

**A Dissertation on**  
**EFFECT OF SURYA NAMASKAR IN PRIMARY DYSMENORROEA**

Submitted by  
**Dr. S.D.ARCHANA, B.N.Y.S**  
**Reg. No. 461412001**

Under the guidance of  
**Prof. Dr. S.T. VENKATESWARAN,**  
N.D. (OSM), M.Sc. (Y&N), P.G.D.O.W.M., P.G.D.Y., D.N.H.E. MBA

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**GOVERNMENT YOGA AND NATUROPATHY MEDICAL COLLEGE AND  
HOSPITAL, CHENNAI – 600 106**

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This is to certify that the dissertation entitled “**EFFECT OF SURYA NAMASKAR IN PRIMARY DYSMENORROEA**” is a bonafide record of work done by the Post Graduate **Dr. S.D. ARCHANA**, Department of Yoga, Government Yoga and Naturopathy Medical College and Hospital, Chennai, under my guidance and supervision in partial fulfillment of regulations of **The Tamil Nadu DR.M.G.R. Medical University, Chennai**, for the award of degree of **DOCTOR OF MEDICINE (M.D.) Branch - II (Yoga)** during the academic year **2014 – 2018**.

**SIGNATURE OF THE GUIDE**

Place: Chennai

Date: 27.09.2017

**Dr. S.T.VENKATESWARAN**

N.D. (OSM), M.Sc. (Y&N), P.G.D.O.W.M., P.G.D.Y., D.N.H.E.,             
Professor and Head – Department of Yoga  
Government Yoga and Naturopathy Medical College  
and Hospital, Chennai – 600 106

**GOVERNMENT YOGA AND NATUROPATHY MEDICAL COLLEGE AND  
HOSPITAL, CHENNAI – 600 106**

**ENDORSEMENT BY THE HEAD OF THE DEPARTMENT**

I certify that the dissertation entitled “**EFFECT OF SURYA NAMASKAR IN PRIMARY DYSMENORROEA**” is a bonafide record of work done by the Post Graduate **Dr. S.D. ARCHANA**, Department of Yoga, Government Yoga and Naturopathy Medical College and Hospital, Chennai, submitted for the degree of **DOCTOR OF MEDICINE (M.D.) Branch – II (Yoga)** under my guidance and supervision, and that this work has not formed the basis for the award of any other degree/diploma/associate-ship/fellowship or other titles in this university or any other university or Institution of higher learning.

Place: Chennai

Date: 27.09.2017

**SIGNATURE OF THE HOD**

**Dr. S.T.VENKATESWARAN**

N.D. (OSM), M.Sc. (Y&N), P.G.D.O.W.M., P.G.D.Y., D.N.H.E.,            MBA

Professor and Head – Department of Yoga

Government Yoga and Naturopathy Medical College  
and Hospital, Chennai – 600 106

**GOVERNMENT YOGA AND NATUROPATHY MEDICAL COLLEGE AND  
HOSPITAL, CHENNAI – 600 106**

**ENDORSEMENT BY PRINCIPAL**

I certify that the dissertation entitled “**EFFECT OF SURYA NAMASKAR IN PRIMARY DYSMENORROEA**” is a bonafide record of work done by the Post Graduate **Dr. S.D. ARCHANA**, Department of Yoga, Government Yoga and Naturopathy Medical College and Hospital, Chennai, submitted for the award of degree of **DOCTOR OF MEDICINE (M.D.) Branch – II (Yoga)** under the guidance and supervision of **Dr. S.T.VENKATESWARAN**, and that this record of original research work has not formed the basis for the award of any other degree/diploma/associate-ship/fellowship or other titles in this university or any other university or Institution of higher learning.

Place: Chennai

Date: 27.09.2017

**SIGNATURE OF THE PRINCIPAL**

**Dr. N. MANAVALAN**

N.D. (OSM), M.A. (G.T.), M.Sc. (Y&N), M. Phil., P.G.D.Y.,  
P.G.D.H.M., P.G.D.H.H.,

Principal and Head – Department of Naturopathy  
Government Yoga and Naturopathy Medical  
College and Hospital, Chennai – 600 106

**GOVERNMENT YOGA AND NATUROPATHY MEDICAL COLLEGE AND  
HOSPITAL, CHENNAI – 600 106**

**DECLARATION BY THE CANDIDATE**

I, **Dr. S.D. ARCHANA** solemnly declare that this dissertation entitled “**EFFECT OF SURYA NAMASKAR IN PRIMARY DYSMENORROEA**” is a bonafide and genuine research work carried out by me in the Department of Yoga, Government Yoga and Naturopathy Medical College and Hospital, Chennai, from July 2016 – June 2017 under the guidance and supervision of **Dr. S.T.VENKATESWARAN, N.D. (OSM), M.Sc (Y&N), P.G.D.O.W.M., P.G.D.Y., D.N.H.E.,MBA.,** Professor and Head, Department of Yoga, Government Yoga and Naturopathy Medical College and Hospital, Chennai. This dissertation is submitted to The Tamil Nadu DR.M.G.R. Medical University, Chennai towards partial fulfillment of the requirements for the award of M.D. Degree (Branch – II: Yoga) in Yoga and Naturopathy.

Place: Chennai

Date: 27.09.2017

**SIGNATURE OF THE CANDIDATE**

**(Dr. S.D. ARCHANA)**

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## 1.0 INTRODUCTION

Menstrual disorders are commonly present in late adolescence. Almost 75% of girls experience some problems associated with menstruation.<sup>1</sup> Dysmenorrhea, or pain during menstruation, has been described as one of the most common complaints seen in medicine. It is probably the most frequent of all symptoms seen in gynecological disorders (Novak, Jones and Jones, 1965; Ogden et al., 1970). Dysmenorrhea can be explained as a cramping pain accompanying menstruation and primary dysmenorrhea refers to the one that which is not associated with any pelvic pathology<sup>2</sup>. Primary dysmenorrhea is the most common gynecological disorder among female adolescents with a prevalence of 70% to 90% It is also a leading cause of the poor quality of life among adolescent girls.<sup>3</sup>

Primary dysmenorrhea usually begins within the first six months after menarche, once the ovulatory cycles are established.<sup>4</sup> The causes of primary dysmenorrhea are strong uterine contractions which are usually stimulated by increased production of the prostaglandin by the lining of the uterus (endometrium).<sup>5</sup> Dysmenorrhea may also be due to emotional instability, anxiety, a faulty outlook on sex and menstruation, or due to the imitation of mother's feelings about menstruation.<sup>6</sup>

There are two types of primary dysmenorrhea, Spasmodic and congestive. The spasmodic type refers to spasms of pain that are similar to labor pains. They usually begin during the first day of menstruation. The congestive type of dysmenorrhea

refers to a variation or a symptom of the premenstrual syndrome accompanied with dull, aching pain, with lethargy and depression prior to the onset of menstruation.<sup>7</sup>

Currently, standard medical treatments for dysmenorrhea includes the use of Nonsteroidal anti-inflammatory drugs (NSAIDs). This inhibits prostaglandin synthetase, oral contraceptive pills, which inhibit ovulation thus reducing myometrial activity. However, these drugs are not 100% effective and are associated with side effects.<sup>8</sup>

Complementary and alternative medical treatments for dysmenorrhea include transcutaneous electric nerve stimulation, acupuncture, acupressure, behavioral intervention, spinal manipulation, relaxation and dietary therapies. Few studies have also examined the effect of life style modification intervention in the management of dysmenorrhea.<sup>9</sup>

The word yoga means union, joining, or to link together as one whole. Yoga is the art and science of resolving the inherent opposition in all things to create a union of body, mind and soul.<sup>10</sup> Iyengar [2001] describes yoga as "...the path, which integrates the body, senses, mind and the intelligence with the self". Essentially all the activities of yoga can be divided into two parts that can be referred to as physical yoga and non-physical yoga. Physical yoga, which consists of physical exercises (Asana) and breath-control (Pranayama), is often thought of as a static or slow-moving type of stretching and relaxation. However, it can also include strenuous exercises that tone muscles, tension (stretch) nerves and stimulate the cardiovascular system [Raju et al.,



1994]. Physical yoga can manipulate internal organs [Kavalayananda, 1925] and modify blood chemistry [Miyamura et al., 2002].

The National Centre for Complementary and Alternative Medicine (NCCAM) refers to yoga as a —mind-body medicine, with its use being recommended as a non-pharmacological tool for managing various non-communicable diseases.<sup>11, 12</sup> Yoga which includes various postures (Asanas), breathing techniques (Pranayama), and meditation has been shown to have therapeutic benefits for individuals with a wide range of health conditions, including hypertension and diabetes.<sup>13,14</sup>

Some of the scientific components or the elements of physical yoga are:

- Stretching
- Isometric strengthening
- Isotonic strengthening
- Isokinetic strengthening
- Joint range of movement exercises
- One-legged exercises
- Cardiovascular (aerobic) conditioning
- Breathing
- Unilateral nostril breathing
- Sense control
- Concentration
- Relaxation
- Health Visualization
- Meditation.<sup>10</sup>

Surya Namaskar (SN) is an integral part of modern yoga training.<sup>15</sup> Surya Namaskar is a set of 12 asanas (postures). These alternating backward and forward bending postures flex and stretch the spinal column through maximum range therefore giving a profound stretch to the whole body.<sup>16</sup> There are numerous effects of Surya Namaskar

on different system of the body especially musculoskeletal, cardiovascular, gastrointestinal, nervous system, respiratory and endocrinal. The heart, liver, chest, throat, intestine, stomach legs and backbone are main benefited organs. By practicing Surya Namaskar each and every cell of body gets revitalize and regenerated. Therefore, the practice of Surya Namaskar is highly recommended by all yoga experts for healthy routine life. The regular practice of Surya Namaskar improves blood circulation throughout the body, maintains health and makes the body disease free. It also helps to regulate menstrual cycles in women and also facilitate an easy childbirth. Regularly practicing Surya Namaskar modulates endocrinal system of the body. The overall effect is very beneficial for Metabolic Syndrome, Obesity, Diabetes Mellitus, Hypothyroidism and menstrual disorders. Regular training of Surya Namaskar requires four times more energy than the daily requirement. Thus SN is a very good fat burner. It's training improves the flexibility of body muscles especially leg, back, chest and gluteal muscles. It is found that by practicing Surya Namaskar regularly one can significantly increase Hand grip, strength and endurance.<sup>17</sup>

Many studies have shown that Surya Namaskar exerts positive effects on both the physiological and psychological variables. It's different postural, breathing and chanting pattern produces calm, relax, more stable and stress free mind.<sup>17</sup>

With such profound effects on the body, Surya Namaskar alone has the ability to bring about physiological changes in the body. Therefore the present was aimed to determine the effects of Surya Namaskar practice on primary dysmenorrhea.

## **2.0 AIMS AND OBJECTIVES**

### **2.1 AIMS:**

The purpose of the study is to determine the effects of Surya Namaskar (SN) on primary dysmenorrhea. It was hypothesized that the practice of SN will help to reduce the pain in primary dysmenorrhea.

### **2.2 OBJECTIVES:**

- ✓ To assess the Numerical Pain Index (NPI) scale before the intervention in primary dysmenorrhea subjects.
- ✓ To assess the NPI scale after the intervention and compare the NPI scale in primary dysmenorrhea subjects.
- ✓ To assess the Modified Menstrual Symptoms Questionnaire before and after the intervention in primary dysmenorrhea subjects.

### **3.0 REVIEW OF LITERATURE**

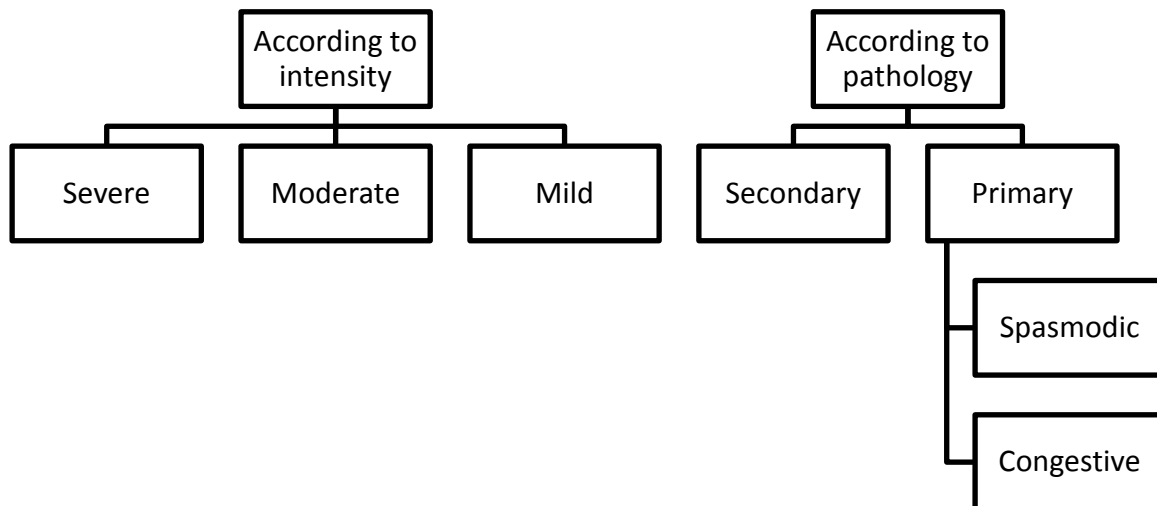
#### **3.1 MENSTRUATION:**

Menstruation is defined as a “periodic and cyclic shedding of progestational endometrium accompanied by loss of blood”. It takes place at approximately 28-days interval between the menarche and menopause. Menstruation is the visible manifestation of cyclic physiologic uterine bleeding due to shedding of the endometrium following invisible interplay of hormones mainly through hypothalamo-pituitary-ovarian endometrial axis.<sup>18</sup>

#### **3.2 DYSMENORRHEA:**

“Dysmenorrhea” is derived from a Greek root which means difficult menstrual flow. The term dysmenorrhea refers to painful menstruation. Dysmenorrhea is a cramp labor-like pain in the lower abdomen that radiates to upper abdomen, waist and thighs and is often accompanied by systemic symptoms like nausea, vomiting, diarrhea, headache and dizziness.<sup>18</sup>

**Figure 1: Classification of Dysmenorrhea**



Dysmenorrhea can be divided into two broad categories of primary dysmenorrhea secondary dysmenorrhea.

### **3.3. SECONDARY DYSMENORRHEA:**

Dysmenorrhea occurring due to pelvic pathology is called secondary dysmenorrhea. This type of dysmenorrhea usually begins in the late 20s or 30s, after previous relatively painless cycles. Often there is heavy menstrual flow or irregular bleeding. There is an evident pelvic abnormality with physical examination and there is a poor response to non-steroidal anti-inflammatory drugs (NSAIDs) or oral contraceptives (OCs). Some of the examples of secondary dysmenorrhea are Endometriosis,

Adenomyosis, Uterine myoma, endometrial polyps, Obstructive malformations of the genital tract etc.<sup>18</sup>

### **3.4 PRIMARY DYSMENORRHEA:**

Primary dysmenorrhea is the pain associated to menstrual cycles without demonstrable pathology. Primary dysmenorrhea is related to myometrial contractions induced by prostaglandins (Pgs) originating in secretory endometrium, which causes uterine ischemia and pain.<sup>18</sup>

#### **3.4.1 TYPES OF PRIMARY DYSMENORRHEA:**

Dysmenorrhea has been classified into following types:

**3.4.1.1 Congestive Dysmenorrhea:** In this type, the pain starts between three and five days before onset of menstruation. It is often relieved by starting of menstrual flow. The causes of this type of dysmenorrhea may or may not be associated to any underlying disease of pelvic area. It is often corrected by modifications in diet, treatment of constipation and implementation of exercise in case of sedentary workers.<sup>19</sup>

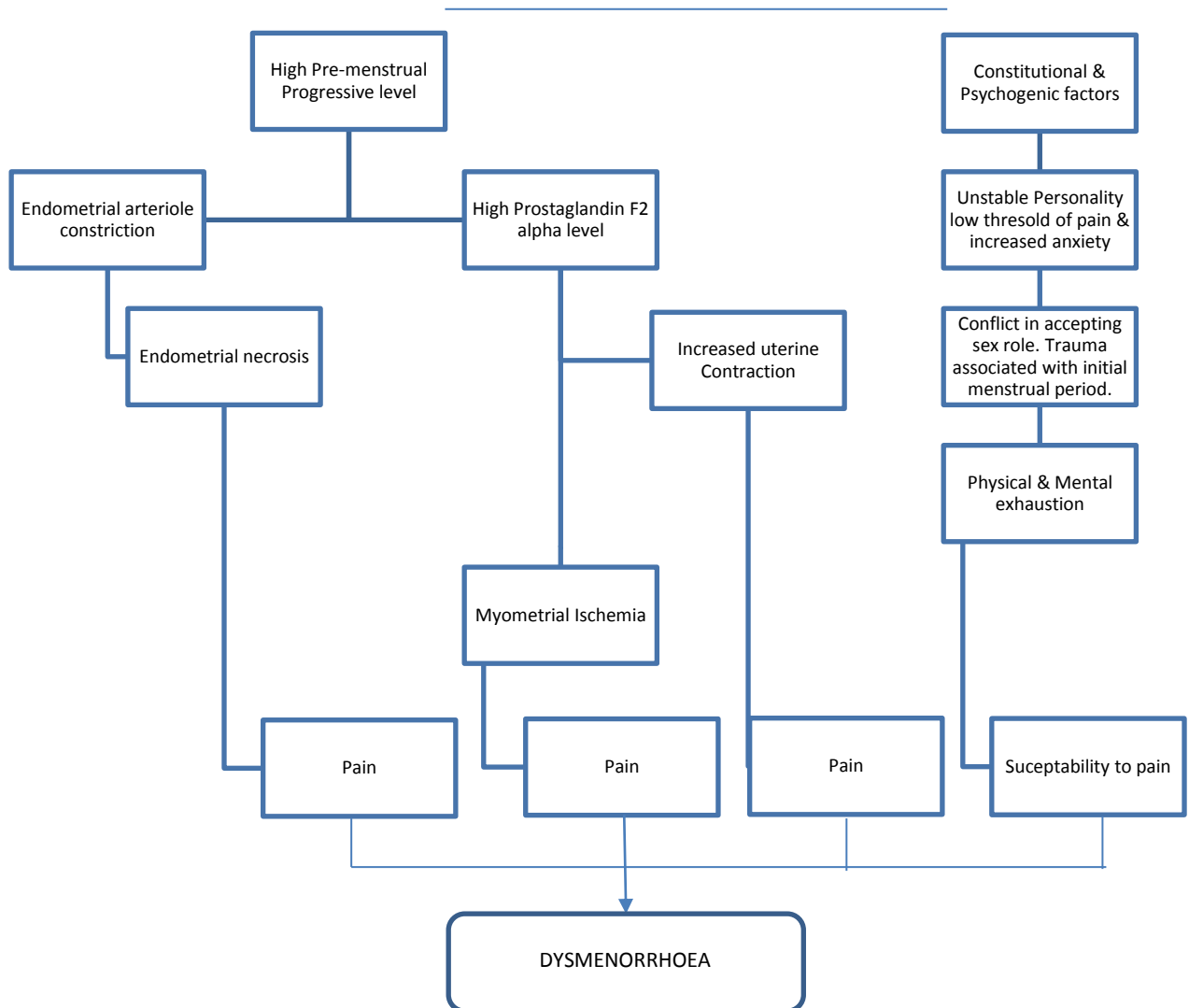
**3.4.1.2 Spasmodic Dysmenorrhea:** This is commonest type of dysmenorrhea. Almost all females suffer from this type of dysmenorrhea at some point of their life. The pain develops on the first day of menstrual period. The pain is severe, intermittent and spasm like in nature. If severe, it may cause nausea, vomiting, faintness or collapse. Often, severe episode of pain is followed by a phase of less severe pain in

abdomen, pelvic area or front of thighs. The spasmodic type of dysmenorrhea pain lasts for around 12 hours.<sup>19</sup>

**3.4.1.3 Membranous Dysmenorrhea:** This type of dysmenorrhea is rare and has a genetic disposition. The pain is associated with passage of membranes which resemble uterine endometrium microscopically.<sup>19</sup>

**3.4.1.4 Ovarian Dysmenorrhea:** In this type of dysmenorrhea, the pain is felt for two to three days before menstruation in right or left lower abdominal or pelvic areas.<sup>19</sup>

**Figure 2: Causes for primary Dysmenorrhea**





### **3.4.2 CAUSES OF PRIMARY DYSMENORRHEA:**

Experimental and clinical research for the last 15 years, has identified uterine prostaglandins as contributing to the pathogenesis of primary dysmenorrhea. It is now known that at the end of the menstrual cycle, prostaglandins increase myometrial contractions and cause constriction of small endometrial blood vessels, which result in consequent tissue ischemia, endometrial disintegration, bleeding and pain. Dysmenorrhea results from tissue ischemia caused by increased intrauterine pressure, vessel constriction and decreased uterine blood flow. The most compelling evidence for the "prostaglandin theory" is the success of prostaglandin synthesis inhibitors in the treatment of dysmenorrhea. The pain relief achieved with these drugs is caused by decrease in prostaglandin synthesis and intrauterine pressure.<sup>19</sup>

#### **3.4.2.1 PROSTAGLANDINS:**

Prostaglandins are lipid autacoids derived from arachidonic acid. They are responsible for both homeostatic functions and they also mediate pathogenic mechanisms, including the inflammatory response. They are generated from arachidonate by the action of cyclooxygenase (COX) isoenzymes and their biosynthesis is blocked by nonsteroidal anti-inflammatory drugs (NSAIDs). Prostaglandin E2 and Prostaglandin F2 are the two types of prostaglandins found in female reproductive organ.<sup>20</sup>

##### **3.4.2.1.1 Prostaglandin E2 and inflammation**

PGE2 is one of the most abundant PGs produced in the body and exhibits versatile biological activities. Under physiological conditions, PGE2 is an important mediator of many biological functions, such as regulation of immune responses, blood pressure, gastrointestinal integrity, and fertility. Deregulated PGE2 synthesis has been associated with many pathological conditions.<sup>20</sup>

Pain results from the action of PGE2 on peripheral sensory neurons and on central nervous system within the spinal cord and the brain.<sup>37</sup> PGE2 is abundantly expressed in the cytosol of various tissues and cells.<sup>20</sup>

### **PGF2 $\alpha$**

It is derived mainly from COX-1 in the female reproductive system, and plays an important role in ovulation, luteolysis, contraction of myometrium and initiation of parturition.<sup>20</sup>

### **3.4.2.2 HYPOTHALAMUS - PITUITARY – OVARIAN AXIS:**

The hypothalamus-pituitary-ovarian axis controls the menstrual rhythm. Hypothalamus is connected with cerebrum and limbic system which is the site for emotions and also to the pituitary gland by portal circulation. Stressful events like anxiety and depression causes emotional response that disturbs the HPO axis. Psychological stressors can directly provoke the increase in inflammatory mediators which is the main cause for pain during menstruation.<sup>21</sup>

### **3.4.2.3 OTHER CAUSES OF PRIMARY DYSMENORRHEA:**

#### **3.4.2.3.1 STRESS RELATED**

Today stress is becoming an inescapable part of modern life and in the search for material comforts; a woman has been losing her health. The basic reason why women has been suffering from life style mediated health issues is because she is not able to follow the codes of healthy living.<sup>18</sup> There is growing evidence of an association between psychosocial induced stress and menses-associated health problem, suggesting that stress may affect menstrual function.<sup>22</sup>

#### **3.4.2.3.2 LIFE STYLE MODIFICATION**

Due to today's sedentary lifestyle and lack of exercise, the problem of dysmenorrhoea is becoming a major problem throughout the world that causes discomfort for women's every day activities and this is the major contributing factor for missing work or school and inability to participate in sports or other activities.<sup>18</sup> The discomforts that accompany menstruation exist due to our lifestyle choices and this can be prevented and cured without the use of hormones and toxic medication.<sup>23</sup> It is generally accepted that a combination of psychological and organic approach should help in curing primary dysmenorrhea. (Paulson and Wood, 1966).

Ebru Dikensoy et al 2008, conducted a study on Malondialdehyde, nitric oxide and adrenomedullin levels in patients with primary dysmenorrhea. The results of this study showed that the serum levels of MDA, NO, and AM increase in subjects with primary dysmenorrhea and this suggests the possibility that lipid peroxidation and oxidative stress may have a significant role in the etiopathogenesis of primary dysmenorrhea.<sup>24</sup>

#### **3.4.3 MULTIDIMENSIONAL PAIN SCORING SYSTEM:**

Intensity of pain was assessed using the Multidimensional Scoring System of Andersch and Milsom (1982) that defines pain as follows:

**Mild dysmenorrhea** is defined as painful menstruation which does not cause limitation of normal activity, with infrequent requirement of analgesics and no systemic complaints.

**Moderate dysmenorrhea** is defined as menstrual pain affecting the day to day activities and that requires an analgesics for pain relief and is associated with few systemic complaints.

**Severe dysmenorrhea** is defined as menstrual pain with severe limitations of daily activities and a poor response to analgesics. There is also apparent systemic complaints like vomiting, fainting. Diarrhea, constipation etc.

#### **3.4.4. DIAGNOSIS OF PRIMARY DYSMENORRHEA:**

Diagnostic criteria of primary dysmenorrhea are subjective. Two tools are commonly used to measure the severity of dysmenorrhea. The first is a verbal multidimensional pain scoring system that helps to measure the pain severity by taking into account the impacts of pain on daily activities, systemic symptoms and analgesic requirements. The second system depends on asking the patient to assess the severity of dysmenorrhea and express it on a linear Visual Analogue Scale (VAS). This scale is a 10 cm line drawn on a sheet of paper. It represents a continuum of severity of pain starting with the extreme of “no pain ” and ending with the extreme of “unbearable pain.”<sup>25</sup>

### **3.4.5 DIFFERENTIAL DIAGNOSIS:**

The differential diagnosis of primary dysmenorrhea are secondary dysmenorrhea, Chronic pelvic inflammatory disease such as Pelvic adhesions, Irritable bowel syndrome, Inflammatory bowel disease, Interstitial cystitis etc. Sudden onset of dysmenorrhea might be seen in ectopic pregnancy or Spontaneous abortion.<sup>18</sup>

### **3.4.6 RISK FACTORS:**

The major risk factors for dysmenorrhea are, age < 20 years, nulliparity, heavy menstrual flow, upper socioeconomic status, smoking, making attempts to lose weight, physical inactivity, anxiety and depression.<sup>22</sup> Family history of dysmenorrhea strongly increases its risk with odds ratios between 3.8 and 20.7.<sup>26</sup>

However, women may not seek professional advise in their attempt to alleviate this condition. It is important to assess the beliefs and experiences of women with dysmenorrhea, including adolescents, as early as possible in gynecological health care as possible.<sup>27</sup>

### **3.4.7 PREVALANCE OF DYSMENORRHEA:**

According to article published in BJOG, states that the burden of dysmenorrhea is greater than any other gynecological problem and it is associated with significant impact in daily activities.<sup>28</sup>

Kiran B et all, in a study analyzed the prevalence of dysmenorrhea. In Chennai among 306 students who gave a history of dysmenorrhea there was a prevalence of 76.30%. Out of 76.3%, 57.1% had severe and 19.20% had mild dysmenorrhea. All the students

enrolled in Bangalore study had history of dysmenorrhea, 73.19% had severe and 26.80% had mild dysmenorrhea. Allopathic treatment was taken by 33% and 37.11%, homemade remedies by 6.20% and 2.06% and Ayurveda medicines by 0.98% and 1.03% by Chennai and Bangalore students respectively. Homeopathic treatment was taken by 2.28% students in Chennai alone. Study stated the fact that it is important to spread awareness about the causes and treatment of dysmenorrhea which avoids undue sufferings such as absenteeism from work and studies.<sup>29</sup>

A systematic review of studies in developing countries, performed by Harlow and Campbell (2002) has revealed that about 25-50% of adult women and about 75% of adolescent women experience pain during menstruation. Out of them 5-20% reported severe dysmenorrhea or pain.<sup>18</sup>

Another study revealed that dysmenorrhea was a significant public health problem that has an impact on academic activities. Most of the subjects were aware that Paracetamol is the drug that helps to relieve the symptoms, **Dittakarn et al (2003).**<sup>30</sup>

Despite of the high prevalence of primary dysmenorrhea and its impact on daily life, it is underdiagnosed and undertreated.<sup>31</sup>

### **3.4.8 B.M.I. IN RELATION TO PRIMARY DYSMENORRHEA:**

#### **3.4.8.1 BODY MASS INDEX:**

The body mass index (BMI), calculated as weight (kg)/height (m) <sup>2</sup>, or as weight (pounds)/height (inches) <sup>2</sup> x 703, is used to classify weight status and risk of disease. BMI is used since it provides an estimate of body fat and is related to risk of disease.

Lower BMI thresholds for overweight and obesity have been proposed for the Asia-Pacific region since this population appears to be at-risk at lower body weights for glucose and lipid abnormalities.

**Table 1: The International classification of adult underweight, overweight and obesity according to BMI<sup>32</sup>**

Classification	BMI (Kg/m <sup>2</sup> )	
	Principal cut-off points	Additional cut-off points
<b>Underweight</b>	<b>&lt;18.50</b>	<b>&lt;18.50</b>
Severe thinness	<16.00	<16.00
Moderate thinness	16.00 – 16.99	16.00 – 16.99
Mild thinness	17.00 – 18.49	17.00 – 18.49
<b>Normal range</b>	<b>18.50 – 24.99</b>	<b>18.50 – 22.99</b>
		23.00 – 24.99
<b>Overweight</b>	<b>&gt;= 25.00</b>	<b>&gt;= 25.00</b>
Pre-obese	25.00 – 29.99	25.00 – 27.49
		27.50 – 29.99
<b>Obese</b>	<b>&gt;= 30.00</b>	<b>&gt;= 30.00</b>
Obese class I	30.00 – 34.99	30.00 – 32.49
		32.50 – 34.99
Obese class II	35.00 – 39.99	35.00 – 37.49
		37.50 – 39.99

Classification	BMI (Kg/m <sup>2</sup> )	
	Principal cut-off points	Additional cut-off points
Obese class III	>= 40.00	>= 40.00

There are several known mechanisms that is responsible for the influence of adipose tissue on ovulation and menstrual cycle:

1. Adipose tissue converts androgens to estrogen by the process of aromisation.
2. Body weight influences estrogen metabolism with thin women making less potent and obese women making more potent forms of estrogen.
3. Obese women have a reduced capacity for estrogen to bind with sex-hormone binding globulin (SHBG) that inactivates estrogen resulting in elevated percentage of free serum estradiol.<sup>33</sup>

**Dipti Mohanpatra et al** conducted a study to determine the relation between dysmenorrhea and Body Mass Index. 200 Medical students were divided into four groups: Underweight, normal, overweight, and obese groups based on the BMI criteria by the World Health Organization. Detailed menstrual history, family history of dysmenorrhea, and detailed H/O of physical exercise and dietary habits were noted with questionnaires. The results showed that there is a **positive correlation between BMI and dysmenorrhea**. The PGF2 $\alpha$  stimulates myometrial contractions, ischemia, and sensitization of nerve endings. The evidence suggests that women with more severe dysmenorrhea have higher levels of PGF2 $\alpha$  in their menstrual blood. Low



caloric intake, fat mass and body weight disturb pulsatile secretion of pituitary gonadotrophins which causes an increase in rate of dysmenorrhea. Intake of balanced diet will help these women in improving their quality of life and enabling them to reform into more socially and economically productive members of the society.<sup>34</sup>

**Madhubala Chauhan et al 2012** conducted a Cross-sectional study of 200 urban and 200 rural school going adolescent girls at Udaipur and Bedla Districts, Rajasthan. The results showed that the relation between dysmenorrhea and BMI was found to be significant ( $p < 0.01$ ) with **increased prevalence in the low BMI group**. Hence, improving the nutritional status of adolescent girls may help in reducing dysmenorrhea. Significant rural versus urban variation in dysmenorrhea were found in girls, with increased prevalence of low BMI found in rural adolescents indicating their poor nutritional status.<sup>35</sup>

**Hong Ju et al** did a study that aims to investigate the long-term association between BMI and dysmenorrhea. 9,688 women from a prospective population-based cohort study were followed for 13 years. Data were collected through self-reported questionnaires. The result showed a longitudinal association between dysmenorrhea and BMI. **A U-shaped association was revealed between dysmenorrhea and BMI, revealing a higher risk of dysmenorrhea for both underweight and obese women.** Maintaining a healthy weight is important for women to have pain-free periods. It found that BMI  $< 20$  kg/m<sup>2</sup> was associated with dysmenorrhea and no relationship was demonstrated between BMI  $> 24$  kg/m<sup>2</sup> and dysmenorrhea.<sup>36</sup>

Further, women who remained underweight or obese over time had a higher risk, whereas the risk disappeared when obese women lost weight and acquired a normal BMI. On the other hand, women with a normal BMI who became underweight acquired a higher risk of dysmenorrhea. From a public health perspective, obesity certainly contributes to a greater burden of disease than underweight due to the fact that larger proportion of women are on a higher BMI. Maintaining a healthy weight over time is important for women to have pain-free periods, and an improved reproductive health.<sup>36</sup>

### **3.4.9 TREATMENT OF PRIMARY DYSMENORRHEA:**

Standard medical treatments for dysmenorrhea includes the use of Nonsteroidal anti-inflammatory drugs (NSAIDs) that inhibits prostaglandin synthetase, and oral contraceptive pills that inhibit ovulation thus reducing myometrial activity. Menstruation in many women is associated with gastrointestinal upsets that are increased by analgesics and anti-inflammatory drugs. They also produce headache, dizziness, drowsiness and blurred vision.<sup>37</sup>

The use of prescribed hormones and oral contraceptives contribute to the most common treatments for dysmenorrhea, but their use is not universally advocated by physicians due to contraindications, such as epilepsy and side effects such as thrombophlebitis, pulmonary embolism, neuro-ocular lesions, cerebral thrombosis (Tyler, 1973). The incidence of these side effects are high. It was estimated that 40 per cent of women taking oral contraceptives for pain relieve experience such reactions.<sup>7</sup>

### **3.4.9.1 OTHER ALTERNATIVE APPROACHES:**

#### **3.4.9.1.1 NUTRITIONAL SUPPLEMENTS:**

Nutritional supplements like omega-3 fatty acids, magnesium, vitamin E, zinc, and thiamine (vitamin B1) are efficient in the treatment of dysmenorrhea. Intake of whole grains, fresh fruits and vegetables, and the avoidance of saturated fats and commercial junk foods also prove to be beneficial. Limiting salt helps to reduce the bloating sensation. Reduce intake of caffeine, sugar, and alcohol helps in reducing the risk of dysmenorrhea.<sup>38</sup>

#### **3.4.9.1.2 BEHAVIOURAL MODIFICATIONS:**

Hormonal treatments available today for the treatment of primary dysmenorrhea are not universally accepted, or effective. One possible alternative treatment includes behavior modification. It has been proved in studies that behavioral modification is an effective treatment for primary dysmenorrhea (Mullen, 1968, 1971; Tasto and Chesney, 1974).

#### **3.4.9.1.3 TRANSCUTANEOUS ELECTRIC NERVE STIMULATION:**

Transcutaneous electric nerve stimulation (TENS) is a mode of treatment which uses low-level electrical pulses to suppress pain. The standard approach is to give 80 to 100 pulses per second for a duration of 45 minutes, maximum three times a day.<sup>38</sup>

#### **3.4.9.1.4 VESTIBULAR STIMULATION:**

Vestibular stimulation may help to relieve pain due to its extensive connections with the thalamus, hypothalamus, Para brachial nucleus, periaqueductal gray, cerebellum,

raphe nucleus and nucleus tractus solitarius. The hypothesis should be subjected to further research for improving the quality and quantity of life of the general population.<sup>25</sup>

#### **3.4.9.1.5 AYURVEDA:**

Ayurveda views Primary Dysmenorrhea as a doshic imbalance. The condition may be improved through balanced living that is characterized with an appropriate diet, herbal supplements, exercise, yoga, meditation, as well as nourishing inputs through all five senses.<sup>18</sup>

#### **3.4.9.1.6 ROLE OF NATUROPATHY:**

Naturopathic procedures act by improving blood circulation to the reproductive organs and by relieving congestion in the pelvic region. The treatment used for Dysmenorrhea includes Revulsive compress over the pelvic region, Neutral Hip Bath, Revulsive Hip Bath, Mud pack to abdomen, Abdominal pack etc. depending upon the type of Dysmenorrhea.<sup>19</sup>

#### **3.5 INTRODUCTION TO YOGA:**

Yoga is believed to be almost 4000 to 8000 years old with its origins in the Indus Valley civilization. The word yoga, means “unity or oneness,” and is derived from the Sanskrit word Yuj meaning “to join.” Yoga was first mentioned in Rig Veda texts which formed the basis of modern day Hinduism approximately in 1500 B.C.E. In the Upanishads, Yoga was thought of as a way of life that helps an individual to achieve liberation from suffering. Through subsequent time periods, texts, and teachers, the

definition of yoga has expanded to include a wide range of disciplines, philosophies, and practices.<sup>39</sup>

Yoga was the first known science to mankind that helped to maintain and promote health. As a system of treatment, it has gained worldwide popularity. It is stated by Yoga experts around the world that Yoga helps to prevent and treat a number of health problems. Numerous scientific studies using modern scientific techniques are being carried out in different parts of world. They have shown that yogic practices have health promotive and curative effects. Yoga can prevent and treat diseases by using the energies within the body, improving the circulation of blood and lymph and promoting waste disposal thereby cleaning the cells. As a practice, yoga aims to harmonize the body & mind. The benefits of Yoga apply to three aspects of health – Prevention, Cure and Rehabilitation. Yoga treats the individual as a whole and not just the symptoms. Therefore, Yoga is not a system of physical exercises but a psycho physiological system of therapy.<sup>39</sup>

The most prominent and recognizable form of yoga, especially in the Western world, is hatha yoga. It is a branch of yoga that concentrates on positive physical health and mental well-being. Hatha Yoga is a gentle form of Yoga which focuses on simple practices like Asanas (the postures), Pranayamas (the breathing techniques) and Kriyas (the purificatory acts). It intends to stretch the muscles, massage and cleanse the internal organs.<sup>39</sup>

Asanas also help in removing congestion in the internal organs, especially uterus, which is one of the reason for dysmenorrhea pain. The practice of Pranayama helps to

reduce sympathetic dominance which is considered to be one of the contributing factors for dysmenorrhea pain. Moreover the practice of Yoga helps in establishing a balance between the endocrine & reproductive systems and regulates the hormonal control of the menstrual mechanism.<sup>39</sup>

### **3.6 INTRODUCTION TO HATHA YOGA**

In order to purify the mind, it is necessary for the body to undergo a process of complete purification. Hatha yoga is also known as the science of purification. The body is cleaned in six different ways for different impurities. When the impurities are cleaned, the nadis function properly and the energy blocks are released. The energies move in the form of waves throughout the nadis (channels) within the physical structure. Thus, we consider Hatha yoga as a preliminary practice for Tantra yoga, Raja yoga, Kundalini yoga and Kriya yoga. When the rishis discovered Hatha yoga, they did not have yoga therapy in mind. Although yoga has proved to be very effective to be in the treatment of incurable disease, the therapeutic effect of yoga is only a byproduct of the much greater cause of Yoga. The main objective of Hatha yoga is to create an absolute balance between the physical body, mind and energy.<sup>40</sup>

### **3.7 YOGA AND PRIMARY DYSMENORRHEA:**

**In a study conducted by Usha Nag et al** on the effect of Yoga on primary dysmenorrhea and Stress in Medical students, it was shown that Yoga gave a significant reduction in pain and perceived Stress. The study was conducted on 113 medical students, with primary dysmenorrhea and stress. They were assigned to study and control group . Semi structured questionnaire, the Numerical rating scale for pain

and the Perceived Stress Scale (PSS) were administered at baseline and after the study period of three months. The study group was subjected to yoga intervention.<sup>22</sup>

After 3 months of yoga intervention absenteeism was reported only in 10% of the study group and there was improvement in the daily activity. After three months of yoga intervention 49 subjects (82%) reported complete stress relief, 8 subjects reported average stress and 3 reported slightly higher than average stress. There was significant ( $p < 0.0001$ ) improvement in the stress levels after three months of yoga intervention.<sup>22</sup>

It was observed that after yoga intervention there was significant ( $p < 0.0001$ ) reduction in the perceived pain using Friedman test. 88% of subjects from the study group reported complete pain relief and 12% of subjects reported mild pain. In contrast there was no reduction of pain in the control group.<sup>22</sup>

The results suggest that psychosocial stress is independently associated with menstrual pain and that Yoga has found to be an effective alternative treatment to produce pain relief in primary dysmenorrhea. **With yogic exercises the stress and pain of dysmenorrhoea were controlled** indicating the benefits of yoga in primary dysmenorrhoea. The study also suggested that alternative Measures like yoga reduces psychosocial stress levels and must be implemented among college students to augment menstrual well-being. This may also help in preventing future illness from occurring.<sup>22</sup>

**In another study conducted by Zahra Rakhshae et al in 2011** on the effect of three Yoga Poses (Cobra, Cat and Fish poses) in women with Primary Dysmenorrhea,

it was observed that the mean of pain duration before doing yoga were 37.49 in experimental group and 40.57 in control group. After the practice of yoga for 20 minutes for duration of 3 months, the duration of pain in experimental group was 32.1 and control group was 40.0. This shows there **is significant reduction (P=0.000) in both the duration and intensity of pain** in experimental group after the practice of Yoga.<sup>9</sup>

**A review article that included two RCTs by Hyun-Nam Ko in 2016** stated the following review. Interventions included in the RCTs were yoga pose and yoga nidra to manage menstrual pain and symptoms. Of the two, one trial reported a significant decrease in pain intensity and pain duration during the menstrual phase. The other trial reported a significant decrease in hormone levels such as thyroid-stimulating hormone, luteinizing hormone, follicle-stimulating hormone and prolactin in the intervention group compared to the control group. This study also stated that after yoga nidra practice, menstrual symptoms were relieved in participants.<sup>41</sup>

**The results support yoga practice to be a positive manager of menstrual pain and dysmenorrhea symptoms.** The trials in this review had no adverse effects. They stated that yoga poses are a safe and simple treatment for primary dysmenorrhea. Yoga provides a safe, cost-effective therapy for dysmenorrhea.<sup>41</sup>

**Ponlapat Yonglitthipagon et al**, conducted a study with a aim to investigate the effect of yoga on the menstrual pain, physical fitness, and quality of life (QOL) of non-athlete women with primary dysmenorrhea between the ages of 18–22 years. The yoga groups were asked to practice yoga for a duration of 30 minutes per day, twice a



week, for a period of 12 weeks at their home. There **was significant improvement in menstrual pain, physical fitness, and QOL in the yoga group subjects.** Therefore, yoga program may be considered as a possible complementary treatment for primary dysmenorrhea.<sup>42</sup>

**Su-Ying Tsai in an article** on the effect of Yoga on Premenstrual Symptoms among Female Employees in Taiwan indicates the following; a 12-week yoga program was given to menstruating female workers. Each 50-minute session comprised of 5-minute breathing exercise, a 35-minute yoga pose practice, and 10-minute supine meditation or relaxation. In this study, they adopted Kapalabhati Pranayama breathing exercises and five basic yoga poses (cat-cow, child's pose, downward dog, plank, and cobra) in yoga protocol.<sup>43</sup>

After 3 months of yoga, the subjects revealed decrease use of analgesics during menstruation (after: 21.9% vs. before: 35.9%,  $p = 0.0290$ ) and the prevalence of menstrual pain was lower (after: 29.7% vs. before: 53.1%,  $p = 0.0011$ ) after the yoga intervention.<sup>43</sup>

**Dauneria S & Jyoti Keswani,** conducted a study on the effect of Yoga and Naturopathy on Dysmenorrhea. A total of 56 girls were selected for the study, 18 girls were placed in Analgesic group and took allopathic antispasmodic medicine (MEFTAL) for 3 months. Out of these, 17 subjects were given placebo. Yoga was given to the rest of girls every day for 30 minutes for a period of one month. After the study period of 3 months, a follow up was carried out for a duration of 3 months in

which the assessment was done using pain scale in the form of Dallas questionnaire of pain and menstrual regularity was assessed using Menstrual Calendar.<sup>19</sup>

The study revealed a significant reduction in symptoms of Dysmenorrhea as seen by reduction in the Dallas pain scale score. 15 girls in Yoga group reported absence of pain during the practice period of 3 months of yoga and during the follow up period. None of the girls reported aggravation or absence of relief in problem. It was stated that yoga establishes a balance among the various koshas especially Manomaya Kosha, Pranayama Kosha and Annamaya Kosha, thus imparting a harmonious function of body and mind .<sup>19</sup>

### **3.8 SURYA NAMASKAR (SALUTATIONS TO THE SUN)**

#### **3.8.1 INTRODUCTION:**

The Sanskrit name Surya refers to the sun and Namaskara means 'salutations'. Surya Namaskar word is a combination of two words, one is Surya and other one is Namaskar. It means Surya is form of fire and Namaskar is form of respect. Surya Namaskara has been handed down from the enlightened sages of Vedic Age. Sage Samarth Ramdas and the Marathas have performed Surya Namaskara as a physical training to develop fit bodies.<sup>44</sup>

The sun symbolizes spiritual consciousness and in ancient times was worshipped on a daily basis. In yoga, the sun is represented by pingala or surya nadi. Surya Namaskar is not regarded as being a traditional part of hatha yoga, as it was added to the original

asana group at a later time. However, it is an effective way of loosening up, stretching, massaging and toning up of all the joints, muscles and internal organs of the body. The practice of Surya Namaskar comprises of actions such as flexion, extension, forward bending, back ward bending, stretching , inhalation, exhalation, squeezing, and compression of almost all the muscles of the body. By these actions, the physiological effects are obtained. Its versatility makes it one of the most useful methods of inducing a healthy, vigorous and active life. The practice of surya Namaskar, at the same time helps for spiritual awakening and the resulting expansion of awareness.<sup>44</sup>

Surya Namaskara is a complete sadhana and spiritual practice in itself as it includes asana, pranayama, mantra and meditation techniques. It is an excellent set of asanas with which to start morning practice. Regular practice of Surya Namaskara regulates pingala nadi, whether it is under active or over active. Regulation of pingala nadi leads to a balanced energy at both mental and physical levels. Surya Namaskara is composed of three elements: form, energy and rhythm. The twelve asanas generate prana, the subtle energy which activates the psychic body. The performance of the asanas in a steady, rhythmic sequence reflects the rhythms of the universe; the twenty four hours of the day, the twelve zodiac phases of the year and the biorhythms of the physical body. The application of this form and rhythm to the body and mind complex helps to generate the transforming force which produces a more dynamic life.<sup>45</sup>

Historically, it is believed that in the state of Maharashtra, Shivaji Maharaja, Sage Samarth Ramdas and the Marathas have all performed Surya Namaskar as a physical

exercise to develop fit bodies. This may be related to vyayam "physical exercise" in Sanskrit<sup>46</sup>

### **3.8.2 PRACTICE OF SURYA NAMASKAR:**

#### **3.8.2.1 Preparation:**

Before commencing the practice, stand with the feet together or slightly apart. The arms should be hanging loosely by the side of the body. Close the eyes gently and have awareness on the whole physical body as one homogeneous unit. In this position the body may sway. Try to minimize the oscillation by balancing the body weight equally on both feet.<sup>45</sup>

Bring the awareness inside the body and mentally begin to relax. Starting from the top of the head, take the awareness systematically through all the parts. By doing so, try to release any tension. Intensify once more, the awareness of the whole physical body and feel in harmony with it.<sup>45</sup>

Take the awareness to the soles of the feet in contact with the floor. Feel the whole body is being pulled downwards due to gravity and that any tensions are being pulled down into the ground. At the same time, experience the vital force rising up from the earth and flooding the whole body.<sup>45</sup>

Finally, take the awareness to the eyebrow center and visualize a rising sun. The rays of the sun infuses the whole body and mind and produces a vitalizing and healing effect.<sup>45</sup>

#### **3.8.2.2 TWELVE STEPS OF SURYA NAMASKAR**



### 3.8.2.2.1 PRANAMASANA:

#### Position 1:

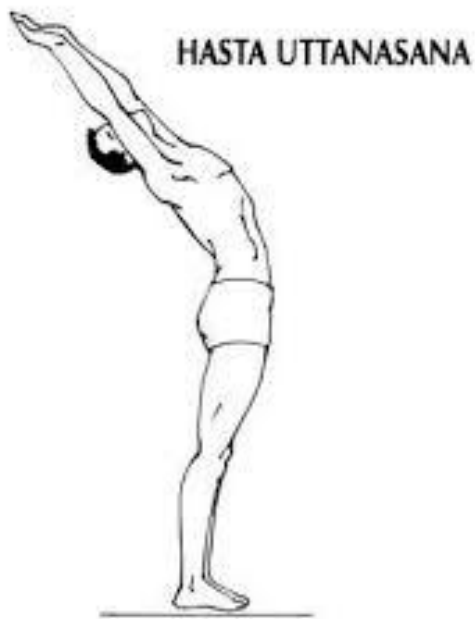
- ✓ Remain standing upright with the feet together.
- ✓ Slowly bend the elbows and place the palms together in front of the chest in Namaskara mudra.
- ✓ Relax the whole body.

**Breathing:** Breathe normally.

**Awareness:** Physical - on the chest area. Spiritual - on Anahata chakra.

**Mantra:** Om Mitraya Namaha, salutations to the friend of all

**Benefits:** This pose establishes a state of concentration and calmness in preparation for the practice to be performed.<sup>47</sup>



### 3.8.2.2.2 HASTA UTTANASANA (RAISED ARM POSE)

#### Position 2:

- ✓ Raise and stretch both arms above the head. Keep the arms separated, shoulder width apart.
- ✓ Bend the head, arms and upper trunk backward.

**Breathing:** Inhale while raising the arms.

**Awareness:** Physical - on the stretch of the abdomen and expansion of the lungs.

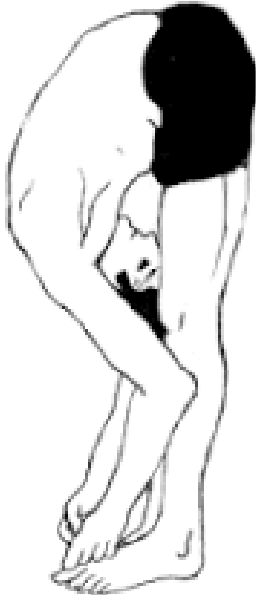
Spiritual - on Vishuddhi chakra.

**Mantra:** Om Ravaye Namaha, salutations to the shining one.

#### Benefits:

- ✓ This pose stretches all the abdominal organs and improves digestion.
- ✓ It exercises the arm and shoulder muscles

- ✓ It helps to tones the spinal nerves
- ✓ It helps to remove excess weight.<sup>45</sup>



### 3.8.2.2.3 PADAHASTASANA: (HAND TO FOOT POSE)

#### Position 3:

- ✓ Bend forward until the fingers or palms of the hands touch the floor on either side of the feet.
- ✓ Try to touch the knees with the forehead.
- ✓ Make a note to keep the knees straight.

**Breathing:** Exhale while bending forward. Try to contract the abdomen to expel the maximum amount of air from the lungs.

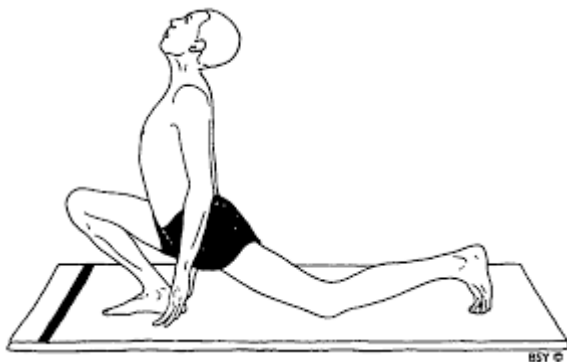
**Awareness:** Physical - on the pelvic region. Spiritual - on Swadhisthana chakra.

**Mantra:** Om Suryaya Namaha, salutations to he who induces activity.

**Contra-indications:** People with back conditions should not bend forward fully. They should bend from the hips, keeping the spine straight. Slowly bend until the back forms ninety degree angle with the legs or bend only as far as comfortable.

**Benefits:**

- ✓ This pose is useful in eliminating or preventing stomach or abdominal ailments.
- ✓ It reduces excess weight in the abdominal region, improves digestion and helps to remove constipation.
- ✓ It improves blood circulation, makes the spine supple and tones the spinal nerves.



**3.8.2.2.4. ASHWA SANCHALASANA: (EQUESTARIAN POSE)**

**Position 4:**

- ✓ Place the palms of the hands flat on the floor beside the feet.
- ✓ Stretch the right leg back as far as possible. At the same time, bend the left knee, keeping the left foot on the floor.
- ✓ Keep the arms straight and in the final position, the weight of the body should be supported on both hands, the left foot, right knee and toes of the right foot.



- ✓ The head should be tilted backward, the back arched and the inner gaze directed upward to the eyebrow center.

**Breathing:** Inhale while stretching the leg back.

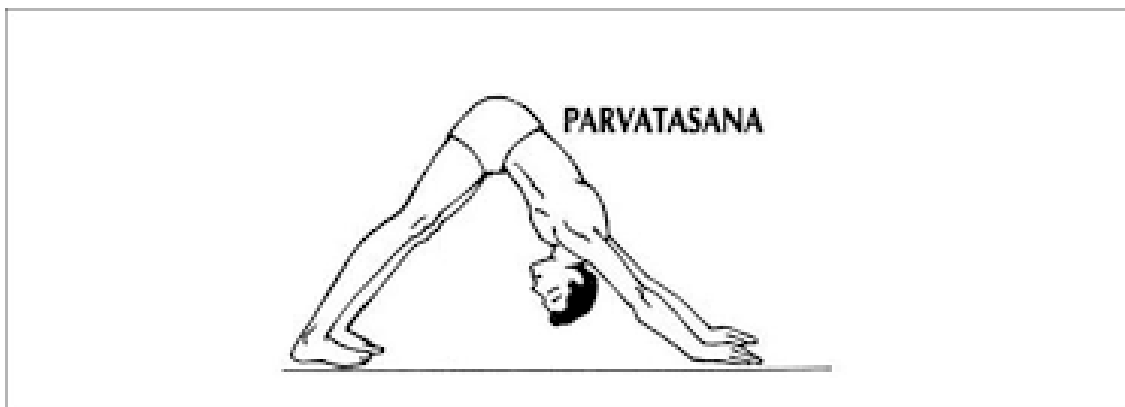
**Awareness:** Physical - on the stretch from the thigh to the chest or on the eyebrow centre. Spiritual - on Ajna chakra.

**Mantra:** Om Bhanave Namaha, salutations to he who illumines.

**Benefits:**

- ✓ This pose massages the abdominal organs and improves their functioning.
- ✓ It strengthens the leg muscles
- ✓ It induces balance in the nervous system.

**Practice note:** In the final pose the palms of the hands are kept flat on the floor initially. Later on, more advanced practitioners may use the fingertips.<sup>45</sup>



### 3.8.2.2.5. PARVATASANA: (MOUNTAIN POSE)

#### **Position 5:**

- ✓ Take the left foot back beside the right foot. Simultaneously, raise the hips and lower the head between the arms, so that the back and legs form the two sides of a triangle.
- ✓ The legs and arms should be straight in the final position. Try to keep the heels on the floor in the final pose and bring the head towards the knees. Do not strain.

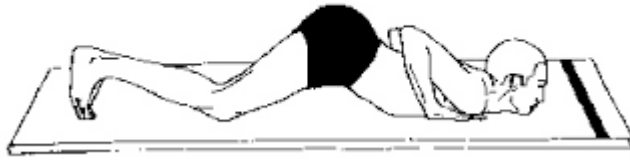
**Breathing:** Exhale while taking the left leg back.

**Awareness:** Physical - on relaxing the hips or on the throat region. Spiritual - on vishuddhi chakra.

**Mantra:** Om Khagaya Namaha, salutations to he who moves quickly in the sky.

#### **Benefits:**

- ✓ This pose strengthens the nerves and muscles in the arms and legs.
- ✓ The spinal nerves are toned and circulation is stimulated especially in the upper spine, between the shoulder blades.<sup>45</sup>



### **3.8.2.2.6. ASTANGA NAMASKAR: (SALUTE WITH EIGHT PARTS OR POINTS)**

#### **Position 6:**

- ✓ Lower the knees, chest and chin on to the floor.
- ✓ In the final position only the toes, knees, chest, hands and chin should touch the floor.
- ✓ Try to touch the knees, chest and chin to the floor simultaneously. If this is not possible, first try to lower the knees, then the chest, and finally the chin.
- ✓ Keep the buttocks, hips and abdomen raised.

**Breathing:** The breath is held outside in this pose. There is no respiration.

**Awareness:** Physical - on the abdominal region. Spiritual - on Manipura chakra.

**Mantra:** Om Pushne Namaha, salutations to the giver of strength.

#### **Benefits:**

- ✓ This pose strengthens the leg and arm muscles
- ✓ It develops the chest and exercises the region of the spine between the shoulder blades.<sup>45</sup>



### 3.8.2.2.7 BHUJANGASANA (COBRA POSE):

#### Position 7:

- ✓ Lower the buttocks and hips to the floor.
- ✓ Straighten the elbows, arch the back and push the chest forward maximum into the cobra pose.
- ✓ Bend the head back and gaze upward to the eyebrow centre.
- ✓ The thighs and hips remains on the floor and the arms supports the trunk.

Unless the spine is very flexible the arms will remain slightly bent.

**Breathing:** Inhale while raising the torso and arching the back.

**Awareness:** Physical - on relaxation of the spine. Spiritual - Swadhisthana chakra.

**Mantra:** Om Hiranya Garbhaya Namaha, salutations to the golden, cosmic self.

**Benefits:**

- ✓ This pose keeps the spine supple, improving circulation in the back region and toning the spinal nerves.
- ✓ It tones the reproductive organs, stimulates digestion and relieves constipation. It also tones the liver and massages the kidneys and adrenal glands.<sup>45</sup>

**Position 8: Parvatasana (mountain pose)** This stage is same as that of position 5.

From Bhujangasana assume Parvatasana. The hands and feet does not move from position 7. Raise the hips and lower the heels to the floor.

**Breathing:** Exhale while raising the hips.

**Awareness:** Physical - on relaxing the hips or on the throat region. Spiritual - on vishuddhi chakra.

**Mantra:** Om Marichaye Namaha, salutations to the Lord of the Dawn.

**Position 9: Ashwa Sanchalanasana (equestrian pose)**

This stage is the same as position 4 but it is done with the opposite side.

The palms are kept flat on the floor. Bend the right leg and slowly bring the right foot forward between the two hands. Simultaneously lower the left knee so that it touches the floor and push the pelvis forward. Tilt the head backward and arch the back. Keep the gaze at the eyebrow centre.

**Breathing:** Inhale while assuming the pose.

**Awareness:** Physical - on the stretch from the thigh to the chest, or on the eyebrow centre. Spiritual - on ajna chakra.

**Mantra:** Om Adityaya Namaha, salutations to the son of Aditi, the cosmic Mother.

**Position 10:** Padahasthasana (hand to foot pose) This position is same as position 3.

Bring the left foot forward next to the right foot and straighten both knees. Bring the forehead as close to the knees as possible without straining.

**Breathing:** Exhale while performing the movement.

**Awareness:** Physical - on the pelvic region. Spiritual - on Swadhisthana chakra.

**Mantra:** Om Savitre Namaha, salutations to Lord of Creation.

**Position 11:** Hasta Utthanasana (raised arms pose) This stage is the repetition of position 2. Raise the torso and stretch the arms above the head. Keep the arms separated at shoulder width apart. Bend the head, arms and upper trunk backward as much as possible.

**Breathing:** Inhale while straightening the body.

**Awareness:** Physical - on the stretch of the abdomen and expansion of the lungs.  
Spiritual - on Vishuddhi chakra.

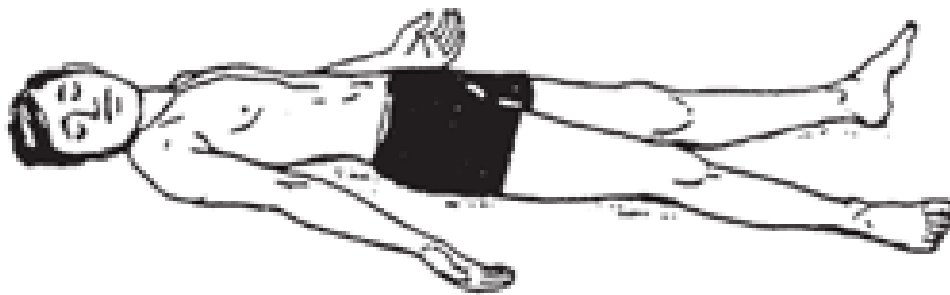
**Mantra:** Om Arkaya Namaha, salutations to he who is fit to be praised.

**Position 12:** Pranamasana (prayer pose) This is the final position and is the same as position 1. Bring the palms together in front of the chest.

**Breathing:** Exhale while assuming the final position.

**Awareness:** Physical - on the region of the heart. Spiritual - on anahata chakra.

**Mantra:** Om Bhaskaraya Namaha, salutations to he who leads to enlightenment.



#### **3.8.2.2.8 Shavasana (corpse pose)**

**Method:** Lie down flat on the back with the arms about 15 cm away from the body with the palms facing upward. A thin pillow or a folded cloth may be placed behind the head to prevent any discomfort. Let the fingers curl up slightly. Move the feet slightly apart to a comfortable position and close the eyes. The head and spine should be kept in a straight line. Make sure the head does not fall to any side. Relax the whole body and stop all physical movement even a slightest as much as possible. Become aware of the natural breath and allow the breath to become rhythmic and relaxed.<sup>45</sup>

**Awareness:** Physical - first on relaxing the whole body, then on the breath and counting. Spiritual - on ajna chakra.<sup>45</sup>

#### **Benefits:**

- ✓ This asana relaxes the whole psycho-physiological system. It should ideally be practiced before sleep or before, during and after asana practice, particularly

after dynamic exercises such as Surya Namaskara. This can also be practiced when the practitioner feels physically and mentally tired.

- ✓ It develops body awareness. When the body is completely relaxed, awareness of the mind increases, developing pratyahara.

**Practice note:** Try not to move the body at all during the practice as even a slightest movement will cause muscular contraction. A personal mantra can be repeated with every inhalation and exhalation.<sup>45</sup>

### **3.8.3 FAST/ SLOW SURYA NAMASKAR:**

Various schools of yoga differ in the practice of SN. Some schools advocate performance in a slow manner in accordance with slow breathing, while others advocate a rapid method by performing multiple rounds in a fast manner very similar to physical exercise. It has been suggested that Surya Namaskar at different speeds gives different benefits and that when it is done rapidly, it warms the body and acts as a cardio tonic. When done slowly it strengthens and tones the musculature and enhances smooth functioning of internal organs. It has also been suggested that the practice of Surya Namaskar can relieve depression through fast rounds or it may even cool down hyperactivity with slow rounds.<sup>48</sup>

### **3.8.4. VARIATIONS OF SURYA NAMASKAR:**

Different forms of Surya Namaskar have been developed from ancient times till the present day. Some of the variations are:

- ✓ Vedic Surya Namaskar



- ✓ Aruna Surya Namaskar
- ✓ Maha Sauri Surya Namaskar
- ✓ Shiva Surya Namaskar
- ✓ Rishikesh Surya Namaskar<sup>49</sup>

### **3.8.5. PHYSIOLOGICAL EFFECT OF SURYA NAMASKAR ON VARIOUS SYSTEMS:**

The practice of Surya Namaskar has its effects directly on the physical body, applying pressure, stretching, massaging, gently toning up and supporting the internal tissue structure. Thus, all the systems of the body are positively influenced by the practice of Surya Namaskar.<sup>50</sup>

#### **3.8.5.1 Effect on respiratory system:**

- ✓ The practice Surya Namaskar, significantly increases maximum inspiratory pressure and maximum expiratory pressure. This suggests that its training improves the strength of both expiratory as well as the inspiratory muscles.<sup>50</sup>
- ✓ It improves the strength of intercostal muscles and ultimately leads to the increased vital capacity and contractility of lungs.
- ✓ Regular Surya Namaskar training causes significant change in forced vital capacity (FVC), peak expiratory flow rate (PEFR), forced expiratory vital volume in 1st second (FEV1) and Vital capacity (VC).<sup>46</sup>
- ✓ These effects are especially seen in the practice of Hasta Uttanpadasana, which maximally expands the chest wall.

- ✓ Padahastasana, when performed with exhalation is a potent breath cleanser. By the performance of the above asanas, respiratory diseases and excess mucus in air passages can be eliminated.<sup>50</sup>

### **3.8.5.2 Effect on cardiovascular system**

- ✓ Surya Namaskar in daily routine life can improve cardiorespiratory efficiency and fitness with an increase in peak expiratory flow rate, systolic blood pressure, forced vital capacity, and reduction of respiratory rate, heart rate, and diastolic blood pressure.<sup>46</sup>
- ✓ Regular Surya Namaskar practices leads to vagal dominance, reduced sympathetic tone, and an improved cardiovascular function.<sup>46</sup>
- ✓ Padahastasana and Parvatasana aids return of blood from the lower body to the heart. It also stretches the leg muscles using the force of gravity in the inverted position.<sup>50</sup>

### **3.8.5.3 Effect on lymphatic system:**

- ✓ The circulation of lymph, which is an important factor in fluid balance and combating infections is toned by the practice of Surya Namaskar.
- ✓ The body gains increased resistance to infections and gains a better ability to heal with the practice of Surya Namaskar.

### **3.8.5.4 Effect on Gastro intestinal system:**

- ✓ The alternating stretching and compressing movements during the practice of Surya Namaskar tones the entire digestive system by thoroughly massaging all the abdominal viscera.
- ✓ Regular Surya Namaskar practice improves digestion, combat constipation and many gastrological problems.<sup>46</sup>
- ✓ Padahastasana and Bhujangasana are powerful in terms of compressing and stimulating the abdominal organs. They help to increase the digestive fire, promotes a healthy appetite and helps in complete and rapid assimilation of food.<sup>50</sup>

#### **3.8.5.5. Effect on Urinary System:**

- ✓ Through the practice of Surya Namaskar, the entire spine and the muscles of the back are toned in such a way that it gently massages the kidneys.
- ✓ Bhujangasana, Astanga Namaskarasana and Ashwa Sanchalasana exert a strong influence on the kidney area.<sup>50</sup>

#### **3.8.5.6. Effect on Skin:**

- ✓ Surya Namaskar produces perspiration, speeds up the circulation and enhances the elimination of waste through the skin.<sup>50</sup>
- ✓ It maintains a healthy skin which is a reflection of the inner health.<sup>50</sup>
- ✓ All asanas stretch the skin and its elastic tissues, toning it and helping to preserve its function.<sup>50</sup>

### **3.8.5.7. Effect on Endocrine system:**

- ✓ Regular practice of Surya Namaskar modulates the endocrinal system of the body especially, pancreas, thyroid, adrenals and pituitary glands. The overall effect is beneficial for Metabolic Syndrome, Obesity, Diabetes Mellitus, Hypothyroidism and menstrual disorders.<sup>46</sup>
- ✓ Surya Namaskara influences the pineal gland and the hypothalamus, helping to prevent pineal degeneration and calcification.<sup>51</sup>
- ✓ Asanas such as Hasta Uttanasana, Parvatasana, Bhujangasana and Ashwa Sanchalanasana have powerful effect on neck thereby stimulating the thyroid gland.<sup>50</sup>

### **3.8.5.8. Effect on nervous system:**

- ✓ Surya Namaskar tunes the central, Peripheral and autonomic Nervous system.<sup>46</sup>
- ✓ The entire spine is stretched and compressed, stimulation the whole spinal cord and the nerve plexus.<sup>50</sup>

### **3.8.5.9 Effect on Reproductive system:**

- ✓ Surya Namaskar has a positive effect in both male and female reproductive system.
- ✓ The supporting muscles of the uterus and vaginal walls are stretched. This helps in painless labour.
- ✓ Blood supply is improved to the pelvic region thus producing a toning effect on the ovaries. This helps to correct menstrual irregularities and pain during menstruation.<sup>50</sup>

### **3.8.5.10 Effect on biochemical parameters:**

- ✓ Surya Namaskar significantly decreases fasting blood sugar, postprandial blood sugar and Glycosylated hemoglobin HbA1c level in diabetic patients.
- ✓ Its regular practice significantly decreases the oxidative stress on the body which plays a key role in insulin resistance and complication in type 2 diabetes patients.
- ✓ It also improves the lipid profile in diabetic patients which plays a supportive role in preventing complications. This causes a reduction of weight, BMI and waist-hip ratio.<sup>46</sup>

### **3.8.5.11 Effect on musculoskeletal system:**

- ✓ Regular training of Surya Namaskar requires four times more energy than the daily requirement. Thus the practice is a very good fat burner.
- ✓ SN training improves the flexibility of most of the body muscles especially leg, back, chest and buttock muscles.
- ✓ Regular practice of Surya Namaskar may significantly increase Hand grip, strength and endurance.<sup>46</sup>

### **3.8.6 RESEARCH PAPERS ON PHYSIOLOGY OF SURYA NAMASKAR:**

**Ananda Balayogi et al** did a comparative study on the physiological effects of fast and slow Surya Namaskar. They divided 42 school children into Group I and Group II and gave 6 months training in the performance of slow suryanamaskar (SSN) and fast

suryanamaskar (FSN), respectively to each group. Group 1 completed fifteen rounds in 30–40 minutes and Group 2 completed 5 rounds in 30 – 40 minutes. They took 6 minutes to complete each round.<sup>48</sup>

The study stated that **SN has positive physiological benefits** as seen by the improvement of pulmonary function, respiratory pressures, hand grip strength and endurance, and resting cardiovascular parameters.<sup>48</sup>

They also found a significant increase in isometric hand grip (IHG) and hand grip endurance (HGE) time after 3 months of Surya Namaskar training. The increase in muscle strength and endurance time can be explained on the basis of stimulation of skeletal muscles during the process of isometric contraction that is maintained during the steady state of the different postures in Surya Namaskar. This may be also because of the delayed onset in muscular fatigue. This study gives evidence **that both Slow Surya Namaskar and Fast Surya Namaskar improve muscle strength** like other yoga practices and it is more apparent in the case of Fast Surya Namaskar.<sup>48</sup>

**Ni M et al** studied the activation of 14 dominant side muscles during the performance of each Surya Namaskar posture and stated that SN has significant effects in all pose for all fourteen muscles except middle trapezius ( $p < 0.02$ ) and of skill level for the vastus medialis; ( $P = 0.027$ ). A significant skill level  $\times$  pose interaction existed for five muscles (pectoralis major sternal head, anterior deltoid, medial deltoid, upper rectus abdominis and gastrocnemius lateralis;  $p < 0.05$ ). They concluded that **different poses can produce specific muscle activation patterns** which may vary according to the practitioners skill levels.<sup>52</sup>

**Amit Vaibhav** et al in their review article discussed the positive health benefits of Surya Namaskar. They stated that Surya Namaskar has a positive impact on autonomic functions of the body. Its regular practice significantly decreases the oxidative stress on the body.<sup>53</sup>

Surya Namaskara comprehensively includes asana, pranayama, mantra and meditative awareness. Different evidence-based study suggests that Surya Namaskar improves metabolic function, strengthens the musculoskeletal system, balances endocrinal system, tunes central nervous system, supports urogenital system and boosts the gastrointestinal system. Thus, there is an important need to incorporate Surya Namaskar practices in modern lifestyle for the maintenance of a healthy mind and body.<sup>53</sup>

**Ananda Balayogi Bhavanani et al** conducted a study on the immediate effect of Surya Namaskar on reaction time and heart rate in female Volunteers. They stated that, Reaction time (RT) is simple and effective method of studying the central neuronal processing. It has been reported that changes in breathing period produced by voluntary control of inspiration correlate to changes in RT. Three rounds of Aruna Surya Namaskar followed by 5 minutes of quiet sitting was given for volunteers in study group. Simple Auditory Reaction Time was recorded for auditory beep sound. Simple Visual Reaction Time was recorded with the help of red light. The results showed that performance of **Surya Namaskar produced immediate and significant decrease in Visual Reaction Time and Auditory Reaction Time.** Faster reactivity may be due to the intermediate level of arousal by conscious synchronization of

dynamic movements along with breathing. The study suggest that Surya Namaskar can be used as an effective training means to improve neuromuscular abilities.<sup>54</sup>

**Manju Deorari et al** conducted a study to determine the therapeutic effect of Surya Namaskara on Emotional Maturity and Psychological Well-Being among college going students. After 60 days of practice, there was significant (  $P= 0.01$  ) improvement in emotional maturity and psychological well-being of the students.<sup>55</sup>

**Sinha B et al** conducted a study to determine the effect of yogic training on various cardiorespiratory responses during the Surya Namaskar practice in yoga trainees after an interval of 3, 6, and 11 months. The study was conducted in healthy male volunteers and Oxygen consumption and heart rate during the actual practice of SN was recorded. The results of the study indicated that yogic training caused significant conditioning of cardiorespiratory parameters.<sup>56</sup>

**Sinha B et al** did a comparative study on cardiorespiratory responses between Surya Namaskar and bicycle exercise at similar energy expenditure level. 20 healthy Yoga instructors practicing different Yogic practices including Surya Namaskar since 7-8 years participated in the study. Surya Namaskar and bicycle exercise were compared at three similar exercise intensity levels in terms of percentage of VO<sub>2</sub> max. The exercise intensities were light (10-20% VO<sub>2</sub> max), moderate (21-40% VO<sub>2</sub> max) and high intensities (41-50% VO<sub>2</sub> max). Heart rate at high work intensity was significantly increased in bicycle exercise than Surya Namaskar ( $P < .001$ ). Also during high intensity work outs, the ventilation and carbon dioxide output were



significantly higher in bicycle exercise than Surya Namaskar ( $P < 0.001$ ). Overall, cardiorespiratory stress is much lower in Surya Namaskar than bicycle exercise at similar work intensities.<sup>57</sup>

**Mody BS in 2010** conducted a study to assess the cardiorespiratory and metabolic responses of four rounds of Surya Namaskar and to determine its potential as a training and weight loss tool. Six healthy Asian Indian men and women (18-22 years) who had been previously trained in Surya Namaskar for over two years participated in the study. Testing was completed in a single session lasting about 30 minutes. Heart rate and oxygen consumption were measured while performing the four rounds of Surya Namaskar. Average intensity during the four rounds was 80% HRmax, sufficient to elicit a cardiorespiratory training effect. Oxygen consumption averaged 26 ml/kg/min during each round that resulted in an energy expenditure of 230 kcals during a 30 minutes session for an individual weighing 60 kgs. The results showed that the regular practice of Surya Namaskar may maintain or improve cardiorespiratory fitness, as well as help in weight management.<sup>58</sup>

**Sinha B et al 2004**, did a study on Energy cost and cardiorespiratory changes during the practice of Surya Namaskar. The participant's pulmonary ventilation, carbon dioxide output, Heart Rate, Oxygen consumption and other cardiorespiratory parameters were measured during the actual practice of Surya Namaskar. The study showed that as an aerobic exercise, Surya Namaskar seemed to be ideal as it comprises both of static stretching and slow dynamic component of exercise with optimal stress on the cardiorespiratory system.<sup>59</sup>

**Sasi Kumar A et al 2011**, did a study to evaluate the effects of a 45 days daily practice of Surya Namaskar on blood pressure(BP), heart rate(HR), respiratory rate (RR), forced vital capacity(FVC) and peak expiratory flow rate (PEFR) in school students of both sexes. 115 school students aged 10 to 14 years were recruited for the study. The participants were trained to perform Surya Namaskar for 45 days study period. The cardio vascular and respiratory parameters Blood Pressure (BP), Heart Rate (HR), Respiratory Rate (RR), Forced Vital Capacity (FVC) and Peak Expiratory Flow Rate (PEFR) were measured before and after practice of SN. The results showed that the Systolic blood pressure, PEFR and FVC increased significantly and RR, HR and diastolic blood pressure decreased significantly after the practice of Surya Namaskar study which proves that even a period of 45 days SN training can show significant change in the cardio and respiratory parameters.<sup>60</sup>

**N. Veeraparameswari et al 2014** conducted a study to find out the effect of SN practices and physical exercises on selected biochemical parameters of college women to find the effect of Surya Namaskar practices and physical exercises on selected biochemical parameters of college women. 60 college women were randomised and divided into three groups consisting of 20 in each group. Group I underwent physical exercises (PEG), group II underwent Surya Namaskar practices (SNG) and group III was kept as control group. The physical exercises (PEG) group was provided with different types of physical exercises, consisting of walking, jogging, floor aerobic exercises and step aerobic exercises for 12 weeks and Surya Namaskar practices (SNG) group underwent, slow, medium and fast variations of Surya Namaskar. From

the blood samples biochemical variables, fasting blood sugar and total cholesterol were obtained.<sup>61</sup>

The results of this study proved that both the experimental protocols significantly contributed for fasting blood sugar and total cholesterol of the college women. Even though it was found that Surya Namaskar practices (SNG) group was found to be better than physical exercises (PEG), the difference between the experimental groups was not significant at 0.05 level.<sup>61</sup>

**Pratima M. Bhutkar et al 2008**, did a pilot study and found significant reduction in pulse rate after regular practice of Surya Namaskara which is attributed to increased vagal tone and decreased sympathetic activity. Decreased sympathetic activity in turn reduces catecholamine secretion and also leads to vasodilation leading to improvement in peripheral circulation. All these may be responsible for reduction in resting pulse rate. These factors also decrease work load on heart leading to decrease in cardiac output and hence systolic blood pressure. They also stated that Yogic practices alter the hypothalamic discharges leading to decrease in sympathetic tone and peripheral resistance and hence the diastolic blood pressure.<sup>62</sup>

### **3.8.7. ENERGY METABOLISM IN RELATION TO SURYA NAMASKAR:**

Review suggests that yoga is typically classified as a light-intensity physical activity. However, a few sequences/poses, including Surya Namaskar, meet the criteria for moderate- to vigorous-intensity activity.<sup>63</sup>

Maintenance of body weight is regulated by the interaction of a number of processes, encompassing homeostatic, environmental and behavioral factors. In homeostatic

regulation, the hypothalamus has a central role in integrating signals regarding food intake, energy balance and body weight, while an 'obesogenic' environment and behavioral patterns exert effects on the amount and type of food intake and physical activity.<sup>64</sup>

It is stated that during the practice of Surya Namaskar oxygen consumption was highest in the eighth posture (1.22+/-0.073 l min<sup>-1</sup>) and lowest in the first posture (0.35+/-0.02 l min<sup>-1</sup>). Total energy cost throughout the practice of SN was 13.91 kcal and at an average of 3.79 kcal/min.<sup>65</sup>

**Rajni Nautiyal 2016**, conducted a study to determine the effect of Surya Namaskar on weight loss in obese persons. 30 obese persons with the age range of 25-30yrs, weight 70-82.5 kg and height 155-167 cm. were selected for the study. They were divided into two equal groups of 15 subjects each. One group was treated as an experimental group and another one as control group. The training of Surya Namaskar was given to only experimental group. The training programme of 30 days was organized for 60 minutes daily practice of Surya and the weight of subjects of experimental & control groups were measured. The study established that one month regular practice of Surya namaskar helped obese persons to reduce their weight.<sup>66</sup>

Surya namaskar is a moderate physical exercise which is linked with the breathing. It consumes calories moderately without much fatigue or exhaustion. Since it is an isotonic type of exercise it does not increase the tension but increases the metabolic rate. Dynamic stretches in forward and backward direction and rhythmic positive and negative pressure changes in the viscera stimulate various viscerceptors. This is the

reason why all the systems work at the optimum level. The intensity of the exercise is increased by adding one or two rounds to everyday practice. This increases the stamina and cardiovascular endurance. It mobilizes the stored or accumulated fat by increasing the blood circulation. The practitioner has little sweating but at the same time experiences refreshed feeling.<sup>66</sup>

**Dr Sarvesh Yadav et al** in a paper titled Surya Namaskar, A Holistic outlook towards Obesity, A Metabolic Disorder, stated that Surya Namaskar (Salutation to the sun) is the best way to burn the calories and reduce weight. Surya Namaskara is full Yoga by itself. It tones up the whole body & has a unique influence on endocrine, circulatory, respiratory, digestive and nervous system, helping to correct metabolic imbalances that cause and perpetuate obesity.<sup>67</sup>

### **3.8.8 PSYCHOLOGICAL ASPECT OF SURYA NAMASKAR**

#### **3.8.8.1 YOGIC CONCEPT OF HUMAN BODY AND SURYA NAMASKAR:**

According to yogic physiology, the human framework is comprised of five bodies or sheaths, which account for the different aspects to dimensions of human existence.

These five sheaths are known as:

- a) Annamayakosha, the food or material body.
- b) Manomayakosha, the mental body.
- c) Pranamayakosha, the bioplasmic or vital energy body.

d) Vijnanamayakosha, the psychic or higher mental body.

e) Anandamayakosha, the transcendental or bliss body.<sup>47</sup>

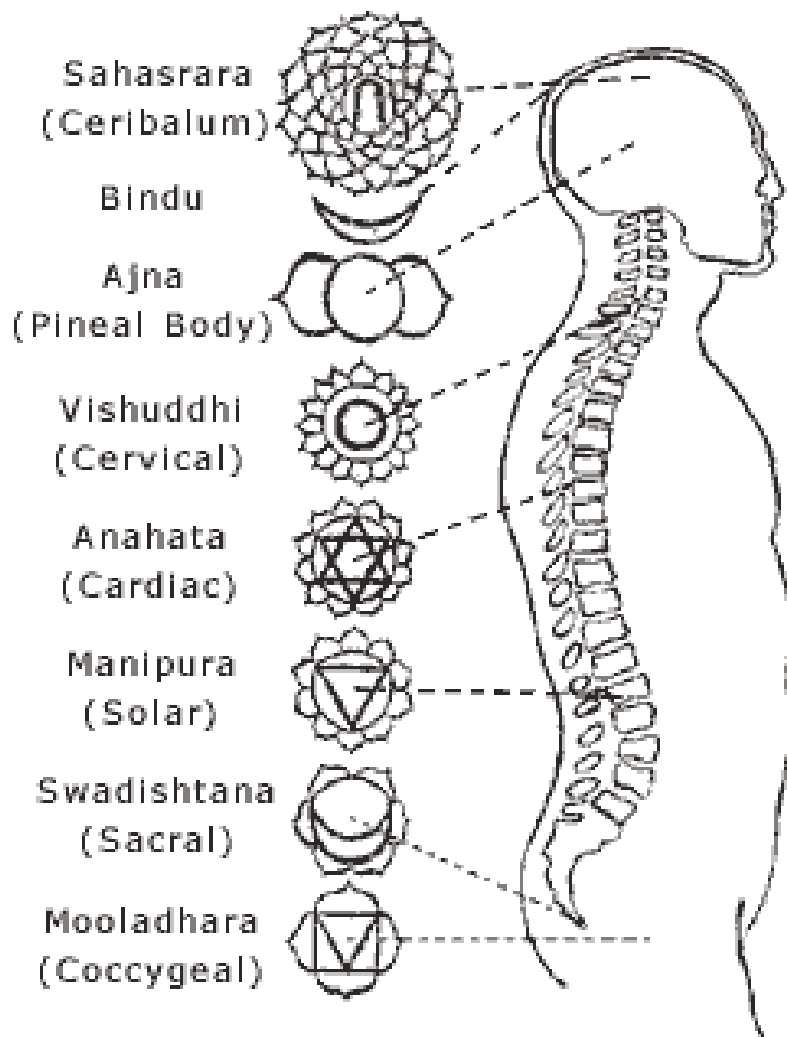
Since the practice of Surya Namaskar involves asanas, breathe modification, Mantra chanting as well as awareness of the chakra, the practice of Surya Namaskar works on all the five koshas.

### **3.8.8.2 INTRODUCTION TO CHAKRAS:**

The word chakra literally means 'wheel' or 'circle' but in the yogic context a better translation is 'vortex' or 'whirlpool'. The major chakras are seven in number and are located along the pathway of sushumna which flows through the centre of the spinal cord. Sushumna originates at the perineum and terminates at the top of the head. The chakras are connected to a network of psychic channels called nadis, which correspond to the nerves but are more subtle in nature.<sup>45</sup>

### **3.8.8.3 LOCATION OF SEVEN MAJOR CHAKRAS:**

## LOCATION OF THE CHAKRAS



### **3.8.8.3.1. Mooladhara chakra:**

The lowest of the chakras is situated at the perineal region in the male body and at the cervix in the female body. The word mool means 'root' and adhara means 'place'. Therefore, it is called as the root centre. Mooladhara chakra is associated with the sense of smell.<sup>45</sup>

### **3.8.8.3.2 Swadhisthana chakra:**

Approximately two fingers' width above Mooladhara chakra in the spine, directly behind the genital organs is located the swadhisthana chakra.<sup>45</sup>

#### **3.8.8.3.3. Manipura chakra:**

Situated in the spine behind the navel region is the Manipura chakra. The word mani means 'gem' and pura means 'city'. Therefore, Manipura means 'city of jewels'. It is so-called because it is the fire centre.<sup>45</sup>

#### **3.8.8.3.4 Anahata chakra:**

Situated in the spine, behind the sternum at the level of the heart is the Anahata chakra.<sup>45</sup>

#### **3.8.8.3.5 Vishuddhi chakra:**

Situated at the back of the neck, behind the throat pit lies the Vishuddhi chakra. It is considered to be the center of purification.<sup>45</sup>

#### **3.8.8.3.6 Ajna chakra:**

Situated in the midbrain, behind the eyebrow center, at the top of the spine is the Ajna chakra.<sup>45</sup>

**Richard William Maxwell in his article** on The Physiological foundation of Yoga chakra expression discusses the following aspects of chakras.

The article is based on earlier work hypothesizing that intercellular gap junction connections provide a physiological mechanism underlying subtle energy systems described in yoga as well as other disciplines such as acupuncture. Three physical



aspects of chakras are distinguished that are integrated through gap junction mechanisms and are proposed to have arisen during embryological development. Furthermore, electrical conductance associated with a high concentration of gap junctions could generate phenomena that, when subjectively experienced, have the radiant qualities attributed to chakras. This theory provides a scientific rationale for previously unexplained details of chakra theory and offers a new orientation to conceptualizing and studying such subjective phenomena.<sup>68</sup>

Shang described chakras as remnants of embryological organizing centers within the CNS, possessing a similar high concentration of gap junction connections.<sup>68</sup>

Chakra locations have sometimes been associated with autonomic plexuses. Those CNS centers represent the physical base of the chakras, the physical structure most immediately connected to subjectively perceived chakra activity.<sup>68</sup>

This difference between chemical and electrical communication within the CNS and ANS could explain why chakras are perceived to be nonphysical. Chemical synaptic activity of the CNS and ANS may be able to be subjectively distinguished from the activity and influence of the chakras because the effect of chemically based nerve function spreads in a manner that is distinct from electrical gap junction networks. Yoga training and probably other practices provide access to these subtle electrical circuits and functions.<sup>68</sup>

The lower five chakras are associated with sites of developmental control over the five classically defined regions of the spine: cervical, thoracic, lumbar, sacral, and

coccygeal. The upper two chakras are located within the brain at points where brain regions have differentiated.<sup>68</sup>

Physical systems related to a chakra have three main aspects: a physical base that exists in the dorsal CNS, a concentration point that is activating to that physical base, and influence of that physical base over the activity of particular glandular secretions that have the potential to bias mental function.<sup>68</sup>

#### **3.8.8.4 PSYCHOLOGICAL ASPECT OF DYNAMIC YOGA:**

It is stated that dynamic form of yoga called as Vyayam, has a relaxing effect on the mind. Telles et al, evaluated the efficacy of an ancient yoga text that suggests that a combination of calming and stimulating practices may be especially helpful in reaching a state of mental equilibrium. They conducted an experiment aimed to compare the effects of whether a combination of activation and relaxation, known as cyclic meditation (CM), or relaxation alone in the supine position, known as shavasana (SH), would alter metabolic and breath rates in the same or different directions.<sup>69</sup>

40 male volunteer ages 20 to 47 years participated in the study. They were divided into two groups. One following cyclic meditation and the other Shavasana. Following both CM and SH, VO<sub>2</sub> was measured with a closed-circuit apparatus. A significant difference was found between values recorded before and after the sessions of CM and SH for VO<sub>2</sub> and ventilation. Oxygen consumption decreased by 32.1% after CM compared to 10.1% in SH, breath rate decreased by 18% after CM and 15.2% after SH, and ventilation increased by 28.8% after CM and 15.9% after SH.

The findings of the study support the idea that CM, which combines stimulating and calming techniques, when coupled with a background of relaxation and awareness, may reduce physiological arousal better than SH, lying in a supine position, which has also been shown to be calming.<sup>69</sup>

#### **3.8.8.5 EFFECTS OF SURYA NAMASKAR ON MIND:**

The psychological benefits of Surya Namaskar are:

- ✓ Increase your mental focus and concentration.
- ✓ Reduce depression, anxiety and stress by reducing key markers like Cortisol.
- ✓ Increase the quantity of “good mood” neurotransmitters like Serotonin.
- ✓ Increase mind to body coordination which is very good especially for older persons.<sup>50</sup>

#### **3.8.8.6 CONTRA-INDICATIONS OF SURYA NAMASKAR:**

- ✓ Fever and acute infections.
- ✓ Patients of hernia and high blood pressure.
- ✓ People suffering from back condition should seek proper advice commencing Surya Namaskar.
- ✓ Women should avoid Surya Namaskar during menses.
- ✓ Coronary artery diseases, or by those who have had a stroke, as it may over stimulate or damage a weak heart or blood vessel system.
- ✓ Hernia or intestinal tuberculosis.<sup>45</sup>

## **4.0 MATERIALS AND METHODOLOGY:**

### **4.1 STUDY DESIGN:**

Pre and post experimental study

### **4.2 SUBJECTS:**

A total of 60 female subjects were selected to participate in the study based upon the symptoms experienced. All subjects were subjected to pelvic scan to rule out any pathologies. Out of 60 subjects 16 had PCOs and were therefore excluded from the study.

The remaining subjects were briefed about the study and informed consent was obtained from them along with permission from their parents in case of minor. This study was conducted within the purview of a larger study on the physiological effects of yoga, and ethical approval was obtained from institutional ethics committee for the entire study.

They were asked to fill the menstrual symptom questionnaires' and were also asked to mark the intensity of pain in Numeric pain intensity (NPI) scale at the beginning of the study. Their detailed history was also collected. Out of the remaining 44 subjects 14 subjects discontinued with the practice during different time of the study. All subjects are free to withdraw from participation in the study at any time, for any reason, specified or unspecified, and without prejudice to further treatment. Subjects who are withdrawn from the study were not being replaced.

The subjects were selected based on the following criteria:

#### **4.2.1 Subject Selection:**

##### **4.2.1.1 Inclusion Criteria:**

1. Subject must be adolescent female with primary dysmenorrhea,
2. The subject must be between 14 to 25 years of age.
3. Subject must demonstrate a willingness and capability to cooperate.

##### **4.2.1.2 Exclusion Criteria:**

1. Subject who are differently abled.
2. Subject with any congenital anomalies.

#### **4.3 INTERVENTION:**

Surya Namaskar according to Bihar school of yoga was given to the subjects. Surya Namaskar consisted of 12 postures. Each posture of Surya Namaskar was given in a slow manner with focus on breathing and chakra awareness.

Twelve postures of Surya Namaskar

##### **Pranamasana (Prayer pose) – 1<sup>st</sup> and 12<sup>th</sup> posture:**

Pranamasana or the Prayer Pose is the starting and twelfth pose of Surya Namaskara.

##### **Method:**

Stand erect with folded hands and placed close to the chest. The palms are held together in the form of prayer pose. Look straight. Exhale normally. The concentration should be on the Anahata chakra at the heart region.

**Hasta Uttanasana (Raised arms pose) –2<sup>nd</sup> and 11<sup>th</sup> posture:**

Hasta Uttanasana or the raised arms pose is part of the Surya Namaskara series of asanas that come at 2<sup>nd</sup> and the 11<sup>th</sup> steps.

**Method:**

Raise both the hands above the head. Inhale normally while raising the hands. Bend the trunk and neck slightly backward. The concentration should be on the Vishuddhi chakra at the throat region.

**Padahastanasana (Hand to Foot pose) –3<sup>rd</sup> and 10<sup>th</sup> posture:**

Padahastanasana or the Hand to Foot pose is part of the Surya Namaskara series of asanas that come at 3<sup>rd</sup> and the 10<sup>th</sup> steps.

**Method:**

Bend forward and try to touch the floor with both the hands. Exhale normally while bending forward slowly. The concentration should be on the Swathisthana chakra at the sacral region.

**Ashwa Sanchalanasana (The Equestrian Pose) – 4<sup>th</sup> and 9<sup>th</sup> posture:**

Ashwa Sanchalanasana or the Equestrian pose is the part of the Surya Namaskara series of asanas that come at 4<sup>th</sup> and the 9<sup>th</sup> steps.

**Method:**

Place the palms of the hands flat on the floor beside the feet. Stretch the right leg backward as far as possible. At the same time, bend the left knee, keep the left foot on

the floor in the same position. Keep the arms straight. In the final position, the weight of the body should be supported by the hands, the left foot, right knee and toes of the right foot. The head should be tilted slightly backward, the back arched and the inner gaze directed upward to the eyebrow center. In position 9 the same should be performed with the left leg stretched and the right knee bend. Awareness should be on the Ajna chakra at the center of the eye brows.

**Parvatasana (The Mountain Pose) – 5<sup>th</sup> and 8<sup>th</sup> posture:**

Parvatasana or the Mountain pose is part of the Surya Namaskara series of asanas and comes at 5th and the 8th step

**Method:**

While exhaling, take the right leg backward and place it parallel to the left leg. Raise the hips at the same time. Place the hands straight supporting the weight of the body. The head should be placed between the hands. Try to place the heels on the floor. The concentration should be on the Vishuddhi chakra at the throat region.

**Ashtanga Namaskara (Eight-Limbed salutation) – 6th posture:**

Ashtanga Namaskara or the Eight-Limbed salutation is part of the Surya Namaskara series of asanas and comes at 6th step. In this pose, the body touches the floor at eight locations –the head, the chest, the two palms, the two knees, and the two toes.

**Method:**

Lower the body to the ground from Parvatasana pose in such a way that it touches the floor at eight locations – the head, the chest, the two palms, the two knees, and the two

toes, Suspended the breath for a while. Try to lift other parts in air. The concentration should be on the Manipura chakra at the solar plexus.

### **Bhujangasana (The Cobra Pose)- 7th posture:**

Bhujangasana is also famous as a cobra pose in yoga. In this asana person's head and trunk resembles a cobra with raised hood, hence the name Bhujangasana. It appears as the 7th pose in the Surya Namaskara series asanas.

### **Method:**

While inhaling, raise the body by using the hands from Ashtanga Namaskara pose. Arch your head backward. The body should be raised upto the navel region. The concentration should be on the Swadisthana chakra at the sacral region.

The Surya Namaskar practice was given in the following manner.

- Day 1 to Day 3 – 3 rounds,
- Day 4 to Day 6 – 6 rounds,
- Day 7 to Day 14 - 12 rounds,
- Day 15 to End of menstrual cycle – 24 rounds

During the practice of 24 rounds, 12 rounds of Surya Namaskar were followed by Shavasana for 5 minutes before beginning of next 12 rounds. Study was started from the sixth day of cycle. Study was conducted for 1 menstrual cycle. After the first menstrual cycle, the subjects were assessed for the intensity of pain with the help of N.P.I. scale. The following months, the subjects were asked to practice Surya



Namaskar regularly for the next two months. Pain intensity was measured at the beginning of each cycle. Subjects were asked to visit hospital for assessment of N.P.I. scale.

#### **4.4 ASSESSMENT:**

The assessment tools used in the study are Modified Menstrual Symptoms Questionnaire and N.P.I. scale. Dysmenorrhea-related symptoms were scored using Modified Menstrual Symptoms Questionnaire. N.P.I. scale was used to assess pain at the beginning of each menstrual cycle during the study period.

##### **4.4.1 MENSTRUAL SYMPTOM QUESTIONNAIRE:**

Menstrual Symptom Questionnaire (MSQ) which includes 24 items that are rated as 1 = “never” to 5 = “always”. Previous research has found support for 2 factor and 5 factor solutions of the items. The 2 factors each have 12 items which are summed to provide a score on Spasmodic and Congestive dysmenorrhea. Items in the Spasmodic factor generally reflect symptoms occurring during menstruation like spasms similar to labor pains while items in the Congestive Factor generally reflect symptoms or moods in the premenstrual phase. The (possible) range of scores was 12–52 for both the Spasmodic factor and the Congestive factor.<sup>7</sup>

##### **4.4.2 NUMERIC PAIN INTENSITY SCALE:**

The most commonly used one-dimensional pain scale is the Numeric Pain Intensity Scale (NPI), also called the Numeric Rating Scale (NRS). This scale is made up of a horizontal line with the beginning point marked as 0, or “no pain,” and the opposite

end marked as 10, or “worst possible pain.” Patients are asked to rate their pain from 0 to 10. Patients choose the number that best represents the intensity of the pain that they are experiencing. Generally the pain in 1–3 range is considered mild pain, 4–6 range indicates moderate pain, and 7–10 is the range that denotes highest level, or severe level of pain. This scale is useful for assessing efficacy of pain interventions. A decrease of at least three points on the NPI scale is considered to be significant (Gordon et al, 2004)



## 5.0 RESULTS

### Statistical Analysis:

Data expressed Mean  $\pm$ SD. Comparison of Mean in between the visit was analyzed by paired t test and Wilcoxon signed-rank test which is applicable. Oneway Anova followed by posthoc Tukey HSD was used to find the inter visit variations. R statistical software version 3.1.1 was used for the analysis.

**Table 2: Anthropometric parameters of the study participants (n=30)**

Variable	Mean $\pm$ SD
Age (yr)	18.8 $\pm$ 1.6
Height (cm)	155.2 $\pm$ 6.26
Weight (kg)	51.06 $\pm$ 9.08
BMI (kg/m <sup>2</sup> )	21.19 $\pm$ 3.29
Respiratory Rate	16.26 $\pm$ 0.90
Pulse Rate (bpm)	76.2 $\pm$ 3.29
SBP (mmHg)	116.66 $\pm$ 4.79
DBP(mmHg)	77.0 $\pm$ 4.66
PP (mmHg)	41.26 $\pm$ 4.90

A total of 30 girls participated and completed the intervention in the present study. Girls were in a mean age of 18.8 years, had weight (51.06 kg) and BMI (21.19

kg/m<sup>2</sup>).They had a normal range of respiratory rate (16.26 cycle/min), heart rate (76.20 beat/min), SBP (116.66 mmHg), DBP (77.0 mmHg) and PP (41.26 mmHg).

**Table 3: Baseline NPI score (n=30)**

<b>NPI Score</b>	<b>Freq.</b>	<b>Percent</b>	<b>Cum.</b>
4	4	13.33	13.33
5	6	20.00	33.33
6	4	13.33	46.67
7	4	13.33	60.00
8	3	10.00	70.00
9	6	20.00	90.00
10	3	10.00	100.00

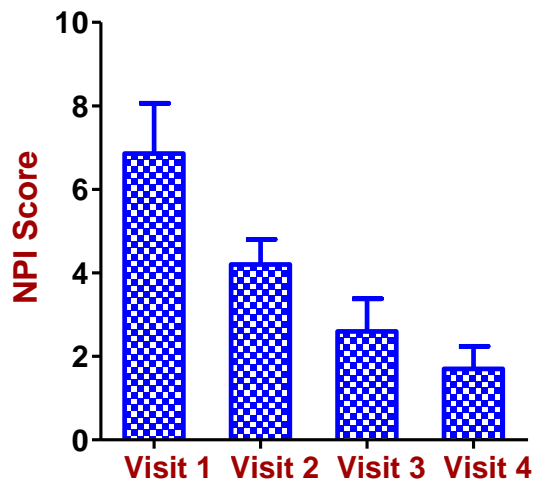
The base line N.P.I. score showed that the subjects suffered from moderate to high intensity pain. The mean score was 6.86 at baseline that comes to moderate intensity of pain.

**Table 4: Effect of Surya Namaskar on NPI score in Primary dysmenorrhea**

**(n=30)**

Visit	Mean	SD	Min	Max	P value
Baseline	6.86	1.2	4	10	0.0001
Visit 2	4.2	0.6	2	8	
Visit 3	2.6	0.78	1	6	0.0001
Visit 4	1.7	0.54	1	4	

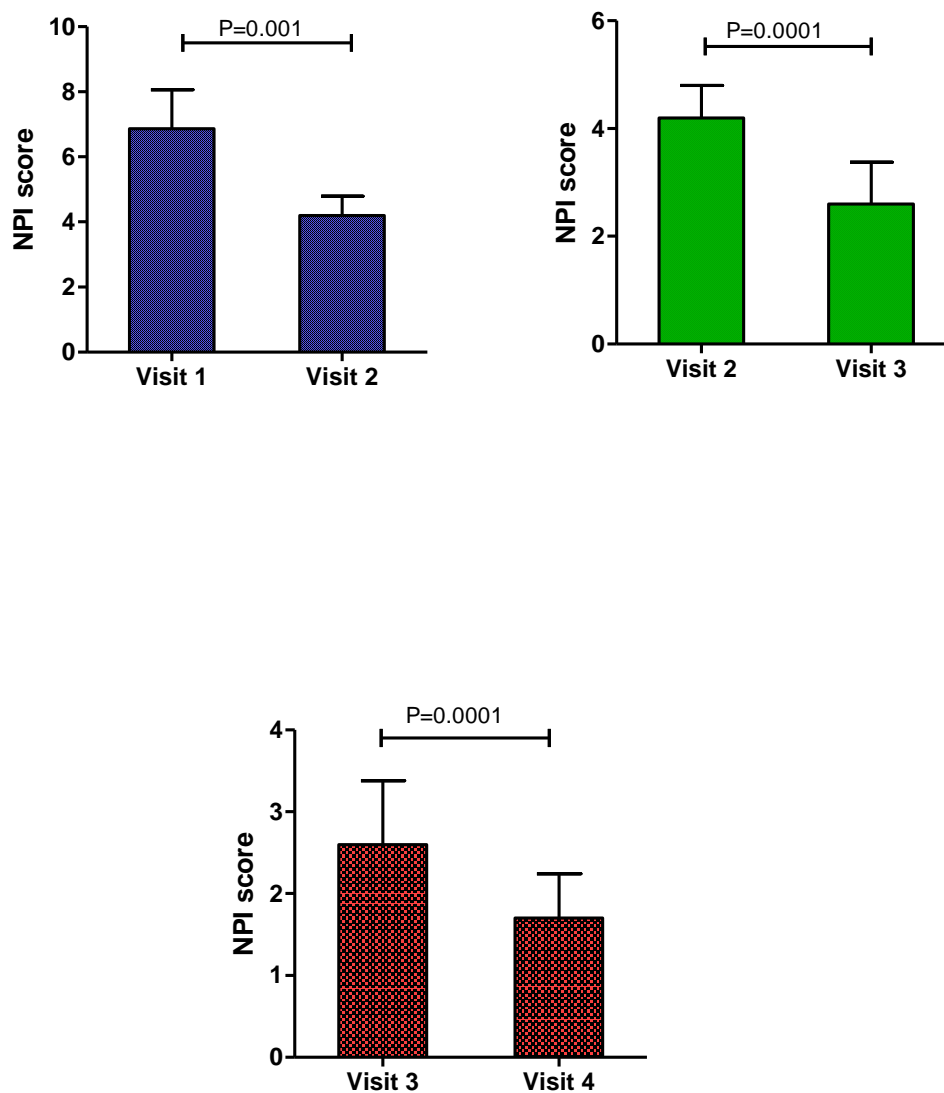
**Effects of Suryanamskar on NPI score**



After the intervention of Surya Namaskar for 3 months, there was a significant (P=0.0001) reduction in NPI score in primary dysmenorrhea. The NPI score in the first visit was 6.86±1.2 and it shows they had a discomfort during their menstrual

period. After the Surya Namaskar intervention NPI score was significantly decreased in visit 2 ( $4.2\pm 0.6$ ), visit 3 ( $2.6\pm 0.78$ ) and visit 4 ( $1.7\pm 0.54$ ).

**Fig: Comparison of NPI score in between Visits in Primary dysmenorrhea**



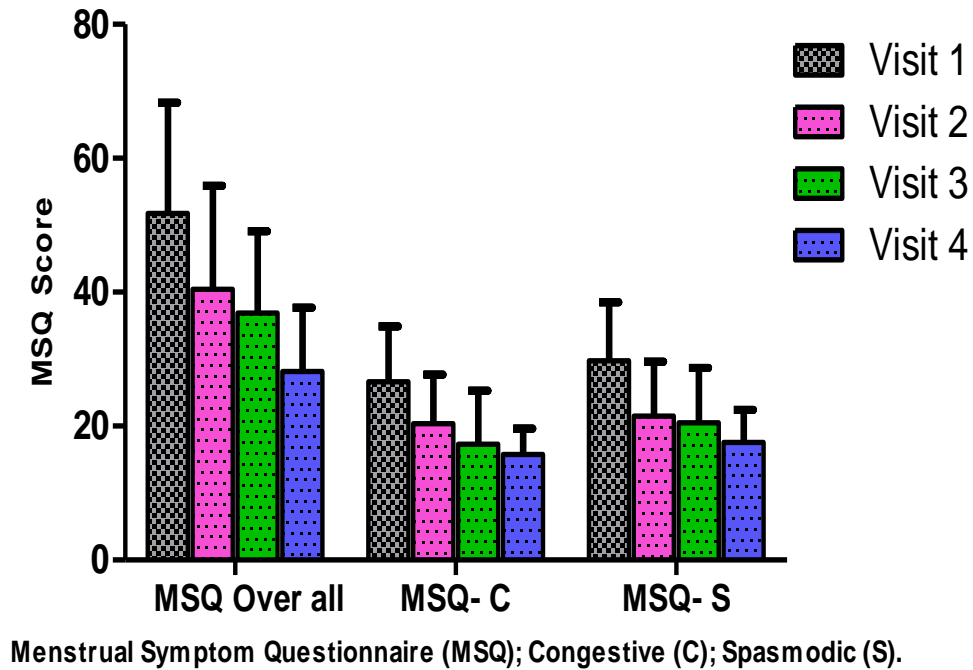
**Table 5: Effect of Surya Namaskar on MSQ scale in Primary dysmenorrhea**

**(n=30)**

<b>MSQ score</b>	<b>Visit 1</b>	<b>Visit 2</b>	<b>Visit 3</b>	<b>Visit 4</b>	<b>P value</b>
MSQ-Sum (24 items)	51.8 ± 16.5	40.4 ± 15.5	36.9 ± 12.2	28.16±9.56	0.001
MSQ – C (12 items)	26.6 ± 8.3	20.4 ± 7.3	17.3 ± 8.0	15.76±3.87	0.001
MSQ – S (12 items)	29.8 ± 8.7	21.5 ± 8.1	20.5 ± 8.2	17.54±4.86	0.001

Menstrual Symptom Questionnaire (MSQ); Congestive (C); Spasmodic (S).

### Comparison of MSQ score in between Visits in Primary dysmenorrhea



MSQ overall score at baseline ( $51.8 \pm 16.5$ ) was higher and reflecting that they had a painful menstruation. After the Surya Namaskar intervention, the overall score was significantly ( $P=0.001$ ) decreased in visit 2 ( $40.4 \pm 15.5$ ), visit 3 ( $36.9 \pm 12.2$ ), and visit 4 ( $28.16 \pm 9.56$ ) and this shows the effect of Surya Namaskar practice in primary dysmenorrhea. Same kind of response were obtained in the MSQ congestive factor and spasmodic factor scale and showed a significant ( $P=0.001$ ) reduction in subsequent visits.



## **6.0 DISCUSSION:**

This present study shows that practice of Surya Namaskar for the period of 3 months has a positive impact on primary dysmenorrhea as it reduces the intensity of pain and symptoms related to primary dysmenorrhea.

N.P.I. scale was used to measure the pain in primary dysmenorrhea and it is considered to be one of the best and appropriate method to evaluate pain in primary dysmenorrhea.<sup>70</sup> During the baseline measurement, before the beginning of Surya Namaskar all subject had pain ranging between moderate to high intensity as marked in NPI scale. During the first visit the intensity of pain ranged between 4 and 10 in N.P.I. with the mean of 6.86.

At the end of one menstrual cycle, the pain experienced by subjects varied with the maximum of 8 and minimum of 2. The mean is 4.2. This shows that mean value of pain reduced from 6.8666 at the baseline to 4.2 at the end of one month practice of Surya Namaskar cycle. During the subsequent cycle the maximum and minimum NPI values are 6 and 1 respectively. Thus the mean value further reduced to 2.6. During the final visit at the end of three menstrual cycles, the maximum and minimum values of NPI are 4 and 1 with mean 1.7.

The reduction of mean value of NPI from 6.86 to 1.7 during the three months trial shows that the practice of Surya Namaskar has a significant effect ( $P < 0.0001$ ) on reduction of pain in primary dysmenorrhea. This clearly confirms that Surya

Namaskar has a positive effect on reducing the pain in primary dysmenorrhea which is the objective of this study.

Similar results have been obtained by **Usha Nag, et al (2013)**, in their study on Medical Students and they found that the practice of Yoga has an efficient role in the management of stress that is caused by Primary Dysmenorrhea among the Medical Students.<sup>22</sup>

In another study conducted by **Zahra Rakhshae et al, in 2011** stated that after the practice of three yoga poses (Cat, fish and Cobra pose), there was a significant reduction in pain intensity as well as pain duration after the practice of Yoga in primary dysmenorrhea patients.<sup>9</sup>

Mechanism that is responsible for dysmenorrhea is an abnormal increase in vasoactive prostanoids in endometrium and menstrual fluid. This may in turn induce myometrial hyperactivity and tissue ischemia. Yoga intervention increases blood flow at the pelvic level and also stimulates the release of B endorphine that may act as nonspecific analgesics. In addition, another study reported that yoga causes improved spinal flexibility and strengthens the muscles of back. This helps to relax the pelvic muscles and act as an effective treatment for spasmodic dysmenorrhea.<sup>41</sup>

Growing body of evidence supports the belief that yoga benefits physical and mental health through down-regulation of the hypothalamic pituitary-adrenal axis and sympathetic nervous system.<sup>71</sup> Yoga may be a safe and cost-effective intervention for the management of menstrual problems. Yoga plays an important role in reducing

stress and activity of sympathetic nervous system, increasing parasympathetic activity, improving quality of life, and reducing psychological symptoms levels.<sup>72</sup>

Treatment should be given according to the cause of disease, but there is no exact pathology in primary dysmenorrhea. There are two main factors, sedentary life style and family history of dysmenorrhea which are responsible for the changes occurring in the body. Yoga plays an important role in the management of these type of disorders. It is also being stated that physical activity helps to lower inflammatory biomarkers which are found to be high in primary dysmenorrhea. Thus Yoga plays an important role in the management of Primary dysmenorrhea.<sup>21</sup> Yoga is now recommended as a noninvasive treatment and easily accessible intervention for pain relief. It is safe and cost-effective intervention with minimal or no side effects.

Surya Namaskar is a procedure in which 90% to 95% of muscles are stretched and activated. This series gives a profound stretch to the body that it is considered to be a complete yoga practice by itself. Therefore Surya Namaskar has been rightly called “Sarvang Sunder Vyayam” or the best all round exercise.<sup>73</sup>

In a book titled, “Surya Namaskar: For Health, Efficiency & Longevity” authored by Bhavarav Shrinivasrav, and published under the patronage of the Raja of Aundh, states about the benefits of Sun Salutation. In the book, it is listed that one of the benefits is that "Surya namaskar improves the uterus (womb) and ovaries, removes menstrual disorders such as dysmenorrhea and consequent pain and misery."

David Coulter explains, the various mechanism involved in each posture of Surya Namaskar.

**Standing postures (Pranamasana and Hasta Uttanasana)** floods the nervous system with sensory input from all over the body.

**In Ashwa Sanchalāsana**, one thigh is flexed with respect to the body and the other thigh is hyper extended. In this sense, the abducted hip is more in alignment with the frontal plane of the trunk. Such Position helps in facilitation of autonomic nervous system causing increased awareness of the nervous system, co-ordinating and stretching of the muscles, leading to increase in blood supply and pain relief.

**Forward bending Padahastāsana**, tends to inhibit the somatic nervous system and sympathetic limb of the autonomic nervous system. Flexing forward enough in the spine and hips compresses the abdomen and have mildly invigorating effects on abdominal organs and causes stimulation of enteric nervous system.<sup>74</sup> Relaxation of pelvic floor muscles will lead to the reduction of stimulus passing through the spasmodic muscles and will lead to pain relief.<sup>75</sup>

Karel Nespor published an article on yoga and pain relief in which he mentions that, decreased activation of brain may be due to decreased input of stimuli from the internal as well as external environment.<sup>76</sup> Lying posture like Shavasana, will minimise the sympathetic effects on organs and tissues throughout the body. Thus when a person lies in Shavsana, the sympathetic nervous system calms down, reduces the muscle tone in smooth muscle that encircles the artery and arterioles which allows those vessels to dilate to increase the blood supply.

**MSQ** is a psychometric capable of differentiating between the two types of primary dysmenorrhea. This questionnaire supports Dalton's theory that states that hormonal imbalance as a cause of two types of primary dysmenorrhea. It suggests that

spasmodic dysmenorrhea is caused by an excess of progesterone compared to estrogen, while congestive dysmenorrhea is caused by an excess of estrogen compared to progesterone. This questionnaire describes the symptoms experienced by two types of dysmenorrhea, Spasmodic and congestive. Both type of dysmenorrhea have complete different clinical features.

The menstrual symptom questionnaire was calculated using the two factor analysis. The congestive factors of the subjects were analyzed and the mean of the baseline score was 26.6 +/- 8.3. After 3 months of Surya Namaskar practice the score reduced to 15.76 +/- 3.87 which show a significant reduction ( $P < 0.001$ ) of congestive symptoms.

The spasmodic factors of the subjects were analyzed and the mean of the baseline score was 29.8 +/- 8.7. After 3 months of Surya Namaskar practice the score reduced to 17.5 +/- 4.86 which show a significant reduction ( $P < 0.001$ ) of spasmodic symptoms.

Since both the spasmodic and congestive factors have reduced, the overall score has also dropped down from the baseline mean of 51.8 to 28.16 over a period of 3 months of the practice which shows a significant reduction of symptoms.

The analysis of MSQ shows that Surya Namaskar not only reduces pain in dysmenorrhea but also helps to reduce the menstrual symptoms experienced by the subjects.

According to Dalton (1969), the discomfort in spasmodic dysmenorrhea is related to muscular tension and contractions, while the discomfort in congestive dysmenorrhea

is related to an ischemia. Surya Namaskar helps to stretch the supporting muscles of the uterus and vaginal walls. The blood supply is improved to the pelvic region thus exerting a toning effect on the ovaries. SN training also improves the flexibility of body muscles especially the leg, back, chest and buttock muscles. With such physiological benefits Surya Namaskar helps in the correction of both spasmodic and congestive symptoms.

## **7.0 CONCLUSION:**

The present study confirms that Surya Namaskar alone proves to be effective in the reduction of pain and symptoms with primary dysmenorrhea. Surya Namaskar is a simple procedure without any side effects and which can be practiced by anyone with minimum flexibility. Also childhood and adolescent obesity ratio is on a high ratio in recent years and Surya Namaskar also helps in weight reduction. Now a days adolescent female have very little time to focus on their personal health midst their academic work. Thus a few rounds of Surya Namaskar daily can help them to prevent and get relieve from primary dysmenorrhea. With many physiological benefits it can also be suggested that Surya Namaskar be included in curriculum in schools and colleges.

## **LIMITATIONS:**

- ❖ The current study was a pilot study with minimum number of subjects.
- ❖ The outcome variable (Pain scale) used in the study is subjective one.
- ❖ Randomization was not done.

## **RECOMMENDATIONS:**

The same study can be conducted on a larger population with suitable study design and some objective kind of outcome variables could be included to validate the current results. Other studies can be conducted on subjects with secondary dysmenorrhea and observed if the pathologies reduce.

## 8.0 SUMMARY

The objective of this study was to determine the effect of Surya Namaskar on reducing pain and symptoms in primary dysmenorrhea. The causes of primary dysmenorrhea are strong uterine contractions which are stimulated by increased production of the hormone prostaglandin by the lining of the uterus (endometrium). Life style modifications and stress are considered to be important factors contributing to primary dysmenorrhea in the present generation. Surya Namaskar is a procedure in which about 90% to 95% of muscles are stretched and activated. The series gives such a profound stretch to the body that it is considered to be a complete yoga practice by itself.

The study was conducted on 30 subjects who experienced primary dysmenorrhea. Surya Namaskar practice was given to them according to the Bihar school of Yoga for a period of three menstrual cycles. The practice started with 3 rounds of SN and gradually increased to 24 rounds with Shavasana practiced for 5 minutes after 12 rounds of SN. The N.P.I. scale and Modified MSQ was given to analyze the pain and symptoms at the baseline and at the beginning of each cycle. Comparison of Mean in between the visit was analyzed by paired t test and Wilcoxon signed-rank test.

There was reduction of mean value of NPI from 6.86 to 1.7 during the three months trial and this shows that the practice of Surya Namaskar has a significant effect ( $P < 0.0001$ ) on reduction of pain in primary dysmenorrhea. The two factor analysis of MSQ during the three months duration also showed that the mean congestive score reduced from 26.6 +/- 8.3. to 15.76 +/- 3.87 which show a significant reduction ( $P <$



0.001) of congestive symptoms. Similarly the spasmodic factors of the subjects also reduced from the mean baseline score of 29.8 +/- 8.7 to 17.5 +/- 4.86 which show a significant reduction ( $P < 0.001$ ) of spasmodic symptoms. Therefore the present study confirms that Surya Namaskar alone proves to be effective in the reduction of pain and symptoms with primary dysmenorrhea.

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## 10.0 ANNEXURES

### ANNEXURE 1: CONSENT FORM

#### INFORMED CONSENT FORM

Title of the study: “Effect of Surya Namaskar in primary dysmenorrhoea”

Name of the Participant:

Name of the Principal Investigator: Dr.S.D.Archana

Name of the Institution: Government yoga and naturopathy medical college, Chennai – 106.

Documentation of the informed consent

I \_\_\_\_\_ have read the information in this form (or it has been read to me). I was free to ask any questions and they have been answered. I am over 18 years of age and, exercising my free power of choice, hereby give my consent to be included as a participant in “Effect of Surya Namaskar in primary dysmenorrhea patients”

1. I have read and understood this consent form and the information provided to me.
2. I have had the consent document explained to me.
3. I have been explained about the nature of the study.
4. I have been explained about my rights and responsibilities by the investigator.
5. I have been informed the investigator of all the treatments I am taking or have taken in the past \_\_\_\_\_ months including any native (alternative) treatment.
6. I have been advised about the risks associated with my participation in this study.
7. I agree to cooperate with the investigator and I will inform him/her immediately if I suffer unusual symptoms.
8. I have not participated in any research study within the past \_\_\_\_\_ month(s).
9. I am aware of the fact that I can opt out of the study at any time without having to give any reason and this will not affect my future treatment in this hospital.
10. I am also aware that the investigator may terminate my participation in the study at any time, for any reason, without my consent.

11. I hereby give permission to the investigators to release the information obtained from me as result of participation in this study to the sponsors, regulatory authorities, Govt. agencies, and IEC. I understand that they are publicly presented.

12. I have understood that my identity will be kept confidential if my data are publicly presented.

13. I have had my questions answered to my satisfaction.

14. I have decided to be in the research study.

I am aware that if I have any question during this study, I should contact the investigator. By signing this consent form I attest that the information given in this document has been clearly explained to me and understood by me, I will be given a copy of this consent document.

For adult participants:

Name and signature / thumb impression of the participant (or legal representative if participant incompetent)

Name \_\_\_\_\_ Signature \_\_\_\_\_

Date \_\_\_\_\_

Name and Signature of impartial witness (required for illiterate patients):

Name \_\_\_\_\_ Signature \_\_\_\_\_

Date \_\_\_\_\_

Address and contact number of the impartial witness:

Name and Signature of the investigator or his representative obtaining consent:

Name \_\_\_\_\_ Signature \_\_\_\_\_

Date \_\_\_\_\_

**ANNEXURE 2: MODEL CASE SHEET**

**GOVERNMENT YOGA AND NATUROPATHY MEDICAL COLLEGE,**

**ARUMBAKKAM, CHENNAI-600106**

**P.G. DEPARTMENT OF YOGA**

**PRINCIPAL INVESTIGATOR: Dr.S.D.Archana B.N.Y.S.**

**HEAD OF DEPARTMENT:**

**DR. S.T. Venkateswaran, N.D. (OSM), M.Sc. (Y&N) PGDOM, PGDY, DNHE**

**NAME:**

**O.P.NO:**

**SEX:**

**PARTIPITANT NO:**

**AGE:**

**DATE:**

**ADDRESS:**

**PHONE NO:**

**OCCUPATION:**

**MARITAL STATUS:**

**PRESENT COMPLAINTS:**

HISTORY OF PRESENT COMPLAINTS:

PAST HISTORY:

MEDICAL HISTORY:

SURGICAL HISTORY:

FAMILY HISTORY:

OCCUPATIONAL HISTORY:

PERSONAL HISTORY:

Diet:

Appetite:

Digestion:

Bowel Movement:

Micturition:

Sleep:

Exercise:

Addiction:

Allergic to:

**ANTHROPOMETRY:**

Height:

Weight:

B.M.I.

**VITAL DATA:**

Respiratory count:

Pulse Rate:

Temperature:

Blood pressure:

**MENSTRUAL HISTORY:**

Age of menarche:

Last menstrual period:

Menstrual cycle length and frequency:

Heaviness of bleeding:

Intermenstrual bleeding:

Leucorrhoea:

Associated symptoms:

## **SYSTEMIC EXAMINATION**

CARDIOVASCULAR SYSTEM:

RESPIRATORY SYSTEM:

GASTRO-INTESTINAL SYSTEM:

CENTRAL NERVOUS SYSTEM:

ENDOCRINE SYSTEM:

GENITO URINARY SYSTEM:

LOCOMOTOR SYSTEM:

PAST INVESTIGATIONS:

FINAL DIAGNOSIS:

YOGIC INTERVENTION:



**ANNEXURE 3: MODIFIED MENSTRUAL SYMPTOM QUESTIONNAIRE**

**MODIFIED MENSTRUAL SYMPTOM QUESTIONNAIRE**

**NAME:**

**DATE:**

**O.P. NO:**

**VISIT NO:**

**PARTICIPANT CODE:**

**TICK IN THE APPROPRIATE BOX:**

		Never	Rarely	Sometimes	Often	Always
	Item	1	2	3	4	5
1	I feel irritable, easily 'agitated, and am impatient a few days before my period.					
2	I have cramps that begin on the first day of my period.					
3	I feel depressed for several days before my period.					
4	I have abdominal pain or discomfort which begins one day before my period.					
5	For several days before my period I feel exhausted. lethargic or tired.					
6	I only know that my period is coming by looking at the calendar.					
7	I take a prescription drug for the pain during my period.					
8	I feel weak and dizzy during my period.					
9	I feel tense and nervous before my period.					
10	I have diarrhoea during my period.					
11	I have backaches several days before my period.					

	Item	Never 1	Rarely 2	Sometimes 3	Often 4	Always 5
12	I take aspirin for the pain during my period.					
13	My breasts feel tender and sore a few days before my period.					
14	My lower back, abdomen. and the inner sides of my thighs begin to hurt or be tender on the first day of my period.					
15	During the first day or so of my period. I feel like curling up in bed. using a hot water bottle on my abdomen, or taking a hot bath.					
16	I gain weight before my period.					
17	I am constipated during my period.					
18	Beginning on the first day of my period, I have pains which may diminish or disappear for several minutes and then reappear.					
19	The pain I have with my period is not intense, but a continuous dull aching.					
20	I have abdominal discomfort for more than one day before my period.					
21	I have backaches which begin the same day as my period.					
22	My abdominal area feels bloated for a few days before my period.					
23	I feel nauseous during the first day or so of my period.					
24	I have headaches for a few days before my period.					

**SIGNATURE OF  
PARTICIPANT**

**SIGNATURE OF  
PRINCIPAL INVESTIGATOR**

**ANNEXURE 4: NPI SCALE MODEL**

**NAME:**

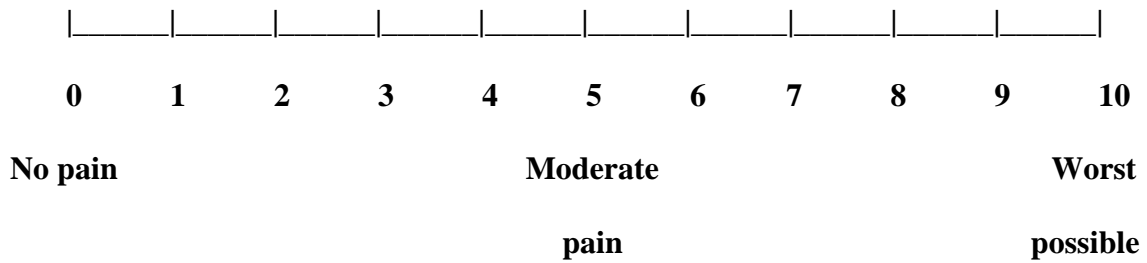
**DATE:**

**O.P. NO:**

**VISIT NO:**

**PARTICIPANT CODE:**

**RATE THE PAIN DURING MENSTRUATION:**



**SIGNATURE OF  
PARTICIPANT**

**SIGNATURE OF  
PRINCIPAL INVESTIGATOR**

## ANNEXURE 5: RAW DATA

### MENSTRUAL SYMPTOMS QUESTIONNAIRE (RAW DATA)

Case #	Visit	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8	Question 9	Question 10	Question 11	Question 12
U1	1	2	3	3	2	3	5	1	4	3	3	3	2
	2	2	3	3	2	2	4	1	2	2	2	3	2
	3	1	2	2	2	2	4	1	1	2	2	2	2
	4	1	1	1	1	2	4	1	1	1	1	2	1
U2	1	3	3	2	2	5	4	3	4	2	2	2	3
	2	3	2	2	2	4	4	2	3	1	1	1	2
	3	2	1	1	1	2	4	1	3	1	1	1	2
	4	1	1	1	1	2	4	1	2	1	1	1	1
U3	1	2	4	4	3	3	5	1	4	4	2	3	1
	2	2	4	3	3	2	5	1	3	3	2	3	1
	3	1	3	2	2	1	4	1	2	2	1	2	1
	4	1	2	1	1	1	4	1	1	2	1	2	1
U4	1	2	5	1	3	1	1	1	5	1	1	2	1
	2	2	4	1	3	1	1	1	3	1	1	1	1
	3	1	4	1	3	1	1	1	1	1	1	1	1
	4	1	2	1	2	1	1	1	1	1	1	1	1
U5	1	2	5	4	2	1	1	1	4	2	1	1	1
	2	2	4	3	1	1	1	1	4	1	1	1	1
	3	2	4	3	1	1	1	1	3	1	1	1	1
	4	1	2	2	1	1	1	1	3	1	1	1	1
U6	1	1	2	1	3	1	4	1	4	1	1	4	1
	2	1	2	1	3	1	4	1	4	1	1	2	1
	3	1	2	1	1	1	4	1	3	1	1	1	1
	4	1	1	1	1	1	4	1	3	1	1	1	1

Case #	Visit	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8	Question 9	Question 10	Question 11	Question 12
U7	1	4	4	2	3	1	1	1	4	3	1	3	1
	2	3	3	1	3	1	1	1	3	3	1	2	1
	3	2	3	1	2	1	1	1	2	2	1	2	1
	4	2	2	1	1	1	1	1	2	2	1	1	1
U8	1	3	4	2	1	2	3	1	3	2	2	5	1
	2	2	3	1	1	1	2	1	2	2	2	2	1
	3	1	2	1	1	1	2	1	1	1	1	2	1
	4	1	2	1	1	1	2	1	1	1	1	2	1
U9	1	4	5	2	3	2	3	3	2	2	1	3	3
	2	3	3	2	2	1	1	2	2	2	1	2	3
	3	2	1	1	2	1	1	1	1	1	1	2	2
	4	1	1	1	2	1	1	1	1	1	1	1	1
U10	1	1	3	1	3	1	5	1	3	1	1	5	1
	2	1	2	1	2	1	4	1	2	1	1	2	1
	3	1	1	1	1	1	4	1	1	1	1	1	1
	4	1	1	1	1	1	4	1	1	1	1	1	1
S1	1	4	5	4	4	5	3	1	5	3	4	3	1
	2	3	4	2	3	3	3	1	4	2	2	2	1
	3	2	2	1	2	1	3	1	2	1	2	1	1
	4	1	1	1	1	1	3	1	2	1	1	1	1
S2	1	4	5	5	2	1	1	2	4	4	1	3	2
	2	3	3	3	1	1	1	2	3	3	1	2	2
	3	1	2	2	1	1	1	1	2	1	1	2	1
	4	1	2	1	1	1	1	1	1	1	1	1	1
S3	1	5	4	4	5	4	1	1	3	4	1	2	1
	2	4	4	3	3	3	1	1	2	3	1	2	1
	3	2	2	2	2	2	1	1	2	2	1	1	1
	4	1	1	1	2	1	1	1	1	1	1	1	1

Case #	Visit	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8	Question 9	Question 10	Question 11	Question 12
S4	1	1	3	1	2	4	1	1	2	1	1	4	1
	2	1	3	1	2	4	1	1	2	1	1	4	1
	3	1	3	1	2	3	1	1	2	1	1	3	1
	4	1	3	1	2	3	1	1	2	1	1	3	1
S5	1	1	5	1	5	1	3	3	5	1	1	1	1
	2	1	5	1	3	1	3	3	5	1	1	1	1
	3	1	4	1	3	1	3	3	5	1	1	1	1
	4	1	3	1	2	1	3	2	4	1	1	1	1
S6	1	1	4	1	5	4	1	1	4	1	1	4	1
	2	1	3	1	3	2	1	1	1	1	1	3	1
	3	1	2	1	2	1	1	1	1	1	1	3	1
	4	1	1	1	2	1	1	1	1	1	1	1	1
S7	1	1	2	1	3	1	1	1	3	1	1	5	1
	2	1	2	1	3	1	1	1	2	1	1	3	1
	3	1	1	1	2	1	1	1	2	1	1	2	1
	4	1	1	1	2	1	1	1	2	1	1	2	1
S8	1	1	4	1	4	2	1	1	3	1	1	5	1
	2	1	3	1	3	2	1	1	3	1	1	4	1
	3	1	2	1	2	1	1	1	2	1	1	3	1
	4	1	2	1	2	1	1	1	1	1	1	2	1
S9	1	2	3	1	2	2	4	1	2	1	1	1	1
	2	2	3	1	2	2	4	1	1	1	1	1	1
	3	2	2	1	2	2	3	1	1	1	1	1	1
	4	1	2	1	2	2	2	1	1	1	1	1	1
S10	1	2	5	1	1	1	5	5	4	1	1	1	5
	2	2	4	1	1	1	5	3	4	1	1	1	3
	3	1	1	1	1	1	5	2	3	1	1	1	2
	4	1	1	1	1	1	5	2	3	1	1	1	2

Case #	Visit	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8	Question 9	Question 10	Question 11	Question 12
S11	1	2	5	1	5	1	3	1	3	1	3	1	1
	2	2	5	1	5	1	3	1	1	1	2	1	1
	3	2	2	1	4	1	3	1	1	1	2	1	1
	4	1	2	1	3	1	3	1	1	1	2	1	1
S12	1	3	4	2	4	2	2	1	4	3	1	2	3
	2	3	4	2	2	2	3	1	3	1	1	2	1
	3	3	2	2	2	2	3	1	2	1	1	2	1
	4	2	2	2	2	2	3	1	2	1	1	2	1
S13	1	1	3	1	5	1	1	1	1	1	1	1	1
	2	1	3	1	4	1	1	1	1	1	1	1	1
	3	1	2	1	4	1	1	1	1	1	1	1	1
	4	1	2	1	3	1	1	1	1	1	1	1	1
S14	1	1	1	1	1	1	1	1	3	1	1	2	1
	2	1	1	1	1	1	1	1	3	1	1	2	1
	3	1	1	1	1	1	1	1	2	1	1	2	1
	4	1	1	1	1	1	1	1	2	1	1	2	1
S15	1	3	4	1	5	5	1	3	5	1	1	5	1
	2	2	4	1	4	4	1	2	4	1	1	4	1
	3	2	3	1	4	3	1	2	3	1	1	4	1
	4	2	2	1	2	1	1	2	1	1	1	3	1
S16	1	1	4	1	4	1	2	1	1	1	1	4	1
	2	1	3	1	3	1	2	1	1	1	1	3	1
	3	1	2	1	2	1	2	1	1	1	1	3	1
	4	1	2	1	2	1	2	1	1	1	1	2	1
S17	1	3	5	1	5	5	1	5	5	3	1	1	5
	2	2	5	1	3	3	1	5	3	3	1	1	3
	3	2	3	1	2	2	1	5	3	2	1	1	2
	4	2	2	1	2	2	1	4	2	2	1	1	2

Case #	Visit	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8	Question 9	Question 10	Question 11	Question 12
N1	1	2	4	1	5	2	1	1	5	1	1	1	1
	2	2	4	1	4	1	1	1	4	1	1	1	1
	3	1	3	1	4	1	1	1	3	1	1	1	1
	4	1	3	1	3	1	1	1	3	1	1	1	1
N2	1	4	2	2	5	5	4	1	4	2	1	3	1
	2	3	2	2	5	3	3	1	4	2	1	3	1
	3	2	2	1	4	3	2	1	4	1	1	2	1
	4	2	2	1	3	3	2	1	4	1	1	2	1
N3	1	5	2	2	3	3	2	1	4	2	3	3	1
	2	5	2	2	3	3	2	1	3	2	3	3	1
	3	4	2	1	3	2	2	1	3	1	3	3	1
	4	4	1	1	2	2	2	1	2	1	4	2	1

Case #	Visit	Question 13	Question 14	Question 15	Question 16	Question 17	Question 18	Question 19	Question 20	Question 21	Question 22	Question 23	Question 24
U1	1	1	5	3	1	2	4	3	2	4	1	4	1
	2	1	3	2	1	2	3	3	2	3	1	3	1
	3	1	2	2	1	1	3	2	1	2	1	2	1
	4	1	2	1	1	1	2	2	1	2	1	2	1
U2	1	1	4	5	1	5	3	4	4	5	1	1	3
	2	1	3	4	1	3	2	3	2	3	1	1	3
	3	1	3	2	1	3	2	2	2	3	1	1	2
	4	1	2	1	1	1	1	2	1	1	1	1	2
U3	1	2	5	3	1	1	2	3	4	2	1	3	1
	2	1	3	2	1	1	1	2	3	1	1	2	1
	3	1	3	2	1	1	1	2	3	1	1	2	1
	4	1	2	1	1	1	1	2	2	1	1	1	1



Case #	Visit	Question 13	Question 14	Question 15	Question 16	Question 17	Question 18	Question 19	Question 20	Question 21	Question 22	Question 23	Question 24
U4	1	1	4	5	1	2	4	4	2	1	1	1	1
	2	1	3	4	1	2	3	3	1	1	1	1	1
	3	1	3	2	1	1	2	2	1	1	1	1	1
	4	1	2	2	1	1	2	2	1	1	1	1	1
U5	1	1	3	5	1	1	4	3	3	1	1	4	1
	2	1	2	3	1	1	3	2	2	1	1	3	1
	3	1	2	2	1	1	3	2	2	1	1	3	1
	4	1	1	1	1	1	2	1	2	1	1	2	1
U6	1	1	5	2	1	1	3	3	1	4	1	2	1
	2	1	3	2	1	1	2	2	1	3	1	1	1
	3	1	2	1	1	1	1	1	1	3	1	1	1
	4	1	2	1	1	1	1	1	1	3	1	1	1
U7	1	1	2	1	1	1	4	3	3	5	1	1	4
	2	1	1	1	1	1	2	3	2	3	1	1	4
	3	1	1	1	1	1	1	1	2	2	1	1	3
	4	1	1	1	1	1	1	1	1	2	1	1	3
U8	1	1	3	2	1	1	3	3	1	4	1	4	1
	2	1	1	2	1	1	1	2	1	4	1	2	1
	3	1	1	1	1	1	1	1	1	2	1	1	1
	4	1	1	1	1	1	1	1	1	2	1	1	1
U9	1	1	3	3	5	2	3	2	5	2	2	1	1
	2	1	2	2	4	1	2	2	3	1	1	1	1
	3	1	2	1	3	1	2	2	2	1	1	1	1
	4	1	2	1	2	1	1	2	1	1	1	1	1
U10	1	1	4	1	1	1	2	4	1	4	2	1	1
	2	1	3	1	1	1	1	3	1	3	1	1	1
	3	1	1	1	1	1	1	3	1	3	1	1	1
	4	1	1	1	1	1	1	2	1	1	1	1	1

Case #	Visit	Question 13	Question 14	Question 15	Question 16	Question 17	Question 18	Question 19	Question 20	Question 21	Question 22	Question 23	Question 24
S1	1	1	5	5	2	1	5	5	5	5	4	3	2
	2	1	3	3	1	1	3	3	2	4	2	1	1
	3	1	2	2	1	1	1	2	1	2	1	1	1
	4	1	2	1	1	1	1	2	1	2	1	1	1
S2	1	1	5	3	1	1	1	3	4	5	3	2	1
	2	1	3	2	1	1	1	2	2	2	2	1	1
	3	1	2	1	1	1	1	2	1	2	1	1	1
	4	1	1	1	1	1	1	1	1	1	1	1	1
S3	1	2	3	4	1	2	3	3	4	3	4	2	3
	2	1	2	2	1	1	2	1	2	1	2	2	1
	3	1	2	2	1	1	2	1	2	1	2	1	1
	4	1	1	1	1	1	1	1	1	1	1	1	1
S4	1	1	4	3	1	1	2	2	2	5	2	1	1
	2	1	4	3	1	1	2	2	2	4	2	1	1
	3	1	3	2	1	1	1	2	2	4	2	1	1
	4	1	3	2	1	1	1	2	2	3	2	1	1
S5	1	1	5	1	1	1	1	5	5	4	1	1	2
	2	1	5	1	1	1	1	5	4	3	1	1	2
	3	1	5	1	1	1	1	5	4	3	1	1	2
	4	1	2	1	1	1	1	3	4	3	1	1	2
S6	1	1	5	5	1	1	2	2	1	5	4	1	5
	2	1	4	3	1	1	2	2	1	3	2	1	3
	3	1	3	2	1	1	1	2	1	3	1	1	2
	4	1	2	1	1	1	1	1	1	2	1	1	2
S7	1	1	3	1	1	1	4	1	1	3	1	1	1
	2	1	3	1	1	1	2	1	1	3	1	1	1
	3	1	2	1	1	1	2	1	1	2	1	1	1
	4	1	2	1	1	1	2	1	1	2	1	1	1

Case #	Visit	Question 13	Question 14	Question 15	Question 16	Question 17	Question 18	Question 19	Question 20	Question 21	Question 22	Question 23	Question 24
S8	1	1	3	1	1	1	3	2	2	3	1	1	1
	2	1	2	1	1	1	3	1	2	2	1	1	1
	3	1	1	1	1	1	2	1	1	2	1	1	1
	4	1	1	1	1	1	2	1	1	2	1	1	1
S9	1	1	1	1	1	1	1	2	1	1	1	1	1
	2	1	1	1	1	1	1	2	1	1	1	1	1
	3	1	1	1	1	1	1	2	1	1	1	1	1
	4	1	1	1	1	1	1	2	1	1	1	1	1
S10	1	4	5	5	1	1	1	5	1	5	3	1	1
	2	3	5	3	1	1	1	4	1	5	2	1	1
	3	2	2	3	1	1	1	3	1	3	1	1	1
	4	2	2	3	1	1	1	3	1	3	1	1	1
S11	1	1	3	1	1	1	4	2	2	1	1	1	1
	2	1	3	1	1	1	3	2	2	1	1	1	1
	3	1	2	1	1	1	2	2	2	1	1	1	1
	4	1	2	1	1	1	1	2	2	1	1	1	1
S12	1	1	3	1	2	3	4	4	3	4	2	2	2
	2	1	2	1	1	2	3	3	2	3	2	1	1
	3	1	2	1	1	1	3	3	2	2	2	1	1
	4	1	2	1	1	1	3	3	2	2	2	1	1
S13	1	1	3	1	1	1	5	4	1	1	1	1	1
	2	1	3	1	1	1	4	3	1	1	1	1	1
	3	1	2	1	1	1	4	3	1	1	1	1	1
	4	1	2	1	1	1	4	3	1	1	1	1	1
S14	1	1	4	1	1	2	1	3	2	2	1	1	1
	2	1	3	1	1	2	1	2	2	1	1	1	1
	3	1	2	1	1	2	1	2	2	1	1	1	1
	4	1	2	1	1	2	1	2	2	1	1	1	1

Case #	Visit	Question 13	Question 14	Question 15	Question 16	Question 17	Question 18	Question 19	Question 20	Question 21	Question 22	Question 23	Question 24
S15	1	1	5	3	1	5	4	1	1	5	1	5	2
	2	1	4	3	1	4	4	1	1	4	1	4	2
	3	1	4	2	1	3	4	1	1	3	1	2	1
	4	1	3	1	1	2	2	1	1	2	1	1	1
S16	1	1	3	1	1	3	3	3	4	3	1	1	3
	2	1	2	1	1	2	2	2	3	2	1	1	2
	3	1	1	1	1	1	1	2	2	2	1	1	2
	4	1	1	1	1	1	1	1	1	2	1	1	1
S17	1	4	5	5	1	1	1	3	5	3	2	5	2
	2	2	4	4	1	1	1	3	3	3	1	4	1
	3	2	3	3	1	1	1	2	3	3	1	2	1
	4	2	3	3	1	1	1	2	3	3	1	2	1
N1	1	1	2	5	1	1	1	3	5	5	1	1	1
	2	1	2	4	1	1	1	3	4	3	1	1	1
	3	1	2	3	1	1	1	3	4	3	1	1	1
	4	1	2	3	1	1	1	3	4	3	1	1	1
N2	1	2	5	5	2	2	5	2	2	5	4	3	2
	2	1	4	4	2	1	5	2	2	4	3	3	2
	3	1	4	3	1	1	3	1	2	3	2	2	1
	4	1	4	3	1	1	3	1	2	3	2	2	1
N3	1	4	3	4	1	2	4	3	5	3	2	1	3
	2	3	3	3	1	1	3	2	5	3	1	1	2
	3	3	3	2	1	1	2	2	4	2	1	1	2
	4	3	3	2	1	1	2	2	4	2	1	1	2

## NPI SCALE (RAW DATA)

Case #	Visit1	Visit2	Visit3	Visit4
U1	4	2	1	1
U2	5	4	2	2
U3	5	2	2	2
U4	6	3	2	2
U5	8	5	4	2
U6	4	2	2	2
U7	5	2	2	2
U8	5	3	2	1
U9	6	3	2	1
U10	5	3	2	1
S1	10	5	4	2
S2	8	4	2	1
S3	9	7	3	2
S4	5	4	2	2
S5	8	6	6	2
S6	9	8	4	3
S7	4	3	1	1
S8	7	6	3	4
S9	4	3	1	1
S10	10	6	4	2
S11	7	6	3	2
S12	7	2	2	1
S13	7	3	1	1
S14	6	3	1	1
S15	9	5	5	2
S16	6	3	2	1
S17	10	7	2	2

Case #	Visit1	Visit2	Visit3	Visit4
N1	9	6	5	2
N2	9	5	4	1
N3	9	5	2	2