A STUDY OF PREVALENCE OF MENSTRUAL IRREGULARITIES

IN LATE ADOLESCENT GIRLS AND

USEFULNESS OF NON PHARMACOLOGICAL ADJUNCTS

Dissertation submitted to

THE TAMIL NADU DR.M.G.R. MEDICAL UNIVERSITY,

CHENNAI - 600032

In partial fulfilment of the requirement for the award of the degree of

Doctor of Medicine in Physiology (Branch V)

M.D. (PHYSIOLOGY)

APRIL 2015

DEPARTMENT OF PHYSIOLOGY

TIRUNELVELI MEDICAL COLLEGE

TIRUNELVELI-11.

CERTIFICATE

This dissertation entitled **"A STUDY OF PREVALENCE OF MENSTRUAL IRREGULARITIES IN LATE ADOLESCENT GIRLS AND USEFULNESS OF NON PHARMACOLOGICAL ADJUNCTS**" is submitted to the **Tamil Nadu Dr. M.G.R. Medical University,** Chennai, in partial fulfilment of regulations for the award of **M.D. Degree in Physiology** in the Examinations to be held during April 2015.

This dissertation is a record of fresh work done by the candidate DR**. A. KALA,** during the course of the study (2012-2015).

This work was carried out by the candidate herself under my supervision.

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DECLARATION

I solemnly declare that the dissertation titled **"A STUDY OF PREVALENCE OF MENSTRUAL IRREGULARITIES IN LATE ADOLESCENT GIRLS AND USEFULNESS OF NON PHARMACOLOGICAL ADJUNCTS"** is done by me at Rani Anna College for Women, Tirunelveli.

The dissertation is submitted to The Tamilnadu Dr. M.G.R. Medical University towards the partial fulfilment of requirements for the award of M.D.Degree (Branch V) in Physiology.

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PROTOCOL TITLE: A Study of Prevalence of Menstrual Irregularities in Late Adolescent Girls and Usefulness of Non Pharmacological Adjuncts

NAME OF PRINCIPAL INVESTIGATOR: A.Kala

DESIGNATION OF PRINCIPAL INVESTIGATOR: Post Graduate Resident

DEPARTMENT & INSTITUTION: Department of Physiology, Tirunelveli Medical College

Dear Dr A.Kala, *the Tirunelveli Medical College Institutional Ethics Committee (TIREC) reviewed and discussed your application during the IEC meeting held on* 29.07.2013.

THE FOLLOWING DOCUMENTS WERE REVIEWED AND APPROVED

1. TIREC Application Form ☐
2. Study Protocol ☐
3. Department Research Committee Approval ☐
4. Patient Information Document and Consent Form in English and Vernacular Language ☐
5. Investigator's Brochure ☐
6. Proposed Methods for Patient Accrual Proposed ☐
7. Curriculum Vitae of the Principal Investigator ☐
8. Insurance /Compensation Policy ☐
9. Investigator's Agreement with Sponsor ☐
10. Investigator's Undertaking ☐
11. DCGI/DGFT approval ☐
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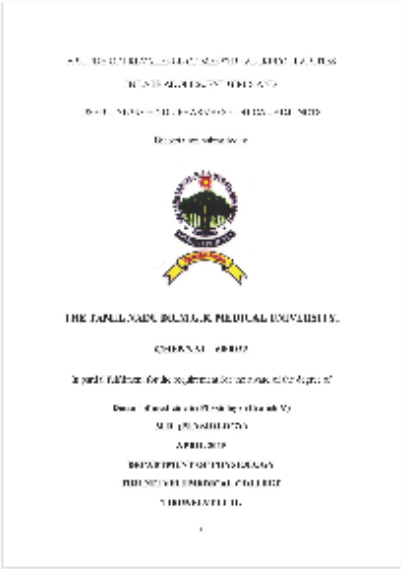

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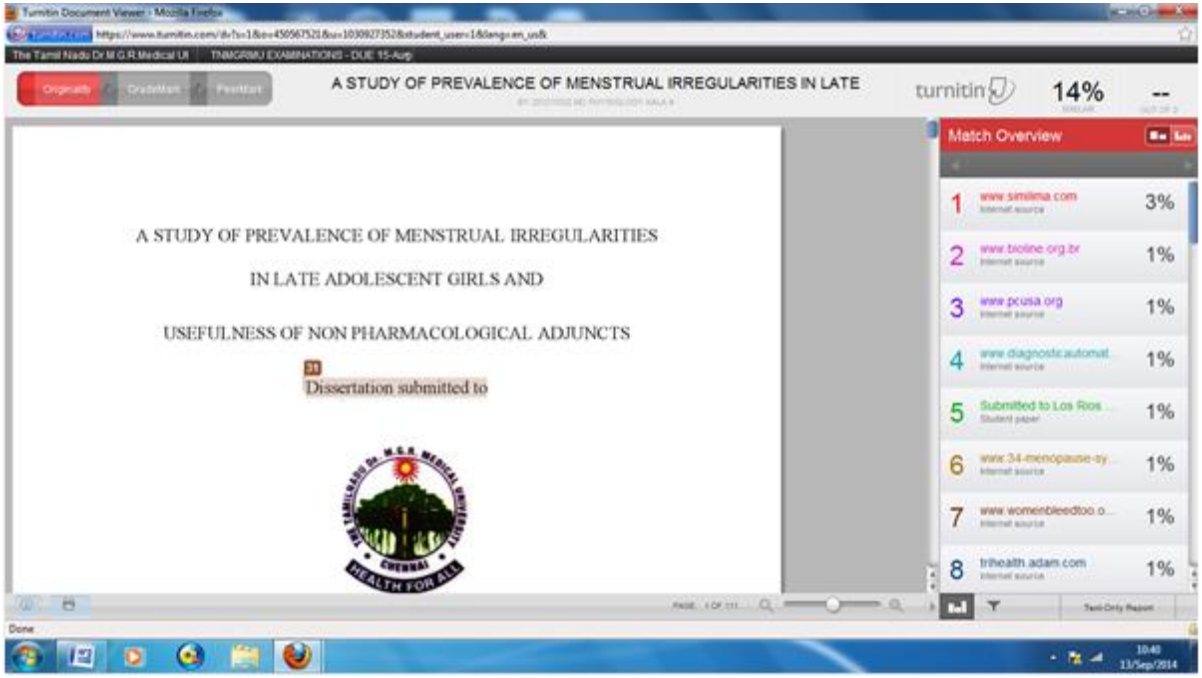
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CONTENTS

ABBREVIATIONS USED IN THE STUDY

BMI	-	Body Mass Index
WHO	-	World Health Organization
FSH	-	Follicle Stimulating Hormone
LH	-	Leuteinizing Hormone
HPO Axis	-	Hypothalamo Pituitary Ovarian Axis
PCOD	-	Poly Cystic Ovarian Disease
GnRH	-	Gonadotropin Releasing Hormone
IVF	-	In Vitro Fertilization
PID	-	Pelvic Inflammatory Disease
CRH	-	Corticotropin Releasing Hormone
TSH	-	Thyroid Stimulating Hormone
ELISA	-	Enzyme Linked Immuno Sorbant Assay
CLIA	-	Chemiluminescent Immunosorbant Assay
PBAC	-	Pictorial Blood Assessment Chart
HDL	-	High Density Lipoprotein
PR	-	Progesterone Receptor
ER	-	Estrogen Receptor
PMS	-	Pre Menstrual Syndrome

A STUDY OF PREVALENCE OF MENSTRUAL IRREGULARITIES IN LATE ADOLESCENT GIRLS AND USEFULNESS OF NON PHARMACOLOGICAL ADJUNCTS

Dr.A.Kala, Dr.B.Sujatha, Dr.S.Sudha.

Abstract

Objective: To study the prevalence of menstrual irregularities in late adolescent girls and to study the effect of Non Pharmacological Adjuncts like relaxation exercises among them. **Methods:** The prevalence of menstrual irregularities noted by conducting a study on 800 college girls at Rani Anna College for Women,Tirunelveli. The girls with menstrual irregularities were given an intervention with brisk walking exercise, Deep breathing exercise and Shavasana exercise for a period of 6 months. The effect of these exercises on menstrual pattern studied after intervention. **Results:** The prevalence ofmenstrual irregularities were 12% among college girls. Among those with menstrual irregularities, the relaxation exercises and physical exercise produced significant reduction in menstrual cycle irregularities(P value <0.05) but no significant change in menstrual volume. Conclusion: Physical activity and mental relaxation exercises are effective in correction of menstrual irregularities.

Key Words: Late Adolescent Girls, Menstrual Irregularities, Non Pharmacological Adjuncts.

A STUDY OF PREVALENCE OF MENSTRUAL IRREGULARITIES IN LATE ADOLESCENT GIRLS AND USEFULNESS OF NON PHARMACOLOGICAL ADJUNCTS

INTRODUCTION

Adolescence is a period of transition from childhood to adult life along with pubertal development and sexual maturation. For girls, it is a period of physical and psychological transformation for motherhood[1]. During adolescence, crucial endocrinological, metabolic, somatic and psychological changes occur in the body. Especially their hypothalamo pituitary ovarian axis undergo activation and full maturation during this period producing normal menstrual cycle.

A normal ovulatory menstrual cycle is a prerequisite for future reproductive capabilities for adolescent girls. Any deviation from normal will affect the reproductive function in later life. The most common cause for infertility in married women is irregular menstrual period from teenage. Regarding this aspect proper knowledge and awareness is still lacking in adolescent girls and their parents.

Menstrual irregularities are major problems in adolescents producing psychological stress in parents and children. Studies show that the prevalence of menstrual irregularities among South Indian adolescent population seems to be 11.9%[2]. The common menstrual disorders prevalent among themselves are

menorrhagia(17.82%), oligomenorrhoea (16.08%), hypomenorrhoea (59.56%), dysmenorrhoea (49.13%), and premenstrual tension (46.52%)[3]. Eventhough abnormal menstruation has multifactorial causes one among the common accompaniment is stress factor. Stress may be a causative factor by disturbing the normal functioning of hypothalamo pituitary ovarian axis or it may have an additive effect upon individuals with menstrual irregularities.

Stress needs special attention because adolescent girls are more prone for stress due to their change in modern lifestyle pattern. Moreever academic stress in college girls produces a psychological distress which has a definite influence on their endocrinological status. So minimising stress in them by various lifestyle modifications help to regulate the hormone levels and irregular periods. A healthy lifestyle is an essential companion to any stress reduction program. Healthy lifestyle includes regular exercise, eating a balanced diet rich in variety of whole grains, vegetables and fruits, deep breathing exercises, asanas for mind relaxation.

All the above said non pharmacological strategies if applied to adolescent girls provide a positive impact on their reproductive system enabling them to become a stable motherhood in future. Hence the present study helps to lead the adolescent girls to proceed with a less stressful and more powerful reproductive life.

AIMS

&

OBJECTIVES

AIMS AND OBJECTIVES

1.To find out the prevalence of menstrual irregularities in late adolescent girls.

2.To assess the stress level in the study group by stress questionnaire.

3.To assess the stress level in the study group by estimating early morning serum cortisol level.

4.To detect anaemia among study group population by haemoglobin estimation.

5.To detect any thyroid dysfunction by performing thyroid function tests.

6.To evaluate obesity status among late adolescent girls by BMI estimation.

7.To detect any gross structural abnormalities in uterus and ovaries by ultrasound study.

8.To study the effect of non pharmacological adjuncts in girls with menstrual irregularities.

REVIEW

OF

LITERATURE

REVIEW OF LITERATURE

Adolescence is a transitional stage in human development. From Latin, Adolescence means **"To grow up."** The progress of human body starts from the day they come in this world. The stage when the body transfers from childhood to adulthood is called as puberty. WHO has defined adolescence as a progression from appearance of secondary sexual characters to sexual and reproductive maturity and development of adult mental process. WHO also describes adolescence as the period of life between 10 to 19 years of age. But its physical and psychological expression may start earlier and end later. Physical growth and cognitive development can also extend into early twenties.

A change occur in the adolescent period in the ability to abstract thinking. Major pubertal and biological changes including changes in the sex organs, height, weight, muscle mass and also changes occur in structure and organization of brain during adolescence[4].

PUBERTY IN A FEMALE

In all mammals, there is a period in which the gonads remain quiescent until activated by gonadotropins from anterior pituitary to bring about maturation of reproductive system. This period of final maturation is called as adolescence. It is also known as puberty. Strictly speaking, puberty is the period

when the gametogenic and endocrine function of the gonad has first developed at a point when reproduction is possible.

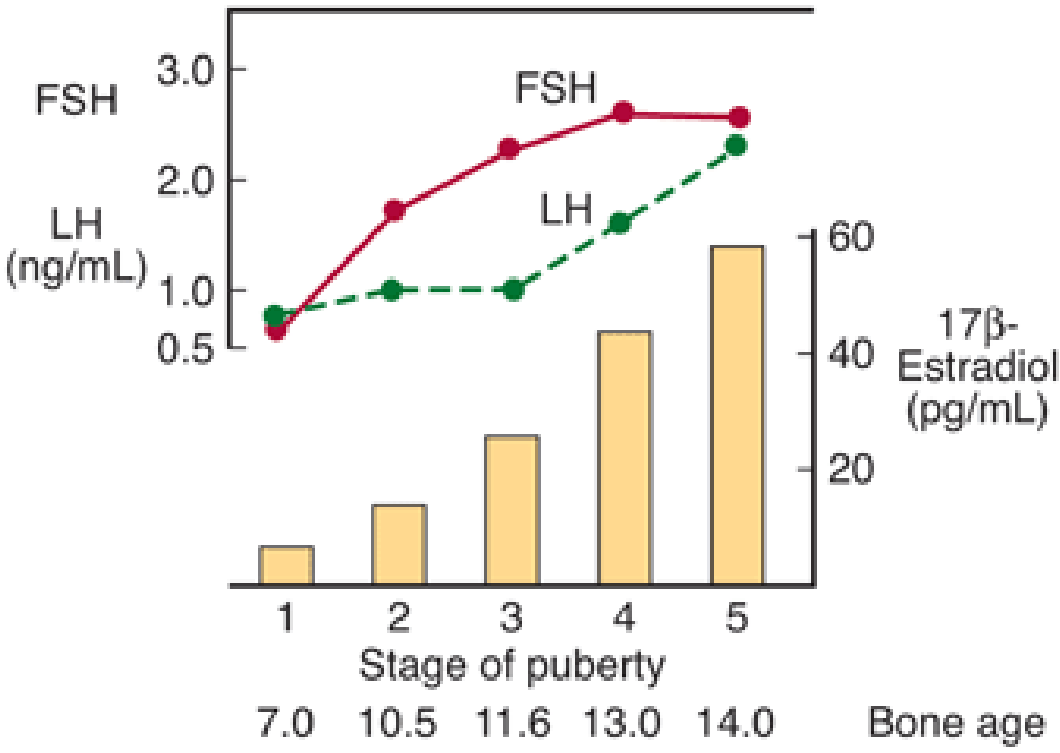
Puberty is a natural phenomenon. In females, it begins when the pituitary starts secreting the hormones called FSH and LH. These hormones work in synergy triggering the production of female sex hormone estrogen from the ovary and aid in ovulation. Usually the onset of menstruation otherwise called as menarche is believed to be the onset of puberty, but actually it begins much earlier than that. Not every girl attains puberty at the same age. The age varies between 8 to 14 years. The difference in attainment of menarche is due to the influence of various factors like genetic factor, environmental factor, ethnicity, nutrition and social factors[5].

Recent studies suggest that the onset of puberty in girls have become earlier over past 30 years.Increasing rate of obesity over the same time period is a major factor[6]. Several cross sectional studies in United States proved that girls who have relatively higher BMI are more likely to have early menarche[7].

ROLE OF LEPTIN ON PUBERTY

Leptin may be the critical link between body fat and early puberty. Eating habits and energy balance is regulated by a peptide called as Leptin which is secreted by fat cells. If it's level is higher, then menarche is earlier through stimulation of neuro endocrine chain of events[8]. So in an obese girl,

HORMONAL CHANGES DURING ADOLESCENCE



growth spurt and menarche starts earlier. However, estrogen which is produced thereby causes early closure of epiphysis of long bones and there is stunting of final growth. Similarly studies proved that girls with nutritional deficiencies thereby with low BMI have delayed puberty[9]. During puberty major growth and development takes place in a girl's body.

STAGES OF FEMALE PUBERTY

The most visible changes during puberty are growth in stature and development of secondary sexual characters. Equally important are changes in body composition, Achievement of fertility, changes in neuro endocrine axis, bone mineralization and normal cardiovascular changes like more aerobic power reserve, electrocardiographic changes as well as blood pressure changes.

Pubertal maturation can be described in terms of sequence, timing and tempo. The staging system is the one which was described by Marshall and Tanner which consists of 5 stages[10]:

They occur in the following sequences.

- Physical growth
- Development of secondary sex organs and breast development. This occurs around the age of 10 to 12 years.
- Pubic and axillary hair growth one year later.

- Development of ovaries and genital organs.
- Growth spurt and menstruation.

Changes in the psychological outlook occur over this period. Some will react positively but many of them become conscious of their external appearance and the fear of future unknown events.

Physical growth

The growth in weight and height begins around 10 years of age and is completed by the age of 14. The growth is at the rate of 5 to 10 cm per year. This growth is brought about by growth hormone of the anterior pituitary gland and also by insulin like growth factor (IGF-1)[11].There is alteration in shape like that of a female pelvis.

Breasts

Stage1 : Prepubertal elevation of papilla.

Stage2 : Elevation of breast tissue and papilla as a small mound, areolar enlargement.

Stage 3: Further enlargement of breast and areola.

Stage 4: Areola and papilla project like a secondary mound.

Stage 5: Adult breast with typical contour.

Pubic hair staging

Stage 1: No sexually stimulated pubic hair. Some non sexual hair may be present in the genital area.

Stage 2: Appearance of coarse crinky hair along the labia majora.

Stage 3: Coarse curly hair extending onto mons pubis.

Stage 4: Adult hair in thickness and texture, lateral extension onto mons pubis giving the vulva an inverted triangular appearance.

Stage 5: Further lateral extension onto inner aspects of the thighs and perineum.

Axillary hair appear a little later. These are under control of adrenal hormone, although estrogen also have a role in their occurrence.

Changes in genital organs

Vulva develops into labia majora with fat deposition. Under the influence of estrogen, the skin becomes keratinized and becomes resistant to infection. Vaginal mucosa becomes multilayered and the superficial layer contains mature squamous cells[12]. On desquamation these cells release glycogen and there will be appearance of Doderlein's bacilli which forms lactic acid and the vaginal pH is maintained at 4.5.

There is rapid growth of uterus so that the prepubertal ratio of uterus/cervix ratio of 1:1 changes to 2:1 or 3:1. The ovaries enlarge and primordial follicles start develop into Grafian follicles, under hormonal stimulus. With the functioning of H-P-O axis, estrogen is secreted by the

granulosa cells. Estrogen receptors are formed in the target tissues and this hormone brings about breast and genital organ changes. Ovulation may occur 1 to 2 years after menarche, until then menstrual cycles are anovulatory.

Abnormalities in Puberty

Precocious Puberty

Precocious puberty is the appearance of secondary sexual characteristics before the age of 8 years and occurrence of menstruation before 10 years of age.

There are several causes for precocious puberty

1. Constitutional

Most common cause is constitutional (true) due to premature activation of H-P-O axis. Regular menstrual cycles are established earlier .This causes initial spurt in height but the ultimate height is shunted due to premature closure of epiphysis. It is advisable to investigate the girl to rule out other causes before giving reassurance to the parents. It is desirable to suppress menstruation until the right age for puberty is reached. GnRH analogues are used for suppression of menstruation but prolonged therapy causes osteoporosis and therefore, at a time the drug should be given for 6 months only[13].

2. Pseudopuberty

These are due to gonadotropins or sex steroid stimulation independent of H-P-O axis. The causes are

- Pituitary tumours, encephalitis, meningitis, hydrocephalus.
- Ovarian feminizing tumours
- Hypothyroidism
- Adrenal tumours

Investigations required are:

1.Radiography of pituitary fossa, CT and MRI brain

2.Ultrasound abdomen to look for ovarian tumour

3. Thyroid Function tests

4. Hormonal profile FSH, LH and Estrogen..

Precocious puberty in girls warrants prompt evaluation and early initiation of treatment to optimize adult height and to minimize psychosocial stress to the child[14]. Treatment is directed at primary cause.

Delayed Puberty

Puberty is said to be delayed when secondary sexual characters do not appear by the age of 14.This may be familial or idiopathic. Children who are

healthy but having a slower rate of physical development than average have a constitutional delay in growth and adolescence[15]. Delayed puberty most commonly results from inadequate gonadal steroid secretion which in turn is mostly due to defective gonadotropin secretion . This in turn is due to defective production of GnRH from hypothalamus, the key functional defect in patients with constitutional delay of puberty. Delayed puberty causes anxiety to the girls and their parents. It is necessary to perform radiological assessment of bone age. Eventually, most of these girls develop secondary sexual characteristics and establish menarche.

The other causes for delayed puberty are

- Development of secondary characters, but no menstruation. This is due to absent uterus, or due to imperforate hymen or vagina.
- Pituitary and hypothalamic inadequacy.
- Ovarian Causes: Turner syndrome, resistant ovary syndrome, autoimmune diseases. FSH level is high.
- Polycystic ovarian disease (PCOD), Testicular feminizing syndrome.
- Malnutrition, anorexia nervosa and childhood illness may delay puberty.
- Hypothyroidism[16].

Historical References about Ovaries

The earliest reference to the ovary is in the writings of Aristotle (384-322 B.C). Later Herophilus of Alexandria (300 B.C) was probably the first person to recognize ovaries as anatomical entities. Soranus of Epesus (ca.50 A.D.E) was the first to give a detailed description of the ovaries[17].

In 14th century Henri De mondeville in his book showed a depiction of an opened abdomen with visible uterus and ovaries. Berengario da Capri mentioned about structural description of ovaries (1460-1530 A.D).

In 1514-1564 A.D, Andreas Vesalius, an anatomist who described follicular fluid and the structure of the ovary. Later, Faricious (1533-1619) made an enormous contribution to embryology and the first person to give an accurate account about the role of ovary. The ovaries first acquired their name in the beginning of 17th century. Malpighi (1628-1694) named Corpus Luteum.

The concept of control of ovarian function developed in 18th century. In 1827 Von Bear first described and illustrated the ovum within the follicle. The initial discovery of Estrogen was made by Lataste in 1886-1887, who demonstrated cyclical changes in the vaginal epithelium in relation to development of ovarian follicles.

In 19th century, two Frenchmen Prevost and Dumas described ovulation and the formation of Corpus Luteum in the bitch.

FEMALE REPRODUCTIVE SYSTEM

The main difference between female and male reproductive system is the cyclical release of gametes in females during reproductive life, but it is a continuous process in males from puberty onwards till death. In females, fertility is cyclical and is restricted during their reproductive life. The cyclical changes of female reproductive system are synchronized with the changes in the hypothalamo pituitary ovarian axis. The ovarian response to hypothalamic pituitary hormones are mainly responsible for cyclical changes in reproductive organs of females especially in uterus and ovaries.

The ovarian changes are growth, maturation and release of ovum and hormonal secretions and the uterine changes are mainly alterations in the endometrium to provide nourishment to the implanted fertilized gamete or shedding of the endometrium producing menstrual bleeding in the absence of fertilization. These cyclical changes are called as menstrual cycles and the bleeding is called as menstruation.

Menstrual cycle begins at puberty and ends at menopause. In between, there is temporary stoppage during pregnancy and lactation. During different stages of menstrual cycle, the ovarian hormones oestrogen and progesterone provide feedback effects on hypothalamo pituitary secretions causing cyclical release of the pituitary hormones FSH and LH which are collectively known

as Gonadotropins. Since hypothalamo pituitary axis is subjected to so many influences, menstrual cycle is also affected by stress and various psychosocial and environmental factors.

Development of the Gonad

A primitive gonad arises from genital ridge, on each side of the embryo. Genital ridge is a condensation of tissue near the adrenal glands. The gonad develops into a cortex and medulla. These structures are identical in both sexes until 6th week of development. In genetic females, the medulla regresses and the cortex develops into ovary. In genetic males, the cortex regresses and the medulla develops into a testis. The embryonic ovary does not produce hormones[18].

Embryology of the genitalia

At 7th week of gestation the embryo contains both male and female primordial genital ducts. In a female fetus, the uterine tubes and uterus develops from mullerian duct system. In male fetus, the wolffian duct system develops into epididymis and vas deferens. Similarly the external genitalia are bipotential until 8th week of gestation. Thereafter the urogenital slit disappears in male and forms male genitalia and in female the slit remains open and forms female genitalia[19].

When the embryo has testes, male internal and external genitalia forms. The leydig cells of fetal testis secretes testosterone and the sertoli cells secrete mullerian inhibiting substance also called as mullerian regression factor. In genetic females, in the absence of testis no mullerian inhibiting substance is secreted. Absence of mullerian inhibitory substance causes no regression of mullerian duct system and so there will be development of female internal and external genitalia.

FUNCTIONAL ANATOMY

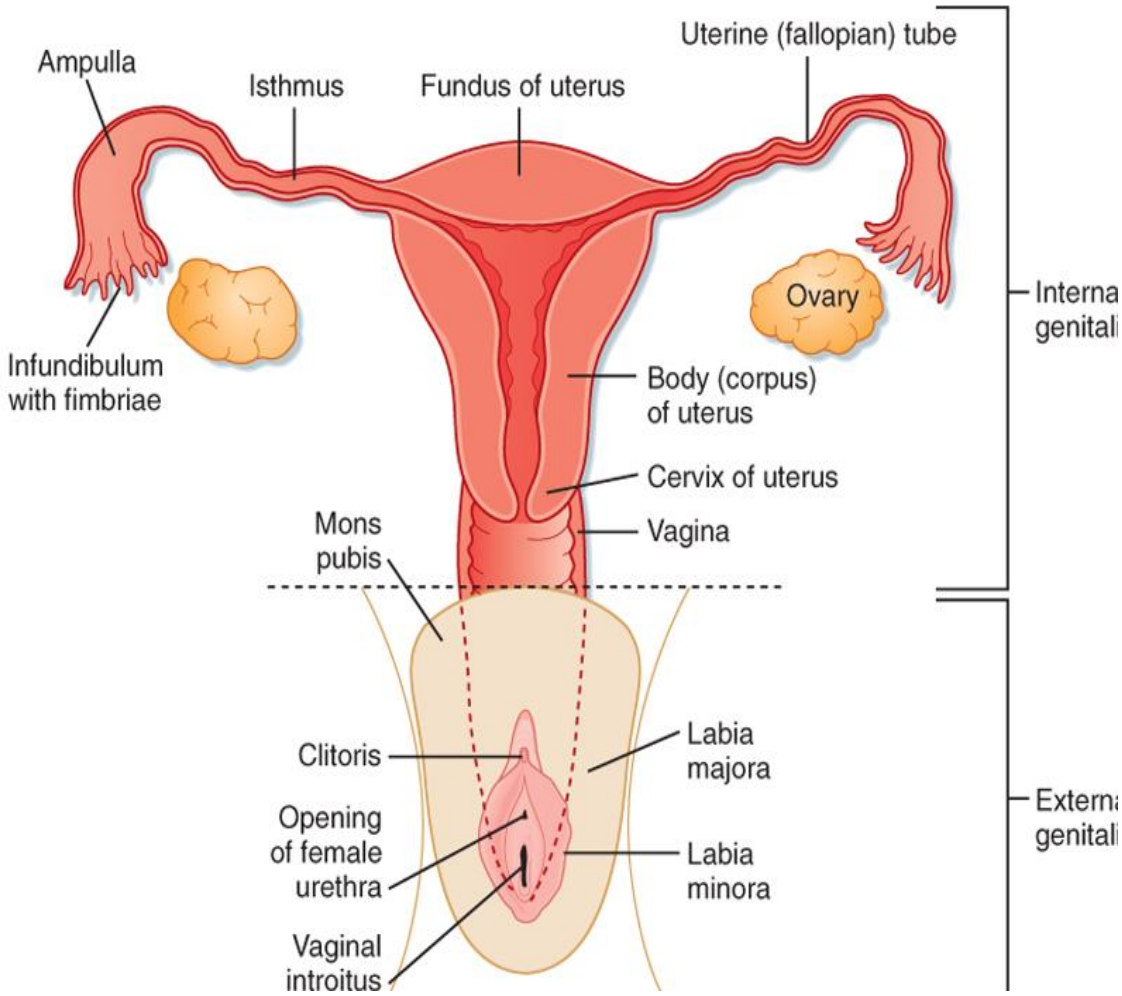
The female reproductive organs are divided into Internal and External genitalia. The internal genitalia consists of vagina, uterus, fallopian tubes and ovaries. The external genitalia consists of labia majora, labia minora, clitoris, vestibule of vagina and vestibular glands[20].

Vagina:

It is a tubular canal which is present anterior to rectum and posterior to the urethra and bladder. The length of vagina is about 8 cm but it can be stretchable up to double its length during sexual act and it further stretches during parturition. Vaginal epithelium changes during different phases of menstrual cycle. In the proliferative phase, under the influence of oestrogen cornification otherwise known as keratinisation of vaginal epithelium occurs

and there will be increased secretion of thin mucous. In the luteal phase, cornification is reduced under the influence of progesterone. There will be

FEMALE REPRODUCTIVE SYSTEM



infiltration of polymorpho nuclear leucocytes and the vaginal epithelium secretes thick mucous.

Uterus:

Uterus is a hollow muscular organ approximately 9 cm in length, 6.5 cm in width and 3.5 cm in thickness. It is divided anatomically and functionally into 2 parts corpus or the body and the cervix. The line of division is at the level of internal os. The wall of the uterus consists of three layers namely outer peritoneal layer called as perimetrium, middle muscular layer known as myometrium and inner mucous layer known as endometrium. The endometrium has 2 layers: A stromal layer made up of connective tissues penetrated by spiral arteries which lies close to myometrium and an inner epithelium containing uterine glands which are lined by columnar secretory cells.

Changes occur in the arteries and the endometrial glands during different phases of menstrual cycle. Endometrial tissue sheds at the end of luteal phase which results in menstrual bleeding. During pregnancy uterus enlarges to accommodate the growing fetus.

Cervix:

Cervix is a narrow muscular tube that connects vagina with the body of the uterus. It consists of internal os, cervical canal and external os. The

cervical secretion changes in quality as well as quantity during different phases of menstrual cycle under the influence of various hormones. The cervical mucous is rich in fructose, mucopolysaccharides and glycoproteins[21]. Fructose gives nutrition to sperms during its passage through cervical canal.

In the preovulatory phase, under the influence of estrogen the glycoprotein network is arranged parrellel to each other which facilitates sperm penetration. In the post ovulatory phase, under the influence of progesterone, the network forms interlacing bridges which prevents entry of sperms into cervical canal. Because of this property, progesterone is used in a contraceptive pill. Under the influence of estrogen the cervical mucous becomes thinner and more elastic which forms the physiological basis of spinbarkeit test and Fern test for ovulation.

Fallopian Tubes

There are two fallopian tubes one on each side which arises from upper poles of both sides of uterus and passes outwards and backwards in the upper part of broad ligament. Each fallopian tube measures 10 cm in length and approximately 8 mm in diameter. The fallopian tube is divided anatomically into 4 parts namely interstitium, isthmus, ampulla and infundibulum. Fertilization occur in the ampullary portion of fallopian tube[22].

Ovaries

Morphology and Physiology

There are 2 ovaries each weighing about 10 gms in adults. Each ovary measures about 35 mm in length, 25 mm in width and 18 mm in thickness. The ovary is almond shaped, surface is corrugated. The ovary is attached to the back of the broad ligament by a mesentery called mesovarium. Medially it is close to the fimbria of the fallopian tube which spreads over it around ovulation. Ovary is attached to uterus by ovarian ligament. Ovary consists of 2 zones- outer cortex and inner medulla.

Cortex is the outer zone lined by germinal epithelium surrounded by fibrous tissue layer called as tunica albugenia. Ovarian cortex contains oocytes enclosed within a follicle, the follicles are present in various stages of development. Mature ovarian follicle is called as Grafian follicle. The stroma consists of connective tissue and interstitial cells which are present in between follicles.

Medulla is the inner zone of ovary where different types of interstitial cells and connective tissue cells are present. Blood vessels and lymphatics enter through the hilum of the ovary.

Blood Supply:

Ovarian artery supplies the ovary and outer part of fallopian tube which is a direct branch from aorta. Uterine artery supplies the uterus and inner part of the fallopian tube. Uterine artery arises from anterior trunk of internal iliac artery. Branches from uterine artery supplies the cervix and vagina. The blood vessels of perineum and external genitalia are derived from the internal pudental artery, a branch of the internal iliac artery[23].

The primordial follicle

The primordial follicle first makes its appearance around 20 weeks of gestation. The primordial follicle contains a large cell called primordial ovum, surrounded by flattened cells called as follicle epithelial cells. These follicle epithelial cells give rise to granulosa cells of the grafian follicle[24].

The primitive ovum or primary oocyte is spherical in shape and is 18 to 24 micrometer in diameter. Its chromatin stains clearly and the nuclear membrane is well defined. Until puberty, the primary oocyte remains in the prophase of the first meiotic division. The ovary of the newborn contains about 2 lakhs primordial follicles which drops down to few hundreds at puberty. The most curious feature of the ovary is the tendency of the sex cord cells to undergo degeneration. The process of degeneration continues throughout childhood and reproductive period so that no ovum is detected in

the woman who has passed the menopause. Only 450 follicles are available during childbearing period.

The Grafian Follicle

The Grafian follicle described by Regnier de Graaf in 1672 is a vesicle measuring 12 to 16 mm in diameter after puberty. Before that, it very rarely reaches more than 5 mm in diameter.

The mature Grafian follicle is spherical or ovoidal in shape and contains pent up secretion, which is called as liquor folliculi. The lining has two layers (i) theca interna and (ii) granulosa layer. The theca interna layer consists of cells which are derived from the stromal cells of the ovarian cortex. The theca cells produce ovarian hormones estrogen, progesterone and sometimes extended to androgen production. The granulosa cell layer lies within the theca interna layer, the cells of which has a characteristic appearance. The cells are 8 to 10 micrometer in diameter, the nuclei stain deeply and the cells contain little cytoplasm.

The granulosa cells are collected together in one area to form a projection into the cavity called as discus proligerus or cumulus oophorus. The ovum lies within the discus proligerus. The peripheral granulosa cells form a layer having few cells in thickness whereas at discus the cells are having 12 to 20 layers thickness. Capillaries cannot be identified in granulosa

layer since it is avascular. Small spherical globules are scattered among granulosa cells around which the granulosa cells are arranged radially. These structures are called as **call exner** bodies. A basement membrane called as membrana limitans externalis is present between granulosa layer and theca interna.

The mature ovum is 140 micrometer in diameter. There is a vitelline membrane at the periphery of the deutoplasm outside which is an acellular layer known as zona pellucida which envelops the ovum. The entire periphery of the ovum is surrounded by granulosa cells. These granulosa cells have a radial arrangement called as corona radiata. Even after the detachment of the ovum after its discharge into peritoneal cavity, the corona radiata remains attached to the ovum. A third layer called as theca externa layer is still ill defined in the ovary. The liquor folliculi contains the ovarian hormone estrogen and is secreted by granulosa cells[25].

The fate of Grafian follicle

The process by which a primary follicle is converted into a grafian follicle called as folliculization is first recognized as early as 32nd week of fetal life. Until puberty, the follicles undergo a process called as follicular atresia. Ovulation is the process by which grafian follicle discharges its ovum into the peritoneal cavity which occurs first time at puberty and is restricted to the reproductive period. The development of primordial follicle into grafian

follicle is under control of an anterior pituitary hormone called as follicle stimulating hormone Several follicles begin to develop in each menstrual cycle. Of the several follicles, one grows faster and produces more FSH and estrogen.

The rising estrogen stimulates LH receptors in theca cells but inhibits anterior pituitary leading to decline in level of FSH and gonadotropic support to lesser developed follicles which undergo atrophy. The level of FSH and LH as well the sensitivity of the follicles determine the number of follicles that is going to develop in any one cycle. In a spontaneous menstrual cycle, only one dominant follicle develops into mature grafian follicle resulting in single ovulation. Follicular atresia occurs first in ovum then in granulosa cells. There is hyaline degeneration of follicles and gradual absorption of follicular fluid causes collapse of the follicle.

Ovulation

Ovulation occurs when the ovum with surrounding corona radiata escapes into peritoneal cavity out of grafian follicle. The tubal fimbria hugs the ovary at ovulation and picks up the discharged ovum. The peak level of 75 ng/ml of LH is required for ovulation. Rupture of grafian follicle occurs due to contraction of micro muscles of theca externa which are brought about by prostaglandins under influence of LH. Serial ultrasonographic appearance

of sudden shrinkage of a follicular size, free fluid in pouch of douglas and regrowth of collapsed cyst suggest that ovulation has occurred[26].

In case of irregular cycles, only the follicular phase varies, but luteal phase remains constant at 14 days. Sometimes multiple ovulation can occur and result in multiple pregnancy. It can be therapeutically induced with hormones during In Vitro fertilization.

The aperture through which egg escapes is called as stigma. It appears laparoscopically as a red spot which heals in 3 to 4 days. The methods of detecting ovulation are based on serial vaginal cytology, serial cervical mucous study, observing daily basal body temperature, estimation of serum progesterone levels in the post ovulatory phase and premenstrual endometrial biopsy. Sometimes there is failure of rupture of grafian follicle, instead it grows into a corpus luteum. This is called as luteinized unruptured follicle, which is the cause for infertility[27].

Anovulation is the cause for 10 % cases of infertility[28]. Unless fertilized, the ovum will survive for 24 hours only. Thereafter it degenerates in the fallopian tube without producing any trace.

Corpus luteum

Soon after ovulation, the grafian follicle collapses and there occurs luteinisation of granulosa and theca cell. The cells increase in size with pale

staining cytoplasm. Therefore the nuclei appear small. The cells proliferate and becomes 8-10 fold in size due to which the cyst wall is crenated. The corpus luteum becomes highly vascularised from vessels of theca interna. Bleeding occur in the cavity of the corpus. By 22nd day of normal cycle, the corpus luteum attains the size of 2 cm and reaches maximum maturity. If no pregnancy occur, the corpus luteum starts degenerating on18th post ovulatory day. Due to the presence of carotene, corpus luteum appear yellow in colour.

During last premenstrual week, there is decreased vascularity of corpus luteum and vacuolated cells appear due to atrophy and degeneration of granulosa cells. Later, there is hyaline tissue deposition, and the hyaline body is called as corpus albicans. It takes 9 months for complete replacement of hyaline tissue. The regression is due to fall in LH, rise in estrogen and PGF2 alpha.

Menstruation

It is brought about by fall in estrogen and progesterone following degeneration of corpus luteum.

Corpus luteum of pregnancy

Following fertilization, corpus luteum continues to grow, becomes larger, attains a size of 2.5 cm now known as corpus luteum of pregnancy.

It is functionally active upto 12weeks. Afterwards placenta takes over the hormonal function and carries pregnancy to term.

MENSTRUAL CYCLE

The reproductive system of women shows regular cyclical changes that occur regularly over a period of one month. This is known as **menstrual cycle** which is actually the periodic preparation of the reproductive system for fertilization and pregnancy. In humans and primates the cycles manifest by periodic vaginal bleeding which is called as menstruation. The first menstrual cycle is called as menarche. The length of the menstrual cycle is variable in women but an average is 28 days from the start of one menstrual period to the start of next menstrual period. The days are identified by number, starting from 1^{st} day of menstruation.

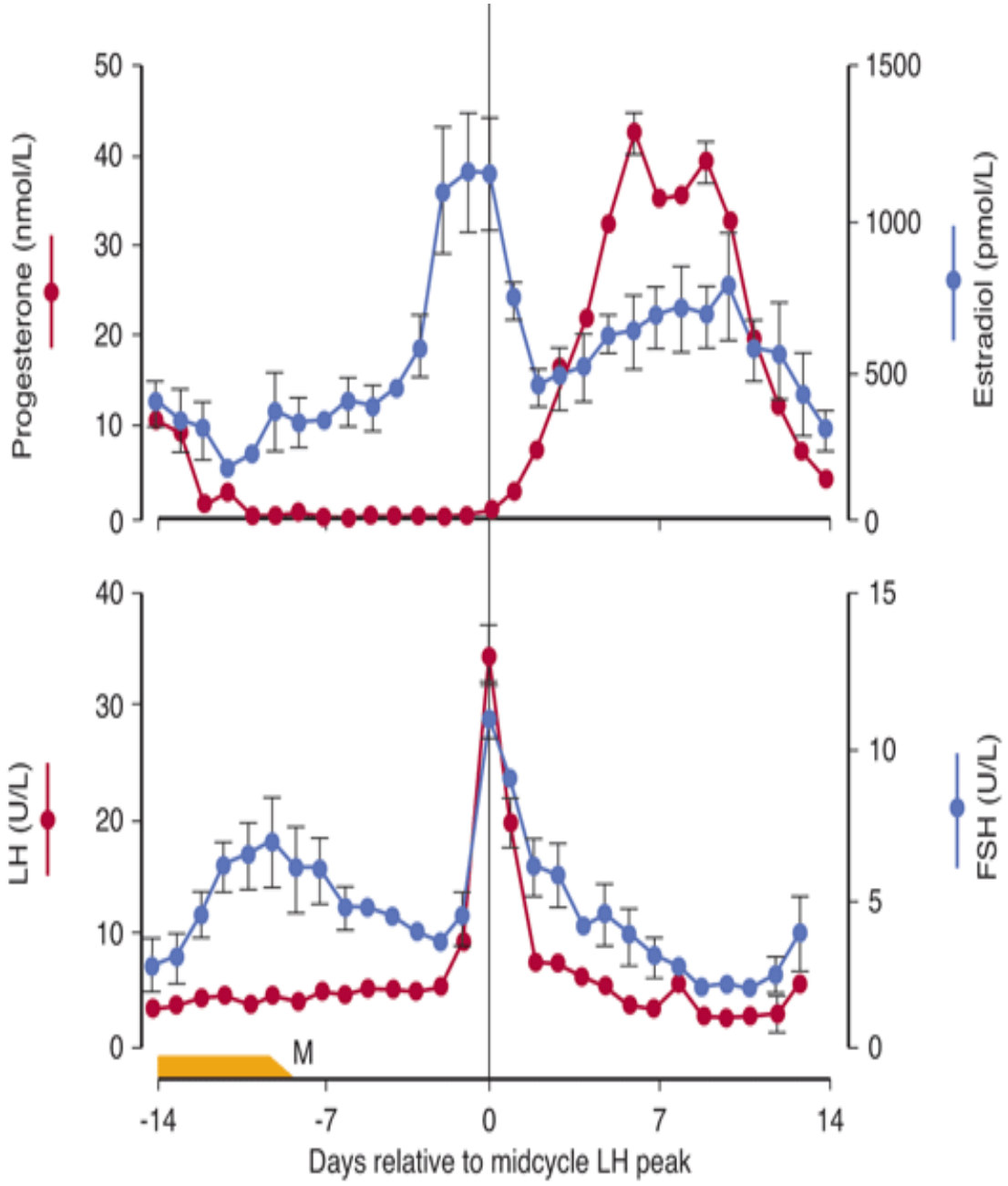
Phases of Menstrual cycle

The menstrual cycle is characteristically divided into 2 phases namely follicular phase and luteal phase with ovulation that seperates these 2 phases.

Follicular Phase

This is the phase from onset of bleeding to day of ovulation. The dominant follicle in ovary matures to end in ovulation. Hence this phase is called as follicular phase .This phase is again subdivided into two parts

HORMONAL CHANGES DURING MENSTRUAL CYCLE



namely menstrual phase and proliferative phase. This phase is otherwise known as preovulatory phase[29].

Luteal Phase

This is the phase between ovulation and onset of next menstrual bleeding. Corpus luteum is formed in this phase, so it is also called as luteal phase. It is also called as secretory phase since uterine endometrium is secretory during this phase. This phase is also called as post ovulatory phase.

Length of each phase of cycle:

In a 28 days cycle, the first 14 days are follicular phase and the next 14 days are luteal phase. However if the cycle length is altered, there will be alteration in the follicular phase and the luteal phase remains constant.

CHANGES IN REPRODUCTIVE ORGANS IN MENSTRUAL CYCLE

Changes in the Follicular phase

Ovarian changes

By the 4th day of follicular phase, one follicle is selected to become a dominant follicle. The mechanism of selection of a particular follicle is not known. The dominant follicle finally develops into mature grafian follicle .The granulosa and the theca cells which are present in the follicle proliferate and produce estrogen. The volume of stromal fluid increases and the size of

the antrum increases. This mature and distended follicle ruptures around 14th day resulting in ovulation.

Uterine changes

In the early follicular phase, menstrual bleeding occur and there is sloughing of layers of the uterine endometrium. The thickness of the endometrium increases rapidly under the influence of estrogen which is secreted from the developing follicle. This increase in thickness occur from 5th to 14th day of the menstrual cycle.

The following changes occur in the uterus[30].They are,

1. Hyperplasia and hypertrophy of the endometrium which increases in size as well as thickness.

2. Endometrial glands lengthen, drawn out and lined with columnar epithelium.

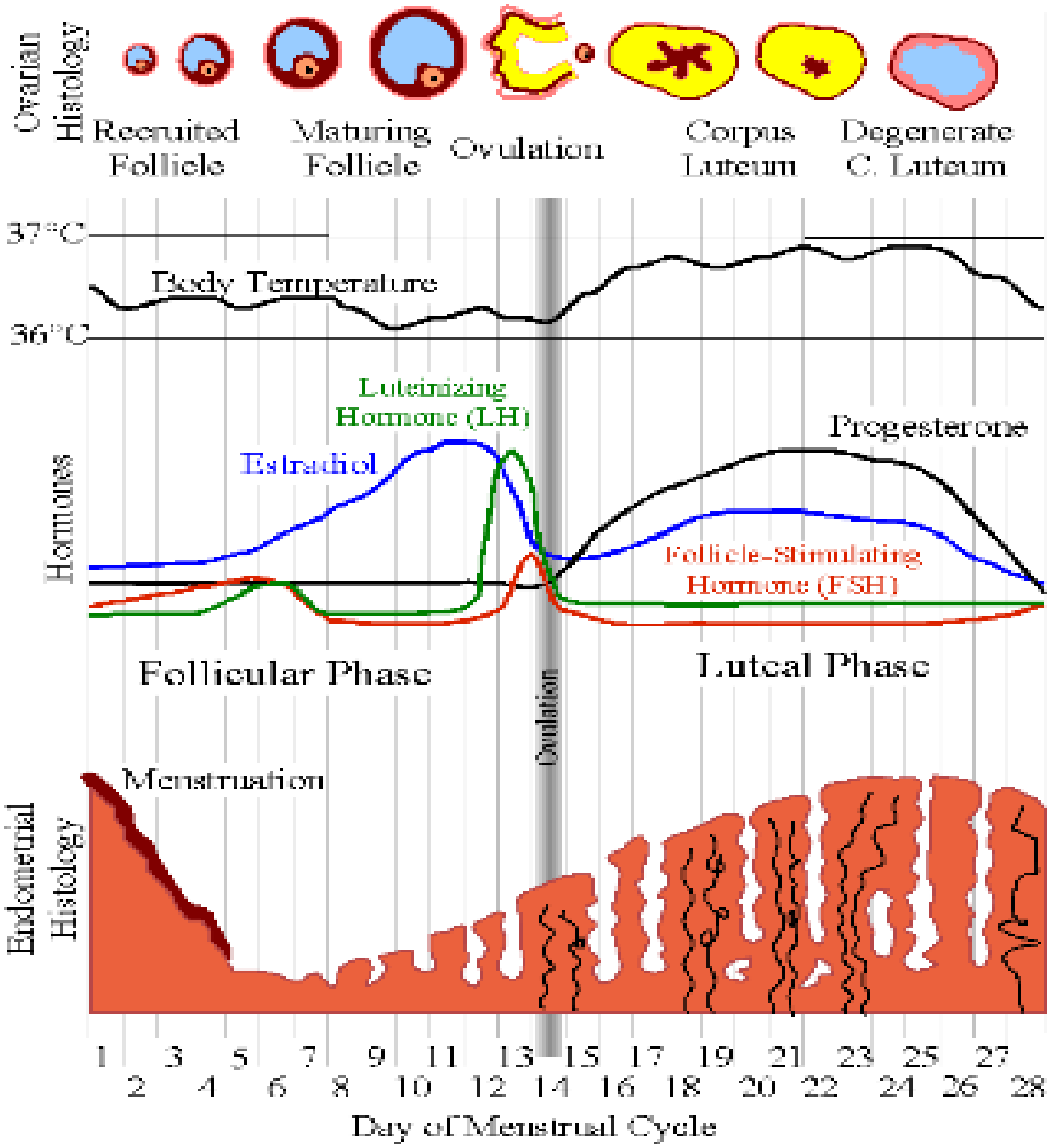
3. Blood supply increases to endometrium with formation of more number of spiral arteries. It promotes growth of uterine mucosa.

4. Endometrial veins also increase in size.

5. Estrogen produces increase in myometrial excitability[31].

UTERINE AND OVARIAN CHANGES

DURING MENSTRUAL CYCLE



(Average values. Durations and values may differ between different females or different cycles.)

Cervical changes

Volume of cervical mucous increases under the effect of estrogen. The alkalinity and elasticity of cervical mucous increases which produces spinbarkeit effect. The cervical epithelium becomes more secretory so that sperm easily passes through cervical mucous.

Vaginal changes

Vaginal epithelial cells become cornified under the influence of estrogen. The cornification index increases to maximum on 14^{th} day.

All the above said changes occur during follicular phase. Likewise, during luteal phase also some changes occur in the reproductive organs.

Changes in the luteal phase

Ovarian changes

The phase immediately following ovulation is known as luteal phase. In luteal phase, the follicle is rapidly filled with blood which is now known as corpus hemorrhagicum. The blood clot inside is replaced by proliferation of granulosa cells. The follicular cells undergo luteinization and forms granulosa and theca lutein cells. So the follicle now develops into corpus luteum. The lutein cells secrete progesterone and estrogen. Corpus luteum

persists if pregnancy occurs otherwise degeneration occurs and corpus albicans forms between 26^{th} to 28^{th} days.

Uterine changes

Progesterone secretion increases during luteal phase. Estrogen also increases mildly. Under the combined effect of estrogen and progesterone, the following uterine changes occur.

1. The glands of the uterus becomes coiled as well as tortuous.

2. The glandular cells secrete fluid and mucous which is rich in carbohydrate. Therefore this phase is called as secretory phase.

3. Further increase in the vascularity of the endometrium. Spiral arteries become tortuous.

4. The endometrium becomes edematous and thick due to increased blood supply and secretions.

5. Formation of venous anastamosis and venous lakes in the endometrium.

6. Myometrial excitability decreases due to progesterone.

7. During later part, hormonal secretion decreases due to regression of corpus luteum. There will be constriction of coiled arteries that reduces blood supply to the endometrium. Foci of necrosis appear in endometrium which coalesce

and sloughing of endometrium occurs that heralds the onset of menstrual bleeding.

Changes in cervix

The cervical mucous becomes thick and the elasticity decreases. Sperm cannot enter through this progesterone dominated thick cervical mucous.

Vaginal changes

Vaginal epithelium proliferates and mucous production becomes thick. The cornification decreases and vaginal epithelium is infiltrated with leucocytes.

The changes produced in the reproductive organs during follicular and luteal phase is repeated cyclically every month.

PHYSIOLOGY OF REPRODUCTIVE HORMONES

Hypothalamo Pituitary Ovarian Axis

It is well established that normal menstrual cycle depends upon cyclical ovarian steroid hormone secretions which in turn depends upon control by pituitary and hypothalamic hormones, and also influenced by thyroid and adrenal glands. Therefore it is essential to know the hypothalamo pituitary ovarian axis in every women and application of

this knowledge is essential in managing infertility, family planning and various reproductive disorders.

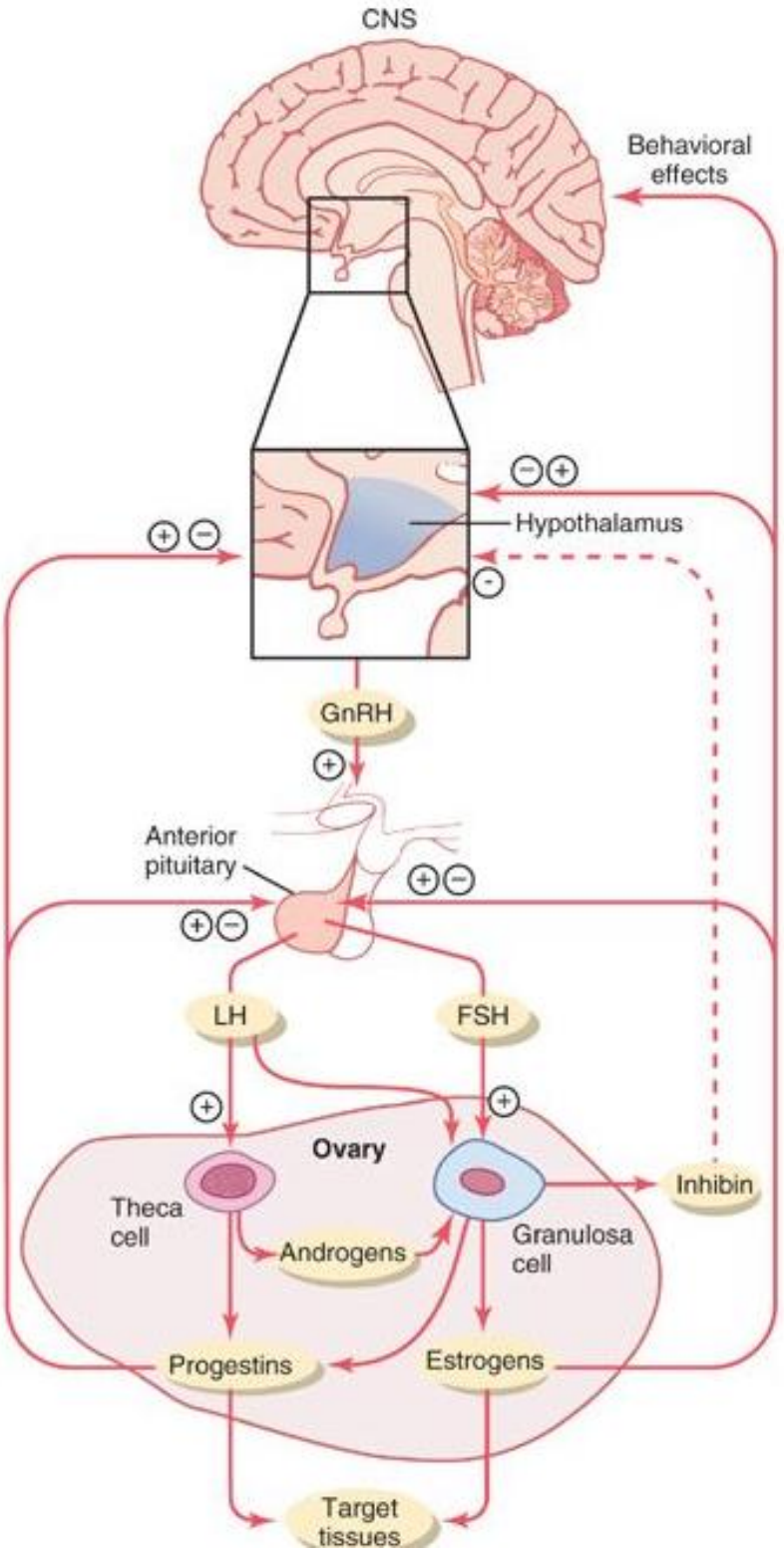
Hypothalamus

Hypothalamus is now considered as the main regulatory factor and neuro endocrine gland as a part of hypothalamo pituitary ovarian and uterine axis.It forms the floor and lateral wall of lateral ventricle. In 1971 Schally and Guillemin were the first persons who discovered a decapeptide called gonadotropin releasing hormone.

GnRH is secreted by arcuate nucleus and median eminence which regulates the neural control of FSH and LH which is secreted by anterior pituitary. Hypothalamus is connected by portal system of vessels to the anterior pituitary gland. It is directly connected to posterior pituitary gland by supraoptic and paraventricular nuclei. GnRH is released near tuber cinerium at the nerve endings. The half life is 2 to 4 minutes. It is released into portal vessels in a pulsatile fashion and reaches anterior pituitary. The pulsatality varies with different phases of menstrual cycle. The pulse is once in 60 minutes in follicular phase and is once in 3 hours in the luteal phase.

Depending on the manner of release, GnRH exhibits different actions. Continuous release of GnRH causes suppression of gonadotropins thereby ovarian functions by the procJess of downregulation of pituitary hormones.

HYPOTHALAMO-PITUITARY-OVARIAN AXIS



At the same time the pulsatile release causes cyclical release of Gonadotropins, thereby inducing ovulation and pregnancy.

Hpothalamus is influenced by higher centres, especially the temporal lobe. Emotional upsets stimulate or depress the H-P-O axis thereby disturbs the menstrual cycles[32]. The hypothalamus is in a dormant state until puberty and is under the inhibitory effect of adrenal cortex and higher centres. The sensitivity gradually increases and its hormonal function started around 8 to 11 yrs. By the age of 13 to 14 yrs the hormonal functions are fully established. GnRH secretion is continuous in males but pulsatile in females.

Synthetic analogues of GnRH are now used for shrinkage of uterine fibroids, endometriosis and for treating hirsuitism and precocious puberty. GnRH on prolonged administration cause osteoporosis, therefore the therapy should be on a short term basis. GnRH is also employed for reducing endometrial thickness prior to endometrial ablation for treating menorrhagia.

Pituitary Gland

The pituitary gland measures 30 x 6 x 9 mm in size which is located in a bony cavity at the base of the brain called sella turcica. Three types of cells are present called as i) The chromophobe or parent cell ii) Chromophil cells or alpha cells iii) Basophil cells or beta cells. Gonadotropins are

secreted by beta cells that control menstrual cycles. The Gonadotropins are FSH and LH.

FSH

FSH is a glycoprotein with high molecular weight secreted by beta cells. Mannose is the carbohydrate fraction. It controls the ripening of primordial follicles and along with luteinizing hormone, it activates estrogen secretion. FSH activity starts as menstruation ceases, reaches a peak around middle of follicular phase and then decline around 18th day. Due to fall in estrogen level, another peak occurs after ovulation, in the premenstrual phase. Half life of FSH is 4 hours. Defective folliculogenesis occurs if FSH is low and causes suppression of FSH secretion by negative feedback mechanism.

FSH was isolated initially by Gemzell from pituitary of human cadaver. Now FSH is obtained commercially from menopausal women's urine. It contains mixture of FSH and LH. Fresh FSH is also available, but is expensive.

Luteinizing Hormone

It is a water soluble glycoprotein secreted by beta cells having high molecular weight. Mannose is the carbohydrate fraction. Along with FSH, it has a role on activation of estrogen secretion and brings about maturation of ovum and causes ovulation. The completion of reduction division of ovum is

stimulated by LH. After ovulation, there is luteinization of granulosa and theca cells by LH and there is initiation of progesterone secretion. There is an LH surge which precedes ovulation by 24 to 36 hours. The minimal requirement is 75 ng/ml for ovulation.

The relationship of time interval between LH surge to ovulation is helpful to predict the time of ovulation in infertile women who have taken gonadotropin as therapy. It is helpful in the retrieval of ova in IVF and to arrange artificial insemination. In the ovarian stroma, secretion of testosterone and androstenidione is stimulated by LH. These hormones diffuse into follicular fluid and aromatised into estradiol[33].

Nowadays, a rapid ELISA Dipstick test which is called as ovustick is available to detect LH surge by doing LH estimations around the period of ovulation. It is an effective non invasive method of predicting ovulation. The half-life of LH is 30 minutes.

Human Chorionic Gonadotropin

HCG is secreted by trophoblastic tissue in pregnancy. It has luteinising action. It is made up of alpha and beta subunits. Alpha subunit resembles alpha subunit of LH, FSH and TSH. HCG appears in maternal plasma as early as 6^{th} day after fertilization. The peak value is obtained around 12^{th} week of gestation. Then the concentration of HCG decreases which remains in that

level till term. The functions of HCG are stimulation of progesterone production by corpus luteum, role in placental steroidogenesis, sexual differentiation in male fetus.

Prolactin

Prolactin is a polypeptide hormone without carbohydrate fraction. The half-life is 30 minutes. It is secreted by alpha cells. Prolactin has a suppressive effect on pituitary ovarian axis. Normal prolactin level is 25 ng/ml. Prolactin is under control by hypothalamic inhibitory factor probably which is dopamine that is released into portal system[34].

Ovarian Hormones

Ovarian hormones are the steroids derived from cholesterol. They are estrogen, progesterone, testosterone and androstenedione, inhibin and relaxin.

Estrogen

Naturally synthesized estrogen are 17 beta estradiol, estrone and estriol. They are C18 steroids. Estrogen is secreted from granulosa cells of ovaries, corpus luteum and placenta. Adrenal androgen is also converted to estrogen by the enzyme aromatase.

Synthesis of Estrogen

Biosynthesis of estrogen depends upon the enzyme aromatase which converts testosterone to estradiol and androstenidione to estrone. Later reaction also occur in fat, muscle, liver and the brain. Theca interna cells have LH receptors, they produce androstenidione from cholesterol. This androstenidione is supplied to granulosa cells. These cells make estradiol from androgens. FSH receptors are present in granulosa cells and FSH facilitates the secretion of estradiol by cyclic AMP mechanism to increase their aromatase activity. Mature granulosa cells contain LH receptors. LH also causes estradiol production. 60% of estradiol is bound to albumin, 38% to gonadal steroid binding globulin and 2% remain free in circulation.

Secretion

In plasma, two peaks of secretion occurs: one just before ovulation (36mcg/day of estradiol) and one during mid luteal phase.(380 mcg/day of estradiol). After menopause estrogen level comes down to low levels.

Actions of Estrogen on female genitalia

Estrogen facilitates growth of ovarian follicles, increases motility of fallopian tubes. They increase blood flow to uterus and they increases the amount of uterine muscle and amount of contractile proteins. The muscle becomes more exitable and in the individual fibres, action potential becomes

more frequent. The estrogen dominated uterus becomes more sensitive to oxytocin. Estrogen treatment for longer period makes the endometrium to hypertrophy and when the therapy is discontinued it causes withdrawal bleeding.

Effects on endocrine organs

Estrogens cause decrease in FSH secretion, It inhibits LH secretions under some circumstances and in some other circumstances they produce a positive feedback and increase LH secretion. Secretion of angiotensinogen and thyroid binding globulin increases under the effect of estrogen.

Effect on CNS

Estrogen increase libido in humans. They are responsible for estrous behaviour in females. Estrogen also acts on other areas of brain, effect the neuronal discharge and thus effect the brain functioning.

Effect on breast

Ductal growth in the breast is due to estrogens and estrogen is mainly responsible for breast engorgement at puberty in girls. Estrogen is otherwise called as growth hormone of the breast. Estrogen is the cause for areolar pigmentation which becomes more intense during first pregnancy than at puberty.

Effects on Female secondary sexual characters

The changes in the body that develop at puberty in girls are in part due to estrogens, which are called as **"feminizing hormones".** The female body configuration with narrow shoulders and broad hips, converging thighs and diverging arms are all due to estrogen.

Other actions of Estrogen

Estrogens cause salt and water retention. Women gain weight just before menstruation. Aldosterone secretion is elevated in luteal phase, which may also contribute to premenstrual fluid retention. Estrogens make sebaceous gland secretions more fluid and thus inhibits the formation of acne and comedones. Estrogens have a plasma cholesterol lowering action and produce vasodilatation by increasing local production of nitric oxide.

Mechanism of action of Estrogen

There are two types of estrogen receptors ER alpha, and ER beta. After binding to estrogen, they bind to DNA and alters its transcription. ER alpha is found mainly in the uterus, heart, kidneys and liver. ER beta is found in the ovaries, prostate, GIT, lungs, hemopoietic system and CNS. Most of the effects of estrogens are due to its actions on nucleus and some actions are mediated via production of mRNAs. The effects on neuronal discharge in

brain and effect on gonadotropin secretion are mediated by cell membrane receptors.

Progesterone

It is a C21 steroid which is secreted by corpus luteum, placenta and the follicle. It is an intermediate in steroid biosynthesis. 2% of circulating progesterone is free. In the bound form 80% is bound to albumin and 18% is bound to corticosteroid binding globulin. Progesterone is converted to pregnanediol in the liver, which is conjucated to glucuronic acid and excreted in the urine.

Secretion of Progesterone

In women plasma progesterone level is 0.9ng/ml during follicular phase of menstrual cycle and in men it is approximately 0.3ng/ml. Theca cells provide pregnenolone to granulosa cells where it is converted to progesterone. Progesterone secretion begins to increase late in the follicular phase. During luteal phase, plasma progesterone reaches a peak value of 18 ng/ml. LH has a stimulating effect on progesterone secretion due to activation of adenylyl cyclase.

Actions of Progesterone

Progesterone acts mainly on uterus, and brain. It has anti estrogenic activity on myometrial cells, their exitability is decreased, sensitivity to

oxytocin and spontaneous electrical activity decreases, at the same time the membrane potential increases. It decreases the number of endometrial receptors in the endometrium and increases the conversion of 17 beta estradiol to less active estrogens.

Progesterone stimulates the development of lobules and alveoli in the breast. It supports secretory function of the breast at the time of lactation. The feedback effects are exerted at hypothalamic as well as pituitary levels. LH secretion is inhibited by large doses of progesterone and the inhibitory effect of estrogen is also potentiated thereby preventing ovulation.

Progesterone is responsible for increase in basal body temperature during ovulation[35]. It stimulates respiration and in luteal phase the alveolar PCO2 is lower in women than in men. Progesterone in large doses produces natriuresis by blocking the action of aldosterone. Progesterone decreases the serum HDL level thereby acting as proatherogenic agent.

Mechanism of action of Progesterone

Progesterone acts by its action on DNA and by initiation of new mRNA synthesis. Without progesterone binding, the progesterone receptor is bound to a heat shock protein and the binding of progesterone releases the heat shock protein, so DNA binding domain of the receptor is exposed. There

are two isoforms of progesterone receptor, PRa and PRb. Progestational agents are substances that mimic the actions of progesterone.

Relaxin

Relaxin is a polypeptide hormone produced in the corpus luteum, placenta, uterus, mammary gland of women and prostate gland of men. It causes relaxation of pubic symphysis and pelvic joints and softening and dilatation of uterine cervix. Main function of relaxin is facilitation of delivery process. In men relaxin is found in semen, which helps to maintain sperm motility and helps in penetration of sperm into ovum[36].

Inhibin

It is secreted from granulosa cells of ovary. It inhibits FSH secretion from anterior pituitary.

Activin

It activates FSH secretion from the pituitary.

Androgens

Androgens like testosterone and androstenidione are secreted from adrenal glands and ovaries of women. They play some role in female reproductive system. They stimulate pubic and axillary hair growth and also promote skeletal muscle growth. They help to maintain sexual desire also.

Control of Ovarian Functions

The ovarian functions are controlled by hormones of hypothalamus, anterior pituitary and ovaries. They are GnRH, FSH and LH, and gonadal steroids. The major factors controlling ovarian function is the pulsatile release of GnRH from hypothalamus. The frequency and amplitude of GnRH pulses during 24 hr period is different during the course of menstrual cycle. The responsiveness of the pituitary to GnRH and ovaries to gonadotropins also varies in different phases of menstrual cycle.

Hypothalamic control

Hypothalamus plays a key role in regulating ovarian functions. This regulation is exerted by GnRH secreted into portal hypophyseal vessels. This determines the circhoral seretions of LH secretions. If GnRH is administered constantly, then the GnRH receptors in the anterior pituitary downregulate and LH secretion comes down to zero. The episodic burst of GnRH is a general phenomenon and the fluctuation in the frequency and amplitude of these bursts are important for the other hormonal changes responsible for the menstrual cycles. Frequency is increased by estrogen and it is decreased by progesterone and testosterone. In the late follicular phase, the frequency increases ending in the LH surge.

The frequency decreases during secretory phase due to the action of progesterone but at the end of the menstrual cycle, the frequency once again increases due to decline in level of estrogen and progesterone. During mid cycle LH surge, the sensitivity of gonadotropins to GnRH is very much increased. This self-limiting effect of GnRH is important for maximum LH response. Norepinephrine and epinephrine increases GnRH pulse frequencies and opioids such as enkephalins and beta endorphin reduces the GnRH pulse frequencies.

Pituitary control

Anterior pituitary secretes FSH and LH. The main target organs are ovaries. They control ovarian function in all the phases of menstrual cycles. The pattern of gonadotropin secretion is that the FSH level slowly increases in the early follicular phase, then declines steadily in the remaining follicular phase and then rapidly increases towards the end of the follicular phase and attains a mid cycle peak. The LH level is lower in most part of the cycle except around ovulation. It starts increasing rapidly about 24 hrs before ovulation reaches a large mid cycle peak which is called as LH surge followed by rapid decline in the luteal phase[37].

Regulation by FSH

Between puberty and menopause a number of primary and early antral follicles are present. Further development of follicles require the stimulation by FSH. Before puberty, the FSH concentration in the plasma is low. After puberty, in first half of menstrual cycle, the FSH secretion increases which stimulates follicular growth. FSH causes proliferation of granulosa cells which produces estrogen. FSH stimulates antral follicular enlargement. FSH primes granulosa and theca cells to effect of LH.

Regulation by LH

LH cause luteinization of theca and granulosa cells and they are converted to lutein cells after ovulation.

Ovarian control

Ovary controls its own function by secreting hormones which has direct influence on granulosa cell function or indirectly influence hypothalamo pituitary ovarian axis by a negative feedback mechanism.

Pattern of secretion of ovarian hormones

Estrogen : Remains low in first week, increases slowly initially then rapidly in the second week with the growth of ovarian follicles which secretes more

estrogen. Estrogen peak occurs 48 hrs before ovulation, and then declines in next 2 days. The second peak occurs in luteal phase.

Progesterone: During proliferative phase, progesterone level is low. Soon after ovulation, its concentration increases rapidly because of large release from corpus luteum.

Methods of Regulation by Ovary

Direct: Theca cells secrete androgen which facilitates secretion of estrogen.

Feedback Regulation: Dominant follicle secretes estrogen which inhibits gonadotropins from anterior pituitary and GnRH from hypothalamus. However if the estrogen concentration is very high, gonadotropin seretion increases, which is called as positive feedback effect. Large doses of progesterone inhibits LH and potentiates the inhibitory effect of estrogen. Inhibin concentration increases in the luteal phase which contributes to suppression of FSH secretion. Therefore in luteal phase, plasma gonadotropins are low.

DISORDERS OF MENSTRUATION

Menstruation is the final point of series of events that involves cerebral cortex and hypothalamus and ends in the uterus through hypothalamo pituitary ovarian uterine axis. Any break in the axis produces menstrual problems.

The most common complaints are excessive or inappropriately timed menstruation and amenorrhoea for which women seek medical advice.

Normal menstruation requires the integration of the hypothalamic pituitary ovarian axis with a normal functioning uterus, a normal and patent lower genital outflow tract and a normal genetic karyotype of 46XX. In healthy normal women, menarche occurs between 10 to 16 yrs, mean age is around 12.5 yrs[38]. Throughout reproductive life cyclical bleeding persists with an average rhythm of 28 ± 7 days including 4-6 days bleeding.

Definition of menstrual cycle irregularities[39]

In terms of nature of cyclic disturbances the irregularities are classified into

1.Amenorrhoea

It is absence of menstruation. It is only a symptom but not a disease entity.

2.Oligomenorrhoea

It is infrequent, irregularly timed bleeding usually periods occurring at an interval of more than 35 days.

3. Polymenorrhoea

It is defined as frequent occurrence of bleeding usually occurring at an interval of 21 days or less.

4.Menorrhagia

It means regular bleeding but that are excessive in quantity (>80 ml) or increased duration of flow.(>5 days).

5.Metrorrhagia

It means irregularly timed episodes of bleeding superimposed on normal cyclical bleeding.

6.Menometrorrhagia

It means excessive, prolonged bleeding that occurs at irregularly timed and frequent intervals.

7.Hypomenorrhoea

It means scanty but regularly timed bleeding.

8. Intermenstrual spotting

It is bleeding occurring between otherwise normal cycles.

9. Precocious menstruation

Occurrence of menstruation before 10 yrs of age.

10. Post coital bleeding

Vaginal bleeding occurring after sexual intercourse.

Causes of Adolescent Menstrual Irregularities

Eventhough it may be a normal physiological variation due to immature hypothalamo pituitary ovarian axis that produces various menstrual irregularities in the early adolescent period, there may be so many other causes for these irregularities in late adolescence because during this period the axis would have attained full maturity.

The various causes for menstrual irregularities are

1.Endocrine causes

Poorly controlled diabetes mellitus, Polycystic ovary syndrome, Thyroid disorders, Cushing syndrome, Premature ovarian failure and Late onset congenital adrenal hyperplasia are the endocrine causes for irregular menstruation.

2. Acquired conditions

Stress related hypothalamic dysfunction, Medications (Antiepileptics or antipsychotics), Exercise induced amenorrhoea and Eating disorders (Both anorexia and bulimia) are some of the acquired causes.

3. Tumours

Ovarian,Adrenal tumours and prolactinomas are some of the tumours producing irregularities in periods.

4. Anaemia and other nutritional as well as environmental factors.

Classification of Menstrual Disorders

According to cycle variation, they are classified into amenorrhoea, oligomenorrhoea and polymenorrhoea. According to amount of blood loss, they are classified into hypomenorrhoea and menorrhagia.

Amenorrhoea

Amenorrhoea means absence of menstruation. It may be physiological or pathological. According to cause, it may be primary or secondary.

Physiological Amenorrhoea:

Physiological amenorrhoea occur before puberty, During pregnancy, lactation and after menopause.

Pathological Amenorrhoea:

It may be due to genetic causes, systemic diseases, disturbances in hypothalamo pituitary ovarian uterine axis, endocrinopathies, nutritional factors, drug intake, psychological causes, gynatresia and other causes.

Primary Amenorrhoea:

It refers to failure of onset of menstruation beyond 16 yrs of age, regardless of development of secondary sexual characteristics[40]. In the

presence of well developed secondary sexual characteristics, one can wait until 16 yrs for investigations with the hope that in due course of time, spontaneous menstruation will ensue.

In majority of cases, a detailed and careful history including evaluation of growth charts, height and weight record, body habitus, chronology of development of secondary sexual characteristics, history of cyclical abdominal pain, H/O drug intake, past history of medical illnesses such as thyroid diseases, tuberculosis, juvenile diabetes, and H/O any previous surgery may be useful and important in revealing the possible cause.

Physical examination includes measurement of height-weight ratio, stature, observation for genetic or endocrine stigmata, Tanner evaluation for development of secondary sexual characteristics. Presence of uterus and vagina should be established by ultrasonography of pelvis.

Estimation of hormones like serum FSH, estradiol, and prolactin are the must for primary amenorrhoea cases. Radiological evaluation of bone age and a skull film is useful to rule out pituitary macro adenoma. Genetic karyotyping should be done in subjects with FSH levels more than 40 mIU/ml. When indicated some selective investigations like Thyroid profile, androgen estimation and renal function tests should be done.

Classification of Primary Amenorrhoea

Primary amenorrhoea is classified into Hypergonadotropic, Eugonadotropic and Hypogonadotropic primary amenorrhoea.

1. Hypergonadotropic primary amenorrhoea

FSH value is > 40 mIU/ml. Causes are

a) Sex chromosomal abnormalities – Turner's Syndrome

b) Normal sex chromosomes _ 46XX pure gonadal dysgenesis, Testicular feminizing syndrome, Savage syndrome or Gonadotropin resistant ovarian syndrome

2. Eugonadotropic Primary Amenorrhoea

a) Absent mullerian development - Testicular feminization syndrome, Mullerian agenesis called as Rokitansky-Kuster -Hauser syndrome

b) Normal mullerian development - True intersex, Polycystic ovary syndrome, Adrenal diseases and Thyroid diseases[41].

c) Cryptomenorrhoea – Imperforate hymen, vaginal septem.

3. Hypogonadotropic primary amenorrhoea

A. Hypothalamic causes - Delayed menarche, Kallman's syndrome, Stress, weight loss, malnutrition, psychogenic causes.

B. Pituitary causes - Underdevelopment of pituitary, Craniopharyngeoma, prolactinoma, adenoma, Chiari-Frommel syndrome, simmond's disease.

C. Systemic diseases like tuberculosis.

D. Endocrinal Disorders - Thyroid or adrenal gland disorders

Secondary amenorrhoea

It is defined as amenorrhoea of 6 months or more in women with previous normal periods in the absence of pregnancy and lactation.

Aetiology

For majority of cases, dysfunction of the hypothalamo-pituitary-ovarian-uterine axis is the cause.

Classification of Secondary Amenorrhoea

1.Physiological - Pregnancy, Lactation

2.Pathological

1) Genital tract causes - a) cervical steosis, atresia, cervical amputation in Fothergill's operation.

b) Asherman's syndrome following excessive curettage, endometrial tuberculosis

c) Vesico vaginal fistula

2) Ovarian causes - Polycystic ovarian syndrome, Surgical extirpation, Infection - Mumps and tuberculosis, Virilizing ovarian tumours, Resistant ovarian syndrome.

3) Nutritional causes - Anorexia nervosa, bulimia, Extreme obesity, Excess weight loss in athletes.

4) Pituitary causes - Sheehan's syndrome, Simmond's disease, Pituitary tumours, Cushing's disease, Drugs like oral pills, tranquilizers, dopamine blockers and antihypertensives.

5) Hypothalamus - Vigorous exercise[42], GnRH deficiency, Brain tumours.

6) Supra renal causes - Adrenogenital syndrome, Suprarenal tumours, Addison's disease.

7) Thyroid Causes - Hypothyroidism, Grave's disease.

8) Other causes – Diabetes, Tuberculosis, Renal diseases, Severe anaemia, Malnutrition.

Oligomenorrhoea

In some women the menstrual cycle length exceeds 35 days. Many women are obese, hirsute, and have ovarian subfunctions. Genital tuberculosis and polycystic ovarian disease also produces oligomenorrhoea.

Hypomenorrhoea

In some women, menstruation lasts 1 to 2 days only and blood loss is very scanty. Since cycles are regular it indicates normal HPO axis relationship. The uterine end organ may be at fault.

Polymenorrhoea

It is shortened cycles. The complaint is more frequent in adolescent girls and in perimenopausal women[43]. The follicular phase is accelerated. Ovaries appear hyperaemic and contain haemorrhagic follicles. The endometrial lining is thickened. The cause seems to be the result of disturbed endocrine axis. It is frequently seen after a delivery when women resume their menstrual activity. Excessive stimulation by the gonadotropins cause frequent ovulation and menstruation. PID, endometriosis and fibroid may also be the cause. When no definite cause is found, cyclical hormone therapy may restore the normal menstrual pattern. The amount of bleeding is assessed by PBAC score i.e. by counting the no. of pads soaked and giving a score according to whether the pad is minimally, moderately or fully soaked.

Menorrhagia

Menorrhagia is a Greek word, **"men"** means **menses** and **"rrhagia"** means **burst forth**. Menorrhagia is cyclic regular bleeding which is excessive in amount or duration. It is generally caused by any conditions which affect

the uterus or its vascularity rather than any disturbance of function of the hypothalamic- pituitary-ovarian axis. Whenever there is enlargement of the endometrial surface, the bleeding surface is also increased and there will be excess bleeding. Such conditions occur in uterine fibroids, adenomyosis, and endometrial hyperplasia.

Menorrhagia is also seen in pelvic inflammatory disease and pelvic endometriosis. There is often retroverted uterus with restricted mobility. Presence of IUCD may lead to heavy and prolonged bleeding. Menorrhagia may also be due to bleeding disorder like Von Willibrand's disease.

A normal blood loss is 50 to 80 ml and does not exceed 100 ml. Menorrhagia is essentially a symptom and not in itself a disease. It affects 20 to 30 % of the women with significant adverse effects on quality of life in terms of anaemia and interfere with day to day activities.

Causes of menorrhagia can be divided into

1) Those due to general diseases, 2) Those which are local in the pelvis, 3) Those caused by endocrine disorders, 4) Contraceptives , 5) Iatrogenic.

General diseases causing menorrhagia are Blood dyscrasias, i.e. leukemia, thrombocytopenic purpura, severe anaemia, coagulation disorders in 20 % of adolescents.

Endocrinal causes - hypothyroidism and hyperthyroidism.

Local pelvic causes are

1. Uterine causes: Uterine fibroids, endometrial hyperplasia, fibroid polyp and adenomyosis.

2. Chocolate cyst of the ovary, ovarian tumours, polycystic ovarian disease, endometriosis.

3. Pelvic inflammatory disease, genital tuberculosis.

4. Immediate puerperal and post abortal periods.

Iatrogenic causes

Include administration of hormonal pills. IUCD is another etiological factor, 5 to 10 % women suffer from menorrhagia in the first few months of IUCD administration.

Management of menorrhagia includes

- General measures to improve the health status of the individual, adequate rest during periods, haematinics, protein and vitamin supplements.
- Treating the cause of menorrhagia.

Dysmenorrhoea

Dysmenorrhoea means cramping pain accompanying menstruation.

There are 2 types of dysmenorrhoea. They are

1. Primary dysmenorrhoea

   It is not associated with any identifiable cause. It affects mostly girls in the age group of 18 to 25 years.

2. Secondary dysmenorrhoea

It is associated with organic pelvic pathology. For example adenomyosis, fibroids, PID, endometriosis.

Clinical varieties

1. Spasmodic dysmenorrhoea - It is most prevalent and manifests as cramping abdominal pain on first and second day of menstruation.

2. Congestive dysmenorrhoea - The pelvic discomfort is present a few days before menses begins. Once menses begins there is relief of symptoms.

3.Membranous dysmenorrhoea - Endometrium is shed as a cast during menstruation.

Clinical Features:

70% of teenagers and 30-50% of menstruating women suffer from dysmenorrhoea. The severe type which interferes with one's daily activities affects about 5 to 15 % of the population. The symptoms are due to high prostaglandins in the menstrual fluid. This produces cramps, nausea,

vomiting, diarrhoea, syncope and fainting. It is responsible for absenteeism resulting in loss of work hours thereby producing more economic loss[44].

Treatment

Treatment includes counselling, modification of behavioural attitude, medical and surgical interventions if needed.

Premenstrual Syndrome

Premenstrual syndrome also called as premenstrual tension is a symptom complex primarily due to cyclical changes associated with ovulatory cycles. It occur about one week prior to menstruation and resolves spontaneously after menstruation. Most frequently it occur in middle aged women. The symptoms are responsible for socioeconomic loss of the woman[45].

Causes of Premenstrual Syndrome

The exact etiology is not known but it represents a syndrome which is the result of multiple abnormalities like

1) Estrogen excess or progesterone deficiency in the luteal phase.
2) Increased carbohydrate intolerance in the luteal phase.
3) Pyridoxine deficiency
4) Increased production of vasopressin, prolactin, aldosterone,

prostaglandins affecting renal functions contributing to fluid retention and bloating.

5) Fluctuations in opiate peptide affecting endorphin level.

At present it is not clear whether PMS is due to hormonal abnormalities or due to abnormal response to normal hormonal fluctuations. Symptoms include breast tenderness, headache, abdominal bloating, sleeplessness, emotional lability, fatigue, depression, irritability, weight gain starting 7 days prior to menstruation. Diagnosis depends on careful history taking. Sometimes it may be very distressing to the women if not treated.

Treatment of PMS

Counselling for psychological symptoms, vitamins $B_{1,}$ $B_{6,}$ and vitamin E may help. Drugs will help for severe symptoms.

STRESS AS A CAUSE FOR MENSTRUAL DISORDERS

Eventhough so many causative factors are involved in producing menstrual irregularities, one among the factor, i.e. stress which needs more attention because academic stress is more prevalent among college as well as school girls nowadays because of modern lifestyle changes and this factor is the one which can be corrected without medications by producing a change in lifestyle pattern[46].

Many people experience stress as they combine busy lives and the demands of study or work while trying to save time for friends and family. For some people, stress becomes almost a way of life. We all experience episodic stress when we prepare for major exams, completing an important paper, getting ready for an important interview. However a continuous state of stress should not become a way of life. We know that stress, over a prolonged period of time increase certain health risks and affect the general well being of people. So we have to give much importance to stress when health is concerned.

What is stress?

Stress is nothing but body's non-specific response to any demand made on it. As the body responds to various forms of physical or psychological stress, certain predictable changes occur. These include increased heart rate, increased blood pressure and secretion of certain hormones. These responses to stress will occur whether the stress is positive or negative in nature.

The results of continuous stress may cause disruption in physical, emotional, spiritual or social aspects of health.

Common stressors in college life include

- Greater academic demands.
- Being on one's own in a new environment with new responsibilities.
- Change in family relations and one's social life.
- Financial responsibilities.
- Exposure to new people, ideas and temptation.
- Being away from home, often for the first time.
- Making decisions on a higher level than one is used to.
- Preparing for life after graduation.

For many young adults, college is the best time of life. But at the same time, these critical years of adjustments can also be undermined by anxiety, depression, substance abuse and eating disorders. Researches found that many mental illnesses are traced to trauma, whose damage surfaces in times of stress and change especially the college years[47].

According to a recent survey of college students, more than 30 % of all college women report feeling overwhelmed, a great deal of the time. Depression affect over 19 million adults in the U.S annually. In a recent

national college health survey, 10 % of college students had been diagnosed with depression.

Anxiety disorders affect millions of adults every year, and anxiety levels among college students have been rising since 1950's. Women are 5 times more likely to have anxiety disorders compared to men.

Individuals who are stressed are more likely to have accidents. According to the centre for Disease Control and prevention (CDC), 7.8% of men and 12.3% of women between ages 18-24 report frequent mental distress - a key indicator for depression and other mental disorders. Stress affects almost all systems in the body.

How stress affects menstruation?

While many factors influence irregular periods, a stress induced hormonal imbalance is one of the common cause. Stress is an unavoidable consequence of life. The hypothalamic- pituitary- adrenal axis when activated by stress exerts an inhibitory effect on female reproductive system[48]. CRH inhibits GnRH secretion and glucocorticoid inhibits pituitary hormone, ovarian estrogen and progesterone secretion. These effects are responsible for hypothalamic amenorrhoea of stress, which is observed in anxiety and depression, malnutrition and chronic excessive exercise.

In addition, CRH and its receptors are identified in most reproductive tissues including ovary, uterus and placenta. Also CRH is secreted in peripheral inflammatory sites where it exerts inflammatory actions. Reproductive CRH is regulating reproductive functions with an inflammatory component such as ovulation, luteolysis, decidualization, implantation and early maternal tolerance. Placental CRH participates in the physiology of pregnancy and the onset of labour. When a women is under high stress, the adrenal glands produce more of the hormone cortisol in response. This excess cortisol has an influence on the amount of estrogen and progesterone that are produced which in turn has a negative impact on menstrual cycle. In most instances this leads to irregular periods.

This menstrual irregularity can manifest in so many ways like longer or shorter cycles than normal, heavier or lighter periods, painful menstruation and spotting in between cycles.

For many women experiencing stress induced menstrual irregularities, the better option is making lifestyle changes to reduce and eliminate stress. This will often balance hormones like cortisol once again, normalize irregular periods and lead to overall better health.

Studies in some western population done by Cakir et al[49] showed that this menstrual irregularity was reported in 43 to 62% of girls during first year of post menarcheal year and in some girls it persisted for 3 to 5 years. Then

only the hypothalamo pituitary ovarian axis become stabilized. If persistent, this irregularity then becomes a major gynaecological problem during adolescence as well as in adult life. Definitely it has an adverse impact on day to day activities such as avoidance of outdoor activities or exercise and increase in absenteeism from school or college.

The spectrum of irregularity ranges from disorder of cycle length to disorder of menstrual flow. They include amenorrhoea otherwise known as absent menstruation, excessive or prolonged flow called as menorrhagia. Infrequent or delayed flow called as oligomenorrhoea, Frequent flow called as polymenorrhoea, painful menstruation known as dysmenorrhoea as well as premenstrual syndrome.

Apart from physiological variations, there are so many factors which have been known to be the cause for menstrual irregularities. These include environmental, nutritional, physical activities and stress especially physical, emotional as well as mental stress.

The effect of chronic stress on women's menstrual characteristics have been confirmed by cross sectional and prospective studies by Christiani et al. Similar associations are observed for cardiovascular, musculoskeletal disorders, mental illness and both prevalence as well as severity of menstrual irregularities by Kivimak et al[50].

Perceived stress in the school/college involves multiple factors such as academic demands, health related, financial and self imposed type of stressors. Students report academic stress, with the greatest source being found in studying for examinations and grade competition and large amount of content in mass in small period of time. All these factors put the female students under increasing tension.

These stress factors are associated with negative health outcomes to the students which include depression and physical illness such as head ache, loss of appetite, loss of energy, sleep problems.

Non Pharmacological Adjuncts for Stress Reduction

The present day physical and mental challenges have altered the life style pattern and increases stress altering people's health which is actually a complete hormony of body and mind. Almost every one experiences stress in their life time. In a stress survey done at U.S. in 2011 by American Psychological Association, it was found that the major causes listed for stress were work load, money and economy. Stress related unhealthy habits were also reported.

What they need is non pharmacological strategies like changing their lifestyle and doing some stress relaxation exercises or techniques all of which can produce reduction in their stress levels at the same time producing

beneficial effects on all the systems which are affected by increased physical as well as mental stress. Many strategies have been shown to help reduce stress such as physical exercise, Practising meditation and yogasanas, Breathing exercise and engaging in a cognitive behavioural therapy program[51].

1. Exercise

Physical inactivity produces sluggishness in the body as well as in the mind. Brisk walking for half an hour improves circulation to all vital organs, improving oxygenation of organs at the same time giving freshness to the mind also. It has an additive effect to obese persons in reducing excess weight and avoiding unwanted deposition of hormones in the subcutaneous fat. Regular physical exercise improves functioning of reproductive system also. Exercise acts as an effective distraction from the stressful events. Exercise blunt the harmful effects of stress on blood pressure and the heart because exercise protects the heart.

Exercise should be started slowly. For people who are not used to it, strenuous exercise might be dangerous. It is better to select exercises that are exciting, challenging and satisfying. Some of the suggested exercises are,

- Aerobic exercise
- Brisk walking

- Swimming
- Yoga or Tai chi

2.Healthy Diet:

Eating high calorie food produces obesity as well as some other related health problems. This health related problems are some of the leading causes for stress also. A study published in the journal of paediatrics that looked at the effect of food with high glycemic index like sugars and refined carbohydrates on hormonal levels. The result was food with high glycemic index produced spike in blood sugar level which then crashed. Along with that, there was rising level of stress hormone adrenaline. So eating healthy diet has a positive role on stress relieving. Healthy diet means avoiding fat and oily foods rich in calories, adding plenty of vegetables and fruits in diet, taking about 8 glasses of water a day. Healthy diet improves physical health and also mental health. There is a positive correlation between healthy diet and regular menstrual cycle.

3. Deep breathing exercises

Oxygen is vital for the cellular activity. Entry of air into and out of lungs is important for proper oxygenation of organs. By practising the slow, deep breathing there is increased movement of diaphragm and so the oxygen uptake increases. Deep breathing reduces dead space ventilation. This

increased uptake of oxygen improves vascularity of the tissues and prevents diseases in which oxygen deficiency plays a major role.

Deep breathing renews the air even in the deeper part of the lungs in contrast to superficial breathing which renews only the initial parts. Deep breathing also soothes the nerves and produces a state of peace and calmness. The deep breathing exercises causes a change in the autonomic nervous system towards parasympathetic dominance through stretch induced inhibitory signals and hyperpolarization currents. Practising deep breathing exercises definitely has positive impact on hormonal axis regulation by inhibiting the negative role played by stress upon these axis[52].

Procedure of Deep Breathing Exercise

- Slow and Deep inhalation through the nose to the count of ten.
- Make sure the abdomen expands during inhalation.
- Slow exhalation through the nose completely. This procedure is also for a count of ten.
- To help quiet the mind, concentration should be made fully on breathing and counting through each cycle.
- The procedure should be done for 5-10 minutes, and make a habit of doing the exercise several times a day even when not feeling stressed.

4. Shavasana

The aim of asanas is to create free flow of life energy in and out of the body for the the perfect functioning of the body. Yogic techniques in general and particularly shavasana promote psychosomatic health and enhance the ability of the body to combat stressful situations. The Sanskrit word "shava" means dead body and "asana" means posture. So shavasana is otherwise called as corpus pose or posture .This posture produces complete relaxation of the body, decreases anxiety, prevents exhaustion, calm the heart and nervous system and circulation becomes regular. This yoga posture eliminates toxins from the blood and helps to correct the disorder of menstrual cycle[53]. It is simplest to do also. The muscles are relaxed voluntarily and completely. It also relaxes the mind by conscious breathing and autosuggestion. It is an useful asana for stress reduction[54].

Procedure of Shavasana: (Final relaxation or resting pose)

- Initially, the person should lie down at the back.
- The feet should fall out to either side.
- The arm should be brought alongside the body, but slightly separated from the body, and the palms should be turned to face upward.
- The whole body should be relaxed including the face also. Let the body feel heavy.

- The breath should occur naturally.
- To come out, first begin to deepen the breath. Then the fingers and toes should be moved awakening the body.
- The knees should be brought into the chest and the body rolled over to one side, keeping the eyes closed.
- Slowly the body is brought up into a sitting position.

Studies related to adolescent menstrual irregularities

A case control study conducted by **Sule Gokyildiz et al**[55] on adolescent girls with menorrhagia showed that 12% of adolescent girls suffered from menorrhagia which produced negative effects in their quality of life by producing iron deficiency anaemia in them which affected their health.

Amanda Daley et al[56] in their study of impact of physical exercise in adolescent girls with irregular periods concluded that moderate exercise proved improvement in correcting primary dysmenorrhoea and premenstrual tension.

A pilot study done by **Alphonsus et al** [57]about the relationship of thyroid disorders in girls with menstrual problems found out that hyperthyroidism was the most common accompaniment than hypothyroidism.

Wang et al[58]studied the relationship between stress and dysmenorrhoea among adolescent girls and documented that there was a positive association between stress and the incidence of dysmenorrhoea. They also proved that stress reduction measures produced improvement in their symptoms.

A clinico biochemical study done by **Goyal et** al[59] showed a significant correlation between stress and serum cortisol and in girls with menstrual irregularities the stress level assessment by serum cortisol gave a positive association.

Giovanni et al[60] studied the prevalence rate of dysmenorrhoea and found out that 43% of young women were suffering from the problem of dysmenorrhoea.

Ameera Takreem et al[61] studied about polymenorrhoea, and concluded the the incidence was much less in young girls and in perimenopausal women 15% of polymenorrhoea was associated with endometrial hyperplasia.

Anupriya et al [62]studied the impact of BMI with menstrual irregularities in young girls. In their studies they found that adolescents with high BMI are associated with oligomenorrhoea and girls with low BMI are

associated with polymenorrhoea. They also insisted about correction of both overweight as well as underweight in the treatment of menstrual problems.

Dimitrios et al[63] studied about PCOS in adolescent girls and concluded that in PCOS, there is more association of amenorrhoea and insulin resistance among young girls.

Esimai et al[64] studied the mean age of menarche as well as about the awareness of menstrual irregularities in college and they found out the mean age of menarche was 14.18 years and they also revealed that their was a lack of awareness among college students about their menstrual irregularities.

Ulka Natu et al[65] studied the effect of yogic practises on menstrual disorders in adolescents and proved significant improvement in dysmenorrhoea as well as other menstrual irregularities.

Rupa Vani et al [66]studied the impact of dietary pattern and exercise on menstrual irregularities in adolescents and found out menstrual irregularities are more prevalent in girls taking high calorie diets and those with physical inactivity. They also revealed lifestyle modifications like regular physical activity, decrease in intake of junk food and healthy eating habits improved their menstrual irregularities.

A study by **Shika Joshi et al**[67] about the causes of menorrhagia in adolescents documented that 78% of puberty menorrhagia were due to

immaturity of H-P-O axis. There was 14% association with PCOD and 8% association with hypothyroidism.

Saira Darsi et al[68] in their studies on BMI and menstrual irregularities in adolescents showed an association between overweight and infrequent periods. The study also showed that majority of the girls had nutritional deficiency.

Studies on Reproductive health of adolescent girls by **Kajal Jain et al**[69] found out the mean age of menarche was 13.16 years and they also found out a significant relationship between poor hygiene and menstrual abnormalities.

Susan et al[70] in their studies on dietary pattern and menstrual cycle disturbances showed increased incidence of menstrual disturbances in non vegetarians .They revealed a correlation between high calorie diet and menstrual irregularities.

A rural school based survey conducted by **wang et al**[71] determined the prevalence of dysmenorrhoea among school girls as 76%. They concluded health education for school girls for effective management of dysmenorrhoea.

Rajangam et al[72] done cytogenic studies among cases of primary amenorrhoea and found out that the frequency of chromosomal anamolies

was 23.35%. So they emphasized the need for karyotyping in primary amenorrhoea.

Kalantaridou et al[73] studied the impact of stress on female reproductive system and showed the inhibitory effect of stress on H-P-O axis producing menstrual irregularities in adolescent girls.

MATERIALS

&

METHODS

MATERIALS AND METHODS

STUDY DESIGN:

This is a cross- sectional study followed by an interventional study.

STUDY PLACE & STUDY PERIOD:

This study was conducted in Government Rani Anna College for Women, Tirunelveli District. The study period extended from January 2014 to June 2014.

STUDY SUBJECTS:

A total of 800 students, studying in various departments, girls in the age group between 17 to 20 yrs were selected for the study. Among them, girls with menstrual irregularities were subjected to intervention.

INCLUSION CRITERIA:

- College girls in the age group of 17 to 20 years.
- Students with menstrual irregularities for interventional study.

EXCLUSION CRITERIA:

- Girl students with known medical illnesses.
- Cases of severe anaemia.
- Subjects with thyroid disorders.

- Students with structural anamolies in the reproductive system.

Materials used for the study:

1. Oral questionnaire form - To obtain the details of menstrual pattern of the subjects for studying the prevalence of menstrual irregularities.
2. Proforma - To get the detailed history of the students with menstrual problems and for recording clinical as well as biochemical findings of the subjects.
3. Perceived stress scale questionnaire - To find out the level of stress in them.
4. Portable weighing machine - To record the body weight in kilogram.
5. Standardised Mercury sphygmomanometer -To record the blood pressure.
6. Semi Auto Analyzer - For Hb estimation.
7. Elisa reader - For T3,T4,TSH and for serum cortisol estimation.
8. 2 D Ultrasound scan machine (L&T Company) - To do ultrasound abdomen.

METHODOLOGY

The study was approved by the Ethical Committee of Tirunelveli Medical College. The study was done in college girls. After getting consent from the college authorities, the study was proceeded.

At the beginning of the study, an oral questionnaire was given to 800 students of age group between 17 to 20 years studying in various departments in the college. The questionnaire contains questions regarding their menstrual pattern. i.e. duration, amount of menstrual flow and menstrual cycle regularity.

The questionnaire answered by the students were analyzed, and the prevalence of menstrual irregularities noted. According to the type of irregularity, they were divided into 4 groups namely oligomenorrhoea group, polymenorrhoea group, hypomenorrhoea and menorrhagia group. All the groups were subjected to Hb and thyroid profile estimation.

For that purpose, the subjects were asked to assemble in a nearby primary health centre, on a week end (i.e. Saturday) in empty stomach at 7.00 AM. Permission got from the Medical Officer, PHC.

On that day, with due precautions, 5 ml of venous blood sample was collected. 20 cubic mm of blood was taken in a pipette for Hb estimation by semi auto analyzer method. Remaining blood was centrifuged and serum was

COLLECTION OF BLOOD SAMPLE

separated to be used ELISA test. After taking blood samples, the students were sent home.

Hb Estimation

By using Semi auto analyzer, Hb was estimated.

Principle : Drabkin's principle (cyan methaemoglobin method).

Method: 5 ml of Drabkin's reagent which contains potassium ferricyanide/ potassium cyanide/ sodium bicarbonate/ sterox is taken in a test tube. To this reagent 20 microliter of whole blood is pipetted and added. The mixture is allowed to stand for 5 minutes and then feeded into auto analyzer. Within few seconds the result is interpreted as a value of gm/dl. It is an accurate method of estimation of haemoglobin. Anaemia is then graded.

According to WHO, anaemia is graded into

Normal - Hb 11 & above

Grade 1 - Hb between 9.5 to 10.9 gm% (mild anaemia)

Grade 2 - Hb between 8 to 9.4 gm% (moderate anaemia)

Grade 3 - Hb between 6.5 to 7.9 gm% (severe anaemia)

Grade 4 - Hb <6.5 gm% (Life threatening anaemia) .

Anaemia among the group was graded and the correlation with menstrual irregularities noted.

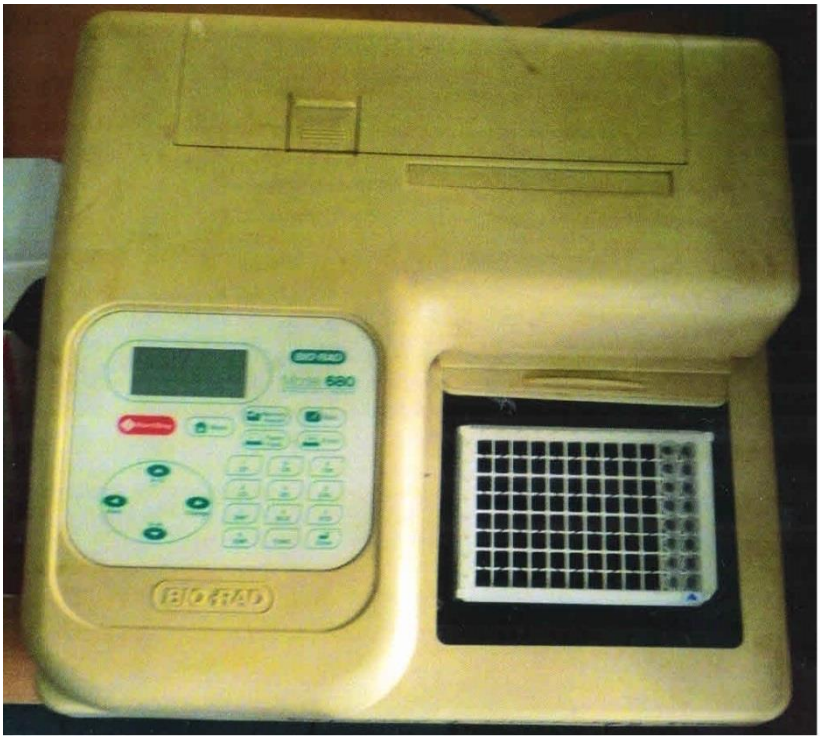
Thyroid profile and seum cortisol estimated from the separated sample of serum.

TSH Estimation

TSH is estimated using CLIA kits. (chemiluminescence Immuno Assay). The TSH CLIA test utilizes a unique monoclonal antibody directed against a distinct antigenic determinant on the intact TSH molecule. Mouse monoclonal anti TSH is used for solid phase immobilization and a goat anti TSH antibody is in the antibody- enzyme conjucate solution. The test sample is allowed to react simultaneously with the two antibodies resulting in the TSH molecules being sandwiched between the solid phase and enzyme linked antibodies. After 60 minutes interaction at room temperature, the wells are washed 5 times by wash solution to remove unbound anti TSH conjucate. A solution of chemiluminescent substrate is then added and read relative light units in a luminometer. The intensity of the emitting light is proportional to the amount of enzyme present and is directly related to the amount of TSH in the sample. By reference to a series of TSH standard assayed in the same way, the concentration of TSH in the unknown sample is quantified.

SEMI AUTO ANALYZER FOR HAEMOGLOBIN ESTIMATION

ELISA READER FOR CORTISOL ESTIMATION



T3 and T4 is also estimated in the same way using T3, T4 CLIA kits. After getting the thyroid results, the relation between thyroid disorders and menstrual irregularities noted.

From the same sample of blood serum cortisol was also estimated.

Serum cortisol estimation:

The serum separated was used for ELISA test for cortisol estimation. Cortisol was estimated using cortisol ELISA kit.(Diagnostic automation cortex Diagnostic inc) test. The principle behind the test is competitive ELISA and the detection range is 0- 50mcg/dl. The sample needed is 25 microlitre serum or plasma. Total time required is 75 minutes. At a time 96 tests can be performed from a single ELISA kit.

The test principle is competitive Enzyme immunoassay (type 7). The essential reagents include antibody, enzyme, antigen conjugate and native antigen. Upon mixing biotinylated antibody, enzyme antigen conjucate and a serum containing the native antigen a competition reaction happens between native antigen and the enzyme antigen conjucate for a limited number of antibody binding sites.

The cortisol level was analysed in the ELISA plate reader. A dose response curve is used to ascertain the concentration of microplate reader. The absorbance obtained from the printout of microplate reader is recorded.

The absorbance of each duplicate serum reference versus the cortisol concentration is plotted. The points connected with a best fit curve.

The results of Hb estimation and thyroid profile was analyzed. Cases of severe anaemia and thyroid disorders were excluded from the study of non pharmacological interventions since they need pharmacological treatment. Those with mild anaemia were advised iron rich foods and they were included for the intervention.

The study group who are going to be subjected to intervention were asked to come to the same primary health centre on some other day. They were given a proforma to fill the details details such as age, age of menarche, family history of menstrual disorders, duration of menstrual cycle, volume of menstrual blood in the last periods and the severity of dysmenorrhoea if present. The menstrual volume calculated from the no. of diapers they have changed in each day of last periods and from the degree of soakage of the diapers. It was calculated by PBAC score. A stress questionnaire was also given to assess the degree of stress in them.

HEIGHT:

Height of the individuals recorded by using a stadiometer in which the measurements were printed in the vertical stem. The students were asked to

stand erect with their back in contact with the vertical stem. Height was measured to the nearest 0.5 cm and noted down.

WEIGHT:

Weight was measured using standard portable weighing machine to the nearest 0.1 kg.

BMI of the study group calculated using the formula:

BMI = Weight in kg/ Height in m^2. After BMI estimation, they were graded into underweight (BMI<18.5), normal (BMI 18.5 to 24.9), overweight (BMI 25 to29.9), obese (BMI 30 and above) categories.

Blood pressure recorded in the sitting posture using standard sphygmomanometer.

The stress level of the study group were assessed by the perceived stress scale questionnaire, designed by Sheldon and Cohen[74]. It consists of 10 items of questions designed to measure the degree in which situation one's life are appraised as stressful.

After reading the questions, answer how often you felt or thought the way over the past month (never, almost never, sometimes, fairly often, very often) for questions. PSS scores were obtained by reversing responses (0=4,

MEASUREMENT OF HEIGHT

MEASUREMENT OF WEIGHT

MESUREMENT OF BLOOD PRESSURE

1=3, 2=2, 3=1 &4=0) to four positively stated items. The results interpreted after analyzing the stress score form.

Interpretation of Stress Score

Higher perceived stress scale scores are associated with higher levels of stress.

Perceived Stress Score by Sheldon and Cohen

Total score	Your perceived stress level	Health concern level
0-7	Much lower than average	Very low
8-11	Slightly lower than average	Low
12-15	Average	Average
16-20	Slightly higher than average	High
21 and over	Much higher than average	Very high

In this way, the degree of stress in the students was noted. After assessing stress, the correlation between stress score and serum cortisol estimated.

Assessment of Dysmenorrhoea

In the present study, verbal multi dimensional scoring system was used to measure the severity of menstrual pain and takes into account the impact of menstrual pain on daily activities, systemic symptoms, absence from work or going to college and requirement of analgesics. According to this scoring system, Dysmenorrhoea is graded into,

Grade 0 - No Dysmenorrhoea

Grade 1 - Mild Dysmenorrhoea

Grade 2 - Moderate Dysmenorrhoea

Grade 3 - Severe Dysmenorrhoea

Ultrasonography

Ultrasound abdomen done on the same day. Using 2D ultrasound scan machine of L&T company 2010 make, ultrasound abdomen and pelvis done for all the study groups to exclude any structural uterine and ovarian pathologies and to look for poly cystic ovaries. Association of PCOD with menstrual irregularities noted. The students with structural anamolies in the reproductive system were excluded from the intervention study. Groups with polycystic ovaries were included.

ULTRASOUND ABDOMEN EXAMINATION

Assessment of Menstrual Blood Loss

There is a scoring system called Pictorial Blood Assessment Chart and scoring system for assessment of menstrual blood loss. Study group were asked to score their previous periods after explaining the scoring system.

Using the PBAC scoring system

During the course of menstrual period, the use of sanitary napkins are recorded by noting the no. of diapers used and how the sanitary materials are stained each time a person changes them. The blood clots are recorded by indicating whether they are the size of a 1p or 50 p coin in the clots/flooding row under the relevant day.

Eg: Under day one may say 50 p× 1 and 1p× 3.

Any incidence of flooding is recorded by placing a tally mark in the clots/ flooding row under the relevant day.

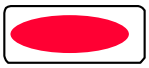
Scores:

A lightly stained napkin will score 1 point, a moderately stained napkin 5 points, a napkin which is saturated with blood will score 20 points.

Results: Score > 100 - Heavy periods. Score < 20 – Scanty periods.

PBAC SCORE:

Enter the No. of diapers used daily inside the relevant staining column.

DIAPER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
								
								
								
CLOTS/ FLOODING								

Assessment of menstrual cycle irregularities

The duration of menstrual cycle between last two periods calculated. Normal menstrual cycle duration is 28 days and it ranges from 22 to 35 days. Polymenorrhoea (reduction in cycle length) and oligomenorrhoea (prolongation in cycle length) are assessed by the number of days of variation from the normal 28 days.

The study group were given advice regarding healthy diet. Then they were trained to do brisk walking exercise, to perform deep breathing exercise and shavasana. No medications were given to the study group during the intervention period. They were asked to do the exercises daily for half an hour in the morning and similarly in the evening. Total period of this intervention was for 6 months. They were reviewed every month for strict adherence to the exercises and relaxation techniques, for reassessment of their menstrual problems. After the end of this follow up study, blood pressure recorded, Height and weight taken, BMI calculated, stress assessment procedures like perceived stress scale oral questionnaire, serum cortisol estimation were repeated and the menstrual pattern recorded. PBAC score calculated for the menstrual cycle after the intervention period and the cycle duration calculated between last two cycles of the intervention period. The results were tabulated, compared with pre test findings, statistically analyzed to find the significance of variations before and after the relaxation techniques.

RESULT ANALYSIS

RESULT ANALYSIS

Data collected by oral questionnaire from 800 college girls, 200 each in age groups 17,18,19,20 yrs respectively.

When the data was analyzed, it was found that 96 out of 800 students were having menstrual irregularities i.e. a prevalence of 12 % for menstrual irregularities was noted. When the types of irregularities were analyzed they come under 4 groups namely, 1)Oligomenorrhoea 2) Polymenorrhoea 3) Hypomenorrhoea 4)Menorrhagia groups. 5 of them had both oligo and hypomenorrhoea, 5 of them had both polymenorrhoea and menorrhagia.

Among the group, the distribution of oligomenorrhoea was 39.5%, polymenorrhoea 11.5%, hypomenorrhoea 15.7%, menorrhagia 22.9%, combined oligo with hypomenorrhoea 5.2% and poly menorrhagia 5.2%. The mean age of menarche was 13±2years. 19.4% of girls with menstrual irregularities had polycystic ovaries.

The results of non-pharmacological adjuncts were analyzed by paired t test, Pearson correlation .The statistical analysis done by SPSS version-11.

TABLE - 1

AGEWISE DISTRIBUTION OF MENSTRUAL IRREGULARITIES

Age	No. of students studied	No. with Normal Menstruation	With menstrual Irregularities
17 yrs	200	172	28
18 yrs	200	175	25
19 yrs	200	177	23
20 yrs	200	180	20
Total	800	704	96

As age decreases, there is progressive decrease in incidence of menstrual irregularities, but the decrease is statistically not significant.

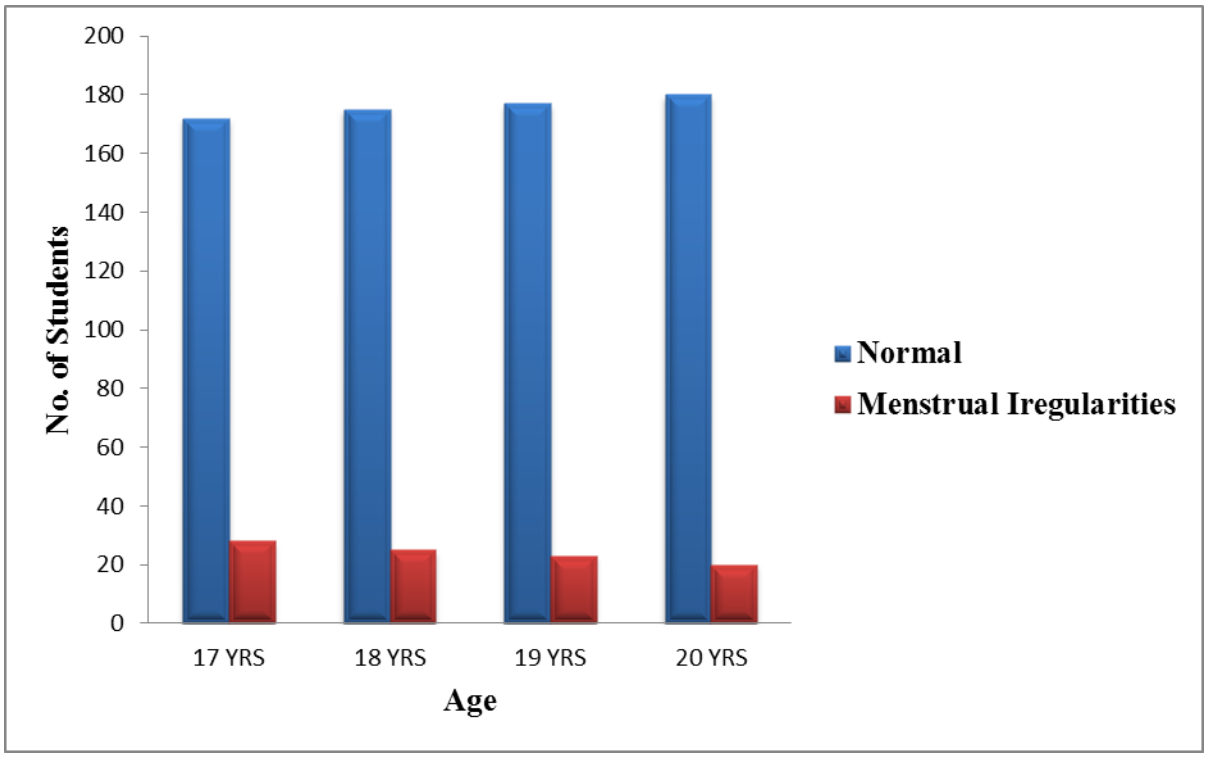


TABLE - 2

Prevalence of Different types of menstrual irregularities

Age	Oligo menorrhoea	Poly menorrhoea	Hypo menorrhoea	Menorrhagia	O+H	P+M	Total
17 yrs	13	2	6	4	1	2	28
18 yrs	9	3	3	8	1	1	25
19 yrs	8	4	4	5	1	1	23
20 yrs	8	2	2	5	2	1	20
Total	38	11	15	22	5	5	96

Among the group, the distribution of oligomenorrhoea was 39.5%, polymenorrhoea 11.5%, hypomenorrhoea 15.7%, menorrhagia 22.9%, combined oligo with hypomenorrhoea 5.2%, poly menorrhagia 5.2%.

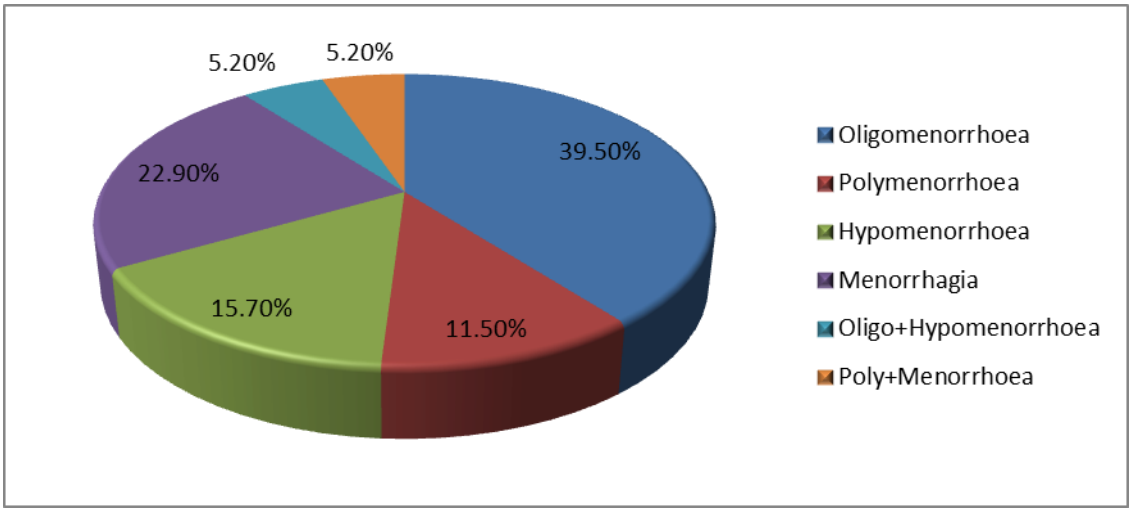


TABLE- 3

DIETARY PATTERN AMONG STUDY GROUP

AGE	17 yrs	18 yrs	19 yrs	20 yrs	Total
VEG	3	5	4	3	15
NON VEG	25	20	19	17	81
Total	28	25	23	20	96

Among the study group, 15.63 % were vegetarians and 84.37 % were taking non-vegetarian diet. The occurrence of menstrual irregularities were 5.39 times more among non-vegetarians in comparison with vegetarians.

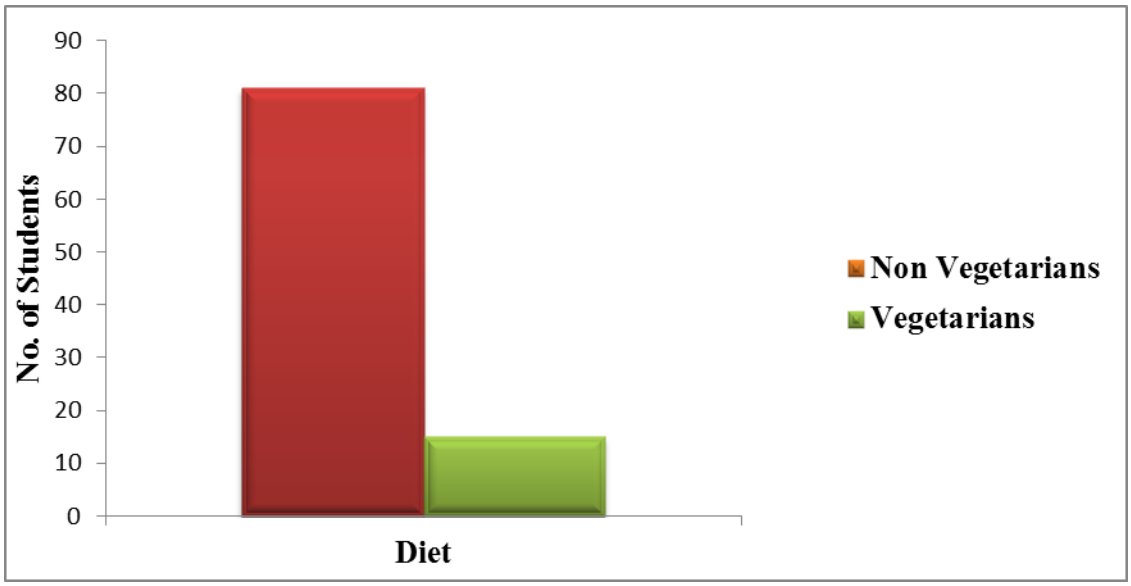


TABLE - 4

GRADING OF ANAEMIA AMONG STUDY GROUP

Age	No Anaemia	Mild Anaemia	Moderate Anaemia	Severe Anaemia	Total
17 yrs	18	8	0	2	28
18 yrs	20	2	0	3	25
19 yrs	15	8	0	0	23
20 yrs	14	6	0	0	20
Total	67	24	0	5	96

The association of mild anaemia was 25 % and severe anaemia was 5.2% among the study group.

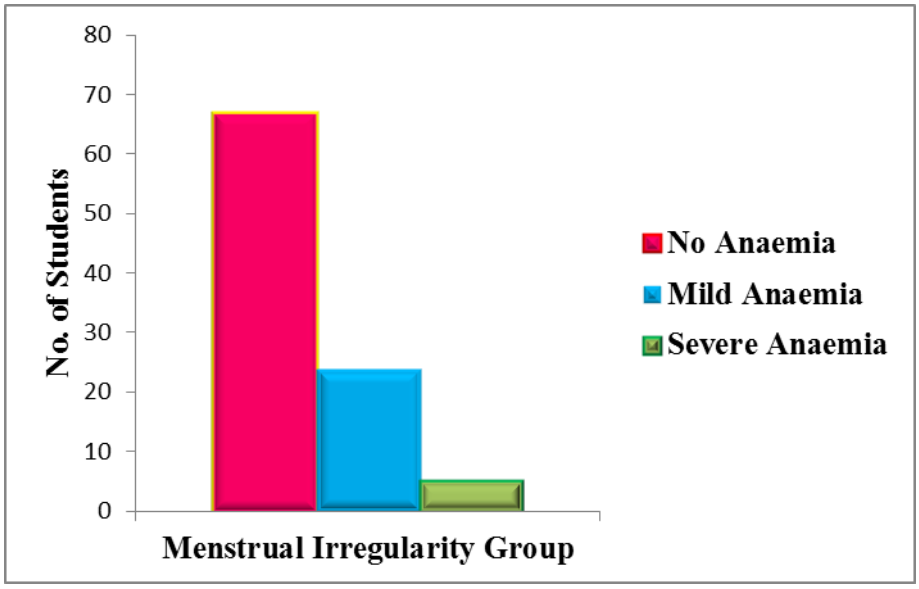
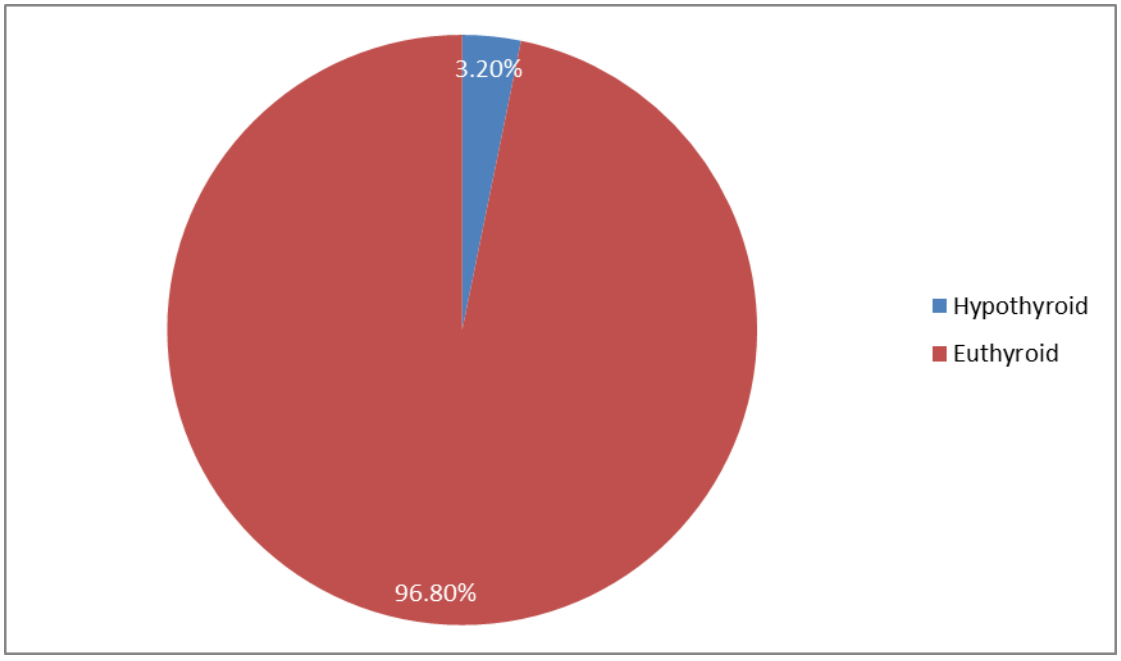


TABLE -5

THYROID PROFILE ANALYSIS

Age	Hypothyroid	Euthyroid	Total
17 yrs	2	26	28
18 yrs	0	25	25
19 yrs	1	22	23
20 yrs	0	20	20

Out of 96 students, 3 persons were found to have hypothyroidism. Of the hypothyroid cases, two were in the age group 17 and one in the age group 19.



5 subjects with severe anaemia and 3 cases of hypothyroidism were excluded from the study and the remaining 88 students were given relaxation exercises.

TABLE -6

DETECTION OF PCOD BY ULTRASOUND ABDOMEN

AGE	PCOD CASES	NORMAL	Total
17 YRS	4	21	25
18 YRS	5	16	21
19 YRS	3	20	23
20 YRS	5	14	19
Total	17	71	88

17 students had polycystic ovaries by ultrasound among the 88 students studied.

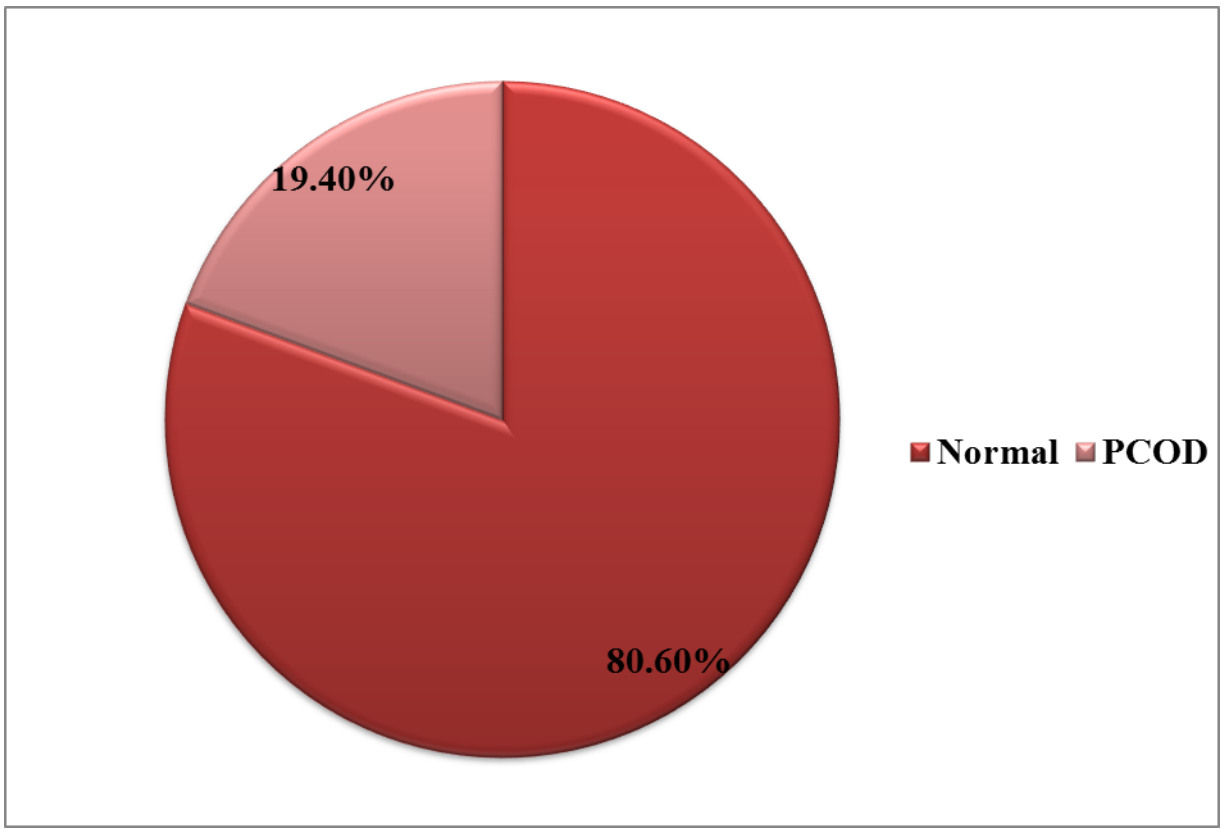


TABLE -7

BMI IN RELATION TO MENSTRUAL IRREGULARITIES

AGE	BMI<18.5	BMI 18.5-24.9	BMI 25-29.9	BMI 30&ABOVE	TOTAL
17yrs	6	14	4	1	25
18yrs	2	16	2	1	21
19yrs	1	18	4	_	23
20yrs	3	16	_	_	19
TOTAL	12	64	10	2	88

In the study group, 72.8% belongs to normal weight, 13.6% underweight, 11.4% overweight and 2.2 belongs to obese category. Obesity has not much influence on menstrual irregularity in this study.

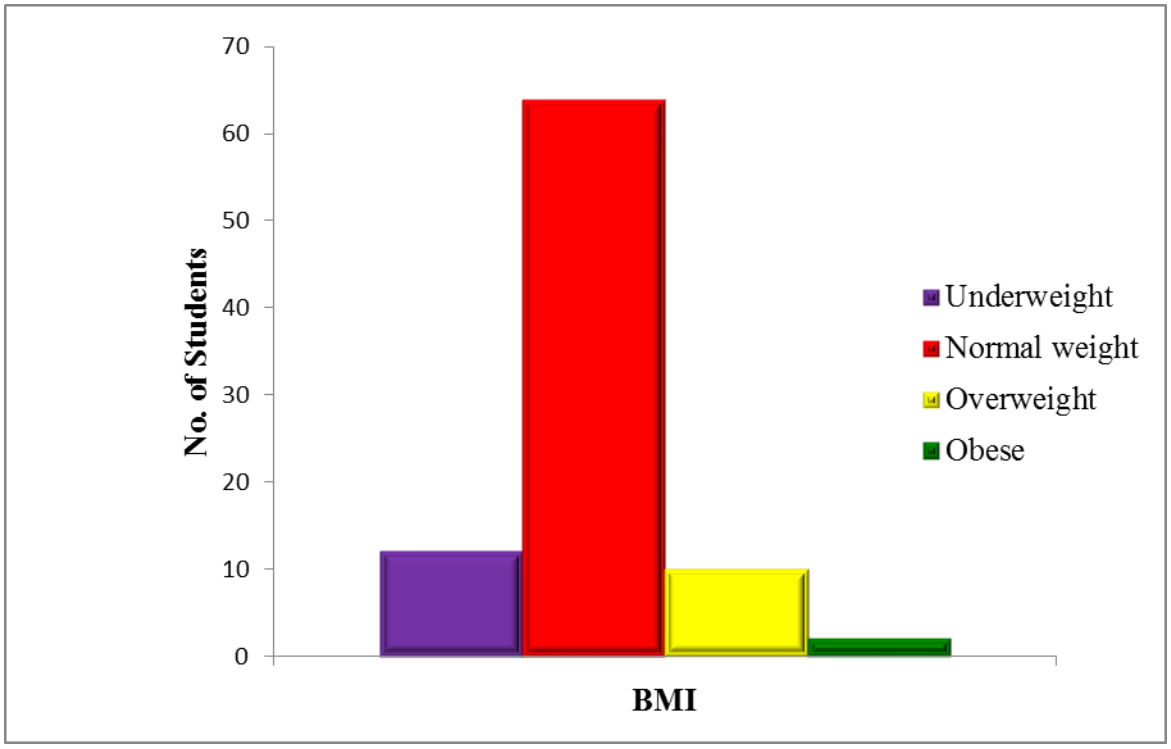


TABLE -8

COMPARISON OF BMI BEFORE AND AFTER INTERVENTION

Parameters	BMI	
	Pre	Post
Mean	22.07	22.05
SD	3.18	3.00
P	0.06	
Significance	Not Significant	

P Value > 0.05 – Not Significant. SD – Standard Deviation.

There was no significant change in BMI before and after intervention.

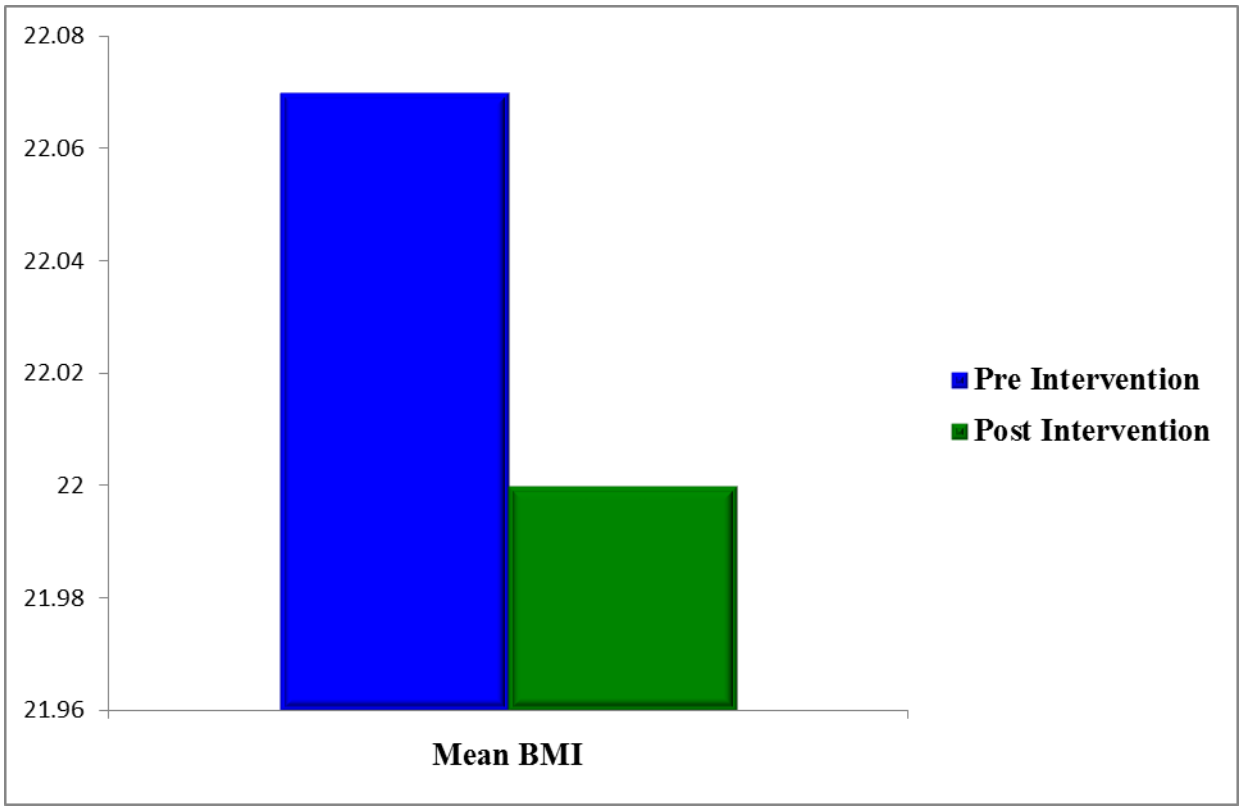


TABLE -9

BLOOD PRESSURE BEFORE AND AFTER INTERVENTION

Parameters	S.BP(in mm Hg)		D.BP(in mmHg)	
	Pre test	Post test	Pre test	Post test
Mean	111.11	106.06	75.88	73.04
SD	5.29	5.40	4.78	4.36
P	0.0001*		0.0001*	
Significance	Significant		Significant	

*P Value <0.05 – Significant. SD – Standard Deviation.

There was significant reduction in blood pressure after intervention.

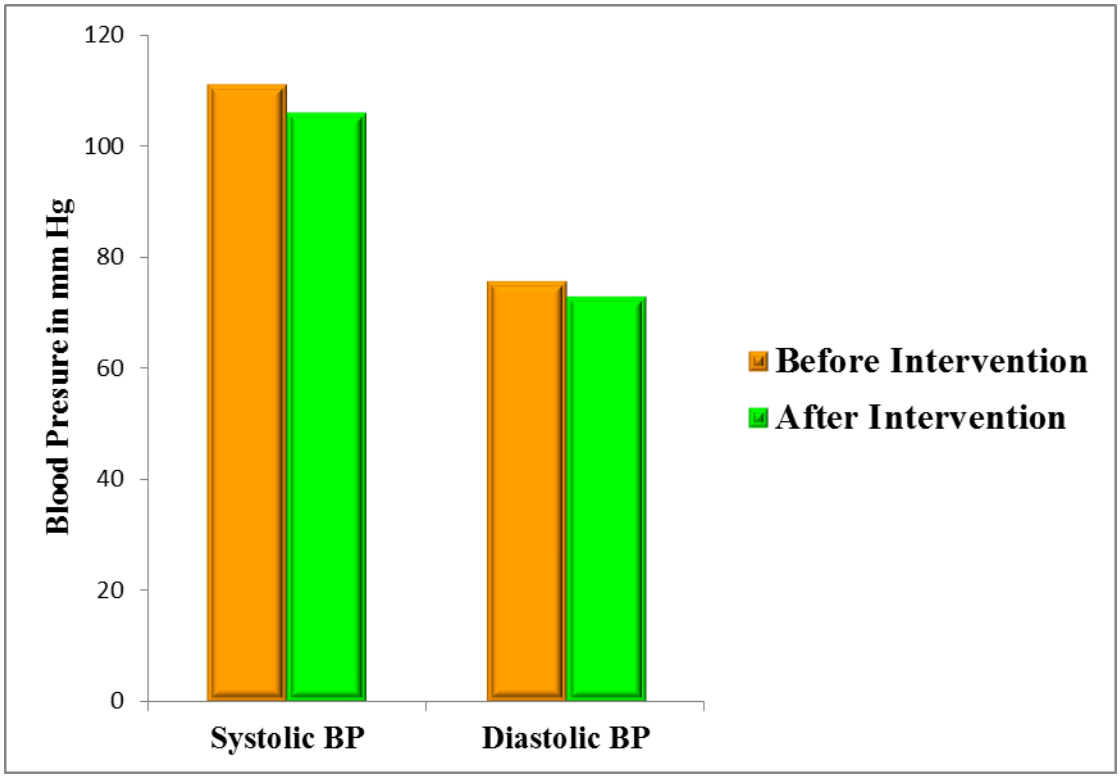


TABLE - 10

STRESS SCORE AND SERUM CORTISOL

BEFORE AND AFTER INTERVENTION

Parameters	Stress score		Serum Cortisol (mcg/dl)	
	Pre test	Post test	Pre test	Post test
mean	15.81	13.07	16.59	14.25
SD	2.81	1.91	3.69	2.48
P	0.0001*		0.0001*	
Significance	Significant		Significant	

***P Value < 0.05 – Significant. SD – Standard Deviation.**

When the stress scores and serum cortisol were compared before after relaxation techniques for a period of 6 months, it was found that there was significant reduction in stress score and serum cortisol on post intervention.

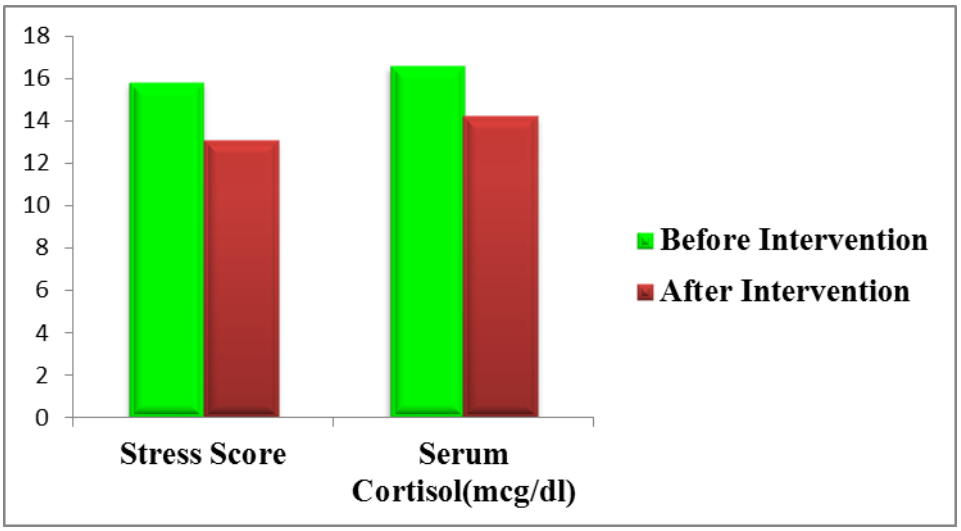


TABLE -11

PEARSON CORRELATION BETWEEN

STRESS SCORE AND SERUM CORTISOL

	Stress Score	Serum Cortisol	r value	p	Significance
Before Intervention	**15.61±2.81**	**16.59±3.69**	**0.399**	**0.01***	**Significant**
After Intervention	**13.07±1.91**	**14.25±2.48**	**0.427**	**0.01***	**Significant**

***P Value <0.05 – Significant.**

There was significant correlation between stress score and serum cortisol before as well as after intervention.

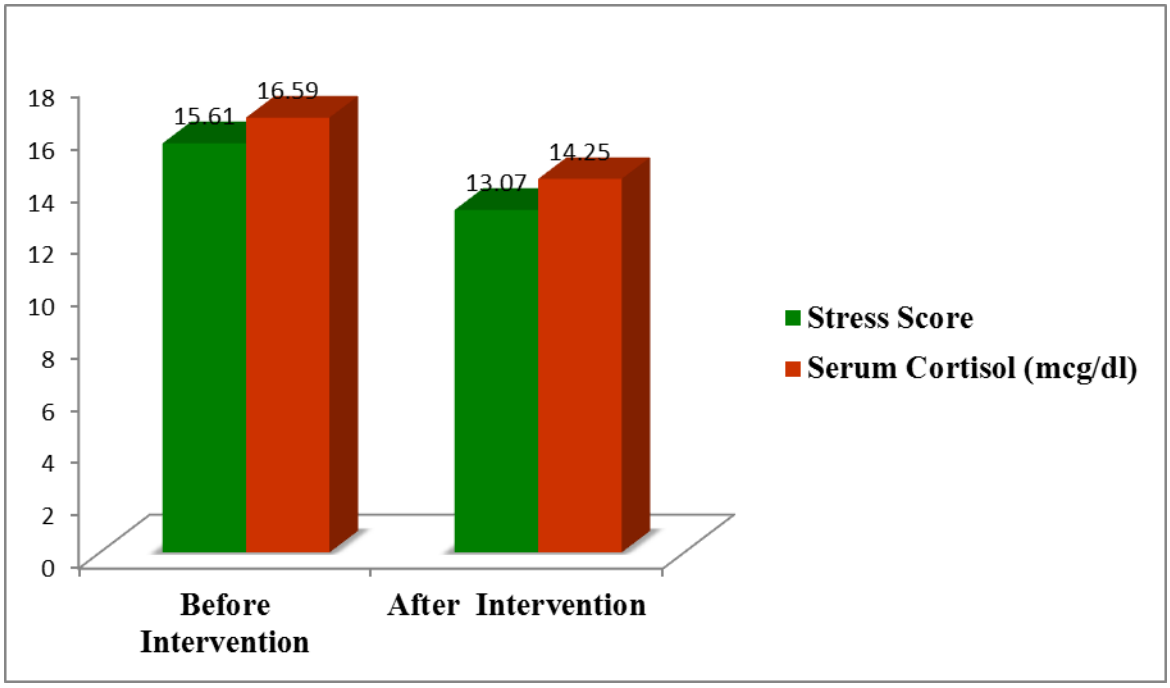


TABLE -12

COMPARISON OF MENSTRUAL CYCLE DURATION

BEFORE AND AFTER INTERVENTION

Parameter	Menstrual Cycle Duration			
Group	Oligomenorrhoea		Polymenorrhoea	
	Pre test	Post test	Pre test	Post test
Mean	43	40	18.66	24.53
SD	4.02	4.27	1.58	3.27
P	0.001*		0.001*	
Significance	Significant		Significant	

*P Value < 0.05 – Significant. SD – Standard Deviation.

Significant improvement of cycle duration was seen in both the groups.

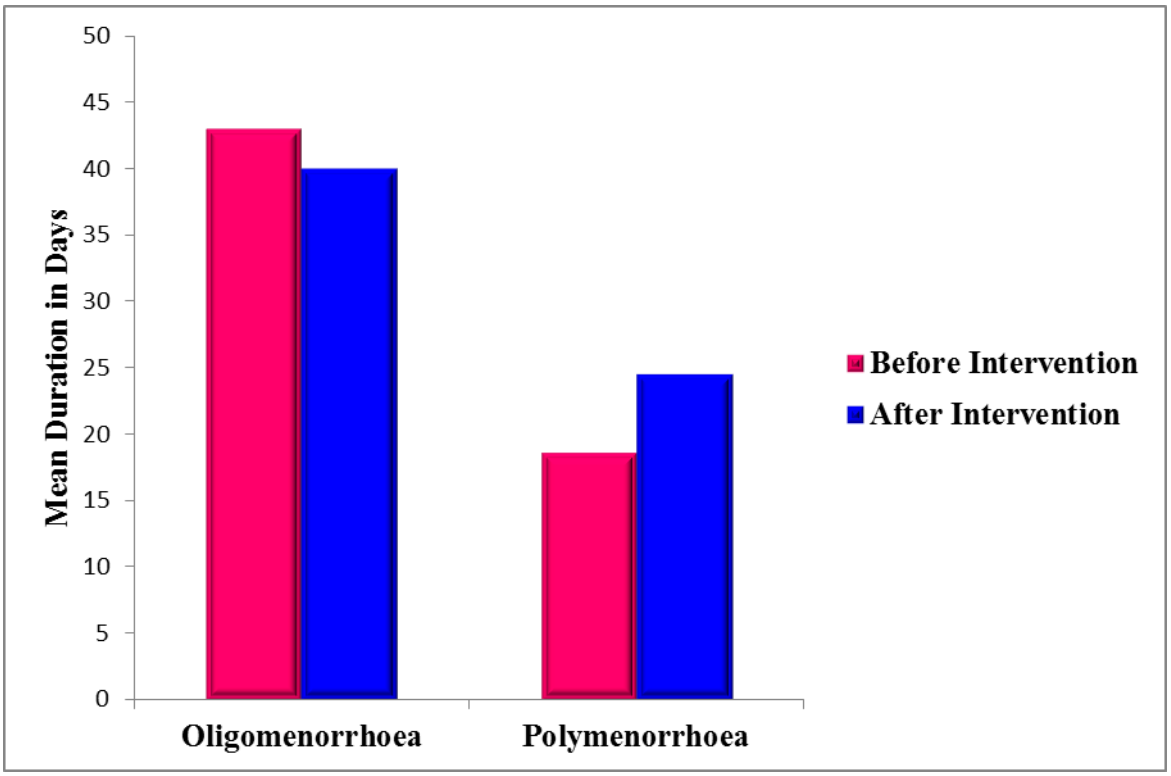


TABLE -13

COMPARISON OF AMOUNT OF MENSTRUAL FLOW BEFORE AND AFTER INTERVENTION

Parameter	Amount of Menstrual Flow (PBAC SCORE)			
Group	Hypomenorrhoea		Menorrhagia	
	Pre test	Post test	Pre test	Post test
Mean	14.47	17.21	128.7	121.04
SD	2.83	5.07	10.24	21.31
P	0.07		0.06	
Significance	Not Significant		Not Significant	

P Value >0.05 – Not Significant. SD - Standard Deviation.

Statistically no significant alteration in the amount of menstrual flow in both hypo as well as amenorrhoea groups before and after intervention.

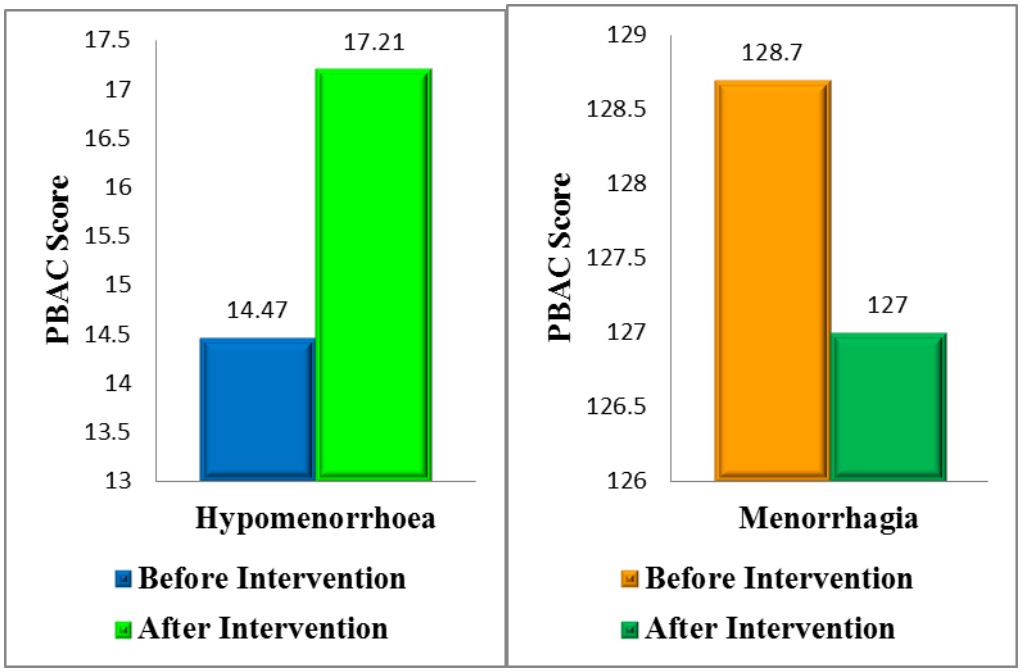


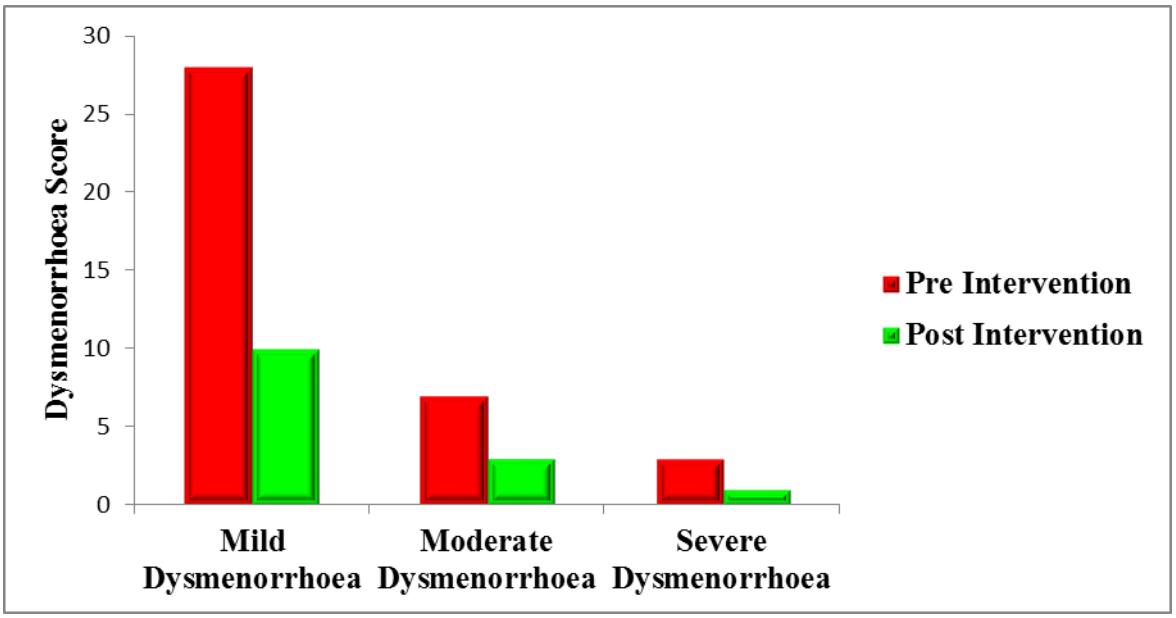
TABLE - 14

COMPARISON OF DYSMENORRHOEA SCORE BEFORE AND AFTER INTERVENTION

Parameters	Mild Dysmenorrhoea		Moderate Dysmenorrhoea		Severe Dysmenorrhoea	
	Pre test	Post test	Pre test	Post test	Pre test	Post test
Mean	28	10	7	3	3	1
SD	0.54	0.33	0.57	0.47	0.51	0.43
P	<0.001*		<0.01*		<0.001*	
Significance	Significant		Significant		Significant	

*P Value < 0.05 – Significant. SD – Standard Deviation.

There was significant reduction in all grades of dysmenorrhoea in the study group.



DISCUSSION

DISCUSSION

Stress is an unavoidable consequence of life. In females, stress has relation to reproductive system by modulating the activity of hypothalamo-Pituitary-Ovarian axis. Stress can modify this axis, producing changes in the normal menstrual pattern of females. Abnormality in menstruation lead on to future infertility. During adolescent period itself women are facing these problems of irregular menstruation due to increasing incidence of academic stress imposed upon them. There are lot of studies which showed the relationship between academic stress and irregular menstruation.

For this study, a group of 800 girls from a college were selected. A questionnaire was given to all of them to know the presence or absence, and the type of menstrual irregularities if present. The set of questions were more or less similar to another study done by Lee et al at Malaysia[75].The prevalence of menstrual irregularities among college students were noted. In this study, the prevalence was 12% which correlates well with a similar study done by Agarwal et al[76] at singapore in which the prevalence was 12.2%.

Among the students with menstrual irregularities, the dietary habits were observed which showed the irregularities were 5.39 times more in non vegetarians when compared to vegetarians. This finding also coincides with the study done by Llyod, Tom Et al[77] in which there is 5.25 times more

incidence of menstrual irregularities among non vegetarians compared to vegetarians.

Hb% studied among the menstrual irregularity group. In this study, among the menstrual irregularity group, 69.8% were not anaemic, 25 % of them had mild anaemia, 5.2% had severe anaemia. Association of anaemia with menstrual irregularities were similar to the study by Rakesh Kakkar et al[78].

For all the students with menstrual irregularities, thyroid profile estimation was done to find out hypo or hyperthyroidism. In this study, hypothyroidism was found in 3.1% of the subjects with menstrual irregularities. In a study by Neelu Sharma and Anita Sharma[79], there was11% association of thyroid abnormalities with menstrual irregularities. Another study by Menon VK, Barucha KE et al[80] showed similar association with our study.

5 cases of severe anaemia and 3 cases of hypothyroidism were excluded from study group and others were subjected to clinical as well as biochemical analysis before and after the intervention with non pharmacological strategies.

When the BMI was analyzed before and after the intervention study, there was no significant change in the BMI at the end of the study. But similar studies of lifestyle modifications done on obese individuals showed significant reduction in obesity and the BMI[81]. In the present study, 68.8% of them had normal BMI , 2 % were obese in the study group and the change in BMI was

also not significant. Studies by Harlow SD et al[82] showed higher association between obesity and menstrual irregularities.

Analysis of systolic and diastolic blood pressure before and after intervention showed that there was significant reduction in both mean systolic as well as diastolic blood pressure at the end of the study which is similar to the study by Anita herur.

In the study by Anita herur[83], the effect of relaxation technique on blood pressure in normal subjects above 30 years of age showed a significant reduction on blood pressure after relaxation technique. This study also showed a better response to yoga therapy in younger individuals. The relaxation techniques by modifying the state of anxiety reduces stress induced sympathetic over activity thereby decreasing arterial tone and peripheral resistance resulting in decreased blood pressure and heart rate. Another study by Kaushik et al[84] also proved the effect of mental relaxation in reducing essential hypertension. The shavasana brings about altered proprioceptive and exteroceptive influences to the hypothalamus thereby decreasing sympathetic activity and hence a decrease in basal heart rate and blood pressure.

The stress score when analysed before and after intervention, there was significant reduction in the stress scoring among the study group at the end of the study when compared to before intervention. There are studies which also proved the effect of relaxation techniques on stress reduction[85].(Rain Forth).

Serum cortisol assessed before and after intervention which showed significant reduction in serum cortisol at the end of the study. Studies by Little Mahendra et al showed the relationship between stress and serum cortisol Level[86]. Similarly, in this study also in correlation with the reduction in stress as evidenced by reduction in stress scoring, there was corresponding reduction in serum cortisol level.

When the grading of dysmenorrhoea was analysed before and after intervention, there was significant reduction in menstrual pain severity after physical exercise and relaxation techniques. Studies by Chiou et al[87] and Ferin et al[88] proved that dysmenorrhoea has a psychological factor associated with it and it improved by relieving the psychological stress.

When the menstrual cycle abnormality was analysed, the subjects were initially divided into 2 groups namely oligomenorrhoea group and polymenorrhoea group.

In the oligomenorrhoea group, i.e. with prolonged menstrual cycles there was very significant reduction in cycle duration which means improvement in disease activity after the intervention.

In the polymenorrhoea group, i.e. with shortened menstrual cycles there was significant correction in cycle length towards normal. These two findings showed that there occurred a change in the hypothalamo- pituitary- ovarian axis after the intervention.

Studies by Remzi Cevic et al[89] showed the inhibitory effect of depressive mood and stress on HPO axis. In our study also the stress reduction techniques have removed the inhibition thereby normalizing the HPO axis and produced improvement in the cycle irregularities.

The menstrual flow assessment was done between two groups namely hypomenorrhoea group and menorrhagia group.

In the hypomenorrhoea group (scanty flow) eventhough the PBAC score has increased, this increase was not significant.

In the menorrhagia group, (excess flow) the PBAC score decreased but it was also not significant. Both these findings showed that it is not only stress which is involved in the causation of menstrual flow abnormalities but some other factors like nutritional factors and other causative factors might be involved.

SUMMARY

&

CONCLUSION

SUMMARY AND CONCLUSION

- The present study has been undertaken to find out the prevalence of menstrual irregularities in late adolescent girls and to know the effect of non pharmacological strategies like physical exercise and stress relaxation techniques like deep breathing exercise and shavasana in adolescent girls with menstrual irregularities.
- For this study, 800 college girls studying in various departments in the age group 17-20 years were selected. A questionnaire given regarding their menstrual pattern and the prevalence of various menstrual irregularities detected.
- Among the students with irregular periods, the association of anaemia and hypothyroidism noted.
- Prevalence of PCOD among the study group detected.
- 88 adolescent girls having menstrual irregularities were subjected to non pharmacological strategies like walking exercise, and stress relaxation techniques like deep breathing exercise and shavasana daily for 30 minutes morning and evening. No medications were given during this period of intervention for their menstrual problems.
- During the study period of 6 months the selected subjects were assessed every 4 weeks for menstrual flow and cycle duration. BMI, Blood pressure estimation, Stress scoring, serum cortisol measurement, USG

detection of PCOD, disease scoring for cycle duration and amount of flow done both at the starting and end of the study.

- The study showed the prevalence of 12 % for menstrual irregularities among college students.
- The study has shown statistically significant reduction in the stress level scores in the study group. Thus it is concluded that the stress relaxation techniques are effective measures in treating stress induced menstrual irregularities.
- This study also shows a statistically significant reduction in serum cortisol at the end of the study. This fact adds to the beneficial effect of stress reduction in the treatment of menstrual disorders.
- Also there is statistically significant reduction in the mean systolic and diastolic blood pressure. This shows the role of stress reduction measures not only has actions on reproductive system but also has actions on cardio vascular system.
- There is significant reduction in the severity of dysmenorrhoea in the study group. This shows that there is a psychological component also which is associated with dysmenorrhoea and by reducing stress, menstrual pain can be reduced.
- The improvement in the menstrual cycle duration was statistically significant. This indicates that stress produces alterations in the hypothalamo pituitary ovarian axis thereby altering normal menstrual

cycle which can be corrected by stress reduction techniques and also physical exercise has a positive influence on HPO axis.

- There was no significant change in the menstrual flow among the study group. This shows that nutritional factors and other factors also influences menstrual flow in addition to stress factor.
- Hence the non pharmacological strategies like physical exercise, relaxation techniques have been useful as evidenced by reduction in stress level parameters and improvement in the menstrual cycle abnormalities.
- To conclude, adolescent girls with menstrual irregularities can be advised physical activity and stress reducing relaxation techniques as an initial measure for improvement of menstrual disorders without any medications.
- Continuance of the simple relaxation techniques if advised for the adolescent girls will help either in complete cure or at least improvement of menstrual irregularities which otherwise could be a cause for future infertility.

BIBLIOGRAPHY

BIBLIOGRAPHY

1. Adolescence. The critical phase, the challenges and the potential. Published by W.H.O. Regional office for South-East Asia, Ne 5.

2. Menstrual pattern among unmarried women from south India, Shabnam Omdivir et al . J Nat Sci Biol Med. 201,2(2):174-179.

3. Menstrual Pattern and Common Menstrual Disorders among Students in Dinajpur Medical College-Begum J, I Hossain AM.

4. Sex steroids and brain structure in pubertal boys and girls-a mini review of Neuro imaging studies. J.S. Peper, H.E. Hulshof Pol et al. Neuroscience volume191, September 2011, pages 28-37.

5. Genetic and environmental effects on age at menarche, and its relationship with reproductive health in twins. Shayesteh Jahanfar, Munn-Sann et al. Indian Journal of human Genetics 2o13 vol. 19 page 245-250.

6. The relation of menstrual age to obesity in childhood and adulthood. David S.Freedman Laura Kettel Khan et al. BMC Pediatrics 2003, 3:3.

7. Link between Body fat and the timing of puberty. Paul B. Kaplowitz. Pediatrics vol. 121, Feb. 2008.

8. Leptin and puberty- A review. Gusorgiev M, Gothi M L, Pituitary 2001 Jan-April 4(1-2) 79-86.

9. Food insecurity and age at menarche among adolescent girls in Jimma zone South west Ethiopia: a longitudinal study. Tefera Belachew, Craig Hadly et al. Reproductive Biology & Endocrinology 2011, 9:125.

10. Child growth foundation: Puberty and Tanner stages: Developed by Professor James M. Tanner. Endocrinology: an integrated approach S.S. Nussey and I.A.Whitehead 2001.

11. Serum IGF-1 and Insulin levels in girls with normal and precocious puberty.Sorensen K, Peterson JH, Eur J Endocrinology 2012 May16(3), page 903-910.

12. Factors affecting vaginal Ph levels among female adolescents: BMJ vol.81, issue 6. L Brabin, S.A.Roberts et al

13. Early puberty in Girls. Diana Zucke et al. National Center for Health Research volume-2, November 2001.

14. Recent trends in pubertal timing and current management of precocious puberty in girls. Anjana Hulse, Apollo Medicine vol.10, issue 2, page 134-137. June 2013.

15. Disorders of pubertal Development. Traggiai C, Stanhope R. Best Pract. Res Cli. Obst 7 gynaecol 17(1): 41-56.

16. Effect of hypothyroidism on puberty and growth. K.V.S Harikumar. International Journal of Gynaecology and Obst. 2008.

17. The discovery of the ovaries-Wikipedia.org/wiki/discovery of ovaries.

18. Larsen Human Embryology, 3rd editio page 276-293.

19. Inder Bir Singh, G.P.Pal Human Embryology, 8th edition page 264, 82-96.

20. Atlas of Microscopic Anatomy, curated by Ronald A. Bergman, Ph.D. Section 13.

21. Optimization of SELDI-TOF protein profiling for analysis of cervical mucous. Journal of Proteomics. Gitika Panicker volume 71, issue- 6 page 637-646.

22. The fallopian tube and Reproctive health. Journal of pediatric and Adolescent Gynaecology, volume 12, issue 3, August 1991, page 126.

23. Text Book of Anatomy, B D Chaurasia 2010, 5th edition. Page 387-388.

24. Gougeon A : Dynamics of follicular growth in the human: A model from preliminary results. Human Reprod 1:81, 1986.

25. Text Book Medical Physiology, Guyton and Hall, 12th edition, page 636-651.

26. Ultrasound assessment of ovulation and endometrial receptivity. Juan Luis, Reproductive Biology and Endocrinology, 2006, 4:56.

27. Lutenized Unruptured Follicle Syndrome: Incidence & recurrent rate in infertile women. Qubion, Amarin Oxford Journals, Human Reproduction, vol. 21, page 2110-2113.

28. Anovulatory Infertility: A prospective study, Geetu Bhandoria, Samar Rudra, JP Journals-10016-1055.

29. Text Book of Physiology, Saradha Subramaniam 6th edition, page 581-585.

30. Ultrasound evaluation of uterine size and endometrial changes in a normal menstrual cycle, Abasiattai et al, Tropical Journal of Medical Research, volume 2 , issue 20, 2006.

31. Estrogen receptors in normal and pathological myometrium.AJ Physiology 276. Page 1112-1115.

32. Hypothalamic Pituitary Adrenal axis, Neuroendocrine factors and stress,Constantine T. Et al,P.J.Psycho Res.53:865-871.

33. Text Book of Physiology G.K. Paul 2nd edition, page no. 462-465.

34. The human menstrual cycle: neuro endocrine regulation,Yen, Jaffe. Reproductive endocrinology 1999:191-217.

35. Text Book of Physiology,R L Bijlani, 4th edition, page no. 493-495.

36. Text Book of Ganong, 23rd edition, page no. 386-387.

37. Studies of circulating steroids on menstrual cycle, Aedo, Landgren et al, Acta Endocrin 1996 July(3), 600-616.

38. Age at menarche and racial comparisons in US girls, Chumla et al, Paediatrics:111:110-113.

39. Shaw's text book of Gynaecology, 14th edition, page no.256.

40. Primary Amenorrhoea, Analysis in 108 cases, Habiba et al, Jaypee Journals,2012.

41. Menstrual disturbances in various thyroid diseases, Kakuno et al,Endoc.J, 2010:57(12) 1017-22.

42. Exercise and menstrual function: A review study,Sikiru Lamina et al, Scientific Research Health, vol 5,no.12(2013).

43. Endometrial Histology in abnormal uterine bleeding,MC vol 17, 2011(68-71).

44. Prevalence of Dysmenorrhoea among Omani High School students, Rahma et al, SQUMJ, Nov 2011, 11(4), 485-491.

45. Premenstrual Syndrome and Academic stress in emerging adulthood women, BMJ Pameela 2009.

46. Psychological stress in the work place and menstrual function. Fenster L, Walker et al. AMJ Epidemiol 149,127-134.

47. Academic stress and menstrual disorders among female undergraduates- the need for health education. K.J.Davis, U.P.Akpan et al, Niger J Physiol. Sci. 2011 Dec. 193-198.

48. Environmental Stress and ovarian function. Armstrong DT et al, Biol Reprod.34, 29-38.

49. Menstrual Pattern and common menstrual disorders among university students. Cakir et al. Pediatric Int 49:938-942.

50. Psychological stress and the menstrual cycle. Kivimac, Sanders et al, J Blosoc Science 31(3):393-402.

51. Non pharmacological strategies used by adolescents for the management of menstrual discomfort. Campbell et al. Clin J Pain 1999;15:313-20.

52. Physiology of long pranayamic breathing: Neural respiratory elements may provide a mechanism that explains how slow deep breathing shifts autonomic nervous system, Ravinder Jerath, 23 Feb 2006.

53. Impact of Yoga Nidra on psychological general well being in patients with menstrual irregularities. A randomised controlled trial. Kushbu Rani, SC Tiwari et al. International Journal of Yoga 2011/volume4/page 20-25.

54. Neurophysiological Studies in Yoga in Health and Diseases, Dr. N. Sathyaprabha, International symposium on Yogism, Dec.2010

55. The effects of Menorrhagia on women's quality of life: A case control study. ISRN Obst. Gynecol 2013.Sule-Gokyildis, Ergul Aslan.

56. The role of exercise in the treatment of menstrual disorders: The Evidence. Amanda Daley Br J Gen. Pract. April 2009, 241-242.

57. Thyroid disorders in childhood and adolescence, Alphonsus N Onyiriuka, Philip et al. Greener Journal of Medical Sciences, volume 2 page 45-50.

58. Stress and Dysmenorrhoea: A Population based prospective study.Wang, Chan. Occupational Environ Med 2004 1021-1026.

59. Estimation of relationship between psychological stress and serum cortisol level: A clinico biochemical study. Goyal,Jaioo et al. Indian J Dent Res 2011.

60. Prevalence of menstrual pain in young women: Giovanni Grandhi, Serena et al, J pain Res. 2012, 5:169-174.

61. Incidence of Endometrial hyperplasia in 100 cases of polymenorrhagia- Amera Takreem, Nargis Danish et al, J Ayub Med Coll. 2009;21(2).

62. Questionnaire study on menstrual disorders in adolescent girls in Singapore. Anupriya Agarwal, Annapoorna Venkat. Journal of pediatric & adolescent gynaecology volume 22 page 365-371.

63. Association between menstrual cycle irregularities and poly cystic ovarian syndrome. Dimitrios Panidis, Elena.European Journal of Endocrinology Oct 2012. Page 145-152.

64. Awareness of menstrual abnormality amongst college students in Nigeria. Esimai, Esan et al. Department of Community Health Article volume 35, page 63-66.

65. Effect of yogic practices on menstrual disorders in adolescents. Ulka Natu, Mrunalini –International Conference at Suyasa, Bangalore.

66. Menstrual abnormalities in school going girls- Are they related to Dietary & Exercise pattern? Rupa Vani, Veena et al. JCDR/2013/6464.3546.

67. Study of puberty menorrhagia in adolescent girls in a rural set up. Shikka Joshi, Hariharan Chella. JP Journals-10006-1187.

68. Relationship of menstrual irregularities to BMI and nutritional status in adolescent girls- Saira Darsi, Khashia Sayed. Pak J Med Sci 2014 30(1): 140-144.

69. Reproductive health of adolescent girls in an urban population of Meerut, Uttar Pradesh. Kajal Jain, S.K.Garg. Health and population: Perspectives & issues. Volume 32(4), 204-209.

70. Vegetarian and menstrual cycle disturbances: Is there an association? Susan, Barr et al. American Journal of clinical nutrition. 1999 volume 70.

71. Attitudes towards dysmenorrhoea, impact and treatment seeking among adolescent girls. Wong L.P. J Rural health 2011 Aug 19(4) page 218-23.

72. Cytogenic studies in amenorrhoea. Rajangam, Nanjappa L. Saudi Med J 2007 28((2):187-92.

73. Stress and Female reproductive system. S.N. Kalantaridou, Chrouros. Journal of Reproductive Immunology. Volume 62, issue 1. Pages62-68.

74. Health scene investigation, Cohen S, Kamark T, A global measure of perceived stress. J Health social behaviour, 1983;24;385-396.

75. A Questionnaire study on Menstrual disorders in Adolescent girls in Singapore, Agarwal et al,Jped. Adoles Gyn. 2009:22(6), 365-371.

76. Menstruation among adolescent girls in Malaysia. Singapore Med J 2006:47. 869-874.

77. Menstrual differences due to vegetarian and non vegetarian diets. Lloyd, Tom et al, American Journal for Clinical Nutrition.Health ISSN:0002-9165 year 1991.

78. Study of anaemia in adolescent school girls of Bhopal.Rakesh Kakkar, Monica et al. Indian Journal of community health, volume 22, No.2(2010-2011).

79. Thyroid Profile in menstrual disorders, Neelu Sharma, Anita Sharma, JK Science, vol 14 no. 1, Jan-March 2012.

80. Menstrual dysfunction and thyroid Disorders. Menon VK, Barucha KE, J Obst. Gyne India 1995;45(4) 521-526.

81. Lifestyle modifications for obesity. Thomas A Wadden, Victoria et al, Circulation, March 2012:125(9):1157-1170.

82. The association between weight, physical activity and stress and variation in length of menstrual cycle. Harlow SD,Matanoski et al. AMJ Epidemiol 133,38-49,ork Env Health.

83. Effect of Yoga on cardiovascular and mental status in normal subjects above 30 years of age. Anita Herur et al, Al Ameen J Med Sci 2010,(4):337-344.

84. Effect of mental relaxation and slow breathing in essential hypertension. Kaushik R.M, Mahajan S.K. Complement Ther Med 2006; 14(2), 120.

85. Stress reduction programme in patients with elevated Blood Pressure. A Systematic review and Meta analysis. Curr. Hypertens Rep 2007 9(6) 520-528. Rainforth m.v, Schneider R.H.

86. Relationship between psychological stress, serum cortisol, Expression of MMP-1 in Male police personnel. Little Mahendra et al, International Journal of Scientific and Engineering Research volume 3, issue 9. Sept 2012.

87. Effect of systematic of menstrual health education on dysmenorrheic female adolescent's knowledge,attitudes and self carebehaviour. Chiou MH,Wang et al. Kaohsiung J Med Sci. 2007;23:183-190.

88. Association between emotional stress and menstrual pain in young women. Ferin et al, Health Psychol 2001;20: 411-441.

89. Hypothalamic-Pituitary-Gonadal axis hormones and cortisol in both menstrual phases of women with chronic fatigue syndrome and effect of depressive mood on these hormones. Remzi cevic et al, BMC Muscular Disorder. 2004:5:47.

ANNEXURES

Questionnaire

A study of Prevalence of Menstrual Irregularities in late Adolescent Girls and usefulness of Non-pharmacological adjuncts

Name : Age:

1.During last 6 months, have you had absence of periods for more than 3 months? Yes/No

2.During last 6 months ,have your periods occur at regular intervals? Yes/No

(22 to 35 days interval is normal)

If not regular, is the periods occurring at <21 days : Yes/No

Or periods occurring at more than 35 days : Yes/No

3. During last 6 months,is the amount of menstrual flow normal?

Yes/No

3 to 5 days flow is normal and changing a total of 3 to 12 pads is normal. If not normal,

Are you

A) changing less than 2 pads totally : Yes/No

b) changing more than12 pads totally : Yes/No

c) Duration of flow less than 2 days : Yes/No

d) Duration of flow more than 6 days : Yes/No

e) passing blood clots during periods : Yes/No

4. During last 6 months,any spotting or bleeding inbetween normal periods (Yes/No)

5. Do you suffer from severe lower abdominal pain during periods affecting your daily activities? (Yes/No)

6. Are you taking any drugs for menstrual problems during last 6 months? (Yes/No).

If yes details about it. Signature

PROFORMA

A STUDY OF PREVALENCE OF MENSTRUAL IRREGULARITIES IN LATE ADOLESCENT GIRLS AND USEFULNESS OF NON PHARMACOLOGICAL ADJUNCTS

Sl No: Date: Age:

Name: Ht: Wt: BP:

Address:

Personal History:

Diet:Veg/Nonveg/Milk intake/Green leafy vegetables/Snacks

Smoking/Alchohol

Drugs for menstrual problems/other problems :

H/O Diabetes/Hypertension/operations/others :

Family History of menstrual problems :

Menstrual History

Age of menarche :

Menstrual cycle duration between last two periods :

Menstrual blood loss during last period :

i.e. No of pads soaked in each day : Mildly soaked/Moderately soaked/ Fully soaked

(Describe separately for each day)

PBAC Score :

Severity of menstrual pain :

No pain/Mild/Moderate/Severe

Fits into the category : Primary amenorrhoea/ Secondary amenorrhoea / Oligomenorrhoea / Polymenorrhoea / Hypomenorrhoea / Menorrhagia

H/O Physical activity:Yes/No Hours of sleep per day: Duration of watching TV:

Stress Scoring :

Haemoglobin :

Thyroid profile :

Serum cortisol :

Ultrasound findings :

POST INTERVENTION

Ht : Wt : BMI :

Stress scoring :

Serum cortisol :

Severity of Menstrual pain :

No pain/ Mild/ Moderate/ Severe

No. of pads soaked in each day of last periods : Mildly soaked/ Moderately soaked/ Fully soaked

(Describe for each day separately)

PBAC Score :

Cycle duration between last two periods :

I consent for the study to be done on me having been informed about its significance.

Signature

PERCEIVED STRESS SCALE

(இந்த அட்டவணையில் கடந்த ஒரு மாதத்தில் உங்களுக்கு ஏற்பட்ட உணர்வுகள் மற்றும் எண்ணங்கள் குறித்த கேள்விகள் உள்ளன. ஓவ்வொரு கேள்விக்கும் உள்ள பதில்களை வட்டமிட்டு குறிப்பிடவும்.)

பெயர் :..... தேதி .....

வயது ..... (இனம்) ஆ/பெ பிற .....

(0 – எப்பொழுதும் இல்லை 1- அநேகமாக எப்போதும் இல்லை

2 – சிலசமயங்கள் 3 – அடிக்கடி 4 - அநேகமாக எப்போதும்)

(கடந்த ஒரு மாதத்தில்)

1. கடந்த ஒரு மாதத்தில் நடந்த எதிர்பாராத சம்பவங்களை எண்ணி எத்தனை முறை வருந்தியிருப்பீர்கள்? 0 1 2 3 4
2. எத்தனை முறை உங்கள் வாழ்க்கையில் ஏற்பட்ட முக்கியமான நிகழ்ச்சிகளை கட்டுப்படுத்த முடியாமல் வருந்தினீர்கள்?

   ..... 0 1 2 3 4
3. எத்தனை முறை பதட்டம் மற்றும் மன உளைச்சல் ஏற்பட்டது? 0 1 2 3 4
4. எத்தனை முறை உங்கள் சொந்த பிரச்சனைகளை உங்கள் திறமை மீது நம்பிக்கை வைத்து கையாள முடிந்தது?

   ..... 0 1 2 3 4
5. எத்தனை முறை சம்பவங்கள் நீங்கள் நினைத்த மாதிரி நடந்ததாக உணர்ந்தீர்கள்? 0 1 2 3 4

6. எத்தனை முறை நீங்கள் செய்ய வேண்டிய அனைத்துச் செயல்களையும் உங்களால் எதிர்கொள்ள முடியவில்லை என எண்ணிணீர்கள்?

..... 0 1 2 3 4

7. எத்தனை முறை உங்கள் வாழ்க்கையில் ஏற்பட்ட எரிச்சலூட்டதக்க விசயங்களை உங்களால் கட்டுப்படுத்த முடிந்தது?

..... 0 1 2 3 4

8. எத்தனை முறை நீங்கள் நல்ல முறையில் செயலாற்றியதாக உணர்ந்தீர்கள்? 0 1 2 3 4

9. எத்தனை முறை உங்களால் கட்டுப்படுத்த முடியாத செயல்கள் உங்களை கோபப்படுத்தியிருக்கும்? 0 1 2 3 4

10. எத்தனை முறை துன்பங்கள் அடுக்கடுக்காக வந்ததால் உங்களால் சமாளிக்க முடியவில்லை என்று நீங்கள் உணர்ந்தீர்கள்?

..... 0 1 2 3 4

Score

CONSENT FORM

Dr.A.Kala, Postgraduate student in the department of physiology, Tirunelveli Medical College, Tirunelveli is studying the Prevalence of menstrual irregularities in late adolescent girls and the usefulness of non pharmacological adjuncts. The procedures involved are clinical examination, relevant blood investigations and application of non pharmacological interventions. The procedure was explained to me clearly. After knowing about the details of the procedure, I give my valid consent to participate in the study. The data obtained can be very well used for research and other publication purpose.

Name :

Place :

Signature :

MASTER CHART

DATA OF STUDY GROUP

Sl.No.	Hb gm%	T3 ng/dl	T4 mcg/dl	TSH mIU/ml
1	11.2	104	11	1.4
2	12	110	8.6	3.8
3	10	96	8	3.8
4	10.6	102	8.4	2.8
5	12.2	98	8.8	3.6
6	10.8	110	10.2	1.2
7	10.6	86	6.4	4.2
8	11.8	116	11.2	1.3
9	11.2	102	9.8	2.2
10	10.8	82	8.2	4
11	11.4	86	6.8	4.2
12	11.4	120	10.2	3.1
13	11.8	92	6.4	3.8
14	10.6	90	9.6	2.8
15	11.2	86	6.8	4.8
16	12	120	9.6	2.1
17	11.6	88	8.8	3.2
18	12.4	96	9.6	2.2
19	11.8	98	8.8	3
20	12	98	11.2	1.8
21	10.6	86	8.6	1.8
22	10.8	110	11.2	0.8
23	11.2	100	6	2.8
24	11	70	1.8	75
25	7.3	110	10	2.5
26	11.2	120	11	2.8
27	6.8	127	10.3	3
28	12	110	10.2	3.2
29	7	120	11	3.2
30	7.8	68	18	20
31	7.2	100	10	2.3
32	11.6	130	9.8	1.1

Sl.No.	Hb gm%	T3 ng/dl	T4 mcg/dl	TSH mIU/ml
33	12.2	98	9.6	0.8
34	11.2	104	8.8	3.8
35	11.4	110	11	1.8
36	11.2	104	6.8	0.8
37	12.4	120	10	3.6
38	11	124	8.2	1.6
39	11.2	98	9.6	2.8
40	10.2	110	9.2	2.6
41	11.8	90	9.6l	3
42	11	130	10	0.8
43	12	140	10.2	0.8
44	11.2	100.2	7.8	2.6
45	11.8	110	8.8	3.2
46	11	106	8.6	1.2
47	12.2	124	11.6	0.9
48	11	106	9,6	2.4
49	10.8	96	7.2	1.1
50	11.2	90	10.2	3.4
51	11.8	106	10.2	1
52	11.2	90	8	1.4
53	12	78	5.8	4.8
54	11.8	126	10.8	0.8
55	12.8	110	8.6	2
56	12	86	8.2	3.6
57	11.2	106	8.8	3.6
58	11.8	108	6	3.6
59	12.2	110	10.6	0.8
60	13	112	9.8	1.4
61	10.2	106	10.6	1.4
62	10.8	100	6.8	1.4
63	9.9	88	5.8	4.2
64	10	120	10.8	1.2

Sl.No.	Hb gm%	T3 ng/dl	T4 mcg/dl	TSH mIU/ml
65	11	100	10	1.8
66	11	86	5.6	4.4
67	12.2	102	9.8	1.8
68	10	106	10	0.8
69	9.6	88	6.2	4
70	10.2	90	6.2	3.6
71	11.8	110	9.8	0.8
72	12.6	98	9.6	3.8
73	11.2	142	10.3	2.1
74	12	120	9.8	3
75	10.8	114	9.6	3.2
76	11,0	102	10.2	2
77	12.3	96	8.6	3.8
78	10.8	126	9.8	3
79	11.2	140	11	1.8
80	10.7	100	10	2
81	10.8	121	10.3	2.2
82	11.4	130	11.2	1.8
83	11	128	11	1.6
84	12.2	94	9.8	3.8
85	10.6	132	12	0.8
86	11	88	9	3
87	10	150	13	0.8
88	11.8	102	10	2.8
89	11	116	10.2	2.6
90	12	140	11	1.1
91	13	100	9.8	2.8
92	11.8	98	8.6	4
93	10.4	110	9.8	2.6
94	11.6	130	11.2	1.2
95	12.2	128	11	2
96	11	110	11.4	2.1

DATA OF OLIGOMENORRHOEA GROUP

S.NO	AGE	DIET	AGE AT MENARCHE	Blood Presure in mm Hg				BMI		CYCLE LENGTH IN DAYS		PBAC SCORE		DYSMENORRHOEA SCORE		STRESS SCORE		SERUM CORTISOL (mcg/dl)		USG
				PRE BP		POST BP														
				SYS BP	Dias BP	SYS BP	Dias BP	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	
1	17	NV	13	110	80	100	70	24.4	24.4	45	40	50	50	0	0	12	11	11.8	10.8	Normal
2	17	NV	14	114	70	110	70	21.9	21.8	48	40	45	40	0	0	14	12	13.4	11.4	Normal
3	17	NV	13	110	80	100	70	16.6	16.9	45	35	50	55	1	0	14	14	14	13	Normal
4	17	NV	13	110	80	100	76	19.4	19.4	45	42	40	50	0	0	13	13	15	15.2	Normal
5	17	NV	13	120	80	110	70	25.1	25	42	33	45	50	0	0	14	13	14	12	Normal
6	17	NV	14	110	80	100	70	18	18	40	32	45	55	0	0	18	16	25	20	PCOD
7	17	NV	13	110	70	100	70	15.97	15.97	38	33	50	55	1	0	14	14	14	14	Normal
8	17	VEG	14	120	76	110	68	20	20	36	36	30	35	0	0	17	15	28	20	PCOD
9	17	NV	12	100	70	100	70	28.88	28.6	42	40	40	45	1	1	16	13	20.2	18	PCOD
10	17	NV	13	110	70	102	70	22.89	22.6	40	33	35	35	0	0	14	13	16.2	15	Normal
11	17	NV	12	110	76	110	72	24.14	24	45	42	50	50	0	0	20	18	18.8	16	Normal
12	17	NV	13	120	70	120	70	24.88	24.88	42	40	50	50	1	1	16	11	18.8	13	PCOD
13	17	NV	12	110	70	100	70	20.02	20.02	50	40	15	20	0	0	15	16	14	15	Normal
14	18	NV	15	110	70	100	70	30.22	29	45	30	45	40	0	0	18	15	16.8	14.8	PCOD
15	18	NV	14	100	70	100	70	23.11	23.11	45	35	50	50	1	1	15	14	16.2	14.2	Normal
16	18	NV	14	110	80	110	80	18.26	18.26	40	35	50	50	0	0	20	15	18	15	PCOD
17	18	NV	14	120	80	110	80	24.65	24	42	35	60	60	0	0	13	13	12	12.1	Normal
18	18	NV	12	110	80	104	70	23.37	23.37	45	35	70	70	0	0	13	12	13	12	Normal
19	18	NV	14	110	70	110	70	20.81	20.81	42	33	20	20	0	0	13	12	20	15	Normal
20	18	NV	15	120	70	110	70	21.48	21.48	38	32	45	45	0	0	15	11	20.2	14	Normal
21	18	VEG	12	110	70	100	70	21.33	21.33	40	30	50	50	0	0	18	12	18.2	15	Normal
22	18	NV	14	104	74	100	70	17.77	17.77	40	40	50	50	0	0	18	12	16	15	PCOD
23	19	NV	15	96	70	100	70	22.22	22.22	45	40	60	60	1	1	13	11	13.2	12	Normal
24	19	NV	15	106	80	100	80	21.64	21.64	58	45	60	60	0	0	15	11	17.4	13	Normal
25	19	VEG	13	120	80	116	76	19.53	20	42	40	60	60	1	1	13	13	12.6	16	Normal
26	19	VEG	13	110	80	110	80	21.64	21.64	45	35	15	15	0	0	21	15	17.8	11	Normal
27	19	NV	15	120	70	120	70	19.97	19.97	36	30	45	50	1	1	19	17	16.2	16	Normal
28	19	NV	13	110	80	100	70	25.87	25.87	43	42	60	60	0	0	13	11	18.2	15	PCOD
29	19	NV	13	110	80	100	80	23.37	23.37	46	40	65	65	1	0	14	14	14	15	Normal
30	19	NV	13	110	80	100	76	22.65	22.65	42	40	60	60	0	0	14	15	16	15	PCOD
31	20	NV	13	110	80	104	80	26.23	26.23	38	34	40	40	0	0	16	11	20	15	PCOD
32	20	NV	13	110	80	110	80	20.2	20.2	42	40	15	20	1	1	14	12	18	16	Normal
33	20	NV	12	110	80	110	80	20.56	20.56	44	40	45	45	1	1	14	11	26	20	Normal
34	20	NV	10	120	80	106	80	20.31	20.31	50	40	40	40	0	0	18	12	19	14	Normal
35	20	NV	13	110	80	100	80	24.77	24.77	42	30	45	45	0	0	18	12	16	13	Normal
36	20	VEG	13	130	80	120	80	20.81	20.81	40	35	45	45	0	0	18	12	20	14	Normal
37	20	NV	13	120	80	110	80	20.34	20.34	42	30	60	120	0	0	18	13	18	16	Normal
38	20	VEG	15	110	80	110	76	24.65	24.65	43	30	15	15	0	0	16	12	20	12	PCOD
39	20	NV	13	110	80	106	80	18.82	18.82	43	40	15	20	0	0	14	12	16	14	Normal
40	20	VEG	13	110	76	110	80	20.02	20.02	43	40	50	50	0	0	10	12	14	13	Normal

DATA OF POLYMENORRHOEA GROUP

S.NO	AGE in yrs	AGE AT MENARCHE in Yrs	Blood Presure in mm Hg				BMI		CYCLE LENGTH IN DAYS		PBAC SCORE		DYSMENORRHOEA SCORE		STRESS SCORE		SERUM CORTISOL (mcg/dl)		USG
			PRE BP		POST BP														
			SYS BP	Dias BP	SYS BP	Dias BP	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	
1	17	12	110	74	106	70	28.6	28.6	20	25	75	51	1	1	18	16	20	15	Normal
2	17	14	114	70	110	70	16.88	16.9	18	22	140	100	0	0	16	12	20	15	Normal
3	17	13	104	70	100	70	22.22	22.22	20	25	40	45	2	1	12	12	13	12	Normal
4	17	12	110	80	106	76	17.57	17.57	18	20	120	120	2	1	15	14	18	15	Normal
5	18	13	110	70	110	70	20.52	20.52	18	25	50	50	2	1	17	12	18	14	PCOD
6	18	14	110	70	104	70	22.95	22.8	16	25	30	40	1	1	14	11	12.8	12	Normal
7	18	14	110	70	110	70	24.44	24.44	20	30	130	110	1	1	15	15	17.4	15	Normal
8	19	14	110	82	110	80	26.66	26	18	26	15	50	0	0	21	17	18.2	19	PCOD
9	19	11	110	70	104	70	23.23	23.23	20	30	50	50	1	1	14	11	14.6	12.2	Normal
10	19	15	110	70	110	70	22.03	22.03	20	25	40	45	3	2	22	18	18.2	16	PCOD
11	19	14	110	80	110	76	24.97	24.97	20	22	120	110	1	0	22	15	14.2	14	Normal
12	19	13	118	70	106	70	23.78	23.78	15	20	40	40	0	0	16	12	20.2	18	Normal
13	20	13	110	80	110	80	21.33	21.33	19	20	35	35	1	0	22	18	24	20	Normal
14	20	13	110	80	100	80	20.95	20.95	18	25	40	40	1	1	17	15	18	17	Normal
15	20	16	110	80	100	70	24.77	24.77	20	28	110	110	1	0	20	12	14	12	Normal

DATA OF HYPOMENORRHOEA GROUP

S.NO	AGE in yrs	AGE AT MENARCHE in yrs	Blood Presure in mm Hg				BMI		CYCLE LENGTH IN DAYS		PBAC SCORE		DYSMENORRHOEA SCORE		STRESS SCORE		SERUM CORTISOL (mcg/dl)		USG
			PRE BP		POST BP														
			SYS BP	Dias BP	SYS BP	Dias BP	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	
1	17	15	100	70	100	70	22.6	22.6	30	30	15	20	0	0	12	11	13	12	Normal
2	17	14	110	72	100	68	27.5	27.5	28	30	15	20	0	0	21	16	22	16	PCOD
3	17	13	110	70	100	70	16.6	18	30	30	15	20	0	0	12	12	14	15	Normal
4	17	13	110	80	110	70	17.6	18	32	35	15	30	0	0	14	13	15.2	14.2	Normal
5	17	12	110	70	100	70	20	20.02	50	40	15	20	0	0	15	16	14	15	Normal
6	17	13	110	70	106	70	17.6	17.57	30	30	15	15	0	0	15	11	10.4	10	Normal
7	18	13	110	76	104	70	23.1	24	30	30	15	30	0	0	14	10	10.8	11	Normal
8	18	11	110	80	110	70	26.7	26	32	32	20	25	0	0	16	14	11	10	Normal
9	18	14	110	70	100	70	25	24.97	30	30	15	20	0	0	12	12	12	13	Normal
10	18	14	110	70	110	70	20.8	20.81	42	33	20	20	0	0	13	12	20	15	Normal
11	19	13	120	80	110	76	25.8	25.77	33	30	10	15	0	0	12	12	13	13.6	Normal
12	19	13	110	80	100	70	18.3	20	32	30	15	15	0	0	18	14	14	11	Normal
13	19	13	110	80	110	80	21.6	21.64	45	35	15	15	0	0	21	15	17.8	11	Normal
14	19	13	110	80	110	70	20	20	32	33	15	20	0	0	18	15	14	12	Normal
15	19	14	120	84	116	80	25	24.97	30	30	10	15	0	0	16	14	18	15	Normal
16	20	13	110	80	110	80	20.2	20.2	42	40	15	20	1	1	14	12	18	16	Normal
17	20	15	110	80	110	76	24.7	24.65	43	30	15	15	0	0	16	12	20	12	PCOD
18	20	13	110	80	104	80	20	19.97	32	30	10	10	1	0	14	12	14	13	Normal
19	20	12	110	76	110	76	18.5	18.49	33	30	10	20	0	0	14	14	16	15	Normal

DATA OF MENORRHAGIA GROUP

S.NO	AGE	DIET	AGE AT MENARCHE in Years	Blood Presure in mm Hg				BMI		CYCLE LENGTH IN DAYS		PBAC SCORE		DYSMENORRHOEA SCORE		STRESS SCORE		SERUM CORTISOL (mcg/dl)		USG
				PRE BP		POST BP														
				SYS BP	Dias BP	SYS BP	Dias BP	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	
1	17	NV	14	100	70	100	70	24.9	24.8	28	30	140	90	2	1	15	14	11.4	11	Normal
2	17	NV	14	114	70	110	70	16.88	16.9	18	22	140	100	0	0	16	12	20	15	Normal
3	17	NV	13	110	80	100	70	30.22	28	30	32	120	95	0	0	16	12	20	15	PCOD
4	17	NV	12	106	74	100	70	21.33	21.33	32	33	130	95	1	0	14	15	18.2	14	Normal
5	17	VEG	12	110	80	106	76	17.57	17.57	18	20	120	120	2	1	15	14	18	15	Normal
6	18	NV	13	120	78	110	70	23.11	23.11	27	30	120	90	1	1	13	12	16	12	Normal
7	18	NV	13	116	70	110	70	20.31	20.31	28	30	115	100	1	0	14	12	13.2	10.2	Normal
8	18	NV	14	110	70	100	70	24.97	24.97	33	30	120	95	1	0	15	12	12.8	12	Normal
9	18	NV	13	118	82	104	76	17.77	17.77	28	28	130	110	1	1	14	11	18	18	Normal
10	18	NV	14	106	78	100	70	26.03	26.03	32	32	130	90	0	0	18	13	24	20	Normal
11	18	VEG	14	110	70	110	70	24.44	24.44	20	30	130	110	1	1	15	15	17.4	15	Normal
12	18	NV	13	110	70	110	70	23.43	23.43	28	28	150	130	0	0	12	11	12.8	13	Normal
13	19	NV	10	110	70	106	70	22.22	22.22	27	28	130	110	1	0	14	12	16	13.2	Normal
14	19	NV	14	110	80	110	70	20	20	28	30	150	120	2	1	14	13	12.6	12	Normal
15	19	NV	15	110	80	100	76	21.48	21.48	30	30	135	90	0	0	22	12	11.4	11	Normal
16	19	NV	16	110	70	110	70	23.49	23.49	30	30	130	80	0	0	20	18	24	20	Normal
17	19	NV	14	110	80	110	76	24.97	24.97	20	22	120	110	1	0	22	15	14.2	14	Normal
18	19	VEG	13	110	80	110	80	22.03	22.03	28	30	130	120	1	0	15	13	1o	11	Normal
19	20	NV	13	116	80	110	80	17.34	17.34	30	30	130	110	3	2	18	12	14	12	Normal
20	20	NV	14	110	80	110	70	22.18	22.18	28	28	120	110	2	1	19	11	20	15	Normal
21	20	NV	13	110	80	110	70	21.64	21.64	26	40	140	20	2	1	14	11	22	16	Normal
22	20	NV	13	110	80	110	70	16.66	16.64	28	30	130	120	1	1	18	13	15	16	PCOD
23	20	NV	13	110	70	110	70	21.64	21.6	27	28	120	100	0	0	20	13	18	12	Normal
24	20	NV	16	110	80	100	70	24.77	24.77	20	28	110	110	1	0	20	12	14	12	Normal