Effects of Yoga on Digestive System

Digestive System in human body is also known as alimentary or gastrointestinal system. It provides nourishment to all the body cells from the external environment. Food intake, its digestion, absorption and assimilation; water balance, elimination of residue, waste products and poisonous substances are the main functions of this system. The system includes gastrointestinal tract (alimentary canal), salivary glands and portions of liver and pancreas. The alimentary canal is a continuous tube. It consists of mouth (buccal cavity), throat (pharynx), esophagus, stomach, small intestine, large intestine (colon), rectum and anal canal, ending in the anus. In order to keep this system healthy yoga can be instrumental. Some of the Kriyas like Dhauti, Basti and Nauli influence the functioning of the digestive system significantly. But before beginning with the yogic practices it is essential to acquire knowledge about the digestive system in details.

Most of the digested food is absorbed in the small intestine. The large intestine absorbs mainly sodium along with the large quantities of water. This makes the fecal material dry. In turn, potassium is transported from blood capillaries into the lumen of the large intestine to keep feces moisturised. Repeated enemas or diarrhea may lead to serious loss of potassium in the body and therefore one may experience weakness in the muscles. The large intestine also absorbs some of the products synthesized by the bacteria. For example, small amounts of vitamins, which are synthesized by bacteria in the large intestine, are absorbed by the large intestine itself.

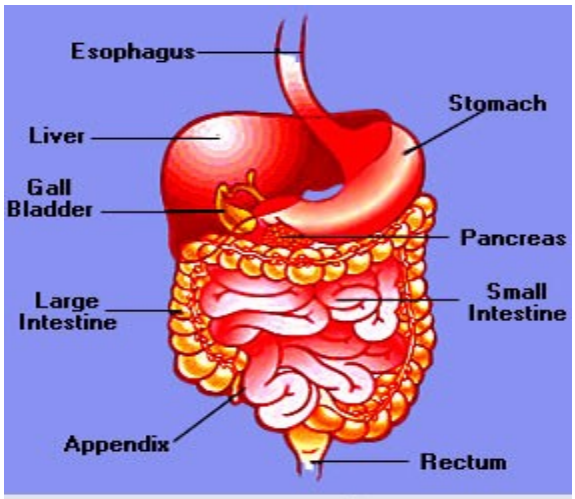
Undigested, unwanted and toxic residues of food are passed on to the rectum and then eliminated through the anus during the process of defecation. This evacuation of the bowel is assisted by a deep inspiration followed by closure of the glottis and contraction of the abdominal and chest muscles, causing a marked increase in intrathoracic pressure. There is a sudden rise in the blood pressure. This is followed by a fall in the blood pressure due to decreased venous return (returning blood) to the heart.

The smooth muscles of the digestive parts are involuntary muscles, which are not working under the individual's will. Major autonomic nerve of the gastrointestinal tract (GIT) is the vagus nerve, which sends branches to the stomach, small intestine and upper portion of large intestine. In fact, the activity of smooth muscles and exocrine (digestive) glands are controlled by the autonomic nervous system and the internal nerve plexus as well as the hormones secreted by GIT itself. Gastrointestinal receptors initiate reflexes and the information is conveyed to the central nervous system (CNS). Short reflexes bring about self-regulation in the tract. Sometimes an individual can experience sensations like pressure, pain, temperature, or burning in the abdominal region. This is mainly due to various viscероreceptors situated along the GIT. When they are stimulated because of stretching, pressure or the chemical action, the strong sensory impulses are sent to the CNS and one's attention is drawn. Hunger and appetite are such sensations coming from the stomach.

The central nervous system has no direct control on the digestive function but the appetite and satiety centers lie in the hypothalamus. The emotional balance and behavior of the human beings are also controlled by the hypothalamic centers. It has been found that even the muscular tone of the smooth muscles of the visceral parts is affected due to an individual's emotional status, such as, rage, abhorrence and annoyance. Thus, it can be concluded that digestion is affected due to one's thinking style, tense and unsatisfied mind and the negative approach. This causes indigestion, acidity, and gastric troubles. If the digestive function is disturbed, health is also affected. In order to maintain mental peace and balance, a positive approach, contentment and happiness are required, which can be achieved through yoga.

Yoga asanas create movements in the human body that greatly enhances the activities of the digestive organs. There are several ailments that occur in the digestive tract due to various reasons. Bowel irregularities can be caused due to several reasons like unhealthy lifestyle, consuming the wrong kinds of foods, chronic indigestion, and extra sensitive digestive system. One must always check the eating habits before the digestive system becomes disable of its function. It is always advisable to eat simple and healthy meals. One should avoid foods that cause bowel disorders. Refined oily and spicy foods should always be avoided. Digestive system works best if fresh foods such as vegetables, salads, fruits, curd and buttermilk are consumed at a regular basis. One should chew the food well before swallowing it and one should practice eating at the same time daily if possible. Besides this yoga asanas are the best possible ways to treat the digestive ailments naturally.

Yoga asanas increase blood flow to the digestive tract and stimulate the intestinal action known as peristalsis that results in digestion more efficiently. Yoga also calms the mind, which in turn relaxes the digestive system and leads to more effective elimination. Forward bend asanas increase the space in the abdomen and facilitate the release of entrapped gases. These poses heat the frontier part of the body and cool the back body as well.



Human Digestive System


Bhujangasana

Human digestive system

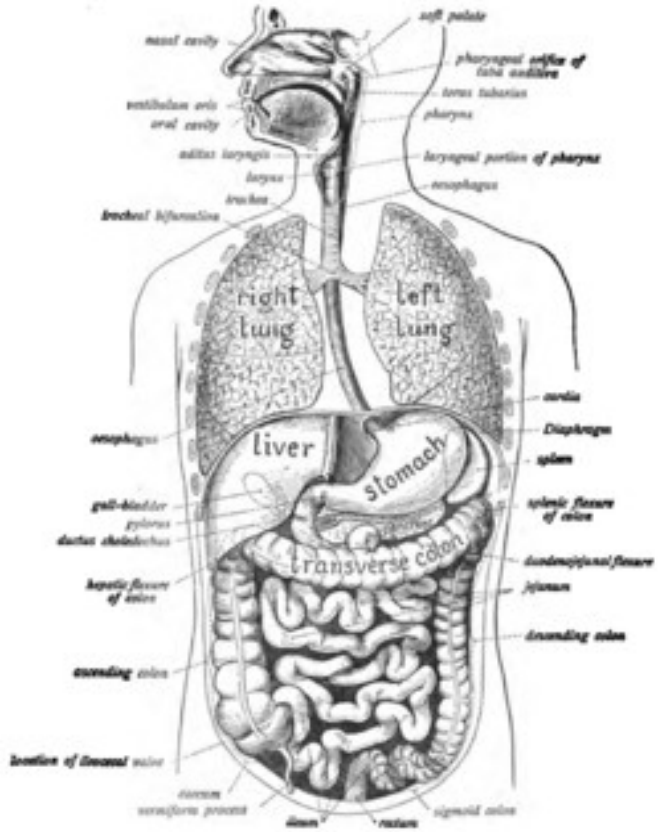
The **human digestive system** consists of the gastrointestinal tract plus the accessory organs of digestion (the tongue, salivary glands, pancreas, liver, and gallbladder). In this system, the process of digestion has many stages, the first of which starts in the mouth. Digestion involves the breakdown of food into smaller and smaller components, until they can be absorbed and assimilated into the body.

Chewing, in which food is mixed with saliva begins the process of digestion. This produces a bolus which can be swallowed down the esophagus and into the stomach. Here it is mixed with gastric juice until it passes into the duodenum, where it is mixed with a number of enzymes produced by the pancreas. Saliva also contains a catalytic enzyme called amylase which starts to act on food in the mouth. Another digestive enzyme called lingual lipase is secreted by some of the lingual papillae on the tongue and also from serous glands in the main salivary glands. Digestion is helped by the mastication of food by the teeth and also by the muscular actions of peristalsis and segmentation contractions. Gastric juice in the stomach is essential for the continuation of digestion as is the production of mucus in the stomach.

Surya Yoga

Peristalsis is the rhythmic contraction of muscles that begins in the esophagus and continues along the wall of the stomach and the rest of the gastrointestinal tract. This initially results in the production of chyme which when fully broken down in

the small intestine is absorbed as chyle into the lymphatic system. Most of the digestion of food takes place in the small intestine. Water and some minerals are reabsorbed back into the blood in the colon of the large intestine. The waste products of digestion (faeces) are defecated from the anus via the rectum.



Components

There are several organs and other components involved in the digestion of food. The organs known as the **accessory digestive glands** are the liver, gall bladder and pancreas. Other components include the mouth, salivary glands, tongue, teeth and epiglottis.

The largest structure of the digestive system is the gastrointestinal tract (GI tract). This starts at the mouth and ends at the anus, covering a distance of about nine (9) metres.[1]

The largest part of the GI tract is the colon or large intestine. Water is absorbed here and remaining waste matter is stored prior to defecation.[2]

Most of the digestion of food takes place in the small intestine.
A major digestive organ is the stomach. Within its mucosa are millions of embedded gastric glands. Their secretions are vital to the functioning of the organ.
There are many specialised cells of the GI tract. These include the various cells of the gastric glands, taste cells, pancreatic duct cells, enterocytes and microfold cells.

Mouth

The mouth is the first part of the gastrointestinal tract and is equipped with several structures that begin the first processes of digestion.[3] These include salivary glands, teeth and the tongue. The mouth consists of two regions, the vestibule and the oral cavity proper. The vestibule is the area between the teeth, lips and cheeks,[4] and the rest is the oral cavity proper. Most of the oral cavity is lined with oral mucosa, a mucous membrane that produces a lubricating mucus, of which only a small amount is needed. Mucous membranes vary in structure in the different regions of the body but they all produce a lubricating mucus, which is either secreted by surface cells or more usually by underlying glands. The mucous membrane in the mouth continues as the thin mucosa which lines the bases of the teeth. The main component of mucus is a glycoprotein called mucin and the type secreted varies according to the region involved. Mucin is viscous, clear, and clinging. Underlying the mucous membrane in the mouth is a thin layer of smooth muscle tissue and the loose connection to the membrane gives it its great elasticity.[5] It covers the cheeks, inner surfaces of the lips, and floor of the mouth.
The roof of the mouth is termed the palate and it separates the oral cavity from the nasal cavity. The palate is hard at the front of the mouth since the overlying mucosa is covering a plate of bone; it is softer and more pliable at the back being made of muscle and connective tissue, and it can move to swallow food and liquids. The soft palate ends at the uvula.[7] The surface of the hard palate allows for the pressure needed in eating food, to leave the nasal passage clear.[8] The lips are the mouth's front boundary and the fauces (the passageway between the

tonsils, also called the throat),[6]:686 mark its posterior boundary. At either side of the soft palate are the palatoglossus muscles which also reach into regions of the tongue. These muscles raise the back of the tongue and also close both sides of the fauces to enable food to be swallowed.[6]:1208 Mucus helps in the mastication of food in its ability to soften and collect the food in the formation of the bolus.

Salivary glands

There are three pairs of main salivary glands and between 800 and 1,000 minor salivary glands, all of which mainly serve the digestive process, and also play an important role in the maintenance of dental health and general mouth lubrication, without which speech would be impossible.[9] The main glands are all exocrine glands, secreting via ducts. All of these glands terminate in the mouth. The largest of these are the parotid glands – their secretion is mainly serous. The next pair are underneath the jaw, the submandibular glands, these produce both serous fluid and mucus. The serous fluid is produced by serous glands in these salivary glands which also produce lingual lipase. They produce about 70% of the oral cavity saliva. The third pair are the sublingual glands located underneath the tongue and their secretion is mainly mucous with a small percentage of saliva.

Within the oral mucosa (a mucous membrane) lining the mouth and also on the tongue and palates and mouth floor, are the minor salivary glands; their secretions are mainly mucous and are innervated by the facial nerve (the

seventh cranial nerve).[10] The glands also secrete amylase a first stage in the breakdown of food acting on the carbohydrate in the food to transform the starch content into maltose. There are other glands on the surface of the tongue that encircle taste buds on the back part of the tongue and these also produce lingual lipase. Lipase is a digestive enzyme that catalyses the hydrolysis of lipids (fats). These glands are termed Von Ebner's glands which have also been shown to have another function in the secretion of histatins which offer an early defense (outside of the immune system) against microbes in food, when it makes contact with these glands on the tongue tissue.[9][11] Sensory information can stimulate the secretion of saliva providing the necessary fluid for the tongue to work with and also to ease swallowing of the food.

Saliva

Saliva functions initially in the digestive system to moisten and soften food into the formation of a bolus. The bolus is further helped by the lubrication provided by the saliva in its passage from the mouth into the esophagus. Also of importance is the presence in saliva of the digestive enzymes amylase and lipase. Amylase starts to work on the starch in carbohydrates, breaking it down into the simple sugars of maltoseand dextrose that can be further broken down in the small intestine. Saliva in the mouth can account for 30% of this initial starch digestion. Lipase starts to work on breaking down fats. Lipase is further produced in the pancreas where it is released to continue this digestion of fats. The presence of salivary lipase is of prime importance in young babies whose pancreatic lipase has yet to be developed.[12]

As well as its role in supplying digestive enzymes, saliva has a cleansing action for the teeth and mouth.[13] It also has an immunological role in supplying antibodies to the system, such as immunoglobulin A.[14] This is seen to be key in preventing infections of the salivary glands, importantly that of parotitis.

Saliva also contains a glycoprotein called haptocorrin which is a binding protein to vitamin B_{12}.[15] It binds with the vitamin in order to carry it safely through the acidic content of the stomach. When it reaches the duodenum, pancreatic

enzymes break down the glycoprotein and free the vitamin which then binds with intrinsic factor.

Tongue

Food enters the mouth where the first stage in the digestive process takes place, with the action of the tongue and the secretion of saliva. The tongue is a fleshy and muscular sensory organ, and the very first sensory information is received via the taste buds on its surface. If the taste is agreeable the tongue will go into action, manipulating the food in the mouth which stimulates the secretion of saliva from the salivary glands. The liquid quality of the saliva will help in the softening of the food and its enzyme content will start to break down the food whilst it is still in the mouth. The first part of the food to be broken down is the starch of carbohydrates. The tongue is attached to the floor of the mouth by a ligamentous band called the frenum[16] and this gives it great mobility for the manipulation of food (and speech); the range of manipulation is optimally controlled by the action of several muscles and limited in its external range by the stretch of the frenum. The tongue's two sets of muscles, are four intrinsic muscles that originate in the tongue and are involved with its shaping, and four extrinsic muscles originating in bone that are involved with its movement.

Taste

Taste is a form of chemoreception that takes place in the specialised taste receptors, contained in structures called taste buds in the mouth. Taste buds are mainly on the upper surface (dorsum) of the tongue. The function of taste perception is vital to help prevent harmful or rotten foods from being consumed. There are also taste buds on the epiglottis and upper part of the esophagus. The taste buds are innervated by a branch of the facial nerve the chorda tympani, and the glossopharyngeal nerve. Taste messages are sent via these cranial nerves to the brain. The brain can distinguish between the chemical qualities of the food. The five basic tastes are referred to as those of saltiness, sourness, bitterness, sweetness, and umami. The detection of saltiness and sourness enables the control of salt and acid balance. The detection

of bitterness warns of poisons – many of a plant's defences are of poisonous compounds that are bitter. Sweetness guides to those foods that will supply energy; the initial breakdown of the energy-giving carbohydrates by salivary amylase creates the taste of sweetness since simple sugars are the first result. The taste of umami is thought to signal protein-rich food. Sour tastes are acidic which is often found in bad food. The brain has to decide very quickly whether the food should be eaten or not. It was the findings in 1991, describing the first olfactory receptors that helped to prompt the research into taste. The olfactory receptors are located on cell surfaces in the nose which bind to chemicals enabling the detection of smells. It is assumed that signals from taste receptors work together with those from the nose, to form an idea of complex food flavours.[17]

Teeth

Teeth are complex structures made of materials specific to them. They are made of a bone-like material called dentin, which is covered by the hardest tissue in the body—enamel.[18] Teeth have different shapes to deal with different aspects of mastication employed in tearing and chewing pieces of food into smaller and smaller pieces. This results in a much larger surface area for the action of digestive enzymes. The teeth are named after their particular roles in the process of mastication—incisors are used for cutting or biting off pieces of food; canines, are used for tearing, premolars and molars are used for chewing and grinding. Mastication of the food with the help of saliva and mucus results in the formation of a soft bolus which can then be swallowed to make its way down the upper gastrointestinal tract to the stomach.[19]The digestive enzymes in saliva also help in keeping the teeth clean by breaking down any lodged food particles.

Epiglottis

The epiglottis is a flap that is made of elastic cartilage and attached to the entrance of the larynx. It is covered with a mucous membrane and there are taste buds on its lingual surface which faces into the mouth.[20] Its laryngeal surface faces into the larynx. The epiglottis functions to guard the entrance of the glottis,

the opening between the vocal folds. It is normally pointed upward during breathing with its underside functioning as part of the pharynx, but during swallowing, the epiglottis folds down to a more horizontal position, with its upper side functioning as part of the pharynx. In this manner it prevents food from going into the trachea and instead directs it to the esophagus, which is posterior. During swallowing, the backward motion of the tongue forces the epiglottis over the glottis' opening to prevent any food that is being swallowed from entering the larynx which leads to the lungs; the larynx is also pulled upwards to assist this process. Stimulation of the larynx by ingested matter produces a strong cough reflex in order to protect the lungs.

Pharynx

The pharynx is a part of the conducting zone of the respiratory system and also a part of the digestive system. It is the part of the throat immediately behind the nasal cavity at the back of the mouth and above the esophagus and larynx. The pharynx is made up of three parts. The lower two parts–the oropharynx and the laryngopharynx are involved in the digestive system. The laryngopharynx connects to the esophagus and it serves as a passageway for both air and food. Air enters the larynx anteriorly but anything swallowed has priority and the passage of air is temporarily blocked. The pharynx is innervated by the pharyngeal plexus of the vagus nerve.[21] Muscles in the pharynx push the food into the esophagus. The pharynx joins the esophagus at the oesophageal inlet which is located behind the cricoid cartilage.

Esophagus

The esophagus commonly known as the gullet, is an organ which consists of a muscular tube through which food passes from the pharynx to the stomach. The esophagus is continuous with the laryngeal part of the pharynx. It passes through the posterior mediastinum in the thorax and enters the stomach through a hole in the thoracic diaphragm–the esophageal hiatus|, at the level of the tenth thoracic vertebra (T10). Its length averages 25 cm, varying with height. It is divided into

cervical, thoracic and abdominal parts. The pharynx joins the esophagus at the esophageal inlet which is behind the cricoid cartilage.

At rest the esophagus is closed at both ends, by the upper and lower esophageal sphincters. The opening of the upper sphincter is triggered by the swallowing reflex so that food is allowed through. The sphincter also serves to prevent back flow from the esophagus into the pharynx. The esophagus has a mucous membrane and the epithelium which has a protective function is continuously replaced due to the volume of food that passes inside the esophagus. During swallowing, food passes from the mouth through the pharynx into the esophagus. The epiglottis folds down to a more horizontal position so as to prevent food from going into the trachea, instead directing it to the esophagus. Once in the esophagus, the bolus travels down to the stomach via rhythmic contraction and relaxation of muscles known as peristalsis. The lower esophageal sphincter is a muscular sphincter surrounding the lower part of the esophagus. The junction between the esophagus and the stomach (the gastroesophageal junction) is controlled by the lower esophageal sphincter, which remains constricted at all times other than during swallowing and vomiting to prevent the contents of the stomach from entering the esophagus. As the esophagus does not have the same protection from acid as the stomach, any failure of this sphincter can lead to heartburn. The esophagus has a mucous membrane of epithelium which has a protective function as well as providing a smooth surface for the

passage of food. Due to the high volume of food that is passed over time, this membrane is continuously renewed.

Diaphragm

The diaphragm is an important part of the body's digestive system. The diaphragm separates the thoracic cavity from the abdominal cavity where most of the digestive organs are located. The suspensory muscle attaches the ascending duodenum to the diaphragm. This muscle is thought to be of help in the digestive system in that its attachment offers a wider angle to the duodenojejunal flexure for the easier passage of digesting material. The diaphragm also attaches to the bare area of the liver, which it anchors. The esophagus enters the abdomen through a hole in the diaphragm at the level of T10.

Stomach

The stomach is a major organ of the gastrointestinal tract and digestive system. It is a consistently J-shaped organ joined to the esophagus at its upper end and to the duodenum at its lower end. Gastric acid (informally *gastric juice*), produced in the stomach plays a vital role in the digestive process, and mainly contains hydrochloric acid and sodium chloride. A peptide hormone, gastrin, produced by G cells in the gastric glands, stimulates the production of gastric juice which activates the digestive enzymes. Pepsinogen is a precursor enzyme (zymogen) produced by the gastric chief cells, and gastric acid activates this to the enzyme pepsin which begins the digestion of proteins. As these two chemicals would damage the stomach wall, mucus is secreted by innumerable gastric glands in the stomach, to provide a slimy protective layer against the damaging effects of the chemicals.

At the same time that protein is being digested, mechanical churning occurs through the action of peristalsis, waves of muscular contractions that move along the stomach wall. This allows the mass of food to further mix with the digestive enzymes. Gastric lipase secreted by the chief cells in the fundic glands in the gastric mucosa of the stomach, is an acidic lipase, in contrast with the alkaline

pancreatic lipase. This breaks down fats to some degree though is not as efficient as the pancreatic lipase.

The pylorus, the lowest section of the stomach which attaches to the duodenum via the pyloric canal, contains countless glands which secrete digestive enzymes including gastrin. After an hour or two, a thick semi-liquid called chyme is produced. When the pyloric sphincter, or valve opens, chyme enters the duodenum where it mixes further with digestive enzymes from the pancreas, and then passes through the small intestine, where digestion continues. When the chyme is fully digested, it is absorbed into the blood. 95% of absorption of nutrients occurs in the small intestine. Water and minerals are reabsorbed back into the blood in the colon of the large intestine, where the environment is slightly acidic. Some vitamins, such as biotin and vitamin K produced by bacteria in the gut flora of the colon are also absorbed.

The parietal cells in the fundus of the stomach, produce a glycoprotein called intrinsic factor which is essential for the absorption of vitamin B12. Vitamin B12 (cobalamin), is carried to, and through the stomach, bound to a glycoprotein secreted by the salivary glands - transcobalamin I also called haptocorrin, which protects the acid-sensitive vitamin from the acidic stomach contents. Once in the more neutral duodenum, pancreatic enzymes break down the protective glycoprotein. The freed vitamin B12 then binds to intrinsic factor which is then absorbed by the enterocytes in the ileum.

The stomach is a distensible organ and can normally expand to hold about one litre of food.[22] This expansion is enabled by a series of gastric folds in the inner walls of the stomach. The stomach of a newborn baby will only be able to expand to retain about 30 ml.

Spleen

The spleen breaks down both red and white blood cells that are *spent*. This is why it is sometimes known as the 'graveyard of red blood cells'. A product of this *digestion* is the pigment bilirubin, which is sent to the liver and secreted in the bile. Another product is iron, which is used in the formation of new blood cells in the bone marrow.[5] Western medicine treats the spleen solely as belonging to the lymphatic system, though it is acknowledged that the full range of its important functions is not yet understood.[23] In contrast to this view, traditional Chinese medicine sees the spleen to be of central importance in the digestive system. The role of the spleen is seen to affect the health and vitality of the body in its turning of digested material from the stomach into usable nutrients and energy. Symptoms that include poor appetite, indigestion, bloating and jaundice, are seen to be indications of an imbalance in the spleen. The spleen is further seen to play a part in the metabolism of water, in ridding the body of excess fluid.[24] In the west, the spleen is seen to be paired with the stomach but in Chinese medicine, reference is made to the spleen system, which involves the pancreas. Fluids in the body are seen in traditional Chinese medicine to be under the control of the spleen. Fluids include digestive enzymes, saliva, mucus, fluid in the joints, tears, sweat and urine. They are categorised as thin and thick and together they are seen as nourishing all tissues and organs. In acupuncture two widely used acupuncture points - the stomach, (close to the knee) and the spleen, (halfway down from the knee) have long been seen to be connected and involved in digestive issues.

Liver

The liver is the second largest organ (after the skin) and is an accessory digestive gland which plays a role in the body's metabolism. The liver has many functions some of which are important to digestion. The liver can detoxify various metabolites; synthesise proteins and produce biochemicalsneeded for digestion. It regulates the storage of glycogen which it can form from glucose(glycogenesis). The liver can also synthesise glucose from certain amino acids. Its digestive functions are largely involved with the breaking

down of carbohydrates. It also maintains protein metabolism in its synthesis and degradation. In lipid metabolism it synthesises cholesterol. Fats are also produced in the process of lipogenesis. The liver synthesises the bulk of lipoproteins. The liver is located in the upper right quadrant of the abdomen and below the diaphragm to which it is attached at one part, This is to the right of the stomach and it overlies the gall bladder. The liver produces bile, an important alkaline compound which aids digestion.

Bile

Bile produced by the liver is made up of water (97%), bile salts, mucus and pigments, 1% fats and inorganic salts.[25] Bilirubin is its major pigment. Bile acts partly as a surfactant which lowers the surface tension between either two liquids or a solid and a liquid and helps to emulsify the fats in the chyme. Food fat is dispersed by the action of bile into smaller units called micelles. The breaking down into micelles creates a much larger surface area for the pancreatic enzyme, lipase to work on. Lipase digests the triglycerides which are broken down into two fatty acids and a monoglyceride. These are then absorbed by villion the intestinal wall. If fats are not absorbed in this way in the small intestine problems can arise later in the large intestine which is not equipped to absorb fats. Bile also helps in the absorption of vitamin Kfrom the diet. Bile is collected and delivered through the common hepatic duct. This duct joins with the cystic duct to connect in a common bile duct with the gallbladder. Bile is stored in the gallbladder for release when food is discharged into the duodenum and also after a few hours.[26]

Gallbladder

The gallbladder is a hollow part of the biliary system that sits just beneath the liver, with the gallbladder body resting in a small depression.[27] It is a small organ where the bile produced by the liver is stored, before being released into the small intestine. Bile flows from the liver through the bile ducts and into the gall bladder for storage. The bile is released in response to cholecystokinin (CKK) a peptide hormonereleased from the duodenum. The production of CKK (by

endocrine cells of the duodenum) is stimulated by the presence of fat in the duodenum.[28]

It is divided into three sections, a fundus, body and neck. The neck tapers and connects to the biliary tree via the cystic duct, which then joins the common hepatic duct to form the common bile duct. At this junction is a mucosal fold called *Hartmann's pouch*, where gallstones commonly get stuck. The muscular layer of the body is of smooth muscle tissue that helps the gallbladder contract, so that it can discharge its bile into the bile duct. The gallbladder needs to store bile in a natural, semi-liquid form at all times. Hydrogen ions secreted from the inner lining of the gallbladder keep the bile acidic enough to prevent hardening. To dilute the bile, water and electrolytes from the digestion system are added. Also, salts attach themselves to cholesterol molecules in the bile to keep them from crystallising. If there is too much cholesterol or bilirubin in the bile, or if the gallbladder doesn't empty properly the systems can fail. This is how gallstones form when a small piece of calcium gets coated with either cholesterol or bilirubin and the bile crystallises and forms a gallstone. The main purpose of the gallbladder is to store and release bile, or *gall*. Bile is released into the small intestine in order to help in the digestion of fats by breaking down larger molecules into smaller ones. After the fat is absorbed, the bile is also absorbed and transported back to the liver for reuse.

Pancreas

The pancreas is a major organ functioning as an accessory digestive gland in the digestive system. It is both an endocrine gland and an exocrine gland.[29] The endocrine part secretes insulin when the blood sugar becomes high; insulin moves glucose from the blood into the muscles and other tissues for use as energy. The endocrine part releases glucagon when the blood sugar is low; glucagon allows stored sugar to be broken down into glucose by the liver in order to re–balance the sugar levels. The pancreas produces and releases important digestive enzymes in the pancreatic juice that it delivers to the duodenum. The pancreas lies below and at the back of the stomach. It connects to the duodenum via the pancreatic duct which it joins near to the bile duct's connection where

both the bile and pancreatic juice can act on the chyme that is released from the stomach into the duodenum. Aqueous pancreatic secretions from pancreatic duct cells contain bicarbonate ions which are alkaline and help with the bile to neutralise the acidic chyme that is churned out by the stomach.
The pancreas is also the main source of enzymes for the digestion of fats and proteins. Some of these are released in response to the production of CKK in the duodenum. (The enzymes that digest polysaccharides, by contrast, are primarily produced by the walls of the intestines.) The cells are filled with secretory granules containing the precursor digestive enzymes. The major proteases, the pancreatic enzymes which work on proteins, are trypsinogen and chymotrypsinogen. Elastase is also produced. Smaller amounts of lipase and amylase are secreted. The pancreas also secretes phospholipase A2, lysophospholipase, and cholesterol esterase. The precursor zymogens, are inactive variants of the enzymes; which avoids the onset of pancreatitis caused by autodegradation. Once released in the intestine, the enzyme enteropeptidase present in the intestinal mucosa activates trypsinogen by cleaving it to form trypsin; further cleavage results in chymotripsin.

Lower gastrointestinal tract

The lower gastrointestinal tract (GI), includes the small intestine and all of the large intestine.[30] The intestine is also called the bowel or the gut. The lower GI starts at the pyloric sphincter of the stomach and finishes at the anus. The small intestine is subdivided into the duodenum, the jejunum and the ileum. The cecum marks the division between the small and large intestine. The large intestine includes the rectum and anal canal.[2]

Small intestine

Food starts to arrive in the small intestine one hour after it is eaten, and after two hours the stomach has emptied. Until this time the food is termed a bolus. It then becomes the partially digested semi-liquid termed chyme.
In the small intestine, the pH becomes crucial; it needs to be finely balanced in order to activate digestive enzymes. The chyme is very acidic, with a low pH,

having been released from the stomach and needs to be made much more alkaline. This is achieved in the duodenum by the addition of bile from the gall bladder combined with the bicarbonate secretions from the pancreatic duct and also from secretions of bicarbonate-rich mucus from duodenal glands known as Brunner's glands. The chyme arrives in the intestines having been released from the stomach through the opening of the pyloric sphincter. The resulting alkaline fluid mix neutralises the gastric acid which would damage the lining of the intestine. The mucus component lubricates the walls of the intestine.

When the digested food particles are reduced enough in size and composition, they can be absorbed by the intestinal wall and carried to the bloodstream. The first receptacle for this chyme is the duodenal bulb. From here it passes into the first of the three sections of the small intestine, the duodenum. (The next section is the jejunum and the third is the ileum**)**. The duodenum is the first and shortest section of the small intestine. It is a hollow, jointed C-shaped tube connecting the stomach to the jejunum. It starts at the duodenal bulb and ends at the suspensory muscle of duodenum. The attachment of the suspensory muscle to the diaphragm is thought to help the passage of food by making a wider angle at its attachment.

Most food digestion takes place in the small intestine. Segmentation contractions act to mix and move the chyme more slowly in the small intestine allowing more time for absorption (and these continue in the large intestine). In the duodenum, pancreatic lipase is secreted together with a co-enzyme, colipase to further digest the fat content of the chyme. From this breakdown, smaller particles of emulsified fats called chylomicrons are produced. There are also digestive cells called enterocytes lining the intestines (the majority being in the small intestine). They are unusual cells in that they have villi on their surface which in turn have innumerable microvilli on their surface. All these villi make for a greater surface area, not only for the absorption of chyme but also for its further digestion by large numbers of digestive enzymes present on the microvilli.

The chylomicrons are small enough to pass through the enterocyte villi and into their lymph capillaries called lacteals. A milky fluid called chyle, consisting mainly of the emulsified fats of the chylomicrons, results from the absorbed mix with the

lymph in the lacteals. Chyle is then transported through the lymphatic system to the rest of the body.

The suspensory muscle marks the end of the duodenum and the division between the upper gastrointestinal tract and the lower GI tract. The digestive tract continues as the jejunum which continues as the ileum. The jejunum, the midsection of the small intestine contains circular folds, flaps of doubled mucosal membrane which partially encircle and sometimes completely encircle the lumen of the intestine. These folds together with villi serve to increase the surface area of the jejunum enabling an increased absorption of digested sugars, amino acids and fatty acids into the bloodstream. The circular folds also slow the passage of food giving more time for nutrients to be absorbed.

The last part of the small intestine is the ileum. This also contains villi and vitamin B12; bile acids and any residue nutrients are absorbed here. When the chyme is exhausted of its nutrients the remaining waste material changes into the semi-solids called feces, which pass to the large intestine, where bacteria in the gut flora further break down residual proteins and starches.[31]

Cecum

The cecum is a pouch marking the division between the small intestine and the large intestine.[32] The cecum receives chyme from the last part of the small intestine, the ileum, and connects to the ascending colon of the large intestine. At this junction there is a sphincter or valve, the ileocecal valve which slows the passage of chyme from the ileum, allowing further digestion. It is also the site of the appendix attachment.

Large intestine

In the large intestine,[2] the passage of the digesting food in the colon is a lot slower, taking from 12 to 50 hours until it is removed by defecation. The colon mainly serves as a site for the fermentation of digestible matter by the gut flora. The time taken varies considerably between individuals. The remaining semi-solid waste is termed feces and is removed by the coordinated contractions of the intestinal walls, termed peristalsis, which propels the excreta forward to reach

the rectum and exit via defecation from the anus. The wall has an outer layer of longitudinal muscles, the taeniae coli, and an inner layer of circular muscles. The circular muscle keeps the material moving forward and also prevents any back flow of waste. Also of help in the action of peristalsis is the basal electrical rhythm that determines the frequency of contractions.[33] The taeniae coli can be seen and are responsible for the bulges (haustra) present in the colon. Most parts of the GI tract are covered with serous membranes and have a mesentery. Other more muscular parts are lined with adventitia.

Blood supply

The digestive system is supplied by the celiac artery. The celiac artery is the first major branch from the abdominal aorta, and is the only major artery that nourishes the digestive organs.

There are three main divisions – the left gastric artery, the common hepatic artery and the splenic artery.

The celiac artery supplies the liver, stomach, spleen and the upper 1/3 of the duodenum (to the sphincter of Oddi) and the pancreas with oxygenated blood. Most of the blood is returned to the liver via the portal venous system for further processing and detoxification before returning to the systemic circulation via the hepatic portal vein.

The next branch from the abdominal aorta is the superior mesenteric artery, which supplies the regions of the digestive tract derived from the midgut, which includes the distal 2/3 of the duodenum, jejunum, ileum, cecum, appendix, ascending colon, and the proximal 2/3 of the transverse colon.

The final branch which is important for the digestive system is the inferior mesenteric artery, which supplies the regions of the digestive tract derived from the hindgut, which includes the distal 1/3 of the transverse colon, descending colon, sigmoid colon, rectum, and the anus above the pectinate line.

Nerve supply

The enteric nervous system consists of some one hundred million neurons[35] that are embedded in the peritoneum, the lining of the gastrointestinal tract extending

from the esophagus to the anus.[36] These neurons are collected into two plexuses - the myenteric (or Auerbach's) plexus that lies between the longitudinal and the smooth muscle layers, and the submucosal (or Meissner's) plexus that lies between the circular smooth muscle layer and the mucosa.[37][38][39] Parasympathetic innervation to the ascending colon is supplied by the vagus nerve. Sympathetic innervation is supplied by the splanchnic nerves that join the celiac ganglia. Most of the digestive tract is innervated by the two large celiac ganglia, with the upper part of each ganglion joined by the greater splanchnic nerve and the lower parts joined by the lesser splanchnic nerve. It is from these ganglia that many of the gastric plexuses arise.

Clinical significance

Each part of the digestive system is subject to a wide range of disorders many of which can be congenital. Mouth diseases can also be caused by bacteria, viruses and fungi. Mouth diseases include tongue diseases and salivary gland diseases. A common gum disease in the mouth is gingivitis which is caused by bacteria in plaque. The most common viral infection of the mouth is gingivostomatitis caused by herpes simplex. Another common infection which is fungal is candidiasis commonly known as *thrush* which affects the mucous membranes of the mouth.

There are a number of esophageal diseases such as the development of Schatzki rings that can restrict the passageway, causing difficulties in swallowing. They can also completely block the esophagus.[40]

Stomach diseases are often chronic conditions and include gastroparesis, gastritis, and peptic ulcers.

A number of problems including malnutrition and anemia can arise from malabsorption, the abnormal absorption of nutrients in the GI tract. Malabsorption can have many causes ranging from infection, to enzyme deficiencies such as exocrine pancreatic insufficiency. It can also arise as a result of other gastrointestinal diseases such as coeliac disease. Coeliac disease is an autoimmune disorder of the small intestine. This can cause vitamin deficiencies due to the improper absorption of nutrients in the small intestine.

The small intestine can also be obstructed by a volvulus, a loop of intestine that becomes twisted enclosing its attached mesentery. This can cause mesenteric ischemia if severe enough.

A common disorder of the bowel is diverticulitis. Diverticula are small pouches that can form inside the bowel wall, which can become inflamed to give diverticulitis. This disease can have complications if an inflamed diverticulum bursts and infection sets in. Any infection can spread further to the lining of the abdomen (peritoneum) and cause potentially fatal peritonitis.[41]

Crohn's disease is a common chronic inflammatory bowel disease (IBD), which can affect any part of the GI tract,[42] but it mostly starts in the terminal ileum.

Ulcerative colitis an ulcerative form of colitis, is the other major inflammatory bowel disease which is restricted to the colon and rectum. Both of these IBDs can give an increased risk of the development of colorectal cancer. Ulcerative coliltis is the most common of the IBDs[43]

Irritable bowel syndrome (IBS) is the most common of the functional gastrointestinal disorders. These are idiopathic disorders that the Rome process has helped to define.[44]

Giardiasis is a disease of the small intestine caused by a protist parasite *Giardia lamblia*. This does not spread but remains confined to the lumen of the small intestine.[45] It can often be asymptomatic, but as often can be indicated by a variety of symptoms. Giardiasis is the most common pathogenic parasitic infection in humans.[46]

There are diagnostic tools mostly involving the ingestion of barium sulphate to investigate disorders of the GI tract.[47] These are known as upper gastrointestinal series that enable imaging of the pharynx, larynx, oesophagous, stomach and small intestine and lower gastrointestinal series for imaging of the colon.

In pregnancy

Gestation can predispose for certain digestive disorders. Gestational diabetes can develop in the mother as a result of pregnancy and while this often presents with few symptoms it can lead to pre-eclampsia.

Yoga

Yoga is a group of physical, mental, and spiritualpractices or disciplines which originated in ancient India. There is a broad variety of Yoga schools, practices, and goals[2] in Hinduism, Buddhism, and Jainism.[3][4][5] Among the most well-known types of yoga are Hatha yoga and Rāja yoga.[6]

The origins of yoga have been speculated to date back to pre-Vedic Indian traditions, it is mentioned in the Rigveda,[note 1] but most likely developed around the sixth and fifth centuries BCE, in ancient India's ascetic and chronology of earliest texts describing yoga-practices is unclear, varyingly credited to Hindu Upanishads[9] and Buddhist Pāli Canon,[10] probably of third century BCE or later. The *Yoga Sutras of Patanjali* date from the first half of the 1st millennium CE,[11][12] but only gained prominence in the West in the 20th century.[13] Hatha yoga texts emerged around the 11th century with origins in tantra.[14][15]

Yoga gurus from India later introduced yoga to the west,[16] following the success of Swami Vivekananda in the late 19th and early 20th century.[16] In the 1980s, yoga became popular as a system of physical exercise across the Western world.[15] Yoga in Indian traditions, however, is more than physical exercise, it has a meditative and spiritual core.[17] One of the six major orthodox schools of Hinduism is also called Yoga, which has its own epistemology and metaphysics, and is closely related to Hindu Samkhya philosophy.[18]

Many studies have tried to determine the effectiveness of yoga as a complementary intervention for cancer, schizophrenia, asthma, and heart

disease.[19][20] The results of these studies have been mixed and inconclusive, with cancer studies suggesting none to unclear effectiveness, and others suggesting yoga may reduce risk factors and aid in a patient's psychological healing process.

Etymology

In Vedic Sanskrit, yoga (from the root *yuj*) means "to add", "to join", "to unite", or "to attach" in its most common literal sense. By figurative extension from the yoking or harnessing of oxen or horses, the word took on broader meanings such as "employment, use, application, performance" (compare the figurative uses of "to harness" as in "to put something to some use"). All further developments of the sense of this word are post-Vedic. More prosaic moods such as "exertion", "endeavour", "zeal", and "diligence" are also found in Indian epic poetry.[21]

There are very many compound words containing *yoga* in Sanskrit. *Yoga* can take on meanings such as "connection", "contact", "union", "method", "application", "addition" and "performance". In simpler words, Yoga also means "**combined**". For example, *guṇáyoga* means "contact with a cord"; *chakráyoga* has a medical sense of "applying a splint or similar instrument by means of pulleys (in case of dislocation of the thigh)"; *chandráyoga* has the astronomical sense of "conjunction of the moon with a constellation"; *puṃyoga* is a grammatical term expressing "connection or relation with a man", etc. Thus, *bhaktiyoga* means "devoted attachment" in the monotheistic Bhakti movement. The term *kriyāyoga* has a grammatical sense, meaning "connection with a verb". But the same compound is also given a technical meaning in the *Yoga Sutras* (2.1), designating the "practical" aspects of the philosophy, i.e. the "union with the supreme" due to performance of duties in everyday life[22]

According to Pāṇini, a 6th-century BCE Sanskrit grammarian, the term yoga can be derived from either of two roots, *yujir yoga* (to yoke) or *yuj samādhau* (to concentrate).[23] In the context of the *Yoga Sutras of Patanjali*, the root *yuj samādhau* (to concentrate) is considered by traditional commentators as the correct etymology.[24] In accordance with Pāṇini, Vyasa who wrote the first commentary on the *Yoga Sutras*,[25] states that yoga means *samādhi* (concentration).[26]

According to Dasgupta, the term yoga can be derived from either of two roots, *yujir yoga* (to yoke) or *yuj samādhau* (to concentrate).[23] Someone who practices yoga or follows the yoga philosophy with a high level of commitment is called a yogi (may be applied to a man or a woman) or yogini (traditionally denoting a woman).[27]

Goals

The ultimate goal of Yoga is *moksha* (liberation), although the exact definition of what form this takes depends on the philosophical or theological system with which it is conjugated.
According to Jacobsen, "Yoga has five principal meanings:[28]

1. Yoga, as a disciplined method for attaining a goal;
2. Yoga, as techniques of controlling the body and the mind;
3. Yoga, as a name of one of the schools or systems of philosophy (*darśana*);
4. Yoga, in connection with other words, such as "hatha-, mantra-, and laya-," referring to traditions specialising in particular techniques of yoga;
5. Yoga, as the goal of Yoga practice."[28]

According to David Gordon White, from the 5th century CE onward, the core principles of "yoga" were more or less in place, and variations of these principles developed in various forms over time:[29]

1. Yoga, is a meditative means of discovering dysfunctional perception and cognition, as well as overcoming it for release from suffering, inner peace and salvation; illustration of this principle is found in Hindu texts such as the *Bhagavad Gita* and *Yogasutras*, in a number of Buddhist Mahāyāna works, as well as Jain texts;[30]
2. Yoga, as the raising and expansion of consciousness from oneself to being coextensive with everyone and everything; these are discussed in sources such as in Hinduism Vedic literature and its Epic *Mahābhārata*, Jainism Praśamaratiprakarana, and Buddhist Nikaya texts;[31]

3. Yoga, as a path to omniscience and enlightened consciousness enabling one to comprehend the impermanent (illusive, delusive) and permanent (true, transcendent) reality; examples are found in Hinduism Nyaya and Vaisesika school texts as well as Buddhism Mādhyamaka texts, but in different ways;[32]
4. Yoga, as a technique for entering into other bodies, generating multiple bodies, and the attainment of other supernatural accomplishments; these are, states White, described in Tantric literature of Hinduism and Buddhism, as well as the Buddhist Sāmaññaphalasutta;[33] James Mallinson, however, disagrees and suggests that such fringe practices are far removed from the mainstream Yoga's goal as meditation-driven means to liberation in Indian religions.[34]

White clarifies that the last principle relates to legendary goals of "yogi practice", different from practical goals of "yoga practice," as they are viewed in South Asian thought and practice since the beginning of the Common Era, in the various Hindu, Buddhist, and Jain philosophical schools.[35]

Schools

The term "yoga" has been applied to a variety of practices and methods, including Jain and Buddhist practices. In Hinduism these include Jnana Yoga, Bhakti Yoga, Karma Yoga, Laya Yoga and Hatha Yoga.
The so-called Raja Yoga refers to Ashtanga Yoga, the eight limbs to be practiced to attain *samadhi*, as described in the Yoga Sutras of Pantajali.[36] The term *raja yoga* originally referred to the ultimate goal of yoga, which is usually *samadhi*,[37] but was popularised by Vivekananda as the common name for Ashtanga Yoga.[38]

Classical yoga

Yoga is considered as a philosophical school in Hinduism.[39] Yoga, in this context, is one of the six *āstika* schools of Hinduism (those which accept the Vedas as source of knowledge).[40][41]

Due to the influence of Vivekananda, the *Yoga Sutras of Patanjali* are nowadays considered as the foundational scripture of classical yoga, a status which it only acquired in the 20th century.[38] Before the twentieth century, other works were considered as the most central works, such as the *Bhagavad Gita* and the *Yoga Vasistha*,[38] while Tantric Yoga and Hatha Yoga prevailed over Ashtanga Yoga.[38]

Modern history

Reception in the Wes

The first Hindu teacher to actively advocate and disseminate aspects of yoga to a western audience, Swami Vivekananda, toured Europe and the United States in the 1890s.[215] The reception which Swami Vivekananda received built on the active interest of intellectuals, in particular the New England Transcendentalists, among them R. W. Emerson (1803–1882), who drew on German Romanticism and the interest of philosophers and scholars like G.W.F. Hegel (1770–1831), the brothers August Wilhelm Schlegel (1767–1845) and Karl Wilhelm Friedrich Schlegel (1772–1829), Max Mueller (1823–1900), Arthur Schopenhauer (1788–1860) and others who had (to varying degrees) interests in things Indian.[216]
Theosophists also had a large influence on the American public's view of Yoga.[217] Esoteric views current at the end of the 19th century provided a further basis for the reception of Vedanta and of Yoga with its theory and practice of correspondence between the spiritual and the physical.[218] The reception of Yoga and of Vedanta thus entwined with each other and with the (mostly Neoplatonism-based) currents of religious and philosophical reform and transformation throughout the 19th and early 20th centuries. M. Eliade, himself rooted in the Romanian currents of these traditions, brought a new element into the reception of Yoga with the strong emphasis on Tantric Yoga in his seminal book: *Yoga: Immortality and Freedom*.[note 22] With the introduction of the Tantra traditions and philosophy of Yoga, the conception of the "transcendent" to be attained by Yogic practice shifted from experiencing the "transcendent" ("Atman-Brahman" in Advaitic theory) in the mind to the body itself.[219]

The American born yogi by the name of Pierre Arnold Bernard, after his travels through the lands of Kashmir and Bengal, founded the Tantrik Order of America in 1905. His teachings gave many westerners their first glimpse into the practices of yoga and tantra.[220]

The modern scientific study of yoga began with the works of N. C. Paul and Major D. Basu in the late 19th century, and then continued in the 20th century with Sri Yogendra (1897–1989) and Swami Kuvalayananda.[221] Western medical researchers came to Swami Kuvalayananda's Kaivalyadhama Health and Yoga Research Center, starting in 1928, to study Yoga as a science.

The West, in the early 21st century typically associates the term "yoga" with Hatha yoga and its asanas (postures) or as a form of exercise.[223] During the 1910s and 1920s in the USA, yoga suffered a period of bad publicity due largely to the backlash against immigration, a rise in puritanical values, and a number of scandals. In the 1930s and 1940s yoga began to gain more public acceptance as a result of celebrity endorsement. In the 1950s the United States saw another period of paranoia against yoga,[217] but by the 1960s, western interest in Hindu spirituality reached its peak, giving rise to a great number of Neo-Hinduschools specifically advocated to a western public. During this period, most of the influential Indian teachers of yoga came from two lineages, those of Sivananda Saraswati (1887–1963) and of Tirumalai Krishnamacharya (1888–1989).[224] Teachers of Hatha yoga who were active in the west in this period included B.K.S. Iyengar (1918–2014), K. Pattabhi Jois (1915–2009), Swami Vishnu-devananda (1927–1993), and Swami Satchidananda (1914–2002).[225][226][227] Yogi

Bhajan brought Kundalini Yoga to the United States in 1969.[228] Comprehensive, classical teachings of Ashtanga Yoga, Samkhya, the subtle body theory, Fitness Asanas, and tantric elements were included in the yoga teachers training by Baba Hari Dass (1923–), in the United States and Canada.[229]

A second "yoga boom" followed in the 1980s, as Dean Ornish, a follower of Swami Satchidananda, connected yoga to heart health, legitimizing yoga as a purely physical system of health exercises outside of counter-culture or esotericism circles, and unconnected to any religious denomination.[215] Numerous asanas seemed modern in origin, and strongly overlapped with 19th and early-20th century Western exercise traditions.[230]

Since 2001, the popularity of yoga in the USA has risen constantly. The number of people who practiced some form of yoga has grown from 4 million (in 2001) to 20 million (in 2011). It has drawn support from world leaders such as Barack Obama who stated, "Yoga has become a universal language of spiritual exercise in the United States, crossing many lines of religion and cultures,... Every day, millions of people practice yoga to improve their health and overall well-being. That's why we're encouraging everyone to take part in PALA (Presidential Active Lifestyle Award), so show your support for yoga and answer the challenge".[231]

The American College of Sports Medicine supports the integration of yoga into the exercise regimens of healthy individuals as long as properly-trained professionals deliver instruction. The College cites yoga's promotion of "profound mental, physical and spiritual awareness" and its benefits as a form of stretching, and as an enhancer of breath control and of core strength.[232]

Exercise and health applications

Yoga has been studied and is increasingly recommended to promote relaxation, reduce stress and some medical conditions such as premenstrual syndrome in Europe as well as in the United States.[233] According to Dupler and Frey, Yoga is a low-impact activity that can provide the same benefits as "any well-designed exercise program, increasing general health and stamina, reducing stress, and improving those conditions brought about by sedentary lifestyles". It is particularly suited, add Dupler and Frey, as a physical therapy routine, and as a

regimen to strengthen and balance all parts of the body.[233] Yoga has also been used as a complete exercise program and physical therapy routine.[233]
In 2015 the Australian Government's Department of Health published the results of a review of alternative therapies that sought to determine if any were suitable for being covered by health insurance; Yoga was one of 17 practices evaluated for which no clear evidence of effectiveness was found, with the caveat that "Reviewers were limited in drawing definite conclusions, not only due to a lack of studies for some clinical conditions, but also due to the lack of information reported in the reviews and potentially in the primary studies."[234]
While the practice of yoga continues to rise in contemporary American culture, sufficient and adequate knowledge of the practice's origins does not. According to Andrea R. Jain, Yoga is being marketed as a supplement to a cardio routine with health benefits, but in Hinduism it is more than exercise and incorporates meditation with spiritual benefits.[235]

Potential benefits for adults

While much of the medical community regards the results of yoga research as significant, others point to many flaws which undermine results. Much of the research on yoga has taken the form of preliminary studies or clinical trials of low methodological quality, including small sample sizes, inadequate blinding, lack of randomization, and high risk of bias.[236][237][238] Long-term yoga users in the United States have reported musculoskeletal and mental health improvements, as well as reduced symptoms of asthma in asthmatics.[239] There is evidence to suggest that regular yoga practice increases brain GABA levels, and yoga has been shown to improve mood and anxiety more than some other metabolically-matched exercises, such as walking.[240][241] The three main focuses of Hatha yoga (exercise, breathing, and meditation) make it beneficial to those suffering from heart disease. Overall, studies of the effects of yoga on heart disease suggest that yoga may reduce high blood-pressure, improve symptoms of heart failure, enhance cardiac rehabilitation, and lower cardiovascular risk factors.[242] For chronic low back pain, specialist Yoga for Healthy Lower Backs has been found 30% more beneficial than usual care alone in a UK clinical trial.[243] Other smaller studies

support this finding.[244][245] The *Yoga for Healthy Lower Backs* programme is the dominant treatment for society (both cheaper and more effective than usual care alone) due to 8.5 fewer days off work each year.[246] A research group from Boston University School of Medicine also tested yoga's effects on lower-back pain. Over twelve weeks, one group of volunteers practiced yoga while the control group continued with standard treatment for back pain. The reported pain for yoga participants decreased by one third, while the standard treatment group had only a five percent drop. Yoga participants also had a drop of 80% in the use of pain medication.[247]

There has been an emergence of studies investigating yoga as a complementary intervention for cancer patients. Yoga is used for treatment of cancer patients to decrease depression, insomnia, pain, and fatigue and to increase anxiety control.[248] Mindfulness Based Stress Reduction (MBSR) programs include yoga as a mind-body technique to reduce stress. A study found that after seven weeks the group treated with yoga reported significantly less mood disturbance and reduced stress compared to the control group. Another study found that MBSR had showed positive effects on sleep anxiety, quality of life, and spiritual growth in cancer patients.[249]

Yoga has also been studied as a treatment for schizophrenia.[250] Some encouraging, but inconclusive, evidence suggests that yoga as a complementary treatment may help alleviate symptoms of schizophrenia and improve health-related quality of life.[20]

Implementation of the Kundalini Yoga Lifestyle has shown to help substance abuse addicts increase their quality of life according to psychological questionnaires like the Behavior and Symptom Identification Scale and the Quality of Recovery Index.[251]

Yoga has been shown in a study to have some cognitive functioning (executive functioning, including inhibitory control) acute benefit.[252]

A 2016 systematic review and meta-analysis found no evidence that yoga was effective for metabolic syndrome.[253]

Physical injuries

A small percentage of yoga practitioners each year suffer physical injuries analogous to sports injuries;[254] therefore, caution and common sense are recommended.[255] Yoga has been criticized for being potentially dangerous and being a cause for a range of serious medical conditions including thoracic outlet syndrome, degenerative arthritis of the cervical spine, spinal stenosis, retinal tears, damage to the common fibular nerve, "Yoga foot drop,"[256] etc. An exposé of these problems by William Broad published in January, 2012 in *The New York Times Magazine*[257] resulted in controversy within the international yoga community. Broad, a science writer, yoga practitioner, and author of *The Science of Yoga: The Risks and the Rewards*,[258] had suffered a back injury while performing a yoga posture.[259] Torn muscles, knee injuries,[260] and headaches are common ailments which may result from yoga practice.[261]

Surya Yoga

An extensive survey of yoga practitioners in Australia showed that about 20% had suffered some physical injury while practicing yoga. In the previous 12 months 4.6% of the respondents had suffered an injury producing prolonged pain or requiring medical treatment. Headstands, shoulder stands, lotus and half lotus (seated cross-legged position), forward bends, backward bends, and handstands produced the greatest number of injuries.[254]

Some yoga practitioners do not recommend certain yoga exercises for women during menstruation, for pregnant women, or for nursing mothers. However, meditation, breathing exercises, and certain postures which are safe and beneficial for women in these categories are encouraged.[262]

Among the main reasons that experts cite for causing negative effects from yoga are beginners' competitiveness and instructors' lack of qualification. As the demand for yoga classes grows, many people get certified to become yoga instructors, often with relatively little training. Not every newly certified instructor can evaluate the condition of every new trainee in their class and recommend refraining from doing certain poses or using appropriate props to avoid injuries. In turn, a beginning yoga student can overestimate the abilities of their body and strive to do advanced poses before their body is flexible or strong enough to perform them.[257][261]

Vertebral artery dissection, a tear in the arteries in the neck which provide blood to the brain can result from rotation of the neck while the neck is extended. This can occur in a variety of contexts, but is an event which could occur in some yoga practices. This is a very serious condition which can result in a stroke.[263][264]

Acetabular labral tears, damage to the structure joining the femur and the hip, have been reported to have resulted from yoga practice.[265]

Pediatrics

It is claimed that yoga can be an excellent training for children and adolescents, both as a form of physical exercise and for breathing, focus, mindfulness, and stress relief: many school districts have considered incorporating yoga into their P.E. programs. The Encinitas, California school district gained a San Diego Superior Court Judge's approval to use yoga in P.E., holding against the parents who claimed the practice was intrinsically religious and hence should not be part of a state funded program.[266]

Physiology

Over time, an extended yoga physiology developed, especially within the tantric tradition and hatha yoga. It pictures humans as composed of three bodies or five sheaths which cover the atman. The three bodies are described within the Mandukya Upanishad, which adds a fourth state, turiya, while the five sheaths (pancha-kosas) are described in the Taittiriya Upanishad.[267] They are often integrated:

1. *Sthula sarira*, the Gross body, comprising the *Annamaya Kosha*[268]
2. *Suksma sarira*, the Subtle body, composed of;
    1. the *Pranamaya Kosha* (Vital breath or Energy),
    2. *Manomaya Kosha* (Mind)
    3. the *Vijnanamaya Kosha* (Intellect)[268]
3. *Karana sarira*, the Causal body, comprising the *Anandamaya Kosha* (Bliss) [268]

Within the subtle body energy flows through the nadis or channels, and is concentrated within the chakras.

Yoga and specialized meditation

Zen Buddhism

Zen, the name of which derives from the Sanskrit "dhyāna" via the Chinese "ch'an"[note 23] is a form of Mahayana Buddhism. The Mahayana school of Buddhism is noted for its proximity with yoga.[270] In the west, Zen is often set alongside yoga; the two schools of meditation display obvious family resemblances.[271] This segregation deserves attention because yogic practices integrally exist within the Zen Buddhist school.[note 24] Certain essential elements of yoga are important both for Buddhism in general and for Zen in particular.[272]

Vajrayana or Tibetan Buddhism

In the Nyingma tradition, the path of meditation practice is divided into nine *yanas*, or vehicles, which are said to be increasingly profound.[273] The last six are described as "yoga yanas": "Kriya yoga", "Upa yoga," "Yoga yana," "Mahā yoga," "Anu yoga" and the ultimate practice, "Ati yoga."[274] The Sarma traditions also include Kriya, Upa (called "Charya"), and Yoga, with the Anuttara yoga class substituting for Mahayoga and Atiyoga.[275]
Other tantra yoga practices include a system of 108 bodily postures practiced with breath and heart rhythm. The Nyingma tradition also practices Yantra yoga (Tib. "Trul khor"), a discipline that includes breath work (or pranayama), meditative contemplation and precise dynamic movements to centre the

practitioner.[276] The body postures of Tibetan ancient yogis are depicted on the walls of the Dalai Lama's summer temple of Lukhang. A semi-popular account of Tibetan yoga by Chang (1993) refers to caṇḍalī (Tib. "tummo"), the generation of heat in one's own body, as being "the very foundation of the whole of Tibetan yoga."[277] Chang also claims that Tibetan yoga involves reconciliation of apparent polarities, such as prana and mind, relating this to theoretical implications of tantrism.

Reception in other religions

Christianity

Some Christians integrate yoga and other aspects of Eastern spirituality with prayer and meditation. This has been attributed to a desire to experience God in a more complete way.[278] In 2013, Monsignor Raffaello Martinelli, servicing Congregation for the Doctrine of the Faith, having worked for over 23 years with Cardinal Joseph Ratzinger (Pope Benedict XVI),[279] said that for his Meditation, a Christian can learn from other religious traditions (zen, yoga, controlled respiration, Mantra), quoting Aspects of Christian meditation: "Just as "the Catholic Church rejects nothing of what is true and holy in these religions," neither should these ways be rejected out of hand simply because they are not Christian. On the contrary, one can take from them what is useful so long as the Christian conception of prayer, its logic and requirements are never obscured. It is within the context of all of this that these bits and pieces should be taken up and expressed anew."[280] Previously, the Roman Catholic Church, and some other Christian organizations have expressed concerns and disapproval with respect to some eastern and New Age practices that include yoga and meditation.[281][282][283]
In 1989 and 2003, the Vatican issued two documents: *Aspects of Christian meditation* and "A Christian reflection on the New Age," that were mostly critical of eastern and New Age practices. The 2003 document was published as a 90-page handbook detailing the Vatican's position.[284] The Vatican warned that concentration on the physical aspects of meditation "can degenerate into a cult of the body" and that equating bodily states with mysticism "could also lead to psychic disturbance and, at times, to moral deviations." Such has been compared

to the early days of Christianity, when the church opposed the gnostics' belief that salvation came not through faith but through a mystical inner knowledge.[278] The letter also says, "one can see if and how [prayer] might be enriched by meditation methods developed in other religions and cultures"[285] but maintains the idea that "there must be some fit between the nature of [other approaches to] prayer and Christian beliefs about ultimate reality."[278] Some fundamentalist Christian organizations consider yoga to be incompatible with their religious background, considering it a part of the New Age movement inconsistent with Christianity.[286]

Another view holds that Christian meditation can lead to religious pluralism. This is held by an interdenominational association of Christians that practice it. "The ritual simultaneously operates as an anchor that maintains, enhances, and promotes denominational activity and a sail that allows institutional boundaries to be crossed." [287]

Islam

In early 11th century, the Persian scholar Al Biruni visited India, lived with Hindus for 16 years, and with their help translated several significant Sanskrit works into Arabic and Persian languages. One of these was Patanjali's Yogasutras.[288][289] Al Biruni's translation preserved many of the core themes of Patañjali 's Yoga philosophy, but certain sutras and analytical commentaries were restated making it more consistent with Islamic monotheistic theology.[288][290] Al Biruni's version of Yoga Sutras reached Persia and Arabian peninsula by about 1050 AD. Later, in the 16th century, the hath yoga text *Amritakunda* was translated into Arabic and then Persian.[291] Yoga was, however, not accepted by mainstream Sunni and Shia Islam. Minority Islamic sects such as the mystic Sufi movement, particularly in South Asia, adopted Indian yoga practises, including postures and breath control.[292] [293] Muhammad Ghawth, a Shattari Sufi and one of the translators of yoga text in 16th century, drew controversy for his interest in yoga and was persecuted for his Sufi beliefs.[294]

Malaysia's top Islamic body in 2008 passed a fatwa, prohibiting Muslims from practicing yoga, saying it had elements of Hinduism and that its practice

was blasphemy, therefore haraam.[295] Some Muslims in Malaysia who had been practicing yoga for years, criticized the decision as "insulting."[296] Sisters in Islam, a women's rights group in Malaysia, also expressed disappointment and said yoga was just a form of exercise.[297] This fatwa is legally enforceable.[298] However, Malaysia's prime minister clarified that yoga as physical exercise is permissible, but the chanting of religious mantras is prohibited.[299]

In 2009, the Council of Ulemas, an Islamic body in Indonesia, passed a fatwa banning yoga on the grounds that it contains Hindu elements.[300] These fatwas have, in turn, been criticized by Darul Uloom Deoband, a Deobandi Islamic seminary in India.[301] Similar fatwas banning yoga, for its link to Hinduism, were issued by the Grand Mufti Ali Gomaa in Egypt in 2004, and by Islamic clerics in Singapore earlier.[302]

In Iran, as of May 2014, according to its Yoga Association, there were approximately 200 yoga centres in the country, a quarter of them in the capital Tehran, where groups can often be seen practising in parks. This has been met by opposition among conservatives.[303] In May 2009, Turkey's head of the Directorate of Religious Affairs, Ali Bardakoğlu, discounted personal development techniques such as reiki and yoga as commercial ventures that could lead to extremism. His comments were made in the context of reiki and yoga possibly being a form of proselytization at the expense of Islam.[304]

International Day of Yoga

On 11 December 2014, The 193-member United Nations General Assembly approved by consensus, a resolution establishing 21 June as 'International Day of Yoga'.[305] The declaration of this day came after the call for the adoption of 21 June as International Day of Yoga by Indian Prime Minister Narendra Modi during his address to UN General Assembly on 27 September 2014.[306][307][308][309][310] In suggesting 21 June, which is one of the two solstices, as the International Day of Yoga, Narendra Modi had said that the date is the longest day of the year in the Northern Hemisphere and has special significance in many parts of the world.[311]

The first International Day of Yoga was observed world over on 21 June 2015. About 35000 people, including Indian Prime Minister Narendra Modi and a large number of dignitaries, performed 21 Yoga asanas (yoga postures) for 35 minutes at Rajpath in New Delhi. The day devoted to Yoga was observed by millions across the world.[312] The event at Rajpath established two Guinness records – largest Yoga Class with 35985 people and the record for the most nationalities participating in it- eighty four.

Impact of Yoga on Digestive System

Digestive System in human body is also known as alimentary or gastrointestinal system. It provides nourishment to all the body cells from the external environment. Food intake, its digestion, absorption and assimilation; water balance, elimination of residue, waste products and poisonous substances are the main functions of this system. The system includes gastrointestinal tract (alimentary canal), salivary glands and portions of liver and pancreas. The alimentary canal is a continuous tube. It consists of mouth (buccal cavity), throat (pharynx), esophagus, stomach, small intestine, large intestine (colon), rectum and anal canal, ending in the anus. In order to keep this system healthy yoga can be instrumental. Some of the Kriyas like Dhauti, Basti and Nauli influence the functioning of the digestive system significantly. But before beginning with the yogic practices it is essential to acquire knowledge about the digestive system in details.

The entire digestive and other parts are properly held and protected by means of very strong muscles that form the wall of the belly. This abdominal wall prevents displacement of the stomach, intestine or any other organ in the abdomen. The abdominal wall also provides mechanical support to the abdominal viscera as it contains strong rectus abdominus muscles. This helps to maintain the tone of the involuntary muscles of the abdominal organs. The oral cavity (mouth) is one of the organs of the digestive system. It is made-up of a small outer portion (vestibule) between the teeth and the lips and the inner major part between the teeth and the tongue. Roof of the mouth consists of a hard and soft palate. This soft palate helps in swallowing, sucking, blowing and producing sound. The

tongue, on the other hand, is a muscular organ. It helps in chewing, swallowing, speaking and tasting, Pharynx is a muscular tube, which leads to esophagus and ends into the stomach. Digestive glands are situated in the wall of the stomach. They secrete juices, containing enzymes, which break down the food particles into simple soluble substances. The digested food, in turn, is easily absorbed through inner wall of the small intestine into the blood capillaries. Pancreas and liver also help in digestion by supplying the pancreatic juice and bile respectively. The absorbed food particles are carried to the liver and then into the general circulation.

The stomach opens into the duodenum, which further leads y to small intestine. The small intestine is about 5 meters long. It joins large intestine (colon), which is about 1.5 meters long and has got three distinct parts, viz., ascending, transverse and descending colon. Last parts of the large intestine are known as rectum and anal canal, which open to the external environment through anus. The colon contents are greatly influenced during uddiyan, nauli and basti kriyas.

Most of the digested food is absorbed in the small intestine. The large intestine absorbs mainly sodium along with the large quantities of water. This makes the fecal material dry. In turn, potassium is transported from blood capillaries into the lumen of the large intestine to keep feces moisturised. Repeated enemas or diarrhea may lead to serious loss of potassium in the body and therefore one may experience weakness in the muscles. The large intestine also absorbs some of the products synthesized by the bacteria. For example, small amounts of vitamins, which are synthesized by bacteria in the large intestine, are absorbed by the large intestine itself.

Undigested, unwanted and toxic residues of food are passed on to the rectum and then eliminated through the anus during the process of defecation. This evacuation of the bowel is assisted by a deep inspiration followed by closure of the glottis and contraction of the abdominal and chest muscles, causing a marked increase in intrathoracic pressure. There is a sudden rise in the blood pressure. This is followed by a fall in the blood pressure due to decreased venous return (returning blood) to the heart.

The smooth muscles of the digestive parts are involuntary muscles, which are not working under the individual's will. Major autonomic nerve of the gastrointestinal tract (GIT) is the vagus nerve, which sends branches to the stomach, small intestine and upper portion of large intestine. In fact, the activity of smooth muscles and exocrine (digestive) glands are controlled by the autonomic nervous system and the internal nerve plexus as well as the hormones secreted by GIT itself. Gastrointestinal receptors initiate reflexes and the information is conveyed to the central nervous system (CNS). Short reflexes bring about self-regulation in the tract. Sometimes an individual can experience sensations like pressure, pain, temperature, or burning in the abdominal region. This is mainly due to various visceroreceptors situated along the GIT. When they are stimulated because of stretching, pressure or the chemical action, the strong sensory impulses are sent to the CNS and one's attention is drawn. Hunger and appetite are such sensations coming from the stomach.

The central nervous system has no direct control on the digestive function but the appetite and satiety centers lie in the hypothalamus. The emotional balance and behavior of the human beings are also controlled by the hypothalamic centers. It has been found that even the muscular tone of the smooth muscles of the visceral parts is affected due to an individual's emotional status, such as, rage, abhorrence and annoyance. Thus, it can be concluded that digestion is affected due to one's thinking style, tense and unsatisfied mind and the negative approach. This causes indigestion, acidity, and gastric troubles. If the digestive function is disturbed,

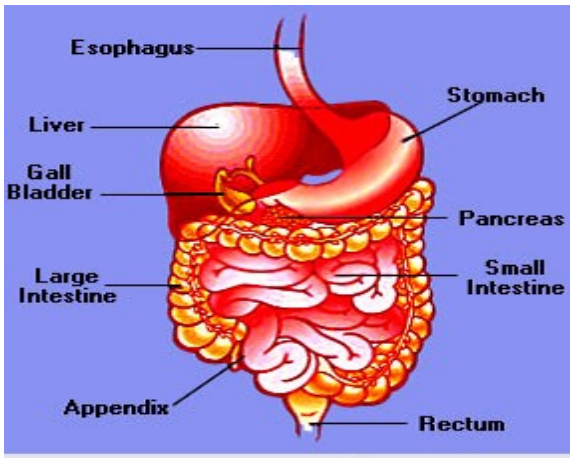
health is also affected. In order to maintain mental peace and balance, a positive approach, contentment and happiness are required, which can be achieved through yoga.

Almost all the yoga asanas as well as kriyas influence stomach, colon, urinary bladder and liver. Dhauti is mainly related to esophagus and stomach while Basti is concerned with the anus, rectum and the colon. The external sphincters of the anus are contracted and relaxed alternately in Ashwini mudra.

Yoga asanas create movements in the human body that greatly enhances the activities of the digestive organs. There are several ailments that occur in the digestive tract due to various reasons. Bowel irregularities can be caused due to several reasons like unhealthy lifestyle, consuming the wrong kinds of foods, chronic indigestion, and extra sensitive digestive system. One must always check the eating habits before the digestive system becomes disable of its function. It is always advisable to eat simple and healthy meals. One should avoid foods that cause bowel disorders. Refined oily and spicy foods should always be avoided. Digestive system works best if fresh foods such as vegetables, salads, fruits, curd and buttermilk are consumed at a regular basis. One should chew the food well before swallowing it and one should practice eating at the same time daily if possible. Besides this yoga asanas are the best possible ways to treat the digestive ailments naturally.

Jathara Parivartanaasana or the 'Revolved Abdominal Pose' is truly beneficial for the internal organs and to relieve the stiffness in the back. It also helps to get rid of excess fats, tones the liver, pancreas and spleen. It boosts the strength of the intestines and also helps to keep the abdominal organs healthy. Apanaasana or the 'Knees to Chest' pose helps to keep the digestive system healthy and improves the elimination of wastes. Uttanaasana or 'standing forward bend' asana helps to alleviate depression and stress. It also has a stimulating effect on the kidneys and liver and improves the functions of the digestive system. If a person frequently suffers from bloating, cramping, and gas after meals, one should practice the Bhujangasana and Pawan Muktasana regularly.

Yoga asanas increase blood flow to the digestive tract and stimulate the intestinal action known as peristalsis that results in digestion more efficiently. Yoga also calms the mind, which in turn relaxes the digestive system and leads to more effective elimination. Forward bend asanas increase the space in the abdomen and facilitate the release of entrapped gases. These poses heat the frontier part of the body and cool the back body as well.



Human Digestive System


Bhujangasana

Yoga for Digestion- Rejuvenate Your Digestive System The Ancient Way

A healthy digestive system in Ayurveda is referred to as the mainstream of our well-being. The root cause of most of the diseases is inefficient digestion. The metabolic energy of digestion called agni helps in eliminating the body wastes and toxins. It breaks down the dense physical matter into subtle energy the body needs, generates internal warmth and produces a clear mind

Let's think of our digestive system as a juicer, body toxins as fruit waste, agni as juicer blades and energy as juice. If the juicer blades are weak, less juice is generated and there is more of fruit waste left. Similarly when this agni (juicer blade) is weak, there is not enough digestive power to metabolise food into energy(juice).The result? More toxins(fruit waste) are accumulated in the cells. Thus a stronger agni (better juicer blades) is required for a good digestive system. An easy way to support digestive agni is through Yoga.

How Does Yoga Help In Having A Better Digestive System?

Yoga couples exercises with rhythmic breathing. Breathing brings life force into the body and cleans the body of toxic materials formed due to wrong diet,

unhealthy lifestyle & accumulated stresses. It improves agni, creates body balance and longevity rejuvenating the whole system.

Yoga Poses To Aide Digestion:

- Trikonasana (Triangle pose)-Improves digestion, stimulates appetite and alleviates constipation.
- Paschimottanasana (Forward bending pose)- Relieves digestive problems like constipation.
- PavanaMuktsana- Improves gastrointestinal problems
- Matsyendrasana- Massages the abdominal organs, alleviating digestive ailments.
- Ushtrasana (Camel pose)- It stretches the stomach and intestines, alleviating constipation.

Yoga – Brings In A Wow Factor

There are more reasons to do yoga than not to. If we think of it, we are certain to get a list of things that be gained by having a good digestive system.

- A light, supple body
- A body that remains alert & active • Strong bones and muscle
- Fat reduction
- Increased physical strength

- Improved appetite
- Increased capability of coping with fatigue

All this can come our way. All we need to do is to practice yoga daily and have a good digestive system. Every time we do yoga, we are gifting ourselves an opportunity to enhance our health.

Yoga is a multi-functional tool. It helps to resolve many issues that get in the way of connecting to your true self. Times change, people change, but yoga is still relevant in what it can do for each one of us.

One of the recent problems plugging society is chronic constipation. If you are feeling heavy and bloated, you are among the 100 million Americans who may not have regular daily bowel movements. Okay, this may not be anyone's favorite topic, but did you know that Americans spend over $725 million on laxatives each year?!

The good thing is that yoga can help deal with this issue without relying on pills.

When one’s body feels clean and empty, yoga practice becomes a lot easier, and more natural, as does life. It’s easier to meditate, to feel at peace, and to feel at home living in a body that is free of waste. You need to take care of your body by keeping the sewage system clean.

As a yogi, you have tools at your disposal that many other people don't. You can adapt your yoga practice to address the issue of digestion just the same way you adjust your diet to address your needs.

Here are a few yoga practices that you can add to your routine to help attain internal purity:

1. Agnisar Kriya - This cleansing technique draws its name from the words Agni (Fire), Sar (Essence) and Kriya (Action). Fire is the essential element of digestion, and this cleansing action stimulates this digestive fire to work at its optimum level. It is easy to learn, and takes just a few minutes a day. Do it first thing in the morning after a glass of water. Let it burn, baby, burn! Click here for a video that will show you exactly how to learn it

2. Nauli - This technique takes a little bit more practice, but the benefits are well worth the effort. Similar to Agnisar, it is said to improve digestion, assimilation and elimination. It is similar to self-massage of the abdominal area. It helps to tone muscles in the abdominal area and improves circulation. Click here to learn about this one.

3. Twists - Most twists directly affect the area below the ribcage where most digestion happens. Twists squeeze your body's most important detox player, the liver, hastening an inner cleanup of all the junk we consume. While doing a twist, focus on the breath. Don't rush out of them; spend at least 8-10 breaths on each side.

4. Deep breath - Deep breathing is similar to a mild massage for the digestive organs. There are several different pranayama practices to choose from, but the essence stays the same. Inhale and let your belly expand from the diaphragm moving down, and on the exhale relax the stomach and let it fall in. The key here is not to force the movement of the stomach but to reduce all the tension that might get in the way of this natural movement. Especially when you exhale,

don't contract the stomach, but fully relax and soften it. It will naturally go toward the spine.

5. Yoga nidra - Stress effects digestion in a very adverse way. You need to relax, and things will move along more easily. Try this yoga nidra:

6. Peacock - I love this one! According to ancient traditional texts, a yogi who practices peacock can digest nails. All we are trying to achive is to digest modern day food; let's hope that what you are eating is not worse than nails! Do it after inversions, before restorative poses. Click here to learn this.

7. Abhyanga on the stomach - If Nauli is out of reach for the time being, use your hands. Using coconut or almond oil, gently massage your stomach in circular movements starting from the belly button and moving towards the outer areas in a clockwise direction. It helps everything to move along.

Surya Yoga