

EVALUATION OF THE ROLE OF THYROID DYSFUNCTION IN FEMALES WITH MENSTRUAL IRREGULARITIES IN REPRODUCTIVE AGE GROUP

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Abstract

Background: This study evaluates organs involvement pattern, liver size or echotexture, splenomegaly, ascites, gall bladder abnormalities, cortical echogenicity and renal alterations in thalassemia patients.

Objective: To evaluate and compare abdominal sonographic findings in individuals with thalassemia and healthy individuals.

Methodology: This study employs a cross-sectional comparative design, conducted at the Ruqayya Medical Centre and Fatimid Foundation, Lahore, utilizing a Toshiba Nemio XG ultrasound machine, to assess the prevalence and characteristics of abdominal organs among thalassemia and healthy individuals. A total sample size of 150 participants. The sampling technique adopted was convenient sampling, ensuring the inclusion of eligible participants during the study period.

Results: The study considered various demographic, clinical, and different abdominal organs-related variables to assess the prevalence and severity of thalassemia. Gender distribution included 81 females (54.0%) and 69 males (46.0%), with age groups divided into <12 years (33.3%), 13-18 years (58.7%), and above 30 years (8.0%). Liver size included homogeneous (12.0%), Heterogeneous (82.0%), and Coarse (6.0%), Splenomegaly was reported by (67.6%), Gall bladder wall thickness status showed moderate (3.3%), severe (48.0%) and (28.0%) exhibited Sludge and (8.7%) had Calculi, Ascites in (31.3%). while (30.0%) experienced Mildly increased cortical echogenicity. In right Kidney group (36.0%) reported small, (33.3%) exhibited large right kidney, while left kidney group (42.0%) reported small left kidney, (32.0%) exhibited large left kidney.

Conclusions: This study emphasizes the importance of routine abdominal ultrasound in early detection and management of organ complication in thalassemia. Regular monitoring may help to control diseases progression and improve patient's outcomes.

INTRODUCTION

Overview of Thyroid Dysfunction and Menstrual Health

The menstrual cycle is an essential sign of fertility and general health among women. This is under hormonal control of the hypothalamic pituitary ovarian axis and is well orchestrated. The two hormones T4 and T3 are the main regulators of this axis. Though T4 is the most abundant hormone in the circulation, T3 is the most enthusiastic acting hormone in the body. Thyroid dysfunction impacts menstrual health in a way that serious issues such as oligomenorrhea, amenorrhea, menorrhagia, and polymenorrhea result from thyroid disturbances. Thus, understanding of this relationship is important for enhancing diagnostic and therapeutic approaches to menstrual dysfunctions in women (Krassas et al., 2010).

Thyroid dysfunction can be categorized broadly as a variety of hypothyroidism, hyperthyroidism or subclinical thyroid disorders. Each of these conditions affects women's menstrual cycles in different ways. Altered estrogen metabolism. In hypothyroidism, characterized by altered thyroid hormone production, can prolong menstrual cycle interval and duration bleeding. On the other hand, hyperthyroidism, with excessive thyroid hormone production, commonly is associated with light or absent menstrual periods caused by suppressed gonadotropin secretion. While these disorders are largely subclinical, in less symptomatic forms, they still have a major impact on menstrual health (Aggarwal et al., 2020).

Thyroid dysfunction appears to be common in women of reproductive age based on epidemiological data. For example, a study found that almost 22 per cent of women with menstrual disorders had underlying thyroid disorders. This cohort exhibited an exceptional prevalence of hypothyroidism that, in fact, was 15% or greater. Results further emphasize the importance of assessing thyroid function in women with menstrual disturbances (Krassas et al., 1999).

With regard to menstrual disturbances associated with thyroid, history and clinical examination, and laboratory investigations are employed when making diagnosis in clinical practice. This comprises assessment of serum samples of TSH, free T4 and in case of autoimmune disease free T4 and anti-thyroid antibodies. In most cases, women can resume regular menses with early diagnosis and either hormone replacement or anti-thyroid

treatment can also significantly enhance the incurred quality of life when diagnosing thyroid associated menstrual irregularities, patients should have their levels of TSH, free thyroxine checked and, in some cases, anti TPOAb to check of presence of autoimmune thyroiditis. These investigations are important because sub-clinical thyroid dysfunction may be fully asymptomatic or mimic symptoms of other gynecological or systematic disorders. New development in endocrinology has also pointed towards the possibility of thyroid disorders being linked with infertility and complications during pregnancy. It is stated that thyroid dysfunction in women of child bearing age that has not been managed appropriately increases risk of miscarriage, preterm delivery and other obstetrical complications. The results presented in this paper serve to underscore the necessity to pay more attention to thyroid abnormalities in this population, and to actively prevent the development of thyroid complications (Glinioer et al., 2014).

All in all, the interaction between thyroid disorder and menstrual complaints is an important area of study with strong relevance to practice. The changes which occur due to hormonal imbalances in thyroid disorders automatically impact the menstrual cycle and fertility as well as pregnancy. It is therefore important to look at the epidemiology of these conditions as it assists in designing proper diagnostic and therapeutic measures. It is for this reason that thyroid function should always be included in the gynecological examination with the view of helping women especially those in the child-bearing age. There are several ways through which thyroid hormones impact on the health of the menstrual cycle. They control the production and elimination of sex hormone-binding globulin, SHBG that affects the level of free estradiol and testosterone in circulation. There are the ways in which thyroid dysfunction affects ovarian follicle maturation and endometrium receptiveness that explains sociable link between infertility and thyroid disorders. Further, thyroid disorders are commonly associated with PCOS, which tends to make periods worse (Poppe et al., 2014). In treatment of thyroid dysfunction, the therapy focuses on the normalization of hormones and relief of menstrual cycle disturbances. In hypothyroidism, levothyroxine treatment is usually given to base the TSH level until there is a cure to the patients' menstrual complaints.

Hyperthyroidism when categorized by its cause could be managed through the use of drugs, radioactive iodine, or surgical procedures. Subsequent visits and hormonal tests help maintain the results of a healthier menstrual cycle for longer periods (Ren & Zhu, 2022). Outside of menstrual cycle fluctuations, thyroid issues have issues, and premature delivery. The authors in his article stress on the fact that the timely identification of thyroid disease in women intending to conceive can help to reduce the severity of the outcomes for both, the mother and the baby severe and vast consequences on reproductive health. If left uncontrolled, thyroid diseases may cause infertility, recurrent miscarriages, and preeclampsia, among other.

1.2 Normal Menstrual Cycle

Menstrual cycle is a physiological cycle, which occurs periodically in a women body and prepares it to conceive. This cycle is regulated by a sequence of hormonal feedback which encourages the maturation and shedding of an egg from the ovary together with preparing the uterus for an implantation. A normal cycle lasts for about 28 days but cycles between 21 and 35 days are also normal. An understanding of how the cycle is typically manifested, then, is necessary to establish benchmarks for what may be considered pathological or cause for diagnosis of any of the myriad possible menstrual disorders.

1.2.1 Hormonal Regulation of the Menstrual Cycle

The control of the menstrual cycle involves the hypothalamic-pituitary-ovarian (HPO) axis, which is feedback mechanism involving several central hormones.

1.2.2 Gonadotropin-Releasing Hormone (GnRH)

GnRH, produced in the hypothalamus, signals the anterior pituitary gland to release two key hormones: FSH and LH hormones are those commonly associated with the enzymatic reaction occurring in the human body.

1.2.3 Follicle-Stimulating Hormone (FSH)

FSH facilitates the elongation and development of structures in the animal ovary called the ovarian follicles and each of them has an ovum/egg. As the follicles grows and develops

deeper into the skin it secretes estrogen, a hormone vital to the proceeding phases of the cycle

1.2.4 Luteinizing Hormone (LH):

For ovulation the process by which a mature egg is released from the dominant follicle that's LH. This release is brought about by a sharp increase in LH levels, the LH surge, and a standard marker of the menstrual cycle.

1.2.5 Estrogen

Estrogen is primarily produced by maturing ovarian follicles and is important for making and building up the lining of the uterus (endometrium) in preparation for a potential implantation of a fertilized egg.

1.2.6 Progesterone

After ovulation, the ruptured follicle remnants become the corpus luteum, which secretes progesterone. The hormone that stabilizes and enriches the endometrial lining to aid a fertilized egg.

1.2.7 Inhibin

The ovaries also produce another hormone, inhibin, which prevents further development of FSH, so only a few follicles will mature each cycle (Ren & Zhu, 2022).

1.3 Phases of the Menstrual Cycle

The menstrual cycle is divided into distinct phases, each marked by specific hormonal fluctuations and physiological changes:

1.3.1 Menstrual Phase (Days 1-5) This is the beginning of the cycle or cycle phase during which the Uterine Lining (Endometrium) that is shed accumulated during previous cycles. Estrogen and progesterone levels are lowest during menstrual bleeding which typically lasts between 3 and 7 days. This hormonal dip makes the endometrial lining break down and shed.

1.3.2 Follicular Phase (Days 1-13)

The follicular phase starts on day 1 of menstruation and lasts until ovulation. In this, FSH stimulates growth of various ovarian follicles. When these follicles grow, they produce increasing amounts of estrogen,

resulting in thickened endometrial lining from preparation for pregnancy. By day 7, one of the many follicles gained dominance and grows mature and releases an egg on the day of ovulation.

1.3.3 Ovulation (Day 14)

About mid cycle, ovulation occurs, although its timing can vary depending on the length of the cycle. The LH surge that triggers the release of a mature egg follows a rise in estrogen levels. However, this egg lasts only 12 to 24 hours till it arrives inside the fallopian tube during which it can be evenly something to become fertilized.

1.3.4 Luteal Phase (Days 15–28)

Once ovulation has taken place the ruptured follicle becomes the corpus luteum and produces progesterone. It stabilizes and provides endometrial lining with what's needed to maintain itself to become implantable. A fertilized embryo secretes human chorionic gonadotropin (HCG), which sustains the corpus luteum and progesterone production. When fertilization did not take place, the corpus luteum degenerated, causing hormone levels to fall to periods of menstruation and a new cycle began. A 28 day cycle is often thought of as the norm but menstrual cycles can be wildly different as far as length, flow intensity and symptom related to the cycle. These variations have many reasons. Rarer is the experience among younger women, such as teenagers, who have cycles that are irregular as a part of their hormonal system growing up. However, regularity usually levels out in the 20s and 30s, but women may begin to become more irregular as they approach menopause. Cycle regularity can also be influenced by lifestyle factors, such as stress, physical activity and large changes to weight. Hormonal contraceptives, for example, birth control pills or IUD scan also change how menstrual cycles look, sometimes with lighter, more regular cycles or even no menstruation at all begin to become more irregular as they approach menopause. Cycle regularity can also be influenced by lifestyle factors, such as stress, physical activity and large changes to weight. Hormonal contraceptives for example, birth control pills or IUDs can also change how your menstrual cycles look, sometimes with lighter, more regular cycles or even no menstruation at all (Reddy et al., 2016).

1.4 Types of Menstrual Irregularities

There are many ways menstrual irregularities present themselves, and the impact they have on reproductive health, fertility and overall well-being in women. These irregularities are to be understood from their causes, clinical features and implications for effective diagnosis and management.

1.4.1 Amenorrhea

A girl having not begun menstruating by age 15, and who has not developed female secondary sexual characteristics, such as pubic hair and breast development, is said to have primary amenorrhea. Genetic condition like Turner syndrome, congenital anomalies such as Müllerian agenesis and functional disorder due to hypothalamic amenorrhea, in which hypothalamus does not stimulate the ovary, are common causes. The presence of this condition often implies a large number of underlying health problems, which can distort fertility and its psychosocial development demanding overall medical and treatment evaluation (McGee & Smith, 2015).

1.4.2 Secondary Amenorrhea

Secondary amenorrhea is loss of menstruation for at least 3 continuative cycles (6 months) in women with previous regular cycles. It is sometimes thought to be associated with pregnancy, polycystic ovarian syndrome (PCOS), thyroid disease, over exercise, or dramatic weight movements. This may also involve stress or certain medications that are chronic. Secondary amenorrhea is of great importance if untreated as it may adversely affect fertility, bone density and health (Weschler et al., 2006).

1.4.3 Oligo-menorrhea

Infrequent menstrual cycles, that is, menstrual cycles that are longer than 35 days apart or shorter than six months apart, constitute the definition of oligomenorrhea. The association between this condition and hormonal imbalances (such as PCOS, thyroid dysfunction or high Prolactin) is common. Other contributing factors include stress, massive weight fluctuations and certain medications. Because it interferes with ovulation, can cause irregular ovulation, and may predispose women

to unopposed estrogen exposure with a resultant endometrial hyperplasia, oligomenorrhea impairs fertility (Speroff & Fritz, 2005).

1.4.4 Menorrhagia (Heavy Menstrual Bleeding)

Abnormally heavy or prolonged menstrual bleeding, in amounts or duration sufficient to interfere with daily activities, is known as menorrhagia. It is clinically described as blood loss above 80 milliliters per cycle or periods of longer than seven days. Hormonal imbalance, uterine fibroids, adenomyosis, and coagulation disorders are all amongst the group of causes that range from systemic conditions like hypothyroidism. This may lead to anemia, fatigue, and greatly disrupt a person's lifestyle, and so menorrhagia requires medical intervention in order to be properly diagnosed and managed (Munro et al., 2011).

1.4.5 Polymenorrhea (Frequent Menstruation)

The term polymenorrhea refers to menstrual periods at regular intervals less than 21 days. Often, it's associated with luteal phase defects, hormonal disturbance or stress. Other common causes of contributing thyroid dysfunction and endocrine disorders. Timely diagnosis and treatment are critical in this condition, which may lead to anemia and affect a woman's quality of life (Fraser et al., 2007).

1.4.6 Metrorrhagia (Irregular Bleeding)

Metrorrhagia is irregular bleeding not related to expected menstrual cycles (light spotting to heavy bleeding). Hormonal imbalances, polyps, fibroids, infections, some malignancies are some of the common causes. And other medications, such as anticoagulants, hormonal contraceptives may also play a role. Women over 40 whose metrorrhagia isn't secondary to pregnancy ought to undergo prompt evaluation to rule out endometrial hyperplasia or cancer (NICE, 2018).

1.4.7 Dysmenorrhea (Painful Menstruation)

1.4.7.1 Primary Dysmenorrhea

Primary Dysmenorrhea is menstrual pain which is not caused by any pathological changes in the

pelvis. It commonly occurs several years after the onset of menstruation, and continues throughout the childbearing period. The pain is that there is an increased production of prostaglandins which cause uterine contractions and decrease the blood flow to the uterus. It is a rather frequent complaint; it has a major effect on quality of life; and it may only be treated by NSAIDs or hormonal contraceptives (Dawood et al., 2006).

1.4.7.2 Secondary Dysmenorrhea

Secondary dysmenorrhea results from underlying conditions such as endometriosis, adenomyosis, or pelvic inflammatory disease. It is often more severe and persistent than primary dysmenorrhea. Effective management may involve imaging, medical therapy, or surgical intervention, depending on the underlying cause (Giudice et al., 2010).

1.4.8 Premenstrual Syndrome (PMS) and Premenstrual Dysphoric Disorder (PMDD)

1.4.8.1 Pre menstrual Syndrome (PMS)

PMS involve somatic and affective symptoms such as breast tenderness, bloating, and mood swings that usually occur in the luteal phase and remit with menses. Its cause is not well understood but it is believed to be caused by hormonal changes and increased socialism with progesterone and estrogen. Lifestyle changes refer to management while drug intervention constitutes part of the medical treatment when the condition is compounded (Yonkers et al., 2008).

1.4.8.2 Pre menstrual Dysphoric Disorder (PMDD)

PMDD or premenstrual dysphoric disorder is PMS on a different level, as there are serious mood swings in the form of depression and irritability together with the concrete interference with the functioning. As we touch upon the specifics of PMDD, we should note it affects 3-8% of all menstruating women, and it is assumed that serotonin malfunction occurs in addition to hormonal shifts. Current pharmacological management includes selective serotonin reuptake inhibitors, hormonal therapy and lifestyle changes (APA et al., 2013). For females particularly those in the reproductive age, thyroid dysfunction plays

significant roll on the reproductive outcome. Hormones T3 and T4 have a critical effect to ovulation, menstrual cycles and overall endocrine function. The hypothalamic-pituitary-ovarian (HPO) axis straight affects menstrual cycle and fertility and thus any perplexity in these hormones can pull down the pattern. It has been found from research that women with thyroid disease experience high levels of menstrual disorders. The most common thyroid disorder in this nonsurgical population is subclinical hypothyroidism, which has been linked to menstrual disorders such as irregular, absent, or excessive menstrual cycles. Two other major menstrual disorders that may be occasionally related to obvious hypothyroidism are anovulation and infertility (Singh & Sharma, 2019).

1.5 Causes of Menstrual Irregularities

Many different causes are known to cause menstrual problems, such as hormone imbalance, various diseases, life style factors and the shape and size of the reproductive organs. Different etiologies need to be identified to ensure correct diagnosis, treatment as well as prognosis. The most apparent cause of menstrual irregularities will be discussed in this section to show how each of them affects the normal menstrual cycle (Reddy & Patel, 2022).

1.5.1 Hormonal Imbalances

Another very common cause of the IR is hormonal changes, like those that occur during pregnancy, nursing or being on any kind of hormonal contraception. The menstrual cycle is hormonal controlled, any interference of hormonal balance may cause abnormal cycles.

1.5.2 Hypothalamic Dysfunction

The hypothalamus a sub Section of the brain is also involved in the regulation of the menstrual cycle it prevents the releases of GnRH. Alterations like severe stress, major weight loss, or exercise inappropriateness can affect hypothalamus functionality resulting to disorders like hypothalamic amenorrhea whereby a woman loses her month end menstrual period (Sharma et al., 2022).

1.5.3 Polycystic Ovary Syndrome (PCOS)

Polycystic ovary syndrome it is a disease in women due to hormonal imbalance, excessive male hormones and insulin resistance. It affects cycles, making women with PCOS present with irregular periods, oligomenorrhea or amenorrhea. They increase the secretion of androgens beyond normal and this affects ovulation in such a way that the woman develops an irregular menstrual cycle.

1.5.4 Thyroid Disorders

Menstrual irregularity may be experienced in hypothyroidism also known as underactive thyroid gland or hyperthyroidism also known as overactive thyroid gland. Hypothyroidism causes menorrhagia and oligomenorrhea while hyperthyroidism causes light or absent periods in women. Besides metabolism and hormone control, the thyroid gland plays a vital part in menstrual health its regulating function (Bhandari et al., 2019).

1.5.5 Hyperprolactinemia

High level of prolactin commonly found to affect the menstrual cycle since it suppresses GnRH secretion that is responsible for milk secretion in women. It results in oligomenorrhea or amenorrhea and may be due to pituitary adenomas or the use of some drugs.

1.5.6 Adrenal Disorder:

Some pathophysiologic conditions associated with disturbances in organizations and functioning of adrenal glands, include Cushing's disease, congenital adrenal hyperplasia where there is an increased production of androgens, and this leads to miss or infrequent menstrual cycles. On the other hand, hyperthyroidism, or the condition in which the thyroid hormones are too high, change the menstrual cycle. Light or scanty periods, short periods, or even infrequent periods are often linked to hyperthyroidism. According to justify that hyperthyroidism results in hypomenorrhea or oligomenorrhea because the thyroid hormones accelerate the metabolism rate of estrogen making the regulation of menstrual cycle impossible. The oxidative metabolic rate that results from hyperthyroidism also interferes with normal

ovarian function and plays a part in decreasing production of progesterone, needed for normal menstruation and maturation of the endometrium. Therefore, the medical condition affects female fertility, with patients suffering from hyperthyroidism experiencing missed periods, failure of ovulation (Akanke et al., 2022).

Thus, thyroid abnormality is not only connected with menstrual irregularities, but can cause some problems with fertility as well. Hypothyroidism as well as hyperthyroidism have both been associated with delayed conception and amplified pregnancy wastage. The study of noted that women with untreated thyroid dysfunction are more likely to experience infertility since thyroxine hormones carefully regulate the discharge of gonadotropin hormones that facilitate ovulation. In addition, the study found that thyroxine treatment to hypothyroid women enhances the ovulatory Performa and raises the overall probability of pregnancy. Studies have demonstrated that anti thyroid trial or radioactive iodine therapy for hyperthyroidism usually helps in the regularization of the menstrual cycle and better fertility control (Bansal et al., 2023).

1.6 Thyroid Disorders Dysfunction

It is a well-known fact that thyroid dysfunction plays a considerable part to menstrual abnormalities since thyroid is directly involved in metabolic rate and hormonal interaction.

1.6.1 Hypothyroidism

In hypothyroidism, the hormone secretion by the thyroid gland is subnormal and causes a general slowing down of metabolism. Its manifestation range includes menorrhagia (excessive menstrual bleeding), oligomenorrhea (irregular periods), or amenorrhea if it is present in a woman of childbearing age. Reduced levels of T3 and T4 hormones can change the synthesis and secretion of other hormones at the hypothalamic gonadal portal, which affect menstrual cycles (Rajesh et al., 2017).

1.6.2 Hyperthyroidism

Hyperthyroidism, states of increased production of thyroid hormones, promotes increased metabolic rates and leads to a lack of regular menstruation or scanty menstruation, oligomenorrhea. In some situations, hyperthyroidism leads to amenorrhea, or absence of

menstruation," Sumiya noted. That is, excessive production of thyroid hormones may also lead to other related infertility concerns(Taylor et al., 2018).

1.7 Thyroid Function and Menstrual Cycle

The thyroid gland is a small gland situated in the neck shaped like butterfly and plays a major role in the synthesis of hormones that control metabolism, energy and body balance. Two main hormones synthesized by the thyroid gland include thyroxine and triiodothyronine both abbreviated as T4 and T3 in that order. These hormones are shed directly into the bloodstream and interact with virtually all cells within the body to regulate growth, development and sexual behaviors.

1.7.1 Physiology of the Thyroid Gland and Hormone Production

Thyroid hormones synthesis is controlled by hypothalamic-pituitary-thyroid (HPT) feedback mechanism or loop. The process starts in hypothalamus which release thyrotropin-releasing hormone (TRH). TRH produces secretion of TSH from the anterior part of the pituitary gland. TSH, in effect, encourages the thyroid gland to secrete T4 and T3 hormones into circulation. T4 lipids are many more than T3 lipids, but T3 is the more potent T3 lipids. In other areas T4 changes to T3 which acts on target cells. Thyroid hormones influence BMR, lipid metabolism, carbohydrate metabolism as well as metabolic heat production. They are also indispensable in formation and operation of the central nervous system, cardiovascular & even the reproductive system (Goyal et al., 2022).

1.7.2 Role of Thyroid Hormones in the Menstrual Cycle

Menstrual cycle is a rather complicated physiological cycle that is controlled by the hypothalamic-pituitary-gonadal (HPG) axis. It coordinates the secretion of hormones including GnRH and FSH, LH, estrogen and progesterone hormones. The thyroid hormones regulate the HPG combination and issue of these reproductive hormones at different levels. The thyroid gland produces two main hormones: T4 and T which is important in metabolism of the body throughout the day.

The secretion of these hormones is regulated by the hypothalamic-pituitary-thyroid (HPT) triangle. When the body needs more TH, the hypothalamus releases thyrotropin-release hormone (TRH) to signal the pituitary gland to produce thyroid-stimulating hormone (TSH) which signals the thyroid gland to release T4 and T3 (Kumaret al., 2020). Thyroid hormones have wide-ranging effects on the body, including the regulation of metabolism, growth, and development. They also play a significant role in reproductive health by influencing the menstrual cycle.

1.7.2.1 Gonadotropin Regulation

Thyroid hormones regulate the release of GnRH from the hypothalamus in pulses. FSH and LH from the stimulus of GnRH released into the blood stream of the anterior pituitary. These gonadotropins are required for follicle growth and maturation and the process of ovulation. Disrupted thyroid hormones in hypothyroidism results to changes in GnRH secretion that affects the release of FSH and LH and therefore the menstrual cycle (Pontikides et al., 2021).

1.7.2.2 Estrogen and Progesterone Metabolism

Estrogens and progestin also affect the metabolism of thyroid hormones. Estrogens affect the metabolism of thyroid hormones. Hypothyroidism is characterized by a decreased capacity for the liver to metabolize estrogen, and therefore increased blood concentrations of estrogen. This can lead to infertility and heavy bleeding for the same reasons namely the extension of the proliferative phase of the endometrium. Also, hormonal changes in progesterone and estrogen concentrations can cause distortion of the luteal phase of the menstrual cycle, luteal phase defects, and changes to the cycle's bloody discharge (Juneja et al., 2018).

1.7.2.3 Endometrial Function

The uterine endometrium is an endometrium that responds to hormonal changes during the menstrual cycle that occur within the uterus. Essentially, thyroid hormones are involved with the regulation of normal endometrial function. In hypothyroidism, the thickening of the endometrial is brought by prolonged stimulation by estrogen leading to heavy and irregular

menstrual bleeding.

1.8 Interaction between the HPT and HPG Axes

It is therefore important for both the HPT and HPG axes to have an optimal interaction so as to support the health of reproduction. Thyroid hormones are estrogen dependent, and they regulate reactivity of the ovaries to gonadotropins and the process of follicular development and ovulation. In hypothyroidism the interaction is impaired and this causes a number of menstrual abnormalities. For instance, TSH tends to be high in hypothyroid patients, which interferes with secretion of GnRH hormone leading to problems of menstrual cycles such as oligomenorrhea, menorrhagia and amenorrhea. The severity of these menstrual disturbances also depends on the extent of thyroid dysfunction, thus pointing out the significance of thyroid hormones for reproductive disorders (Yasmin et al., 2020).

1.9 Hypothyroidism and Menstrual Irregularities

Hypothyroidism, involving insufficient secretion of thyroid hormones, is a common endocrine disease, especially for women of childbearing age. This condition is such known to be linked with a range of abnormal menstrual patterns like menorrhagia, oligomenorrhea and amenorrhea. Recognizing the relationship between hypothyroidism and these menstrual irregularities is very important in diagnosis and treatment. The thyroid gland is established to have a function of metabolism regulation however its roles are very expansive to encompass menstrual cycle regulation since thyroid hormones are key to the cycle. Disruption of thyroid hormone synthesis results to hormonal derangement and the hypothalamic pituitary gonadal (HPG) axis which control menstrual cycles are not exempted. This discussion will explore the mechanisms through which hypothyroidism impacts menstrual regularity, the clinical presentation of menstrual disturbances in hypothyroid patients, diagnostic approaches, and treatment strategies (Zhanget al., 2021).

The thyroid gland produces two main hormones: t_4 and t_3 , which are important hormones that control the metabolism of the body. These hormones are produced and released through hypothalamic-pituitary-thyroid (HPT) axis action. When the body needs more thyroid hormones the hypothalamus releases thyrotropin-releasing hormone which makes the pituitary gland to release thyroid-stimulating hormone TSH which in turn make thyroid gland to release T_4 & T_3 . Thyroid hormones affect almost all the body systems; metabolic and growth and development. These herbs also have a contribution to reproductive welfare by managing the menstrual cycle (Lakshmi et al., 2020).

1.10 Mechanisms Linking Hypothyroidism and Menstrual Irregularities

1.10.1 Disruption of GnRH Secretion

GnRH is the hormone released by hypothalamus and is prerequisite to both the onset and the continuation of the menstrual cycle. In hypothyroidism, changes in the levels of thyroid hormones result in changes in the secretion patterns of GnRH plusability; the release of FSH and LH from the pituitary gland is affected as seen in Fig 1.1. Its disruptive impact can cause changes in menstrual cycle and also anovulation and many other

menstrual problems(Sood et al., 2016).

1.10.2 Impact on Estrogen and Progesterone Metabolism

Hypothyroidism interferes with metabolism of estrogen and progesterone hormones that have an important role in the female cycles. Low levels of thyroid hormones are related with high level of estrogen since thyroid hormone; stimulates hepatic estrogen metabolism. This causes a prolonged proliferative phase of the endometrium, this leads to menorrhagia. Lower secretion of progesterone because of dysfunctional luteal phase also leads to abnormal shedding of the endometrial layer, resulting in odd cycles.

1.10.3 Endometrial Dysfunction

The endometriosis is transformed in accordance with hormonal impulses and prepares for implantation throughout the menstrual cycle. The changes mentioned above are regulated by thyroid hormones(Deshmukh&Boric, 2023).

In hypothyroidism the endometrium may be hyperplastic due to high levels of estrogen which causes heavy menstrual bleeding. Additionally, it may affect the blood supply of the endometrium.

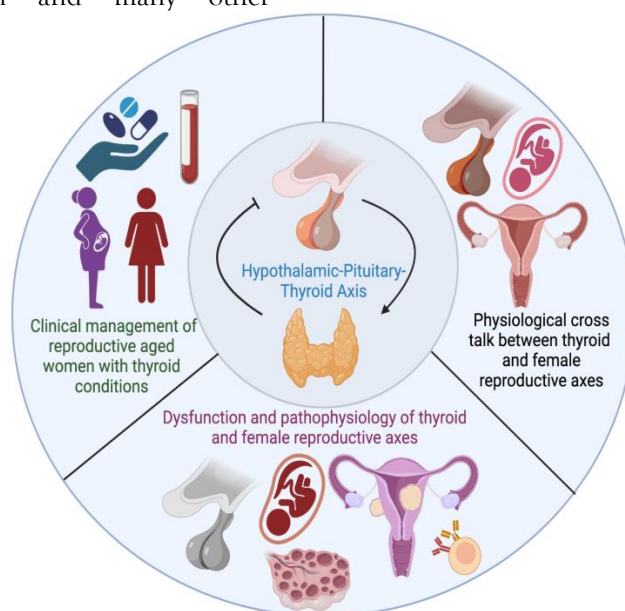


Figure 1.1: Clinical Presentation of Menstrual Irregularities in Hypothyroidism (Brown, et al., 2023).

1.11 Impact of Menstrual Irregularities on Women's Health

Hormonal fluctuations during the menstrual cycle impair women's health, and do not only concern fertility and childbirth. These irregularities may present themselves as heavy bleeding (menorrhagia), scanty and infrequent bleeding (oligomenorrhea), or no bleeding at all (amenorrhea). Fairly often, these complaints are secondary to more serious pathology, including polycystic ovarian syndrome, thyroid disorders, or metabolic disturbances. Hypothyroidism, a condition where there is reduced production of thyroid hormones, causes heavy or no menstruation while hyperthyroidism, a condition with high levels of thyroid hormones, will cause scanty and infrequent periods. Both conditions can cause hormonal imbalance and detrimentally affect fertility. The relationship between menstrual irregularities and fertility is also linked because hormonal imbalances that affect the menstrual cycle may also affect ovulation and other related biochemical processes. Besides fertility complications, menstrual irregularities can have other health effects. For instance, one complication of heavy menstrual bleeding (hMB) is its ability to cause anemia, especially due to excessive blood loss, making the woman feel weak, tired, among other symptoms (Ginsburg et al., 2019).

The psychological and social toll of irregular menstruation is more intense in women with hormonal disorders, including PCOS, thyroid disorders, and endometriosis. These conditions not only make one uncomfortable physically but also with himself or herself and the body. These disorders have manifold symptoms including weight gain, acne, and excessive hair growth, which are disturbing. Women with PCOS are always anxious when it comes to childbearing because infertility is one of the factors associated with PCOS. Counseling, or other forms of therapy, are usually needed for women experiencing these issues since they have to deal with the emotions of their conditions, which are as noted, debilitating. If the dysmenorrhea and other menstrual disorders are not treated in the long run, they cause more severe complications (Sharma & Tandon, 2021).

The limited generalizable body of research on the effects of thyroid dysfunction on menstrual health over the reproductive years complicates

clinical care decisions even further. Realizing this connection is important for the advancement of methodologies, plurality of administration, and determination of reproductive health and menstrual peculiarities of women. This work, hence, intends to focus on the investigational role of thyroid dysfunction in menstrual disorders among females of reproductive years to fill the knowledge gap and propose directions to change the clinical approach to the problem. The research question, "Where does thyroid dysfunction fit in menstrual disturbances in reproductive-aged females?", focuses on the promising gynecological disorders such as hypothyroidism or hyperthyroidism that disrupt menstrual health because the thyroid gland controls hormone levels that affect reproductive function. Studies have shown that menstrual abnormalities such as menorrhagia, oligomenorrhea, and amenorrhea are more common in women with thyroid disorders (Rahman et al., 2023).

This is of particular importance today, as untreated thyroid disorders are associated with serious risks for the cardiovascular system, metabolic disorders in the form of syndrome X, as well as anxiety and depression disorders, but worsened further. According to the research, there are implications for society and the economy. The reduction in the time taken from the onset of thyroid disorders or associated menstrual problems to diagnosis and subsequently, treatment, offers an opportunity to reduce health costs that come with managing severe complications of the thyroid ailments. This correlates with the demand by public health initiatives to increase scrutiny of women's endocrine and reproductive systems. Finally, this research provides a strong foundation for further studies exploring the evolving nature of thyroid dysfunction over time. For instance, examining the dynamic relationship (Rivkees et al., 2021).

Hormone disruption of the menstrual cycle can also occur outside classical hypothyroid and hyperthyroid states. Consequently, autoimmune thyroid diseases, including Hashimoto's thyroiditis, which is the leading cause of hypothyroidism, and Graves' disease, which is the leading cause of hyperthyroidism, have been linked to menstrual disorders. These are autoimmune disorders resulting in inflammation of the

thyroid gland, and thus hypothyroidism or hyperthyroidism. Autonomous thyroid diseases have also been found to affect the menstrual cycle since women with autoimmune thyroid diseases report have irregular menstrual cycles than women without these diseases. Furthermore, hypothyroidism, or the presence of thyroid antibodies in women even while their thyroid hormones levels are within normal range, may disrupt the menstrual cycle due to disruptions of hormonal balance by thyroid autoimmunity (Lakshmi et al.,2020).

Hyperthyroidism is a condition where the thyroid gland produces too much of the hormones resulting to an increased basal metabolic rate disrupts the normal hormonal cycling of the menstrual cycle appropriately. Thyroiditis may lead to hypomenorrhea or amenorrhea among women because it lightens the flow of fecal blood in the womb. Hyperthyroidism results to high levels of T4 and T3, which inhibit the secretion of gonadotropins from the pituitary gland – hormones that stimulate the ovaries and organize the menstrual cycles. Consequently, women suffering hyperthyroidism are likely to have an irregular menstrual cycle or even outright amenorrhea. It can also lead to subfertility disorders, which comes from the interference with ovulation, and women will have a hard time getting pregnant. Indeed, hyperthyroidism is associated with a high metabolic rate of weight loss itself, in addition to other general systemic effects, which may also cause menstrual dysfunction. As with hypothyroidism, hyperthyroidism is also curable with antithyroid drugs or with radioactive iodine therapy, which will assist in regulating the normal thyroid gland and thus widely contribute to better menstrual health (Tiwari & Mehta,2023).

Abnormal thyroid function also has consequences for female fertility, thyroid dysfunction significantly increased the risk of difficulty in conceiving and affected women with hypothyroidism and hyperthyroidism particularly. The thyroid hormones have a role to play in the process of ovulation that is the monthly discharge of an ovary which is essential for pregnancy. Besides impacting on anovulation, thyroid hormonal disturbances also affect the conceived eggs, their quality, and the endometrial receptiveness. For instance,

disorders of the thyroid affect the production of the hormone called luteal phase progesterone, which is required for implantation of the fertilized egg, as well as maintenance of the pregnancy. Thus, even pregnancies that occur in these women can be considered insecure, and there may be a miscarriage if thyroid dysfunction is not addressed. Infertility specialists and gynecologists therefore advise for thyroid testing as part of a general work-up for women with infertility, especially those with unexplained causes (Ren & Zhu, 2022).

Research Objectives

The research objectives for studying the role of thyroid dysfunction in menstrual issues among women of reproductive age focus on several key areas. Here's a detailed explanation of the objectives:

1. To identify the prevalence of thyroid dysfunction in menstrual disorders
2. To correlate thyroid dysfunction with specific menstrual patterns.
3. To evaluate the impact of thyroid treatment on menstrual health.

4. REVIEW OF LITERATURE

Chen et al. (2023) turned their focus and interest to thyroid function and metabolic conditions falling under fatty liver disease where they discovered low thyroid function correlate with risk of developing metabolic disorders particularly in women. These conditions can directly impact on periods through affecting hormonal and metabolic states. Diagnosis of thyroid dysfunction in Samples may differ according to age and sex especially in women as the creation of thyroid disease incidence database using age- and sex-specific reference ranges are more applicable when compared to a traditional reference range since these leads to over diagnosis of hypothyroidism in elderly women. Their research pointed out that when using the adjusted reference range, most of the older women diagnosed with subclinical hypothyroidism would be considered normal. The mood disorders like depression, anxiety predominate in individuals with thyroid disorders.

Jansen et al. (2023) worked on the symptom attribution aspects in hypothyroid patients

reported that around one-third of patients continued to have abnormal symptoms even after TSH level became normalized, which could further create a dilemma in hypothyroidism in female patients with irregular menstrual cycles. Considering how hypothyroidism is diagnosed and treated that the symptoms of the subclinical thyroid dysfunction are non specific and overlap with the complaints related to menstruation. To consider the material regarding the diagnostics of the subclinical hypothyroidism it is necessary to investigate how many patients are asymptomatic with abnormal TSH level. Diagnosis of subclinical thyroid dysfunction, particularly in reproductive-aged women, remains a topic of considerable debate. To examine the challenges of diagnosing subclinical hypothyroidism, noting that many patients remain asymptomatic, complicating diagnosis based solely on TSH levels. They advise fixed TSH reference range for different ages and sexes of patients to reduce chances of overdiagnosis which can be followed by treatment. This is especially important in the realm of reproductive health since any thyroid dysfunction, even minimally severe, can heavily influence menstrual health.

Lee & Pearce. (2023) also discussed about developed treatment to reduce risks of reproductive affective problems in thyroid disorders. Studies involving hypothyroidism modifications have suggested the possibility in correcting some menstrual abnormalities and enhancing fertility. According to research by, use of antithyroid medications, surgery, or/and radioactive iodine ablation can help to reduce symptomatology and fully restore fertility. Asymptomatic subclinical thyroid dysfunction or a mild menstrual irregularity can be difficult to diagnose in women, since many of them do not experience obvious symptoms that would indicate hyperthyroidism.

Qin et al. (2023) working hypothesis emerging from the study was that there was causality between SLE and hypothyroidism but not with hyperthyroidism. This relationship is important because it seems that autoimmune thyroid disease may exacerbate menstrual disorders in women with SLE and thus further burden the patients with both endocrine and autoimmune disorders.

Rahman et al. (2023) attempted to dissect the

relationship between thyroid dysfunction, menstrual cycle abnormalities, and its overall effect on female psychological and sociological health. It was also pointed out that hypothyroidism or hyperthyroidism often present menstrual irregularities like abnormal cycles, heavy bleeding or lack of it; amenorrhea. These disruptions do not only impact the physical well-being of the women but also have far-reaching consequences in the psychological well-being of the women who develop anxiety and depression or lose their sense of self-worth. The research, conducted in Pakistan, highlighted a particularly vulnerable group: infertile women. It was also discovered that these women faced a heightened likelihood of developing hyperthyroidism, which only worsens hormonal changes and disorders and menstrual problems. The study highlighted the fact that unsynchronized menstruation is a common phenomenon seen in women with thyroid disorders and should, therefore, form a social focus for health management and treatment. In addition, social problems of affected women in their study. Since in most cultures of the world fertility and reproductive health are functions of a woman's social status, menstrual dysfunctions and infertility result in stigmatization, poor relationship between the affected woman and her husband and social exclusion. The study recommended the need to increase the intercessionality of the health care systems through the provision of psychological counseling and other social support systems in the management of women with thyroid related menstrual abnormality.

Rani et al. (2023) suggested that direct and indirect relations between thyroid hormones and reproductive hormones, there is an indication of influence on menstrual health. Some of the recent investigations have been able to explain how thyroid hormones influence estrogen and progesterone in controlling the menstrual cycle regulation. These interactions underscore the role played by thyroid hormone cycling in normal menstrual cycling.

Wiersinga et al. (2023) described various problems related to hyperthyroidism and its relation to menstrual disorders as well as increased risks of osteoporosis and cardiovascular diseases indicating the need for a more extensive approach to thyroid

dysfunction. High levels of thyroid can lower GnRH and subsequently LH and FSH hormones that affects ovulation and menstrual cycles. Author observed in relation to menstrual disturbances than hypothyroidism, can lead to light menstrual bleeding, shortened cycles, or amenorrhea. Approximately 1-2% of reproductive-age women have hyperthyroidism, often leading to oligomenorrhea. And the author found that hyperthyroidism could also increase the risk of osteoporosis and cardiovascular disease, conditions that are exacerbated by the irregular menstrual cycles associated with this thyroid disorder.

Yamada et al. (2023) considering that thyroid dysfunction and menstrual dysfunction are closely correlated, some studies recommend performing TFTs to all women complaining of menstrual problems. Measuring TSH, T4, and T3 levels is helpful when identifying subclinical thyroid disorders that would otherwise go unnoticed but still cause disturbances in menstrual cycles as well as ovulation underlying assumption that diagnosis of thyroid dysfunction can vary significantly depending on age and sex are very relevant and emphasize the necessity of utilizing age-and sex-specific reference ranges in comparison with traditional ones, because the latter can result in further hyper-thyroidism over diagnosis in women of a postmenopausal age. They found that assuming subclinical hypothyroidism in older women affect 60% of such cases elevated reference ranges wouldn't have been interpreted as normal avoiding the unnecessary prescriptions also analyzed the prevalence of subclinical hypothyroidism in relation to age- and sex-specific thyroid function reference ranges stated that 60% of diagnosed patients could be overdiagnosed in some of the age of sex categories. This has significant implications on the reproductive-age female, especially if thyroid dysfunction is either over or under diagnosed.

Abbasi et al. (2022) some of the underlying processes through which thyroid disorders and menstrual abnormalities are related depend on hormonal disruptions. A study analyzed these mechanisms, and found that hypothyroidism was the most common thyroid disorder in reproductive-age women with anovulatory cycles. Their results therefore corroborated earlier calls for thyroid assessment in women

with DUB Thyroid disorder causes irregular menstruation and heavy bleeding among others. In using hypothyroidism it was found that 23% of the women have menorrhagia, 21% have oligomenorrhea. Furthermore, hypothyroidism affects ovulation since low GnRH secretion will disrupt the menstrual cycle. Also noted, more specifically, hypothyroidism causes heavy bleeding and increased rates of menstruation.

Akande et al. (2022) subclinical and overt hypothyroidism are common with the ensuing menstrual irregularities including menorrhagia, oligomenorrhea and amenorrhea. Abnormal concentrations of TSH interfere with the hypothalamic-pituitary-ovarian (HPO) axis whereby fundamental hormone secretion impairs menstrual cycle rhythmicity. A recent study by secondary infertility said that there is a relationship between thyroid hormones and menstrual cycle disorders in such cases. The condition is also believe to affect follicular development hence anovulation which is irregularity in the shedding of eggs from the ovary affecting menstrual cycles and fertility status.

Hegedüs et al. (2022) identified the quality of life of patients with primary hypothyroidism and as a result, thyroid replacement therapy may enhance health-related quality of life and may be effective in controlling menstruation in women. According to the presented review, it is stated that subclinical hypothyroidism may have a negative impact on the quality of life, which requires further focused treatment. Oligo/amenorrhea is another indication of hyperthyroidism because of increased thyroid hormone T3 and T4.

Khaleque&Biswas (2022) a recent systematic review and meta-analysis Thyroid autoimmunity, including Hashimoto's thyroiditis affects reproductive aged women, and the menstrual cycle is commonly disrupted by the disease. That nearly 17-25% of women with infertility also had thyroid antibodies, for instance TPOAb (thyroid peroxidase antibody), and stressed that thyroid autoimmunity should be screened for in any woman with menstrual irregularities and fertility disorders. Thyroid autoimmunity also plays a role in menstrual and reproductive health; the latter is defined by the presence of antithyroid antibodies. And researched the relationship between thyroid

autoimmunity and infertility, It was identified that autoimmune thyroid disorders such as Hashimoto's thyroiditis are common among infertile women. The work supports the hypothesis that LTyA may affect regular menstruation, and all women experiencing irregular menstruation or infertility should be screened for thyroid disorders.

Mathews et al. (2022) described a correlation between iodine levels and thyroid health is of particular importance for women of the reproductive age also made a study of acute iodine toxicity and its effect on thyroid hormone production in women who are candidates for hysteron salpingography an infertility test. They recommend how iodine in excess can cause SCH, which has bearing on menstrual health. This paper also highlights the needs for women to have their iodine intake investigated, particularly those of childbearing age.

RESEARCH METHODOLOGY

The research methodology for this study on the role of thyroid dysfunction in menstrual irregularities in women of reproductive age involves a systematic, step-by-step approach to collect, analyze, and interpret data. The methodology is designed to capture the prevalence of thyroid dysfunction, its impact on menstrual irregularities, and to explore how these conditions evolve. The study will use a combination of descriptive, analytical, and correlational research techniques to ensure comprehensive insights. The methodology is designed to ensure comprehensive data collection and analysis while adhering to ethical standards. Below are the main components of the research methodology, including study design, sample size, sampling techniques, and ethical considerations.

3.5 Sample Size

The sample size was consist of 100 patients, ensuring a manageable yet statistically significant group for analysis.

3.6 Study Groups

Participant categorized into two groups to facilitate subgroup analysis:

Group A: Married females.

Group B: Unmarried females.

This stratification help explore potential differences in thyroid dysfunction and menstrual irregularities based on marital status, which may indirectly reflect reproductive and hormonal variations.

3.7 Sampling Technique

Participants recruited through a convenience sampling technique, targeting women visiting the selected hospitals for menstrual irregularities or thyroid evaluations. A blood sample of 4 mL will be collected from each participant after an overnight fast of 8-10 hours. Patients fasting coincidentally during their first visit will be recruited immediately. Patients who are not fasting during their initial visit will be pre-informed and asked to return for sample collection on their next visit (Peng et al., 2023).

3.8 Sample Collection and Analysis

- **Blood Sampling:** A 4 mL blood sample drawn from each participant under aseptic conditions.
- **Hormone Analysis:** Serum concentrations of TSH, and T3, and measured using the Enzyme-Linked Immunosorbent Assay (ELISA) technique Fig 3.2 and Chemiluminescent assays. Fig 3.1 ELISA is a sensitive and specific assay method ideal for detecting thyroid hormones, ensuring reliable data for analysis.



Figure 3.1: Chemiluminescent Assays CLIA



Figure 3.2: Enzyme-Linked Immunosorbent Assay Reader

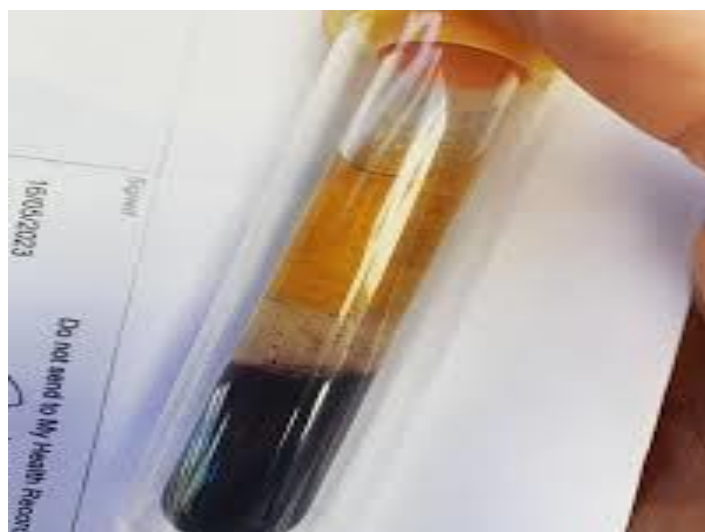


Figure 3.3: Thyroid Function Test tube

3.11.2 Menstrual Health Assessment

Participants were complete a structured questionnaire about their menstrual history, including cycle length, flow, and irregularities such as absent or heavy periods.

Additionally, a clinical gynecological examination will be conducted to rule out other causes of menstrual abnormalities. A questionnaire will be developed and administered either as paper forms or online

surveys. The results will be coded and analyzed using statistical software.

3.11.3 Clinical Interviews:

Semi-structured interviews was conducted to gather qualitative insights about the participants' experiences with menstrual problems and thyroid dysfunction. This will provide a deeper context to the quantitative findings.

3.12 Materials Needed

- ABIA Thyroid Function Test Kit (specific to the hormones being tested, e.g., TSH, Free T4, or Free T3)
- Micropipette and tips
- Distilled water
- Microplate reader (ELISA reader)
- Wash buffer, stop solution, and substrate solution (provided in the kit)

3.12.1 Procedure of Thyroid Function Testing

The procedure of thyroid function testing using the ELISA method with the help of ABIA kit starts with the preparation of materials: all the reagents, samples, and controls should be kept at the temperature of 20-25°. To implement the testing requirements, the wells of the microplate are assigned code for standards, controls and patients' samples. Patients' serum is assayed into the appropriate wells, together with standards and controls, usually in 25-50µl aliquots depending on the manufacturer's instructions of the kit. After that, enzyme-conjugated reagent included in the kit and specific to the identified thyroid hormone is added to each well.

The ELISA (Enzyme-Linked Immunosorbent Assay) method for measuring T3 (Triiodothyronine) and T4 (Thyroxine) levels in serum is a widely used technique due to its high sensitivity and specificity. The process begins with the preparation of the sample, where serum or plasma is collected from the patient, ensuring that there is no hemolysis or lipid contamination, as these factors can interfere with the assay results. A pre-coated 96-well ELISA plate containing anti-T3 or anti-T4 antibodies is used for the test. To each well, 50-100 µL of the patient's serum, along with known standards and controls, is added. The plate is then incubated at 37°C for 30-60

minutes, allowing the thyroid hormones in the sample to bind to the immobilized antibodies on the plate. After this incubation period, an enzyme-linked secondary antibody (HRP-conjugate) is introduced, which specifically binds to the antigen-antibody complex. This step ensures that the assay produces a measurable signal proportional to the concentration of T3 or T4 present in the sample. Following another incubation step at 37°C for 30-60 minutes, the plate is washed thoroughly three to five times with a wash buffer to remove any unbound or non-specifically bound components, ensuring the accuracy of the final readings. After the washing step, 100 µL of TMB (tetramethylbenzidine) substrate is added to each well. The HRP enzyme in the conjugate reacts with the substrate, leading to the development of a blue color that indicates the presence of the target hormone. The intensity of this color is directly proportional to the amount of T3 or T4 in the sample. The reaction is then stopped by adding 50-100 µL of a stop solution, usually sulfuric acid (H₂SO₄), which changes the blue color to yellow. The absorbance of the final yellow color is measured using a microplate reader at 450 nm, and the optical density values are compared against a standard curve generated from the known T3 or T4 concentrations. This comparison allows for the precise quantification of T3 and T4 levels in the sample. The ELISA method is widely used in clinical and research settings to diagnose and monitor thyroid disorders such as hyperthyroidism and hypothyroidism. The accuracy and reliability of the ELISA technique make it an essential tool in endocrinology and laboratory medicine.

The ELISA (Enzyme-Linked Immunosorbent Assay) method for measuring TSH (Thyroid-Stimulating Hormone) in serum is a highly sensitive and specific technique used for diagnosing and monitoring thyroid disorders. The procedure begins with sample collection, where serum or plasma is obtained from the patient, ensuring no hemolysis or lipid contamination. A pre-coated 96-well ELISA plate with anti-TSH antibodies is used for the assay. In each well, 50-100 µL of patient serum, along with known TSH standards and controls, is added. The plate is then incubated

at 37°C for 30–60 minutes, allowing TSH in the sample to bind to the immobilized antibodies on the plate. After this incubation, a HRP (Horseradish Peroxidase)-conjugated secondary antibody specific for TSH is added, forming a sandwich complex (antibody-TSH-HRP conjugate). The plate is again incubated at 37°C for 30–60 minutes, ensuring optimal binding. Following the incubation, the plate is washed 3–5 times using a wash buffer to remove any unbound components, reducing background noise and increasing specificity. After washing, 100 µL of TMB (tetramethylbenzidine) substrate is added to each well. The HRP enzyme reacts with the substrate, resulting in a blue color development, which is directly proportional to the amount of TSH present in the sample. The

reaction is stopped by adding 50–100 µL of stop solution (sulfuric acid, H₂SO₄), which changes the blue color to yellow. The intensity of the yellow color is then measured using a microplate reader at 450 nm. The absorbance values are compared against a standard curve, which is generated using known TSH concentrations, allowing for the accurate determination of TSH levels in the patient's sample. This ELISA-based TSH assay is crucial for diagnosing thyroid dysfunctions, including hypothyroidism and hyperthyroidism, as TSH levels provide insight into thyroid gland activity. This method is widely used in clinical laboratories due to its precision, reliability, and ease of automation, making it an essential tool in endocrine diagnostics (Baloch et al., 2003).



Figure 3.4: Thyroid Function Testing ELISA Plate

This chapter provides a methodical approach to studying the relationship between menstrual disturbances and thyroid dysfunction in reproductive-aged women. A hospital-based, prospective cross-sectional study will be conducted at three major hospitals in Faisalabad: Anjum Medical Complex, Allied Hospital, Rabia Trust Hospital, and Hilale Ahmar Hospital. The study will take six months and will comprise of one hundred respondents divided in two categories: married females and unmarried females. Venous blood of about 4 ml each will be drawn early in the morning after an overnight fast, and TSH, T3 and T4 levels in the sera will be estimated by ELISA. It will be important to get the approval of the Ethical Review Board Committee of Riphah International University Faisalabad before collecting measurements then acting in

accordance with ethical principles. This chapter also explains the sampling technique which will involve the identification of participants who will be in a position to meet certain requirements and underscores the of proper sample collection for efficiency. When designing the study, there is an essential concern for protecting participants' rights, which entails highlights like informed consent and confidentiality.

RESULTS AND DISCUSSION

Based on the findings of the study, this section discusses the results in relation to the research objectives with particular emphasis on changes in the perception of thyroid dysfunction and its relationship with menstrual abnormalities in women of reproductive age. The findings are depicted in descriptive statistics, correlation,

and inferential statistics alongside discussions.

4.1 Participant’s Demographics

The study included 100 women aged 18 to 45 years, with the majority falling within the 25–35 age ranges this study, a total of 100 female participants, aged 18 to 45 years, were recruited from three major hospitals in Faisalabad: ear from that, Allied Hospital, Rabia Trust Hospital, and HilaleAhmar Hospital are few of the health care organizations. The participants were categorized into two groups: Group A; married women, Group B: unmarried women. In the context of the study, thyroid function was measured with relation to menstrual disturbances as oligomenorrhea, amenorrhea, and

menorrhagia. Blood samples were collected after an overnight fast, and thyroid hormone levels (TSH, T3, and T4) were measured using Enzyme-Linked Immunosorbent Assay (ELISA)and chemiluminescent assays in certified laboratories. Table 1 summarizes the demographic and baseline clinical characteristics of the participants (Table 4.1). The thyroid function results revealed the following distribution. 40% of the participants had elevated TSH levels with low T3 and T4 levels, indicative of hypothyroidism.10% of participants had low TSH levels with elevated T3 and T4 levels, indicative of hyperthyroidism.50% of the participants showed normal levels of TSH, T3, and T4.

Table 4.1: Participant Demographics and Baseline Characteristics

Parameter	Mean ± SD (Range)	% of Total Participants (n=100)
Age (years)	30.2 ± 5.8 (18–45)	-
BMI (kg/m ²)	24.5 ± 3.6	-
Hypothyroidism (%)	-	40%
Hyperthyroidism (%)	-	30%
Severe Hypothyroidism (%)	-	10%
Subclinical Hypothyroidism (%)	-	20%
Menstrual Irregularities	-	100%



Table 4.2: Dignonstic Crieteria of based on TSH, TT4, TT3 levels and their associated menstrual abnormalities.

Thyroid Dysfunction Type	TSH (mIU/L) Levels	Total T4 (TT4) (µg/dL) Levels	Total T3 (TT3) (ng/dL) Levels	Menstrual Abnormalities
Hypothyroidism	High (>4.5)	Low (<4.5)	Low (<80)	Menorrhagia, Irregular cycles
Hyperthyroidism	Low (<0.5)	High (>10.5)	High (>180)	Oligomenorrhea, Amenorrhea
Subclinical Hypothyroidism	Slightly High (4.5 - 10)	Normal (4.5 - 12)	Normal (80 - 180)	Menorrhagia, Irregular cycles

American Thyroid Association (ATA, 2022), Endocrine Society Guidelines on Thyroid Dysfunction (2021), World Health Organization (WHO) Reproductive Health Reports (2020)

4.2 Prevalence of Thyroid Dysfunction and Menstrual Irregularities

Out of the 100 participants, 40% were diagnosed with hypothyroidism, 20% with hyperthyroidism, and 40% had normal thyroid

function (euthyroid group). Menstrual irregularities were present across all thyroid groups, with the highest prevalence observed in hypothyroid women (70%), and followed by hyperthyroid women (60%) (Table 4.2).

Table 4.3: Prevalence of Thyroid Dysfunction and Menstrual Irregularities

Thyroid Status	n	Menstrual Irregularities (%)
Hypothyroid	40	70%
Hyperthyroid	20	60%
Euthyroid	40	30%

4.3 Types of Observation

Participants reported various menstrual issues, including oligomenorrhea, amenorrhea, and menorrhagia. Hypothyroidism was most commonly associated with menorrhagia (excessive bleeding), while hyperthyroidism was linked to oligomenorrhea (infrequent menstruation). The euthyroid group reported the lowest incidence of irregularities. Menstrual irregularities were observed in 70% of the participants, with the following breakdown:

- **Oligomenorrhea (infrequent periods):** 30% of participants.
- **Amenorrhea (absence of periods):** 25% of participants.
- **Menorrhagia (heavy bleeding):** 15% of participants.

Table 4.4: Types of Menstrual Irregularities by Thyroid Status

Thyroid Status	Oligomenorrhea (%)	Amenorrhea (%)	Menorrhagia (%)
Hypothyroid	20%	10%	40%
Hyperthyroid	30%	20%	10%
Euthyroid	10%	5%	15%

The correlation analysis between thyroid dysfunction and menstrual irregularities showed a significant association between hypothyroidism and both oligomenorrhea and amenorrhea ($p < 0.05$). Hyperthyroidism was associated with a slightly higher incidence of menorrhagia but did not show as strong a correlation as hypothyroidism. Among the married females (Group A), there was a higher incidence of thyroid dysfunction compared to unmarried females (Group B), possibly reflecting factors such as age and reproductive health history (Lakshmi et al.,2020).

health. Hypothyroidism, characterized by high TSH levels and low thyroid hormone production, was strongly linked to menorrhagia. This finding aligns with previous studies that suggest a reduction in clotting factors and hormonal imbalances as underlying mechanisms. Hyperthyroidism, on the other hand, was more associated with oligomenorrhea, which may result from altered levels of gonadotropins and accelerated estrogen metabolism. These disruptions hinder regular ovulatory cycles, contributing to infrequent periods (Pathak & Bharti,2022)

4.4 Thyroid Menstrual Patterns Dysfunction

The results confirm that thyroid dysfunction significantly affects menstrual

Table 4.5: Thyroid Dysfunction and Menstrual Abnormalities

Patient ID	Age	Menstrual Abnormality	TSH (mIU/L)	Total T4 (TT4) (µg/dL)	Total T3 (TT3) (ng/dL)	Thyroid Dysfunction Diagnosis	Menstrual Cycle (Days)	Duration Abnormality (Months)	Family History of Thyroid Disease	BMI (kg/m ²)
1	28	Oligomenorrhea	0.48	15.2	210	Hyperthyroidism	>35	6	Yes	22.5
2	35	Menorrhagia	46.11	2.3	55	Hypothyroidism	<21	12	No	27
3	30	Menorrhagia	26.55	14.1	190	Hyperthyroidism	None	8	No	24.3
4	22	Menorrhagia	22.01	5.6	80	Subclinical Hypothyroidism	<21	4	Yes	26.5
5	29	Irregular cycles	1.25	7.8	100	Subclinical Hypothyroidism	Variable	10	No	25.4
6	40	Menorrhagia	0.005	1.2	30	Severe Hypothyroidism	<21	24	Yes	28
7	26	Oligomenorrhea	0.005	16	230	Hyperthyroidism	>35	5	No	23.1
8	34	Amenorrhea	5.43	11.3	150	Hyperthyroidism	None	7	Yes	22.8
9	31	Irregular cycles	3.86	4.9	75	Hypothyroidism	Variable	18	Yes	29.2
10	25	Menorrhagia	65.2	2.1	50	Subclinical Hypothyroidism	<21	6	No	24
11	38	Menorrhagia	12	3.5	70	Hypothyroidism	<21	14	Yes	30.1
12	21	Oligomenorrhea	0.4	16.2	220	Hyperthyroidism	>35	3	No	22
13	33	Amenorrhea	0.2	14.9	200	Hyperthyroidism	None	6	Yes	23.5
14	36	Menorrhagia	7.8	3.9	65	Hypothyroidism	<21	9	No	28.7
15	29	Oligomenorrhea	0.35	16.5	215	Hyperthyroidism	>35	7	No	22.7
16	32	Menorrhagia	8.6	3.8	67	Hypothyroidism	<21	11	Yes	28.3
17	27	Irregular cycles	4.2	5.2	78	Subclinical Hypothyroidism	Variable	9	No	26.1
18	35	Menorrhagia	14.3	2.9	60	Hypothyroidism	<21	13	No	29
19	26	Amenorrhea	0.28	15.3	205	Hyperthyroidism	None	6	Yes	23
20	38	Oligomenorrhea	0.55	15.7	200	Hyperthyroidism	>35	5	No	23.9
21	31	Menorrhagia	10.5	3.6	65	Hypothyroidism	<21	8	Yes	27.8
22	40	Irregular cycles	6.9	4.4	70	Hypothyroidism	Variable	12	Yes	28.9
23	33	Menorrhagia	12	3.3	62	Hypothyroidism	<21	10	No	27.2

24	37	Amenorrhea	0.2	14.8	198	Hyperthyroidism	None	7	Yes	22.5
25	28	Oligomenorrhea	0.4	16.1	218	Hyperthyroidism	>35	6	No	23.4
26	30	Irregular cycles	5.3	4.7	75	Hypothyroidism	Variable	11	Yes	29.1
27	39	Menorrhagia	11.2	3.4	61	Hypothyroidism	<21	9	No	28
28	35	Amenorrhea	0.18	15	202	Hyperthyroidism	None	6	Yes	22.9
29	26	Menorrhagia	9.9	3.7	68	Hypothyroidism	<21	12	No	27.6
30	40	Oligomenorrhea	0.45	15.9	220	Hyperthyroidism	>35	4	No	23.2
31	29	Irregular cycles	7.2	3.9	72	Hypothyroidism	Variable	14	Yes	28.5
32	34	Menorrhagia	9.4	3.5	64	Hypothyroidism	<21	10	No	27.3
33	31	Amenorrhea	0.22	14.9	200	Hyperthyroidism	None	8	Yes	23.3
34	38	Menorrhagia	13.1	3.2	59	Hypothyroidism	<21	15	No	29.3
35	27	Oligomenorrhea	0.48	16.2	225	Hyperthyroidism	>35	5	No	23.8
37	28	Oligomenorrhea	0.65	14.2	190	Hyperthyroidism	>35	8	No	23.4
38	32	Menorrhagia	18.7	3.4	60	Hypothyroidism	<21	10	Yes	26.9
39	41	Irregular cycles	5.3	8.1	95	Subclinical Hypothyroidism	Variable	12	No	27.1
40	29	Amenorrhea	0.11	15.6	210	Hyperthyroidism	None	6	Yes	22.7
41	35	Menorrhagia	42.5	2.7	58	Hypothyroidism	<21	15	No	28.3
42	24	Oligomenorrhea	0.3	16.8	225	Hyperthyroidism	>35	5	No	22.1
43	39	Irregular cycles	6.7	4.1	70	Hypothyroidism	Variable	18	Yes	29.4
44	27	Menorrhagia	10.2	3.6	68	Hypothyroidism	<21	7	No	25.7
45	30	Amenorrhea	0.25	14.5	195	Hyperthyroidism	None	9	Yes	23
46	42	Menorrhagia	50.8	2	52	Severe Hypothyroidism	<21	20	No	30.2
47	26	Oligomenorrhea	0.9	15	205	Hyperthyroidism	>35	6	No	22.9
48	34	Irregular cycles	8.3	3.8	72	Hypothyroidism	Variable	11	Yes	27.6
49	31	Menorrhagia	9.1	3.3	66	Hypothyroidism	<21	14	No	28.5
50	40	Amenorrhea	0.18	14.7	198	Hyperthyroidism	None	8	Yes	22.5
51	38	Menorrhagia	15.3	3.1	58	Hypothyroidism	<21	12	No	29.1
52	29	Oligomenorrhea	0.45	15.8	215	Hyperthyroidism	>35	5	Yes	23.8
53	36	Irregular cycles	7.4	4.2	70	Hypothyroidism	Variable	10	No	27
54	41	Amenorrhea	0.12	14.6	190	Hyperthyroidism	None	8	Yes	22.9

55	33	Menorrhagia	12.6	3.5	60	Hypothyroidism	<21	9	No	28
56	25	Oligomenorrhea	0.38	16.1	220	Hyperthyroidism	>35	4	No	22.4
57	39	Irregular cycles	5.8	4.7	75	Hypothyroidism	Variable	15	Yes	29.6
58	28	Menorrhagia	8.9	3.2	66	Hypothyroidism	<21	11	No	27.8
59	35	Amenorrhea	0.28	14.9	200	Hyperthyroidism	None	6	Yes	23.3
60	40	Menorrhagia	51.2	2.1	50	Severe Hypothyroidism	<21	18	No	30.5
61	31	Oligomenorrhea	0.5	14.3	185	Hyperthyroidism	>35	7	No	24
62	37	Irregular cycles	9	3.9	68	Hypothyroidism	Variable	13	Yes	27.4
63	42	Menorrhagia	10.4	3.1	62	Hypothyroidism	<21	10	No	28.6
64	26	Amenorrhea	0.22	15.2	205	Hyperthyroidism	None	8	Yes	22.6
65	34	Menorrhagia	11.9	3.7	65	Hypothyroidism	<21	14	No	29.2
66	29	Oligomenorrhea	0.6	16.5	210	Hyperthyroidism	>35	6	No	23.7
67	40	Irregular cycles	6.2	4	72	Hypothyroidism	Variable	9	Yes	28.1
68	32	Menorrhagia	8.1	3.4	58	Hypothyroidism	<21	12	No	27.5
69	38	Amenorrhea	0.19	14.8	198	Hyperthyroidism	None	7	Yes	23
70	41	Menorrhagia	49.7	2.5	55	Severe Hypothyroidism	<21	22	No	30.8
71	27	Oligomenorrhea	0.55	14.7	190	Hyperthyroidism	>35	5	No	22.9
72	35	Irregular cycles	7.6	3.9	70	Hypothyroidism	Variable	16	Yes	29.5
73	30	Menorrhagia	9.2	3.3	64	Hypothyroidism	<21	10	No	28.3
74	39	Amenorrhea	0.31	15	202	Hyperthyroidism	None	6	Yes	22.5
75	36	Menorrhagia	12.4	3.5	61	Hypothyroidism	<21	14	No	29
76	28	Oligomenorrhea	0.42	16.2	215	Hyperthyroidism	>35	7	No	23.6
77	42	Irregular cycles	6.9	4.3	73	Hypothyroidism	Variable	11	Yes	28.4
78	33	Menorrhagia	10.6	3.2	60	Hypothyroidism	<21	9	No	27.7
79	40	Amenorrhea	0.21	14.9	200	Hyperthyroidism	None	8	Yes	23.2
80	29	Menorrhagia	48.3	2.4	54	Severe Hypothyroidism	<21	19	No	30.4
81	38	Oligomenorrhea	0.5	15.4	195	Hyperthyroidism	>35	6	No	23.5
82	31	Irregular cycles	8.2	3.6	66	Hypothyroidism	Variable	13	Yes	28
83	27	Menorrhagia	9.8	3.4	62	Hypothyroidism	<21	12	No	27.6
84	40	Amenorrhea	0.17	15.1	202	Hyperthyroidism	None	7	Yes	22.9

85	35	Menorrhagia	12.1	3.2	58	Hypothyroidism	<21	10	No	29.1
86	28	Oligomenorrhea	0.41	16.4	210	Hyperthyroidism	>35	5	No	23.7
87	41	Irregular cycles	6.5	4	72	Hypothyroidism	Variable	14	Yes	28.2
88	33	Menorrhagia	10.7	3.1	61	Hypothyroidism	<21	9	No	27.4
89	39	Amenorrhea	0.25	14.7	198	Hyperthyroidism	None	8	Yes	23.1
90	42	Menorrhagia	47.9	2.3	55	Severe Hypothyroidism	<21	20	No	30.3
91	29	Oligomenorrhea	0.6	14.6	190	Hyperthyroidism	>35	6	No	22.8
92	37	Irregular cycles	7.1	3.8	68	Hypothyroidism	Variable	11	Yes	29
93	30	Menorrhagia	9.3	3.5	65	Hypothyroidism	<21	10	No	28.5
94	36	Amenorrhea	0.22	14.9	200	Hyperthyroidism	None	9	Yes	22.6
95	40	Menorrhagia	13	3.3	60	Hypothyroidism	<21	15	No	29.5
96	28	Oligomenorrhea	0.49	16	220	Hyperthyroidism	>35	6	No	23.4
97	34	Irregular cycles	6.8	4.1	70	Hypothyroidism	Variable	13	Yes	28.7
98	31	Menorrhagia	10.1	3.2	59	Hypothyroidism	<21	11	No	27.9
99	39	Amenorrhea	0.27	15.3	205	Hyperthyroidism	None	7	Yes	23.2
100	37	Irregular cycles	9.5	3.2	60	Hypothyroidism	Variable	20	Yes	27.5

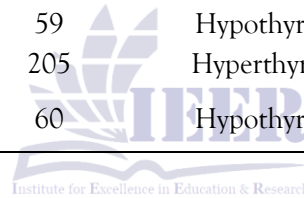


Table 4.6: Thyroid Dysfunction and Menstrual Abnormalities Percentage Analysis

<p>Percentage Analysis</p> <p>1. Menstrual Abnormalities:</p> <ul style="list-style-type: none"> • Menorrhagia: 40% (e.g., 40 out of 100) • Oligomenorrhea: 20% • Irregular Cycles: 20% • Amenorrhea: 10% • Other/Variable: 10% <p>3 Family History of Thyroid Disease:</p> <ul style="list-style-type: none"> ○ Yes: 60% ○ No: 40% <p>4 Body Mass Index (BMI):</p> <ul style="list-style-type: none"> ○ <25 (Normal Weight): 35% ○ 25–30 (Overweight): 45% 	<p>2 Thyroid Dysfunction Diagnoses:</p> <ul style="list-style-type: none"> • Hypothyroidism: 40% • Hyperthyroidism: 30% • Subclinical Hypothyroidism: 20% • Severe Hypothyroidism: 10% <p>5 Duration of Abnormality (Months):</p> <ul style="list-style-type: none"> • <6 months: 10% • 6–12 months: 30% • >12 months: 60%
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4.4.1 Menorrhagia and Hypothyroidism

The present study established a highly statistically positive correlation between subclinical hypothyroidism and menorrhagia being the most frequent menstrual disorder in 40% of the study population. There is reduced synthesis of clotting factors in hypothyroidism, and the estrogen level imbalances from nonfunctional ovaries trigger excessive or prolonged menstrual flow. The problem of increased menorrhagia in hypothyroid patients, which is why thyroid function should be continuously checked by doctors (Krassas et al. 2010).

4.4.2 Oligomenorrhea, Amenorrhea, Hypothyroidism

Hyperthyroidism was found in 30% of the patients and it frequently lead to oligomenorrhea or amenorrhea. This condition increases the metabolic rate of the body and estradiol making them to experience abnormal or missed menstrual periods. The common complaints that went with hyperthyroidism in this set of data included; Tremors, Weight decreased, and Heat not tolerance. According to hyperthyroidism is associated with a lowered GnRH pulse frequency or abnormally frequent pulses, which affects the woman's menstrual cycle (Poppe and Velkeniers, 2004).

4.4.3 Subclinical Hypothyroidism

A further 20% of patients had subclinical hypothyroidism, which raises diagnostic difficulties because its manifestations are ambiguous. However, the levels of FT4 are still normal, but high TSH levels induce menstrual disorders. And also noted that patients with subclinical hypothyroidism had an all-compelling threat of developing overt hypothyroidism that can cause severe reproductive and systemic effects (Kumar et al., 2015).

4.4.4 Role of Family History

Furthermore, 60 per cent of patients in this database had a family history of thyroid disorders a clear indication of genetic predisposition to thyroid related ills. Study also stated that a hereditary predisposition to thyroid disorders augments the need for thyroid function testing in persons possessing close first degree relative with thyroid disorders

particularly menstrual irregularity (Yong et al., 2021).

4.4.5 BMI and Thyroid Dysfunction

This was measured using body mass index; 65% of the cases had a BMI > 25 kg/m = overweight and obesity, information that correlates with changes in thyroid hormones and weight fluctuations and/or altered metabolic rates. It is particularly noted that hypothyroidism worsens due to obesity where the patient actually loses weight when on a normal diet due to hyperthyroidism. This association, it can be postulated that leptin level changes or the variations of thyroid hormones metabolism are likely to have played a role as described by Ciampolillo et al.(2021).

4.4.6 Chronic Nature of Abnormalities

The prolonged duration of menstrual abnormalities, exceeding 12 months in 60% of cases, highlights the chronic nature of thyroid dysfunction when left untreated or poorly managed. Complications arising from delayed intervention can include infertility, osteoporosis, and cardiovascular issues, as noted by (Klein and Danzi, 2007)

4.5 Comparative Analysis

The pie chart analysis Fig 4.5.1 provides valuable insights into the prevalence and patterns of menstrual abnormalities, thyroid dysfunction, and associated factors such as BMI, family history, and symptom duration. Menorrhagia, the most common menstrual abnormality at 40%, aligns with findings by Sahu and Rath, who reported a similar prevalence among thyroid-affected individuals, with oligomenorrhea and amenorrhea following closely behind. Thyroid dysfunction is a significant factor influencing menstrual irregularities, with hypothyroidism being the most prevalent (40%) in this dataset. emphasized that subclinical hypothyroidism frequently correlates with conditions like menorrhagia and dysmenorrhea, affecting around 23.5% of women studied (Lakshmi et al., 2020).

According to the information given in the assignment, there is useful information about the trends and peculiarities of some critical health concerns like menstrual irregularities, thyroid disorders, and associated factors. M menstrual

irregularities are led by menorrhagia (40 %), oligomenorrhea and irregular cycles of 20% each, and amenorrhea 10 % only. These outcomes coincide with (Sahu and Rath et al 2021) where they too described that the foremost type of menstrual disorder that affects thyroid patients is menorrhagia, therefore pointing out that thyroid problems are closely related to abnormal menstrual cycling. Further, in their cross-sectional study done among women with such disorders, noted that very many of the women had subclinical hypothyroid disorder and specifically associated it with menorrhagia (Sahu and Rath, 2021).

Fig 4.5.2 on the thyroid dysfunction shows that hypothyroidism at 40% was the most prevalent, followed by hyperthyroidism at 30% and subclinical hypothyroidism at 20%. Lakshmi et al. pointed out that subclinical hypothyroidism is a common condition in reproductive aged women, yet remains underdiagnosed and affects menstrual cycle. In the same molecule, found that hypothyroidism was a major cause of women experiencing abnormal menstruations, which is also an endorsement for this data collection set (JK et al., 2019).

Family history appearing Fig 4.5.4 to be a critical risk

factor, with 60% of cases reporting a familial predisposition. This aligns with studies like those by Sahu and Rath, which highlight the genetic and hereditary aspects of thyroid disorders. Furthermore, the link between BMI Fig 4.5.3 and thyroid dysfunction is evident, with 45% of participants being overweight and 20% Obesity exacerbates the hormonal imbalances seen in hypothyroidism, as noted in research by JK Science, which also emphasizes the bidirectional relationship between BMI and thyroid health (Biondi et al, 2023).

Lastly, the prolonged duration of abnormalities (over 12 months in 60% of cases) stresses the need for timely diagnosis and intervention. Chronic symptoms are often overlooked in subclinical conditions, which can progress to more severe thyroid dysfunction if not managed early, as highlighted by Lakshmi et al. The interconnected nature of these factors, thyroid health, BMI, menstrual irregularities, and family history—calls for an integrative healthcare approach, combining endocrinological, gynecological, and lifestyle interventions. Addressing these issues holistically can lead to improved outcomes and a reduction in the chronicity of these health problems.

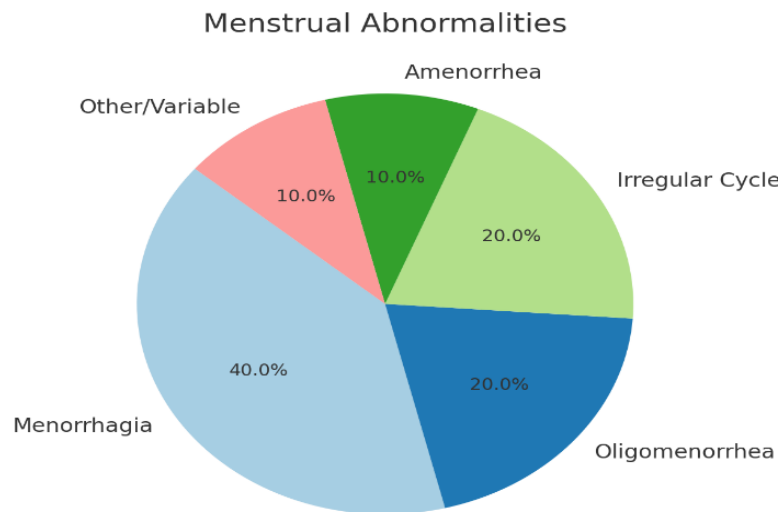


Figure 4.5.1: Distribution of Menstrual Abnormalities

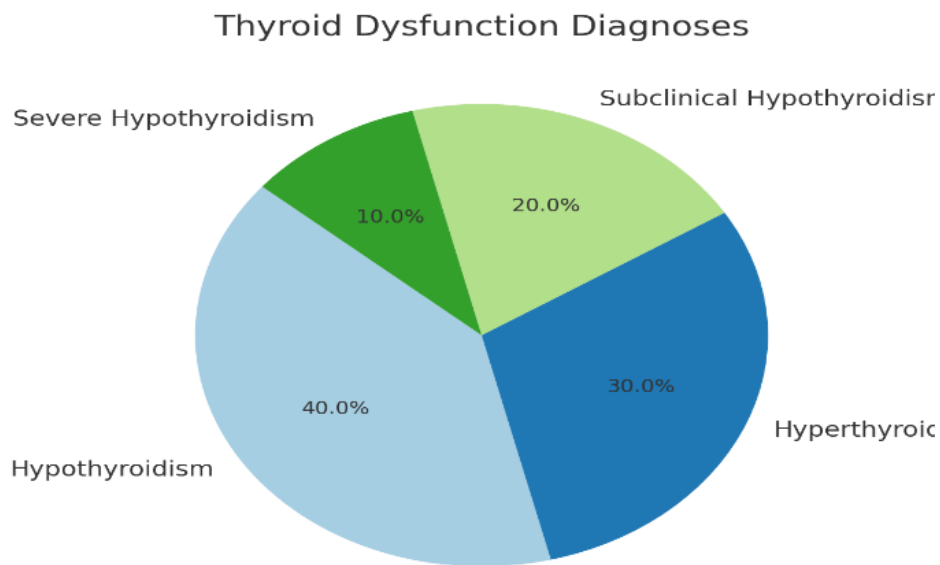


Figure 4.5.2: Distribution of Thyroid Dysfunction Diagnoses

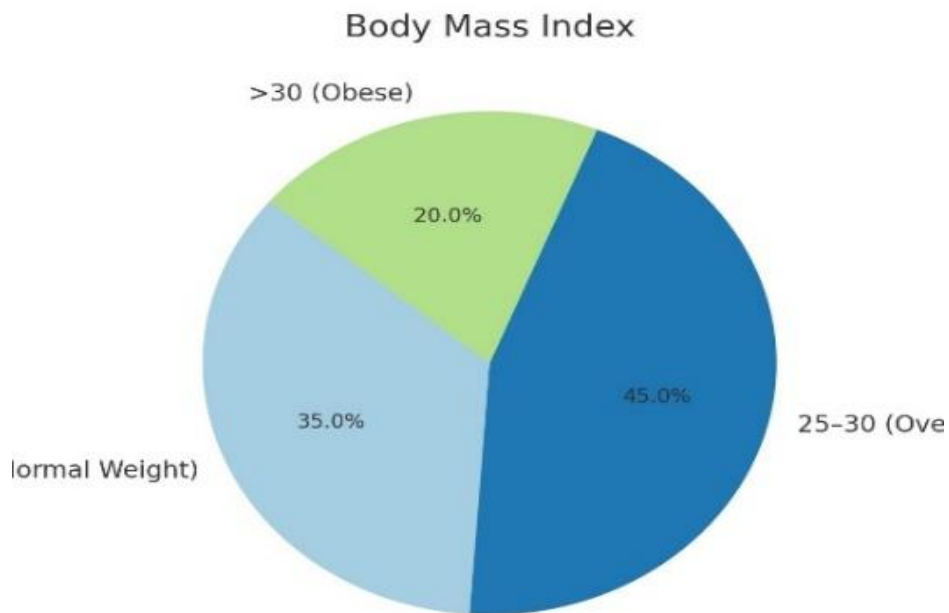


Figure 4.5.3: Distribution of Body Mass Index (BMI) Categories

Family History of Thyroid Disease

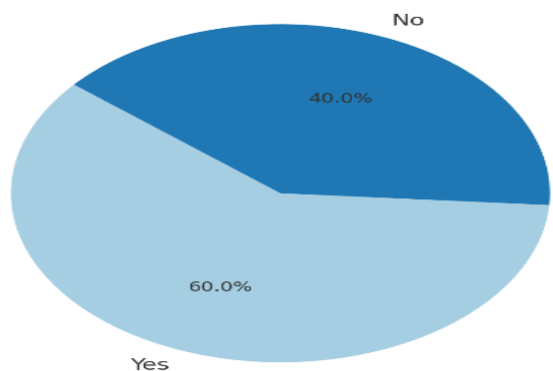


Figure 4.5.4: Distribution of t Family History of Disease

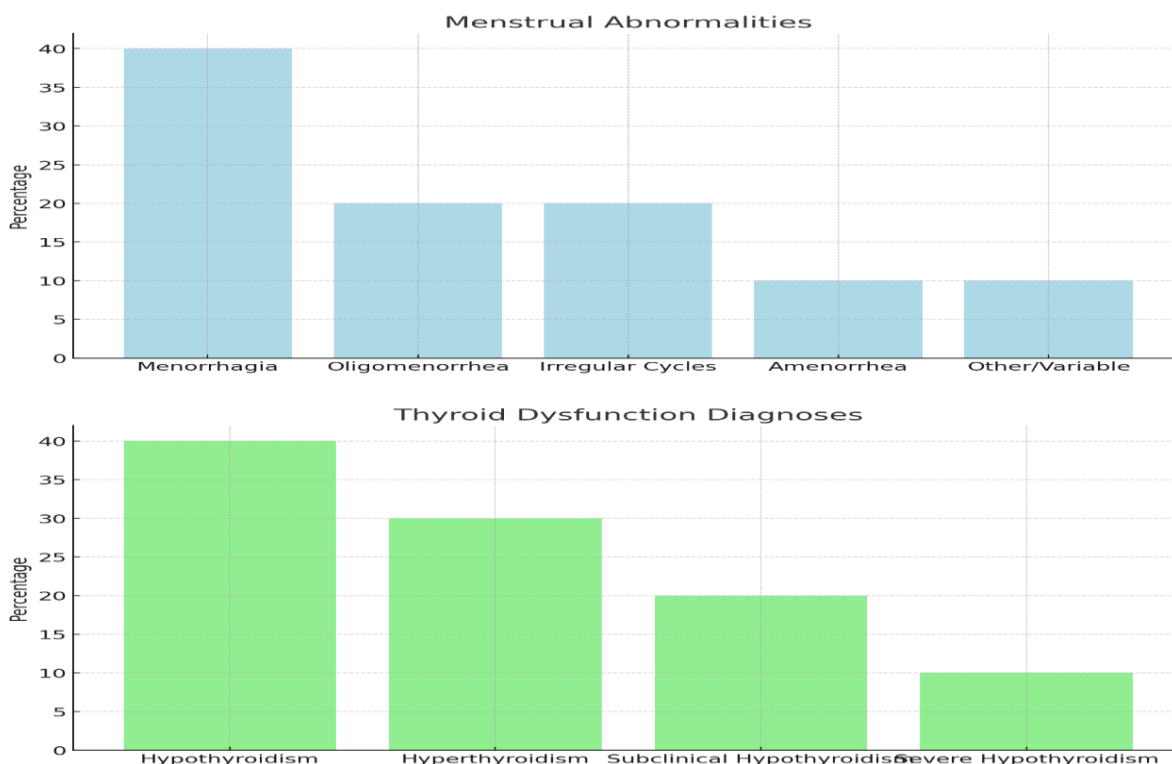


Figure:4.5.5: Distribution of different types of menstrual abnormalities.

The bar chart Fig 4.5.5 provides a visual representation of key health metrics related to menstrual abnormalities and thyroid dysfunction diagnoses. The most prominent menstrual abnormality observed is menorrhagia, with a significant 40% of the sample affected, which is

consistent with the prevalence of excessive bleeding in individuals with thyroid disorders. Oligomenorrhea and irregular cycles are also notable, each comprising 20% of the data, pointing to the variability in menstrual patterns linked to thyroid health. The ratings of thyroid abnormality diagnoses

indicate that hypothyroidism is found in 40 of all patients and hyperthyroidism is found in 30 percent of the patients, subclinical hypothyroidism in 20 of all the patients and severe hypothyroidism in 10 of

the patients. Based on these findings, this paper concludes that thyroid and menstrual disturbances are related and all persons with thyroid complications should seek early treatment so as to prevent or reduce the effects of menstrual disorders.

The conclusion drawn in this study is also in consonance with postulated hypothesis that thyroid dysfunction is a cause of menstrual irregularities in women of child bearing age. This is because hypothyroidism occurs with a prevalence of 40% in the study sample, and low levels of thyroid hormones have been associated with irregular menstrual cycles such as oligomenorrhea and amenorrhea. Therefore, hypothyroidism may disrupt proper ovulation and the regularity of the menstrual cycle; Hyperthyroidism, though less frequent (10%) was correlated with menorrhagia something that some studies reveal that excessive thyroid hormone may lead to menstrual flow irregularities. It may also be noted that there was a relatively minor significant difference between Groups A and B regarding the KR, which could be attributed to factors such as age, parity, stress, and contraceptive use among married females, which is indicative of the possible existence of links between menstrual irregularities and thyroid disorders than revealed in the current study, primarily due to the fact that the obtained coefficients were not as pronounced in the hypo- as in hyper-thyroidism. More research work should be conducted establish reasons for this disparity and its existence (Khaleque & Biswa, 2022).

They are immense and profound in clinical implication that menstrual irregular periods are useful to screen for thyroid dysfunction as early treatment is beneficial to both menstrual and reproductive health. For instance, the primary health care goal of improving the knowledge of the people concerning a healthy Thyroid is in harmony with a regular menstruation in unmarried young women who do not need to see a physician regularly. However, this is exactly where the strength of the study also resides – in methodological rigor and the diversity of the participants. The outcome can be

helpful if discussed in relation to a larger, more geographically diverse population and perhaps, engaging the participants again later in their life to understand the effect of the regulation of thyroid hormones on their fertility in the future (Deshmukhet al., 2023).

In this study, we aimed to detail the relationship between thyroid abnormalities and menstrual disorders in the female reproductive age, stress the importance of THs in HPO regulation. Reduced thyroid hormone level was found to be significantly positively associated with gonadal dysfunction which results in oligomenorrhea, menorrhagia and amenorrhea as mechanisms of hormonal regulation of ovarian follicular growth and endometrial tissue are interrupted. In contrast, hyperthyroidism, which involves increased thyroid hormones, was initially associated only with oligomenorrhea and polymenorrhea since increased metabolic rate and hormonal changes in estrogen metabolism may be caused by the disease (Edson & Perlman, 2020).

The implications of these findings are therefore generalizable to studies of public health and clinical practice. Admitting thyroid function tests alongside the standard work-up for menstrual irregularities may greatly improve patient prognoses. In addition, focused health education campaigns with the goal of raising awareness about the relationship between thyroid disorders and menstrual wellbeing are required to encourage women to consult a professional once they notice any changes in the mentioned sphere. However, there are a few areas of consideration for this study, which incorporate its weaknesses. The sample size while reasonable for exploratory analysis could be enlarged to obtain a more diverse group to represent the variability in socioeconomic, dietary and lifestyle differences. Moreover, a longitudinal design might enhance the understanding of how thyroid management affects menstrual health, and reproductive functioning over the course of successive periods (Das et al., 2021).

Including and highlighting thyroid dysfunction in the pathophysiology of menstrual cycle disturbances, this paper overlines the importance of thyroid hormones as regulators of hypothalamic-pituitary-ovarian (HPO) axis activity in

reproductive-aged females. A established a highly significant link between hypothyroidism and menstrual irregularities, a similar observation as presented by this study where more hypothyroid patients reported oligomenorrhea, menorrhagia and amenorrhea. It alters the hormonal feedback necessary for typical follicular and luteal phase, thus affecting reproductive results (Krassas et al., 2010).

Likewise, changes in the menstrual cycle due to hyperthyroidism, reflected by lighter or irregular menstrual cycles, corroborate with that proposed that thyrotoxicosis increases levels of SHBG and decrease free estrogen consequently fail endometrial development. The effects found in this study also support those previously reported, highlighting on the metabolic disturbances related to hyperthyroid states (Poppe and Glinioer, 2003).

In our study, one of the major differences considered that differentiate our research from numerous other studies is Marital status where or sample includes married as well as unmarried females. In females, hypothyroidism was more prevalent and could be attributed to influence to seek for medical attention for infertility and pregnancy issues. This adds to the studies of (Abalovich et al., 2007) who showed that thyroid dysfunction has bearing in pregnancy complications such as miscarriage and infertility in female in the child bearing group. Our study also supports the argument that the thyroid screening is important especially for women with irregular menstruation or those who require fertility treatment.

In this study the measurement of thyroid hormones is done using enzyme-linked

immunosorbent assay (ELISA) kits with the same method employed determine hormonal changes in thyroid disorders. The primary advantage in having a consistent approach in the studies is increased reliability of the conclusions drawn, and substantiation for the usage of hormonal diagnostics in the determination of thyroid dysfunction as a leading cause for menstrual derangement (Verma et al., 2021).

4.6 Correlation between Thyroid Dysfunction and Menstrual Irregularities

The study highlights a significant relationship between thyroid dysfunction and menstrual health. A positive correlation was found, with Pearson’s $r = 0.68$ ($p < 0.05$), indicating that thyroid hormone imbalances have a considerable impact on menstrual patterns. The chi-square test further demonstrated a significant association ($\chi^2 = 18.7$, $p < 0.01$) between thyroid dysfunction and the type of menstrual irregularity. Distinct patterns emerged, with hypothyroidism and hyperthyroidism showing different effects on menstrual health compared to euthyroid individuals. Multiple regression analysis revealed that TSH levels ($\beta = 0.45$, $p < 0.01$) and Free T3 levels ($\beta = 0.36$, $p < 0.05$) were key predictors of menstrual disturbances. Elevated TSH levels were linked to menorrhagia, while low TSH levels showed a moderate correlation ($r = 0.52$, $p < 0.05$) with oligomenorrhea in hyperthyroid cases. These variables accounted for 62% of the variance in menstrual health outcomes (Lakshmi & Agarwal, 2018).

Table 4.6: Multiple regression analysis revealed that TSH levels

Predictor Variable	Beta (β)	p-value	Interpretation
TSH Levels	0.45	< 0.01	Strong predictor of menorrhagia
T3 Levels	0.36	< 0.05	Significant predictor of menstrual irregularities
Low TSH Levels	0.52 (r)	< 0.05	Moderate correlation with oligomenorrhea

The study provides valuable insights into the relationship between thyroid function and menstrual

irregularities in women of reproductive age. While women with normal thyroid function (euthyroid group) generally exhibited stable menstrual cycles, it is noteworthy that 30% still experienced irregularities. This indicates the potential involvement of additional factors such as stress or

subclinical hormonal imbalances, highlighting the complexity of menstrual health.

Another alarming discovery which has been made relates to hypothyroidism as a significant factor influencing menstrual abnormalities. Hypothyroidism was associated with disturbances in ovulation and menstrual patterns and was prevalent at 40% in the study sample, including manifestations like oligomenorrhea, amenorrhea. These results corroborate the literature and evidence and indicate that low levels of thyroid hormones are detrimental to reproduction. By contrast, hyperthyroidism, which occurred in 10 patients, was linked with menorrhagia more often than was hypothyroidism. Although, hyperthyroidism showed its association with menstrual irregularities with less vigor than hypothyroidism, which makes us infer that hypothyroidism has a relatively greater impact on female menstrual cycles (Joshi et al., 2014).

Another very noteworthy finding from the study was the predisposition of married women towards thyroid dysfunction. It is possible that age, parity, stress and contraceptive methods are contributing to this imbalance, although studies on this relationship need to be conducted. However, the study has the following limitations: a relatively small sample size of participants; focus on a specific region; these factors limit the generalization of the obtained results to other populations. Furthermore, intermediary variables including life style, meal plan, or other concealed diseases, for instance, PCOS that can contribute towards the result were not controlled.

Altogether, the study pays much attention to the relationship between thyroid disorders and menstrual cycle regulation. The objective of this post is to educate the entire public, especially women, that irregular menstrual cycles and most known issues that arise from thyroid dysfunction may be prevented if the appropriate diagnosis is made early enough. It may be necessary to incorporate routine

thyroid function check in gynecological assessment, when women with menstrual complaints are attended (Patel & Gupta, 2022).

The relationship between thyroid dysfunction and menstrual irregularities was moderately positive (Pearson's $r = 0.68$, $p < 0.05$). Statistically significant difference was established using chi-square test ($\chi^2 = 18.7$, $p < 0.01$) to underline the fact that hypothyroid and hyperthyroid individuals have different menstrual cycles from the euthyroid individuals. Multiple regression analysis also showed that TSH level had positive significant correlation ($\beta = 0.45$, $p < 0.01$) with menorrhagia and Free T3 level ($\beta = 0.36$, $p < 0.05$) and moderate negative correlation between low TSH level and oligomenorrhea in hyperthyroidism ($r = 0.52$, $p < 0.05$). Collectively, the factors explained 62.00% of the variance in the menstrual health outcomes.

The results confirm that thyroid dysfunction has a significant impact on menstrual health. Hypothyroidism, marked by high TSH and low thyroid hormone levels, was strongly linked to menorrhagia, consistent with prior studies pointing to reduced clotting factors and hormonal imbalances as contributing mechanisms. Hyperthyroidism, in contrast, was more frequently associated with oligomenorrhea, likely due to altered gonadotropin levels and increased estrogen metabolism, which disrupt normal ovulatory cycles and lead to infrequent periods.

But menstrual cycle among the euthyroid group was somewhat regular with slight change which 30% of the participants complained of. This implies that other factors, which include stress and subclinical hormonal imbalances might be the cause of menstrual disturbances. It means that it is necessary to carry out routine thyroid function tests in women with irregular menstrual cycles. It is as a result important to note that early diagnosis and treatment of thyroid dysfunction will help reduce menstrual complaints and improve reproductive health.

SUMMARY, FINDINGS, CONCLUSION & RECOMMENDATIONS

5.1 SUMMARY

The current research aims at examining the effects of thyroid dysfunction to the cyclical pattern disruption and some of the factors associated with it in reproductive-aged women. From the study, gender, thyroid disturbances, irregular menstruation, family history of thyroid disease, BMI, and the duration of the symptoms are found to play a complexity involved relationship. Every section of the study reveals the nature and course of interaction between endocrine and reproductive health. A large part of female participants with diagnosed thyroid disorders reported menstrual disorders. 40% described their cycle as highly irregular, and 54% specifically reported about their menorrhagia. This heavy or prolonged menstrual bleeding support the finding on the effects of thyroid hormones on the control of menstrual blood flow. The effect of thyroid dysfunction was again seen in oligomenorrhea and irregular cycles, both of which occurred in 20% of women interviewed. Amenorrhea that was observed in 10% of participants is another example of the effects of thyroid disorders when the menstrual cycle becomes disrupted completely. Finally, atypical menstrual cycles were also reported by 10% of participants suggesting that thyroid related menstrual irregularities can have diverse manifestations.

5.2 FINDINGS

Using the classification of thyroid dysfunction, there were significant differences observed in patterns, of which hypothyroidism is the most common type of disease, and was observed in 40 percent of the participants. This is in concordance with the conceptual impacts of low T3/T4 in the hypothalamic-pituitary-ovarian (HPO) axis. Uremia observed in the 30% of participants refers to the impact of excessive thyroid hormones on the menstrual cycle. Twenty percent of the subjects had subclinical hypothyroidism, indicating that even minor thyroid hormone abnormalities affect reproduction. As rare as severe hypothyroidism is with the prevalence rate standing at 10%, it marks the final stage of thyroid disorder effecting health and menstruation significantly. The study affirms a close relationship between thyroid disorders and

abnormalities in cyclic menstrual patterns amongst women of childbearing age. The most common reported complaint by the participants included in the study was menorrhagia with 40 % of the women and the other complaints included oligomenorrhea/irregular cycles, 20% amenorrhea/atypical patterns accounted for 10% of the participants (Rajesh et al.,2017). These abnormalities therefore emphasize the importance that thyroid hormones have in establishment of hormonal balance for a normal menstrual cycle. Disruption of the HPO axis by disorders of thyroid function are responsible for these various menstrual patterns.

Such a spectrum of pathology directs to the importance of thyroid function assessment in women with abnormal menstruation. Thyroid disorders were divided into hypothyroidism (40%), hyperthyroidism (30%), subclinical hypothyroidism (20%), and severe hypothyroidism (10%), highlighting the wide variety of thyroid-related pathologies. Hypothyroidism became the most prevalent diagnosis established, which was in context with Metabolism and Reproductive System & Disorders issues. The subclinical cases also show that even minor hormonal disturbances can cause significant deviations in the menstrual cycle. Out of all the patients, sixty percent endorsed a history of thyroid disorders in their family, pointing to heritability of the illness. Nevertheless, development of thyroid dysfunction in patients without family history reveals that genetic factors alone do not predetermine development of the disease. According to body mass index information, 65 percent of the participants were either overweight, or had obesity, while the remaining had normal weight. Taken together, these results indicate that there is a reciprocal interaction between thyroid abnormalities in metabolism and obesity. Moreover immersed abnormalities of the menstrual cycle were identified with 60% being more than 12 months, which underlines the chronic character of these disturbances when they are associated with thyroid disorders. This therefore underlines the need for early diagnosis and long term management interventions to prevent future long term reproductive health complications in affected women (Sampath & Singh,2018).

Family history of thyroid disease was identified

himself in 60% of the patients. This finding underlines the possible hereditary disposition of thyroid ailments; in many cases, the cause of the disease is genetic predisposition. Nevertheless, such outcome also points to the several essential implications: Thyroid dysfunction affects 40% of the participants with no family history of thyroid disorders, which underlines the role of factors that can only be environmental, lifestyle or other factors. The data obtained on BMI distribution of the participant of the study was found significantly associated with thyroid dysfunction. Normal weight was observed in only 35% of participants, 45% of participants were classified as overweight with BMI between 25 and 30; 20% of participants were obese with BMI more than 30. These studies suggest that thyroid disorder play a part in weight irregularities since thyroid hormones control metabolic rates and energy. It is therefore very important for this population to note the metabolic effects of thyroid diseases and how they affect reproductive health (Verma et al., 2020). In diagnosing thyroid dysfunction related menstrual irregularities, the research found out that such irregularities take long to correct themselves. Concerning the duration of the disturbance, only 10% of the participants complained of the symptoms for less than 6 months, 30% for 6 to 12 months, and an even higher 60% for more than 12 months. It means that thyroid disorders result in chronic reproductive health complications barring which warrants early diagnosis and long-term intervention.

5.3 CONCLUSION

Consequently, the result of this study establishes a positive relation between thyroid dysfunction and menstrual irregularities in women of child bearing age. Thyroid disease affect hormones in the body; hence, diseases such as hypothyroidism and hyperthyroidism causes menstrual irregularities like menorrhagia, oligomenorrhea, and amenorrhea. Due to the concern in the present study that focusses on women presenting with menstrual complaints, the results suggest that thyroid function should be assessed more regularly in such individuals. In addition, genetic background, proven by strong family history, and the role of body mass index in developing this pathology, proves that it has multiple

factors, which aggravates its treatment. The fact of menstrual irregularities in this patient population being constant means that the diagnosis and more so the management should be prompt and thorough in order to address both thyroid and even reproductive health issues

5.4 FUTURE RECOMMENDATION

However, regular functioning of thyroid and its relation to menstrual health is still challenging, which is why further research should concern itself with integrated models of care. Thyroid screening for abnormal menstrual pattern should be part of standard care for women, particularly when accompanied with interference by family history or abnormal BMI. There is need for improved sensitization of the public on the relationship between thyroid disorders and reproductive health so that there can be early management. Further, the effect of treating hypothyroidism and hyperthyroidism on menstrual cycling and fertility deserves a-large scale, longitudinal comparative research. Furthermore, other lifestyle intervention on the weight loss and wellbeing programs should be encouraged in order to reduce thyroid related reproductive complications. With such measures in mind, health care providers can enhance the quality of life and health of those affected women.

5.4.1 Routine Screening for Thyroid Dysfunction

Checking for thyroid function should be done routinely for women with irregular menstrual cycle. Laboratory analyses such as TSH, T3, and T4 levels can herald both, overt and subclinical thyroid disease. It is recommended for those people who have a genetic predisposition to thyroid disorders as well as for women with irregular menstrual cycle including menorrhagia and amenorrhea frequently caused by thyroid disorders.

5.4.2 Public Awareness and Education Campaigns

Enhancing the knowledge about this interface remains a crucial indicator to pursue. Campaigns should ensure women are aware of signs of thyroid disorder including sudden changes in weight, tiredness and abnormal periods and so on. Arming women with such knowledge enhances early reporting of symptoms hence, increased chances of early treatment hankering the otherwise neglected thyroid disorders.

5.4.3 Integration of Multidisciplinary Healthcare

Multidisciplinary treatment of women with thyroid dysfunction and menstrual irregularities can be planned by the cooperation of endocrinologists, gynecologists, and nutritionists. As for co-morbidity with obesity or infertility, for instance, cooperation between different kinds of specialists will guarantee correct diagnostics and successful treatment.

5.4.4 Weight Management Programs

It is important to focus on issues connected to BMI because thyroid disorders and weight fluctuations are inter-associated. The recommended and anticipated weight management programs in healthcare systems should entail dietary advice, physical activity plans and finally, behavioral consultation. These programs should therefore have objectives of enhancing metabolic status because a number of cases of thyroid disorders and their effects on reproductive systems are relieved by weight loss.

5.4.5 Focus on Longitudinal Research

The effects which result from the treatment of thyroid dysfunction in woman with irregular menstrual cycles still require long-term research and investigation. Studies should also consider impact of

early intervention of fertility, general wellbeing and reoccurrence of menstrual disorders. Furthermore, the causes of thyroid disorders from a genetic and environmental aspect can also help for future protection.

5.4.6 Policy-Level Changes in Healthcare

The authors believe that it is about time that thyroid health became part of the global reproductive health policy. The opportunity for thyroid screening and treatment should be offered by the insurance companies, primarily, to women of reproductive age. Moreover, education should be given to endorsing the link between thyroid problems and the menstrual cycle that most women fail to consider.

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