Characterization and analysis of the major risk factors of the Kidney Patients of Bangladesh: A Retrospective Study

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Submitted by

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DECLARATION

It is to declare that, this thesis, entitled **"Characterization and analysis of the major risk factors of the Kidney Patients of Bangladesh: A Retrospective Study"** is based on my own work and it contains no material previously published or written by another person and not accepted for the award of any other degree of university or other institute of higher education.

This research work was carried out at the institute **"Kidney Foundation, Bangladesh",** Mirpur, Dhaka under the supervision of Dr. Mohammad Rafiqul Islam, Associate Professor, Department of Mathematics and Natural Sciences, BRAC University, Dhaka.

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Sincerely,

Mahmud-Ur-Rahman

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List of Abbreviations

ADPKD	Autosomal Dominant Polycystic Kidney Disease
ARPKD	Autosomal Recessive Polycystic Kidney Disease
BMI	Body Mass Index
BPH	Benign Prostatic Hyperplasia
CAPD	Continuous Ambulatory Peritoneal Dialysis
CKD	Chronic Kidney Disease
DKD	Diabetic Kidney Disease
DM	Diabetes Mellitus
ESRD	End Stage Renal Disease
GFR	Glomerular Filtration Rate
HD	Hemodialysis
IgA	Immunoglobulin A
LDL	Low Density Lipid
LOH	Loop of Henle
PD	Peritoneal Dialysis
PKD	Polycystic Kidney Disease
RBC	Red Blood Cell
RBS	Random Blood Sugar
RRT	Renal Replacement Therapy
UTI	Urinary Tract Infections

Abstract

Kidney disease is a global health burden in recent times. A large number of people all over the world are suffering from some form of kidney disease. The pattern of kidney disease may differ in different parts of the world. Moreover, a large number of kidney patients suffer from Chronic Kidney Disease. The objective of this study is to identify the major risk factors, determine a critical age range for onset of kidney disease and characterizing the kidney patients of Bangladesh by analyzing different cofactors on a retrospective study. The study was carried out in an institution specialized in research, diagnosis and treatment of kidney patients. The name of the institution is "Kidney Foundation, Bangladesh" and it is situated in Mirpur, Dhaka. A total of 200 subjects data were taken under this study for analyzing their cases who were registered patients at the institute in 2016. From the patients file, respective data were collected for further analysis. The prevalence of kidney disease was observed in a higher percentage in man (54%) than women (46%). Most of the subjects were of the age range of 51-60 and above 60 years (25.5% each). This specific age range was found almost similarly predominant within both male and female subjects. After calculating the Body Mass Index of the subjects, it was found that, although the largest percentage of it lies within the normal weight limit (45%), there was a concerning percentage lies within the overweight limit (39.5%). Moreover, 13.5% patients were obese and only 2% were under weight. From the total number of subjects, 70% were suffering from Chronic Kidney disease. In addition, a strong association of diabetes and hypertension with Chronic Kidney Disease was also observed. Among 140 patients of Chronic Kidney Disease, 33% had diabetes, 36% had hypertension and 31% had both diabetes and hypertension. Along with that, from total 200 subjects, 31% had hypertension, 28% had diabetes and 23% had both diabetes and hypertension and remaining 18% had none of them. Besides these, most of the patients (38%) blood group was B+(ve). Although the weight of the kidneys was not available in the patient's medical file, their kidney length was found as normal in size. The evidence from the study presented that, the critical age range for onset of kidney disease is above 50 years for both male and female individual and there is a strong association of diabetes and hypertension with Chronic Kidney Disease.

Keywords:

Kidney Disease, Chronic Kidney Disease, Diabetes, Hypertension, Critical Age Range, Blood Group, Body Mass Index (BMI)

1. Introduction

One of the most important organs of human body is kidney. The basic functions of kidneys involve removing the waste products from the blood and water fluid level regulation. The kidneys basically filter the blood. Blood in our bodies passes through the kidneys several times a day. Since the kidneys filter blood, they create urine which moves downward to the bladder. (Glodny et al., 2009)

Kidneys are bean-shaped organ. The convex side of each organ located laterally and the concave side is at medial. The renal hilus (concave side), provides an area for the renal artery, renal vein, and ureter to enter the kidney. Each kidney is surrounded by a thin layer of fibrous connective tissue forms the renal capsule. The renal capsule facilitates maintaining of the shape of the soft inner tissues. At the deep of the renal capsule is the soft, dense, vascular renal cortex**. (innerbody.com, 2017)**

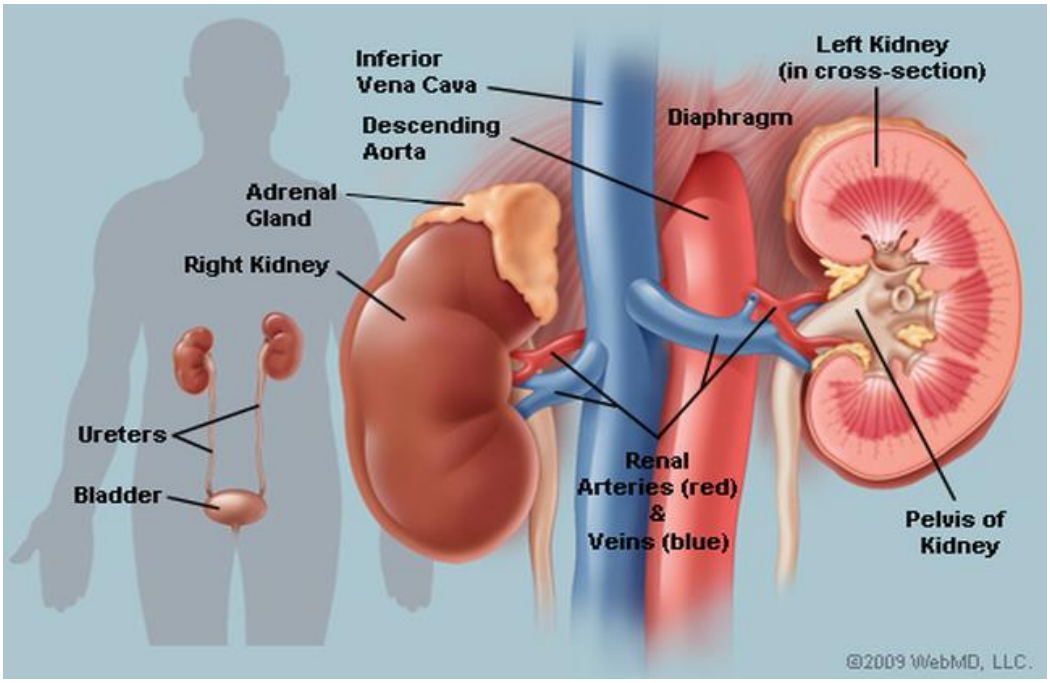

Figure 01: Location and structure of the kidneys in human body

The kidneys are situated at the back of the abdomen. The position of the liver is responsible for the position of the right kidney as it is located lower than the left kidney and smaller in size. The left kidney is at vertebral level and the right kidney is located just below the diaphragm. (Wikipedia.com, 2017)

The average size of an adult human kidney is about 10 to 13 cm (4 to 5 inches) long, width is approximately 5 to 7.5 cm (2 to 3 inches) and thickness is about 2 to 2.5 cm (1 inch).

The weight of the kidney is approximately 150 to 160 grams of each. Both the kidneys together weight about 0.5 percent of total body weight. The right kidney is slightly smaller than the left kidney. (Kidneychat.com, 2017)

Regular kidney size is directly correlated with age, height and BMI (body mass index). Therefore, the people who are tall and have greater BMI are likely to have larger kidney size than shorter persons who have less BMI. In addition, kidneys usually shrink along with the increasing of age.

The above information of kidney size is all about normal healthy adult people. The determination of the kidney size in children is more specific and complex.

Kidney disease among people in our country is a common phenomenon. The development of chronic kidney disease (CKD) in developing countries is associated with factors such as poor sanitation hygiene, unavailability of safe water, environmental pollutants and high concentrations of disease-transmitting vectors. The rate of diabetic nephropathy is increasing. Chronic glomerulonephritis and interstitial nephritis are among the major causes of CKD in many countries. Along with that, HIV-associated nephropathy is the major cause of CKD in Sub-Saharan Africa.

A large number of people around the world are suffering from various forms of kidney diseases. Kidney diseases are often associated with several other diseases such as, diabetes, hypertension etc.

According to the information of National Kidney Foundation, there are several tips for preventing kidney diseases. They are as follows:

- Quit Smoking
- Alcohol and Your Kidneys

- Lose Weight if You're Overweight or Obese
- Follow a Healthy Diet
- Lower Salt in Your Diet
- Understanding Food Labels
- Exercise

A large number of people believe that kidney disease is not curable and the only treatment of kidney disease is kidney dialysis. But the prevention of kidney disease can be done by following several tips.

The destination of this study is to identify the prevalence, determine a critical age range for the onset of kidney disease and characterizing the occurrence of kidney disease in Dhaka, Bangladesh by analyzing different cofactors on a retrospective study. Besides these, it is still distinct that, further studies to get a more comprehensive analysis of epidemiological aspect is highly required for establishing better awareness and controlling the disease.

1.1 Functions of the kidney

Kidneys filter extra water and toxins from the blood. According to the National Institutes of Health , the kidneys filter about 120 to 152 quarts (113 to 144 liters) of blood to create 1 to 2 quarts (0.94 to 1.8 l) of urine every day. (Bradford, 2017)

The fluids and toxins pass through and then go through the tubule. The tubule collects minerals that the body needs and sets them back into the bloodstream and filters more toxins. (Bradford, 2017)

During filtration, the kidneys produce urine which carries the toxins away. The urine is sent through two tubes called ureters down to the bladder, where the urine then moves out the body through the urethra. The kidneys also make hormones. These hormones aid to regulate blood pressure, generate red blood cells and promote the bone health. (Bradford, 2017)

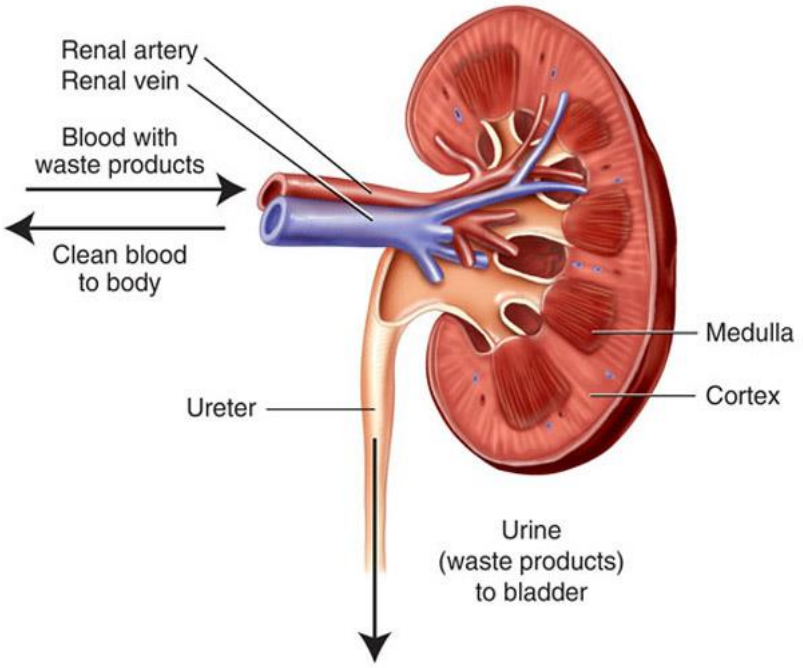

Figure 02: Functions of the kidney

1.2 Types of kidney disease

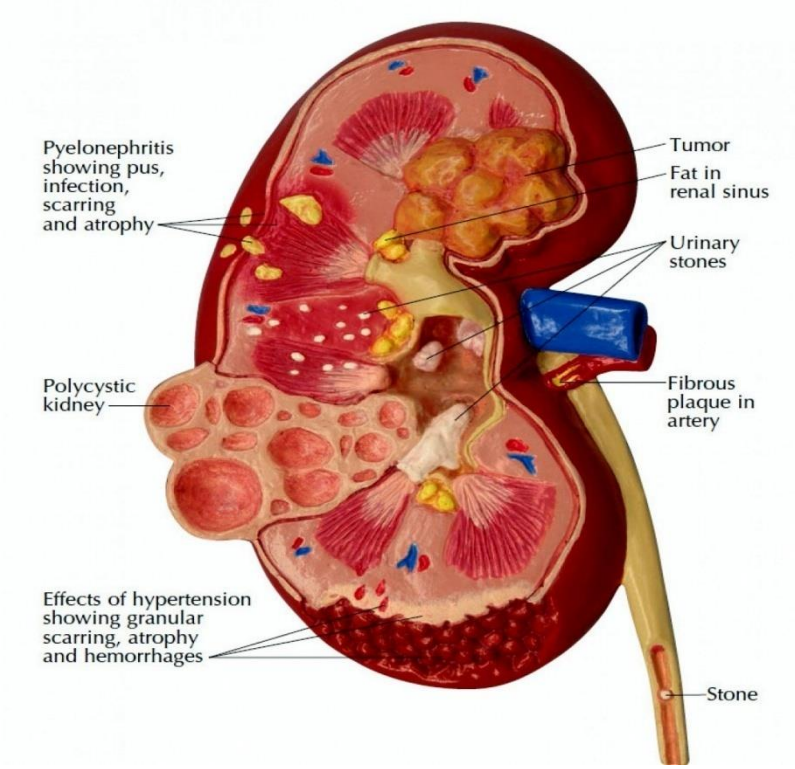

Figure 03: Different types of kidney diseases shown in a kidney

1.2.1 Chronic Kidney Disease (CKD)

Lack of kidney care and genetic construction can result several health problems. Chronic kidney disease, also called chronic kidney failure refers to when the kidneys gradually stop working. According to the National Kidney Foundation, one in three American adults is at high risk for developing kidney disease. According to the Mayo Clinic, There are many stats that can result kidney disease, including type1 and type2 diabetes, hypertension, obstacles in the urinary tract and inflammation of various parts of the kidneys. (Razmaria, 2016)

The basic function of kidneys is the removal of waste product through filtration. If the filtration process gets troubled or damaged, initially they may become porous and substances like proteins can move from blood into urine. At later stages, these filters slowly shut down and lose their ability of filtering. When kidney impairment lasts for more than 3 months, it is called **chronic kidney disease.** This process eventually results in decreased urine production and kidney failure. (Razmaria, 2016)

Moreover, chronic kidney disease is associated with high blood pressure, which not only can be caused by kidney damage but also further facilitates kidney injury and is a major cause for the harmful consequences of chronic kidney disease on other organs that include, increased risk of heart disease and stroke, collection of excess body fluids, anemia, loss of the strength of bones, and impairment of the way the body eliminates medications. (Razmaria, 2016)

1.2.2 Kidney failure

Kidney failure is the most dangerous stage of kidney disease. It happens when kidneys stop functioning without any support. People with kidney failure immediately require dialysis or a kidney transplant to survive. In most cases, people with normal and healthy kidneys can donate part of a kidney or a whole kidney without becoming sick. At present, kidney transplants are one of the most common surgeries. (Solan and Kivi, 2017)

1.2.3 Polycystic kidney disease

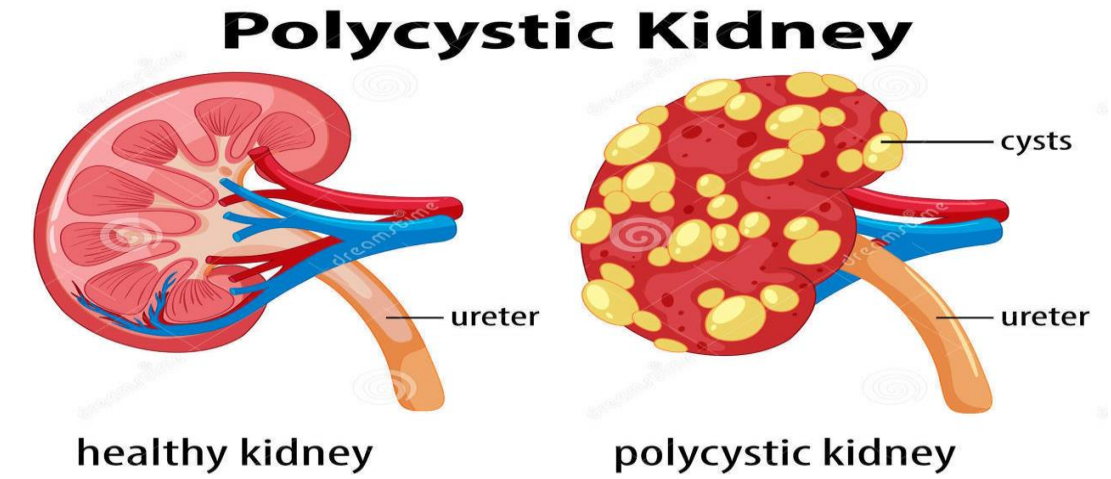

Figure 04: Comparison between a healthy and a polycystic kidney

Polycystic kidney disease (PKD) is basically an inherited disorder which is characterized by cystic expansion of the kidneys. The disease can be inherited in both autosomal dominant and recessive forms. Autosomal dominant polycystic kidney disease (ADPKD) is characterized by progressive and slow enlargement of the kidneys along with renal failure occurring by the fifth to sixth decade of life. (mayoclinic.org, 2017)

1.2.4 Kidney Stones

A kidney stone is a hard, crystalline mineral material usually formed in the kidney or urinary tract. They are a common cause of blood in the urine and often result in severe pain in the abdomen, flank, or groin. Moreover, they are sometimes called renal calculi also.

Kidney stones generate when there is a reduction in urine volume and/or an abundance of stone-forming substances in the urine. The most common type of kidney stone contains calcium along with either oxalate or phosphate. Usually, a majority of kidney stones are calcium stones. There are several other chemical compounds that can form stones in the urinary tract such as uric acid, magnesium, ammonium phosphate and the amino acid cysteine.

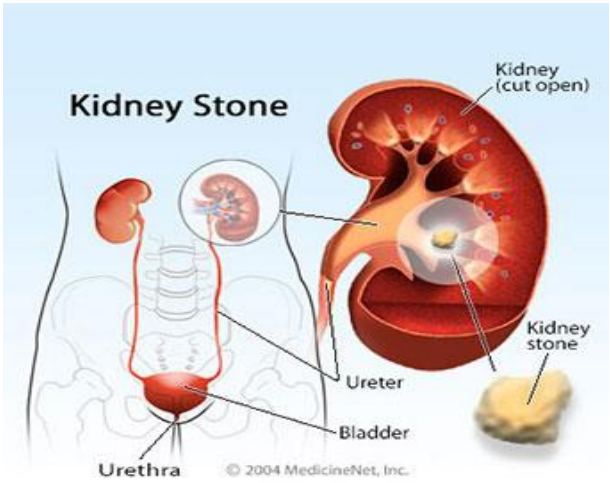

Figure 05: Kidney stones

Dehydration from reduced fluid intake or strenuous exercise without adequate fluid replacement increases the risk of forming kidney stones. Obstruction to the regular flow of urine can also causes stone formation. Therefore, climate can be a risk factor for kidney stone formation as habitants of warm and dry areas are more prone to become dehydrated and vulnerable to stone formation.

Kidney stones can also be generated from infection in the urinary tract. These are commonly known as infection stones. Metabolic abnormalities such as inherited disorders of metabolism can manipulate the composition of the urine and increase the risk of stone formation. (Preminger and Glenn, 2017)

1.2.5 Pyelonephritis

Pyelonephritis refers to the inflammation of the kidney tissue, calyces, and renal pelvis. It is commonly caused by bacterial infection that has spread up the urinary tract or travelled through the bloodstream to the kidneys. (Wikipedia.com, 2017)

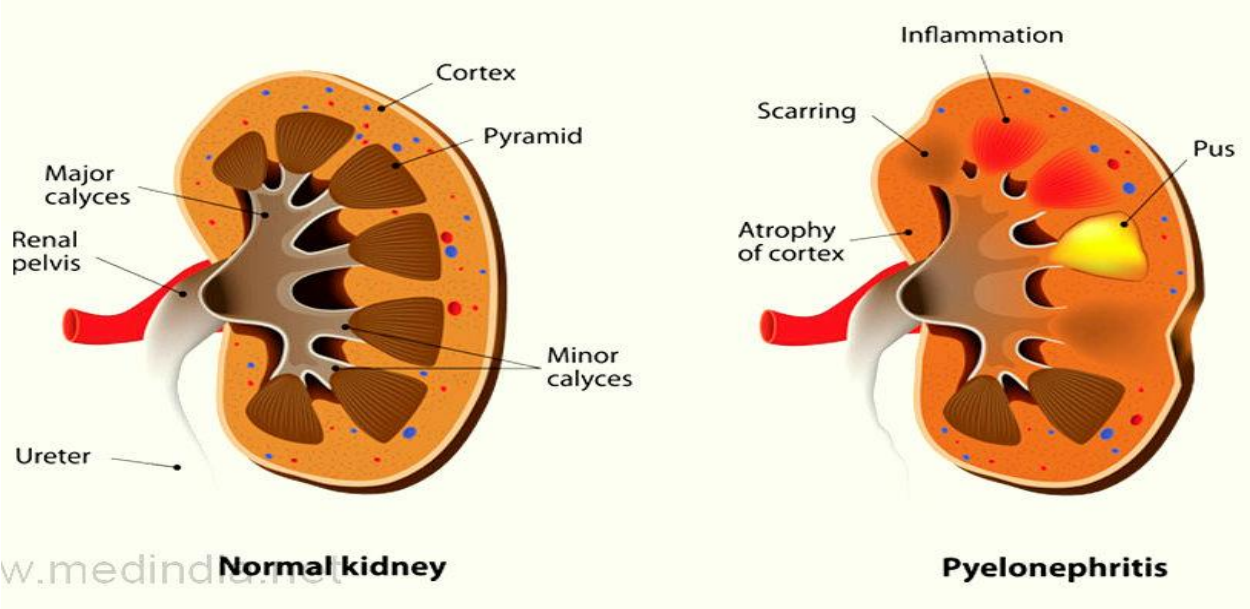

Figure 06: Comparison between a healthy kidney and a kidney with pyelonephritis

1.2.6 Glomerulonephritis

Glomerulonephritis refers to a group of diseases that wound the part of the kidney which involves filtering blood. When the kidneys get injured, it cannot remove wastes and extra fluid from the body. Moreover, the kidneys may stop working completely if the sickness carries on and it may resultin kidney failure. (National Kidney Foundation, 2017)

Glomerulonephritis usually occurs on its own or as part of another disease, such as lupus or diabetes. Severe inflammation along with with glomerulonephritis can damage kidneys. (Mayoclinic.org, 2017)

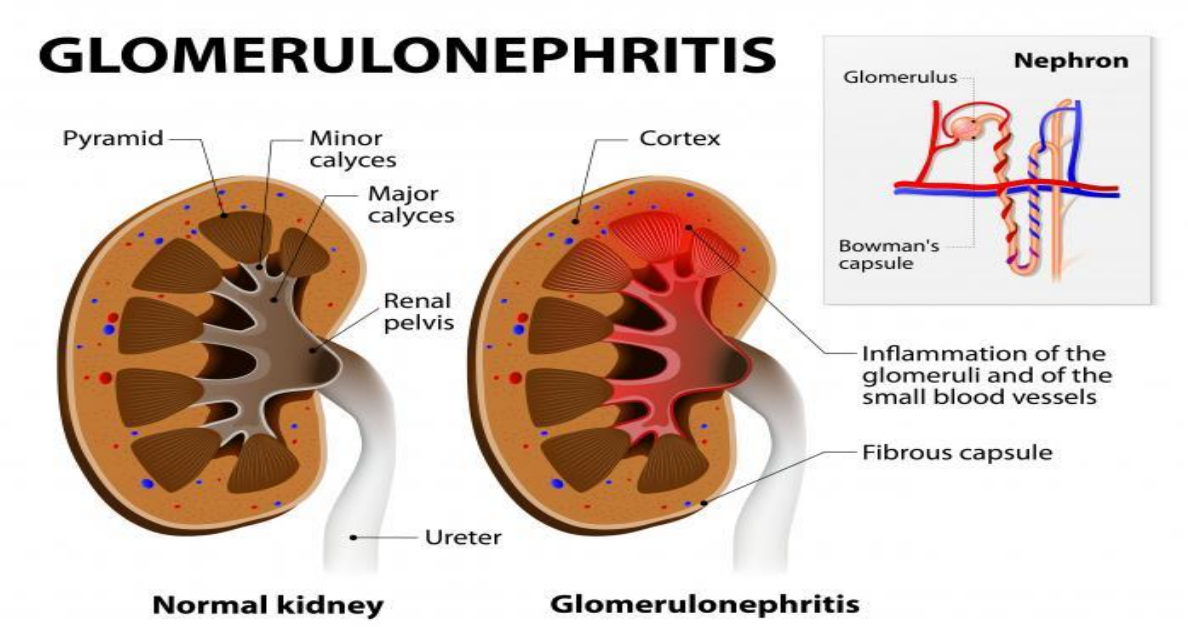

Figure 07: Comparison between a healthy kidney and a kidney with glomerulonephritis

1.2.7 Kidney Cancer

Kidney cancer refers to any type of cancer related to the kidney. Older age, obesity, smoking, and high blood pressure facilitates the risk of developing kidney cancer. Kidney cancers mainly form in two parts of the kidney which include the renal tubule and the renal pelvis. (Nordqvist, 2017)

Throughout the world, North America has the highest percentage of kidney cancer. On the other hand, the phenomenon has been slowly increasing over the last thirty years in developing countries. This progress may be related to a similarly equal rise in obesity rates. (Nordqvist, 2017)

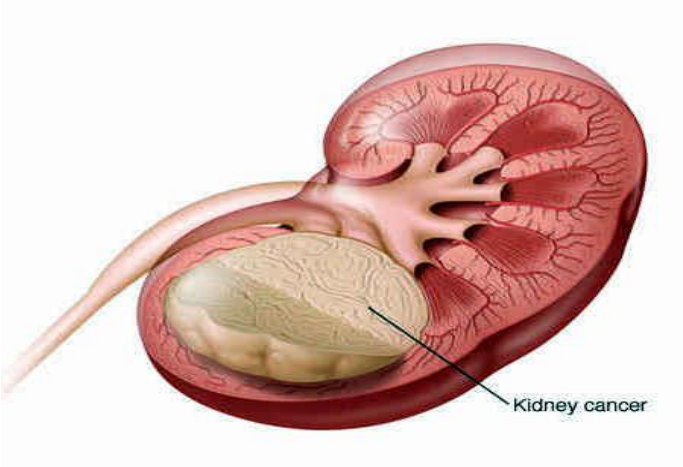

Figure 08: Kidney Cancer

1.2.8 Diabetic Nephropathy

Diabetic nephropathy is considered after a routine urinalysis and screening for microalbuminuria in the setting of diabetes. There are some physical characteristics in patients associated with long-term diabetes mellitus (DM). Strong evidence shows that early treatment has the potential to make delay or prevent the onset of diabetic nephropathy or diabetic kidney disease. Moreover, it has been shown effective in both type1 and type 2 diabetes mellitus. (Batuman, 2017)

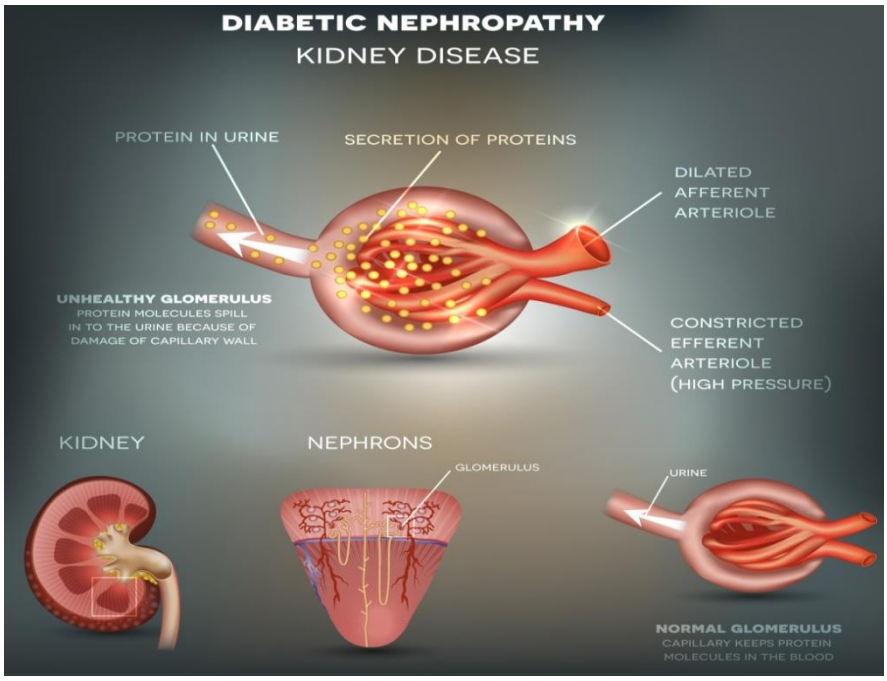

Figure 09: Diabetic Nephropathy

1.2.9 Kidney and Ureteral

Stones form in the kidneys when there is presence of crystal substances in the urine and tiny particles surround and get these crystals. Ureteral stones are particles that move to the ureter from the kidney. (O'Connell, 2016)

These stones can obstruct urine flow and cause a serious pain. Many people can remove small stones from the body without medical assistance, but larger stones may create blockage, which creates problems. (O'Connell, 2016)

To throw out large stones, it requires medical processes in some cases. Extracorporeal shock wave lithotripsy (ESWL) is one of the most commonly used procedures. The technique uses sound waves to impair the stones into smaller pieces as they can escape the body easily. (O'Connell, 2016)

1.2.10 Hematuria

Presence of blood in urine may be a symptom of hematuria. Moreover, this phenomenon can result in severe problem.

Blood that is visible in urine is called gross hematuria and urinary blood which is visible only under a microscope is known as microscopic hematuria and is identified by doctor's examination. However, it is important to correctly determine the reason behind bleeding and treatment as per doctor's advice. (mayoclinic.org, 2017)

Basically, hematuria refers to the presence of 5 or more red blood cells (RBCs) per high-power field in 3 of 3 consecutive centrifuged specimens obtained at least 1 week interval. The important fact is that, it may be symptomatic or asymptomatic, transient or persistent, and even isolated or associated with proteinuria and other urinary problems. (Gulati, 2017)

1.2.11 Nephrotic syndrome

Nephrotic syndrome may occur due to the destruction of the filtering parts of the kidneys. This damage admits protein to leak into the urine in large amounts, which decreases the amount of protein in blood. Since the protein in the blood helps to keep fluid in the

bloodstream, some of this fluid leaks out of the bloodstream into tissues which causes swelling and it is called edema. The swelling may be most dominant in legs. Finally, the swelling in legs may remain all the time and it may also moves on other parts of the body. (National Kidney Foundation, 2017)

Treatment for nephrotic syndrome involves treating the responsible condition and taking prescribed medications. Besides these, nephrotic syndrome can increase risk of infections and blood clots. (Mayoclinic.org, 2014)

1.2.12 Kidney cysts

Kidney cysts are round sacks of fluid substances that form inside or outside the kidneys. Kidney cysts can be accompanied with severe disorders that may hamper kidney function. On the other hand, , noncancerous cysts that hardly cause complications.

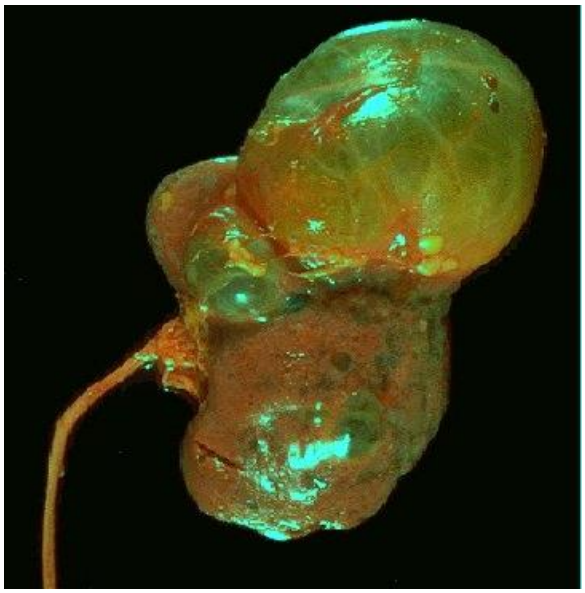

Figure 10: Kidney Cysts

It is yet not distinct what actually causes simple kidney cysts. Usually, only one cyst occurs on the surface of a kidney, but multiple cysts can damage one or both kidneys. However, simple kidney cysts are not the same as the cysts that form with polycystic kidney disease.

Simple kidney cysts are often detected during an imaging test performed for another condition. Simple kidney cysts that do not cause any symptoms therefore, usually do not require treatment. (Mayoclinic.org, 2014)

1.2.13 IgA Nephropathy

IgA nephropathy refers to a kidney disease that occurs when an antibody called immunoglobulin A (IgA) resides in kidneys. This ultimately causes local inflammation that may affect kidneys capacity to filter wastes from the blood.

IgA nephropathy usually advances slowly over many decades, but the course of the disease in each person is not precise. Some people leak blood in their urine without developing problems, some eventually achieve complete remission, and others may develop end-stage kidney failure.

No cure remains for IgA nephropathy, but certain medications can slow down its course. Keeping blood pressure under control and reducing cholesterol levels also reduce disease further progression. (Mayoclinic.org, 2014)

1.2.14 Uremia

Uremia is a clinical syndrome accompanied with fluid, electrolyte, and hormone imbalances and metabolic irregularities, which develop in similar with deterioration of renal activity.

Uremia usually develops with chronic kidney disease (CKD), especially at the later stages of CKD, but it also may occur with acute kidney injury (AKI) if loss of renal function is fast. As yet, no single uremic toxin has been identified that is responsible for all of the clinical manifestations of uremia. A number of toxins, such as parathyroid hormone, beta2 microglobulin, polyamines, advanced glycosylation end products, and other middle molecules are thought to contribute to the clinical syndrome. (Alper, 2016)

Severe complications of untreated uremia include seizure, coma, cardiac arrest, and even death. Spontaneous bleeding can occur with severe uremia and may include gastrointestinal

(GI) bleeding, spontaneous subdural hematomas, increased bleeding from any underlying disorder, or bleeding associated with trauma. (Alper, 2016)

Cardiac arrest may happen from severe underlying electrolyte abnormalities, such as hyperkalemia, metabolic acidosis, or hypocalcemia. Severe hypoglycemic reactions may occur in patients with diabetes if hyperglycemic medications are not adjusted for reduced creatinine clearance in these individuals. Renal failure associated bone disease which is also called renal osteodystrophy, may lead to an increased risk of osteoporosis or bone fracture with trauma. (Alper, 2016)

1.3 Symptoms of kidney diseases

There are several symptoms of kidney diseases. Some notable symptoms are as follows:

Feeling cold: Anemia can make feeling cold all the time, even in a warm room.

Feeling faint, dizzy, or weak: Anemia related to kidney failure means that the brain is not getting sufficient oxygen. This can lead to memory problems, trouble with concentration, and dizziness.

Feeling very itchy: Kidneys remove wastes from the bloodstream. When the kidneys fail, the generation of wastes in blood can cause severe itching.

Ammonia breath: A build-up of wastes in the blood can make the taste of food different and causes bad breath.
(Lifeoptions.org, 2017)

1.4 Causes of kidney disease

According to the National Kidney Foundation, the two leading causes of kidney disease and kidney failure are complications arising from type2 diabetes and high blood pressure. Other causes include glomerulonephritis, kidney infections and damage stemming from the abuse of

pain killers and illegal drugs. However, some cases of kidney disease are effectively treated, others lead to kidney failure.

Type2 diabetes and high blood pressure can develop the risk of kidney disease. According to the American Association, kidney disease happens when damaged kidneys no longer effectively remove waste products or fluids and begin to leak. Type2 diabetes can damage kidneys because high blood glucose levels force the kidneys to work much harder, wearing them out over time and leading to damage.

High blood pressure damages the kidneys by destroying the numerous tiny blood vessels located within them, leading to restricted or blocked blood flow to the kidneys. This leads to a vicious cycle where damaged kidneys cannot regulate hormones accurately, including the hormone that helps to control blood pressure. This causes blood pressure to rise even more, resulting in more destruction to the kidneys. (National Kidney Foundation, 2017)

Excessive use of some over-the-counter pain killers can also damage kidneys Analgesics such as ibuprofen and naproxen, when taken over long periods of time or in heavy doses, can contribute to a kidney condition known as interstitial nephritis. Using analgesics in conjunction with alcohol increases the risk of developing kidney diseases as well. Besides these, use of illegal drugs such as heroin can also lead to the development of kidney disease. (National Kidney Foundation, 2016)

Some other causes for kidney problem include kidney stones, infections and such inherited conditions as polycystic kidney disease. People who take too many pain killers or who take heroin and other illegal drugs can develop kidney disease. The symptoms of this include vomiting, weakness, nausea, fatigue, confusion and loss of appetite. Doctors can perform urine and blood tests to determine whether a person has kidney disease and the extent of the effects on the body. (National Kidney Foundation, 2017)

1.4.1 Risk factors

In addition to diabetes and high blood pressure, age 60 years or more, female sex, African American ethnicity, obesity, high cholesterol, lack of physical exercise, smoking, and excessive salt intake are factors that increase risk of kidney disease. Other responsible circumstances include infections or inflammatory diseases that affect the kidneys; inappropriate use of medications like aspirin, ibuprofen, and other painkillers; and use of

herbal supplements that are known to cause damage to kidneys. Moreover, imaging studies that use iodine contrast substances can have a negative impact on kidneys. Chronic kidney disease sometimes runs in generation. (Razmaria, 2016)

1.5 Relationship of Kidney disease with diabetes

Type2 diabetes mellitus (DM) globally affects 18–20 % of adults over the age of 65 years. Diabetic kidney disease (DKD) is one of the most recurrent and dangerous complications of DM2, affecting about one-third of the patients with DM2. In addition to the pancreas, adipocytes, liver, and intestines, the kidneys also play an important function in glycemic control, precisely due to renal contribution to gluconeogenesis and tubular reabsorption of glucose. (Pecoits-Filho et al., 2016)

Glucose homeostasis is extremely changed in patients with DKD, who are exposed to a high risk of both hyperglycemia and hypoglycemia. Both high and low glycemic levels are accompanied with increased morbidity and shortened survival in this group of patients. Factors that are related to an increased risk of hypoglycemia in DKD patients include decreased renal gluconeogenesis, deranged metabolic pathways (including altered metabolism of medications) and decreased insulin clearance. On the other hand, decrease glucose filtration and excretion, and inflammation-induce insulin resistance are predisposing factors to hyperglycemic episodes. (Pecoits-Filho et al., 2016)

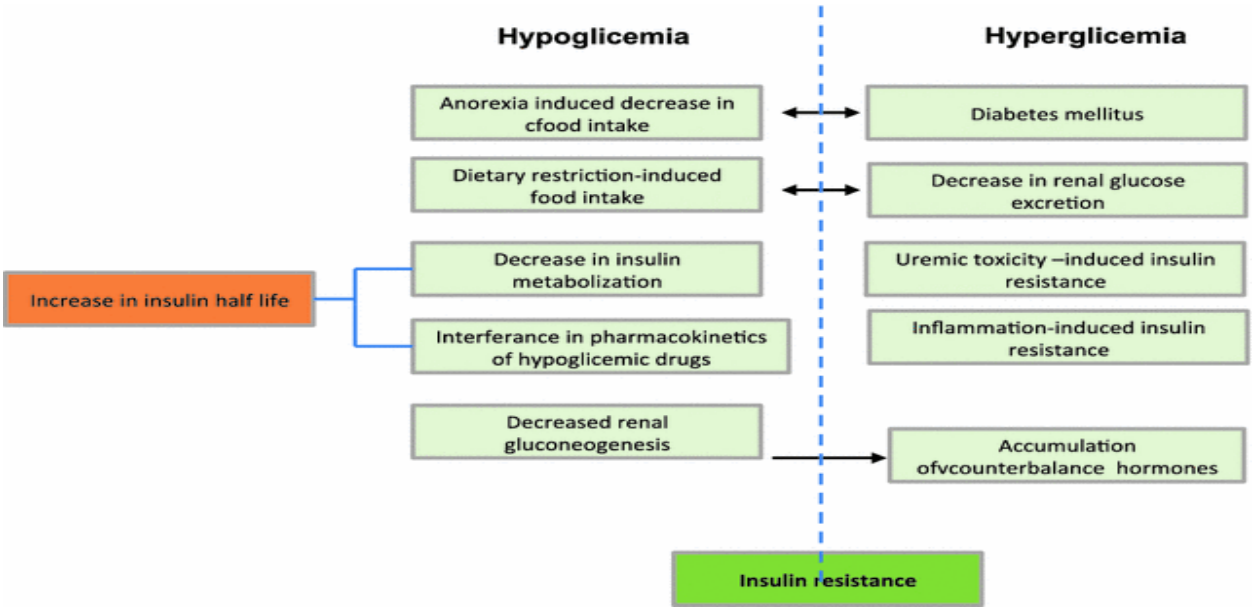

Figure 11: Chronic kidney disease mechanisms predisposing to hyperglycaemia and hypoglycaemia

1.6 Relationship of Kidney disease with hypertension

Hypertension is both an important cause and consequence of chronic kidney disease. Evidence from a large number of clinical trials has demonstrated the benefit of blood pressure control. However, it remains unclear whether available results could be extrapolated to patients with chronic kidney diseases because most studies on hypertension have excluded patients with kidney failure. In addition to that, chronic kidney disease encloses a large group of clinical disorders with heterogeneous natural history and pathogenesis. (Tedla et al., 2011)

Hypertension is a major risk factor for both cardiovascular and renal disease. Inversely, chronic kidney disease (CKD) is the most common form of secondary hypertension and mounting evidence suggests it is an independent risk factor for cardiovascular morbidity and mortality. The prevalence of CKD has been precisley characterized since the National Kidney Foundation issued a standard classification based on the level of glomerular filtration rate (GFR) and the presence or absence of evidence of renal injury. Patients with stages 1 and 2 CKD need to show evidence of renal injury (e.g., proteinuria), and GFR of ≥90 and 60–89 mL/minute, respectively. Stages 3, 4, and 5 correspond to GFR of 30–59, 15–29, and <15 mL/minute, respectively, regardless of any other evidence of renal damage. An estimation showed that, 10–13% of adults in the USA suffer from some degree of CKD. (Tedla et al., 2011)

1.7 Relationship of Kidney disease with blood group

Renal failure underlies various elements among which are infectious and autoimmune origins which may relate directly or indirectly to blood groups. Renal failure patients show more frequency with blood groups A and O and match with other studies in which blood group AB is the least associated blood group with renal failure. The level of potassium is highest in patients with blood group A and lowest in patients with blood group AB. (Alhawary et al., 2015

1.8 Relationship of kidney disease with the size of the kidneys

In hypertensive patients, right and left relative and absolute renal lengths and left renal volume are significantly less than in normotensive patients. Within the hypertensive group, no significant differences present in the parameters (renal size, shape and volume).

In this study, etiopathogenesis of the renal disease, individual and multifactorial impacts, residual renal function and nephron numbers may be involved. The study does not include patients with obese and diabetes mellitus, myeloma, amyloidosis, or polycystic renal disease. (Zumrutdal et al., 2002)

1.9 Relationship of Kidney disease with BMI

Obesity defined by elevated body mass index (BMI) has been considered as a cardiovascular risk factor in the general population. Obesity is also associated with increased risk of incident CKD and ESRD. Negative impacts of obesity include those effects mediated by conditions caused or worsened by it, such as diabetes mellitus (DM) or hypertension, and direct adverse metabolic effects, such as inflammation, increased synthesis of apolipoprotein B and very LDLs, increased production of insulin and insulin resistance. Obesity also induces glomerular hyperfiltration, and weight loss in morbidly obese patients attenuates proteinuria. (Lu et al., 2014)

The latest results from the Physicians' Health Study show that, body-mass index (BMI) is a new risk factor for kidney disease in males. According to Dr. Toblas Kurth, patients with kidney disease can help prevent further organ decline if they maintain a healthy weight. So we suspected that overweight and obesity may increase a person's risk of developing kidney disease, and this turned out to be the case.

A recent stydy shows that, for every one-unit increase in BMI, which is calculated by weight in kilograms divided by height in meters squared, there was a 5% increase in CKD risk. (Zumrutdal et al., 2002)

1.10 Diagnostic of kidney disease

There are several tests that doctor can use to diagnose kidney failure. These include:

Urinalysis

Urine sample can be examined for any abnormalities, including irregular protein or sugar that spills into the urine. Urinary sediment test can also be performed. This measures the amount of red and white blood cells, searches for high levels of bacteria and high numbers of cellular casts.

Urine volume measurements

Measuring urine output volume is one of the simplest examinations to help diagnose kidney failure. For example, low urinary output may suggest that kidney disease is due to a urinary blockage, which can be caused by multiple illnesses or injuries.

Blood samples

Blood test is performed to measure substances that are filtered by kidneys, such as blood urea nitrogen and creatinine (Cr). A quick increase in these levels may point acute kidney failure.

Imaging

Tests such as ultrasounds, MRIs, and CT scans provide images of the kidneys themselves, along with the urinary tract which allows searching for blockages or abnormalities in kidneys.

Kidney tissue sample

Tissue samples are examined for abnormal deposits, scarring, or infectious organisms. Kidney biopsy is performed to collect the tissue sample. The sample is collected with a biopsy needle inserted through the skin and down into the kidney. X-ray or ultrasound apparatus is used to locate the kidneys and assist the doctor to guide the needle.

(Solan and Kivi, 2017)

1.11 Treatments of kidney diseases

There are several treatments for kidney failure. The type of treatment depends on the reason for kidney failure, which may include:

Dialysis

Dialysis filters and purifies the blood using a machine. The machine performs the similar function of the kidneys. According on the type of dialysis, the patient is connected to a large machine or a portable catheter bag. The patient needs to follow a low-potassium, low-salt diet along with dialysis.

Kidney transplant

Another treatment option is a kidney transplant. There is usually a long wait to receive a donor kidney that is compatible with patient's body, though if the patient has a living donor the process may go more rapidly.

The advantages of a transplant are that the new kidney can work perfectly, and dialysis is no longer needed. On the other hand, the disadvantage is that the patient must has to take immunosuppressive drugs after the surgery. These drugs have their own side effects, some of which are dangerous. Moreover, transplant surgery is not always successful. (Solan and Kivi, 2017)

A dietitian or health care provider determines a suitable diet for the specific case of kidney disease. Regular blood tests ensure that the diet is appropriate for the patient's current condition.

An individual using dialysis treatment for kidney disease limits certain foods to keep a sustainable level of minerals, fluids and electrolytes to restrict the buildup of fluid and waste products in the body. Such a person excludes foods that contain a lot of water. Various fruits and vegetables are high in potassium, such as oranges, bananas, tomatoes, asparagus and pumpkin. Kidney patients need to avoid potassium because it sometimes causes dangerous heart rhythms.

Doctors limit protein before some people begin dialysis but recommend a high-protein diet for other patients. It is better to avoid foods that are high in phosphorus. These include milk, most of the cheeses and yogurt. Doctors sometimes suggest the use of phosphorous binder medication to restrict phosphorus intake. Kidney patients avoid salty foods because they cause high blood pressure, fluid retention and thirst.

1.12 Maintaining healthy kidneys

Proper care can keep kidneys functioning properly well into old age. One of the most important things to remember is to remain hydrated. Kidneys require water to function properly and to carry away toxins also.

According to Dr. Parker, the best way to avoid dehydration is drinking water before getting thirsty, since thirst indicates dehydration.

Vitamins can be very important to the function and health of the kidneys. "(Folic acid) helps to reduce levels of homocysteine, which has been linked to heart disease, stroke and kidney disease," said Dr. Kristine Arthur, an internist at Orange Coast Memorial Medical Center in Fountain Valley, California. Vitamin A is also very important to healthy kidney function. (Bradford, A., 2016)

Keeping blood pressure in check may also help to long-term good kidney health. A study by the National Kidney Foundation found that, moderately high blood pressure levels in midlife might contribute to late-life kidney disease and kidney failure. (Bradford, A., 2016)

The American Kidney Fund also suggests that, avoiding a diet high in fat and salt, limiting alcohol, avoiding tobacco and exercising most days are better ways to keep kidneys healthy. (Bradford, A., 2016)

1.13 Global situation of kidney disease

Approximately 10% of the population across the world is affected by chronic kidney disease (CKD), and millions of people die every year because they do not have access to affordable treatment.

According to the 2010 Global Burden of Disease study, chronic kidney disease was ranked 27^{th} in the list of causes of total number of deaths worldwide in 1990, but rose to 18^{th} in 2010.

More than 2 million people worldwide currently get treatment with dialysis or a kidney transplant to stay alive, yet this number may only represent 10% of people who actually need treatment to live.

From the 2 million people who receive treatment for kidney failure, the majority are treated in only five countries – the United States, Japan, Germany, Brazil, and Italy. These five countries represent only 12% of the world population. Only 20% are treated in about 100 developing countries that make up over 50% of the world population.

More than 80% of all patients who receive treatment for kidney failure are in rich countries with universal access to health care and large elderly populations.

It is estimated that, number of kidney failure patients will increase disproportionately in developing countries, such as China and India, where the number of elderly people are increasing.

In middle-income countries, treatment with dialysis or kidney transplantation builds a huge financial load for the majority of the people who require it. In another 112 countries, many people cannot pay for the treatment at all, resulting in the death of over 1 million people annually from untreated kidney failure.

In the US, treatment of chronic kidney disease is likely to exceed $48 billion per year. Treatment for kidney failure spends 6.7% of the total Medicare budget to care for less than 1% of the covered population.

In England, according to a recent report published by NHS Kidney Care, chronic kidney disease spends more than breast, lung, colon and skin cancer combined.

In Australia, treatment for all current and new cases of kidney failure through 2020 will cost approximately $12 billion.

In people aged 65 through 74 across the world, it is estimated that one in five men, and one in four women, have CKD.

Chronic kidney disease is a worldwide health crisis in recent times. According to the World Health Organization, in 2005, there were approximately 58 million deaths worldwide, with 35 million attributed to chronic disease.

Chronic kidney disease can be treated and it is possible to slow or stop the progression of kidney disease by early diagnosis and proper treatment.

(National Kidney Foundation, 2017)

1.14 Kidney disease in Bangladesh Perspective

The annual mortality rate of chronic kidney disease patients in Bangladesh has increased by 52.3% since 1990 and the average is 2.3% per year. (HealthGrove.com, 2017)

For male peoples, the lethalityof chronic kidney disease in Bangladesh peaks at age 80 and more. It kills men at the lowest rate at age 5-9, which means that this age range is the least vulnerable. At 149.1 deaths per 100,000 men in 2013, the peak mortality rate for men was higher than that of women. Women are killed at the highest rate from chronic kidney disease in Bangladesh at age 80 and more. It was least lethal to women at age 15-19. (HealthGrove.com, 2017)

Hospital, urban and underprivileged population based studies show that there is a CKD prevalence of 16-18% in Bangladesh. From them, 11% are at stage-III and above. Hospital based studies and dialysis units suggest that chronic glomerulonephritis (proteinuria and bilaterally small kidneys) and interstitial nephropathy falls on 37% of causes of (End stage renal disease) ESRD. Moreover, Diabetic nephropathy comprises 33% and hypertension 16%. (Rashid, 2014)

(Renal replacement therapy) RRT in ESRD patients is the minor priority area in Bangladesh due to government policy on health. On the other hand, the priority areas include prevention of communicable diseases, mother and child health and family planning. For these reasons, there are very few government hospitals providing treatment of ESRD. Moreover, most of the RRT is performed by non-government hospitals clinics. (Rashid, 2014)

There are now an estimated 84 dialysis centers in the country and from them, 50% of the dialysis centers are in the Capital. If 200 patients per million populations reach ESRD per year, there would be about 30,000 new patients per year. Currently accessible facilities can hardly accommodate only 9000-10,000 new patients (twice weekly dialysis), which means, 66% of patients have no access to (Hemodialysis) HD. (Rashid, 2014)

Cost of dialysis

Cost of single dialysis spans from 3500-5000 taka per dialysis and only 20% are non - profit hospitals. Moreover, 80% dialysis centers are profit oriented. (Rashid, 2014)

Continuous Ambulatory Peritoneal Dialysis (CAPD)

Although (Peritoneal dialysis) PD was started in 1986, it is not yet a popular form of therapy in Bangladesh. There are now 10 centers offering PD services, but only two centers perform PD regularly. (Rashid, 2014)

Renal Transplantation

Although renal transplantation is an important and cost efficient therapy, donor shortage drives back renal transplantation as a first line of treatment for patients with ESRD. Until 2004, there was only one center carrying out renal transplantation therapy. At present, there are eight transplant centers in the country. Only live related transplantation is being carried out in Bangladesh. For this reason, patients have to depend on either HD or PD. PD is a home based therapy and therefore no need for expensive machineries and freedom from severe infections like hepatitis B and C, Quality of life of PD patients is as good compared to HD patients. (Rashid, 2014)

In view of several advantages of PD over HD, it would be suitable for Bangladesh to expand the facility of PD. However, lack of awareness among physicians and patients, and the attitude of physicians towards hemodialysis in profit making hospitals, it is tough to introduce PD in distant places in Bangladesh. (Rashid, 2014)

Renal transplantation is less costly than HD or PD, and it is more preferable. However, donor scarcity remains as a major issue. Without starting deceased donor transplantation, it would be much difficult to increase the number of transplantation in this country. (Rashid, 2014)

2. Material and Method

2.1 Place of study

The study was carried out in an institution specialized in research, diagnosis and treatment of kidney patients. The name of the institution is “Kidney Foundation, Bangladesh” and it is situated in Mirpur, Dhaka.

2.2 Duration of study

The study was carried out from July to October, 2017 for 4 (four) months.

2.3 Population of study

The population of the study was kidney patients who were registered at the institute. A total of 200 patients data were taken under the study for investigating their cases.

2.4 Methodology

The study was conducted after taking approval from Thesis coordinator, Dr. Mohammad Rafiqul Islam, Associate professor, Department of Mathematics and Natural Sciences, BRAC University and Professor Dr. Harun Ur Rashid, President, Kidney Foundation, Bangladesh.

The patients who were with kidney complications and registered at the institution were the subjects of the study. From the patients file, respective data were collected for further analysis. The statistical methods include, frequency tables, cross table analysis, graphs and charts.

3. Objective

3.1 Primary Objective

The objective of the study is to identify major risk factors, determining a critical age range for onset of kidney disease and characterizing the occurrence of kidney disease in Bangladesh by analyzing different cofactors on a retrospective study.

3.2 Secondary objective

Secondary objects of the study include:

1. To collect the information and knowledge about kidney disease.
2. To verify whether kidney problems depends on age and sex with the objectives
3. To learn the specialties of kidney patients.
4. To review the facts based on different variables.
5. To find out the association of other diseases with kidney disease.
6. To evaluate of the factors taking into consideration of different categories.

4. Results and Discussion

4.1Distribution of the Kidney Patients based on gender

Data of two hundred (200) patients were studied. Among them, one hundred eight (108) were male and the remaining ninety two (92) were female.

Table 01: Frequency Table of distribution of Kidney Patients based on gender

Gender	Frequency	Percentage (%)
Male	108	54
Female	92	46
Total	200	100

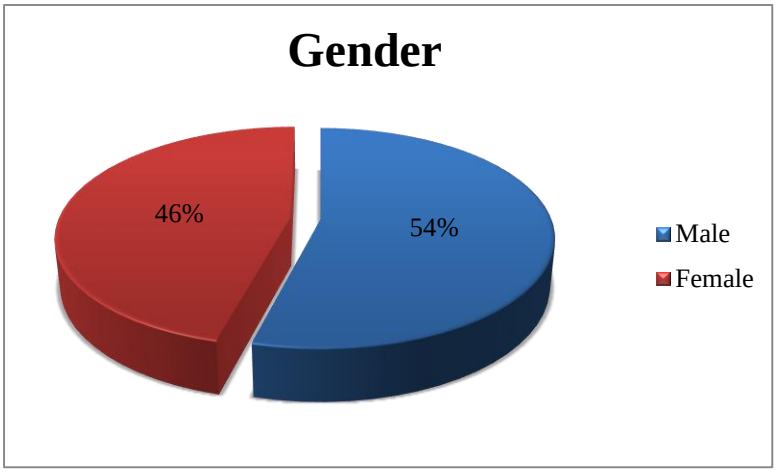

Figure 12: Distribution of kidney patients based on gender

It was observed in the study that, the prevalence of kidney disease is highest in males. From a total of 200 patients, 108 (54%) were males and 92 (46%) were females.

4.2Distribution of Kidney Patients based on Age range

All the patients fall in the age range of 11 to 85. Out of the total number of patients, age group of 11 to 20 years had 12 patients, 21 to 30 years had 20 patients, 31 to 40 years had 32 patients, 41to 50 years had 34 patients, 51 to 60 years had 51 patients and the remaining 51 one patients were more than 60 years old.

Table 02: Frequency Table of Distribution of Kidney patients based on age range

Age	Frequency	Percentage (%)
11-20	12	6
21-30	20	10
31-40	32	16
41-50	34	17
51-60	51	25.5
Above 60	51	25.5
Total	200	100

It was observed from the study that the highest number of kidney patients fall in the age group of both 51 to 60 years and 61years and above (25.5%) each. The percentage of kidney patients based on age group are found as follows, 11 to 20 years (6%), 21 to 30 years (10%), 31 to 40 years (16%), 41 to 50 years (17%), both 51 to 60 years and above 60 years had 25.5% patients.

4.3 Distribution of Age Range of the Kidney Patients based on Gender

It was identified earlier that, the most critical age range for the occurrence of Kidney Disease is 51-60 years and above 60 years as well.

Table 03: Cross Table Analysis between Gender of the Kidney Patients and their Age Range

Age	Gender				Total
	Male	Percentage (%)	Female	Percentage (%)	
11-20	9	8.3	3	3.3	12
21-30	10	9.3	10	10.9	20
31-40	18	16.7	14	15.2	32
41-50	19	17.6	15	16.3	34
51-60	24	22.2	27	29.3	51
Above 60	28	26	23	25	51
Total	108	100	92	100	200

Among the 108 male patients, age group of 11 to 20 years had 8.3% patients, 21 to 30 years had 9.3% patients, 31 to 40 years had 16.7% patients, 41 to 50 years had 17.6% patients, 51 to 60 years had 22.2% patients, and above 60 years had 28 patients.

On the other hand, out of 92 female patients, age group of 11 to 20 years had 3.3% patients, 21 to 30 years had 10.9% patients, 31 to 40 years had 15.2% patients, 41 to 50 years had 16.3% patients, 51 to 60 years had 29.3% patients and above 60 years had 25% patients.

It can be observed from the data assembly that, in both male and female patients, most of the patients are from age range of 51 to 60 years and 61 years and above. The next critical age range is 41 to 50 years.

4.4 Distribution of Kidney Patients based on Body Mass Index (BMI)

Body Mass Index (BMI) is a measurement of body fat based on weight and height of a person and that applies to both men and women. BMI is used to indicate if a person is underweight, normal, overweight or obese. (Wikipedia.com, 2017)

BMI value of less than 18.5 indicates underweight, 18.5 to 24.9 is normal, 25 to 29.9 is overweight and 30 and above is considered as obese. BMI of a person can be calculated by using the following formula:

BMI= Weight (Kilograms) / [Height **(m)]^2**

Table 04: Frequency Table of Distribution of Kidney patients based on Body Mass Index (BMI)

BMI	Frequency	Percentage (%)
Less than 18.5	4	2
18.5 - 24.9	90	45
25 - 29.9	79	39.5
30 and above	27	13.5
Total	200	100

In patients under the study, BMI value was found less than 18.5 for 2% patients, from 18.5 to 24.9 for 45% patients, from 25 to 29.9 for 39.5% patients and 30 and above for 13.5% patients.

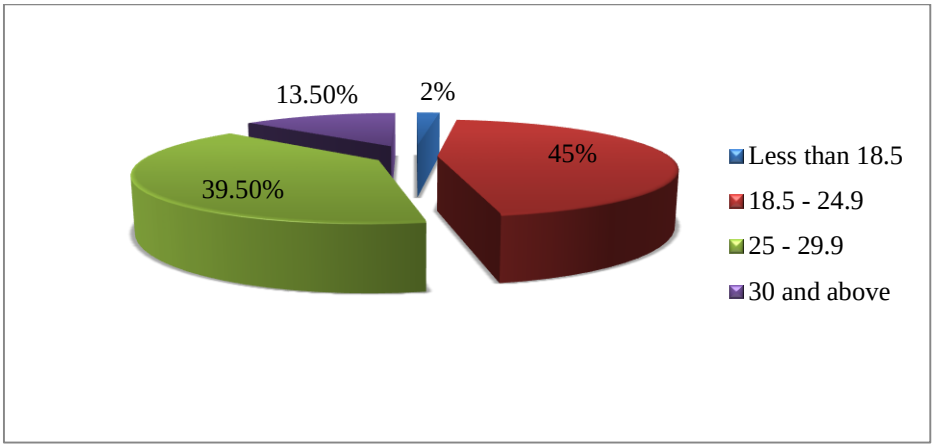

Figure 13: Distribution of Kidney Patients based on Body Mass Index (BMI)

4.5 Distribution of BMI of the Kidney Patients based on Gender

It was observed from the total patients that, most of the patients (45%) fall in the BMI value of 18.5 to 24.9. On the other hand, a high percentage of patients (39.5%) were overweight, 35.5% patients were obese and only 2 % of the patients were underweight.

Table 05: Cross Table Analysis between the Gender of the Kidney Patients and their BMI

BMI	Gender				Total
	Male	Percentage (%)	Female	Percentage (%)	
Less than 18.5	2	1.9	2	2.2	4
18.5 to 24.9	47	43.5	43	46.7	90
25 to 29.9	48	44.4	31	33.7	79
30 and above	11	10.2	16	17.4	27
Total	108	100	92	100	200

Out of 108 male patients, only 1.9% was underweight, 43.5% patients were in normal weight, 44.4% patients were overweight and remaining 10.2% patients were obese. On the other hand, out of 92 female patients, only 2.2% patients were underweight, 46.7% patients were in normal weight, 33.7% patients were overweight and remaining 17.4% patients were obese.

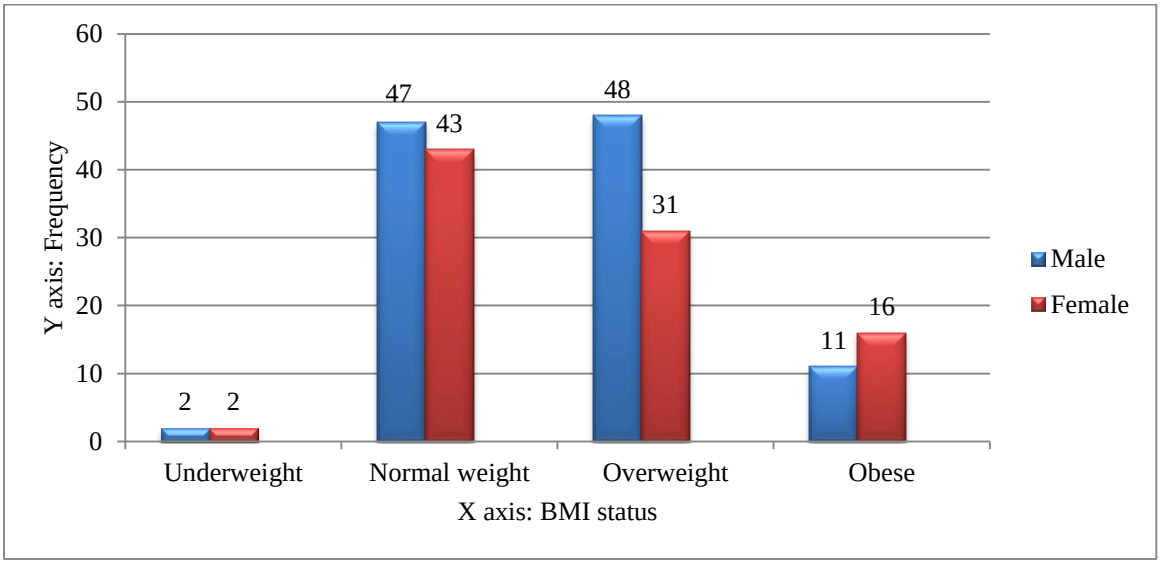

Figure 14: Distribution of male and female patients based on Body Mass Index (BMI)

4.6 Distribution of serum creatinine level of the male Kidney Patients

Normal range of serum creatinine (s. creatinine) is different in male and female. The normal range of s.creatine in male is (0.9 to 1.3) mg/dl. (medicinenet.com, 2017)

From the total 108 male patients, all of them had a creatinine level of more than 1.2 and it confirms that they have kidney problems.

Table 06: Frequency table of Distribution of s. creatinine level of the male kidney patients

s. creatinine (mg/dl)	Frequency	Percentage (%)
0-0.8	0	0
0.9-1.3	0	0
1.3 and above	108	100
Total	108	100

4.7 Distribution of serum creatinine level of the female Kidney Patients

The normal range of s.creatine in female is (0.6 to 1) mg/dl. (medicinenet.com, 2017)

From the total 92 female patients, all of them had a creatinine level of more than 1.1 and it confirms that they have problems with their kidneys.

Table 07: Frequency Table of Distribution of s. creatinine level of the female kidney patients

s. creatinine (mg/dl)	Frequency	Percentage (%)
0-0.5	0	0
0.6-1.1	0	0
1.2 and above	92	100
Total	92	100

4.8 Distribution of Kidney Patients based on their Urea level

Generally, a high urea level also indicates kidney problems. The normal range of urea is (7-20) mg/dl and it is applicable for both male and female. On the other hand, a low urea level can be due to a liver problem. (mayoclinic.org, 2017)

Table 08: Frequency table of Distribution of Kidney Patients based on their Urea level

Urea (mg/dl)	Frequency	Percentage (%)
0-6	14	7
7-20	81	40.5
21 and above	105	52.5
Total	200	100

From the data assembly, it can be observed that, most of the patients (52.5%) had a high urea level. 40% of the patients urea level was normal and 7% patients had low urea level.

4.9 Distribution of urea level of the Kidney Patients based on Gender

It can be observed from the data assembly that, among 108 male patients, 9.3% had a lower value, 38.7% had a normal value and the remaining 52% had a higher value.

Table 09: Cross Table Analysis between the Urea level of the Kidney Patients and their Gender

Urea level (mg/dl)	Gender				Total
	Male	Percentage (%)	Female	Percentage (%)	
0-6	10	9.3	4	4.3	14
7-20	42	38.7	39	42.4	81
Above 20	56	52	49	53.3	105
Total	108	100	92	100	200

On the other hand, from 92 female patients, only 4.3% patients had a lower value, 42.4% had a normal value and the remaining 53.3% had a higher value.

4.10 Distribution of Uric Acid level of the male Kidney Patients

The normal range of Uric Acid in male is (200-430) (µmol/l). (Wikipedia.com, 2017)

From 108 male patients, 8.3 % patients had a low uric acid level, 44.5% had normal and 47.2% had a high uric acid level.

Table 10: Frequency Table of Distribution of Uric Acid level of the male Kidney Patients

Uric Acid (µmol/l)	Frequency	Percentage (%)
0-199	9	8.3
200-430	48	44.5
431 and above	51	47.2
Total	108	100

4.11 Distribution of Uric Acid level of the female Kidney Patients

The normal range of Uric Acid in male is (140-360) (µmol/l). From 92 female patients, 3.3 % patients had a low uric acid level, 30% had normal and 66.7% had a high uric acid level

Table 11: Frequency Table Distribution of Uric Acid level of the female Kidney Patients

Uric Acid (µmol/l)	Frequency	Percentage (%)
0-139	3	3.3
140-30	28	30
361 and above	61	66.7
Total	92	100

4.12 Distribution of Kidney Patients based on their Sodium level

Normal range of sodium is (135-145) mmol/l in both male and female. (Farinde, 2014)

From the total 200 patients, 37% patients had a low sodium level, 61.5% had a normal level and only 1.5% patients had a high sodium level.

Table 12: Frequency table of Distribution of Kidney Patients based on their sodium level

Sodium (mmol/l)	Frequency	Percentage (%)
0-134	74	37
135-145	123	61.5
146 and above	3	1.5
Total	200	100

4.13 Distribution of Sodium level of the Kidney Patients based on Gender

Among the total 108 male patients, 35.2% patients had a low value, 63.9% patients had a normal value and only 0.9% patient had a high level of sodium.

On the other hand, out of 92 female patients, 39.1% patients had a low sodium level, 58.7% patients had a normal value and only 2.2% patients had a high level of sodium

Table 13: Cross Table Analysis between Sodium level of the Kidney Patients and their Gender

Sodium (mmol/l)	Gender				Total
	Male	Percentage (%)	Female	Percentage (%)	
0-134	38	35.2	36	39.1	74
135-145	69	63.9	54	58.7	123
Above 145	1	0.9	2	2.2	3
Total	108	100	92	100	200

4.14 Distribution of Kidney Patients based on their Potassium level

Normal range of potassium is (3.6-5.2)mmol/l in both male and female. (mayoclinic.org, 2017)

From the total 200 patients, 20% had a low potassium level, 65.5% had a normal value and 14.5% patients had a high level of potassium.

Table 14: Frequency Table of Distribution of Kidney Patients based on their Potassium level

Potassium (mmol/l)	Frequency	Percentage (5)
0-3.5	40	20
3.6-5.2	131	65.5
Above 5.2	29	14.5
Total	200	100

4.15 Distribution of Potassium level of the Kidney patients based on Gender

From 108 male patients, 16.7% patients had a low level of potassium, 69.4% patients had a normal level and 13.9% patients had a high level of potassium

On the other hand, from 92 female patients, 23.9% patients had a low level of potassium, 60.9% patients had a normal level and 15.2% patients had a high level of potassium

Table 15: Cross Table Analysis between Potassium level of the Kidney Patients and their gender

Potassium (mmol/l)	Gender				Total
	Male	Percentage (%)	Female	Percentage (%)	
0-3.5	18	16.7	22	23.9	40
3.6-5.2	75	69.4	56	60.9	131
Above 5.2	15	13.9	14	15.2	29
Total	108	100	92	100	200

4.16 Distribution of the Kidney Patients based on their Chloride level

Normal range of chloride is (98-106) mmol/l and this value is applicable for both male and female. If the chloride level is below 71, or if the value exceeds 120, than it create a critical condition. (Kamel, G., 2014)

From the total 200 patients, only 1% had a low chloride level, 21% had a level of (71-97) mmol/l, 66.5% had a level of (98-106) mmol/l, 11.5% had a level of (107-119) mmol/l and no patients had the level of more than 119.

Table 16: Frequency Table of Distribution of the Kidney Patients based on their Chloride level

Chloride (mmol/l)	Frequency	Percentage (%)
0-70	2	1
71-97	42	21
98-106	133	66.5
107-119	23	11.5
Above 119	0	0
Total	200	100

4.17 Distribution of Chloride level of the Kidney patients based on Gender

From 108 male patients, only 1 had a low chloride level, 18 patients had a level of (71-97) mmol/l, 77 patients had a level of (98-106) mmol/l, 12 patients had a level of (107-119) mmol/l and no patients had the level of more than 119.

From 92 female patients, only 1 had a low chloride level, 24 patients had a level of (71-97) mmol/l, 56 patients had a level of (98-106) mmol/l, 11 patients had a level of (107-119) mmol/l and no patients had the level of more than 119.

Table 17: Cross Table Analysis between Chloride level of the Kidney Patients and their gender

Chloride (mmol/l)	Gender				Total
	Male	Percentage (%)	Female	Percentage (%)	
0-70	1	0.9	1	1.1	2
71-97	18	16.7	24	26.1	42
98-106	77	71.3	56	60.9	133
107-119	12	11.1	11	12	23
Above 119	0	0	0	0	0
Total	108	100	92	100	200

4.18 Distribution of Kidney Patients based on Cortex and Medulla Differentiation (CMD) status

Both high blood pressure and diabetes has an impact on CMD status. Since, many patients were suffering from both of the diseases, it is distinct that, there CMD status will be poor in most cases. From the total number of patients, CMD was found well at 35% patients and CMD was found poor at 65% patients.

Table 18: Frequency Table of Distribution of Kidney Patients based on Cortex and Medulla Differentiation (CMD) status

CMD status	Frequency	Percentage (%)
Poor	130	65
Well	70	35
Total	200	100

4.19 Distribution of the Cortex and Medulla Differentiation (CMD) status of the Kidney Patients based on gender

For all the patients, CMD was found well in 35% patients. Among them, 50% patients were male and 50% patients were female. On the other hand, from the total number of patients, CMD was found poor in 65% patients. Among them, 56% patients were male and 44% were female.

Table 19: Cross Table Analysis between Cortex and Medulla Differentiation (CMD) status of the Kidney Patients and their gender

Gender	CMD status				Total
	Poor	Percentage (%)	Well	Percentage (%)	
Male	73	56	35	50	108
Female	57	44	35	50	92
Total	130	100	70	100	200

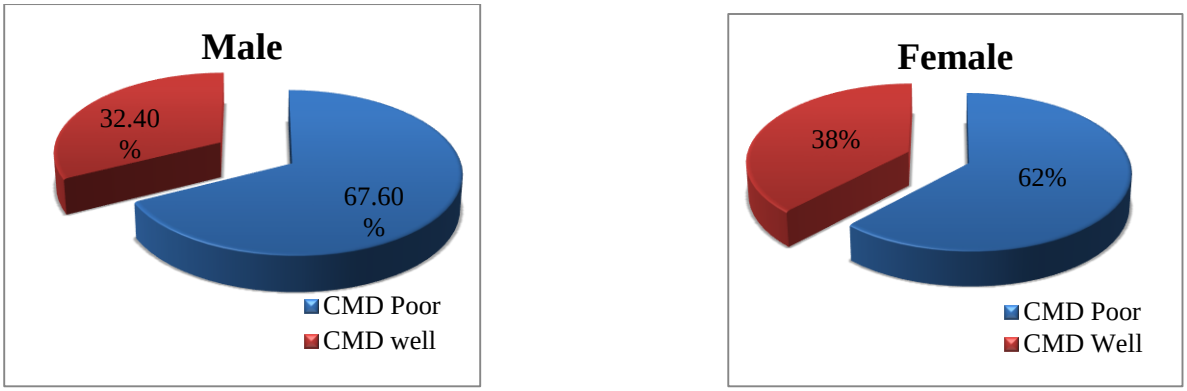

Figure 15: A comparative diagram of distribution of CMD status of the kidney patients based on gender

4.20 Distribution of the average length of the kidneys in male Kidney Patients based on age

Normal length of the kidneys in 10 to 20 years people is (9.8-10.6) cm. In adult, it is (10-13) cm. Moreover, right kidney is a little bit smaller than the left kidney. This range is applicable for both male and female patients. Moreover, kidneys become a little bit smaller when people get older. (kidneychat.com, 2017)

Table 20: Table of Distribution of the average length of the kidneys in male Kidney Patients based on age

Age	Right kidney (cm)	Left kidney (cm)
11-20	9.9	10.2
21-30	9.8	10
31-40	10.2	10.9
41-50	10.4	10.6
51-60	10.8	11.1
61-70	9.9	10.2
Above 70	8.9	9.4

From the study, it can be observed that, all the male patients had a normal kidney size.

4.21 Distribution of the average length of the kidneys in female Kidney Patients based on age

From the study it is found that, like as male patients, all the female patients had also a normal kidney size.

Table 21: Table of Distribution of the average length of the kidneys in female Kidney Patients based on age

Age	Right kidney (cm)	Left kidney (cm)
11-20	9.7	9.9
21-30	9.8	9.9
31-40	10.1	10.3
41-50	9.9	10.4
51-60	9.9	10.8
61-70	9.1	9.8
Above 70	8.4	8.6

Table 22: Cross Table of Analysis between average lengths of the kidneys in Kidney Patients and their Gender

Age	Average length of the Right Kidney (cm)		Average length of the Left Kidney (cm)	
	Male	Female	Male	Female
11-20	9.9	9.7	10.2	9.92
21-30	9.87	9.8	10	9.9
31-40	10.22	10.1	10.9	10.32
41-50	10.44	9.9	10.62	11
51-60	10.79	9.9	11.1	10.97
61-70	9.9	9.1	10.2	9.97
Above 70	8.9	8.39	9.37	8.45

It can be observed from the study that, people with more than 60 years had a little bit smaller kidney size than the younger people. This analysis suggests that, size of the kidneys shrink a little bit with the increasing of age.

4.22 Distribution of Kidney Patients based on their Blood group

From all the 200 patients, 30.5% patients had A+(ve), only 0.5% had A-(ve), 38% had B+(ve), 8.5% had AB+(ve), 0.5% had AB-(ve), 20% had O+(ve), and 2% had O-(ve) .

Table 23: Frequency Table Analysis of Distribution of Kidney Patients based on their Blood group

Blood group	Frequency	Percentage (%)
A+(ve)	61	30.5
A-(ve)	1	0.5
B+(ve)	76	38
B-(ve)	0	0
AB+(ve)	17	8.5
AB-(ve)	1	0.5
O+(ve)	40	20
O-(ve)	4	2
Total	200	100

From the data assembly, it can be observed that, the majority of the patients had B+(ve) blood group and there was no patient with B-(ve) blood group

4.23 Distribution of Blood groups of the Kidney Patients based on Gender

From 108 male patients, majority of them had B+(ve) blood group and there were no patients of B-(ve) and O-(ve) blood group. Blood groups of the patients are as follows: A+(ve): 31.5%, A-(ve): 0.9%, B+(ve): 40.7%, B-(ve): 0%, AB+(ve): 9.3%, AB-(ve): 0.9%, O+(ve): 16.7%, O-(ve): 0%

On the other hand, from 92 female patients, majority of them had also B+(ve) blood group and there were no patients of A-(ve), B-(ve) and AB-(ve) blood group. Blood groups of the patients are as follows: A+(ve): 29.3%, A-(ve): 0%, B+(ve): 34.8%, B-(ve): 0%, AB+(ve): 7.6%, AB-(ve): 0%, O+(ve): 24%, O-(ve): 4.3%

Table 24: Cross Table of Analysis between the Blood group of the Kidney Patients and their Gender

Blood group	Gender				Total
	Male	Percentage (%)	Female	Percentage (%)	
A+	34	31.5	27	29.3	61
A-	1	0.9	0	0	1
B+	44	40.7	32	34.8	76
B-	0	0	0	0	0
AB+	10	9.3	7	7.6	17
AB-	1	0.9	0	0	1
O+	18	16.7	22	24	40
O-	0	0	4	4.3	4
Total	108	100	92	100	200

4.24 Distribution of Kidney Patients based on their Random Blood Sugar (RBS)

Normal Random Blood Sugar (RBS) range in adult is (4.4-7.8) mmol/l. From the data assembly, it can be observed that, RBS range is (0-4.3) mmol/l in 5% patients, (4.4-7.8) mmol/l in 46% and 7.9 mmol/l and above in 49% patients. Therefore, it can be stated that, most of the patients (49%) had a high Random Blood Sugar.

Table 25: Frequency Table Analysis of Distribution of Kidney Patients based on their Random Blood Sugar (RBS)

RBS (mmol/l)	Frequency	Percentage (%)
0-4.3	10	5
4.4-7.8	92	46
7.9 and above	98	49
Total	200	100

4.25 Distribution of Kidney Patients based on their Systolic Blood Pressure

Most of the kidney patients had an irregular blood pressure and they were suffering from hypertension. Moreover, systolic blood pressure of the patients was randomly measured. The majority of the patients had a high systolic blood pressure.

Table 26: Frequency Table of Distribution of Kidney Patients based on their Systolic Blood Pressure

Systolic BP (mmHg)	Frequency	Percentage (%)
80-90	9	4.5
91-100	5	2.5
101-120	41	20.5
121-140	77	38.5
Above 140	68	32
Total	200	100

From the data assembly, it can be observed that, 38.5% patients had a high systolic blood pressure. 20.5% of the patients had a systolic blood pressure of 121 to 140 mmHg and it can be considered that, they had a moderately high systolic BP.

4.26 Distribution of Kidney Patients based on their Diastolic Blood Pressure

Diastolic blood pressure of the patients was randomly measured. The majority of the patients had a high diastolic blood pressure.

From the data assembly, it can be observed that, 28.5% patients had a high diastolic blood pressure. The maximum percentage (59.5%) of the patients had a diastolic blood pressure of 80 to 90 mmHg and it can be considered that, they had a moderately high diastolic BP.

Table 27: Frequency Table of Distribution of Kidney Patients based on their Diastolic Blood Pressure

Diastolic BP (mmHg)	Frequency	Percentage (%)
50-79	24	12
80-90	119	59.5
Above 90	57	28.5
Total	200	100

4.27 Distribution of Kidney Patients based on other diseases

From the medical record of the patients, several other diseases were also found in Kidney patients. These include Diabetes and Hypertension. Several studies suggest that, kidney disease has a correlation with the Diabetes and Hypertension.

Table 28: Frequency Table of Distribution of Kidney Patients based on other diseases

Other Diseases	Frequency	Percentage (%)
Diabetes	56	28
Hypertension	62	31
Diabetes and Hypertension	46	23
None	36	18
Total	200	100

From the data assembly, it can be observed that, 28% patients had Diabetes, 31% patients had Hypertension and 23% patients had both Diabetes and Hypertension. On the other hand, only 18% patients had no other diseases except Kidney Problems.

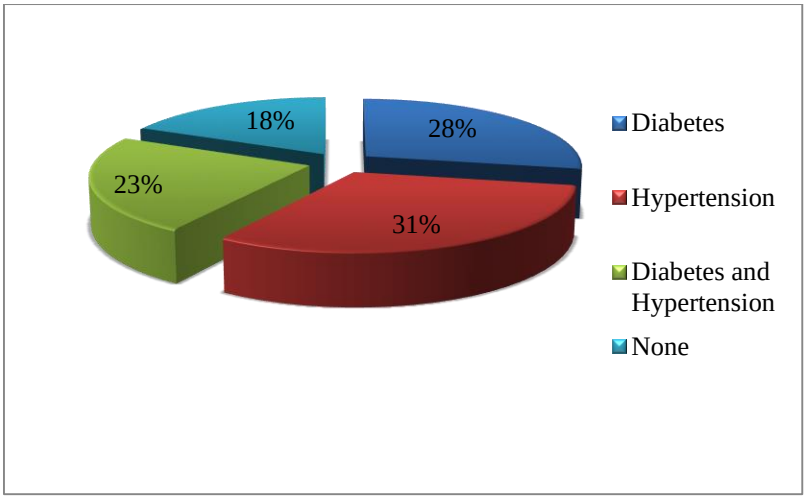

Figure 16: Distribution of Kidney Patients based on other diseases

4.28 Distribution of Diabetes in Kidney Patients based on Gender

Diabetes is disease associated with abnormal blood sugar regulation. Diabetic patients have an injured blood vessel which affects the kidneys for proper functioning. (National Kidney Foundation, 2017)

From 56 diabetic patients, 53.6% patients were males and remaining 46.4% patients were females. The data analysis suggests that, prevalence of diabetes is more dominant in male than the female kidney patients.

Table 29: Frequency Table of Distribution of Diabetes in Kidney Patients based on Gender

Gender	Frequency	Percentage (%)
Male	30	53.6
Female	26	46.4
Total	56	100

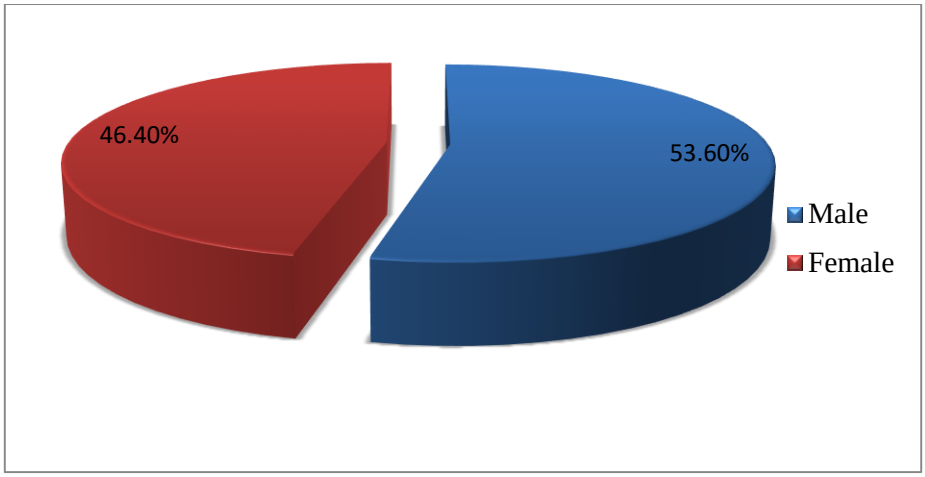

Figure 17: Distribution of Diabetes in Kidney Patients based on Gender

4.29 Distribution of Kidney Patients based on their duration of Diabetes

From the data assembly, it can be observed that, most of the patients (57%) had diabetes for 1 to 10 years, 29% had diabetes for 11 to 20 years and 14% of the patients had diabetes for more than 20 years.

Table 30: Frequency Table Analysis of Distribution of Kidney Patients based on their duration of Diabetes

Duration	Frequency	Percentage (%)
1-10	32	57
11-20	16	29
Above 20	8	14
Total	56	100

4.30 Distribution of duration of Diabetes in Kidney Patients based on Gender

From 30 male diabetic patients, 57% were suffering for 1 to 10 years, 30% were for 11 to 20 years and 13% patients were suffering for more than 20 years.

On the other hand, From 26 female diabetic patients, 58% were suffering from diabetes for 1 to 10 years, 27% were for 11 to 20 years and 15% patients were suffering from diabetes for more than 20 years.

Table 31: Cross Table Analysis between the duration of Diabetes in Kidney Patients and their Gender

Duration	Gender				Total
	Male	Percentage (%)	Female	Percentage (%)	
1-10	17	57	15	58	32
11-20	9	30	7	27	16
Above 20	4	13	4	15	8
Total	30	100	26	100	56

4.31 Distribution of Hypertension in Kidney Patients based on Gender

Blood pressure creates a force on the blood vessels and a high blood pressure is also called hypertension. Since the high blood pressure can damage the blood vessels, kidneys fail to clean the blood as well as extra fluid of the body as it normally does. (National Institute of Diabetes and Digestive and Kidney Diseases, 2017)

It has found earlier that, from all the patients, 62 patients had Hypertension. From them, 52% were male patients and 48% were female patients. This analysis shows that, the prevalence of hypertension in kidney patients is almost similar in both male and female patients.

Table 32: Frequency Table of Distribution of Hypertension in Kidney Patients based on Gender

Gender	Frequency	Percentage (%)
Male	32	52
Female	30	48
Total	62	100

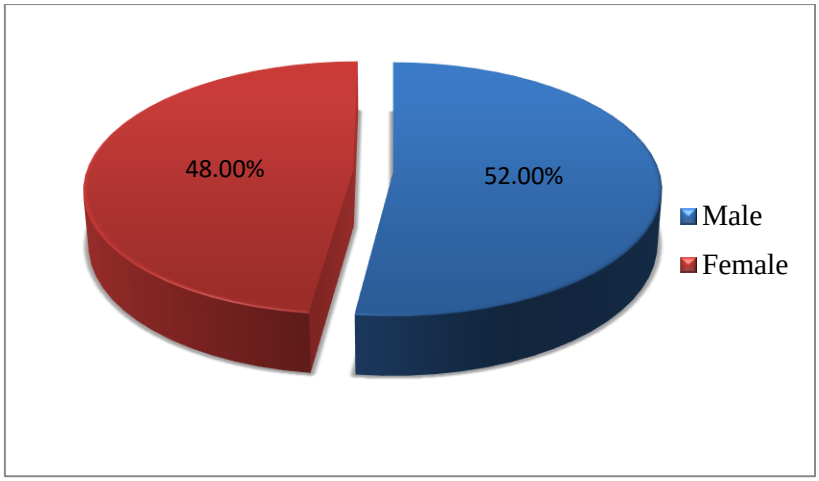

Figure 18: Distribution of Hypertension in Kidney Patients based on Gender

4.32 Distribution of Kidney Patients based on their duration of Hypertension

From the data assembly, it can be observed that, most of the patients (55%) had hypertension for 1 to 10 years, 29% had hypertension for 11 to 20 years and 16% of the patients had hypertension for more than 20 years.

Table 33: Frequency Table Analysis of Distribution of Kidney Patients based on their duration of Hypertension

Duration	Frequency	Percentage (%)
1-10	34	55
11-20	18	29
Above 20	10	16
Total	62	100

4.33 Distribution of duration of Hypertension in Kidney Patients based on Gender

From 32 male patients with hypertension, 59% were suffering for 1 to 10 years, 28% were for 11 to 20 years and only 13% patients were suffering for more than 20 years.

On the other hand, from 30 female patients with hypertension, 50% were suffering for 1 to 10 years, 30% were for 11 to 20 years and 20% patients were suffering from hypertension for more than 20 years.

Table 34: Cross Table Analysis between the duration of Hypertension in Kidney Patients and their Gender

Duration	Gender				Total
	Male	Percentage (%)	Female	Percentage (%)	
1-10	19	59	15	50	34
11-20	9	28	9	30	18
Above 20	4	13	6	20	10
Total	32	100	30	100	62

4.34 Distribution of Kidney Patients based on Chronic Kidney Disease (CKD)

Chronic kidney disease (CKD) is a condition characterized by a gradual loss of kidney function over time. There are two major diseases (diabetes and hypertension) which have a strong correlation with CKD. (National Kidney Foundation, 2017)

At the initial stage, kidney problems slightly increase the serum creatinine level and it can be cured within a short time. On the other hand, in case of CKD, it is really tough to cure the problem and it may require dialysis.

It has been found earlier that, a large number of CKD patients have both diabetes or hypertension and either one of them.

From all the 200 patients, 70% patients were suffering from Chronic Kidney Disease (CKD) and remaining 30% patients had no CKD.

Table 35: Frequency Table Analysis of Distribution of Kidney Patients based on Chronic Kidney Disease

CKD	Frequency	Percentage (%)
Yes	140	70
No	60	30
Total	200	100

4.35 Distribution of Chronic Kidney Disease (CKD) in Kidney Patients based on gender

From 140 CKD patients, 51.4% patients were male and 48.6% patients were female. From the data assembly, it can be observed that, the majority of CKD patients are male.

Table 36: Frequency Table of Distribution of Chronic Kidney Disease (CKD) in kidney patients based on Gender

Gender	Frequency	Percentage (%)
Male	72	51.4
Female	68	48.6
Total	140	100

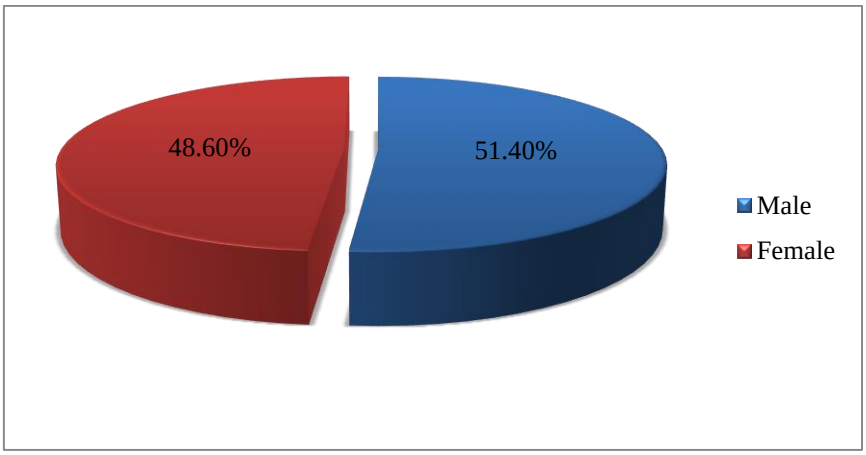

Figure 19: Distribution of Chronic Kidney Disease (CKD) in Kidney Patients based on gender

4.36 Relationship of Chronic Kidney Disease (CKD) Patients with Diabetes and Hypertension

As stated earlier that, both diabetes and hypertension has a strong correlation with CKD, from the study it can observed that, a large number of CKD patients have both diabetes and hypertension or either one of those two.

Table 37: Frequency Table of Distribution of Diabetes and Hypertension in Chronic Kidney Disease (CKD) Patients

Disease	Frequency	Percentage (%)
Diabetes	46	33
Hypertension	50	36
Diabetes & Hypertension	44	31
Total	140	100

From 140 CKD patients, 33% were suffering from diabetes, 36% were suffering from hypertension and 31% were suffering from both diabetes and hypertension.

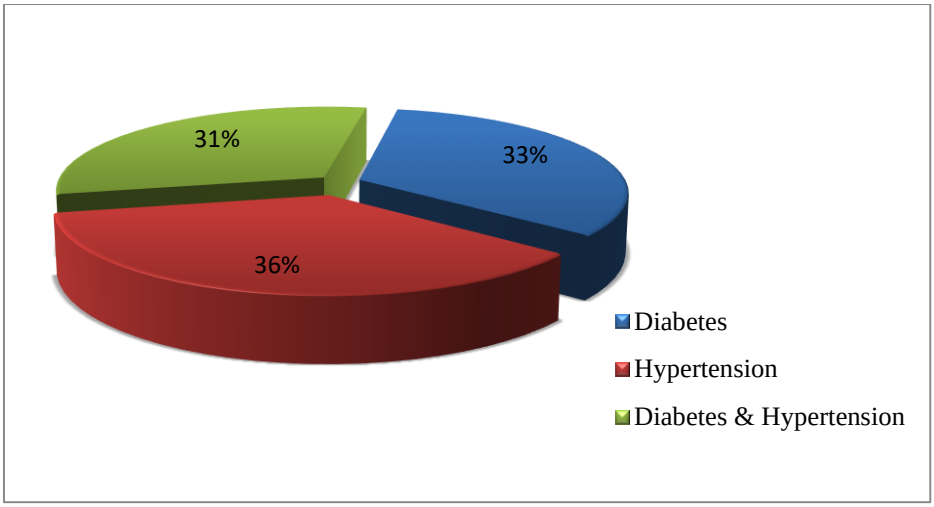

Figure 20: Distribution of Chronic Kidney Disease (CKD) Patients based on Diabetes and Hypertension

4.37 Limitations of the study

One of the limitations of this study is, it was performed on a small size population. Moreover, the family history of the patients was unavailable.

All the required data were not available in each patient's medical record. Therefore, data were collected from a large number of patient's file. Furthermore, although the sizes of the kidneys were available in the ultrasonography report, the weights of the kidneys were unavailable.

Along with that, Random Blood Sugar (RBS) of the patients was analyzed, but there were diabetic patients and the blood sugar level of those patients before meal and after meal were not available. Therefore, the RBS analysis of the patients does not represent the actual state of diabetes in kidney patients.

Moreover, the data of the systolic and diastolic blood pressure of the patients were randomly measured. Along with that, the data of the systolic and diastolic blood pressure after taking antihypertensive drugs by the kidney patients with hypertension were not available. Therefore, this measurement also does not represent the actual state of blood pressure in the patients. In addition to that, all the patients with irregular blood pressure had hypertension and any kidney patient with hypotension was not found. Therefore, a comparative study of kidney patients with hypertension and hypotension was not possible to construct.

Besides these, there was no history of cardiovascular disease available on the patient's medical file and therefore the relationship of kidney disease with cardiovascular disease was not possible to figure out.

Other than that, habitual acts of the patients were not available from the medical file. Therefore, a relation of kidney disease with patient's habitual acts was not possible to construct.

Further studies on similar area should be conducted on a larger population and broader point of analysis to draw a better precise conclusion on trend, prevalence and cause of kidney disease in Bangladesh in recent times.

Conclusion

This is evident from the study that, there is a noticeable increasing trend in the prevalence of Kidney Disease particularly Chronic Kidney Disease in present Bangladesh.

An alarming prevalence rate of kidney disease is observed in the age group of 51-60 and above 60 years. This data was proved almost similarly predominant in both male and female subjects. The prevalence of hypertension was most (31%) in kidney patients. Moreover, diabetes in kidney patients was also found in a concerning percentage (28%). Besides these, 23% patients had both diabetes and hypertension. Along with that, Cortex and Medulla Differentiation (CMD) status was found poor in 65% of the total patients. This analysis also show the negative impacts of high blood pressure and uncontrolled blood sugar regulation on the kidneys since both of these diseases interrupt the functions of the kidneys.

A strong association of both hypertension and diabetes with Chronic Kidney Disease (CKD) was also found where both of the diseases lie in concerning percentages (36% and 33% respectively) on the subjects and remaining 31% had both of them. Although the lengths of the kidneys were also measured, there were no noticeable abnormalities found since all the patients had a normal range. Besides these, most of the patients (38%) blood group was B+(ve) and there were no patients with B-(ve) blood group.

Lifestyle can be a major point of concern behind the rise in number of kidney patients in our country. As a higher percentage of overweight (39.5%) and obese (13.5%) patients found from the study, maintaining a regular body weight is necessary to fight against kidney problems. Moreover, extra body weight increases the risk of diabetes and hypertension where both of the diseases are considered as the major risk factors of Chronic Kidney Disease.

Drinking impure water is also dangerous for the kidneys as it may contain several harmful chemicals or metals. Therefore, it is much important to drink pure water in an adequate amount to facilitate the proper functioning of the kidneys.

Therefore, along with further studies, we need to be more concerned about maintaining a healthy weight by eliminating high calorie foods from our diet as well as doing some physical exercise regularly to correlate lifestyle with onset of Kidney Diseases in our country.

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