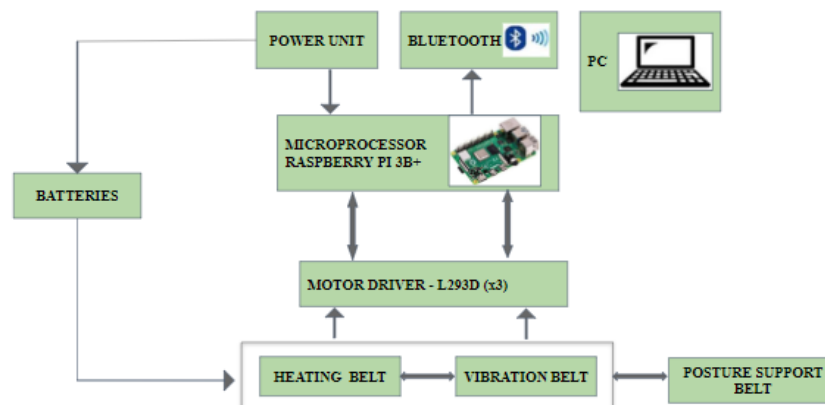


Figure 12: Block diagram of the proposed model

An appropriate Microprocessor is chosen to operate the monitoring of the heating effect and vibration effect. The belt is connected to this microprocessor which supervises the temperatures and vibrations of the respective patches. This is done through the driver L293D and are powered by batteries.

The temperature provided is between 37°C to 48°C [17] and the vibration patch vibrates with a frequency of 20-50 Hz [7].

The belt is user-friendly, and a combination of heat effect, vibration effect and posture support. All of these combinations can be used individually or it can be used together. The application of heat in the form of hot bags has long been a home remedy for menstrual cramps for females across the globe. Additionally, massage therapies provided to the lower abdomen, sides of the abdomen and lower back have also been scientifically proven to yield benefits of pain relief [18]. A combination of heat, vibration and posture support will provide maximum comfort to the user during their menstrual period.

## IV. RESULTS

The project outcome is to provide pain relief for women suffering from dysmenorrhea by providing heating effect, vibration effect and posture support. The heating and vibration effect will be available in three different modes: High, Medium and Low and can be adjusted according to the user's preference. The posture belt acts as a support to the lower back and helps the user to sit in a proper position which in turn leads to improved blood circulation. It is beneficial to be able to provide pain relief without any medication. Thus, this 3-in-1 belt significantly relieves pain and provides comfort and support to females during their menstrual cycle as well as pain relief to individuals in the lower back region, especially those who work for long hours in a sitting position. The effectiveness of the belt will be determined by using a questionnaire that will be answered by the users. The questionnaire will contain questions like:

1. [Before usage of belt]: What is the intensity of pain/discomfort that you are experiencing (On a scale of 0 to 5)?
2. [After usage of belt]: What is the intensity of pain/discomfort that you are experiencing (On a scale of 0 to 5)?

Here, the scale varies as follows [19]:

0 = No pain; 1 = Mild; 2 = Discomforting; 3 = Distressing; 4 = Horrible; 5 = Excruciating

15 subjects were made to use the belt and answer the questionnaire. The data was recorded in a tabular form a pie chart was created to compare the difference in the pain levels of individuals before and after usage of the belt as shown below:

Subject No.	Intensity of pain/discomfort (0 - 5)	Level of heat (High/Medium/Low)	Level of vibration (High/Medium/Low)	Level of pain relief obtained (0 - 5)
1	3	Medium	High	1
2	5	High	High	1

Table 1: Data obtained from questionnaire attempted by 2 subjects

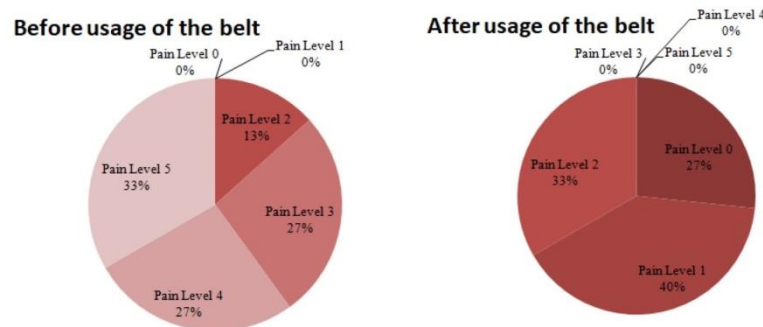


Figure 13: Pie charts comparing the pain levels experienced by 15 subjects before and after usage of the belt

## V. CONCLUSION

Pain relievers are among the most often purchased items, with heat-incorporated pain relievers ranking third in terms of sales. Several heating and vibration belts are already available in the market for various purposes. Some of the devices include orthopedic belts, weight loss belts etc., which use the same area of target in the human body but for different purposes. The proposed belt is intended to work around the same area, i.e., on the anterior side of the abdomen for heating effect and on the posterior side of the abdomen for vibration effect. The belt has many advantages such as providing instant relief from pain and can be used for daily purposes during long working hours; it is portable and provides an additional posture correction belt for improved blood circulation. The heat provided to the region around the lower abdominal region has a relaxing effect in case of muscle spasms (Heat treatment is widely used by swimmers after a strenuous practice session. Similarly, individuals also utilize it after working out at the gym). Furthermore, vibration therapy in the lower back has been shown to provide stress relief to people who lead a laborious lifestyle. Finally, maintaining good posture is critical for maintaining spinal health and avoiding long-term difficulties. This project's goal is to create a belt that provides a combined effect of heat and vibration therapy with the help of microcontroller Raspberry Pi 3b+ with the addition of a posture correction belt. Our aim is to provide relief to women suffering from severe period cramps. This belt can be improved by reducing its complexity and incorporating more advanced technology. It can also be used for statistical research by collecting data from people who use it on a regular basis to evaluate the effects of relief before and after using it.

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