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# Understanding your blood results:

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## Introduction

This document explains briefly the blood tests within a typical metabolic balance screening profile. This document is not intended to interpret pathology results. Like with any medical tests, your medical history and any physical examinations would need to be taken into account before deciding whether a result is of concern. Some conditions may need to be investigated further and if you are concerned about any of your results, then the best person to help you is your General Practitioner.

If a blood result is outside the standard medical range, the computer will put an asterisk (\*) next to it and highlight the result. This does not necessarily indicate an issue from the point of view of the Metabolic Balance diet.

Almost all numeric data within the haematology section is known as a 'Full Blood Count'. Variations in the number, type and form of your red cells, white cells and platelets give insight into the condition of your blood and clinical factors which may affect it. The ESR – a non-specific simple blood test can demonstrate the presence of inflammatory, infective or malignant disorders.

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Biochemical tests for a metabolic balance screening show how well the liver, kidneys and thyroid gland are working, as well as making certain that blood sugar, fats, serum electrolytes (chemicals such as potassium and sodium) are within normal limits.

## Haematology

Red blood cells are specialised cells that transport oxygen as their main function in the blood. However, they also carry a variety of nutrients and waste products as they are carried through the body by the liquid portion of our blood. Anaemia (the literal translation means “without blood”) refers to reduced numbers of red blood cells or very small cells. The average healthy RED BLOOD CELLS lives for 120 days so anaemia of any kind other than haemorrhage indicates a long standing problem.

**Haemoglobin (Hb)** is the specialised protein in the blood that actually binds with oxygen and carbon dioxide. Increased values are seen in B12 deficiency (because there are fewer cells) and decreased values are characteristic of an iron deficiency.

**HCT (Haematocrit)** is the percentage of Red Blood Cells in relation to the fluid (serum) portion of your blood. Decreased values indicate anaemia from haemorrhage, parasites, nutritional deficiency or chronic disease processes.

**Red Cell Count** measures the number of red cells in the blood. A low count often accompanies anaemia, excess body fluid and blood loss. A high count is commonly seen in dehydration and in a rare condition called poly-cythaemia.

**MCV (Mean cell volume)** is a measurement of the average size of the RED BLOOD CELLS . Elevated volumes can be due to B-Vitamins deficiency (usually B12-folic acid) and reduced volumes are characteristic of an iron deficiency.

**MCH (Mean cell haemoglobin)** is a measurement of the weight of Hb in each RED BLOOD CELLS.

**MCHC (Mean cell haemoglobin concentration)** is the average percent of haemoglobin in each RED BLOOD CELLS relative to the total weight of the cell.

**RDW (Red Cell Distribution Width)** measures the degree of size variation in red cells.

**Platelet Count** measures the number of platelets in blood. Platelets are specialised blood cells that will help the blood clot in the event of an injury. High platelet counts are often seen following strenuous activity, in infections and inflammation. Extremely low platelet counts can be associated with spontaneous bleeding.

**MPV (Mean Platelet Volume)** measures the average size of platelets. Abnormally high MPVs mean the platelets are larger, which could put an individual at risk for a heart attack or stroke. Lower MPVs indicate smaller platelets, meaning the person is at risk for a bleeding disorder.

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The **total WHITE CELLS COUNT count** is composed of five basic types of White Blood Cells cells, which are listed below on your analysis (**neutrophils, lymphocytes, monocytes, eosinophils, basophils**).

**White Blood Cells (WBC) or leukocytes** are the cellular portion of your immune system. In addition to floating passively in the blood stream from place to place, the WBCs have the ability to squeeze between the cells in the blood vessel wall and attack invaders such as bacteria, viruses, parasites, cancers and foreign bodies (i.e. splinters etc).

Determining the percentage of each type of WBC is referred to as “differential” and is of great value in the diagnosis of infections, parasites, allergies, leukaemia’s and appendicitis...

**Lymphocytes** are to do with antibody production. Elevated levels are seen in viral infections, TB and some other chronic diseases.

**Neutrophils** are WBC’s which are very active and respond quickly to invading bacteria, viruses, parasites and foreign bodies. Low levels can be a consequence of anaemia, drug toxicity and some infections.

**Monocytes** are the largest of the WBCs and are increased in numbers in more chronic infections (i.e. mononucleosis, tuberculosis etc.). When these WBCs escape into the tissue to attack foreign invaders they are called macrophages.

**Eosinophils** are the most rapidly responding WBCs when you are having an acute (sudden) allergy reaction or parasitic infestation. It can also be elevated in some cases of asthma.

**Basophils** respond to chronic intestinal allergies, eczema, asthma and sometimes with parasitic infections.

**ESR (erythrocyte sedimentation rate)** is the rate at which the red cells separate out when suspended in a glass column of blood. Even minor infections can cause a marked rise in this rate. Elevated levels can be a sign of an inflammatory or rheumatological disease and occasionally malignancy.

## Biochemistry

### MB - 'Electrolytes' (Sodium, Potassium, Chloride, Bicarbonate):

They are involved in the maintenance of the salt and water balance in the body. They may be affected by dehydration and some of the commonly used drugs e.g. diuretics.

**Na (sodium)** is an essential “macro” mineral required in our diet. Sodium is required to maintain the proper acid base balance in our blood and tissues, the fluid pressure in our blood and tissues, the fluid pressure in our blood vessels, cells and neuromuscular function. Elevated sodium levels are characteristic of dehydration, kidney disease and adrenal gland dysfunction. Low blood levels of sodium are typical of excessive water consumption, diabetes and pituitary gland disorders.

**K (potassium)** is another one of the important “macro” minerals. It is important in maintaining proper heart rhythm, acid base balance, osmotic balance (fluid pressure) and kidney function. Elevated levels of potassium are typical of heart block, adrenal gland deficiency and hypoventilation. Decreased potassium levels are typical of diarrhoea, hyperactive adrenals, weakness, fatigue, poor posture, palpitations and irregular heartbeat and chronic kidney disease.

**Cl (chloride)** is involved in digestion (stomach HCL), oxygen-carrying ability of the blood, adrenal function and kidney function. Decreased levels are typical of diarrhoea, infections, diabetes and reduce adrenal function.

**Bicarbonate** is involved in the acid-base balance of the body (pH) and is a common electrolyte measured; it can also indicate fluid retention or dehydration. It is used to look at Kidney problems or lung problems, it is often the buffer used by the body in hyperventilation, with the kidneys excreting bicarbonate to maintain body pH.

**Anion Gap:** this is calculated by adding your total amount of sodium and potassium (which tend to help the body to be acidic), and subtracting your amount of chloride and bicarbonate (which help the body to be more alkaline). This is a good way to see if estimate if you are slightly too alkaline or acidic for optimal metabolic function.

## MB - Kidney parameters

**Urea** is a barometer of the liver and kidneys ability to process the by-products of protein metabolism. Moderate elevations are seen in adrenal, liver and kidney disease. High elevations of urea are a “red flag” for kidney, thyroid, and anterior pituitary disease. Very low levels of urea are typical of chronic liver disease and occasionally posterior pituitary disease.

**Creatinine** levels are a barometer of muscle metabolism and the kidneys filtering capacity. Elevated levels are “red flags” for muscle disease, kidney disease, arthritis, hyperthyroidism and diabetes.

**Urea/Creatinine ratio** is a barometer of kidney function. Elevated levels are typical of high protein/low water diets, kidney disease and benign hypertrophy of the prostate. A decrease in ratio is typical of an anti-diuretic hormone insufficiency.

## MB - Liver Pointers

**Bilirubin** is a pigment present in bile and an excess will make a person with jaundice look yellow. Elevated bilirubin will produce jaundice of the eyes and skin. Mild increases are very common and are of no significance; however a grossly elevated bilirubin may indicate concerns with the liver. It is a barometer of normal metabolism of breakdown products of RED BLOOD CELLS in the liver and spleen. Bilirubin is elevated in liver disease or biliary disorders. Bilirubin and ALP are usually elevated in gallbladder or gallstone issues.

**Alkaline phosphatase (ALP)** another liver enzyme, measures the metabolic function of bone, liver and certain tumours. Elevated levels are seen in hyperparathyroidism, bone disease, liver disease,

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hyperthyroidism and leukaemia. Elevated levels are also seen in healing fractures and young growing bones.

**Aspartate amino Transferase (AST)** is a transaminase enzyme associated with liver function, kidney function, heart, skeletal muscle and brain. Elevated levels are characteristic of liver and heart disease. AST and ALT can be very elevated when common bile duct stones or gallstones are present.

**ALT (alanine amino transferase)** is a transaminase enzyme associated with liver function. Elevated levels are typical of liver disease.

**LDH (lactate dehydrogenase)** is an enzyme associated with carbohydrate metabolism and is widely distributed by the kidney, liver, heart, skeletal muscles and RBC's. Elevated levels are typical of injury to any of the above tissue; however, it is especially useful in monitoring heart attack, liver disease, haemolytic anaemia and invasive cancers.

**CK (Creatine Kinase):** it catalyses the phosphorylation of creatine. This enzyme is found in high concentrations in the heart and body muscle. The brain also contains appreciable amounts. The liver has a role in its processing. While it is in the "liver category", CK's main implication of CK is in the investigation of muscle disease. High values are often seen following strenuous activity and your doctor may question you about this if it seems elevated. The values observed can also depend upon racial origin. It can be elevated as a consequence of statin medication.

**Gamma GT:** Gamma Glutamyl Transferase is an enzyme found abundantly in the liver, kidneys and pancreas. It is widely used to assess liver function. Some drugs, and also alcohol, induce the liver to produce more of this enzyme. GT is a barometer of connective tissue growth in the liver (cirrhosis), and a highly sensitive barometer of alcohol and drug abuse.

## MB - Proteins

**Total protein** is a measure of the protein level in your serum. Albumin and globulin are the most abundant types in the plasma. Low levels indicate insufficient dietary protein and/or poor digestion/absorption or liver disease. Large amounts of protein is synthesised by your liver and released into the blood for use to nourish any needy organ. Changes in total protein concentration are common.

**Albumin** is a specialised protein produced by the liver. It helps maintain the proper fluid pressure in the blood vessels. People short of proteins get easily "oedema" (i.e. fluid under the skin) or "dropsy" (i.e. fluid in the abdominal cavity). Low albumin levels can be seen in conditions resulting in protein loss, reduction in synthesis, abnormal distribution of albumin. High levels are often the result of dehydration, or even prolonged application of a tourniquet at the time of sample taking.

**Globulin** is a specialised protein produced by the liver and is primarily involved in antibody formation and antibody specificity. High levels are seen in the early stages (i.e. acute phase) of a variety of degenerative diseases including allergies, liver disease, heart disease, arthritis, diabetes and malignancy. Increased levels can be seen in a number of conditions e.g. inflammation and infection.

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**A/G ratio** is an abbreviation of albumin/globulin ratio. The A/G ratio is a barometer for the body's defence system. Deviations up or down in this ratio are indications of liver disease and/or a non specific “flag” for chronic degenerative diseases that are exhausting the immune system. The ratio is normally 0.8 to 2.0

## MB - Macro Minerals

Calcium and Phosphate are some of the macro-minerals, the minerals, we need in bigger quantity. Their levels may be increased or decreased in a variety of bone diseases and is also useful in assessing kidney function.

**Calcium (or total calcium blood levels)** is an essential “macro” mineral, meaning we need large amounts in our daily diet to meet our metabolic needs. Calcium is required to maintain bone density, proper neuromuscular function and blood clotting reactions. Elevated levels are rare because of the balancing mechanisms of the thyroid and parathyroid glands. When elevated calcium does occur it signals parathyroid issues or major bone changes. Low levels can indicate Vitamin D deficiency.

**Corrected calcium** (also known as adjusted calcium) allows for the change in total calcium levels due to the change in albumin-bound calcium. This gives an estimate of what the total calcium level would be if the albumin were a specified normal value. Exact formulae used to derive corrected calcium may depend on the analytical methods used for calcium and albumin. When there is a lower than normal level of albumin, the corrected calcium level is higher than the total calcium.

**Phosphate** is another “macro” mineral associated with calcium, vitamin D and parathyroid function. Blood levels are again kept within very narrow physiological limits by the parathyroid hormone. Too much phosphate in the diet (i.e. soft drinks, meat, grains) will result in considerable calcium loss for your bones. Low levels have a wide range is potential issues.

## MB - Other Readings

**Uric Acid** is the end result of purine metabolism. It is also the blood substance that accumulates to high levels precipitating attacks of gout. Increased levels are seen in many disorders and most commonly in those with a predisposition to gout, while decreased levels are probably of little clinical significance.

**Random Blood Glucose:** high level may indicate diabetes although further tests may be needed to confirm this if the level is borderline. These might include a glucose tolerance test where the blood sugar level is measured over two hours in response to a dose of glucose being given by mouth on an empty stomach.

More commonly, **HbA1C** is tested as a long term glucose marker.

**Amylase** is an enzyme that catalyses the hydrolysis of starch into sugars. It is produced by the pancreas and salivary glands. Its main diagnostic application is in the investigation of acute abdominal pain, the highest value being seen in acute pancreatitis.

## MB - Lipid Profile

Among other things, these are markers used to understand how your body metabolises fat. They are pointed for predicting atherosclerosis (the thickening of artery walls) and subsequent risk of heart disease.

**Triglycerides** are fatty acids of esters of glycerol which usually contain a mixture of fatty acids. Mainly of dietary origin these acids are also formed in the liver. They can become elevated in high consumption of alcohol.

**Cholesterol**, one of the circulating blood fats, is considered by everyone to be a barometer of risk of cardiovascular disease including arteriosclerosis and vascular thrombosis (blood clots) or stroke. Elevated levels are indicative of liver disease, cardiovascular disease, diabetes, stress and low thyroid function. Low levels are characteristic of severe intestinal mal-absorption and “hyper” thyroid conditions.

**High Density Lipoproteins (HDL)** are fat/protein complexes. HDLs are an integral part of the cholesterol complex and are considered desirable since they transport cholesterol to the liver for metabolism or excretion in the bile. High levels of HDLs denote that the body is sufficiently nourished in the essential fats necessary for body repair and metabolic functions. HDLs are increased by the consumption of fish oils or seeds' oils. Refined sugars in your diet will lower this valuable substance.

**Low Density Lipoprotein (LDL)** are fat/protein complexes with a high percentage of fat. LDLs transport cholesterol and essential fats from the liver to the cells in the peripheral tissues. For this reason, high levels LDL's are the least desirable of the cholesterol readings as they show a higher-than-expected need for the body in essential fat. High levels are a warning sign for increased risk of cardiovascular disease and stroke. Elevated levels of LDL can be due to poor lifestyles (diet, sleep...), chronic stress or body tissue damages

## MB - Iron Profile

Iron is an essential element, which takes part in many life processes. As a result, iron levels are seen to widely fluctuate. For this reason, several metrics are used to understand how iron is actually used.

**Iron** is an essential constituent of the diet and the level recorded is an indication of iron stores. A very low level may be associated with anaemia and in this case, changes in your haemoglobin would normally be noted.

**TIBC** (Total iron-binding capacity) is a medical laboratory test that measures the blood's capacity to bind iron with transferrin. It is performed by drawing blood and measuring the maximum amount of iron that it can carry, which indirectly measures transferrin since transferrin is the most dynamic carrier.

**Transferrin saturation (TSAT)** is the percentage ratio of serum iron and total iron-binding capacity.

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If abnormal, **iron, TIBC and Transferrin saturation readings** are used in conjunction to understand the cause of anaemia. For example, iron deficiency anaemia would have the following readings: low iron, high TIBC and low transferrin saturation.

## MB -Other Functions

**C-Reactive Protein (CRP)**: another inflammatory/infection marker more used in the acute response. This is a useful risk marker for cardiovascular diseases.

**Lipase** is also produced by the pancreas and is used in conjunction with Amylase. High readings usually show a disturbance of the pancreas, from weakened functions to diabetes or cancer. It can also point to liver and gallbladder organic dysfunctions. A low level of lipase in the blood may indicate permanent damage to the lipase-producing cells in the pancreas. This can occur in chronic diseases that affect the pancreas such as cystic fibrosis.

## Endocrinology

### Thyroid Functions

The thyroid gland secretes hormones that regulate metabolism. The main hormone, called FT4, can be measured in the blood. Another blood test measures the TSH (thyroid stimulating hormone) may detect very early changes in thyroid function, even before the FT4 is out of normal range. An underactive gland, for example, can make you feel, amongst other symptoms, tired and cold and cause dry skin.

**TSH (Thyroid Stimulating Hormone)** is released from the pituitary gland to stimulate the thyroid to produce its hormones.

**Free thyroxin** is the measurement of available T4, one of the hormones managed by the thyroid. **T4 (Thyroxin)** is the storage form of thyroid hormone. The body uses it to make T3. T3 (Triiodothyronin) is the active form of the thyroid hormone.

### Other readings

**The following readings are not part of the metabolic balance blood analysis programme. However, we may ask for them if we expect them to bring some useful readings:**

**Acid Phosphatase**: The main source is found in the prostate although significant amounts are also found in erythrocytes, platelets, the liver and spleen. The levels are raised in 80% of patients with metastatic carcinoma of the prostate.

**Red Cell Zinc**, an essential mineral, is transported in the blood by albumin and transferrin and is essential for, growth, repair and healing. A deficiency is indicated by hair loss, diarrhoea and skin changes, wound healing is also delayed.



**Red Cell Magnesium**, an essential mineral, is found in cereals and vegetables and plays an important role in maintaining a healthy heart, reducing the risk of cardiovascular diseases, high blood pressure and muscle tension. Low levels are indicated by weakness and lethargy although depletion rarely occurs as an isolated deficiency. Magnesium is important for iron absorption and as a Co-factor in Calcium metabolism.

**Ferritin** is where iron is stored and is requested if somebody is anaemic or low iron status is suspected, occasional it can be high in acute inflammation or iron overload.

**DHEA (Dehydroepiandrosterone)** this is an adrenal cortex hormone. It becomes lowered as a consequence of adrenal overload/stress, implicated in 75% of people with Chronic Fatigue Syndrome.