Epidemiology

of blood and blood forming organs/

Hematological diseases

by

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Learning Objective

- **By the end of this lecture students should be able to**:
- Differentiate between diseases of blood, blood forming organs and blood born infections
- Describe the population at risk of nutritional anemia's in Pakistan
- Describe risk factors for different nutritional anemia's
- Explain effective public health strategies for prevention of different types of anemia's in Pakistan

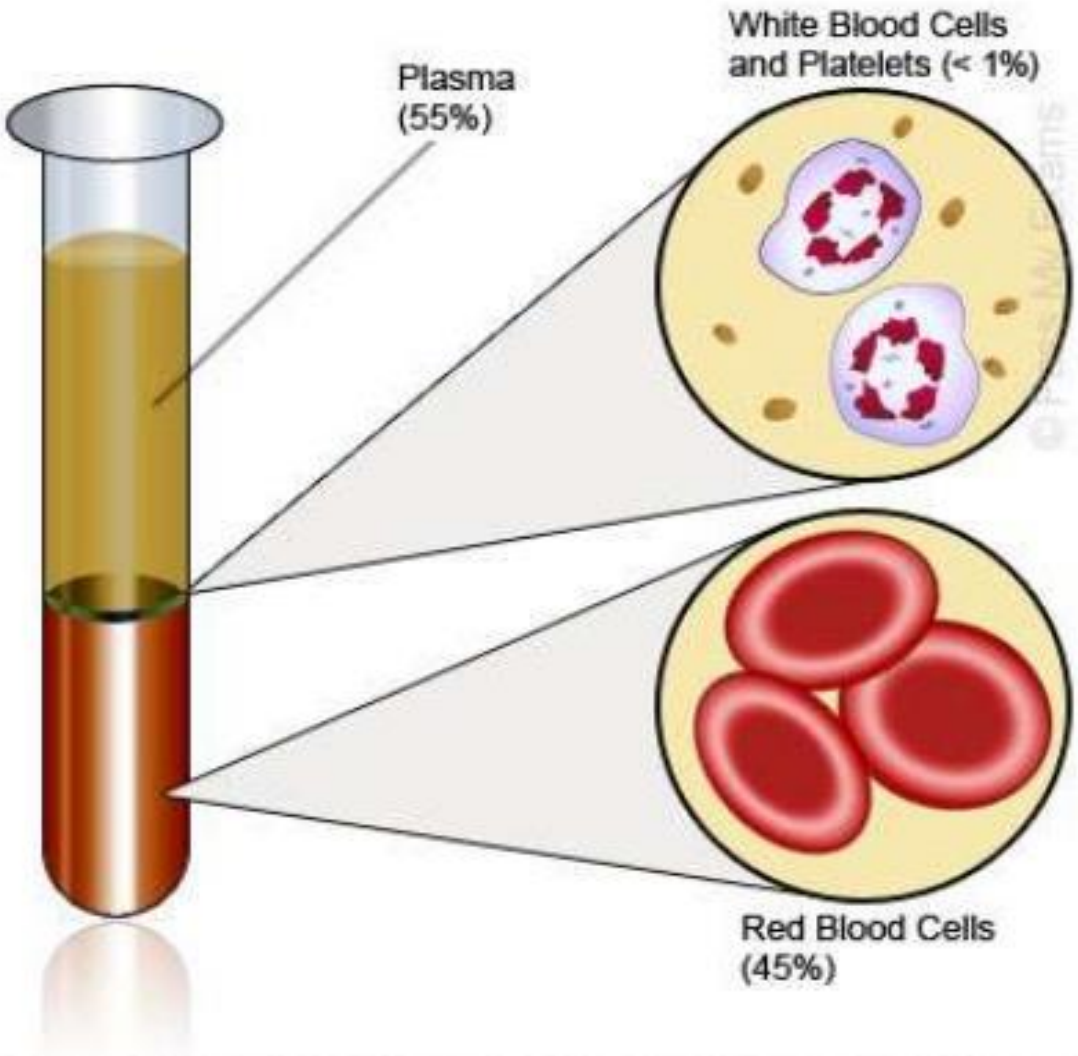
Questions/ Answers

Hematological diseases / **Blood disease**

- **Hematological diseases are disorders which primarily affect the blood & blood-forming organs.**
- Red blood cells (erythrocytes). Carry oxygen to the body tissue
- White blood cells (leukocytes). Fights against infections
- Platelets (thrombocytes). Helps blood to clot
- The tissues in which these elements are formed E.g.
- Bone marrow, lymph nodes, and spleen .
- Blood cell disorders impair the formation and function of one or more of these types of blood cells.

Blood born infections

- Blood borne infections (BBIs) are viruses that are carried in the blood, specifically hepatitis B, hepatitis C and human immunodeficiency virus (HIV).
- They can be transmitted through sexual contact, sharing needles, needle-stick injuries, from mother to baby during pregnancy, during birth or through breast feeding.


White Blood Cells
and Platelets (< 1%)
Plasma
(55%)
Red Blood Cells
(45%)

Blood Disorders

- Erythrocyte disorders
  - Anemia - due to decreased number of red blood cells or a deficiency of hemoglobin
    - aplastic anemia
    - pernicious anemia
    - iron deficiency
    - hemolytic anemia
  - Thalassemia
  - Polycythemia
- White blood cell disorders
  - Leukopenia / leukocytosis
  - Infectious mononucleosis
  - Leukemia
    - predominate cell type
    - acute / chronic

ANEMIA

- Anemia is a condition in which lack enough healthy red blood cells to carry adequate oxygen to body's tissues.
- Having anemia can make feel tired and weak.
- There are many forms of anemia, each with its own cause.
- Anemia can be temporary or long term, and it can range from mild to severe
- Anemia is one of the global public health problem.
- Anemia affects over 30% of the world's population, according to the (WHO).06-Dec-2019

- According to the World Health Organization (WHO), anemia is defined as hemoglobin (Hb) levels <12.0 g/dL in women and
- <13.0 g/dL in men. However, normal Hb distribution varies not only with sex but also with ethnicity and physiological status.
- Anaemia is a serious global public health problem that particularly affects young children and pregnant women.
- WHO estimates that 42% of children less than 5 years of age and 40% of pregnant women worldwide are anaemic and one third of all the women of reproductive age are anemic.

Causes

- **Lack of required nutrients.or dietary deficiency** – lack of iron, vitamin B12 or folic acid in the diet.

- **Loss of blood.**
- **malabsorption** – where the body is not able to properly absorb or use the nutrients in the diet, caused by conditions such as coeliac disease or Chronic Disease.
- **inherited disorders** – such as thalassaemia or sickle cell ...
- **Inadequate production of red blood cells**.

CLASSIFICATION

ETIOLOGY

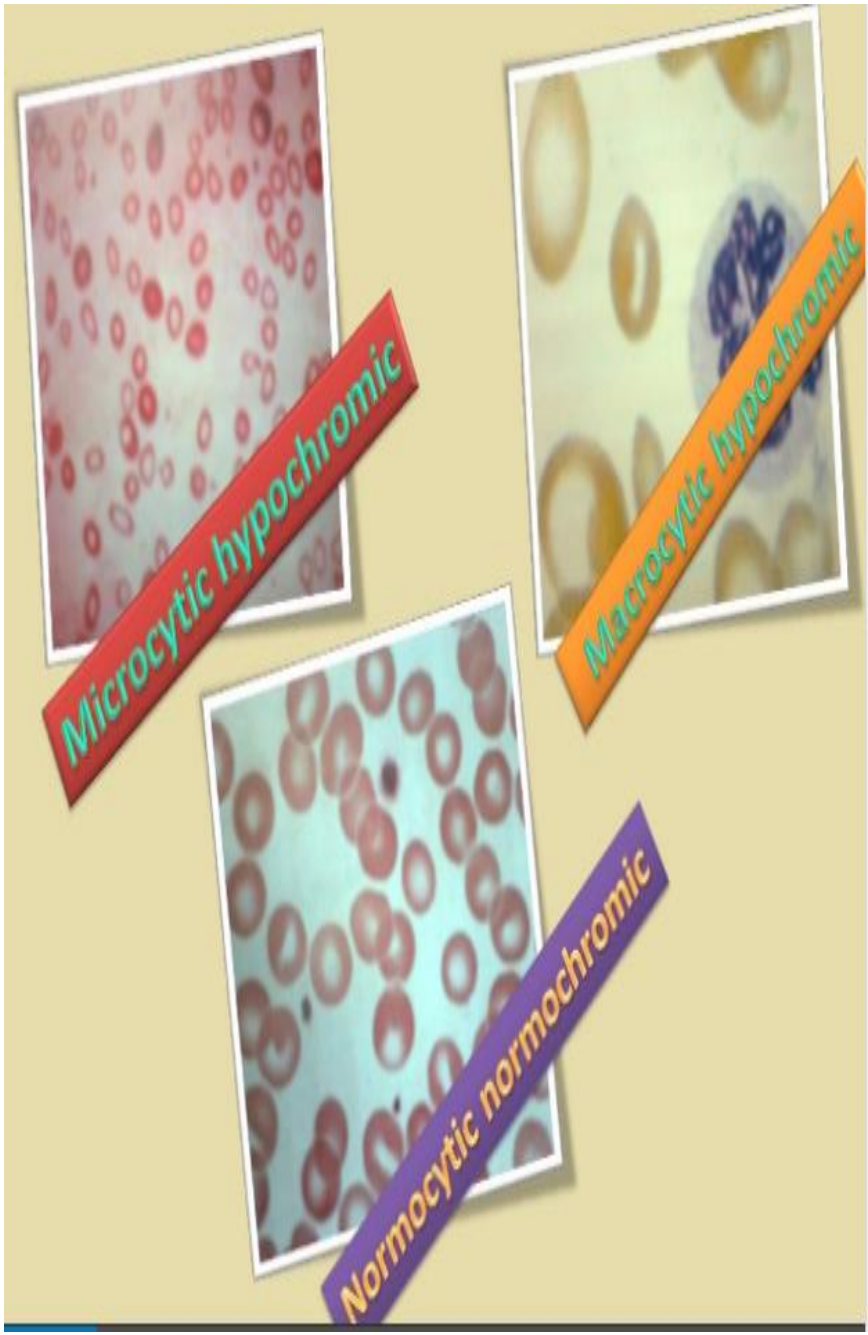
- **DECREASED RED CELL PRODUCTION**
- **INCREASED RED CELL DESTRUCTION / LOSS**

MORPHOLOGY

- MICROCYTIC HYPOCHROMIC
- MACROCYTIC HYPOCHROMIC
- NORMOCYTIC NORMOCHROMIC

Types of Anemia

- **Microcytic Anemia's/hypochromic**
  - Iron Deficiency Anemia
  - Copper Deficiency Anemia
  - Thalassemia
- **Normacytic Anemia/Normochromic**
  - Aplastic Anemia
  - Anemia of Chronic Disease
  - Inherited Anemia
  - Hemolytic Anemia
- **Macrocytic Anemia/hyperchromic**
  - Vit b12 deficency/Pernicious Anemia
  - Folic Acid Deficiency



PREVELANCE

- Globally, anaemia affects 1.62 billion people which corresponds to 24.8% of the population .
- The highest prevalence is in preschool-age children 47.4%,
- and the lowest prevalence is in men 12.7%,
- However, the population group with the greatest number of individuals affected is non-pregnant women that is 468.4 million.

Survey conducted by WHO in 1993–2005

- Globally, anaemia affects 1.62 billion people
- Preschool-age children 47.4%
- School-age children 25.4%
- Pregnant women 41.8%
- Non-pregnant women 30.2%
- Men 12.7%
- Elderly 23.9%
- **Total population 24.8%**

National Nutrition Survey 2011.

In Pakistan:

– Women of Child Bearing Age 50.5%

– Pregnant Women 51%

– Children 62.1% were anemic

National Nutrition Survey of Pakistan-Report AKU ; 2011 Pakistan Nutrition & Dietetic Society –CNE 2012

National Nutrition Survey Pakistan-2011

- **50.4% of non-pregnant women** were found to be suffering from anaemia (49.3% in urban areas and 50.9% in rural areas).
- Provincial data revealed that 62% in Sindh were suffering from anaemia, followed by Balochistan (48.9%), Punjab (48.6%), AJK (41.0%), KP (35.6%) and Gilgit Baltistan (23.3%).
- Similar trends were observed for pregnant women.

National Nutrition Survey 2011:

- Overall, 61.9% of children were found to be anaemic at the national level.
- Regional differences in the prevalence of anaemia were extensive
- Ranging from 40.4% in Gilgit Baltistan to 67.7% in Sindh.
- Prevalence of severe anaemia was comparatively higher in rural areas (5.5%) than in urban areas (3.6%).

WHO: Prevalence of anemia among women of **reproductive age** in Pakistan was **52.10% (2016).**

• Its highest value over the past 26 years was **53.60%** in 1990

• While its lowest value was **48.80%** in 2001.

Definition: Prevalence of anemia among women of reproductive age refers to the combined prevalence of both non-pregnant with Hb levels below 12 g/dL and pregnant women with HB levels below 11 g/dL.

•Prevalence of anemia among **pregnant women** in Pakistan was **51.30**% in 2016.

• Over the past 26 years this indicator reached a maximum value of 51.30% in 2016 and

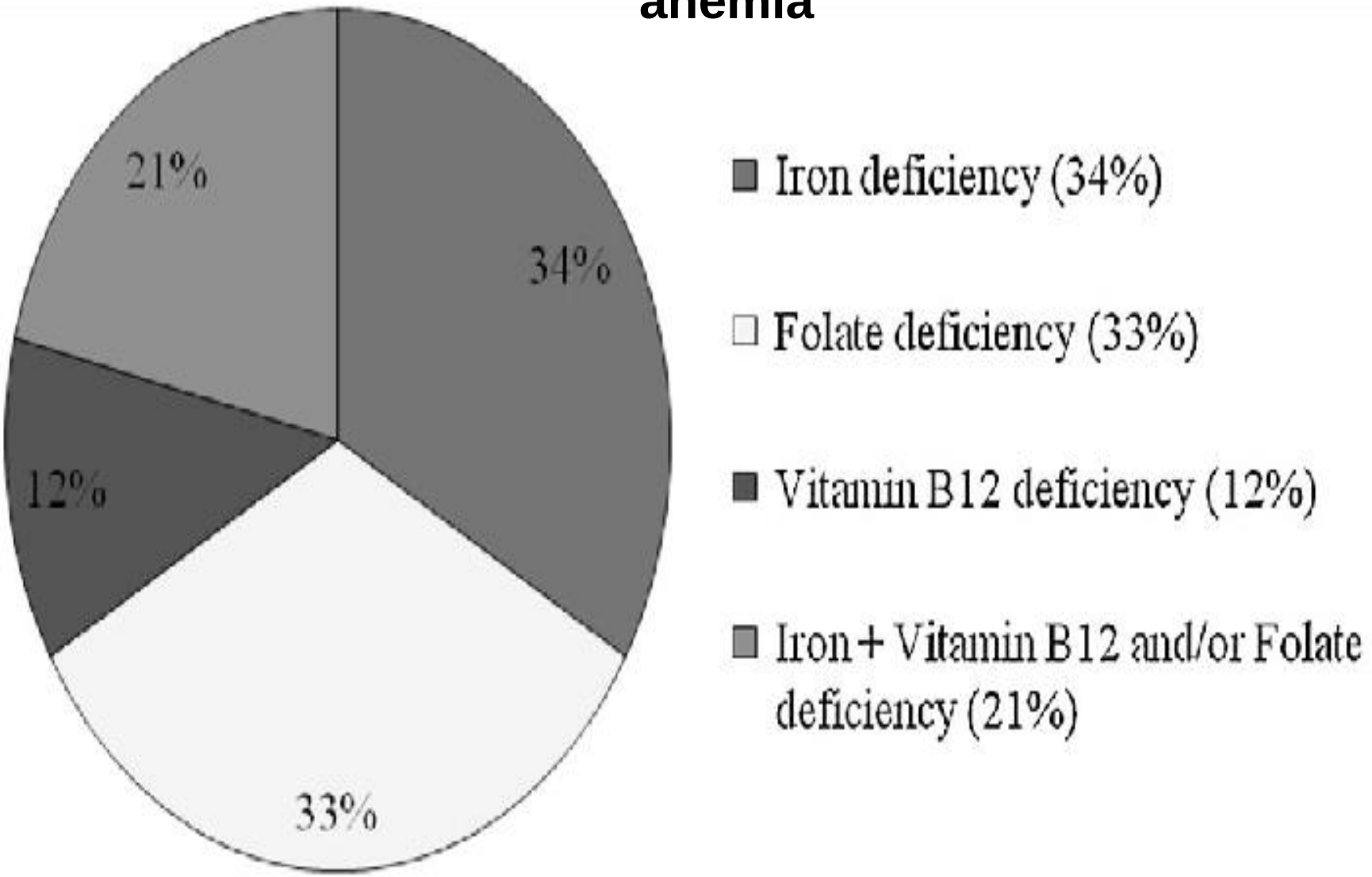
•Minimum value of 47.40% in 2002.

Definition: Prevalence of anemia, pregnant women, is the percentage of pregnant women whose hemoglobin level is less than 110 grams per liter at sea level.

Nutritional Anemia

- is caused by a lack of iron, protein, vitamin B12, and other vitamins and minerals that needed for the formation of hemoglobin.
- Folic acid deficiency is a common association of nutritional anemia and
- iron deficiency anemia is the most common nutritional disorder

Causes/Types of Nutritional anemia



Persons at Greatest Risk of Nutritional Anemia

Inadequate Intake

• Vegetarian, chronic alcoholism, poverty.

•**Inadequate Absorption**

• Diarrhea, intestinal diseases eg. celiac disease, atrophic gastritis, partial or complete gastrectomy, HIV or AIDS.

Increased Requirement

• Infancy , adolescence, pregnancy and lactation.

Increased Loss/excretion: Excessive menstrual blood, hemorrhage from injury, chronic blood loss from a bleeding ulcer, bleeding hemorrhoids, parasites (hook worm disease) or malignant disease.

Risk Factors for Nutritional Anemia

- Gender and Age.
- Low iron is common in women between puberty and menopause. Babies and young children also have a higher risk.
- Pregnancy. A pregnant woman makes more blood to support a growing baby. This can lead to anemia.
- The risk of anemia increases as people grow older.
- Diet. Eating poorly can increase the risk of anemia. ...

IRON DEFICIENCY ANEMIA

- *It Is A Type Of Microcytic Hypo Chromic Anaemia Results From Inadequate Supply Of Dietary Iron In The Body.*

Epidemiology

- IDA is the most common **nutritional deficiency** in developing and developed countries
- IDA is considered to be the leading cause of anemia worldwide, accounting for as many as 50% of cases
- Prevalence of IDA greatly varies according to age, gender, physiological, pathological, environmental, and socioeconomic conditions
- Data from NHANES*, prevalence of IDA
  - Young children 1.2%
  - Women of childbearing age 4.5%

*National Health and Nutrition Examination Survey

http://www.who.int/nutrition/publications/en/ida_assessment_prevention_control.pdf

- According to a UNICEF report, more than two billion individuals have anemia worldwide and most of them have IDA, especially in underdeveloped countries
- where 40-50% of children are iron deficient compared with 6-20% in developed countries

• **WHO Report; 2001**

• Iron deficiency anemia affects nearly 700 to 800 million people worldwide

•South Asia and Africa are the most vulnerable regions showing the highest prevalence (40%) of ID in all age groups except for adult males and pregnant women.

• **Around 65% of pregnant women in South Asia suffer from IDA** and

• In Indian subcontinent alone; the rate of developing IDA during pregnancy is 88%.

National Nutrition Survey (Pakistan) 2011:

- **26.8% of non-pregnant women** had low ferritin levels (27.1% in urban areas and
- 26.6% in rural areas).
- Province wise, Sindh had the highest proportion of women with low ferritin levels (31.3%)
- Followed by Punjab, AJK, Balochistan, Gilgit Baltistan and KP.
- Among **pregnant women, 38.2%** had low ferritin levels at national level whereas it was highest in GB (46%) followed by Punjab, Balochistan, Sindh, AJK and KP.

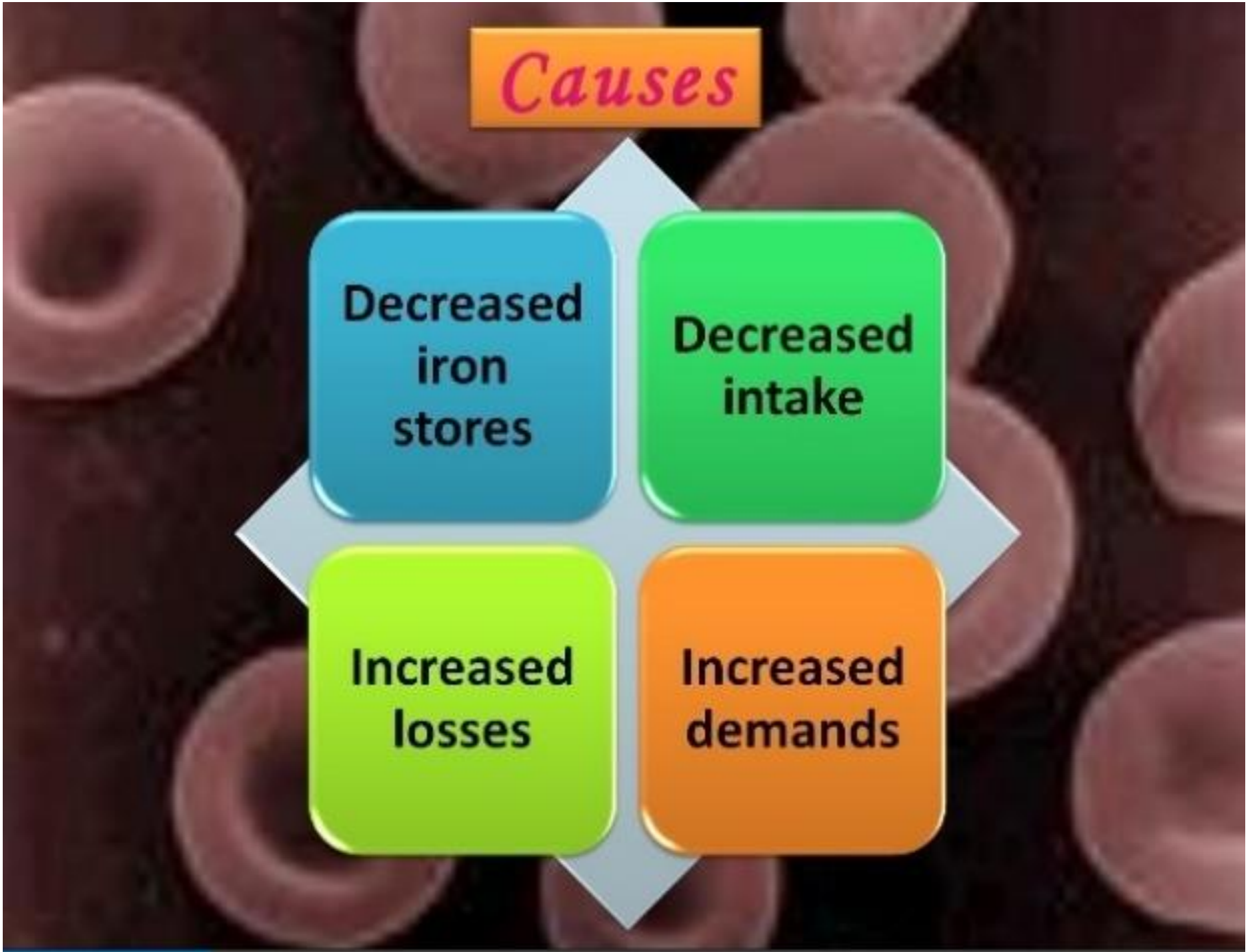
National Nutrition Survey 2011:

- High levels of iron deficiency (low ferritin levels) were observed in 43.8% of children across Pakistan.
- Provincial differences in prevalence of low ferritin levels varied ranging from 26.4% in KP to 48.6% in Punjab.
- Comparatively high prevalence was noted in urban areas (46.1%) as compared to rural areas (42.9%).

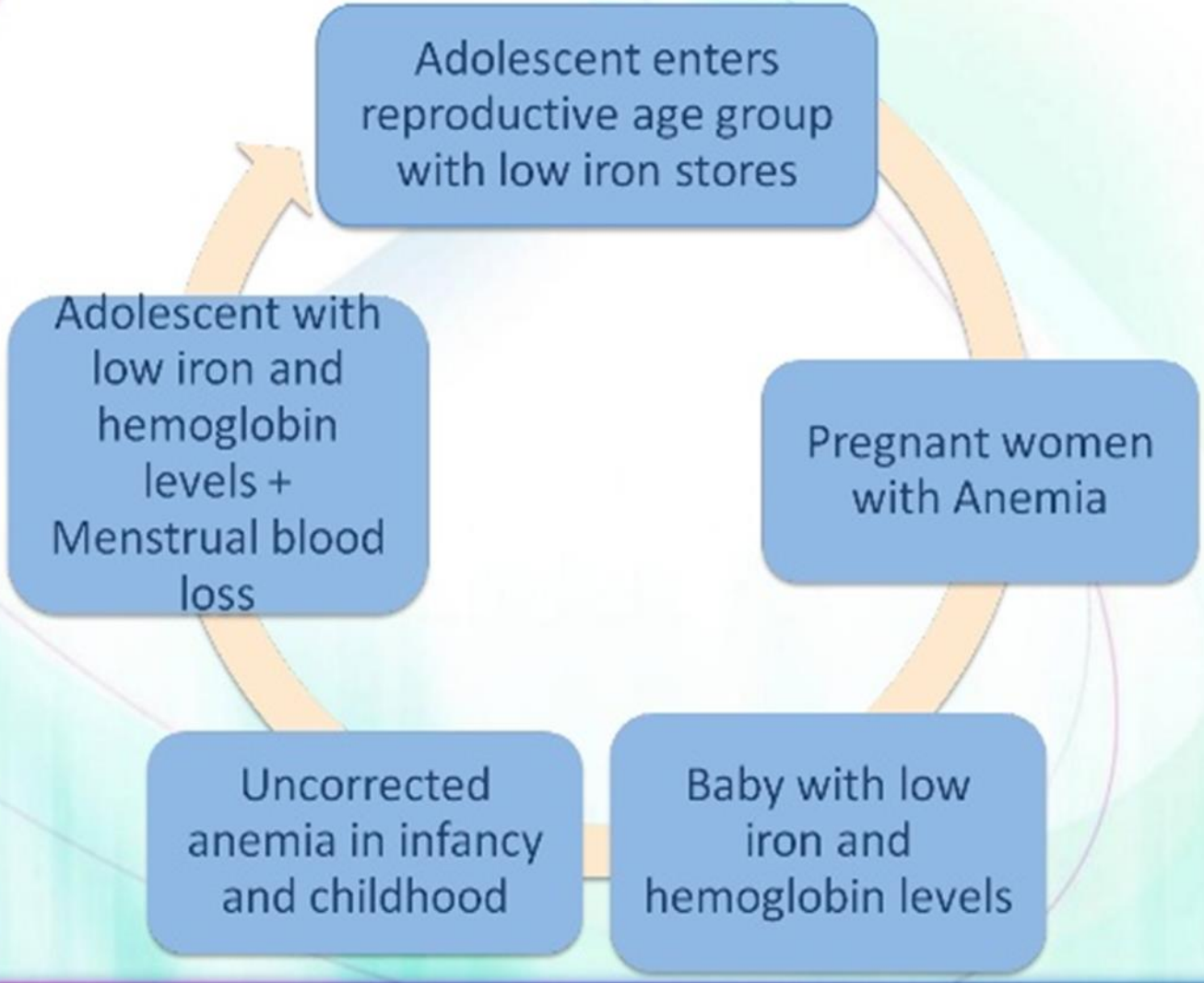
National Nutrition Survey (Pakistan) 2018:

- About 41.7% of Women of Reproductive Age are anaemic, with a slightly higher proportion in rural (44.3%) than urban settings (40.2%)

- More than half (56.6%) of adolescent girls in Pakistan are anaemic, however only 0.9% have severe anaemia.
- Adolescent girls in rural areas are more likely (58.1%) to be anaemic than their counterparts in urban areas (54.2%).


Causes
Decreased iron stores
Decreased intake
Increased losses
Increased demands

Intergenerational cycle of Anemia



Prevention and Control

- WHO has developed a comprehensive package of public health measures addressing all aspects of iron deficiency and anaemia.
  - **Increase iron intake.**
    - Dietary diversification including iron-rich foods and enhancement of iron absorption, food fortification and iron supplementation.
  - **Control infection.**
    - Immunization and control programmes for malaria, hookworm and schistosomiasis.
  - **Improve nutritional status.**
    - Prevention and control of other nutritional deficiencies, such as vitamin B12, folate and vitamin C.

WHO, 2011

WHO recommend iron intake

- The average daily iron intake from foods and supplements is 13.7–15.1 mg/day in children aged 2–11 years,
- 16.3 mg/day in children and teens aged 12–19 years, and 19.3–20.5 mg/day in men and
- 17.0–18.9 mg/day in women older than 19.
- Daily oral iron with 30 mg to 60 mg of elemental iron is recommended for pregnant women

High Protein and High Iron (Fe) Rich Foods

Folic acid deficiency

- Necessary for DNA synthesis, helps the body make healthy red blood cells
- **Sources** :broccoli,leafy green vegetables, such as cabbage, kale, spring greens and spinach, peas.chickpeas and kidney beans.
- liver ,breakfast cereals fortified with folic acid.
- **Causes** :don't eat enough foods that have folic acid.
- You drink too much alcohol.
- diseases, such as celiac disease. ...
- You are pregnant, Cooking destroy folic acid
- Phenytoin or anti metabolites

- Recommended daily allowance (RDA)

- Males: 400 mcg/day
- Females: 400-800 mcg/day
- Pregnant women: 600 mcg/day
- Nursing women: 500 mcg/day


Eat Leafy Greens
to Prevent
Folate Deficiency

Vitamin B12 Deficiency

- Necessary for DNA synthesis
- **Source** :naturally found in animal products, including fish, meat, poultry, eggs, milk, and milk products. Vitamin B12 is generally not present in plant foods, but fortified breakfast cereals are a readily available source of vitamin B12 with high bioavailability for vegetarians
- **Diseases**: megaloblastic anemia, parasthesia of finger and toes

Vitamin B12 Deficiency Causes

- Atrophic gastritis, in which your stomach lining has thinned.
- Pernicious anemia, which makes it hard for your body to absorb vitamin B12.
- Conditions that affect your small intestine, such as Crohn's disease, celiac disease, bacterial growth, or a parasite.
- Immune system disorders, such as Graves' disease or lupus.

Daily Requirement

- The recommended dietary allowance (RDA) for adults is 2.4 micrograms (mcg) a day. (Women who are pregnant or breastfeeding need more.)
- The U.S. Food and Drug Administration sets the Daily Value (DV) for vitamin B-12 at 6 micrograms.

Prevention of Nutritional Deficiency

- Primary prevention measures taken to ensure more appropriate nutrient intakes in the population often include
- (1) education programs to encourage healthier and more nutritious food choices; Safe drinking water

,Iron rich food

- (2) food-based approaches that increase the availability or affordability of nutrient-rich foods;
- (3) national policies to fortify commonly-eaten foods.
- (4) global public health and disease control measures

- Secondary prevention involves selecting population subgroups at risk of nutrient deficiencies, in order to administer additional nutritional support to those at greatest need, for example, dietetic services, dietary supplementation.

- Breast feeding and appropriate weaning diet.
- Periodic deworming especially children.
- early diagnosis and proper treatment of common illnesses can go a long way in preventing malnutrition in the society.
- Footwear use

APLASTIC ANEMIA

- Aplastic anemia is pancytopenia with bone marrow hypocellularity.
- Men and women are affected with equal frequency.
- Age distribution is biphasic, with the major peak in the teens and twenties and a second rise in older adults.

Epidemiology

- The overall incidence was 2.34 per million per year and the incidence increased with age. (pubmed)
- Survival rates at 3 months, and at 2 and 15 years after the diagnosis were 73%, 57%, and 51%, respectively
- There was a biphasic age distribution with peaks between the ages of 15 and 25 years and a second smaller peak in incidence was noted after age 60 years
- with no significant difference in incidence between men and women.
- Aplastic anaemia affects people of all ages and all races.

Thalassemia

- Thalassemia is a blood disorder (inherited) in which the body makes an abnormal form or inadequate amount of hemoglobin. Hemoglobin is the protein in red blood cells that carries oxygen. The disorder results in large numbers of red blood cells being destroyed, which leads to anemia.
- Protein synthesis characterized by disturbance of either alpha or beta hemoglobin chain production, an important part of red blood cells.
- First described by Thomas B Cooley in 1925

Thalassemia Epidemiology

- Thalassaemia is the most common disorder worldwide.
- It is common in areas with prevalent malaria as thalassaemic red cells provide immunity against the parasite.
- The incidence of thalassaemia carriers is high in regions such as Mediterranean, Middle East, Indian subcontinent, Southeast Asia and South China.

- **In world** :Thalassemia affects approximately 4.4 of every 10,000 live births throughout the world. In fact, only 1.7% of the global population has signs as a result of the gene mutations, known as a thalassemia trait. It causes males and females to inherit the relevant gene mutations equally because it follows an autosomal pattern of inheritance with no preference for gender.
- **In Pakistan** ,it is estimated 5000-9000 children with β-thalassemia are born per year, although no documentary registry is available in Pakistan. The estimated carrier rate is 5-7%, with 9.8 million carriers in the total population

How can thalassemia be prevented

- You can't prevent thalassemias because they're inherited .However, prenatal tests can detect these blood disorders before birth.
- Family genetic studies may help find out whether people have missing or altered hemoglobin genes that cause thalassemias.

Polycythemia vera

- is a type of blood cancer. It causes your bone marrow to make too many red blood cells. These excess cells thicken your blood, slowing its flow, which may cause serious problems, such as blood clots ,a stroke, or a heart attack..
- Most people with polycythemia vera have too many white blood cells and platelets.
- PV is caused by a gene (either JAK2 or TET2) that doesn’t work the way it should. Most likely, the problem happened over the course of your life. Rarely, parents can pass these faulty genes to children.

Epidemiology

- Polycythaemia vera is a rare chronic disease diagnosed in an estimated 2 to 3 people per 100,000 population.
- Although it can occur at any age, polycythaemia vera usually affects older people, with most patients diagnosed over the age of 55 years.
- Polycythaemia vera is rare in children and young adults.
- It occurs more commonly in males than in females.

WHITE BLOOD CELLS AND ITS DISORDERS

- **White blood cells (WBCs)**, also called **leukocytes** or **leucocytes**, are the cells of the immune system that are involved in protecting the body against both infectious disease and foreign invaders.
- All white blood cells are produced and derived from multipotent cells in the bone marrow known as hematopoietic stem cells.
- Leukocytes are found throughout the body, including the blood and lymphatic system
- 2 types: granulocytes and agranulocytes

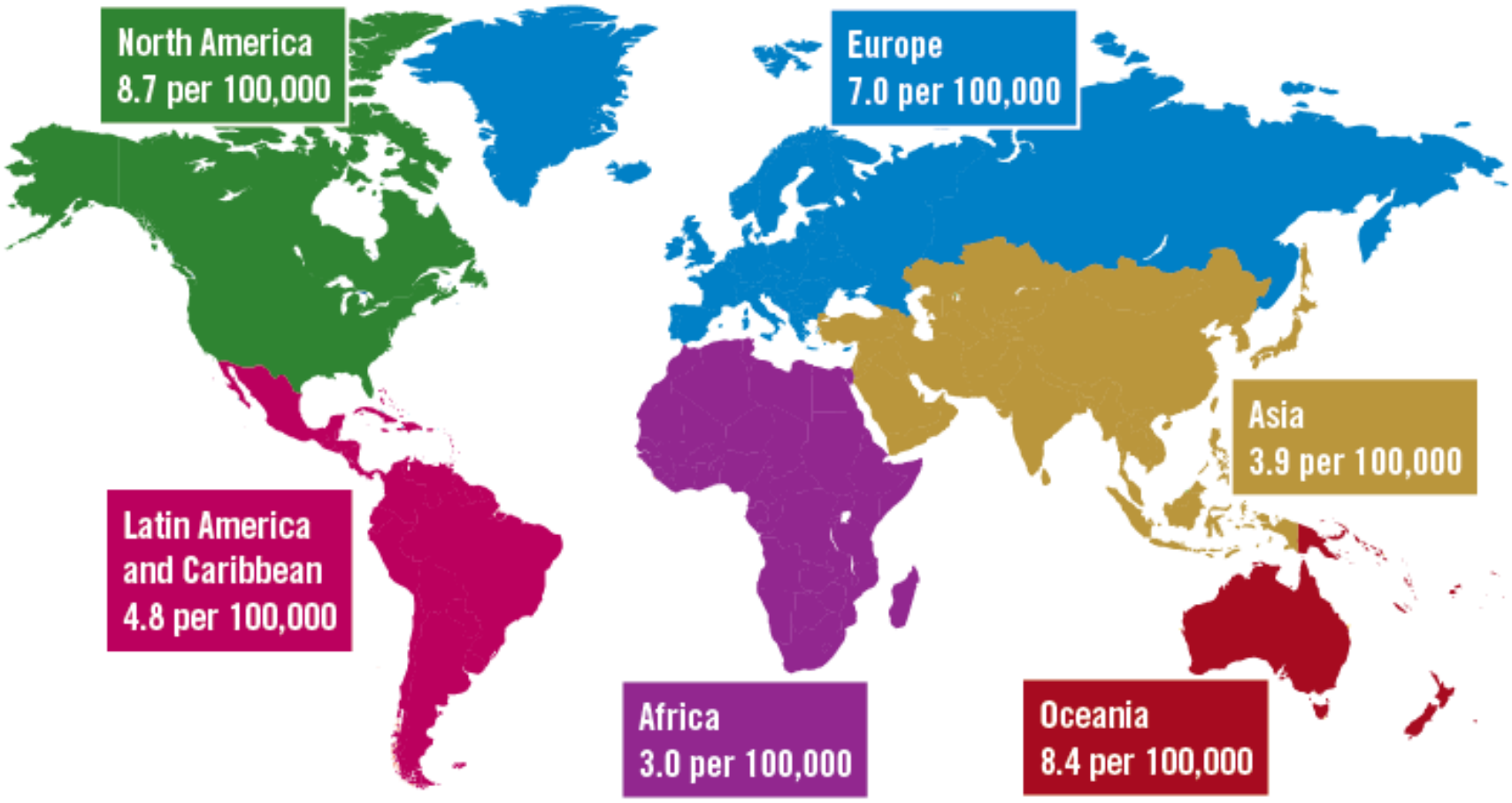
Disorders

- Leukocytosis
- Leukopenia
- Agranulocytosis
- Neutropenia
- Acute leukemia
- Chronic leukemia

Leukemia

- is a group of blood cancers that usually begin in the bone marrow and result in high numbers of abnormal blood cells. These blood cells are not fully developed and are called blasts or leukemia cells.
- Those white blood cells crowd out the red blood cells and platelets that your body needs to be healthy. The extra white blood cells don’t work right. When untreated death occur due to infection and bleeding or both

Estimated age-standardized incidence of leukemia, 2012



Note: Based on data from the GLOBOCAN database of national estimates.

Source: World Health Organization

Epidemiology

- Leukemia accounts for 2.5% of overall cancer incidence and 3.5% of deaths from cancer in the United State.
- It is the most common cancer diagnosed in children, and acute lymphoblastic leukemia (ALL) is about five times more common than acute myeloid leukemia (AML).

Lymphoma

- Lymphoma is a blood cancer that occurs in the body's lymphatic system.White blood cells change and grow out of control.
- Hodgkin's lymphoma and non-Hodgkin's lymphoma are the two major types of lymphoma.

EPIDEMIOLOGY

- Unlike most cancers, rates of Hodgkin lymphoma are highest among teens and young adults (ages 15 to 39 years) and again among older adults (ages 75 years or older).
- White people are more likely than black people to develop non-Hodgkin lymphoma, and men are more likely than women to develop lymphoma..

Epidemiology Pakistan

- In 2016, most common cancer cases of Pakistan are breast, leukaemia, Hodgkin and non-Hodgkin lymphoma.
- Hodgkin lymphoma is 4.9% and non-Hodgkin lymphoma 4.7%.
- In Pakistan the lack of an appropriate registry system leads to widespread of cancer
- . Lymphomas and breast cancer are the most common cancers.

Platelets

- Platelets are the cells responsible for making blood clot so platelet disorders mean that injured blood vessels bleed more than usual and heal more slowly.
- If you have a platelet disorder, your blood has one of three abnormalities
- **Not enough platelets**. Having too few platelets is quite dangerous because even a small injury can cause serious blood loss.
- **Too many platelets**. If you have too many platelets in your blood, blood clots can form and block a major artery, causing a stroke or heart attack

- **Platelets that don’t clot correctly.** Sometimes, deformed platelets can’t stick to other blood cells or the walls of your blood vessels, and so can’t clot properly. This can also lead to a dangerous loss of blood.

- Thrombocytopenia: is a condition in which you have a low blood platelet count.
- Thrombocytopenia might occur as a result of a bone marrow disorder such as leukemia or an immune system problem. Or it can be a side effect of taking certain medications. It affects both children and adults.

- **Idiopathic thrombocytopenic purpura** is an immune disorder in which the blood doesn't clot normally. This condition is now more commonly referred to as immune thrombocytopenia (ITP). ITP can cause excessive bruising and bleeding. An unusually low level of platelets, or thrombocytes, in the blood results in ITP

Epidemiology

- Worldwide, it is estimated that there are well over 200,000 people affected by Immune thrombocytopenia (ITP).

- The incidence of ITP among adults in the USA is estimated to be 3.3 per 100,000 adults/year.

ITP occurring in five per 100 000 children; adult ITP occurs at a rate of roughly two per 100 000 people and may be more common in older adults .

A female predominance occurs only among middle-aged patients, and there is no racial variation in incidence.

Plasma cell disorders

- There are a large variety of disorders that affect the plasma cells that make antibodies.
- **Plasma cell myeloma**
- is a rare blood cancer that develops in the plasma cells in the bone marrow. Malignant plasma cells accumulate in the bone marrow and form tumors called plasmacytomas, generally in bones such as the spine, hips, or ribs. The abnormal plasma cells produce abnormal antibodies called monoclonal (M) proteins.. The cause of plasma cell myeloma is unknown.

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