JIMMA UNIVERSITY

INSTITUTE OF HEALTH SCIENCES

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DEPARTMENT OF BIOMEDICAL SCIENCES

ASSESSMENT OF HEMATOLOGICAL PARAMETER ABNORMALITIES AND THEIR ASSOCIATED FACTORS AMONG PATIENTS WITH THYROID DYSFUNCTION AT JIMMA MEDICAL CENTER, JIMMA, SOUTHWEST ETHIOPIA.

BY: LUNA ABEBE (B.Sc.)

A THESIS SUBMITTED TO DEPARTMENT OF BIOMEDICAL SCIENCE, FACULTY OF MEDICAL SCIENCE, INSTITUTE OF HEALTH, JIMMA UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE MASTER OF SCIENCE DEGREE IN MEDICAL PHYSIOLOGY

January, 2023

Jimma, Ethiopia

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Abstract

Background*: Thyroid dysfunction is one of the leading endocrine disorders and represents around 30% to 40% of patients with an endocrine disorder. Thyroid hormones have a crucial role in the proliferation, production and metabolism of blood cells. Thyroid dysfunction is associated with hematological abnormalities, particularly anemia. However, data on hematological parameter abnormalities of thyroid dysfunction patients in the study area are limited.*

Objectives*: To assess hematological parameter abnormalities and their associated factors in patients with thyroid dysfunction at Jimma Medical Center, Jimma, Southwest, Ethiopia, from October 3 – November 17, 2022.*

Methods: *An institutional-based cross-sectional study was conducted from October 3 to November 17, 2022, at Jimma Medical Center, among thyroid dysfunction patients. A pre-tested, semi-structured questionnaire was used to collect socio-demographic, behavioral, and clinical data from participants. Hematological parameters were measured. The collected data were checked for completeness, entered into the Epi-data version 3.1, and exported to SPSS Version 25. Descriptive statistics like frequency, percentage, mean and standard deviation were carried out. Binary and multiple logistic regression were done. A P-value of less than 0.05 was used as a level of significance.*

Result: *A Total of 198 thyroid dysfunctions patients were included. The prevalence of anemia was (40.9%, 95% CI; 34 -47%), thrombocytopenia was* (31.8%, 95% CI; 25.2-38.3%) *and leukopenia was* (7.6%, 95% CI; 3.8 – 12.3%). *Female [AOR=4.5, 95%, CI=1.1, 17.0, p=0.029], khat chewing [AOR=3.6, 95%, CI=1.35, 9.6, p=0.010], BMI ≤ 18.5 [AOR=3.5, 95%, CI=1.0, 12.4, p=0.048], low fruit and vegetable intake [AOR=3.3, 95%, CI=1.06, 10.2, p=0.007],and co-morbid illness [AOR=2.63, 95%, CI=1.0, 6.6, p=0.040]), were identified independent predictors of anemia. Drinking alcohol [AOR = 2.2, 95%, CI =1.0, 5.0, p=0.04] and hypothyroidism [AOR=2.4, 95%, CI=1.3, 4.6, p=0.005] were identified independent predictors of thrombocytopenia.*

Conclusion and recommendation*: This finding showed that there was high prevalence of hematological parameter abnormalities among patients with thyroid dysfunction. Being female, khat chewing, low BMI, co-morbid illness, low fruit and vegetable intake, could be the potential risk factor for hematological abnormalities. Therefore, routine screening of hematological parameters should be considered for the proper management of thyroid dysfunction patients.*

Keywords: *Thyroid dysfunction; Hematological parameter abnormalities; Anemia; thrombocytopenia; leukopenia*

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LIST OF ABBREVIATIONS

AITD = Autoimmune thyroid disease

AGEs= Advanced glycation end products

AOR= Adjusted odd ratio

BAS= Basophil

BFU-E= Burst forming unit erythroid

BMI= Body mass index

CBC = Complete blood count

CFU-E = Colony forming unit erythroid

COR = Crude odd ratio

DLC = Differential leukocyte count

2, 3 DPG = 2, 3 Diphosphoglyceric Acid

DM = Diabetic mellitus

DNA = Deoxyribonucleic acid

EDTA= Ethylene diamine tetra acetic acid

EOS = Eosinophil

EPHI = Ethiopian public health institute

EPO = Erythropoietin

Hb = Hemoglobin

HCT = Hematocrit

HIV = Human immunodeficiency virus

HT = Hashimoto's thyroiditis

HIF-1 = Hypoxia inducible factor1

JMC = Jimma Medical Center

LYM= Lymphocyte

MCH = Mean corpuscular hemoglobin

MCHC = Mean corpuscular hemoglobin concentration

MCV = Mean corpuscular volume

MON = Monocytes percentage

MPV = Mean platelet volume

NEU = Neutrophil percentage

NSAIDs = Non-steroidal anti-inflammatory drugs

PI = Principal Investigator

RDW = Red cell distribution width

ROS = Reactive oxygen specious

RXR = Retinoid X receptors

TB = Tuberculosis

TR = Thyroid receptors

TRE = Thyroid response elements

TSH = Thyroid stimulating hormone

USA = United States of America

WHO = World health organization

CHAPTER ONE: INTRODUCTION

1.1. Background

The thyroid gland is a vital endocrine organ found in the muscular triangle of the neck. Thyroid hormones, triiodothyronine (T3) and thyroxine (T4), are released by the thyroid gland and play an important role in the growth, development, metabolism, reproduction, and function of almost every organ in the human body (1, 2). Thyroid hormones play an important role in the metabolism and proliferation of blood cells, so they influence blood cell production in bone marrow. Thyroid hormone synthesis problems are often accompanied by blood cell abnormalities (3).

One of the functions of thyroid hormones is its role in hematopoiesis, blood cell production, in the bone marrow. During the differentiation from bone marrow stem cells to mature red blood cells, genes encoding proteins essential for mature red blood cells are switched on. Thyroid hormone exerts a direct stimulating effect on the proliferation of immature erythrocyte precursors and promote erythropoiesis by increasing erythropoietin gene expression and erythropoietin production in the kidneys. Thyroid hormones also augment repletion of hypoxia inducible factor1 (HIF-1) and then motivate growth of erythroid colonies (BFU-E, CFU-E). Erytroid colony growth induced by free triiodothyronine. These hormones also intensify erythrocyte 2,3DPG compactness, which enhances the delivery of oxygen to tissues. With regard to lymphocytes, T3 is as a precursor substance for normal B cell formation in bone marrow through its mediation of pro-B cell proliferation. Therefore, thyroid disorders can induce different effects on various blood cell lineages (4, 5, 6, 7).

Thyroid dysfunction is a group of non-communicable disease conditions characterized by excessive or insufficient thyroid hormone production caused by structural and functional thyroid gland dysfunction. Thyroid disorders are a global health concern and, after diabetes, the most common type of endocrine disorder, accounting for 30% to 40% of the endocrine disorder burden. The most common thyroid disorders are hyperthyroidism and hypothyroidism (8, 9, 10).

Hypothyroidism is characterized by a decrease in thyroid hormone levels as a result of a hypo functioning thyroid gland. The most common clinical thyroid dysfunction is hypothyroidism, which is more common in women and the elderly. About 95% of hypothyroidism is primary

hypothyroidism, which results from thyroid gland problems. Secondary and tertiary hypothyroidism are caused by pituitary gland and hypothalamic disorders, respectively (10**,** 11)**.**

In hypothyroid patients, the number and proliferative activity of erythroid cells in the marrow is reduced. Additionally, gelatinous transformation of the marrow ground substance, characterized by mucopolysaccharide accumulation, was observed in a patient with profound hypothyroidism. Indeed, hypothyroid patients show a decreased plasma concentration of erythropoietin, depressed bone marrow stimulation, decreased erythropoietin production, nutrient deficiency (including iron, vitamin B12, or folate), as well as comorbid diseases are the cause of anemia in hypothyroidism patients (4). Hyperthyroidism refers to increase in thyroid function and characterize by excess metabolic state due to excessive synthesis and secretion of thyroid hormone, Graves' disease (GD) and toxic nodular goiter are the two most common causes of hyperthyroidism. The prevalence of hyperthyroidism is 0.2–0.5% in women that is approximately 10 times higher than in men (10, 12).

The mechanism of anemia development in hyperthyroidism is less clear. In hyperthyroid patients, bone marrow erythroid hyperplasia and elevated erythropoietin levels were observed. However, erythrocytosis in blood morphology is uncommon, most likely due to concurrent iron, vitamin B12, or folate deficiency. Alterations in iron metabolism, hemolysis, and oxidative stress have been proposed as potential causes of anemia in thyrotoxicosis, resulting in increased osmotic fragility of erythrocytes and lipid peroxidation, resulting in shortened erythrocyte survival (12,13).

Although Ethiopia is one of the African countries with a high prevalence of thyroid disorders, there is a scarcity of data on the impact of thyroid disorders on hematological parameters. As a result, the purpose of this study is to assess hematological profile abnormalities and associated factors in thyroid dysfunction patients at Jimma Medical Center in Jimma, southwest Ethiopia.

1.2 Statement of the problem

Thyroid dysfunction is a common endocrine disorder that affects 300 million people worldwide, with more than half of them being unaware of their condition. Hyperthyroidism and hypothyroidism are the two most common thyroid disorders, with 1.6 billion people worldwide at risk in more than 110 countries. It affects approximately 2% of adult females and 0.2% of adult males, increasing to 0.5% by the age of 75. The general population prevalence of hypothyroidism has been reported to range from 0.3% to 3.7% in the United States and from 0.2% to 5.3% in European countries. Hyperthyroidism is estimated to affect 0.5% to 0.8% of people in Europe and 0.5% of people in the United States (14,15).

Thyroid disease research in Africa is limited. Thyroid disease prevalence has been reported in a few countries. For example, in Zambia, the prevalence was 7.3%, and in Uganda, it was 3.6%. The most common thyroid diseases in Africa are hypothyroidism, thyrotoxicosis, thyroiditis, and iodine deficiency disorders (16, 17). A study based on the WHO global database showed that the total goiter prevalence (TGP) of Africa was 28.3%. According to an Ethiopian study, the prevalence of hyperthyroidism, and hypothyroidism is 7%, and 1.1%, respectively. According to a UNICEF report, 78% of Ethiopia's total population was exposed to iodine deficiency, 62% were iodine deficient, and 26% had goiter (18**,** 19). The hematopoietic system is one of the primary systems affected by thyroid dysfunction, with anemia being the most common manifestation (10).

Globally, anemia affects over 1.5 billion people, which is approximately a quarter of the global population. According to data of WHO, anemia prevalence is 24.8% throughout the world and it is more frequent in underdeveloped countries. According to Ethiopia Demographic and Health Survey (EDHS), the national prevalence of anemia in the 2016 was estimated to be 56% among children under the age of 5 years, 23% among women of reproductive age and 18% among adult men. Study done in Jimma among adolescent girls in Jimma town shows prevalence of anemia was found to be 26.7%. Anemia negatively affects cognitive and motor function, increase the risk of maternal and child death, and cause fatigue and low work productivity. Due to the wide range of adverse effects of anemia, the World Health Assembly (WHA) established a commitment to halve anemia prevalence from 2011 levels in women of reproductive age by 2025 (20, 21, 22).

Anemia is the most common hematological abnormality associated with thyroid dysfunction. Although the burden of anemia in thyroid dysfunction patients is not very well understood, it is

estimated that about 20–60% of thyroid dysfunction patients depending on the sex, age, type of thyroid dysfunction and level of clinical measurement (TSH,T4 and T3) and causes different types of anemia. Patients with thyroid abnormalities may have low iron levels that affect hemoglobin levels, as well as low levels of folate, iron and B12, which have been found in up to 25% of patients, which ultimately affects blood parameters such as hemoglobin and red blood cells (RBCs) (3 , 22 , 23)**.**

According to various studies, anemia prevalence among thyroid dysfunction patients was the most significant finding. For instance**,** According to studies conducted in India, there is a significant decrease in Hb concentration, and the prevalence of anemia was 75% (24 , 25)**.** According to a study conducted in Egypt, the prevalence of anemia in these patients was 50%, while in Ethiopia, Addis Ababa, it was 55% (26, 27).

Leukopenia and neutropenia have been reported in as many as 15-30% of patients with thyroid dysfunction. Other hematological parameters alteration associated with thyroid dysfunction include hematocrit (HCT), mean corpuscular volume (MCV), Mean corpuscular hemoglobin (MCH), and platelet count (thrombocytopenia). However, if a euthyroid state is maintained, all of mentioned alterations return to normal. Hematological abnormalities particularly anemia is frequent in patients with thyroid diseases, but often unrecognized, concomitant condition. Hence evaluation of hematological indices in cases of thyroid dysfunction is mandatory for the proper management of thyroid dysfunction patients (6, 23, 28, 29).

It is important to monitor the change in all blood cell parameter of thyroid dysfunction patient, for potential detection hematological abnormalities and make the necessary clinical-intervention to avoid subsequent comorbidity. Although, burden of the disease is significant, data available on the magnitude of hematological abnormalities among thyroid dysfunction patients are limited. Therefore, this study aimed to assess hematological parameter abnormalities and their associated factor among patients with thyroid dysfunction at Jimma medical center.

1.3 Significance of the study

Hematological abnormalities are common in patients with thyroid dysfunction. Thus, this study aims to assess hematological parameter abnormalities and their associated factors among patients with thyroid dysfunction at Jimma Medical Center. The results obtained from this study will be significant in providing baseline information on the effects of thyroid dysfunction on hematological parameters, which will help to establish appropriate timing for screening, monitor prognosis, and manage thyroid disorders before further complications. The results of this study will intended to serve as a source of information for healthcare decision-makers, patients, clinicians, health system leaders, and other stakeholders. It would also provide additional input for clinicians and other healthcare workers involved in the diagnosis and treatment of thyroid disorders, thereby improving the overall quality of thyroid disease treatment plans. This study will also serve as a baseline for future researchers who are interested in similar studies.

CHAPTER TWO: LITRATURE REVIEW

2.1 Mechanism of hematological parameter change in thyroid dysfunction patient

Nearly every cell in the body is affected by the thyroid hormones L-thyroxine (T4) and 3, 3′, 5-L-triiodothyronine (T3) in terms of metabolism, differentiation, and proliferation (29). Thyroid stimulating hormone, produced by the hypothalamus-pituitary axis, controls their production through a negative feedback mechanism (TSH) (30)**.** When retinoid X receptors (RXR) and intra-nuclear thyroid receptors (TR) combine to form a heterodimer, thyroid hormones primarily act through these receptors. To modify gene expression, this heterodimer interacts with the thyroid response elements (TRE), particular regulatory regions of genes in deoxyribonucleic acid (DNA). (31)**.** Hematopoietic stem cells have receptors for thyroid hormone, and serum levels of this hormone may influence how many blood cells are produced (32)**.**

The process of erythropoiesis, in particular, is greatly influenced by thyroid hormones. They directly stimulate the growth of erythrocyte precursors, but they also encourage erythropoiesis via boosting the kidneys' production of erythropoietin and the expression of the gene encoding it. Studies in animals have shown that free triiodothyronine stimulates erythroid colony formation **(**6, 33**,** 34**).**

The quantity and proliferative activity of erythroid cells in the marrow are decreased in hypothyroid patients. In a patient with severe hypothyroidism, the marrow ground substance also underwent gelatinous metamorphosis, which was characterized by mucopolysaccharide buildup. Erythropoietin levels in the plasma are indeed lower in hypothyroid people. Anemia in hypothyroidism has a complicated etiopathogenesis that may be caused by comorbid disorders, decreased erythropoietin production, decreased erythropoietin stimulation, iron, vitamin B12, or folate deficiencies, or diminished bone marrow stimulation. Concomitant autoimmune conditions including pernicious anemia and atrophic gastritis, celiac disease, autoimmune hemolytic syndrome, or soft tissue rheumatic illnesses may increase the incidence of anemia in people with autoimmune thyroid disease (AITD) (4, 35, 36).

Elevated erythropoietin levels and bone marrow erythroid hyperplasia have both been identified in people with hyperthyroidism. Erythrocytosis in blood morphology is uncommon, most often due to an underlying iron, vitamin B12, or folate deficit. Alterations in iron metabolism, hemolysis,

oxidative stress that increased erythrocyte osmotic fragility and lipid peroxidation that decreased erythrocyte survival, ineffective erythropoiesis and, in long standing severe hyperthyroidism, malnutrition, were proposed as probable causes of anemia in thyrotoxicosis (12**,** 37**,** 38**)**.

In addition leukopenia and neutropenia are well-known manifestations of thyroid dysfunction. Leukopenia and neutropenia have been reported in as many as 15-30% of patients with untreated thyrotoxicosis; however, the exact etiologies are poorly understood**.** Megakaryocytes may be affected by thyroid hormones by altering bone marrow matrix proteins like fibronectin. Thyroid hormones increase the expression of the fibronectin gene. Fibronectin appears to influence megakaryocyte maturation and thrombopoiesis via interactions with integrin 41. It also affects platelet function and has a number of other hematopoiesis-related effects. Megakaryocytes generate platelets, which are a-nucleate cells that are released into the bloodstream from the bone marrow. Because thyroid hormones act in the nucleus by modulating gene expression, they can only have an indirect effect on platelets via megakaryocytes. Megakaryocytopoiesis may be severely inhibited in hypothyroid patients, resulting in thrombocytopenia and reduced platelet survival by increasing reticuloendothelial activity in hyperthyroid patients, resulting in thrombocytopenia (39, 40, 41)**.**

2.2. Magnitude of hematological parameter abnormalities in TD patient

Thyroid hormones have a significant influence on the cell cycle, proliferation, apoptosis, differentiation, and metabolism in various types of human cells throughout a person's life. Thyroid hormones influence a wide range of hematological parameters in peripheral blood due to their potential impact on hematopoietic system cell functions. Many authors have suggested that thyroid dysfunction and hematological abnormalities are linked (40).

Prospective population-based cohort study done in Switzerland among thyroid dysfunction patients revealed that anemia prevalence was 12.6 % (37). Two facility based cross-sectional study done in the Saudi Arabia showed that the prevalence of anemia was 54.3% and 44% (42) (43). According to cross sectional study done in Iraq the prevalence of anemia among thyroid dysfunction patient was 44% (44). According to a cross-sectional study conducted, the prevalence of anemia in Egypt was 46% (26) , Kenya 28.1% (45), Addis abeba menelik referral hospital 55.4% (27).

According to a cross-sectional study done in the USA, platelet count and MPV significantly increased when serum levels of T4 or T3 increased. On the other hand, an increase in serum TSH level had no impact on MPV but was linked to a significant decline in platelet count. Therefore, hypothyroidism cause a significant decline in platelet count (39). In a study conducted in USA society of hematology among 71 thyroid disorder patients the prevalence of thrombocytopenia was 32% (46).

According to a study conducted in Kenya to assess thyroid hormone and hematological indices level showed, the prevalence of leukopenia among thyroid dysfunctions patients was 12.2% (45) and India 3.5% (47)**.** According to Study done in Addis abeba menelik hospital the prevalence of leukopenia and thrombocytopenia among thyroid dysfunctions patients was 3.75% and 43.4% (27).

2.3 Type of thyroid dysfunction and their magnitude of hematological parameter abnormalities

2.3.1 Hypothyroidism

A large population-based study conducted in Switzerland in 2016 showed that the prevalence of anemia in hypothyroidism patient was 7.7%. Anemia associated with thyroid dysfunction was normal MCV in 94.0% of patient and high MCV in 6.0% of patient. They conclude that normocytic-normochromic anemia was the most prevalent type of anemia (37). Retrospective study carried out in Turkey revealed that increased RDW values were significantly associated with hypothyroidism (22)**.** Another cross-sectional study done in Turkey among hypothyroidism patient, anemia was 43% prevalent. Anemia was more common in females than in males (3).

The study conducted in India Rajasthan city showed that, the prevalence of anemia was 56% in patients with hypothyroidism which is higher than the WHO reported data of prevalence of anemia throughout the world. Normocytic anemia is most prevalent (50%), followed by Microcytic hypochromic anemia (45%) and macrocytic anemia 3% (48)**.** A cross-sectional study conducted in India, Bhavnagar City, showed that there were female predominance and anemia was found more in female patients. Anemia prevalence was 40% (47)**.** A cross sectional study conducted in china showed that, TSH have a significant positive relationship existed in the 12.5%–17.5% range of RDW and which was prominent in females. The study also showed that there was negative

association between RDW and fT3. They conclude that because of significant association between RDW and TSH, RDW may be a significant clinical marker of subclinical hypothyroidism (49).

A study conducted in India showed, the prevalence of anemia among hypothyroidism patients was 62.5% and the commonest type of anemia was normocytic normochromic (53%), followed by microcytic (30%) and macrocytic anemia (27%). Anemia was severe in cases with high thyroid-stimulating hormone (TSH) and higher TSH values were associated with more severe anemia (50).

Another cross-sectional study conducted in India among thyroid dysfunctions patients showed, significantly lower hematological parameters such as hemoglobin (p=0.000), MCHC (p=0.008), RBC (P=0.0018), platelet (p=0.002) and leukocyte count among hypothyroidism patients compared to hyperthyroidism patients. The RDW was significantly higher among hypothyroid group compared to hyperthyroidism group (p=0.000). This study also showed that hemoglobin was significantly lower with a mean of 11.4 g/dl indicating the prevalence of anemia in hypothyroidism patient and the prevalent type of anemia is normocytic as evident by the MCV (51).

According to retrospective observational study conducted in Pakistan, include total number of 485 thyroid dysfunctions patients, out of which 117 were labeled as hyperthyroid, 169 were hypothyroid and 199 were euthyroid. Comparison between hyperthyroid and hypothyroid groups revealed a statistically significant difference in the mean hemoglobin levels (p=0.036) and hematocrit (p=0.022) but no significant difference was found in the red blood count(RBC), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) (7).

A cross-sectional study was conducted in Saudi Arabia in 2020 showed higher prevalence of anemia (60.27%) and iron deficiency (49.31%) was observed among hypothyroid group as compared to hyperthyroid and euthyroid group. Which was characterized by significantly lower values of erythrocyte indices (RBC count, hemoglobin, MCV, MCH) and iron parameters in hypothyroidism group (42).

Another cross sectional study conducted in Saudi Arabia showed the prevalence of Anemia was detected in 50% hypothyroidism patient. Significant decrease was observed in the number of RBCs, Hb concentration and MCH. The most prevalent types of anemia associated with thyroid dysfunction were Normocytic-normochromic anemia and microcytic hypochromic anemia (43).

According to a comparative-cross sectional study conducted in Sudan in 2015 showed that there was a significant difference in mean value of RBC, RDW, hemoglobin, MCV, MCH and platelet between hypothyroidism and hyperthyroidism patient but there was no significance difference in mean value of WBC and other WBC differential (52). According to study done in Addis Ababa menelik hospital the prevalence of anemia among hypothyroidism patients was 57.7% (27).

2.3.2 Hyperthyroidism

According to a large population-based study conducted in Switzerland the prevalence of anemia among hyperthyroidism patient higher than the other type of thyroid dysfunctions and the prevalence of anemia was 14.6%. They conclude that systematic measurement of thyroid-stimulating hormone in anemic patients is likely to be useful only after excluding common causes of anemia (37).

In a cross-sectional study conducted in Saudi Arabia in 2020 showed higher prevalence of anemia 31.57% was observed among hyperthyroidism patients. Which was characterized by significantly lower values of other erythrocyte indices level (42)**.** According to a comparative cross-sectional studies conducted in Iraq, the study which include 100 hyperthyroid patient There were female predominance, females constituted 60.7% of cases. The level of Hb was significantly associated with thyroid dysfunction and anemia was present in 38.1% of hyperthyroidism patients in this study. Normocytic normochromic anemia is most prevalent. They conclude that thyroid dysfunction affect all blood parameters (44).

According to study conducted in Egypt the study, 68% of patient were female and mean age of patient was 44.6. Result of study show that prevalence of anemia was 42%, microcytic hypochromic anemia was the most frequent type of anemia (78.4%), followed by normocytic normochromic anemia (28.6%) (26)**.** According to a study conducted at Menelik hospital in Addis Abeba, Ethiopia, the study included 120 hyperthyroid patients, hypothyroidism patients and a healthy control group. The study found anemia in 53.3% of hyperthyroidism patients, RBC low in 53 % of patients, and MCV low in the majority patients. They conclude, thyroid dysfunction have a significant influence on blood cell count and blood cell indices (27).

2.4 Factor associated with hematological parameter abnormality

2.4.1 Socioeconomic and demographic factors

Socioeconomic and demographic factors are among the factor affecting hematological parameter of thyroid dysfunction patients. For instance, case-control study conducted in India in 2017 (24) and another study in India in 2019 (47) among thyroid dysfunction patient showed that there is high prevalence of hematological parameter abnormalities in female thyroid dysfunction patient than male. This is because iron-deficiency anemia in women can be exacerbated by hypermenorrhea or menorrhagia, which are clinical manifestations of thyroid hormone deficiency. TSH may have similar effects to FSH and LH because they share a common subunit. It reduces LH secretion, resulting in lower progesterone levels and estrogen breakthrough bleeding as a result of anovulation. Furthermore, hypothyroidism is associated with a lower concentration of sex hormone-binding globulin. This raises circulating free estrogen levels, which promote endometrium proliferation, and higher levels of circulating estrogen can cause bone-marrow suppression, which can lead to anemia (4). Study from different country showed that anemia is more prevalent in low socio-economic status people. Older age was also closely associated with the presence of anemia. There was an association between age and anemia in men and women. Both women and men had a 1% increase in the odds of anemia for every year people were older after age (53)**.**

2.4.2 Dietary factors

Dietary factors affecting the hematological parameters of patient with thyroid dysfunction. For instance low intake of meet result in iron deficiency anemia. A cross-sectional study conducted in sub-Saharan Africa showed that women taking >2 times per week of meet are less likely to have iron-deficiency anemia (54)**.** To reduce ID, the consumption of bioavailable iron-rich food such as red meat would be a logically feasible solution, since this food is the richest source of high absorbable iron (heme-iron). An increase in red meat consumption twice a week would decrease iron deficiencies (55). Different study show that anemia can be prevented by increasing the consumption of iron, folic acid, and B12 rich foods like fruit and vegetable. In addition, fruit and vegetable can also reduce substances that keep iron in the form of ferrous to be absorbed (56)**.** A cross-sectional two studies conducted in Indonesia (57, 58) and Ghana (59) showed low intake fruit and vegetable associated with hematological parameter abnormalities**.**

Cow milk is an important source of key nutrients. However, several available studies indicated that cow milk consumption could be a risk factor for low hemoglobin concentration. This is mainly attributed to the low iron content but excess amount of casein and calcium in cow milk. Casein in milk chelates iron by binding with phosphoserine residues preventing the release of iron in a free form consequently impairing intestinal absorption. In addition, calcium inhibits heme and non-heme iron absorption in a dose-dependent manner (60).

2.4.3 Behavioral factors

Alcohol consumption is one of the behavioral factors influencing the hematological parameters of thyroid dysfunction patients. Alcohol consumption can result in a generalized suppression of blood cell production as well as the production of structurally abnormal blood cell precursors that are incapable of maturing into functional cells. Alcoholics frequently have defective red blood cells that are destroyed prematurely, which can lead to anemia. Alcohol also interferes with the production and function of white blood cells, and it has a negative impact on platelets and other blood-clotting system components (61)**.** Regular alcohol intake leads to malnutrition which may result in insufficient iron distribution and iron overload or deficiency and anemia (62). Alcohol use causes direct and indirect effect on bone-marrow and causing thrombocytopenia. Regular drinking of alcohol has been shown to cause bone marrow suppression, defective platelet formation, a decrease in platelet lifespan and impaired platelet function. In addition to alcohol affecting bone marrow production of platelet it affect the size of platelets and causing thrombocytopenia, alcohol usually has a negative effect on platelet function (63)**.**

Another factor influencing hematological parameters in patients with thyroid dysfunction is khat chewing. Several studies have been conducted on the association of chewing khat and higher prevalence of anemia, which could be explained by loss of appetite and khat contains a significant amount of tannin, which reduces the bioavailability of non-heme iron from the population's diet, which is primarily based on plant-based foods (64). A cross-sectional study conducted in Dire Dawa (65), eastern Ethiopia (66) and Yemen showed that high prevalence of anemia among people chewing khat (67).

2.4.4 Body composition

The coexistence of under nutrition and obesity is an emerging problem for developing countries. Under nutrition is linked with a higher risk of anemia, and lower dietary iron intake might be the

possible reason. A cross-sectional study conducted in Bangladesh (68) and china (69) showed that both overweight/obesity and central obesity were inversely associated with anemia. According to their study the risk of anemia was higher among underweight and lower among obese/overweight women compared to normal weight individual.

2.4.5 Co-morbid illness

Presence of chronic illness are among the factor affecting hematological parameter of thyroid dysfunction patients. For instance according to study conducted among diabetic patient in Debrebirhan (70), anemia is a common hematological abnormality and significantly higher in DM group than non DM group. Hematological changes in diabetes can be caused by a variety of factors, including increased production of reactive oxygen species (ROS) and the formation of AGEs as a result of long-term hyperglycemia. Increased ROS production causes OS, which is linked to tissue damage and hematological changes like RBC dysfunction and endothelial dysfunction. These hematological changes can result in complications like anemia (71, 72). The use of antihypertensive medications has been linked to a drop in hemoglobin concentration in hypertensive patient. Hemolytic anemia, and RBC production suppression are the mechanistic bases for antihypertensive medication-related changes in hemoglobin concentration (73).

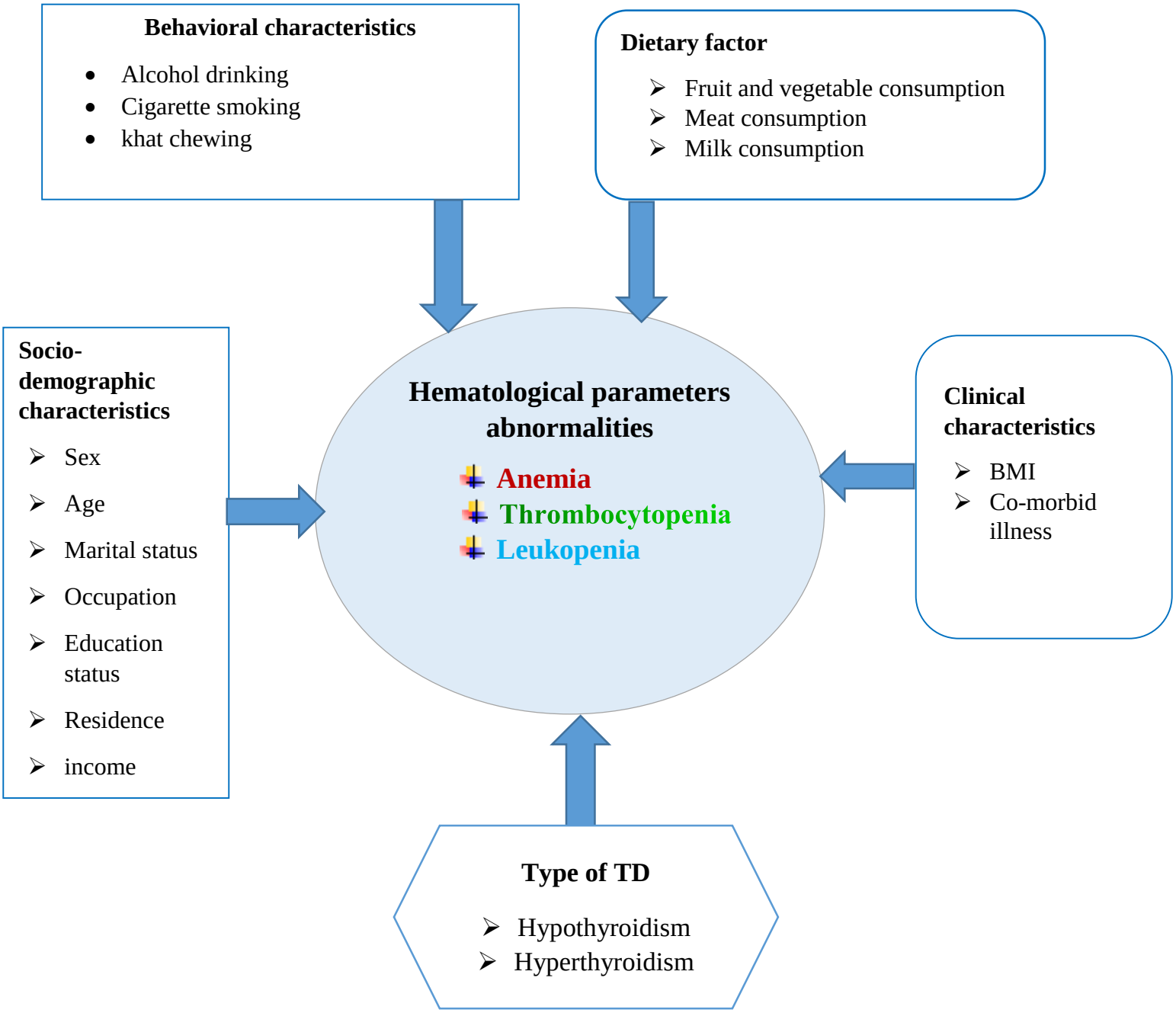

Figure 1: Conceptual framework showing factor associated with hematological parameter abnormalities.

CHAPTER THREE: OBJECTIVES OF THE STUDY

3.1 General objective

- To assess hematological parameters abnormalities and their associated factors among patients with thyroid dysfunction at Jimma Medical Center, 2022.

3.2 Specific objectives

1. To assess the prevalence of anemia among patient with thyroid dysfunction at Jimma Medical Center, 2022.
2. To assess the prevalence of leukopenia among patient with thyroid dysfunction at Jimma Medical Center, 2022.
3. To assess the prevalence thrombocytopenia among patient with thyroid dysfunction at Jimma Medical Center, 2022.
4. To identify factor associated with hematological abnormalities among patient with thyroid dysfunction at Jimma Medical Center, 2022.

CHAPTER FOUR: MATERIALS AND METHODS

4.1 Study area and period

The study was carried out in JMC located in Jimma Town which is located in Oromia Regional State, 350km southwest of Addis Ababa. JMC is one of the specialized referral teaching hospitals in the country providing health service at inpatient and outpatient level for the catchment of over 15 million populations in the southwest of the country. It was established in 1983 as a health science college and transfer to Jimma University. JMC has 1600 staff member, 32 intensive care unit and 800 beds. The study was conducted in chronic medical clinic of Jimma Medical Center among patients with thyroid dysfunction.

The study was conducted from October 3 to November 17, 2022 GC.

4.2 Study design

An institutional based cross sectional study design was employed.

4.3 Populations

4.3.1 Source population

All patients attending Jimma Medical Center who have confirmed thyroid dysfunction.

4.3.2 Study population

All selected thyroid dysfunction patients during the study period who are on chronic follow up at JMC and fulfill the inclusion criteria was included in the study.

4.4 Eligibility criteria

4.4.1 Inclusion criteria

- Patients with thyroid dysfunction aged 18 year and above, visiting Jimma medical center during the study period.

4.4.2 Exclusion criteria

- Pregnant women
- Patients who had traumatic injury or surgical interventions resulting in blood loss during the study period or within 3 months prior to the study period

- Those who are on vitamin and iron supplements for known hematological abnormalities at the time of sampling
- Thyroid dysfunction patient with diagnosed chronic liver diseases and chronic kidney diseases.
- Thyroid dysfunction patient blood transfused within the last three months.

4.5 Sample size determination and sampling technique

4.5.1 Sample size determination:

Sample size was estimated by using single population proportion formula by considering the following assumptions:

p= 55% proportion of anemia from the previous study (27), Margin of error =5% and 95% confidence interval,

$$n = \frac{(z_{\alpha/2})^2 p(1-P)}{d^2}$$

n = sufficient sample size

Z a/2= 1.96 (value for standard normal variable at 1-α % confidence level)

p = 48.9% (estimate of prevalence of degree)

d = 0.05 (Level of precision at 5%)

The sample size n =380

Since our source population is less than 10,000, we use correction formula.

NF= n / (1+ (n/N)

Where n=380

N= 340 (total thyroid dysfunction patient on follow up)

The resulting sample size 188

After considering 10% non- response rate the final sample size is 198.

4.5.2. Sampling method

A consecutive sampling technique was used.

4.6. Data collection procedure

The study participant included in this study was evaluated by the data collector for eligibility criteria. Those eligible and consented to participate was included in the study. The data collection tool was include socio-demographic characteristics, behavioral characteristics, clinical information and dietary information of the study participants were collected through a semi-structured questionnaire. The data collection tools were developed by reviewing different related literatures and assumed in such a way that it can meet the objectives of this study. Training and practical demonstration on interview technique and measurement procedure was given to data collector for two consecutive day by principal investigator. The question prepared in English language and was translated to local language, Afan Oromo and Amharic and retranslated back to English. Personal protective equipment (gloves and gown) was used by the data collector during the entire data collection process, and communication with the patient was held, and permission was obtained from the patient to conduct the procedure. COVID 19 prevention precautions were implemented during data collection for transmission and prevention.

4.6.1 Blood sample collection

The clinician performed a general physical examination. Once a subject was confirmed to be enrolled in the study, the skin was cleaned, an elastic band (tourniquet) was placed above the area to cause the veins to swell with blood, and 4 ml of venous blood was drawn aseptically into plain and ethyl diamine tetra acetic acid (EDTA) vacationer tubes for CBC determination. Blood drew from a median cubital vein, typically from the inside of the elbow or the venous arch on the back of the hand, during a blood sample collection. The test only took a few minutes. During the blood sample collection procedure, technicians first cleaned the patient's hands with antiseptic hand wipes before applying an elastic band or tourniquet to the mid-arm to allow vein access. The elastic band was then removed after the needle was inserted to collect 4ml of blood sample in one or more vials. As a result, the area was bandaged to stop any bleeding, and blood transferred to the EDTA tube and ran the CBC as soon as possible. Finally, an automated hematology analyzer (Beckman

Coulter DxH 500 analyzer, Switzerland brand) was used to examine the hematological parameters. EDTA blood sample (10ul) was placed in the instrument's aspirator. The result was displayed on the LCD display within one minute, was pretended out on the patient, and was saved in the resident memory. All laboratory procedures were performed in accordance with standard operating procedures (74) (75).

4.6.1.1 CBC result interpretation

- Anemia defined as, Hb value <13g/dl for adult male and 12g/dl for women. Severity classified as, mild (11–11.9 g/dl for women and 11.0-12.9 g/dl for men), moderate (8–10.9 g/dl for both sexes) and severe (<8g/dl for both sexes).
- MCV value interpret as, low (<80 fl), normal (80-100 fl) and high (>100 fl).
- MCHC value interpret as, low (< 32 g/dl), normal (32 -36 g/dl), and high (>36).
- MCH value interpret as, low (<27 pg/cell), normal (27-32pg/cell), and high (>32pg/cell). Microcytosis defined as MCV <80 fL and hypochromic as MCHC <31 g/dl.
- RBC value interpret as, low (<4×10 12/L), normal (4-6×10 12 /L) and high (>6×10 12 /L).
- WBC value interpret as, low (<4×10⁹/L), normal (4-10×10⁹/L), and high (≥10.1×10⁹/L). Leukopenia is a total leukocyte/white cell count (TWBC) <4×10⁹/L
- Neutrophil value interpret as, low (<40%), normal (40- 60%), and high (> 60%).
- Monocyte value interpret as, low (< 2%), normal (2 - 8%), and high (> 8%).
- Lymphocyte value interpret as, low (<20%), normal (<20-40%), and high (>40%).
- Basophiles value interpret as, low (<0.5%), normal (0.5 -1%), and high (> 1%).
- PLT count interpret as, low (<150 K/mm3), normal (150-450 K/mm3) and (>450 K/mm3). Thrombocytopenia a PLT count <150×109/L.
- MPV value interpret as, low (< 7fl), normal, normal (7-12fl) and high (7-12fl) (74) (75).

4.6.2 Anthropometric Measurements

4.6.2.1 Weighing procedure

- Participants was asked to remove their heavy outer garments (jacket, coat, trousers, skirts, etc.) and shoes. If subjects refuse to remove trousers or skirt, at least make them empty their pockets and record the fact in the data collection form.
- The participant was stand in the center of the platform, weight distributed evenly to both feet. Standing off-center may affect measurement.
- The weights are moved until the beam balances (the arrows are aligned).
- The weight was recorded to the resolution of the scale (the nearest 0.1 kg or 0.2 kg) (76).

4.6.2.2 Height measurement procedure

- The participant was asked to stand with his/her back to the height rule. The back of the head, back, buttocks, calves and heels was touching the upright, feet together. The top of the external auditory meatus (ear canal) was level with the inferior margin of the bony orbit (cheek bone). The participant will be asked to look straight.
- The head piece of the stadiometer or the sliding part of the measuring rod was lowered so that the hair (if present) is pressed flat.
- Height was recorded to the resolution of the height rule (i.e. nearest mm/half a centimeter) (76).

4.4.2.3 Body mass index

BMI was calculated as a ratio of weight in kg by height in meters squared (kg/m2). It was classified according to WHO international classification of adult BMI: Underweight < 18.5 kg/m2 ; Normal weight = 18.5 - 24.9 kg/m2 ; Overweight = 25.0 - 29.9 kg/m2 and Obesity ≥ 30 kg/m2 (76).

4.7 Study variables

4.7.1 Dependent variables

Hematological parameter abnormalities

- Anemia
- Leukopenia
- Thrombocytopenia

4.7.2 Independent variables

Socio demographic characteristics

- Sex
- Age
- Marital status
- Occupation
- Education status
- Residence
- Monthly income

Behavioral characteristics

- Alcohol drinking
- Cigarette smoking
- Khat chewing

Type of thyroid dysfunction

- Hypothyroidism
- Hyperthyroidism

Clinical characteristics

- BMI
- Co-morbid illness

Dietary factor

- Fruit and vegetable consumption, meat consumption and milk consumption.

4.8 Operational definitions and definition of terms

Thyroid dysfunction: Excess or deficient production of thyroid hormone. Serum TSH level below or above normal range with normal or abnormal T3 and T4 value

Hypothyroidism: Failure of the thyroid gland to produce sufficient thyroid hormone to meet the metabolic demands of the body. Serum TSH value above normal range whereas the value of T3 and T4 were below normal range.

Hyperthyroidism: Excess synthesis and secretion of thyroid hormone. Serum TSH value below normal range whereas the value of T3 and T4 were above normal range.

CBC (complete blood count): Indicates the counts of white blood cells, red blood cells and platelets, the concentration of hemoglobin, and the hematocrit.

Hematological parameter abnormalities: If TD patients consists at least one of these (anemia, leukopenia and thrombocytopenia).

Anemia: Blood has a reduced ability to carry oxygen due to reduction in the amount of Hb. According to WHO, defined as hemoglobin levels <12.0 g/dL in women and <13.0 g/dL in men. **Leukopenia:** A condition in which there is an abnormally reduced amount of WBC (<4000/μL). **Thrombocytopenia:** Condition in which abnormally low levels of platelets count, (150,000/μL)).

Comorbidities: If TD patient has other chronic disease such as Hypertension, diabetic mellitus, cardiac disease, etc.

Khat chewer: If TD patient had chewed Khat for more than 6 months and has chewed in the last 28 days. **Ex- chewer:** if they chew Khat for more than 6 months but not in the last 28 days. **Non Chewer**: if they chew for < 6 month and but not for the last 28 weeks.

Smoker: A respondent who smoke at least one tobacco product either daily or occasionally. **Non-smoker:** A participant who never smoke any tobacco product.

Regular drinker: If TD patient had been drinking alcohol >12 drinks per week for more than 6 months and has drank in the last 28 days **Nondrinker:** if they drunk < 12 drinks per week for more than 6 months but not for the last 28 weeks. **Occasional drinker**: if they drinks <12 drink per week for more than 6 months and has drank in the last 28 days.

Low fruit and vegetable intake: Less than five servings of fruits or vegetables per day which is about 400 grams per day.

4.9 Data analysis procedure

The data was cleaned, edited, checked for completeness manually, and enter in to EpiData version 3.1 software packages. For further analysis, the data was exported to Statistical Program for Social Science (SPSS) version 25 software. Descriptive statistics like frequency, percentage, mean, and standard deviation were carried out for each of the independent variables. Present with figure and graphs. Binary variable analysis was performed to select for multivariable analysis. The variables with a p-value 0.25 in the bivariable analysis were taken as candidate for multivariable logistic regression analysis. Finally multivariable logistic regression was performed. The variable with a p-value of less than 0.05 were taken as statistically significant determinant for of hematological parameter abnormality. Odds ratio with its 95% CI was used to show the degree of association.

4.10 Data management and quality control

To assure the quality of the data, two day training was given for data collectors on the objectives of the study, inclusion and exclusion criteria, contents of the questionnaires, and ethics during data collection. The prepared question was translated to local language, Afan Oromo and Amharic and retranslated back to English. Two day of training was given for data collectors. A pre-test was done among 10 TD patients at Shenen Gibe Hospital prior to data collection. Correction and modification on grammar and sequences were made based on the result of the pre-test before the start of actual data collection. Data collection was conducted by trained data collectors using semi-structured questionnaire under supervision of PI. All the measurement were made according to the respective standards. The collected of data was checked by the PI on daily basis for any incompleteness and /or inconsistency.

4.11 Ethical consideration

The study was carried out after ethical clearance and approval was obtained from Jimma University Institute of Health Research and Ethical Review Board (IRBNo 75/22). The proposal was further evaluated in light of the ethical standards and permission letter was obtained from chief medical director of JMC after letter of cooperation was written from Department of Biomedical Science.

The study title, purpose, procedure, and duration, possible risks, and benefits of the study was clearly explained to the study participants in there understandable language (Amharic or afan

oromo). Then, individual written informed consent was taken from the respondents and was assured of confidentiality by excluding their names during the period of data collection. They was informed well that they would have full right to refuse to participate and/or withdraw from the study at any time if they have any difficulty.

4.12 Dissemination plan

The result of this study will be presented to Department of Biomedical Sciences and copies will be submitted to Jimma University, Institute of Health, Department of Biomedical Science and other concerned bodies. Moreover, the efforts will be presented on seminars, workshops and scientific conferences. Finally, manuscript of the study will be made for publication of the findings in reputable local and international scientific journals.

CHAPTER FIVE: RESULT

5.1 Socio-Demographic characteristics of the Study Participants

A total of 198 patients participated in the study. Among the study participants, most of the patients 163 (82.3%) were females, and the remaining 35 (17.7%) were males. The respondent's mean age was 43.1±12.2 years, with a minimum age of 18 and a maximum age of 75. About 44 (22.2 %) of the individuals were within the age group of 28–37 years; 55 (27.8%) were within the age group of 38–47 years, and about 47 (23.7%) were within the age group of 48–57 years. Housewife respondents were 70 (35.3%), while farmer and merchant respondents were 61 (30.8%) and 29 (14.6%), respectively. With regard to participant residence, more than 135 (68.2%) were rural dwellers, and 63 (31.8%) were urban dwellers. Concerning educational level, 86 (43.4%) were uneducated, 67 (33.8%) were in primary school, and 22.7% were in secondary school or higher. There were 157 married respondents (79.8%), 21 single respondents (10.6%), and 13 widowed respondents (6.6%). According to the findings, 80 (40.4%) of the respondents had a monthly income below 2000 ETB **[Table 1].**

Table 1: Socio-demographic characteristics of respondent of thyroid dysfunction patient in JUMC, 2022

Variable	Category	Frequency	Percent
Age group	18-27	24	12.1
	28-37	44	22.2
	38-47	55	27.8
	48-57	47	23.7
	58-67	22	11.1
	>68	6	3
Sex	Male	35	17.7
	Female	163	82.3
Occupational status	Farmer	61	30.8
	Merchant	29	14.6
	Government worker	30	15.1
	Day labor	8	4.0
	Housewife	70	35.3
Marital status	Single	21	10.6
	Married	158	79.8
	Divorced	6	3.0
	widowed	13	6.6
Educational status	Uneducated	86	43.4
	Primary	67	33.8
	Secondary	27	13.6
	tertiary	18	9.1
Reported income status	<2000	80	40.4
	2000-4000	75	37.9
	>4000	43	21.7
Place of residence	Urban	63	31.8
	Rural	135	68.2

5.2. Behavioral, dietary status, and Clinical characteristics of the study participant

The study subjects' behavioral characteristics revealed that 98.0% were non-smokers. One hundred sixty two (81.81%) were non-alcoholic drinkers and occasional drinkers, while 36 (18.18%) were active/regular drinkers. Regarding the history of khat chewing, 136 (68.6%) were non-chewers, 13 (6.56%) were ex-chewers, and 49 (24.74%) were active chewers. Regarding the dietary factors of the respondent, 143 (72.2%) were using low fruit and vegetable intake per day, and 55 (27.7 %) were using ≥ 5 servings per day fruit and vegetable. Concerning meat consumption, the majority of respondents, 131(66.2%) didn't eat meat at least once a week, 32 (16.2%) used <150 grams per week and 35(17.6%) used meat >150 grams per week, which is weakly recommended meat intake. 148 (74.7%) didn't drink milk per day, 17 (8.6%) drink milk 1 cup per day, and 33 (16.7%) drinking >1 cup per day.

The majority of the respondents, 115 (58.1%), were hyperthyroidism patients, and 83 (41.9%) were hypothyroidism patients. From the total of 198 patients, 46 (23.2%) had a co-morbid illness (chronic disease). The dominant co-morbid illness was, diabetic-mellitus 24(52.1%), hypertension 17 (36.9 %), and heart failure 5 (10.8%). The majority of the respondents 112(56.6%) had normal weight, 56 (28.3 %) had overweight and 30 (15.2 %) had underweight **[Table 2].**

Table 2: Behavioral, dietary and clinical characteristics of respondent of thyroid dysfunction patient in JUMC, 2022

Variable	Category	Frequency	Percent
Type of thyroid dysfunction	Hypothyroidism	83	41.9
	Hyperthyroidism	115	58.1
BMI	≤ 18.5	30	15.2
	18.5 - 25.5	112	56.6
	≥ 25.5	56	28.3
Co-morbid illness	Yes	46	23.2
	no	152	76.7
Type of co-morbid illness	Diabetic mellitus	24	12.1
	Hypertension	17	8.5
	Heart disease	5	2.5
Smoking status	Non-smoker	194	98
	smoker	4	2
Alcohol drinking status	Regular drinker	36	18.1
	Occasional/never drinker	162	79.8
Khat chewing status	Active chewer	49	24.7
	abstainer	13	6.5
	Non-chewer	136	70.2
Fruit and vegetable	<5 serving	143	72.2
	≥5 serving	55	27.7
Meat eating	No serving per week	131	66.2
	<150 gram per week	32	16.2
	>150 gram per weak	35	17.7
Milk drinking status	No serving per/day	148	74.7
	1 cup per day	17	8.6
	>1 cup per day	33	16.7

5.3 The prevalence of hematological abnormalities among thyroid dysfunction

Hematological parameter abnormalities were present in both hypothyroidism and hyperthyroidism patients. The dominant type of hematological abnormality was anemia. The prevalence of Anemia among thyroid dysfunction patients was 81 (40.9%, 95% CI; 34 -47%), with a mean hemoglobin value of 12.11 ± 2.33g/dl and with a mean hematocrit value 36.45 ± 6.99 of TD patients. Its prevalence was 39 (46.9%) among patient with hypothyroidism and 42 (36.5%) in patient with hyperthyroidism. In terms of anemia severity, from the total of anemic patients 4(4.93%) had severe anemia, 38 (47.0%) had moderate anemia, and 39 (48.1%) had mild anemia. From the total of hypothyroidism anemic patients 22 (56.4%) of had moderate anemia, 14 (35.8%) had mild anemia, and 3 (7.7%) had severe anemia. The prevalent type of anemia among hyperthyroidism patients was mild anemia 25 (59.52%), 16 (38.1%) had moderate anemia, and 1 (2.38%) had severe anemia.

The prevalence of thrombocytopenia was 63 (31.8%, 95% CI; 25.2-38.3%) with a mean platelet of 210.05 ± 104.02 (X103 /µL). The prevalence of thrombocytopenia among hypothyroidism patients was 35 (42.1%). The prevalence of thrombocytopenia among hyperthyroidism patient was 28 (24.3%).

The prevalence of leukopenia was (7.6%, 95% CI; 3.8 – 12.3%) with a mean white blood cell value of 6.55 ± 2.43 (X103 /µL). The mean values of neutrophils, lymphocytes, monocytes, eosinophil's, and basophils were 4.23 ± 2.17, 1.59 ± 0.65, 0.52 ± 0.21, 0.210 ± 0.18 and 0.016 ± 0.04 respectively.

The prevalence of leukopenia among hypothyroidism patient was 6 (4.98%). The prevalence of leukopenia among hyperthyroidism patient was 9 (7.8%) **[Figure 2].**

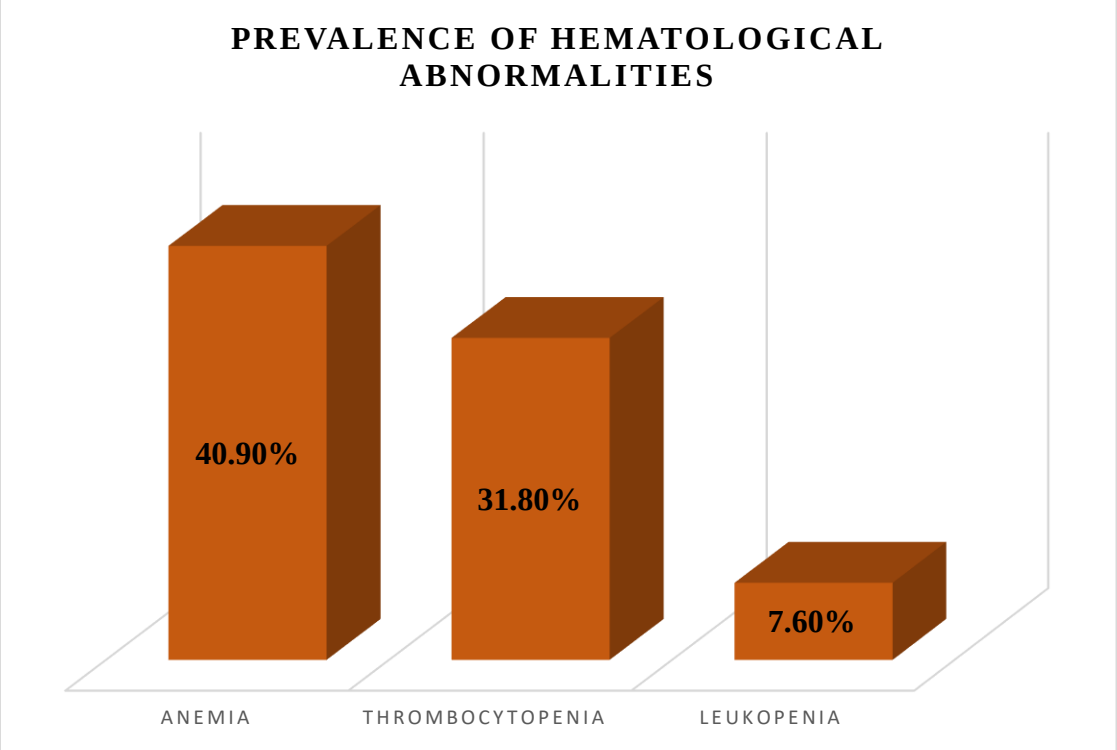

Figure 2: Prevalence of hematological parameter abnormalities among patients with thyroid dysfunction at JMC, 2022.

5.4. Hematological parameters of hyperthyroidism and hypothyroidism patient

There were statistically significant differences in mean values of hemoglobin (12.4 ± 2.41 vs 11.6 ± 2.12), hematocrit (37.5 ± 7.3 vs 34.9 ± 6.2), MCV (86.2 ± 6.9 vs 83.5 ± 8.5), MCH (28.6 ± 2.4 vs 27.3 ± 3.0), MCHC (33.1 ± 1.7 vs 32.4 ± 2.2), RDW (14.4 ± 1.55 vs 15.1 ± 2.5), White blood cell (6.92 ± 2.63 vs 6.05 ± 2.02), Neutrophil (4.52 ± 2.33 vs 3.89 ± 1.86) and platelet count (225.9 ±112.7 vs 189.3 ±91.1) in hyperthyroidism and hypothyroidism patient ($p < 0.05$). White blood cell count, neutrophils, RBC, hemoglobin, hematocrit, MCV, MCH, MCHC, and platelets were significantly higher in hyperthyroidism patients compared to hypothyroidism patients ($p < 0.05$), while RDW values were higher in hypothyroidism patients compared to hyperthyroidism patients **[Table 3]**.

Table 3: Hematological parameters of hyperthyroidism and hypothyroidism patient at Jimma university medical center, 2022.

Parameters	Hyperthyroidism (Mean± SD)	Hypothyroidism (Mean ± SD)	T –value (95%CI)	P-Value
WBC (X103 /µL	6.92 ± 2.63	6.05 ± 2.02	2.5 (0.19 , 1.55)	***0.012**
Neutrophil(X103 /µL)	4.52 ± 2.33	3.89 ± 1.86	2.2 (0.072 , 1.29)	***0.029**
Lymphocyte(X103 /µL)	1.66 ± 0.66	1.5 ± 0.61	1.7 (-0.94, 1.27)	0.088
Monocyte(X103/µL)	0.53 ± 0.24	0.5 ± 0.17	1.1 (-0.02 , 0.34)	0.258
Eosinophil(X103 /µl)	0.22 ± 0.19	0.18 ± 0.17	1.4 (-0.0128 , 0.09)	0.136
Basophil(X103 /µL)	0.015 ± 0.042	0.018 ± 0.04	-0.5(-0.015 , 0.093)	0.608
RBC(X106 /µL	4.47 ± 1.09	4.06 ± 0.72	3.02 (0.14 , 0.68)	***0.003**
Hemoglobin (g/dl)	12.4 ± 2.41	11.6 ± 2.12	2.6 (0.21 , 1.52)	***0.009**
HCT (%)	37.5 ± 7.3	34.9 ± 6.2	2.6 (0.64 , 4.51)	***0.009**
MCV (fl)	86.2 ± 6.9	83.5 ± 8.5	2.4 (0.5 , 4.9)	***0.014**
MCH (pg)	28.6 ± 2.4	27.3 ± 3.0	3.31 (0.5 , 2.0)	***0.001**
MCHC g/dl	33.1± 1.7	32.4 ± 2.2	2.4 (0.1, 1.2)	***0.015**
RDW %	14.4 ± 1.55	15.1 ± 2.5	-2.7 (-1.35 , -0.21)	***0.007**
Platelet (X103 /µL)	225.9 ±112.7	189.3 ±91.1	2.41 (6.7 , 65.9)	***0.017**
MPV (fl)	9.41 ± 1.35	9.20 ± 1.28	1.10 (-0.1, 0.5)	0.27

Where, WBC=White blood cell, RBC= Red blood cell, HGB= Hemoglobin, HCT= Hematocrit, MCV=Mean cell volume. MCH= Mean cell hematocrit, MCHC= Mean Corpuscular Hemoglobin Concentration, RDW= Red cell Distribution Width, PLT= platelet, MPV= Mean platelet volume. *= indicates the level of significance, fl=femtoliter, pg=picograms

5.5 Factors associated with Hematological parameter abnormalities

5.5.1. Factors associated with Anemia

For bivariate analysis, variables like socioeconomic and demographic factors, behavioral factors, clinical factors, dietary factors, and body composition measurements were included. From these variables, sex, educational level, meat consumption, fruit and vegetable consumption, khat consumption status, presence of co-morbid illness, type of thyroid dysfunction, and BMI were associated with anemia at a p-value of less than 0.25.

The finding of multivariable logistic regression indicated that sex, fruit and vegetable consumption, chewing khat, presence of co-morbid illness, and BMI were independently associated with anemia.

Female thyroid dysfunction patients were 4.5 times higher odds of more likely to have anemia compared to males (AOR = 4.5, 95%, CI = 1.1, 17.0). The odds of having anemia were 3.6 times higher among khat chewers compared to non-chewers (AOR = 3.6, 95% CI = 1.35, 9.6). Anemia also showed an association with a participant with a BMI ≤ 18.5 kg/m2, patients with a BMI ≤ 18.5 were 3.5 times more likely to have anemia compared to an overweight patient (AOR = 3.5, 95% CI = 1.0–12.4). A dietary factor is also associated with anemia. Those who had less than five serving per day of fruit and vegetables were 3.3 times more likely to have anemia compared to a patient with >5 servings per day of fruit and vegetables (AOR = 3.3, 95% CI = 1.06–10.2). Thyroid dysfunction patients with co-morbid illness had 2.63 times higher odds of more likely having anemia compared to counter-participants (AOR = 2.63, 95% CI = 1.0–6.6) **[Table 4].**

Table 4: Bivariate and multivariable analysis of factors associated with anemia among thyroid dysfunction patient at JMC, 2022

		Anemia		COR (95% CI)	P-value	AOR(95% CI)	P-value
		Yes	No				
Sex	Male	6 (7.4%)	29 (24.7%)	1			
	Female	75 (92.5%)	88 (75.2%)	4.1(1.6,10.4)	**0.003**	4.5(1.1-17.0)	**0.029**
Type of TD	Hypothyroidism	39 (48.1%)	44 (37.7%)	1.5(0.8,2.7)	0.140	1.5(0.6, 3.0)	0.345
	Hyperthyroidism	42 (51.8%)	73(62.3%)	1			
Khat chewing	Non- chewer	43(53.1%)	106(90.5%)	1		1	
	Active chewer	38(46.9%)	11(9.4%)	8.5(3.9,18)	**0.000**	3.6(1.3,9.6)	**0.010**
Meat intake per weak	No serving	65(80.2%)	66(56.4%)	5.9 (2.1,16.1)	**0.001**	3.3(0.93,12)	0.064
	<150g serving	11(13.6%)	21(17.9)	3.1(0.95,10.3)	**0.060**	2.1(048,9.7)	0.311
	>150g serving	5(6.1%)	30 (25.6%)	1		1	
Co-morbid illness	Yes	34(41.9%)	12(10.2%)	4.4(2.2, 8.8)	**0.000**	2.6(1.0,6.6)	**0.040**
	No	47(58%)	105(89.8%)	1		1	
Milk consumption	No serving	47(58%)	101(86.3%)	1		1	
	1 cup per day	11 (13.5 %)	6 (5.1%)	3.9(1.3,11.2)	**0.011**	2.(0.7 , 12.2)	0.140
	>1 cup per day	23(28.3%)	10(8.5%)	4.9(2.1,11.2)	**0.001**	0.7(0.2,2.3)	0.621
Fruit and vegetable eating status	< 5 serving/day	71 (87.6 %)	72 (61.4%)	4.4 (1.0 , 13.1)	**0.000**	3.3(1.06 , 10)	**0.007**
	>5 serving /day	10 (12.3%)	45 (38.4%)	1		1	
Educational status	Uneducated	39(48.1%)	47 (40.1)	4.1 (1.1, 15.3)	**0.033**	1.6(0.38, 8.2)	0.454
	Primary	31(38.2%)	36 (30.7%)	4.3 (1.1, 16.2)	**0.031**	2 (0.45, 9.4)	0.349
	Secondary	8 (9.8%)	19 (16.2%)	2.1 (0.4 , 9.3)	**0.327**	1.8 (0.35, 10.8)	0.482
	Tertiary	3 (3.7%)	15 (12.8%)	1		1	
BMI	≤ 18.5	21 (25.9%)	9 (7.6%)	5.8 (2.2 , 15.4)	**0.00**	3.5 (1.01 , 12)	**0.048**
	18.5-25.5	44 (54.3%)	68 (58.1%)	1.6 (0.8 , 3.2)	0.808	1.3 (0.56, 3.5)	0.486
	≥25.5	16 (19.7%)	40 (34.1%)	1			

5.5.2 Factors associated with thrombocytopenia

For bivariate analysis, variables like socioeconomic and demographic factors, behavioral factors, clinical factors, dietary factors, and body composition measurements were included. From these variables, sex, alcohol consumption, presence co-morbid illness, and type of thyroid dysfunction were associated with anemia at a p-value of less than 0.25. The finding of multivariable logistic regression indicated that alcohol drinking status and type of thyroid dysfunction were independently associated with anemia. TD patients who were drinking alcohol were 2.2 times more likely to develop thrombocytopenia compared to non-alcoholic drinkers (AOR = 2.2, CI= 1.0, 5.0). The odds of having thrombocytopenia were 2.4 times higher among patients with hypothyroidism compared to hyperthyroidism patients (AOR = 2.4, 95%, CI=1.3, 4.6) **[Table 5].**

Table 5: Bivariate and multivariable analysis of factors associated with thrombocytopenia among thyroid dysfunction patient at JMC, 2022

Variable	Categories	Thrombocytopenia		COR (95%)	P value	AOR (95%)	P value
		Yes (%)	No (%)				
Sex	Male	8 (12.6%)	27 (20%)	1		1	
	Female	55(87.3%	108(80%)	1.7 (0.7 , 4.0)	***0.213**	2.06 (0.8 , 5.0)	0.112
Type of TD	Hypothyroidism	35(55.5%)	48 (35.5%)	2.2 (1.2 , 4.1)	***0.009**	2.4 (1.3 , 4.6)	***0.005**
	Hyperthyroidism	28(44.4%)	87 (64.4%)	1		1	
Alcohol drinking status	Non-alcoholic drinker	46 (73%)	116(85.9%)	1		1	
	Active-alcoholic drinker	17 (26.9%)	19(14.0 %)	2.2 (1.0 , 4.7)	***0.031**	2.2 (1.0 , 5.0)	***0.04**
Co-morbid illness	Yes	17 (26.9%)	29 (21.4%)	1.3(0.8 – 2.9)	***0.192**	1.12 (0.5 , 2.3)	0.747
	No	46 (73%)	106 (78.5%)	1		1	

5.4.3 Factors associated with leukopenia

Factors such us, socioeconomic and demographic, behavioral, dietary, and clinical factors were computed for other hematological abnormalities (leukopenia) however, they were not found to be statistically significant. Since the prevalence of leukopenia 7.6% (< 10%) statistically it is difficult to get factor associated with it.

6. DISCUSSION

The present study was a hospital-based cross-sectional study to assess hematological parameter abnormalities among TD patients. Anemia and thrombocytopenia were the prevalent types of hematological parameter abnormalities. The prevalence of anemia in this study population was found to be 81 (40.9%, 95% CI; 34 -47%), this is consistent with findings reported from various countries in Egypt (46%), Iraq (44%), and Saud Arabia (44%) (26, 44, 43). But lower than the study conducted in Addis Ababa menilik Hospital (55.4 %) and another study done in Saudi Arabia (54.3%) (27, 42) and higher than the study conducted in Switzerland (12.6 %) and Kenya (28.1%) (37, 45). The reasons for this differences might be due to differences in methodology, socio-demography, genetic variation, chronic diseases, health seeking, health quality, behavior and nutritional differences.

In the current study, anemia prevalence was higher among hypothyroidism patients compared to hyperthyroidism patients. Its prevalence was 46.9% in hypothyroid patients. This is comparable to studies conducted in Egypt (50%), Iraq (50%), India (40%), and Saudi Arabia (50%) (26, 44, 47, 43). But, lower than different studies conducted in India (69%), (56%), (73%) and (75%), Saudi Arabia (60.27%) and menelik hospital Addis Ababa (57.7%) (50, 48, 51, 24, 42 , 27). Higher than study conducted in Switzerland (7.7 %) (37). The difference might be study design, sample size, socio-demographic and nutritional deference.

The prevalence of anemia among hyperthyroidism patients was 36.5% this is in agreement with the study conducted in Egypt (42%), Iraq (38.1%), and Saudi Arabia (31.57%) (26, 44, 42). But lower than the finding reported in menelik Hospital 53.3% (27) and higher than the study done Switzerland (14.6% (37). The reasons for the observed differences might be due to differences in socio-demography, genetic variation, presence of parasitic infections, history of co-morbidity, and nutritional differences.

In the current study, the prevalence of leukopenia among patients with thyroid dysfunction was 15 (7.6%, 95% CI; 3.8 – 12.3%). This is concurrent with the studies conducted in Kenya 12.2% (45), and higher than Addis Ababa menelik Hospital 3.75% (27). This could be because thyroid hormone has been shown to contribute towards the normal production of B cells in the marrow by regulating pro-B cell proliferation. The total leukocyte counts are also influenced by thyroid hormonal imbalances (45).

In this study, prevalence of thrombocytopenia was (31.8%, 95% CI; 25.2-38.3%). This is in line with a study conducted in USA society of hematology (32%) (46) and lower than a study done in menilik hospital 43.4% (27). The reason for this observed difference might be methodology, behavioral and socio-demographic variation. A possible explanation for this is megakaryocytopoiesis may be severely inhibited in patients with hypothyroidism and might result in thrombocytopenia and shortened platelet survival, by enhancing reticuloendothelial activity in hyperthyroidism patients may result in thrombocytopenia (39, 41).

The present study has shown, there were statistically significant differences in mean values of RBC (4.47±1.09x106 vs. 4.06±0.72x106 /µl), RDW (14.4±1.55 vs. 15.1±2.5%), hemoglobin (12.4±2.5 vs. 11.6±2.12g/dl), hematocrit (37.5±7.3vs.34.9±6.2%), MCV (86.2 ± 6.9 vs. 83.5±8.5fl), MCH (28.6±2.4 vs. 27.3±3.0 pg), MCHC (33.1±1.7g/dl vs 32.4±2.2g/dl) in hyperthyroidism and hypothyroidism patients, respectively. This is concurrent with studies conducted in India, Saudi Arabia, Saudi Arabia, and Sudan (51, 42, 43, 52). But according to study in Pakistan revealed a statistically significant difference in the mean hemoglobin levels (p=0.036) and hematocrit (p=0.022) but no significant difference was found in the red blood count(RBC), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCH) (7). The reason for this variation is study design.

This study also revealed that, there were also statistically significant differences on mean values platelet (225.9±112.7 vs. 189.3±91.1x103 /µl) in hyperthyroidism and hypothyroidism patient, respectively this in line with study conducted in India and Sudan (51, 52). There were also statistically significant differences in the mean value of WBC (6.92±12.63x106 vs. 6.05±02.02x106 /µl), this is supported by study conduct in India (51), but this parameter was not found to have a statistically significant difference in the study done in Sudan (52).

In this study, the prevalence of anemia was associated with being female. According to two studies conducted in India (25, 47) anemia is highly prevalent among female TD patients. The higher prevalence of anemia in females could be explained by the large amount of menstrual blood loss and drains on iron stores that occur with pregnancy and delivery. Anemia in women might be aggravated by hypermenorrhea or menorrhagia, which are the clinical manifestations of thyroid hormone deficiency. TSH may exert similar effects to those of FSH and LH, since they share a common α subunit. It reduces the LH secretion, thus leading to a decrease in the progesterone level

and estrogen breakthrough bleeding, secondary to anovulation. In addition, a lower concentration of sex hormone-binding globulin is observed in hypothyroidism. This increases circulating free estrogen levels, which exert a proliferative effect on the endometrium, and increasing levels of circulating estrogen can cause BM suppression, which can result in anemia (4).

In this study, less than five serving per day of fruit and vegetable consumption were associated with anemia. According two studies conducted in Indonesia (57, 58) and Ghana (59), consumption of <5 servings of fruit and vegetables had higher odds of anemia compared with those who consume >5 servings per day. A possible explanation is that fruits and vegetables are direct sources of dietary iron (due to their non-heme iron content) and have beneficial effects on blood cells due to their higher vitamin-C content, which increases iron bioavailability in the diet. Fruit and vegetable consumption are important components of folate (folic acid). Fruit and vegetable can also reduce substances that keep iron in the form of ferrous to be absorbed (56).

This study also revealed that Khat chewing was also associated with anemia. According to a study conducted in Dire Dawa (65), eastern Ethiopia (66), and Yemen (67), khat chewing is associated with anemia. A possible explanation for this is that regular chewing of khat leads to insufficient intestinal absorption of bioavailable iron, resulting in anemia. This could be explained by khat chewing could result in loss of appetite and derangement of hematopoiesis and hematological indices. Furthermore, khat contains a substantial amount of tannin, which reduces the bioavailability of non-heme iron from the diet (64).

In this study, the presence of co-morbid illness was associated with anemia. According to a study conducted in Debre-birhan (70), anemia is a common hematological abnormality and is significantly higher in the DM group than in the non-DM group. A possible explanation for this is that hematological changes in diabetes can be caused by several factors, including increased production of ROS and the formation of advanced glycation end products (AGEs) as a result of long-term hyperglycemia. Increased production of ROS results in oxidative stress, which is implicated in tissue damage and hematological changes such as RBC dysfunction and endothelial dysfunction. These hematological changes may lead to complications such as anemia (71, 72) The use of antihypertensive medications has been linked to a drop in hemoglobin concentration in hypertensive patient. Antihypertensive medication use has been linked to a drop in Hb concentration in hypertensive patient. Hemolytic anemia, and RBC production suppression are the

mechanistic bases for antihypertensive medication-related changes in hemoglobin concentration (73).

This study revealed that body weight is also associated with anemia. A decrease in BMI below 18.5 was also associated with anemia. This might be due to the fact that anemia is one of the most common nutritional deficiency disorders observed globally, and an underlying cause of anemia includes nutritional deficiencies. This finding was supported by the study conducted in Bangladesh (68) and China (69). This revealed that the risk of anemia was higher among underweight individuals and lower among obese/overweight individuals compared to normal weight individuals. This showed an inverse association between overweight or obesity and anemia.

In this study, the prevalence of thrombocytopenia was associated with the type of thyroid dysfunction (hypothyroidism). This is supported by a study done in the USA (39), in which an increase in serum TSH level was linked to a significant decline in platelet count, and platelet count significantly increased when serum levels of T4 or T3 increased. A possible explanation for this is that thyroid hormones affect both platelet formation and prolong the survival of platelets, and megakaryocytopoiesis may be severely inhibited in patients with hypothyroidism. Megakaryocytes may be affected by TH by altering BM matrix proteins like fibronectin. fibronectin gene is expressed more frequently by TH. Through interactions with integrin 41, fibronectin appears to have an impact on megakaryocyte maturation & thrombopoiesis. It also alters platelet function & has a variety of other effects on hematopoiesis (39, 41).

This study also revealed that regular alcohol consumption is also associated with thrombocytopenia among thyroid dysfunction patients. A possible explanation for this is that alcohol use causes a direct and indirect effect on bone marrow, causing thrombocytopenia. Regular drinking of alcohol has been shown to cause bone marrow suppression, defective platelet formation, a decrease in platelet lifespan, and impaired platelet function (61 , 63).

LIMITATIONS OF THE STUDY

- The cross-sectional nature of this study cannot show the cause-and-effect association between the outcome variable and the explanatory variable.
- Single institution used for the study.

CHAPTER SEVEN: CONCLUSION AND RECOMMENDATION

7.1. Conclusion

In the present study, the most prevalent type of hematological abnormality was anemia, followed by thrombocytopenia in Jimma Medical Center.

Being females, khat chewing, low body mass index, co-morbid illness, and low intake of fruit and vegetables were all were identified as risk factors of anemia in Jimma Medical Center.

Hypothyroidism and alcohol consumption were identified as risk factors of thrombocytopenia in Jimma Medical Center.

7.2 Recommendation

Based on these findings, it is recommended that all thyroid dysfunction patients should be screened and treated for hematological abnormalities to reduce morbidity and mortality. Physicians should regularly investigate and treat hematological abnormalities in patients with thyroid dysfunction. Close attention should also be given to the behavioral and dietary practices of patients concerning hematological abnormality. In Ethiopia, data concerning the hematological parameters abnormalities among thyroid dysfunction patients are limited, so future longitudinal studies are needed to explore more about the causes of hematological abnormalities and to help health authorities implement policies to improve the health status of patients with thyroid dysfunction.

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ANNEXES

Annex I. Patients' information sheets

English version

Title of Research: Assessment of hematological parameters abnormalities and associated factors among thyroid dysfunction patients at Jimma medical center, 2022.

Greeting; Good morning/afternoon. My name is …… I am working on behalf of research conducted Jimma University, Institution of Health Faculty Medicine, Department of Biomedical medical Science, unit of Physiology. I would like to ask a few questions and to obtain 4ml of venous blood specimen which take around 10 minutes.

The purpose of this study is to assess hematological parameters abnormality of thyroid dysfunction patient in Jimma medical center. The study will be conducted through directly asking the patients or their attendants about current diseases (thyroid disease) and life style. The study is aimed to fill the information gap and provide evidence for health professionals, decision makers and program implementers about the effect of thyroid disease on hematological parameter. If you agree, I would like to obtain 4ml of venous blood specimen and to ask you few question.

The benefit of the study: Even if there is no direct benefit for your participation in this study, the information you give will help you and your physician to know your hematological parameters and if you have hematological abnormalities, management opportunities will be arranged for you.

Risk of the study: The study has no risk for the participants. It make cause minimal discomfort but, will not cause you any physiological, financial and psychological harm.

Confidentiality: Any information forwarded will be kept private your name will not be specified.

Rights of participants: Your participation is based on your willingness and you have the right not to participate and withdrawal from participating in the study at any time after giving your consent and start your participation. You can also jump any question if you don't wish to respond any question. This decision will not affect your current or future medical care in health facility.

If you have any question about this research project you can simply call to:

Luna Abebe, (+251938591528)

Annex II. Data collection tools

English version

Informed Consent

I have read this form or it has been read to me in the language I comprehend and understand all conditions stated above.

Are you willing to participate in this study?

1. No (Say Thank you)

2. Yes participant's signature _____

._____ _____

Date Signature of the interviewer

Result of the interview:

1. Completed 2. Respondent not available 3. Refused. 4. Partially completed Checked by supervisor, name _____Signature _____Date_____

Part One: Socio-Demography Data

No	Question	Response
1	Identification	Code number.....
2	Sex of patients	1. Male 2. Female
3	Age	…….
4	Where do you live (Residence)?	1. Urban 2. Rural
5	Marital status	1. Single 2.Married 3.Divorced 4.Widowed
6	What is your educational status?	1. Not educated 2.Primary 3.Secondary 4.Tertiary
7	What is your occupation?	1. Farmer 2. Merchant 3. Government employee 4. Non-government employee 5. Day laborer 6. Driver 7. Jobless 8.Otherspecify----------
8	What is your monthly family income? (in ETB)	----------

PART Two: Behavioral and dietary Measurements

No	Question	Response
9	Have you ever chewed Khat in your life	1. Yes If no skip to Q#12

	time?	2. No
10	If yes to Q#9, for how many years have you chewed Khat?	1. >6month 2. < 6 month
11	If yes to Q#9, have you chewed Khat within the last 28 days?	1. Yes 2. No
12	Have you ever drunk alcohol in your life time?	1. Yes If 'No' skip to Q# 15 2. No
13	If yes to Q#12, in which year have you been drinking alcohol?	1. >6month 2. < 6 month
14	If yes to Q#12, how much drinks of alcohol you drink per week?	1. > 12 2. < 12
15	Do you smoke tobacco/cigarette?	1. Yes 2. No
16	If your answer to question number 15 is yes, how many cigarettes do you smoke per day on average?	……..
17	Do you eat fruit and vegetable?	1. Yes 2. No
18	In a typical week, on how many days, do you eat fruit and vegetable?	……
19	How many serving/portion of fruit and vegetables do you eat on one of those days?	……
20	Do you drink milk?	1-yes 2-No If 'No' skip to Q# 23
21	If your answer is yes to Q#20, in a typical week, on how many days, do you drink milk?	……
22	How many cup of milk you drink on one of those days?	……
23	Do you eat meat?	……
24	In a typical week, on how many days, do you eat meat?	……

25	How many gram/portion of meat you eat on one of those days?	……

PART THREE CLINICAL DATA

26	Type of Thyroid dysfunction	1. Hypothyroidism 2. Hyperthyroidism
27	Do you have co-morbid illness?	1. Yes 2. No
28	Which one?	1. TB 2. HIV 3. Heart disease 3. Diabetic mellitus 4. Hypertension 5. Other specify……
29	Anthropometry	Height (m)..... Weight (kg)..... Body Mass Index (BMI in kg/m2).....
30	T4_____ T3_____ TSH_____	

PART FOUR: LABORATORY DATA

Hematological parameters results of patients with Thyroid dysfunction
WBC_____ X103 /µL LYM _____ X103 /µL NEU _____ X103 /µL MONO_____ X103 /µL EOS _____ X103 /µL BASO _____ X103 /µL
RBC_____ (X106 /µL Hb____ g/dl HCT____ % MCV_____ (fl) MCH_____(pg) MCHC_____(g/dl) RDW_____%
PLT_____(X103 /µL) MPV_____fl

አባሪ ፤. የታካሚዎች መረጃ ወረቀቶች

ሰላምታ; እንደምን አደሩ። ስሜ ..... ጥቂት ጥያቄዎችን መጠየቅ እና የደም ናሙና ማግኘት እፈልጋለሁ። የዚህ ጥናት ዓላማ በጅማ የሕክምና ማዕከል ውስጥ የታይሮይድ እክል ታካሚን የሂማቶሎጂ መለኪያዎችን መዛባት ለመገምገም ነው. ጥናቱ የሚካሄደው በሽተኞቹን ወይም ረዳቶቻቸውን ስለ ወቅታዊ በሽታዎች (የታይሮይድ በሽታ) እና የአኗኗር ዘይቤን በቀጥታ በመጠየቅ ነው። ጥናቱ የመረጃ ክፍተቱን ለመሙላት እና ለጤና ባለሙያዎች, ውሳኔ ሰጪዎች እና የፕሮግራም አስፈፃሚዎች የታይሮይድ በሽታ በሂማቶሎጂ መለኪያ ላይ ስላለው ተጽእኖ ማስረጃዎችን ለማቅረብ ያለመ ነው. ከተስማሙ 4ml የቬነስ ደም ናሙና ላገኝ እና ጥቂት ጥያቄዎችን ልጠይቅህ እፈልጋለሁ።

የጥናቱ ጥቅም፡ በዚህ ጥናት ላይ ለሚያደርጉት ተሳትፎ ምንም አይነት ቀጥተኛ ጥቅም ባይኖርም፡ የሚሰጡት መረጃ እርስዎ እና ሀኪምዎ የሂማቶሎጂካል መለኪያዎችን እንዲያውቁ እና የሄማቶሎጂ እክል ካለብዎ የአስተዳደር እድሎች ይዘጋጅልዎታል።

የጥናቱ ስጋት፡ ጥናቱ ለተሳታፊዎች ምንም አይነት ስጋት የለውም። ምንም አይነት የፊዚዮሎጂ, የገንዘብ እና የስነ-ልቦና ጉዳት አያስከትልም.

ምስጢራዊነት፡ ማንኛውም የተላለፈ መረጃ በሚስጥር ይጠበቃል ስምዎ አይገለጽም።

የተሳታፊዎች መብቶች፡- ተሳትፎዎ በእርስዎ ፍላጎት ላይ የተመሰረተ ነው እናም ፍቃድ ከሰጡ በኋላ በማንኛውም ጊዜ በጥናቱ ላለመሳተፍ እና ተሳትፎዎን ለመጀመር መብት አለዎት። ማንኛውንም ጥያቄ መመለስ ካልፈለጉ መዝለል ይችላሉ። ይህ ውሳኔ አሁን ያለዎትን ወይም የወደፊት የጤና እንክብካቤዎን በጤና ተቋም ላይ ምንም ተጽእኖ አያመጣም።

ስለዚህ የምርምር ፕሮጀክት ማንኛውም አይነት ጥያቄ ካሎት በቀላሉ ወደዚህ መደወል ይችላሉ፡-

ሉና አበበ፣ (+251938591528)

የጥያቄዎች ዝርዝር መዋቅር (የአማረኛጥያቄ)

በመረጃ የተደገፈ ስምምነት

ይህንን ቅጽ አንብቤዋለሁ ወይም በሚገባኝ ቋንቋው ተነቦልኛል እና ከላይ የተጠቀሱትን ሁሉንም ሁኔታዎች ተረድቻለሁ።

1. አይ (አመሰግናለሁ)
2. አዎ የተሳታፊ ፊርማ _____

የቃለ-መጠይቅ አድራጊው

ስም _____ቀን _____ ፊርማ_____

የቃለ መጠይቁ ውጤት፡-

1) የተጠናቀቀ 2. ተጠሪ የለም 3. እምቢተኛ. 4. በከፊል የተጠናቀቀ

በሱፐርቫይዘሮች የተረጋገጠ

ስም _____ቀን_____ ፊርማ _____

ክፍል I: - ማህበራዊ፥ ኢኮኖሚያዊና ዲሞግራፊያዊ ሁኔታን የሚመለከቱ ጥያቄዎች.

ተ.ቁጥር	ጥያቄ	ምላሽ
1	መለያ	ኮድ ቁጥር.....
2	የታካሚው ፆታ	1. ወንድ 2. ሴት
3	እድሜ	…….
4	መኖሪያ ቦታ	1. ገጠር 2.ከተማ
5	የጋብቻ ሁኔታ	1. ያላገባ/ች 2. ያገባ/ባች 3. የተፋታ 4. በሞት የተለየ/ች 5.ሌላ…….
6	የትምህርት ደረጃ?	1. ያልተማረ 2. የመጀመሪያ ደረጃ 3. ሁለተኛ ደረጃ 4. ከፍተኛ ደረጃ
7	ሥራህ ምንድን ነው?	1. ገበሬ 2. ነጋዴ 3. የመንግስት ሰራተኛ 4. የመንግስት ያልሆነ ሰራተኛ 5. የቀን ሰራተኛ 6. ሹፌር 7. ሥራ አልባ 8.ሌሎች ይግለጹ-------
8	የወርሃዊ የቤተሰብ ገቢህ ስንት ነው?	----------

ክፍል ሁለት፡ የባህሪ እና የአመጋገብ መለኪያዎች

ተ.ቁጥር	ጥያቄ	ምላሽ
9	በህይወትህ ጫት ቅመክ/ሽ ታውቃለህ?	1. አዎ 2. አይ አዎ ካልሆነ ወደ Q#12
10	ለጥያቄ #9 አዎ ከሆነ ስንት አመት ጫት ቅመዋል?	1. > 6 ወር 2. <6 ወር
11	ለ #9 አዎ ከሆነ፣ ባለፉት 28 ቀናት ውስጥ ጫት ቅመዋል?	1. አዎ 2. አይ
12	በህይወትዎ አልኮል ጠጥተው ያውቃሉ?	1. አዎ አዎ ካልሆነ ወደ Q#15 2. አይ
13	ለ Q#12አዎ ከሆነ፣ ስንት አመት አልኮል ጠጥተዋል?	1. > 6 ወር 2. <6 ወር
14	Iለ Q#12 አዎ ከሆነ በሳምንት ምን ያህል የአልኮል መጠጦች ይጠጣሉ?	1. > 12 2. < 12
15	ትምባሆ/ሲጋራ ታጨሳለህ?	1. አዎ አዎ ካልሆነ ወደ Q#17 2. አይ
16	ለጥያቄ ቁጥር 15 የሰጡት መልስ አዎ ከሆነ፣ በአማካይ በቀን ስንት ሲጋራ ያጨሳሉ?	……..
17	አትክልትና ፍራፍሬ ትበላለህ?	1. አዎ 2. አይ
18	በተለመደው ሳምንት ውስጥ, በስንት ቀናት ውስጥ, ፍራፍሬ እና አትክልት ይበላሉ?	……
19	ከእነዚያ ቀናት በአንዱ ስንት ግራም/ከፊል ፍራፍሬ እና አትክልት ይበላሉ?	……
20	ወተት ትጠጣለህ?	1. አዎ 2. አይ

21	በተለመደው ሳምንት፣ ለጥያቄ #20 መልስዎ አዎ ከሆነ በስንት ቀናት ውስጥ ወተት ይጠጣሉ?	……
22	ከእነዚህ ቀናት ውስጥ ስንት ኩባያ ወተት ትጠጣለህ?	……
23	ስጋ ትበላለህ?	……
24	በተለመደው ሳምንት ውስጥ በስንት ቀናት ውስጥ ስጋ ትበላለህ?	……
25	ከእነዚያ ቀናት በአንዱ ስንት ግራም/ከፊል ሥጋ ይበላሉ?	……

ክፍል ሶስት ክሊኒካዊ መረጃ

26	የታይሮይድ ህመሙ አይነት	1. ሐይፖታይሮይዱዝም 2. ሐይፐርታይሮይዱዝም
27	ሥር የሰደደ ሕመም አለብህ?	1. አዎ 2. አይ
28	የትኛው?	1. ቲቢ 2. ኤችአይቪ 3. የልብ ሕመም 3. የስኪር በሽታ 4. የደም ግፊት 5. ሌላ ይግለጹ ……
29	አንትሮፖሜትሪ	ቁመት (ሜ) ..... ክብደት (ኪግ) ..... የሰውነት ብዛት መረጃ ጠቋሚ (BMI በኪግ/ሜ 2) …….
30	T4_____ T3_____ TSH_____	…….. …… ……..

ክፍል አራት፡ የላቦራቶሪ ዳታ

የታይሮይድ እክል ያለባቸው ታካሚዎች የሂማቶሎጂ መለኪያዎች ውጤቶች
WBC_____ X103 /µL LYM _____ X103 /µL NEU _____ X103 /µL MONO_____ X103 /µL EOS _____ X103 /µL BASO _____ X103 /µL
RBC_____ (X106 /µL Hb____ g/dl HCT____ % MCV_____ (fl) MCH_____(pg) MCHC_____(g/dl) RDW_____%
PLT_____(X103 /µL) MPV_____fl

DECLARATION

I, the undersigned, declare that this thesis is my original work, has not been presented for a degree in this or any other university and that all sources of materials used for the thesis have been fully acknowledged.

Name: _____

Signature: _____

Name of the institution: _____

Date of submission: _____

This thesis has been submitted for examination with my approval as University advisor

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Date _____ Signature _____

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Date._____ Signature _____

EXAMINERS

Name of external examiner: _____

Date: _____ Signature _____

Name of internal examiner: _____

Date: _____ Signature _____

Head of the School Signature Date

_____ _____ _____

Place: Jimma, Ethiopia