



# Glossary

## Radox Health California

900 Wilshire Blvd, Ste 200, Santa Monica, CA 90401, USA

Phone: +1 (424)-322-8844 - Email: [Customerservice@radoxhealthla.com](mailto:Customerservice@radoxhealthla.com)

Website: [www.radoxhealthla.com](http://www.radoxhealthla.com)

**Adiponectin** is a hormone produced exclusively by adipose (fat) tissue and is involved in the regulation of glucose levels and fat metabolism. Decreased adiponectin levels may be associated with obesity, type 2 diabetes and increased risk of cardiovascular disease or metabolic syndrome (a set of risk factors for cardiovascular disease and type 2 diabetes occurring simultaneously). Increased adiponectin levels may provide protection against obesity-related cardiovascular diseases and metabolic syndrome. Elevated levels of adiponectin may also be associated with inflammation, as evidence suggests adiponectin has both pro and anti-inflammatory properties.

**Alanine Aminotransferase (ALT)** is an enzyme mainly found in the liver. Normally, a low level of ALT exists in the serum. Liver injury or disease will release ALT into the bloodstream, thus elevating serum ALT levels. Very high levels of ALT can be due to acute (short-term) hepatitis, often resulting from a viral infection. Moderately high or mildly elevated ALT levels can be associated with chronic liver disease, such as cirrhosis (scarring of the liver), alcohol abuse, cholestasis (blockage of the flow of bile from the liver), pancreatitis (inflammation of the pancreas), mononucleosis (viral infection), kidney or heart damage, severe burns, muscle injury or the use of certain medications.

**Albumin** produced by the liver, is the most abundant protein found in the blood. Albumin plays an important role in maintaining plasma pressure (preventing fluid leaking from blood vessels) and transporting a wide variety of small molecules, such as hormones, vitamins and drugs, throughout the body. Various conditions are associated with decreased albumin levels, including kidney and liver diseases, inflammation, malabsorption disorders (conditions that affect the ability of the intestine to absorb nutrients, e.g. Crohn's disease and coeliac disease), prolonged diarrhoea and malnutrition. Low albumin levels are also associated with pregnancy. In individuals suffering from dehydration, albumin levels may be elevated.

**Aldolase** is an enzyme that functions in the conversion of glucose into energy for use by the body. Aldolase is present at high levels in muscle tissue. Damage to muscles or liver tissue can cause aldolase to leak into the bloodstream. Elevated aldolase levels may be associated with skeletal muscle damage, hepatitis (inflammation of the liver), and dermatomyositis or polymyositis (conditions characterised by muscle inflammation and weakness).

**Alkaline Phosphatase (ALP)** is an enzyme found in many tissues, with particularly high amounts found in the liver, bile ducts and bone. Various conditions can increase the level of ALP in the blood. These conditions include liver disorders, such as cirrhosis (scarring of the liver), hepatitis (inflammation of the liver), liver cancer or bile duct obstruction. Rapid bone growth or bone disorders e.g. healing fractures, osteomalacia (softening of the bones), Paget's disease of bone (a disorder featuring abnormal bone growth), rheumatoid arthritis, certain bone tumors or hyperparathyroidism (an overactive parathyroid gland) can increase ALP levels. Increased ALP levels can also be associated with heart failure, heart attack or mononucleosis (viral infection). Decreased levels of ALP can be associated with poor nutrition, pernicious anemia (insufficient red blood cell production due to vitamin B12 deficiency), vitamin C, zinc or protein deficiency, and hypophosphatasia (a rare genetic disorder of bone metabolism).

**Alpha-Fetoprotein (AFP)** is a protein produced during foetal development and liver cell regeneration. Levels of AFP fall soon after birth and are typically very low in men and non-pregnant women. Pregnant women tend to exhibit higher levels of AFP, due to production by the foetus. Certain tumors, e.g. cancer of the liver, testes or ovaries, may produce very high AFP levels. However, elevated AFP does not mean that cancer is present or that an individual is at increased risk of cancer. Liver damage such as hepatitis (inflammation of the liver) and cirrhosis (scarring of the liver) may cause elevated AFP levels.

**Anti-Cyclic Citrullinated Peptide (Anti-CCP) Antibodies** are a type of autoantibody (an antibody generated by the immune system that attacks the body's own tissues). Anti-CCP antibodies are a characteristic feature of rheumatoid arthritis (RA) and may aid diagnosis of RA in individuals with symptoms such as joint pain and inflammation. Rarely, anti-CCP antibodies can occur in other autoimmune conditions, such as Graves' disease (a disorder of the thyroid gland), systemic lupus erythematosus (a connective tissue disorder that affects many organs) and Sjogren's syndrome (a disorder featuring reduced tear and saliva production).

**Anti-Nuclear Antibodies (ANA)** are associated with many autoimmune disorders (conditions caused by the generation of an immune response against the body's own tissues) and are therefore not specific for any particular condition but may indicate an autoimmune process within the body. A positive ANA test may be associated with systemic lupus erythematosus (a connective tissue disorder that affects many organs), Sjogren's syndrome (a disorder featuring reduced tear and saliva production), rheumatoid arthritis, mixed connective tissue disease or polymyositis (a condition characterised by muscle inflammation) among others. However, a positive ANA test can occur in the absence of autoimmune disease and some healthy individuals may test positive for ANA.

**Antistreptolysin O (ASO)** is a blood test that detects antibodies to the streptolysin O toxin produced by streptococcal bacteria. The presence of ASO antibodies is indicative of a recent or current streptococcal infection. Streptococcal bacteria are commonly associated with throat and skin infections and in the long-term may cause complications including glomerulonephritis (inflammation of the kidney) and endocarditis (inflammation of the lining of the heart).

**Anti-Thyroglobulin Antibody (Anti-Tg)** is a protein produced by the immune system that attacks thyroglobulin (a precursor of thyroid hormones). Elevated anti-Tg levels are associated with Hashimoto's thyroiditis, an autoimmune condition that causes hypothyroidism (an underactive thyroid gland) and Graves' disease, an autoimmune condition that causes hyperthyroidism (an overactive thyroid gland).

**Anti-Thyroid Peroxidase Antibody (Anti-TPO)** is a protein produced by the immune system that attacks thyroid peroxidase (an enzyme found in the thyroid gland). Elevated anti-TPO levels are associated with Hashimoto's thyroiditis, an autoimmune condition that causes hypothyroidism (an underactive thyroid gland) and Graves' disease, an autoimmune condition that causes hyperthyroidism (an overactive thyroid gland).

**Anti-tissue Transglutaminase (Anti-tTG) Antibody (IgA) (Coeliac Disease)** is a sensitive marker for coeliac disease. Coeliac disease is an autoimmune disorder in which the body's immune system reacts to gluten in the diet causing inflammation of the intestine. This damage to the intestine impairs the ability of the body to digest food and absorb nutrients. The anti-tTG antibody test is a useful screening tool for coeliac disease; however, testing is only appropriate in individuals who continue to consume gluten.

**Apolipoprotein A-I** is the main protein component of HDL cholesterol ('good' cholesterol). Apolipoprotein A-I (apo A-I) and HDL cholesterol transport cholesterol to the liver where it is processed and subsequently removed from the body. For this reason, a higher apo A-I level is desirable and deficiency is associated with increased risk of developing cardiovascular disease. Low apo A-I levels may be associated with uncontrolled diabetes, kidney or liver disease, obesity, smoking, high triglyceride levels or certain medications (e.g. beta-blockers). Increased levels of apo A-I may not be clinically significant but can be associated with familial hyperalphalipoproteinemia (a rare genetic disorder), alcohol consumption, physical exercise, pregnancy, weight loss and certain prescribed drugs (such as estrogens, oral contraceptives and statins).

**Apolipoprotein B** is the main protein component of LDL cholesterol ('bad' cholesterol). Apolipoprotein B (apo B) and LDL cholesterol transport and deposit cholesterol in blood vessels thereby increasing risk of cardiovascular disease. For this reason, a lower apo B level is desirable and too much is associated with greater risk of developing cardiovascular disease. Males tend to have more apo B than females and levels may increase with age. Elevated apo B may be observed in individuals with diabetes, hypothyroidism (an underactive thyroid gland), nephrotic syndrome (a type of kidney disease) and in those who are prescribed certain medications (e.g. beta-blockers) or are pregnant. Decreased apo B levels may be associated with hyperthyroidism (an overactive thyroid gland), malnutrition, weight loss and various medications (e.g. estrogens, statins and thyroxine).

**Apolipoprotein B / A-I Ratio** is useful when determining cardiovascular risk. Apolipoprotein B (apoB) in combination with LDL cholesterol is damaging to the body as it transports and deposits cholesterol in the blood vessels and increases risk of cardiovascular disease. Apolipoprotein A-I (apo A-I) in combination with HDL cholesterol helps the body to lower cholesterol levels, thus reducing risk of cardiovascular disease. Evidence suggests that apo B / A-I ratio may be a more effective predictor of increased risk of cardiovascular disease. The risk of cardiovascular disease is greater when the apo B/A-I ratio is higher (less apo A-I, more apo B).

**Apolipoprotein CII** is a protein found in various lipoprotein and large fat particles. Apolipoprotein CII (apo CII) is responsible for activation of lipoprotein lipase, an enzyme that is crucial for processing of fat from digested food. Low apo CII levels are associated with apolipoprotein CII deficiency, a rare inherited condition in which fat particles accumulate in the blood. However, too much apo CII, which inhibits lipoprotein lipase activity, also contributes to fat accumulation. Elevated apo CII levels may be associated with coronary heart disease, such as angina or heart attack, or with familial lipoprotein lipase deficiency, a rare genetic disorder.

**Apolipoprotein CIII** is a protein made by the liver and found on the surface of various lipoprotein particles (particles containing both fat and protein). Increased apolipoprotein CIII (apo CIII) levels inhibit the activity of lipoprotein lipase (an enzyme that is crucial for processing of fat) and can lead to high triglyceride levels. Apo CIII may promote atherosclerosis (accumulation of cholesterol and fatty material in blood vessel walls) and consequently increase risk of cardiovascular disease. Equally, apo CIII deficiency may be associated with increased risk of cardiovascular disease.

**Apolipoprotein E** is a protein produced by the liver that is essential for breaking down triglyceride- rich lipoproteins (particles containing both fat and protein). Apolipoprotein E (apo E) is involved in the transport of cholesterol and other lipids to the liver for removal from the body. Reduced availability of apo E impairs clearance of triglycerides from the blood and may be associated with increased risk of atherosclerosis (accumulation of cholesterol and fatty material in blood vessel walls).

**Aspartate Aminotransferase (AST)** is an enzyme found predominantly in the heart, liver and skeletal muscles, and to a lesser degree in the pancreas, kidney and red blood cells. Cell injury or disease will release AST into the bloodstream, thus elevating blood AST levels. Increased AST levels may be associated with hepatitis (inflammation of the liver), cirrhosis (scarring of the liver), drug- induced liver injury, heart diseases (e.g. myocardial infarction), skeletal muscle disorders and other diseases such as acute pancreatitis (inflammation of the pancreas). Decreased AST levels may be associated with acute kidney disease, diabetic ketoacidosis (a complication of diabetes where fat, instead of glucose, provides energy for the body) and pregnancy.

**Basophil Count** refers to the number of basophils per volume of blood. Basophils are white blood cells that are involved in response to infections and allergic stimuli. Basophil levels may be elevated in conditions involving inflammation and allergic reactions. A high basophil count may also be associated with an alteration in bone marrow function such as leukemia. A low basophil count may be associated with hypersensitivity reactions (e.g. acute allergic reaction), hyperthyroidism (an overactive thyroid gland), pregnancy, stress or the use of medications such as corticosteroids.

**Beta-2-Microglobulin** is a protein found on the surface of most cells in the body. The glomeruli (filtering apparatus of the kidneys) filter out 90% of the  $\beta$ -2-microglobulin found in the blood and then the kidney tubules are responsible for reabsorbing it back into the bloodstream. Increased  $\beta$ -2- microglobulin may be associated with kidney conditions that impair glomerular function (e.g. chronic kidney disease), some cancers (e.g. multiple myeloma or leukemia) and conditions that activate the immune system (e.g. inflammatory or autoimmune diseases).

**Bilirubin (Urine)** generated from the breakdown of red blood cells in the spleen, travels to the liver for incorporation into bile (a fluid that facilitates digestion in the intestine). Therefore, bilirubin is normally absent from the urine. The presence of urinary bilirubin may indicate bile duct obstruction (e.g. due to gallstones), hepatitis (inflammation of the liver), cirrhosis (scarring of the liver), and rare inherited disorders of bilirubin metabolism (e.g. Dubin-Johnson syndrome, Rotor syndrome). Certain medications can lead to elevated urine levels of bilirubin, including diuretics, steroids and oral contraceptives.

**Body Fat Percentage** is the proportion of fat to total body weight. Body fat is essential for maintaining body temperature, cushioning joints and protecting internal organs. Yet, too much fat can damage your health. Reducing excess levels of body fat has shown to reduce the risk of certain conditions such as high blood pressure, heart disease, type 2 diabetes and cancer. Too little body fat may lead to irregular periods in women and infertility.

**Body Mass Index (BMI)** calculated from an individual's weight and height, is an indicator of body fat and can identify weight problems, in terms of whether an individual is underweight, overweight or obese. Such weight problems are risk factors for conditions such as heart disease, high blood pressure, metabolic syndrome, diabetes, cancer and respiratory problems. BMI does not take into account age, gender or muscle mass; therefore, an individual with a high muscle mass may be classified as overweight or obese.

**Body Mass Index (BMI)** {Metabolic Syndrome} calculated from an individual's weight and height, is an indicator of body fat and can identify weight problems, in terms of whether an individual is underweight, overweight or obese. The National Cholesterol Educational Program (NCEP) Adult Treatment Panel III (ATP III) states that individuals who have a BMI above 30 kg/m<sup>2</sup> are at risk of metabolic syndrome. BMI does not take into account age, gender or muscle mass; therefore, an individual with a high muscle mass may be classified as overweight or obese.

**Calcitonin** is a hormone secreted by the thyroid gland when calcium levels in the blood are high. Calcitonin acts to lower calcium and phosphorus levels in the blood by inhibiting bone resorption (a process in which bone is broken down resulting in release of minerals into the bloodstream). As calcitonin helps to maintain bone density, it may be used as a therapy for osteoporosis (weakness of the bones). Elevated levels of calcitonin are a marker of medullary thyroid carcinoma (a rare cancer of the thyroid cells that produce calcitonin). However, elevated calcitonin levels may be associated with other types of cancer, use of oral contraceptives and pregnancy.

**Calcium (adjusted)** is a mineral with many important roles in the body including bone and teeth formation, muscle contraction, heart function and nerve conduction. Hypercalcemia, or an elevated calcium level may be associated with hyperparathyroidism (increased production of parathyroid hormone, which regulates calcium levels), hyperthyroidism (an overactive thyroid gland), bone cancer, vitamin D excess and Addison's disease (a rare disorder in which the adrenal glands are underactive). Hypocalcemia, or a low calcium level, may be associated with malnutrition, malabsorption disorders (conditions that affect the ability of the intestine to absorb nutrients), hypoparathyroidism (decreased production of parathyroid hormone) and vitamin D deficiency. Hypocalcemia may increase the risk of developing osteomalacia (softening of the bones) and osteoporosis (weakening of the bones). Approximately half of the body's calcium circulates in the bloodstream bound to the protein albumin. Therefore, calcium levels may appear falsely low or high when blood albumin levels are abnormal. To compensate for this, the calcium level is adjusted according to albumin level.

**Cancer Antigen 125 (CA 125)** is a protein found on the surface of ovarian cancer cells. It can be a useful monitoring tool for ovarian cancer, particularly for assessing treatment or cancer recurrence. However, increased CA 125 levels can occur during normal menstruation and pregnancy, or in conditions such as endometriosis and pelvic inflammatory disease. Therefore,



increased CA 125 alone is not sufficient for identification of ovarian cancer.

**Cancer Antigen 15-3 (CA 15-3)** is a protein produced by normal breast tissue that can be used as a monitoring tool for breast cancer. Although associated with breast cancer, healthy individuals and pregnant women can have increased CA 15-3 levels in the blood. Elevated CA 15-3 levels may also be associated with other cancers, including lung, liver, colon, ovarian and pancreatic cancer. In addition, many benign (non-cancerous) conditions can be associated with increased CA 15-3, including chronic hepatitis (inflammation of the liver), cirrhosis (scarring of the liver), pelvic inflammatory disease and systemic lupus erythematosus (a connective tissue disorder that affects many organs).

**Cancer Antigen 19-9 (CA 19-9)** is a protein found in many tissues of the body, including the pancreas, bile duct, gallbladder, stomach, colon and prostate. Elevated CA 19-9 levels may be associated with colorectal, stomach, ovarian, liver or pancreatic cancer. However, many benign (non-cancerous) conditions can also be associated with elevated CA 19-9 levels, including pancreatitis (inflammation of the pancreas), cirrhosis (scarring of the liver), inflammatory bowel disease and diabetes mellitus. In addition, some healthy individuals can have high levels of CA 19-9. Therefore, increased CA 19-9 levels are not a definitive indication of cancer.

**Carcinoembryonic Antigen (CEA)** is a protein found in the tissues of developing embryos. By adulthood, CEA tends to be detectable only at low levels in the blood. Elevated CEA levels may be associated with cancer of the bowel, lungs, breast, stomach, liver or pancreas. However, many benign (non-cancerous) conditions may be associated with increased CEA, including cirrhosis (scarring of the liver), hepatitis (inflammation of the liver), kidney disease, inflammatory bowel disease, irritable bowel syndrome and pneumonia. In addition, ageing and smoking may increase CEA levels in the blood. Therefore, an elevated CEA value does not provide a definitive diagnosis of cancer.

**Cardiovascular Risk Score** is a calculation that takes into account age, blood pressure, cholesterol levels and other risk factors for cardiovascular disease, which can help assess an individual's risk of developing diseases of the cardiovascular system over the next ten years. A higher cardiovascular risk score is associated with increased risk of angina, heart attack and stroke.

**Chloride** helps to maintain acid-base balance (pH) and water balance within the body. Chloride levels are associated with sodium levels, but may change independently. Hyperchloremia, or an elevated chloride level, may be associated with kidney dysfunction, dehydration and hyperparathyroidism (an overactive parathyroid gland). Hypochloremia, or a decreased chloride level, occurs with certain kidney disorders and any disorder that causes low blood sodium. Hypochloremia may also occur with excessive consumption of water, vomiting and chronic diarrhoea.

**Complement Component 3 (C3)** is a protein that is part of the complement system. The complement system is an essential part of the immune system that helps to promote inflammatory and immune responses and eradicate infectious agents. Therefore, C3 levels rise during episodes of acute (short-lived) or chronic (long-lasting) inflammation. Low C3 levels may be associated with autoimmune diseases, e.g. systemic lupus erythematosus (a connective tissue disorder that affects many organs), kidney disease, recurrent bacterial infections, malnutrition and angio-oedema (an allergic reaction in the skin causing patches of swelling). Infection caused

by parasites or fungi may also be associated with low C3 levels.

**Complement Component 4 (C4)** is a protein that is part of the complement system. The complement system is an essential part of the immune system that helps to promote inflammatory and immune responses and eradicate infectious agents. Therefore, C4 levels rise during episodes of acute (short-lived) or chronic (long-lasting) inflammation. Low C4 levels may be associated with autoimmune diseases, e.g. systemic lupus erythematosus (a connective tissue disorder that affects many organs), kidney disease, recurrent bacterial infections, malnutrition and angio-oedema (an allergic reaction in the skin causing patches of swelling).

**Copper** is an essential mineral that plays a part in many enzyme systems within the body. In the bloodstream, 95% of copper is bound to ceruloplasmin, an acute phase protein, which rises in the blood in response to inflammation. Excess or deficiency of copper is very rare. This copper test measures the 'free copper' level. An increased free copper level in the blood may be indicative of Wilson's disease (a rare inherited disorder in which copper accumulates in the brain, liver and other tissues). Elevated copper levels can occur during pregnancy and in women who use estrogen- containing medications, e.g. oral contraceptives. Chronic liver disease or acute hepatitis (inflammation of the liver) may also cause copper levels in the blood to rise. Copper deficiency may occur in individuals with severe malabsorption (impaired ability of the intestine to absorb nutrients).

**Cortisol** is a hormone produced by the adrenal glands that is involved in blood pressure regulation, glucose metabolism and the body's response to stress. Cortisol levels vary throughout the day and tend to be high in the morning and lower at night. Elevated cortisol levels may be associated with acute stress, alcoholism, depression, obesity, oral contraceptives, hyperthyroidism (an overactive thyroid gland) or Cushing's syndrome (a rare condition in which the adrenal glands are overactive). Low cortisol levels may be associated with Addison's disease (decreased production of cortisol by the adrenal glands) or hypothyroidism (an underactive thyroid gland).

**C-peptide** is released from the pancreas to the bloodstream during production of insulin. C-peptide is a useful marker of insulin production and may aid the evaluation of individuals with hypoglycemia (low blood sugar) or metabolic syndrome (a set of risk factors for diabetes and cardiovascular disease occurring simultaneously). Elevated C-peptide levels may be associated with insulin resistance (a key feature of type 2 diabetes), pregnancy, low potassium levels, kidney failure and rare conditions such as Cushing's syndrome (overactive adrenal glands) and insulinoma (an insulin-producing tumor of the pancreas).

**C-Reactive Protein (CRP)** is an acute phase protein produced primarily by the liver. Acute phase proteins are proteins that increase or decrease in the blood in response to inflammation. Measurement of CRP cannot help with diagnosis of a particular disease, as it is a non-specific marker but instead it serves as a valuable general marker of inflammation or infection. A high level of CRP in the blood is indicative of an inflammatory process, resulting from conditions such as arthritis or inflammatory bowel disease. Elevated CRP may also indicate presence of infection or autoimmune disease (conditions caused by the body generating an immune response against its own tissues). In addition, evidence supports a role for elevated CRP in risk of future cardiovascular disease. Many research studies have identified long-term inflammation as a contributing factor to atherosclerosis (accumulation of cholesterol and fatty material within



blood vessel walls), which is a major feature of cardiovascular disease. However, before evaluating CRP in a cardiovascular context, consideration of infection or inflammation is essential. Obesity, pregnancy and oral contraceptives may also increase CRP.

**Creatine Kinase** is an enzyme present in muscle, which leaks out into the bloodstream when damage to muscle tissue occurs. Increased creatine kinase levels may be associated with greater muscle mass, muscle damage resulting from very heavy exercise (weight lifting, contact sports or long exercise sessions), myositis (inflammation of muscle tissue), crush injuries, surgery, or intramuscular injection. Early pregnancy can cause creatine kinase levels to fall.

**Creatine Kinase-MB (CK-MB)** is a form of creatine kinase, an enzyme produced by muscle tissue. Primarily produced by heart muscle, CK-MB measurement may be useful for distinguishing between damage to cardiac muscle and damage to skeletal muscle. Elevated CK-MB levels can be associated with heart muscle injury (e.g. a heart attack), myopathy (characterised by muscle weakness), heavy or strenuous exercise and rarely may occur with low thyroid hormone levels or alcohol abuse.

**Creatinine** is a waste product produced by muscle tissue. Creatinine concentration in the blood represents a balance between muscle production and the filtration and subsequent removal of creatinine from the body by the kidneys. As production from muscle is relatively constant, the filtering ability of the kidneys determines creatinine concentration in the blood. Therefore, when kidney function diminishes, creatinine levels increase. Increased creatinine may be associated with glomerulonephritis (kidney inflammation), pyelonephritis (kidney infection), acute tubular necrosis (death of kidney tubule cells) and situations in which blood flow to the kidney is reduced, such as dehydration, heart failure and complications associated with diabetes. Muscle injury may cause a temporary increase in creatinine. Low creatinine values are rare and can be a sign of low muscle mass.

**Cystatin C** is a relatively small protein, produced by many cell types of the body. The glomeruli of the kidneys filter cystatin C from the blood at a rate referred to as the glomerular filtration rate (GFR). Cystatin C levels in the blood should remain relatively constant if the kidneys are working efficiently and GFR is normal. If the kidneys are damaged or diseased, the GFR will decrease and cystatin C levels can rise. Elevated cystatin C levels may also be associated with an increased risk of metabolic syndrome (a set of risk factors for diabetes and cardiovascular disease occurring simultaneously), heart disease, heart failure and stroke. Cystatin C levels are sensitive to changes in thyroid function. Levels may be lower in hypothyroidism (an underactive thyroid gland) and greater in hyperthyroidism (an overactive thyroid gland). Therefore, when interpreting a cystatin C result, it is important to evaluate any underlying thyroid dysfunction.

**Cystatin C (Urine)** is a relatively small protein, produced by many cell types of the body. Due to its small size, cystatin C is freely filtered from the bloodstream by filtering structures within the kidneys. However, virtually all filtered cystatin C is then reabsorbed back into the blood by kidney tubules; therefore, no cystatin C should appear in the urine. High levels of cystatin C in the urine suggest impaired reabsorption due to injury or poor functioning of kidney tubules, and have been observed in acute kidney injury, drug-induced kidney injury and diabetic kidney disease.

**D-Dimer** is a protein fragment produced during the breakdown of blood clots. Generally undetectable in the blood, D-dimer levels may rise when blood clot formation and destruction

increases. A positive D-dimer test indicates that further investigation may be necessary, as elevated levels can be associated with deep vein thrombosis, stroke, pulmonary embolism, infection, liver disease or pregnancy.

**Dehydroepiandrosterone Sulphate (DHEAS)** (*Female*) is a steroid hormone, produced by the adrenal glands, and found in the bloodstream of both men and women. Typically, DHEAS levels peak at around thirty years of age and then gradually fall. Elevated DHEAS may be associated with adrenal cancer, adrenal hyperplasia (excessive growth of adrenal gland tissue), polycystic ovary syndrome or Cushing's syndrome (a rare condition in which the adrenal glands are overactive). Decreased DHEAS may be associated with adrenal gland dysfunction or hypopituitarism (an underactive pituitary gland).

**Dehydroepiandrosterone Sulphate (DHEAS)** (*Male*) is a steroid hormone, produced by the adrenal glands, and found in the bloodstream of both men and women. Typically, DHEAS levels peak at around thirty years of age and then gradually fall. Elevated DHEAS may be associated with adrenal cancer, adrenal hyperplasia (excessive growth of adrenal gland tissue) or Cushing's syndrome (a rare condition in which the adrenal glands are overactive). Decreased DHEAS may be associated with adrenal gland dysfunction or hypopituitarism (an underactive pituitary gland).

**Diastolic Blood Pressure** is a measure of the pressure in the blood vessels when the heart rests between contractions and refills with blood. According to the National Cholesterol Educational Program (NCEP) Adult Treatment Panel III (ATP III), diastolic blood pressure measurements equal to or greater than 85 mmHg are associated with metabolic syndrome. Additionally, individuals currently receiving treatment for high blood pressure are at risk of metabolic syndrome irrespective of blood pressure measurement.

**Direct Bilirubin** is a yellowish brown pigment found in bile (a fluid produced in the liver that facilitates digestion in the intestine). Elevated direct bilirubin may not be clinically significant when total bilirubin is normal. However, increased levels may be associated with liver or bile duct blockage (e.g. due to gallstones), hepatitis (inflammation of the liver), cirrhosis (scarring of the liver), trauma to the liver, a drug reaction, long-term alcohol abuse or rare inherited disorders (e.g. Dubin-Johnson syndrome which is characterised by mild jaundice).

**Eosinophil Count** refers to the number of eosinophils per volume of blood. Eosinophils are white blood cells that are involved in allergic reactions and in resisting infection. A high eosinophil count may be due to asthma, eczema, hay fever, parasitic infections, autoimmune disease (conditions caused by the generation of an immune response against the body's own tissues), leukemia and certain medications. A low eosinophil count may be associated with excess production of adrenal hormones (e.g. Cushing's syndrome), alcohol intoxication and stress.

**Epidermal Growth Factor (EGF)** is one of a network of growth factors that help to regulate cell growth and development, accelerate wound healing and promote growth of new blood vessels. Due to its role in cell division, elevated EGF levels may be associated with cancer development and tissue repair. Individuals affected by prolonged stress may also have increased EGF levels.

**Estimated Glomerular Filtration Rate (eGFR)** is an equation that takes into account age, gender and blood creatinine level to help determine how well the kidneys are functioning. The kidneys

remove waste products (e.g. creatinine) from the blood by filtration, a process performed by capillary networks called glomeruli. The eGFR assesses this filtering ability and a low eGFR indicates poor kidney function.

**Ferritin** is a major iron-storage protein and provides a good indication of available iron stores. Increased ferritin levels can be associated with disorders of excessive iron storage (e.g. hemochromatosis), iron poisoning, recent blood transfusions, megaloblastic anemia (anemia due to vitamin B12 or folic acid deficiency) or hemolytic anemia (anemia caused by premature destruction of red blood cells). However, ferritin is an acute phase protein, which can non-specifically increase with acute inflammatory disease, infection, liver disease or cancer, regardless of iron stores, due to leakage of ferritin from damaged organs (especially the liver, spleen and bone marrow). Decreased ferritin levels may be associated with iron- deficiency anemia and very low protein levels.

**Folic Acid** along with vitamin B12 is important for the normal development red blood cells. Decreased folic acid levels are associated with megaloblastic anemia (anemia due to folic acid or vitamin B12 deficiency). Low folic acid levels may be due to decreased dietary intake, alcoholism, pregnancy or malabsorption disorders (conditions that affect the ability of the intestine to absorb nutrients, e.g. Crohn's disease or coeliac disease). Increased folic acid levels generally are not cause for concern but may occur in individuals who consume a vegetarian diet or suffer from pernicious anemia (anemia due to impaired absorption of vitamin B12 by the intestine).

**Follicle Stimulating Hormone (Female)**, produced by the pituitary gland in the brain, interacts with receptors in the ovaries to help regulate reproductive function. In women, follicle stimulating hormone (FSH) stimulates the development of ovarian follicles (eggs) during the menstrual cycle. Measurement of FSH is useful for the evaluation of pituitary function, amenorrhoea (absence of menstrual periods) and fertility. Elevated levels of FSH may be associated with primary ovarian failure, which can occur with polycystic ovary syndrome, ovarian tumors or abnormal ovarian development. Low FSH levels may be indicative of hypopituitarism (an underactive pituitary gland) or secondary ovarian failure due to excessive exercise, stress or extreme weight loss.

**Follicle Stimulating Hormone (Male)**, produced by the pituitary gland in the brain, interacts with receptors in the testes to help regulate reproductive function. In men, follicle stimulating hormone (FSH) stimulates testicular growth and supports the production of sperm. Measurement of FSH is useful for the evaluation of pituitary function and fertility. High FSH levels may indicate primary testicular failure, which can occur with abnormal testicular development or testicular cancer. Low FSH levels may be indicative of hypopituitarism (an underactive pituitary gland).

**Free Androgen Index (Female)** describes the ratio of total testosterone to sex hormone binding globulin (a protein that binds testosterone). Calculating free androgen index is useful for the evaluation of abnormal testosterone levels. An elevated free androgen index may be associated with acne, obesity, hirsutism (excessive growth of hair on the face or body), polycystic ovary syndrome and hypothyroidism (an underactive thyroid gland).

**Free Androgen Index (Male)** describes the ratio of total testosterone to sex hormone binding globulin (a protein that binds testosterone). Calculating free androgen index is useful for the

evaluation of abnormal testosterone levels. An elevated free androgen index may be associated with acne, androgenic alopecia (male pattern baldness), obesity and hypothyroidism (an underactive thyroid gland).

**Free Prostate Specific Antigen (FPSA)** refers to the amount of total PSA that is 'free'. The prostate gland produces PSA, which exists in two forms in the bloodstream - 'bound' (where it is attached to a protein) or 'free' (not bound by protein). Research suggests that a decreased FPSA value, in combination with an elevated total PSA, may indicate a higher likelihood of prostate cancer.

**Free Thyroxine (FT4)** is a hormone produced by the thyroid gland that is involved in regulation of the body's metabolism. Free thyroxine is a measure of the amount of active thyroxine circulating in the bloodstream and helps evaluate thyroid function. Elevated FT4 levels are associated with hyperthyroidism (an overactive thyroid gland), whilst decreased FT4 levels are associated with hypothyroidism (an underactive thyroid gland).

**Free Tri-iodothyronine (FT3)** is a hormone produced by the thyroid gland that is involved in regulating the body's metabolism. Free Tri-iodothyronine is a measure of the amount of active tri-iodothyronine circulating in the blood and helps evaluate thyroid function. Elevated FT3 levels are associated with hyperthyroidism (an overactive thyroid gland), whilst decreased FT3 levels are associated with hypothyroidism (an underactive thyroid gland).

**Fructosamine** is a compound, generated in the blood, by the interaction of glucose with protein (e.g. albumin) and its measurement can provide an indication of average glucose levels over a 2-3 week period. A high fructosamine level indicates high blood glucose and in individuals with diabetes, suggests poor glucose control. Fructosamine measurement is particularly useful in situations where HbA1c (another long-term glucose marker) analysis is unreliable, e.g. in individuals with conditions that affect hemoglobin. A falsely low fructosamine result can occur in individuals with protein-losing enteropathy (disorders of the digestive tract that affect the digestion or absorption of protein) or nephrotic syndrome (disease of the kidneys in which protein is lost through the urine).

**Gamma-Glutamyltransferase (GGT)** is an enzyme found mainly in the liver. Increased levels of GGT in the blood may indicate bile duct injury, hepatitis (inflammation of the liver), cirrhosis (scarring of the liver), liver necrosis (death of liver tissue), liver tumors or the use of drugs that are toxic to the liver. A high GGT level is frequently associated with increased alcohol consumption, as this liver enzyme is involved in the breakdown and removal of alcohol from the body. Raised GGT levels can be associated with the use of certain medications and a variety of other clinical conditions including myocardial infarction (heart attack), pancreatic disease and chronic obstructive pulmonary disease (a lung disorder).

**Globulin** refers to a group of proteins that are the key building blocks of antibodies, complement proteins and acute phase reactant proteins (important components of the immune system). Increased globulin levels may occur with autoimmune disease, e.g. systemic lupus erythematosus (a connective tissue disorder that affects many organs) or long-standing liver disease, particularly when cirrhosis (scarring of the liver) exists. High globulin levels may also be associated with kidney disease, tuberculosis or diseases of the blood, such as hemolytic anemia (anemia caused by premature destruction of red blood cells) and various cancers. Low globulin

levels may be associated with immunodeficiency, malnutrition, malabsorption disorders (conditions that affect the ability of the intestine to absorb nutrients), liver disease or kidney disease.

**Glucose** is a simple sugar that provides energy for the body. An increased fasting glucose level is characteristic of diabetes, while higher than normal levels can be associated with a greater risk of developing diabetes in the future ('high risk' or 'pre-diabetes'). Increased levels can also occur following a meal and can be associated with hyperthyroidism (an overactive thyroid gland), pancreatitis (inflammation of the pancreas), chronic kidney failure, and rare conditions such as acromegaly (excess production of growth hormone) and Cushing's syndrome (excess production of adrenal hormones). Various medications such as steroids and diuretics can also increase glucose levels. Decreased levels may be associated with starvation, hypothyroidism (an underactive thyroid gland), extensive liver disease, insulin overdose, and rare conditions such as insulinoma (a tumor of the pancreas), hypopituitarism (an underactive pituitary gland) and Addison's disease (a disorder of the adrenal glands).

**Glucose {Metabolic Syndrome}** is a simple sugar that provides energy for the body. Increased levels can occur following a meal, therefore glucose should be measured following a period of fasting (>12 hours). According to the National Cholesterol Educational Program (NCEP) Adult Treatment Panel III (ATP III), a fasting glucose level equal to or greater than 5.6 mmol/l, or previously diagnosed type 2 diabetes are associated with metabolic syndrome.

**Glucose (Urine)** is a simple sugar and is the major source of energy for most cells of the body, including those in the brain. Glucose is normally absent from urine. The presence of glucose within the urine (glycosuria) may indicate diabetes mellitus and other cause of glucose intolerance. In individuals with poorly controlled diabetes, excessively high blood glucose levels can exceed the capability of the kidney to reabsorb glucose, causing it to spill into the urine. Increased glucose levels can also be due to pregnancy and certain medications.

**Glutamate Dehydrogenase (GLDH)** is an enzyme located within the mitochondria (energy producing machinery) of cells, particularly within liver tissue. Significant liver cell damage may cause release of GLDH into the bloodstream. Toxic liver damage, liver cell necrosis (cell death) or hypoxic liver disease (where liver cells are deprived of oxygen) may cause an increase in GLDH. Measurement of GLDH in combination with other liver markers may help distinguish between different causes of liver dysfunction.

**Glutathione Reductase** is an enzyme that is essential for the maintenance of reduced glutathione levels in the body. Reduced glutathione is an important antioxidant. Antioxidants defend the body against damaging free radicals produced during normal body processes or through environmental exposures such as smoking or pollution. Low levels of glutathione reductase are undesirable as this may diminish reduced glutathione availability and impair the antioxidant capacity of the body.

**Granulocyte Macrophage Colony Stimulating Factor (GM-CSF)** is a pro-inflammatory protein that regulates the production and activation of monocytes and macrophages (specialised white blood cells that ingest and destroy foreign material such as bacteria and viruses), and other white blood cells. Elevated GM-CSF levels may be associated with a high platelet count, a high eosinophil count, infection, hypersensitivity reactions (e.g. allergies), asthma and other inflammatory lung diseases.

**Hematocrit** is the percentage of total blood volume occupied by red blood cells (RBCs). It is an indirect measurement of the RBC count. Abnormal values indicate the same conditions as abnormal RBC and hemoglobin values i.e. decreased levels may indicate anemia whilst increased levels can indicate erythrocytosis (too many RBCs).

**Hemoglobin** serves as a vehicle for oxygen and carbon dioxide transport within the blood and determines the blood's oxygen carrying capacity. Abnormal values indicate the same conditions as abnormal red blood cell (RBC) and hematocrit values i.e. decreased levels may indicate anemia whilst increased levels can indicate erythrocytosis (too many RBCs).

**Haptoglobin** is a protein produced by the liver that collects hemoglobin (the oxygen-carrying component of blood) following its release from red blood cells (RBCs). Haptoglobin is an acute phase protein, meaning that its levels rise in response to inflammation. Elevated haptoglobin levels may also be associated with infection, diabetes mellitus, smoking or nephrotic syndrome (disease of the kidneys in which protein is lost through the urine). Decreased or absent haptoglobin can be associated with liver disease or pregnancy and conditions featuring hemolysis (destruction of RBCs), e.g. thalassemia or hemolytic anemia.

**HbA1c** is a substance formed when hemoglobin in red blood cells (RBCs) combines with glucose in the blood. The HbA1c level does not change quickly as RBCs live for 2-3 months. This test can therefore provide an accurate long-term index of the average glucose level in the blood. Increased HbA1c levels can be associated with diabetes mellitus, gestational diabetes (diabetes that develops during pregnancy), acute stress response, corticosteroid therapy, and other rare non-diabetic conditions including acromegaly (excess production of growth hormone) and Cushing's syndrome (excess production of adrenal hormones). Higher than normal levels can be associated with a greater risk of developing diabetes in the future ('high risk' or 'pre-diabetes').

**HDL Cholesterol** describes cholesterol that is bound to high-density lipoprotein (HDL). Lipoproteins are responsible for transporting cholesterol in the blood. HDL cholesterol is 'protective' as it removes cholesterol from the peripheral tissues and transports it back to the liver for removal from the body. A low HDL cholesterol level is undesirable and is associated with increased risk of atherosclerosis (accumulation of cholesterol and fatty material within blood vessel walls) and cardiovascular disease. Obesity, metabolic syndrome (a set of risk factors for diabetes and cardiovascular disease occurring simultaneously), uncontrolled diabetes, smoking, malnutrition and lack of exercise are associated with low HDL cholesterol levels.

**HDL Cholesterol {Metabolic Syndrome}** describes cholesterol that is bound to high-density lipoprotein (HDL). Lipoproteins are responsible for transporting cholesterol in the blood. HDL cholesterol is considered to be 'good' or to have a 'protective effect' as it removes cholesterol from the peripheral tissues and transports it back to the liver for removal from the body. Individuals receiving treatment for high cholesterol are at risk of metabolic syndrome irrespective of HDL cholesterol levels.

**Heart-type Fatty Acid Binding Protein (H-FABP)** is a small protein predominantly found in heart muscle tissue but is also present in skeletal muscle, kidney tissue and brain tissue. Damage to the heart, such as damage that occurs due to a lack of blood and oxygen supply to heart



muscle (ischaemia), allows H-FABP to escape from heart muscle tissue and leak into the bloodstream. Therefore, H-FABP can serve as a marker of cardiovascular risk or ischaemia and be useful in the evaluation of angina (chest pain). In addition, H-FABP may be associated with kidney dysfunction.

**Height** is used to calculate an individual's Body Mass Index.

**High Sensitivity C-Reactive Protein (hs-CRP)** is an extra sensitive test that can detect very low levels of CRP, an acute phase protein produced primarily by the liver. Acute phase proteins are proteins that increase or decrease in the blood in response to inflammation. Elevated hs-CRP indicates the presence of inflammation, which many research studies have identified as a contributing factor to the development of atherosclerosis (accumulation of cholesterol in the blood vessels), a major feature of heart disease. Therefore, increased levels of hs-CRP are associated with greater risk of developing heart disease. However, before evaluating hs-CRP in this context, consideration of infection or inflammation is essential, as many conditions can raise hs-CRP, including infection, arthritis and inflammatory bowel disease. Obesity, pregnancy and oral contraceptives may also increase hs-CRP.

**Hip Circumference** is the measurement of the hips at their maximum circumference, most often this is around the buttocks. The hip circumference correlates well as a measure of the fat surrounding the internal organs and when used in combination with the waist circumference and waist:hip ratio may be an indicator of cardiovascular disease.

**Homocysteine** is an amino acid that studies have demonstrated is present at higher levels in the blood of individuals with coronary heart disease, stroke and peripheral vascular disease. Homocysteine appears to promote the progression of atherosclerosis, a key feature of cardiovascular disease, by causing damage to blood vessels and encouraging accumulation of cholesterol. Increased homocysteine levels may be associated with older age, hypothyroidism (an underactive thyroid gland), impaired kidney function, smoking and vitamin B12, B6 or folic acid deficiency. Low levels can occur with hyperthyroidism (an overactive thyroid gland) and in individuals who use vitamin B12 or folic acid supplements or oral contraceptives.

**Immunoglobulin A (IgA)** is one of a group of proteins (antibodies) generated by the immune system to protect the body from infection. Antibodies of the IgA class offer protection predominantly in areas of the body that produce mucus, such as the digestive and respiratory tracts. Elevated IgA levels may be associated with acute (short-lived) or chronic (long-lasting) infections, autoimmune disorders (conditions caused by the generation of an immune response against the body's own tissues), cirrhosis (scarring of the liver) and inflammatory bowel disease. Low IgA levels may be associated with protein-losing enteropathy (disorders of the digestive tract that affect the digestion or absorption of protein), nephrotic syndrome (disease of the kidneys in which protein is lost through the urine) or immunodeficiency.

**Immunoglobulin E (IgE)** is an immune system protein involved in allergic reactions. Exposure of an individual to something that they are allergic to prompts the immune system to generate IgE, which is measurable in the blood. In addition to allergies, elevated IgE levels may also be associated with parasitic infection, asthma and eczema.

**Immunoglobulin G (IgG)** is one of a group of proteins (antibodies) generated by the immune

system to protect the body from infection. The vast majority of immunoglobulins present in the blood are of the IgG class, which are important for protection against bacterial and viral infections. Elevated IgG levels may be associated with chronic (long-lasting) infections, chronic hepatitis (inflammation of the liver) or autoimmune disorders (conditions caused by the generation of an immune response against the body's own tissues). Low IgG levels may be associated with protein-losing enteropathy (disorders of the digestive tract that affect the digestion or absorption of protein), nephrotic syndrome (disease of the kidneys in which protein is lost through the urine) or immunodeficiency.

**Immunoglobulin M (IgM)** is one of a group of proteins (antibodies) generated by the immune system to protect the body from infection. Mainly found in the blood and lymph fluid, IgM is the first antibody produced by the immune system to fight a new infection. Therefore, IgM levels typically rise in response to acute infection, particularly viral infections. Increased IgM levels may also be associated with autoimmune disorders (conditions caused by the generation of an immune response against the body's own tissues), liver disease and macroglobulinemia (a plasma cell cancer). Decreased IgM levels may be associated with hereditary IgM deficiency, protein-losing enteropathy (disorders of the digestive tract that affect the digestion or absorption of protein) and nephrotic syndrome (disease of the kidneys in which protein is lost through the urine).

**Insulin** is a hormone produced by the pancreas that is essential for regulation of blood glucose levels. Increased insulin levels are associated with insulin resistance, which is a feature of type 2 diabetes and metabolic syndrome. An elevated insulin level may also be associated with obesity, hypoglycemia (low blood glucose), insulinoma (a rare insulin-producing tumor of the pancreas) or Cushing's syndrome (a rare condition in which the adrenal glands are overactive). Decreased insulin levels may be associated with hypopituitarism (a rare condition in which the pituitary gland is underactive), chronic pancreatitis (inflammation of the pancreas) and type 1 diabetes.

**Insulin-like Growth Factor-1 (IGF-1)** is a hormone produced by the liver, muscle and other tissues in response to stimulation from growth hormone (GH). Growth hormone, produced by the pituitary gland, tends to fluctuate throughout the day whereas IGF-1 levels remain stable. Thus, IGF-1 is a useful indicator of average GH levels and may help when evaluating pituitary function. Decreased IGF-1 levels may be associated with hypopituitarism (an underactive pituitary gland), chronic kidney or liver disease, or nutritional deficiencies (e.g. anorexia). Increased IGF-1 levels are associated with pituitary tumors (often benign) and are normal during puberty and pregnancy.

**Interleukin-10 (IL-10)** is an anti-inflammatory and immune-suppressing protein produced by a variety of immune system cells. IL-10 inhibits the production of inflammatory proteins by T-cells (a type of white blood cell that helps the body to fight infection) and macrophages (specialised white blood cells that ingest and destroy foreign material and help protect the body from infection). Therefore, IL-10 helps to regulate the immune response and acts to prevent damage to cells and tissues that can result from long-term production of pro-inflammatory substances.

**Interleukin-12p70 subunit (IL-12p70)** is the biologically active form of interleukin-12 (IL-12), a critical factor for the development of Th1 cells (a type of white blood cell that regulates the

response of the immune system to infection). IL-12 stimulates production of interferon- $\gamma$ , which is essential for resistance to infection. Therefore, IL-12 levels may be elevated when infection is present or with various inflammatory conditions such as arthritis, inflammatory bowel disease and cardiovascular disease.

**Interleukin-13 (IL-13)** is a protein produced by a variety of immune system cells that promotes the development of allergic responses. IL-13 is necessary for the production of immunoglobulin E (IgE), a type of antibody that is responsible for allergic reactions. IL-13 also has a key role in the development of asthma, as it promotes mucus secretion and hyper-reactivity in the airways.

**Interleukin-15 (IL-15)** is a pro-inflammatory protein produced by many different cell types. IL-15 acts on a variety of immune and non-immune cells and is critical for the generation of cytotoxic T-cells (specific white blood cells that destroy cancer cells and infected cells). Elevated IL-15 levels may be associated with rheumatoid arthritis, systemic lupus erythematosus (a connective tissue disorder that affects many organs) and inflammatory bowel disease.

**Interleukin-1 $\alpha$  (IL-1 $\alpha$ )** is a pro-inflammatory substance that helps regulate immune and inflammatory responses and contributes to the onset of fever (high temperature associated with illnesses such as the flu). Elevated IL-1 $\alpha$  levels may be associated with type 2 diabetes and obesity, and may contribute to risk of metabolic syndrome (a set of risk factors for cardiovascular disease and type 2 diabetes occurring simultaneously).

**Interleukin-1 $\beta$  (IL-1 $\beta$ )** is a protein produced by adipose tissue (fat cells) and macrophages (specialised white blood cells that ingest and destroy foreign material and help protect the body from infection). IL-1 $\beta$  is a pro-inflammatory substance and studies have shown associations between IL-1 $\beta$  and conditions such as hepatitis (inflammation of the liver), arthritis, gout and diabetes. In addition, due to its production from adipose tissue, IL-1 $\beta$  levels are elevated in obesity.

**Interleukin-2 (IL-2)** is a protein produced by T-helper cells (a type of white blood cell that helps the body to fight infection). IL-2 stimulates the activation of T-cells, promotes the production of antibodies from B-cells, activates destruction of 'self-reactive' T-cells and is critical for the development of immune-suppressing regulatory T-cells (Treg cells). Due to its role in Treg cell development and elimination of 'self-reactive' T-cells, IL-2 is crucial for prevention of immune responses against the body's own cells and tissues, and therefore helps to limit development of autoimmune disease.

**Interleukin-23 (IL-23)** is a pro-inflammatory protein produced by antigen-presenting cells (specialised white blood cells that engulf pathogens such as bacteria and viruses and trigger an immune response). IL-23 plays a central role in the development of autoimmunity, where the immune system incorrectly identifies the body's own cells and tissues as foreign and generates an inappropriate immune response. Elevated IL-23 levels may be associated with autoimmune conditions such as psoriasis, inflammatory bowel disease, multiple sclerosis and rheumatoid arthritis.

**Interleukin-3 (IL-3)** is a protein produced predominantly by activated T-cells (a type of white blood cell that helps the body to fight infection). IL-3 acts as a link between the immune

system and the hematopoietic system (the system responsible for the production of blood cells). Activation of immune system cells (e.g. T-cells), triggers production of IL-3, which, in turn, stimulates the blood system to generate the type of blood cells necessary to defend the body against infection. Elevated IL-3 levels may indicate that the immune system is under stress.

**Interleukin-4 (IL-4)** is a protein produced by a variety of immune system cells and is critical for the development of allergic responses. IL-4 helps promote histamine release from mast cells and induces immunoglobulin E (IgE) production from B-cells, a key mediator of the allergic response. IL-4 production leads to hyper-reactivity in the airways and causes asthma.

**Interleukin-5 (IL-5)** is a protein produced by a variety of immune system cells that is critical for the development of eosinophils. Eosinophils are white blood cells that participate in allergic responses and help to protect the body from infection, particularly infection with parasites.

**Interleukin-6 (IL-6)** is a pro-inflammatory substance produced by many cell types that helps regulate immune and inflammatory responses. Chronic inflammatory conditions and autoimmune disorders (conditions caused by the generation of an immune response against the body's own tissues) may be associated with elevated IL-6 levels. In addition, evidence suggests increased IL-6 levels may be associated with stroke, cardiovascular disease and metabolic syndrome (a collection of risk factors for cardiovascular disease and type 2 diabetes occurring simultaneously).

**Interleukin-7 (IL-7)** is a protein produced by both immune and non-immune cells. IL-7 promotes immunity and is an essential factor for the growth and survival of T-cells (a type of white blood cell that helps the body to fight infection). Studies have identified various conditions that are associated with changes in circulating IL-7 levels such as prostate cancer, heart failure, multiple sclerosis and rheumatoid arthritis.

**Interleukin-8 (IL-8)** is a pro-inflammatory substance that helps to regulate acute inflammatory responses (inflammation that develops rapidly following infection or injury to tissue) by recruiting and activating immune system cells at sites of inflammation. Elevated IL-8 levels may be associated with allergic asthma, arthritis, chronic inflammatory conditions and stress.

**Iron** is an essential trace element supplied by the diet, which is necessary for the formation of red blood cells (RBCs). This test measures the quantity of iron bound to the transport protein transferrin in the blood. Low iron levels are associated with iron-deficiency anemia, which may be caused by poor dietary iron intake, inadequate absorption, increased requirement (e.g. in growing children and during late pregnancy) or blood loss (e.g. heavy menstrual or digestive tract bleeding). Increased iron levels may be associated with disorders of excessive iron storage (e.g. hemochromatosis), excessive use of iron supplements, blood transfusions, hemolytic anemia (anemia caused by premature destruction of RBCs), lead toxicity, and liver or kidney disease.

**Ketones (Urine)** are breakdown products of fatty acid metabolism and are not normally present in the urine. Fatty acid breakdown is required to provide energy and is more likely to occur

when the body does not get enough glucose or carbohydrates. As a result, the levels of ketones in the blood will rise and spill into the urine. The presence of ketones in the urine (ketonuria) can be associated with poorly controlled diabetes, nutritional conditions (e.g. fasting, anorexia and high protein or low carbohydrate diets), frequent vomiting, alcoholism, hyperthyroidism (an overactive thyroid gland) and severe stress or illness.

**Lactate Dehydrogenase (LDH)** is an enzyme widely distributed throughout the body that is involved in converting glucose into usable energy. Tissue damage causes release of LDH into the bloodstream. Conditions that can increase LDH in the blood include liver, heart or lung disease, certain types of anemia (e.g. hemolytic anemia), skeletal muscle disease or injury, myocardial infarction (heart attack), pancreatitis (inflammation of the pancreas) and malignancy. Decreased levels can sometimes result from vitamin C overload.

**LDL Cholesterol** describes cholesterol that is bound to low-density lipoprotein (LDL). Lipoproteins are responsible for transporting cholesterol in the blood. LDL cholesterol deposits excess cholesterol in the walls of blood vessels, which can narrow blood vessels or lead to blockage of blood flow to organs such as the heart and brain (a process known as atherosclerosis). Increased LDL cholesterol levels are associated with increased risk of atherosclerosis, cardiovascular disease, stroke and liver disease.

**Leptin** is an appetite-suppressing hormone secreted by adipose tissue (fat tissue). Leptin plays an important role in the maintenance of body weight and regulation of glucose levels. Obese individuals often have elevated blood leptin levels but are resistant to its effects. Increased leptin may also be associated with insulin resistance (a key feature of type 2 diabetes) and metabolic syndrome (a set of risk factors for cardiovascular disease and type 2 diabetes occurring simultaneously).

**Lipase** is an enzyme, mainly produced by the pancreas, which facilitates digestion of fat from the diet. Elevated lipase levels may be observed in pancreatitis (inflammation of the pancreas), peptic ulcer disease, pancreatic or stomach cancer, inflammatory bowel disease, alcoholism and kidney or liver disease. Decreased lipase levels may be associated with permanent damage to the lipase-producing cells of the pancreas (e.g. in individuals with cystic fibrosis).

**Lipoprotein (a)** is similar to low-density lipoprotein (LDL) as it contains apolipoprotein B, which is the main protein component of LDL ('bad') cholesterol. In addition, it also contains apolipoprotein (a). Apolipoprotein (a) may promote accumulation of LDL particles within blood vessel walls, which can cause arteries to narrow and harden, and may contribute to blood clot formation, which could potentially block blood vessels and increase the risk of a heart attack or stroke. Increased lipoprotein (a) levels are associated with increased risk of cardiovascular disease. Other conditions that may contribute to elevated lipoprotein (a) include estrogen depletion (e.g. menopause), severe hypothyroidism (an underactive thyroid gland), uncontrolled diabetes and chronic kidney disease. Lipoprotein (a) is genetically determined and levels tend to remain constant throughout life. Unlike other lipoproteins, diet, exercise, lifestyle modification and most medications used to lower cholesterol levels have no effect on lipoprotein (a) levels.

**Luteinising Hormone** (Female), produced by the pituitary gland in the brain, promotes production of male and female sex hormones. In women, luteinising hormone (LH) promotes estrogen and progesterone production from the ovaries. Measurement of LH is useful for the

evaluation of pituitary function and reproductive function. Elevated levels of LH may be associated with primary ovarian failure, which can occur with polycystic ovary syndrome, ovarian tumors or abnormal development of the ovaries. Low LH levels can be indicative of dysfunction of the pituitary gland or hypothalamus. Low LH levels may also be associated with secondary ovarian failure due to strenuous exercise, excessive weight loss, stress or oral contraceptives.

**Luteinising Hormone** (Male), produced by the pituitary gland in the brain, promotes production of male and female sex hormones. In men, luteinising hormone (LH) stimulates testosterone production by the testes. Measurement of LH is useful for the evaluation of pituitary function and reproductive function. Primary testicular failure, caused by abnormal development of the testes or testicular cancer, may be associated with increased LH. Low LH levels can be indicative of dysfunction of the pituitary gland or hypothalamus.

**Lymphocyte Count** refers to the number of lymphocytes per unit volume of blood. Lymphocytes are small white blood cells that help protect the body against infection. Therefore, an increased lymphocyte count may be associated with a bacterial or viral infection or more rarely with leukemia. Decreased lymphocyte levels are common in later life, but can also be associated with severe stress, systemic lupus erythematosus (a chronic inflammatory connective tissue disorder), steroid therapy and a weakened immune system.

**Macrophage Inflammatory Protein-1 $\alpha$  (MIP-1 $\alpha$ )** {Infection & Inflammation} produced by activated macrophages (specialised white blood cells that ingest and destroy foreign material), helps coordinate inflammatory and immune responses by attracting various immune system cells to sites of injury or infection. MIP-1 $\alpha$  may be associated with various inflammatory states including rheumatoid arthritis, dermatitis, inflammatory lung disease (e.g. asthma) and infection with *Helicobacter pylori*.

**Macrophage Inflammatory Protein-1 $\alpha$  (MIP-1 $\alpha$ )** {Kidney Health} plays an important role in coordinating the body's response to injury or infection. Therefore, MIP-1 $\alpha$  levels may be higher in those with conditions featuring inflammation. Additionally, MIP-1 $\alpha$  has demonstrated utility as a novel test for early identification of chronic kidney disease (CKD), a long-term condition featuring loss of kidney function. Testing for MIP-1 $\alpha$  in combination with other biomarkers, such as FABP-1, sTNFRI and sTNFRII, can help identify the early stages of CKD and may help identify those at risk of progression to a more advanced stage.

**Magnesium** is a mineral that is essential for energy and protein production, muscle contraction and nerve function, and is important for the activity of many enzymes. Magnesium levels are regulated by how much is absorbed from food by the intestine and how much is removed by the kidneys. Increased magnesium levels may be associated with kidney failure, hypothyroidism (an underactive thyroid gland), hyperparathyroidism (an overactive parathyroid gland), dehydration, Addison's disease (a rare disorder in which the adrenal glands are underactive) and ingestion of magnesium-containing antacids or laxatives. Decreased magnesium levels (hypomagnesemia) may be associated with chronic kidney disease, malnutrition, malabsorption disorders (conditions that affect the ability of the intestine to absorb nutrients) hypoparathyroidism (an underactive parathyroid gland), uncontrolled diabetes or alcoholism.

**Matrix Metalloproteinase-9 (MMP-9)** regulates the degradation of collagen and other



proteins that provide structural support to cells within the tissues of the body. Typically, MMP-9 levels correlate with the inflammatory status of the body, and therefore may be elevated with various inflammatory states, including cardiovascular disease. Elevated MMP-9 levels may also be associated with high blood pressure, atrial fibrillation (an abnormal heart rhythm) and infection.

**Mean Cell Hemoglobin (MCH)** is a measure of the average amount (weight) of hemoglobin within a red blood cell (RBC). Since large RBCs generally have more hemoglobin (greater MCH) and small RBCs have less hemoglobin (lower MCH), MCH typically correlates with mean cell volume (a measure of RBC size). Conditions such as iron- deficiency anemia and thalassemia (a group of hereditary blood disorders that impair hemoglobin production) are associated with decreased MCH. Increased MCH can indicate megaloblastic anemia (anemia due to vitamin B12 or folic acid deficiency).

**Mean Cell Hemoglobin Concentration (MCHC)** is the average concentration of hemoglobin present in red blood cells (RBCs). Low MCHC is a feature of conditions such as iron-deficiency anemia, anemia of chronic disease and thalassemia (a group of hereditary blood disorders that impair hemoglobin production). Red blood cells that contain high concentrations of hemoglobin (increased MCHC) are observed in conditions such as hereditary spherocytosis (a rare hereditary condition in which RBCs are ball-shaped and more fragile than usual), sickle cell disease (a group of conditions in which RBCs are abnormally shaped) and autoimmune hemolytic anemia (anemia caused by premature destruction of RBCs).

**Metabolic Age** compares your best basal metabolic rate to other age groups. If the age indicated is higher than your actual age then you need to increase your exercise levels. Improving muscle mass will in turn burn more calories.

**Microalbumin / Creatinine Ratio** is an indicator of kidney disease, which is a major complication of diabetes and high blood pressure. Microalbumin is not normally found in the urine, but can appear when normal kidney function is impaired. Urinary albumin measurement alone is unreliable as levels can vary according to the dilution or concentration of urine. Dividing microalbumin by urinary creatinine, which is unaffected by urine concentration, generates a more reliable indicator of microalbumin. Elevated microalbumin levels (microalbuminuria) are typical of conditions such as kidney disease, diabetes, insulin resistance, cardiovascular disease and high blood pressure.

**Monocyte Chemotactic Protein-1 (MCP-1)** is a pro-inflammatory substance that helps to regulate the inflammatory response by recruiting and activating immune system cells at sites of injury, infection or inflammation. Elevated MCP-1 levels may be associated with arthritis, inflammatory bowel disease, diabetes, cardiovascular disease and stress.

**Monocyte Count** refers to the number of monocytes per unit volume of blood. Monocytes are white blood cells that originate in the bone marrow and play an important role in destroying infectious organisms and tumor cells. A high monocyte count may occur in response to viral or parasitic infection, inflammatory bowel disease, tuberculosis, and in rare conditions such as monocytic leukemia, lymphoma and multiple myeloma. A low monocyte count may be associated with bone marrow injury or failure, some forms of leukemia and corticosteroid therapy.

**Muscle Mass** is the predicted weight of muscle in your body. This includes skeletal muscle, smooth muscles (such as cardiac and digestive) and the water contained within these muscles. Muscles play an important role as they act as an engine in consuming energy. As your muscle mass increase, your energy consumption increases, helping you to reduce excess body fat levels and lose weight in a health way.

**Myoglobin** is an oxygen-binding protein present in muscle. Injury to muscle tissue can cause the release of myoglobin into the bloodstream. Elevated myoglobin levels may be associated with injury to heart or skeletal muscle, muscle disease, strenuous exercise, kidney failure or heavy alcohol consumption.

**Neuron Specific Enolase (NSE)** is a protein produced by the brain that plays a role in the metabolism of glucose. Injury to brain tissue (e.g. stroke) can cause release of NSE into the bloodstream. Therefore, NSE may serve as a circulating marker of brain injury, particularly when damage involves neurons (nerve cells). Various neuroendocrine tumors (rare tumors that begin in hormone-producing nerve cells) may also produce NSE.

**Neutrophil Count** refers to the number of neutrophils per unit volume of blood. Neutrophils are white blood cells that kill and ingest bacteria and fungi. An increased neutrophil count may be associated with infection, inflammation, myeloproliferative disorders (conditions in which the bone marrow produces cells excessively), cancer and some medications (e.g. corticosteroids). A decreased number of neutrophils may be the result of overwhelming bacterial or viral infections, dietary deficiencies (e.g. vitamin B12 or folic acid deficiency), aplastic anemia (failure of bone marrow to produce blood cells), and the use of certain medications or radiation.

**Neutrophil Gelatinase-Associated Lipocalin (NGAL)** is a protein found in many cells and tissues, including neutrophils (a type of white blood cell) and kidney tubules. In healthy individuals, NGAL is present at very low levels in blood and urine. However, during acute kidney injury, NGAL levels rise rapidly. Acute kidney injury, defined by a rapid decline in kidney function, can result from damage caused by inflammation, obstruction of urine or ischemia (a lack of blood and oxygen supply to tissues).

**Nitrite (Urine)** is normally absent from urine. Bacteria produce an enzyme called reductase, which generates nitrites. The presence of nitrites may indicate a bacterial infection in the urinary tract.

**Non-Esterified Fatty Acids** are a major component of triglycerides (fats). Metabolism of fat by the enzyme lipase, results in the release of non-esterified fatty acids (NEFA) into the circulation. Elevated NEFA levels inhibit insulin, which normally suppresses lipase activity. This inhibition of insulin enables lipase to continue to breakdown fat and generate more NEFA. Therefore, elevated NEFA levels may be associated with insulin resistance (a key feature of type 2 diabetes and metabolic syndrome) and obesity, due to greater production of NEFA from fat tissue.

**Estradiol** (Female) is the main form of estrogen found in the body. Primarily produced by the ovaries, estradiol promotes growth of the uterus, vagina, fallopian tubes and breasts. Levels of estradiol peak prior to ovulation during the menstrual cycle. Increased levels may be associated with ovarian tumors or cysts, cirrhosis (scarring of the liver) or hyperthyroidism (an overactive thyroid gland). Low estradiol levels may be observed in hypogonadism (when the sex glands produce little or no sex hormones), polycystic ovary syndrome, menopause, hypopituitarism (a rare condition in which the pituitary gland is underactive) or may be due to excessive exercise or extreme weight loss (e.g. anorexia).

**Pancreatic Amylase** is an enzyme, generated by the pancreas, which aids the digestion of carbohydrates from the diet. Elevated pancreatic amylase levels are associated with acute (short-lived) or chronic (long-lasting) pancreatitis (inflammation of the pancreas), pancreatic cancer, mumps infection and peptic ulcers. Decreased amylase levels may be associated with kidney disease, liver disease, pancreatic cancer or permanent damage to the amylase-producing cells of the pancreas resulting from chronic pancreatitis.

**Parathyroid Hormone (PTH)** produced by the parathyroid glands, is responsible for regulating calcium and phosphorus levels in the body. Low blood calcium triggers the release of PTH, which stimulates release of calcium from the bones and retention of calcium by the kidneys and intestines. Elevated PTH levels are associated with hyperparathyroidism (an overactive parathyroid gland), parathyroid tumors, kidney disease and conditions that lower calcium levels, e.g. malabsorption disorders (conditions that affect the ability of the intestine to absorb nutrients) or vitamin D deficiency. Low PTH levels are associated with hypoparathyroidism (an underactive parathyroid gland) and hypercalcemia (increased blood calcium).

**pH (Urine)** of urine is measured to assess the acid-base balance, which is maintained by the kidneys. A high or alkaline pH (alkalemia) may be due to urinary tract infection, kidney failure, tubular acidosis (accumulation of acid in the kidneys), vomiting or a diet high in citrus fruits, vegetables or dairy products. A low or acidic pH (acidemia) can result from diabetes, respiratory acidosis, starvation, diarrhoea or a diet high in meat products or cranberries.

**Phosphorus** is essential for energy production in the body and is a major component of the skeleton, helping to provide bone strength. The body obtains phosphorus from the diet and parathyroid hormone (PTH) regulates levels in the blood. When blood levels are too high, PTH acts on the kidneys to increase excretion of phosphorus into the urine. Hyperphosphatemia, or elevated phosphorus levels, may be associated with low blood calcium, hypoparathyroidism (decreased production of PTH) or kidney failure. Hypophosphatemia, or decreased phosphorus levels, may be due to or associated with high blood calcium, hyperparathyroidism (increased production of PTH), vitamin D deficiency, chronic alcoholism or the use of certain antacids. Low phosphorus levels are also associated with increased risk of osteomalacia (softening of the bones) and osteoporosis (weakening of the bones).

**Platelet Count** is a measure of the number of platelets per unit volume of blood. Platelet numbers above or below normal can result in abnormal blood clotting or excessive bleeding. A low platelet count can be caused by viral infections, autoimmune disorders, anemia, leukemia or drug use (e.g. aspirin, heparin and some antibiotics). Very occasionally, platelets can clump together within a sample and produce an artificially low platelet count. A high platelet count can occur in iron-deficiency anemia, myeloproliferative disorders (disorders in which the bone

marrow produces too many blood cells), various cancers, and inflammatory conditions such as rheumatoid arthritis and inflammatory bowel disease.

**Potassium** is an essential mineral that is normally only present in the blood at low concentrations. The body obtains potassium through the diet and the kidneys remove any excess in the urine. Hyperkalemia, or raised blood potassium levels, may be associated with kidney disease, Addison's disease (a rare condition in which the adrenal glands are underactive), infection, eating disorders, dehydration or excessive dietary intake. Hypokalemia, or low blood potassium levels, may be due to dehydration, vomiting, diarrhoea or inadequate dietary intake.

**Progesterone (Female)** is a sex hormone, produced during the luteal phase of the menstrual cycle, which prepares the uterus for pregnancy. In addition to the normal increase during the luteal phase, increased progesterone levels can occur with molar pregnancy (a rare growth in the uterus arising from an abnormally fertilised egg) and from a rare over- production of progesterone by the adrenal glands. Decreased progesterone levels can be associated with abnormal development of the ovaries and amenorrhoea (absence of menstrual periods).

**Prolactin (Female)**, a hormone produced by the pituitary gland, typically occurs at low levels in men and non-pregnant women. During pregnancy, prolactin levels rise and promote breast development and lactation (milk production). Levels remain high after childbirth in women who are breast-feeding. High prolactin levels may be associated with stress, abnormal sleep patterns, hypothyroidism (an underactive thyroid gland), chronic kidney disease, polycystic ovarian syndrome, prolactinoma (a prolactin-producing tumor of the pituitary gland), galactorrhoea (a condition in which breast milk production occurs in women who are not breastfeeding) and some medications, including oral contraceptives. Low prolactin levels are associated with hypopituitarism (a rare condition in which the pituitary gland is underactive) and may occur following the use of certain drugs.

**Prolactin (Male)**, a hormone produced by the pituitary gland, typically occurs at low levels in men and non-pregnant women. High prolactin levels may be associated with stress, abnormal sleep patterns, hypothyroidism (an underactive thyroid gland), chronic kidney disease, prolactinoma (a prolactin- producing tumor of the pituitary gland), galactorrhoea (a condition in which breast milk production occurs in men) and some medications. Low prolactin levels are associated with hypopituitarism (a rare condition in which the pituitary gland is underactive) and may occur following the use of certain drugs.

**Protein (Urine)** is an important building block and is essential for the growth of cells and tissue repair. Normally, protein is not present in significant amounts in urine as the kidneys prevent the passage of protein from blood to urine. A high protein level in the urine (proteinuria) may be a sign of kidney dysfunction or urinary tract inflammation, injury or malignancy. Proteinuria can also be associated with heart failure, dehydration, systemic lupus erythematosus (a connective tissue disorder affecting many organs), amyloidosis (abnormal deposition of proteins in tissues and organs), heavy metal poisoning, extreme muscle exertion and drug induced kidney damage.

**Pulse** is a measurement of the heart rate, or the number of times the heart beats per minute. Increased pulse can be associated with anxiety, intense exercise, pregnancy or an abnormal heart rhythm due to an underlying cardiac condition. Trained athletes or individuals who are physically fit can have low pulse rates. However, a low pulse rate can also be associated with an underlying cardiac condition or certain prescribed medications.

**Red Blood Cell Count** is a measure of the number of red blood cells (RBCs) per unit volume of blood that, in conjunction with hemoglobin and hematocrit values, can help to evaluate anemia (too few RBCs) and polycythemia (too many RBCs). An increased RBC count may be associated with dehydration, smoking, lung disease, excess erythropoietin production (a hormone that is essential for RBC production) or polycythemia vera (a rare blood disorder in which the bone marrow produces too many RBCs). A decreased RBC count may be associated with nutritional deficiencies (e.g. folic acid, vitamin B12 or iron-deficiency), hemolytic anemia (anemia caused by RBC destruction), excessive bleeding or chronic inflammatory diseases.

**Red Blood Cell Mean Cell Volume (MCV)** is a measure of the average size of a single red blood cell (RBC), which is useful for determining whether anemia is microcytic (characterised by small RBCs), normocytic (normal sized RBCs) or macrocytic (large RBCs). A common cause of macrocytic anemia (increased MCV) is folic acid or vitamin B12 deficiency. Microcytic anemia (decreased MCV) may indicate iron-deficiency anemia or thalassemia (a group of hereditary blood disorders that impair hemoglobin production).

**Red Blood Cells (Urine)** in urine can be associated with kidney and urinary tract diseases or infection, menstrual bleeding, blood clotting disorders, chronic diseases (e.g. diabetes, high blood pressure), strenuous exercise and use of certain medications.

**Resistin** is a protein produced primarily by macrophages (a type of white blood cell that ingest and destroy foreign material) in adipose (fat) tissue. Inflammation may induce resistin production and increase circulating levels of resistin in the bloodstream. Elevated levels of resistin may be associated with inflammation, obesity, insulin resistance and increased risk of type 2 diabetes. Thus, resistin may also increase risk of metabolic syndrome (a set of risk factors for cardiovascular disease and type 2 diabetes occurring simultaneously).

**Rheumatoid Factor (RF)** is an autoantibody (an antibody that attacks an individual's own tissues when the immune system incorrectly identifies them as foreign). Rheumatoid factor is primarily associated with rheumatoid arthritis but may also be present in other autoimmune conditions, such as systemic lupus erythematosus (a connective tissue disorder that affects many organs), Sjogren's syndrome (a disorder in which tear and saliva production is reduced) and polymyositis (a condition characterised by muscle inflammation). In addition, up to 5% of healthy individuals may be positive for rheumatoid factor.

**Sex Hormone Binding Globulin (Female)** is a protein that binds testosterone and alters how much testosterone is available for use by the body. Amenorrhoea (absence of menstrual periods), infertility, hirsutism (increased growth of hair on the face and body) and polycystic ovary syndrome can be associated with decreased SHBG levels. In addition, women who are post-menopausal typically have lower SHBG levels. Elevated SHBG may be observed in individuals with liver disease, hyperthyroidism (an overactive thyroid gland), and anorexia or in those using estrogen, e.g. hormone replacement therapy or oral contraceptive use.

**Sex Hormone Binding Globulin (Male)** is a protein that binds testosterone and alters how much testosterone is available for use by the body. Elevated SHBG levels reduce testosterone availability and may be associated with infertility or erectile dysfunction. Elderly men typically have higher SHBG levels. Elevated SHBG may be observed in individuals with liver disease, hyperthyroidism (an overactive thyroid gland), and anorexia. Decreased SHBG levels may be associated with hypothyroidism (an underactive thyroid gland), obesity or Cushing's syndrome (a rare condition in which the adrenal glands are overactive).

**Small LDL Cholesterol** is a subtype of low-density lipoprotein (LDL) cholesterol. Lipoproteins are responsible for transport of triglycerides and cholesterol throughout the body but their ability to enter tissues (such as blood vessels) varies according to size. Small particles, such as small LDL (sLDL) cholesterol are more able to penetrate blood vessels and are more susceptible to modification, which can promote atherosclerosis (accumulation of cholesterol and fatty material within blood vessel walls). Therefore, increased sLDL cholesterol can be particularly damaging to blood vessels and is a major risk factor for cardiovascular disease.

**Sodium** is an essential mineral that regulates water balance and blood pressure in the body. Various hormones contribute to regulation of sodium levels in the blood including aldosterone (stimulates the kidneys to reabsorb sodium), natriuretic hormone (stimulates the kidneys to excrete excess sodium in the urine) and antidiuretic hormone (stimulates the kidneys to reabsorb water). Hyponatremia, or elevated sodium levels, may be due to dehydration, hyperaldosteronism (increased aldosterone production), diabetes insipidus (a rare disorder in which urine is produced excessively), and Cushing's syndrome (a rare disorder in which the adrenal glands are overactive). Hyponatremia, or decreased sodium levels, may be due to diarrhoea, vomiting, excessive sweating, hypothyroidism (an underactive thyroid gland), Addison's disease (a rare disorder in which the adrenal glands are underactive), kidney disease or from drinking too much water.

**Soluble IL-2 Receptor  $\alpha$  (sIL-2R $\alpha$ )** {Infection & Inflammation} is the soluble form of the receptor for IL-2. Binding of IL-2 to its receptor triggers a signalling pathway that enables IL-2 to perform its pro-inflammatory actions. Various chronic inflammatory diseases are associated with elevated sIL-2R $\alpha$  levels including psoriasis, rheumatoid arthritis, ankylosing spondylitis (inflammation of the spine and large joints), liver disease and inflammatory bowel disease.

**Soluble IL-6 Receptor (sIL-6R)** {Infection & Inflammation} is the soluble form of the receptor for IL-6, which enables IL-6 to act on a wide variety of cells. Binding of IL-6 to sIL-6R triggers signalling pathways that elicit the pro-inflammatory actions of IL-6. Elevated sIL-6R levels may be associated with a range of inflammatory conditions including rheumatoid arthritis, osteoarthritis, asthma, scleroderma (a disorder characterised by thickening of the skin) and inflammatory bowel disease.

**Soluble Tumor Necrosis Factor Receptor I (sTNFRI)** {Infection & Inflammation} is an anti-inflammatory protein that binds and inhibits the pro-inflammatory activity of substances called tumor necrosis factors (TNFs). Elevated sTNFRI levels may be associated with cardiovascular disease and stroke.



**Soluble Tumor Necrosis Factor Receptor I (sTNFRI)** {Kidney Health} is an indicator of inflammation. Raised levels of sTNFRI are observed in conditions featuring chronic inflammation, including cardiovascular disease and kidney disease. Elevated levels of sTNFRI are associated with early kidney function decline and may indicate those at risk of progressing to a more advanced stage of chronic kidney disease (CKD).

**Soluble Tumor Necrosis Factor Receptor I (sTNFRI)** {Neurological} is an anti-inflammatory protein that binds and inhibits the pro-inflammatory activity of substances called tumor necrosis factors (TNFs). Elevated sTNFRI levels may be associated with cardiovascular disease and stroke.

**Soluble Tumor Necrosis Factor Receptor II (sTNFRII)** {Infection & Inflammation} is an anti-inflammatory protein that binds and protects against the pro-inflammatory activity of substances called tumor necrosis factors (TNFs). Elevated sTNFRII levels may be associated with obesity, insulin resistance, diabetes and infection.

**Soluble Tumor Necrosis Factor Receptor II (sTNFRII)** {Kidney Health} is an indicator of inflammation. Raised levels of sTNFRII are observed in conditions featuring chronic inflammation, including cardiovascular disease and kidney disease. Elevated levels of sTNFRII are associated with early kidney function decline and may indicate those at risk of progressing to a more advanced stage of chronic kidney disease (CKD).

**Systolic Blood Pressure** is a measure of the pressure in the blood vessels when the heart contracts and pushes blood through the circulatory system. According to the National Cholesterol Educational Program (NCEP) Adult Treatment Panel III (ATP III), systolic blood pressure measurements equal to or greater than 130 mmHg are associated with metabolic syndrome. Additionally, individuals currently receiving treatment for high blood pressure are at risk of metabolic syndrome irrespective of blood pressure measurement.

**Testosterone (Female)** is a steroid hormone produced by the adrenal glands, peripheral fat tissue and ovaries. Generally considered a male sex hormone, testosterone is present in women at much lower levels. In women, increased testosterone levels may be associated with ovarian or adrenal gland tumors, or polycystic ovary syndrome. Overproduction of testosterone in women can lead to virilisation (abnormal development of male characteristics), which can cause amenorrhoea (absence of menstrual periods) and excessive growth body hair. Studies have shown that testosterone levels may vary with stress.

**Testosterone (Male)** is a steroid hormone produced by the testes in response to luteinising hormone from the pituitary gland. Testosterone stimulates sperm production and influences the development of male secondary sexual characteristics. Increased testosterone levels may be associated with hyperthyroidism (an overactive thyroid gland), testicular cancer, steroid use or testosterone-producing adrenal gland tumors. A low testosterone level may be due to hypothalamic or pituitary dysfunction, infertility or testicular damage, e.g. damage due to alcoholism. Studies have shown that testosterone levels may vary with stress.

**Thyroid Stimulating Hormone (TSH)** produced by the pituitary gland in the brain, acts on the thyroid gland to regulate thyroid hormone production and release. Thyroid stimulating hormone levels are subject to feedback control, thus when the concentration of thyroid hormones in the blood rise, TSH production decreases. Conversely, when thyroid hormone

concentrations are low, the pituitary gland produces more TSH. A high level of TSH in the blood suggests that the thyroid gland is underactive, a condition known as hypothyroidism. Low TSH levels are associated with hyperthyroidism (an overactive thyroid gland) and hypopituitarism (a rare condition in which the pituitary gland is underactive).

**Total Antioxidant Status (TAS)** is a measure of the antioxidant capacity of the body. Antioxidants defend the body against damaging free radicals, produced during normal body processes or through environmental exposures such as smoking or pollution. Damage to cells and tissues by free radicals may be associated with increased risk of heart disease and cancer. The antioxidant defence system has many components and a deficiency in any one component can reduce the overall ability of the body to defend itself against free radical attack. Therefore, a higher TAS is desirable, indicating a greater antioxidant capacity.

**Total Bilirubin** is the sum of direct and indirect bilirubin. Bilirubin is a yellowish brown pigment found in bile (a fluid that facilitates digestion in the intestine). Indirect bilirubin (formed during red blood cell (RBC) breakdown) is transported to the liver where it is bound by a sugar molecule to form direct bilirubin and is incorporated into bile. Increased indirect bilirubin levels may result from certain types of anemia, e.g. hemolytic (caused by premature destruction of RBCs), sickle cell (a group of conditions in which RBCs are abnormally shaped) or pernicious anemia (insufficient RBC production due to vitamin B12 deficiency). Elevated direct bilirubin may be indicative of liver or bile duct blockage (e.g. due to gallstones), hepatitis (inflammation of the liver), cirrhosis (scarring of the liver), trauma to the liver, a drug reaction or long-term alcohol abuse. Increased bilirubin levels may also be associated with inherited disorders that cause abnormal bilirubin metabolism (e.g. Gilbert's syndrome).

**Total Cholesterol** refers to the measurement of all cholesterol circulating in the blood. Cholesterol is essential for various body functions such as the formation of bile acids, which facilitate digestion and absorption of nutrients, and production of hormones, which are vital for normal growth and development. Elevated total cholesterol levels are associated with increased risk of cardiovascular disease and stroke, as accumulation of cholesterol and fat can narrow blood vessels and impair blood flow. Low total cholesterol levels are associated with decreased risk of cardiovascular disease; however, low total cholesterol may also be associated with other problems, such as malnutrition, malabsorption disorders (conditions that affect the ability of the intestine to absorb nutrients) and liver disease.

**Total Cholesterol / HDL Cholesterol Ratio** is an indicator of cardiovascular risk. As HDL cholesterol is a 'protective' form of cholesterol, a greater proportion of HDL cholesterol as part of the total cholesterol is beneficial. The ratio of total cholesterol to HDL cholesterol should be less than 5.0. If the ratio is greater than 5.0, intervention may be necessary, either with lifestyle modification and / or with cholesterol lowering medications.

**Total Iron Binding Capacity (TIBC)** is a measurement of the ability of the blood to transport iron. Transferrin represents the major iron binding protein in the blood and therefore TIBC is an indirect yet accurate measurement of transferrin. Increased TIBC levels can be associated with iron-deficiency, late pregnancy and the use of oral contraceptives. Decreased TIBC levels can be associated with disorders of excessive iron storage (e.g. hemochromatosis), certain types of anemia in which iron accumulates, poor nutrition, inflammation, liver disease and kidney disease.

**Total Prostate Specific Antigen (TPSA)** refers to the combined measurement of 'free' and 'bound' PSA. The prostate gland produces PSA, which exists in two forms in the bloodstream - 'bound' (where it is attached to a protein) or 'free' (not attached to a protein). Increased PSA levels may be associated with prostate cancer, benign prostatic hyperplasia (a non-cancerous swelling of the prostate), prostatitis (inflammation of the prostate), urinary tract infections and enlargement of the prostate that occurs with age. In addition, PSA levels may temporarily increase following ejaculation or vigorous physical activity, such as cycling.

**Total Protein** refers to the combined measurement of albumin and globulin proteins in the blood. These proteins fulfill vital functions within the body. Albumin keeps fluid within blood vessels preventing it from leaking out into tissues and acts as a transport molecule for hormones, vitamins and drugs. Globulins are the key building blocks of antibodies and other immune system proteins. Low total protein levels may be associated with kidney or liver disease, malnutrition or malabsorption disorders (conditions that affect the ability of the intestine to absorb nutrients). Increased total protein levels may be due to chronic inflammation, hepatitis (viral infection of the liver), multiple myeloma (a type of bone marrow cancer that typically affects the elderly) or dehydration.

**Transferrin** is a protein that binds and transports iron through the blood to tissues where iron is needed (e.g. liver, spleen and bone marrow). Transferrin is largely made in the liver and regulates the body's absorption of iron into the blood. Decreased transferrin levels may be associated with poor production by the liver or excessive loss through the kidneys. Several conditions including infection and malignancy can decrease transferrin levels. Increased transferrin levels may be associated with iron-deficiency anemia.

**Transferrin Saturation** represents the percentage of transferrin saturated with iron and is determined by dividing the iron level by the total iron binding capacity (TIBC). Calculation of transferrin saturation is helpful in determining the cause of abnormal iron and TIBC levels. A decrease in transferrin saturation can be associated with iron-deficiency anemia and chronic illnesses. An increase in transferrin saturation can be associated with disorders of excessive iron storage (e.g. hemochromatosis), increased iron intake or other types of anemia, such as hemolytic anemia (anemia caused by premature destruction of red blood cells) and megaloblastic anemia (anemia due to vitamin B12 or folic acid deficiency).

**Triglycerides** are obtained from the diet and are the most abundant form of lipid (fat) stored by the body. Any food not immediately converted to energy by the body is stored as triglycerides for use when required. Increased triglyceride levels are associated with atherosclerosis (accumulation of cholesterol and fatty material within blood vessel walls), and increased risk of cardiovascular disease and metabolic syndrome (a set of risk factors for diabetes and cardiovascular disease occurring simultaneously). Elevated triglyceride levels may be due to obesity, hypothyroidism (an underactive thyroid gland), smoking, alcohol consumption, kidney disease or type 2 diabetes and can occur following a meal.

**Triglycerides {Metabolic Syndrome}** are obtained from the diet and are the most abundant form of fat stored by the body. Any food not immediately converted to energy by the body is stored as triglycerides for use when required. Blood triglyceride levels rise after eating a meal. Therefore, the test should be performed following a period of fasting (>12 hours). According to the National Cholesterol Educational Program (NCEP) Adult Treatment Panel III (ATP

III), a fasting triglyceride level equal to or greater than 1.7 mmol/l is associated with metabolic syndrome. Additionally, individuals receiving treatment for high triglyceride levels are at risk of metabolic syndrome, irrespective of triglyceride levels.

**Tumor Necrosis Factor- $\alpha$  (TNF $\alpha$ )** is a potent pro-inflammatory protein that contributes to the onset of fever during infection and induces the acute phase response (an intrinsic defence mechanism of the body that occurs in response to infection or injury). Excessive production of TNF- $\alpha$  can be damaging and is associated with various conditions including meningitis, sepsis (blood poisoning from a severe response to infection), hepatitis (inflammation of the liver), inflammatory bowel disease, rheumatoid arthritis, coeliac disease, heart failure, stroke, cancer, thyroid disease and asthma.

**Urea** is a by-product of protein metabolism in the liver. The vast majority of all urea produced in the liver is removed by the kidneys. Therefore, urea levels in the blood are indicative of how well the kidneys are functioning. Elevated urea levels may be due to kidney disease, decreased blood flow to the kidneys, bleeding in the digestive tract, obstruction in the urinary tract or dehydration. Urea levels tend to increase with age and in individuals who consume a high protein diet. Low urea levels are rare but can occur during pregnancy and chronic liver disease.

**Uric Acid** is a waste product formed from the breakdown of purines (the building blocks of DNA). The kidneys are responsible for excretion of 75% of the uric acid produced by the body. Accumulation of uric acid, which may be due to increased production or impaired removal by the kidneys, can cause crystals to form in the joints, leading to a type of arthritis called gout. In addition to gout, elevated uric acid levels may be associated with kidney disease, hypothyroidism (an underactive thyroid gland), alcohol consumption or a high protein diet. Decreased uric acid levels may be associated with coeliac disease (gluten sensitivity), Wilson's disease (a rare hereditary disorder in which the body accumulates copper) or Fanconi syndrome (a disorder of the kidneys).

**Urobilinogen (Urine)** is normally present in urine at low concentrations. Urobilinogen is a product of bilirubin (a by-product of red blood cell (RBC) destruction), produced by the action of bacteria in the intestines. Most urobilinogen is excreted in the stool or is reabsorbed and passed back to the liver. The remaining urobilinogen (about 1%) is excreted in the urine. High urobilinogen levels may be associated with hemolytic anemia (anemia caused by premature destruction of RBCs) or pernicious anemia (insufficient RBC production due to vitamin B12 deficiency). Increased urobilinogen levels may also be associated with early hepatitis (inflammation of the liver), mild liver cell damage or toxic liver injury.

**Vascular Cell Adhesion Molecule-1 (VCAM-1)** is a type of protein that enables different cells to attach to one another. Typically absent during normal physiological conditions, VCAM-1 appears on the surface of endothelial cells (cells that line the inside of blood vessels) during periods of inflammation, particularly in blood vessels affected by build-up of cholesterol. VCAM-1 enables white blood cells to attach to sites of inflammation or injury. Levels may be elevated in individuals with rheumatoid arthritis, atherosclerosis (accumulation of cholesterol and fatty material within blood vessel walls), high blood pressure, heart disease and diabetes.

**Vascular Endothelial Growth Factor (VEGF)** is a chemical substance that promotes the development of new blood vessels in areas where blood circulation is inadequate. Various cell types produce VEGF at sites of inflammation. Elevated levels of VEGF may be associated with inflammatory disorders (e.g. rheumatoid arthritis), cancer, diabetic retinopathy (damage to the retina of the eye caused by diabetes), autoimmune diseases (conditions caused by the generation of an immune response against the body's own tissues) and stress.

**Vitamin B12** along with folic acid is important for the normal development of red blood cells (RBCs). Vitamin B12 is also vital for the normal functioning of nerves. Decreased vitamin B12 levels are associated with megaloblastic anemia (anemia due to vitamin B12 or folic acid deficiency) and pernicious anemia (anemia due to impaired absorption of vitamin B12 by the intestine). Low vitamin B12 levels may be due to decreased dietary intake, malabsorption disorders (conditions that affect the ability of the intestine to absorb nutrients), gastritis (inflammation of the stomach) or liver disorders that affect vitamin B12 storage. Liver injury, myeloproliferative disorders (a group of conditions in which blood cells grow abnormally) and vitamin C, vitamin A or estrogen supplementation may cause vitamin B12 levels to rise.

**Vitamin D** regulates calcium and phosphorus levels in the blood and is important for good health, growth and strong bones. Low vitamin D levels are commonly due to inadequate sunlight exposure or dietary intake but may occur with malabsorption disorders (conditions that affect the ability of the intestine to absorb nutrients, e.g. Crohn's disease), liver disease or kidney disorders. Low vitamin D levels can increase the risk of bone disorders such as osteoporosis (weakening of the bones) and osteomalacia (softening of the bones), and may increase the risk of certain cancers, immune diseases and cardiovascular disease. Increased vitamin D levels may be associated with excessive supplementation, hyperparathyroidism (increased production of parathyroid hormone) or sarcoidosis (a rare disease in which areas of the body are inflamed). High levels of vitamin D can cause calcium levels in the blood to rise, which can be damaging to the body.

**Waist Circumference** relates closely to body mass index (BMI) and is part of the waist to hip ratio measurement. Waist circumference is a measure of central or abdominal fat and provides additional information on disease risk and other long-term health problems. Increased weight around the abdomen can increase the risk of developing conditions such as type 2 diabetes, metabolic syndrome, coronary heart disease and high blood pressure.

**Waist Circumference {Metabolic Syndrome}** relates closely to body mass index (BMI) and is part of the waist to hip ratio measurement. Waist circumference is a measure of central or abdominal fat and provides additional information on disease risk. The National Cholesterol Educational Program (NCEP) Adult Treatment Panel III (ATP III) states that individuals who have central obesity (defined as waist circumference greater than or equal to either 94 cm or 90 cm for males (depending on ethnicity) and greater than or equal to 80 cm for females) are at risk of metabolic syndrome.

**Weight** is used to calculate an individual's Body Mass Index..

**White Blood Cell Count** refers to the total number of WBCs per unit volume of blood. White blood cells are an essential part of the immune system and help protect the body against infection. An increased WBC count may be associated with infection, inflammation, tissue damage, leukemia, trauma, stress or dehydration. A decreased WBC count may occur with overwhelming infections, dietary deficiencies (e.g. vitamin B12 or folic acid deficiency), an overactive spleen, autoimmune diseases (conditions caused by the generation of an immune response against the body's own tissues), bone marrow disorders, or medication, particularly chemotherapy.

**White Blood Cells (Urine)** are an essential part of the immune system, which help to protect the body against infection. Normally, urine is sterile and contains no WBCs. The presence of WBCs in a urine sample may suggest a urinary tract infection such as cystitis (bladder infection) or pyelonephritis (kidney infection).

**Zinc** is a mineral found widely throughout the body, including the skin, hair, bones, teeth, liver and muscle. Zinc is an important component of numerous enzymes and is necessary for healthy skin, growth, wound healing and production of DNA. Found in the diet, a regular intake of zinc is required, as the body does not store zinc for future use. Low levels of zinc may be associated with poor diet, alcoholism, malabsorption disorders (conditions that affect the ability of the intestine to absorb nutrients, e.g. Crohn's disease), chronic kidney disease, diabetes mellitus or liver disease. Excess zinc in the blood is rare but may be associated with consumption of food or drinks packaged in galvanised (zinc-coated) containers.