Lifestyle Modifications to Have a Healthy Renal System

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A thesis submitted to the School of Pharmacy in partial fulfilment of the requirements for the degree of Bachelor of Pharmacy (B. Pharm.)

School of Pharmacy
BRAC University
September, 2025

Declaration

It is hereby declared that

1. The thesis submitted is my own original work while completing degree at BRAC University.
2. The thesis does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
3. The thesis does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.
4. I have acknowledged all main sources of help.

Student's Full Name & Signature:

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Approval

The thesis titled " Lifestyle Modifications to Have a Healthy Renal System" submitted by Saiyara Jahin Anika (20146064) in Spring, 2025 has been accepted as satisfactory in partial fulfilment of the requirement for the degree of Bachelor of Pharmacy (B.Pharm.).

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Ethics Statement

Through this project, no animal is used or harmed, and no human trials have been conducted.

Abstract

With 850 million cases chronic kidney disease (CKD) is one of the leading causes of death globally. Because they lack the resources to prevent detect and treat it low- and middle-income countries are more affected. Bangladesh needs a comprehensive approach because its rate of chronic kidney disease (CKD) is higher than the global average. This subject focuses on preventing and reversing kidney disease by examining the effects of lifestyle nutrition and medical conditions. Due to their modifiability diabetes high blood pressure obesity and smoking are emphasized. It also admits that the issue is made worse by socioeconomic inequality and arsenic contamination. The best place to start is with a change in lifestyle. This entails eliminating smoking managing stress increasing physical activity eating more plants and consuming less salt. The study also draws attention to current problems in Bangladesh including poor kidney care and expensive medical care. Community-based screening easily accessible healthcare digital health technologies and culturally sensitive public health initiatives are just a few of the important policy changes it suggests addressing this.

Keywords: Chronic Kidney Disease; Lifestyle Modification; Public Health; Bangladesh; Prevention.

Dedication

This work is lovingly dedicated to my parents, whose unwavering guidance, sacrifices, and encouragement have shaped every step of my journey. Their faith in me has been my greatest strength. I also dedicate this thesis to my beloved husband, whose patience, love, and constant support have carried me through the challenges and long hours of this work. His presence has been both my comfort and my inspiration. Without their love and belief in me, this achievement would not have been possible.

Acknowledgement

Firstly, I would like to express my deepest gratitude to the Almighty Allah; without His boundless mercy and blessings, this journey would not have been possible.

Secondly, I am sincerely thankful to my respected supervisor, Mehedi Islam, Lecturer, School of Pharmacy, BRAC University. Working under his guidance has been a privilege, and his support, encouragement, and valuable advice have been instrumental in completing this project. I would also like to extend my heartfelt appreciation to all the distinguished faculty members of the School of Pharmacy, BRAC University, for their constant guidance and encouragement throughout my academic journey.

My deepest thanks go to my parents, whose prayers, moral strength, and unconditional support have always been my greatest motivation. I am also profoundly grateful to my beloved husband, whose patience, encouragement, and unwavering support have been my anchor during this work.

Finally, I would like to acknowledge the respected teaching assistants and lab officers for their cooperation and assistance throughout the course of this project.

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List of Acronyms

AKI – Acute Kidney Injury

CDC – Centers for Disease Control and Prevention

CKD – Chronic Kidney Disease

eGFR – Estimated Glomerular Filtration Rate

ESRD – End-Stage Renal Disease

GBD – Global Burden of Disease

ISN – International Society of Nephrology

NSAIDs – Non-Steroidal Anti-Inflammatory Drugs

RAAS – Renin–Angiotensin–Aldosterone System (if discussed in pathophysiology section)

SPSS – Statistical Package for the Social Sciences (if used in data analysis)

USRD/USRDS – United States Renal Data System

WHO – World Health Organization

Chapter 1

Introduction

The Renal System are commonly known as the urine system in the human body (Jha et al., 2013). This system also responsible for maintaining the homeostasis in human body. This kidney function Synthesizes and discharges both erythropoietin and renin, regulate the blood pressure (Levey et al., 2017), Maintains homeostasis of body fluids and electrolytes balance while excreting, disposes of waste. The kidney system filters about 180 (one hundred eighty liters blood daily. It disposes excess fluid and waste while preserving vital & essential minerals (Luyckx et al., 2017). These processes & mechanism assist the renal system in preserve homeostasis to promoting the optimal organ function. Some errors which can arise from this well controlled system can cause to major health issues in fatal chronic kidney disease. Nowadays (Hill et al., 2016), the chronic kidney disease causes early death & high morbidity which is particularly prominent progressive disease in worldwide. The WHO claims that chronic kidney disease becomes worldwide health concern. The most significant variables that lead to the growing prevalence are involve in longer lifespan (Luyckx et al., 2017), obesity, insulin resistance and high blood pressure. Maintains daily routine & activities play a major impact on renal function. Using Tobacco, refined food intake, lack of physical activity and prolonged anxiety ultimately damage the ability of the kidney (Muntner et al., 2022). The Chronic kidney dysfunction may arise from an excessive intake of processed carbohydrates, saturated fats and mineral salts and it further raises the chance of developing both hypertension and diabetes (Afshin et al., 2019).

Obesity and metabolic disorders are the results of inactivity (Clark et al., 2023). Smoking has a detrimental effect on vascular structures linked to filtration and stress-induced hormonal alterations raise blood pressure and damage kidney function (Yacoub and Habib, 2021). Healthy patterns on the other hand provide security. The risk of developing chronic kidney disease is decreased by eating a

diet high in fruits vegetables whole grains lean meats and adequate water intake (Clark et al., 2023). Frequent exercise enhances renal circulation and cardiovascular fitness (Gansevoort et al., 2013; Levey et al., 2017) whereas yoga meditation and mindfulness control blood pressure and ultimately promote kidney health (Choi et al., 2020). One of the most effective ways to prevent renal disease is to identify it early (Jha et al., 2013). Because chronic kidney disease develops asymptomatically in its early stages high-risk individuals should undergo routine blood pressure glucose and urine protein screenings (Hill et al., 2016). Rapid intervention to stop or lessen the deterioration of renal function is made possible by early detection of abnormalities (Levey et al., 2017). For public health programs to be widely successful screening and awareness must be given top priority (Luyckx et al., 2017). However, outcomes are significantly impacted by social and economic disparities. Chronic kidney disease is less likely to be identified or treated quickly in communities with poor access to healthcare (Luyckx et al., 2017). Households with limited resources may experience financial strain as a result of advanced disease stages because dialysis and transplantation costs are higher (Jha et al., 2013). The problem is exacerbated in Bangladesh by a lack of medical infrastructure public ignorance and insufficient preventive measures (Banik and Ghosh, 2021). Community-focused education publicly funded healthcare and easily accessible screening are necessary to address these disparities.

While affluent countries face obesity and malnutrition those with low or moderate incomes experience illness (Jha et al., 2013), water contamination, and hygiene problem. Changes to eating habits and obesity are witnessing growing in the USA and China. day by day. Even though like USA & India, observing a rising rate an inflammation of the kidney and infection that associated with renal disorders in South Africa & south Asian countries (Levey et al., 2017). The impact of both environmental & psychological behavior plays a crucial role in the maintenance of renal well-being by the variation in outcomes demonstrate. By current developments in both healthcare technology and scientific knowledge used Revolutionary methods for controlling and avoiding kidney damage have been

successfully developed. Applications for smartphones which monitor consumption of sodium and devices with technology that measures dehydration are transforming individuals' medical treatment. Customized healthcare provides accurate & efficient treatment options by targeting prevention strategies to how people lives & the histories of biological risk. Bangladesh have only few assets that require specific focus or attention as these nations have insufficient construction and safeguards. A research study that examines global epidemiology of kidney conditions throughout the globe can be utilized to share their results. By mixing effective therapeutic procedures with research-based data knowledge this research attempts to motivate patients and healthcare providers to adopt some environmentally friendly habits which support the function of kidney while maintaining overall well-being of health.

Chapter 2

Methodology

For this thesis, emphasis was given to wide range of peer-reviewed publications and official reports. Research articles were collected from well-established databases such as Google Scholar, PubMed, ScienceDirect, Springer Nature, and MDPI. To tackle the missing data issue, I refined my search strategy by using keywords such as “chronic kidney disease,” “CKD prevalence,” “risk factors,” “hypertension,” “diabetes mellitus,” “Bangladesh,” “epidemiology,” and “lifestyle modification.” I carefully read about 75 articles and reports in total to make sure that only those that were directly related to the prevalence of CKD risk factors lifestyle impacts and global–regional comparisons were included. To preserve a defined research scope studies that exclusively addressed unrelated illnesses or organ systems were disqualified.

2.1 Searching Details Table

Table 1: Pubmed search results (article counts for each keyword query)

Source name	CKD with Hypertension	CKD with Diabetes Mellitus	CKD Prevalence	CKD Risk Factors	CKD in Bangladesh	Lifestyle modification and CKD
PubMed	1,245	2,876	54,320	8,945	512	1,134

Table 2: Google Scholar search results (article counts for each keyword query)

Source name	CKD with Hypertension	CKD with Diabetes Mellitus	CKD Prevalence	CKD Risk Factors	CKD in Bangladesh	Lifestyle modification and CKD
Google Scholar	1,850	3,420	34,560	21,220	2,340	1,760

Chapter 3

Global Prevalence of Renal Disease

3.1 Worldwide Epidemiology

Nowadays Renal disorders become one of the most significant health problems in worldwide. The World Health Organization and ISN estimates that in the whole world around 851 million individuals affect by the chronic kidney disease. This long-term kidney disease is identified as the 9th cause of death globally which is declared by the Global burden of disease study (Banik and Ghosh, 2021; Francis et al., 2024). To allows distinguish between the 5 stage of chronic kidney disease, the estimated glomerular filtration rate (eGFR) play a vital role here. Acute kidney injury (AKI) and chronic kidney disease must be differentiated from one another due to the notable variations in their onset and progression. AKI develops abruptly and is often reversible with timely treatment whereas chronic kidney disease (CKD) is a progressive irreversible decline in renal function over time (Luyckx et al., 2017).

3.2 Epidemiological Reports from Global Agencies (CDC, WHO)

The scope of this health crisis is demonstrated by data from the Centers for Disease Control and Prevention (CDC) the World Health Organization and other relevant sources. According to WHO efforts (WHO, 2023) CKD is thought to be the cause of 1 in 3 million deaths worldwide each year. Only ten percent of the nearly 37 million people in the US who are afflicted—roughly one in seven—are aware of their condition (Huda et al., 2012). Among older populations the prevalence is particularly high especially for those 65 and older (Hallan et al. (2012). complete worldwide statistics on the. Resource compilations of CKD incidence prevalence and mortality include the

Global Kidney Health Atlas ISN reports and the GBD 2019 study (Anand et al., 2014; Huda et al., 2012; Feng et al., 2018).

3.3 Regional Variation in CKD Burden

There is significant regional variation in the global burden of chronic kidney disease (CKD) which is influenced by both variations in healthcare infrastructure and lifestyle risks. South Asia Sub-Saharan Africa Latin America and the Middle East have some of the highest prevalence rates where limited access to healthcare and rising rates of diabetes and hypertension coexist (Hallan et al., 2012) For example, one of the top three causes of death for adults in Mexico is chronic kidney disease (CKD). According to Jha et al. the diabetes epidemic in South Asia has also contributed to a dramatic rise in CKD cases in recent decades (Francis et al., 2024). Conversely nations like Canada Japan and Scandinavia that have robust public health systems and well-established preventive initiatives typically have relatively lower rates of kidney disease (Luyckx et al., 2017). Within national borders there is an additional layer of inequality especially between urban and rural areas. Because dialysis and kidney transplantation are two advanced treatment options that are frequently concentrated in large cities access to life-saving care is uneven. Consequently, rural residents are more likely than their urban counterparts to suffer from higher mortality and faster disease progression (Hill et al., 2016).

3.4 Historical Trajectory

Globally, the prevalence of CKD increased by about 30% in the past three decades, primarily due to ageing populations and rising non-communicable diseases such as diabetes (Gansevoort et al., 2013; KDIGO, 2021). Environmental hazards and misuse of non-steroidal anti- inflammatory drugs (NSAIDs) are increasingly recognized as contributors (Clark et al., 2023). The COVID-19

pandemic has also led to increased hospital-related AKI cases, raising concerns about long-term consequences for renal health (Ng et al., 2021).

3.5 At-Risk Populations

- **By Age:** CKD risk rises dramatically after age 60, though risk factors like childhood obesity and malnutrition start early (Hill et al., 2016).
- **By Gender:** CKD is more common in women, but men progress to ESRD at a faster rate (Jha et al., 2013).
- **By Socioeconomic Status:** Low-income groups are more affected due to increased occupational exposures, lack of healthcare, and inadequate nutrition (Luyckx et al., 2017).
- **By Comorbidities:** Individuals with hypertension, diabetes, cardiovascular disease, or obesity are at significantly higher risk (Afshin et al., 2019).

3.6 Healthcare Expenses

The financial burden of kidney disease is immense. In the United States alone, Medicare allocates nearly $120 billion each year to the management of CKD and end-stage renal disease (ESRD) (Kar and Islam, 2023). In contrast, patients in low-income countries often face prohibitive costs for dialysis or transplantation, leaving many unable to access life-saving treatment. This not only deepens the hardship for families but also places heavy pressure on national health systems (Luyckx et al., 2017). The consequences are evident in the form of insufficient specialist availability, overcrowded dialysis facilities, and inadequate investment in early screening and preventive programmes (WHO, 2023).

Chapter 4

Renal Disease in Bangladesh

4.1 Nationwide Statistics

A 2019 systematic review found that Bangladesh's pooled CKD prevalence is approximately 22.5%, which is far higher than double the global average of about 10% (Banik and Ghosh, 2021; Hill et al., 2016). There are roughly 262 nephrologists, including those who treat children that's mean pediatrics specialists, to care for a serving more than 170 million people in the nation (Kar and Islam, 2023). Between 2019 and 2020, more than 10,500 people (about 63.8 per million) in Bangladesh started renal replacement therapy (RRT) due to end-stage kidney disease. In 2020 alone, this number slightly decreased to around 9,500 patients which is approximately near to 57.7 per million (Ripon et al., 2023).

4.2 Disease Statistics & Occurrence Rate

CKD prevalence in urban and community surveys ranges from 13–26% that based on different survey methods and population groups (Anand et al., 2014; Huda et al., 2012; Feng et al., 2018). In the slum areas of Mirpur, Dhaka, the prevalence is estimated at 16% of the population using the Cockcroft-Gault equation and 13.1% of the population with the MDRD formula (Huda et al., 2012). Among middle-class urban adults, about 20% are affected by CKD, with insulin resistance being a common issue in this population (Anand et al., 2014). In rural areas of Bangladesh, around 36.4% of people with hypertension also have CKD which has a rate higher than in Pakistan and equivalent to Sri Lanka (Feng et al., 2018). Because of sedentary lifestyles and eating habits, the prevalence is higher in urban populations (Afshin et al., 2019).

4.3 Gender and Age-Based Demographic Structure

End-stage renal disease (ESRD) appears to be slightly more common in men, although chronic kidney disease (CKD) affects both men and women (Francis et al., 2024). Although incidences among younger people are on the rise more cases occur in individuals aged 40 and above (Hallan et al., 2012). There is a growing concern about younger people developing early-stage kidney disease, largely due to poor or unhealthy lifestyle habits (GBD Chronic Kidney Disease Collaboration, 2020).

4.4 Frequent Reasons in the Region

The leading cause of chronic kidney disease is diabetes mellitus, accounting for around 40% of cases. Hypertension is the second most common contributor that affecting about 30% of individuals (Gansevoort et al., 2013; KDIGO, 2021). Other significant causes include congenital abnormalities of the kidneys, glomerulonephritis which refers to inflammation of the kidney's filtering units and urinary tract infections (Levey et al., 2017; Jha et al., 2013).

4.5 Diabetes Mellitus, Hypertension, Environmental Exposures & Lifestyle

Diabetes: When diabetes is not well managed, it can lead to diabetic nephropathy, it's a condition that damages the kidneys over time (Levey et al., 2017). This is one of the main causes of end-stage renal disease (ESRD), where the kidneys lose nearly all function.

Hypertension: Consistently high blood pressure puts extra strain on the blood vessels in the kidneys, gradually causing them to weaken (KDIGO, 2021). This damage can lead to chronic kidney disease if not controlled.

Environmental Exposure: Kidney damage may result from drinking water contaminated with especially water containing arsenic or heavy metals (Peters et al., 2014; Peters et al., 2015). In rural farming communities regular contact with agricultural chemicals and pesticides also increases the risk of kidney-related problems (Melgaço et al., 2021; Kan et al., 2022; Campbell et al., 2023).

Lifestyle Factors: The overuse of painkillers (like NSAIDs), frequent consumption of junk or fast food, smoking, high salt intake, and a sedentary lifestyle all contribute to kidney damage (Melgaço et al., 2021; Yacoub and Habib, 2021; Zhang et al., 2025). These behaviors often lead to conditions like diabetes and hypertension, which further worsen kidney function.

4.6 Healthcare System Resources

In Bangladesh, tertiary care hospitals such as Dhaka Medical College, BSMMU, and NICRH provide specialized nephrology training programs. In the private sector, facilities like United Hospital, Evercare (known as Apollo), and Labaid deliver dialysis and kidney transplant services. However, the country still faces a significant shortage of nephrologists and dialysis centers compared to the growing demand (Kar and Islam, 2023).

4.7 Dialysis Centers and Nephrology Care Availability

Bangladesh has fewer than 300 dialysis centers, most of which are concentrated in urban areas. The number of nephrologists is very limited, leading to a high patient-to-doctor ratio. Dialysis sessions cost between 3,000 and 5,000 BDT, making them unaffordable for many people (Ripon et al., 2023). Kidney transplants are conducted only in a few specialized hospitals, where patients often face long waiting periods (Kar and Islam, 2023).

4.8 Renal Health Promotion and Awareness Campaigns

National Kidney Foundation (NKF): This function engages in awareness campaigns, organizes health screenings, and offers professional training programs (World Health Organization, 2023).

Public Campaigns: Events like World Kidney Day are observed with educational activities and free screening services (CDC, 2023).

Government Efforts: Certain public hospitals provide free or low-cost dialysis, and there are plans to establish dialysis centers in every division (Kar and Islam, 2023).

4.9 Issues

- **Lack of Awareness**: Many cases go undetected until the disease has progressed significantly. Misconceptions and social stigma surrounding dialysis and kidney transplants remain common (Jha et al., 2013).
- **High Treatment Costs**: Both dialysis and transplantation are expensive, making them inaccessible for many patients (Ripon et al., 2023).
- **Uneven CKD Prevalence**: The occurrence of chronic kidney disease varies across different regions (Francis et al., 2024).
- **Urban–Rural Gap**: Patients in rural areas often face limited access to proper diagnosis and treatment, and many must travel long distances for consultations or dialysis sessions (Feng et al., 2018).

Chapter 5

Pathogenesis of Renal Disease

5.1 Medical Causes

Diabetes Mellitus or Diabetic Nephropathy: Long-term high blood sugar levels damage the tiny blood vessels in the kidneys, known as glomeruli. This damage causes proteins to leak into the urine (proteinuria) and gradually reduces the kidneys' ability to filter waste. Diabetes is the leading cause of end-stage renal disease (ESRD) globally. Up to 40% of people with diabetes develop kidney disease (Levey et al., 2017).

Hypertension (Hypertensive Nephropathy): High blood pressure puts extra strain on the tiny filtering vessels in the kidneys, leading to scarring and a gradual loss of their filtering ability over time (KDIGO, 2021).

Glomerulonephritis: This condition involves inflammation of the kidney's filtering units, called glomeruli. It can be triggered by autoimmune responses, infections. Glomerulonephritis leads to a progressive decline in kidney function (Jha et al., 2013).

5.2 Behavioral Factors

It is well recognized that unhealthy lifestyle choices play a significant role in the development of kidney disease (Afshin et al., 2019; Neale et al., 2023).

- **Poor Diet**: high salt, animal protein, processed foods, low hydration (Muntner et al., 2022).
- **Sedentary Lifestyle**: raises obesity, diabetes, high BP (Chuang et al., 2024; Zhang et al., 2025).
- **Smoking**: damages kidney vessels (Yacoub and Habib, 2021).

- **Alcohol**: linked to kidney injury (Gansevoort et al., 2013).

5.3 Surrounding and Occupational Threats

Kidney tissues can sustain direct damage from environmental causes. CKD is more common in areas with high air pollution (Duan et al., 2022; Wathanavasin et al., 2024). Toxic heavy metals such as lead, cadmium, mercury, and arsenic harm the kidney's filtering tubules (Peters et al., 2015). Long-term dehydration from hot work environments leads to chronic interstitial nephritis, also known as Mesoamerican Nephropathy (Afsar, Elsurer Afsar and Kanbay, 2019).

5.4 Inherited and Congenital Influences

Polycystic Kidney Disease (PKD): A genetic disorder called polycystic kidney disease (PKD) results in numerous fluid-filled kidney cysts that progressively impair kidney function (Taal et al., 2022).

Congenital Anomalie: Congenital defects may include anatomical abnormalities such as renal hypoplasia (small kidneys) or obstructions in urine outflow (KDIGO, 2024; Taal et al., 2022).

Alport Syndrome: Alport Syndrome is a genetic illness that damages collagen in kidney membranes and can also impair hearing and vision (Taal et al., 2022).

5.5 Medication Misuse and Illicit Drug Use

Excessive or improper use of certain medicines and substances can harm the kidneys. Common examples include non-steroidal anti-inflammatory drugs (NSAIDs) (Taal et al., 2022).

Non-steroidal anti-inflammatory drugs: Such as ibuprofen and diclofenac. These drugs block the production of prostaglandins, chemicals that help maintain blood flow to the kidneys. Reduced

blood flow can be especially harmful for people who already have kidney problems. Certain antibiotics, such as vancomycin and aminoglycosides, can cause acute tubular necrosis. This is a type of kidney injury, if used inappropriately or for prolonged periods (Melgaço et al., 2021; Kan et al., 2022; Campbell et al., 2023).

Herbal toxins: Some traditional medicines contain aristolochic acid, a compound known for its strong kidney-toxic effects (Zhou et al., 2023).

Illicit drugs: Substances such as heroin, cocaine, and various synthetic drugs can cause severe kidney damage, sometimes leading to permanent loss of kidney function (Taal et al., 2022).

Chapter 6

Association of Kidney Disorders with Nutrition and Lifestyle

6.1 Dietary Effects

Diet plays a crucial role in both the prevention and progression of kidney disease. Since the kidneys are responsible for filtering waste produced during digestion, what we eat directly affects their workload (Ikizler et al., 2020; Afshin et al., 2019).

Salt Intake: Consuming too much salt can raises blood pressure which is one of the major cause of chronic kidney disease (CKD) and also leads to water retention, which places additional strain on the kidneys (KDIGO, 2021; Ikizler et al., 2020; Afshin et al., 2019).

Protein Overload: Protein is essential for health, but excessive intake, especially from animal sources, increases the amount of nitrogen-based waste the kidneys must filter. In people with reduced kidney function, this extra load can speed up disease progression (Kalantar-Zadeh et al., 2020; Ikizler et al., 2020).

High Sugar Consumption: Diets rich in refined sugars raise the risk of obesity and diabetes, both of which are major risk factors for kidney damage (Muntner et al., 2022; Afshin et al., 2019).

Dehydration: Insufficient fluid intake makes it harder for the kidneys to flush out toxins, it increases the risk of kidney stones and urinary tract infections, both of which can impair kidney function (Clark et al., 2023).

6.2 Influence of a Sedentary Lifestyle

One known risk factor for kidney disease is leading a sedentary or inactive lifestyle which has been connected to a number of kidney-related illnesses (Bull et al., 2020; Chuang et al., 2024; Jang et al., 2023; Zhang et al., 2025).

Hypertension: High blood pressure is a result of irregular physical activity. Increased body weight and weakened cardiovascular health both put additional strain on the kidneys and impair their capacity to filter (Bull et al., 2020; WHO 2021). One of the main causes of chronic kidney disease (CKD) type 2 diabetes is increased by physical inactivity (Chuang et al., 2024; Zhang et al., 2025).

Obesity: Being obese increases the risk of diabetes and puts additional metabolic strain on the kidneys. Obesity is frequently the result of inactivity. This may eventually lead to proteinuria a condition in which proteins seep into the urine as a sign of renal damage (Bull et al., 2020; Neale et al., 2023).

6.3 Interdependent Relationships

The three factors of diet, exercise and kidney function are connected, therefore don't operate separately of other factors. An impaired kidney may prevent the ability of exercise (Neale et al., 2023; Clegg, 2019). The kidneys condition may negatively affect by improper nutrition & food habits. Lacking regular physical activity may outcome in excessive high blood pressure, increase sugar levels (diabetes) and obesity that can be dangerous to our kidney system. As a result, compared to analyzing those variables on their own, we need to be evaluated altogether for controlling & reducing renal disease. Protein, Phosphorus, sodium salt & potassium consumption may frequently have limits in patients who have severe acute kidney disease. When the kidney function cannot effectively filter waste products, the below nutrients can build up in the circulatory

system that reaching hazardous levels-

- Protein intake: Excessive intake of protein worsens the condition of renal disorder through rising the uric acid level and toxin amounts (KDIGO, 2024).
- Salt intake: Excessive intake of salt may outcome retention of fluid & increased the level of blood pressure.
- Potassium intake: Excessive intake of potassium may outcome as severe heartbeat disturbances (Taal et al., 2022).
- Phosphorus intake: A severe intake of phosphorus may damage the bones and increases the chance of coronary heart disease (Baker et al., 2022).

Thus, a vicious cycle may be experienced by patients with chronic kidney disease (CKD) where a reduction in physical activity can worsen kidney damage cardiovascular disease and obesity. To safely preserve strength and general health physical therapy and specialized exercise programs are usually needed (Baker et al., 2022 Battaglia et al., 2024).

6.4 Nutrition and Exercise Effects on Kidney Health

Healthy eating habits and regular physical activity support the management of blood pressure, blood sugar, and body weight. Together, they promote overall well-being and help slow the progression of kidney damage. The two main causes of kidney damage, obesity and hypertension, can be avoided with a well-balanced diet low in sodium, processed carbs, and harmful fats. While CKD patients are subject to potassium and phosphorus limitations, an adequate diet of fruits, vegetables, and whole grains supports cardiovascular health and reduces metabolic stress on the kidneys. Consuming protein in moderation and according to the stage of kidney disease reduces the buildup of nitrogenous waste products and delays further declines in kidney function. Frequent exercise protects against kidney injury by enhancing insulin sensitivity, assisting with weight

control, and improving cardiovascular efficiency. By improving arterial stiffness and vascular flexibility, exercise lowers systemic blood pressure. It also helps with mental health, bone health, and muscle strength all of which are commonly impacted in CKD patients. Additionally, oxidative stress and inflammation are two factors that lead to kidney injury that are reduced by exercise (Clegg, 2019; Kalantar-Zadeh et al., 2020; Zarantonello et al., 2023; Nakamura et al., 2020; Baker et al., 2022; Hayden et al., 2024; Battaglia et al., 2024).

Combining diet and exercise leads to a holistic approach to kidney protection. By lowering risk factors, enhancing metabolic balance, and increasing the body's overall resistance, they cooperate to stop kidney disease from progressing. In addition to maintaining kidney function, this comprehensive lifestyle approach enhances quality of life, lowers hospitalisation rates, and boosts long-term survival for those with or at risk for chronic renal disease (Neale et al., 2023).

Scientific Research on Lifestyle and Kidney Health:

Extensive research highlights the vital role of lifestyle in protecting kidney health and slowing disease progression.

Dietary Research: Studies show that plant-based diets low in sodium and with moderate protein intake are associated with reduced cardiovascular risk and slower progression of chronic kidney disease (CKD) (Clegg, 2019; Kalantar-Zadeh et al., 2020; Zarantonello et al., 2023; Muntner et al., 2022).

Exercise Research: Regular resistance and aerobic exercise in CKD patients have been found to improve quality of life, reduce complications, and enhance markers of kidney function (Nakamura et al., 2020; Baker et al., 2022; Hayden et al., 2024; Battaglia et al., 2024).

Lifestyle Intervention Trials: Programs combining nutrition counseling with exercise training have demonstrated significant improvements in blood pressure, blood sugar regulation, and kidney function in high-risk populations (Neale et al., 2023).

Chapter 7

Kidney-Supportive Dietary Patterns

Proper nutrition plays a vital role in protecting the kidneys, ensuring they function effectively, and slowing the progression of kidney disease. The kidneys are responsible for regulating fluid balance, filtering waste, and maintaining electrolyte levels, all of which depend on healthy dietary habits (Ikizler et al., 2020).

7.1 Nephroprotective Nutrients

In sufficient quantities a number of nutrients are essential for maintaining and safeguarding kidney function. Vitamins C E flavonoids and carotenoids are examples of antioxidants. These substances aid in lowering inflammation and oxidative stress both of which can damage kidney tissues. They are abundant in fresh fruits such as oranges and berries as well as in vegetables nuts and seeds (Afshin et al., 2019). Known for their anti-inflammatory qualities' omega-3 fatty acids can help reduce blood pressure and inflammation. Walnuts and flaxseeds are also good sources as are fatty fishlike salmon and sardines (Ikizler et al., 2020). Dietary fiber facilitates digestion lowers kidney strain and helps control blood sugar and cholesterol levels. Whole grains legumes and vegetables are common sources of it (Afshin et al., 2019). Magnesium and calcium are vital minerals for healthy bones and kidney stone prevention. To ensure safety a healthcare provider should oversee and direct their intake (KDIGO, 2017).

7.2 Significance of Regulating Potassium, Sodium, Phosphorus, and Protein

For kidney health it's critical to maintain a balanced intake of essential minerals and protein. Although potassium promotes healthy heart and muscle function people with kidney disease

(CKD) are at risk for hyperkalemia and are therefore encouraged to eat fruits and vegetables that are lower in potassium such as apples grapes and green beans. Consuming too much sodium can cause kidney damage and increase blood pressure so people with CKD should limit their daily intake to 2300 mg or less. Processed foods salty snacks and canned soups should also be avoided. Patients should limit high-phosphorus foods like some dairy products nut's seeds dark colas and foods with phosphate additives because phosphorus is necessary for bone strength and energy metabolism but can build up in CKD and cause vascular and bone problems. Protein is necessary for good health but too much of it can overload the kidneys and increase nitrogenous waste. While CKD patients frequently follow low-protein diets under professional guidance concentrating on sources like fish lean meats eggs and beans in controlled portions healthy adults should consume moderate amounts (0–8–1 g per kg of body weight per day). The progression of the disease can be slowed and kidney function preserved with careful nutrient management (KDIGO, 2024; Ikizler et al., 2020; St-Jules et al., 2017; Tuominen et al., 2022; Kalantar-Zadeh et al., 2020).

7.3 Regulation of Fluid Balance

A healthy diet lowers the risk of kidney stones and aids in the kidneys ability to eliminate toxins. In addition to preventing dehydration adequate hydration supports regular urine production and preserves electrolyte balance. Adults should consume two to three liters of water each day depending on their age level of physical activity and the surroundings. Limiting fluid intake however may be necessary for patients with heart failure or chronic kidney disease (CKD) in order to avoid edema and elevated blood pressure. Drinking lots of water and avoiding sugary drinks and sodas which can have high phosphorus content are advised for the best kidney health (Clark et al., 2023).

7.4 Nutritional Prevention Strategies

The adoption of dietary practices that support renal health and reduce the incidence of chronic illnesses is one method of nutritional preventive for kidney function. Consuming fruits, vegetables, lean protein, low-fat dairy products, and whole grains is encouraged by the DASH diet (Dietary Approaches to Stop Hypertension) (Bull et al., 2020; Afshin et al., 2019). In order to preserve kidney function and avoid further damage, this dietary plan is specifically made to reduce sodium intake, which lowers blood pressure (Ikizler et al., 2020). In a similar vein, the Mediterranean diet encourages the intake of nuts, whole grains, legumes, fish, and olive oil. Vascular health benefits from a variety of nutrients in this diet that have anti-inflammatory and antioxidant qualities (Muntner et al., 2022). Renal function is indirectly preserved by the Mediterranean diet via reducing cardiovascular risk. Consuming less saturated fat, phosphorus, and animal protein while focusing on fruits, vegetables, whole grains, and legumes is the hallmark of a plant-based diet. A nutritional approach like this lessens the burden on the kidneys by preventing the buildup of waste products from metabolism. As a preventive measure, plant-based diets seem to slow the progression of chronic kidney disease (CKD) (Clegg, 2019; Zarantonello et al., 2023; Kalantar-Zadeh et al., 2020).

7.5 Nutritional Components Recommended for Restriction

Supplemental Elements Suggested for Limitation. In order to avoid renal overload and maintain a healthy diet meal planning is essential. The focus of dietary planning strategies is on a variety of fruits and vegetables fresh nutrient-dense foods and moderate amounts of protein ideally lean (Ikizler et al., 2020). Changing potassium levels as necessary is also crucial (KDIGO, 2024). To reduce intake of sodium and additives it is also recommended to eat fewer packaged and processed

foods (St-Jules et al., 2017). Renal dieticians consider clinical conditions like serum potassium phosphorus and creatinine levels when tailoring dietary recommendations. According to Lambert et al. this expert advice helps people with kidney disease maintain proper nutrition and lower their renal load.

7.6 Food Constituents Requiring Limitation

Food ingredients that must be kept to a minimum. Using digital health tools has emerged as a practical strategy for improving diet management for patients with kidney disease. People can closely monitor the nutrients they eat with mobile apps like Kidney Appetite and MyFitnessPal particularly sodium potassium and phosphorus which are all essential for renal health (Neale et al., 2023). There are also tools for tracking daily fluid intake in some applications to assist patients in adhering to suggested fluid restrictions. Online platforms and patient support websites frequently offer renal-friendly meal plans and recipes in addition to tracking assisting patients in creating and sustaining healthier eating habits. Together these digital resources function as more than that. monitoring tools in addition to motivational and educational materials that promote long-term dietary compliance.

Chapter 8

Fitness Approaches to Support Kidney Function

Kidney function necessitates a multifaceted approach and lifestyle modification is crucial. The direct and indirect effects of physical activity on renal function are two of these changes (Bull et al., 2020). By tackling comorbid conditions such as obesity diabetes and hypertension exercise lowers risk factors that lead to the development and advancement of chronic kidney disease (CKD) (Bull et al., 2020). Higher insulin sensitivity improved cardiovascular health, and balanced metabolic pathways have all been associated with regular exercise and these factors directly affect renal outcomes (Nakamura et al., 2020). According to clinical research patients who regularly participate in moderate exercise have better general health and see a slower rate of disease progression than sedentary patients (Battaglia et al., 2024).

8.1 Types of Exercise Beneficial for Kidney Health

Exercise also includes a range of movements with different physiological effects durations and intensities. Numerous forms of physical activity have been specifically linked to the preservation and enhancement of renal health. Aerobic Exercise: Walking cycling swimming and running are exercises that strengthen the heart increase oxygen delivery to tissues and support metabolic balance. According to Bull et al. aerobic exercise indirectly protects kidney function by enhancing endothelial function reducing systemic inflammation and assisting in blood pressure regulation. Strength training also known as resistance exercise increases insulin sensitivity supports metabolic health and increases muscle mass. You can use resistance bands weights and bodyweight exercises. For CKD patients' strength training is especially important to prevent sarcopenia a common and harmful side effect of renal dysfunction (Baker et al., 2022).

Exercises for Flexibility and Balance: Practices like yoga tai chi and stretching increase joint mobility weaken muscles and increase one's capacity for general function. These exercises lower injury risk and encourage adherence to aerobic and resistance training regimens even though they have no direct effect on kidney filtration (Battaglia et al., 2024). The most complete benefits come from combined exercise programs that incorporate aerobic strength balance and flexibility exercises. Such multimodal programs enhance physical function metabolic health muscular strength and cardiovascular fitness all of which support kidney health and lower the risk factors linked to the advancement of CKD (Hayden et al., 2024). It is strongly advised to participate in a range of exercise activities in order to optimize renal function and optimize health benefits (WHO, 2021).

8.2 Exercise Schedule and Duration

The World Health Organization (WHO) recommends that adults between the ages of 18 and 64 engage in resistance training sessions that focus on their main muscle groups two to three times a week in addition to 150–300 minutes of moderate-intensity aerobic activity or 75–150 minutes of vigorous-intensity aerobic activity (WHO 2021 and Bull et al. 2020). Exercises for balance and flexibility should be prioritized for older adults (≥65 years) in order to lower their risk of falling. preserving the same guidelines for aerobic exercise. Maintaining muscle mass and functional independence through resistance training is still crucial (WHO, 2021). Exercise consistency is more important for kidney health than intensity. According to Baker et al. gradual increases in duration and intensity are advised to prevent overtaxing the kidneys and cardiovascular system and to ensure safe and long-lasting physical activity.

8.3 Role of Physical Activity in Promoting Renal Health

The main way that physical activity benefits kidney health is by lowering risk factors for chronic kidney disease (CKD). There are multiple ways to explain its protective effects. Glycaemic Control Improvement: Regular exercise improves insulin sensitivity and aids in blood glucose regulation. According to studies people with diabetes who regularly exercise have lower fasting blood glucose and HbA1c levels. Exercise slows the progression of diabetic nephropathy and reduces kidney damage from hyperglycemia by enhancing glycaemic control (Nakamura et al., 2020; Baker et al., 2022). Management of Obesity and Visceral Fat: Exercise facilitates the reduction of fat especially visceral adiposity and raises energy expenditure. Lowering visceral fat reduces the workload on the kidneys and the production of pro-inflammatory cytokines both of which are essential in halting the development of CKD (Hayden et al., 2024). Blood Pressure Regulation: Aerobic exercise improves overall vascular function lowers arterial stiffness and has a positive effect on the renin-angiotensin-aldosterone system (RAAS). Both the diastolic and systolic blood pressures decrease as a result of these effects. due to appropriate control. Maintaining glomerular function requires blood pressure control and exercise indirectly protects renal health (Battaglia et al., 2024; Baker et al., 2022). Non-Pharmacological Renal Protection: By addressing common comorbidities such as hypertension, obesity, and diabetes, physical activity serves as a non-pharmacological strategy to reduce renal burden and protect against the onset and progression of CKD (Baker et al., 2022; Hayden et al., 2024). Overall, consistent engagement in physical activity provides a multi-faceted approach to kidney health by modulating metabolic, cardiovascular, and inflammatory pathways, thereby offering both preventive and supportive benefits (Battaglia et al., 2024).

8.4 Risk Management Strategies for At-Risk Populations

Dialysis or severe CKD patients should avoid undue strain during their exercise regimens. For those with chronic kidney disease moderate resistance training and aerobic exercise under supervision are generally advised (Baker et al., 2022). Scheduling exercise around dialysis sessions may reduce the risk of hypotension and fatigue (Battaglia et al., 2024). For safe involvement patients must be taught how to avoid high-impact activities stay hydrated and recognize warning signs such as chest pain or lightheadedness (Hayden et al., 2024). Including exercise in your daily routine is one of the best ways to maintain kidney function and postpone the onset of illness. A comprehensive program that enhances cardiovascular fitness lowers the risk of obesity diabetes and hypertension and improves metabolic control includes aerobic strength and flexibility training (Bull et al., 2020; WHO 2021). Adhering to the World Health Organizations recommendations regarding the frequency and duration of exercise enhances these benefits while lowering potential risks particularly for those who are more susceptible. Early and consistent physical activity can therefore be a preventive measure that improves renal and general health outcomes.

Chapter 9

Lifestyle Modifications for Kidney Health

Physical activity alone is not enough to prevent chronic kidney disease (CKD) and maintain proper renal function dietary and lifestyle changes are also necessary (WHO, 2023). Examples of behavioral therapy include health education stress reduction substance abuse prevention health routine monitoring and proper sleep hygiene.

9.1 Resilience building

There are several physiological and hormonal pathways that impair kidney function. Prolonged activation of the hypothalamic-pituitary-adrenal (HPA) axis increases renal workload and hastens the development of chronic kidney disease (CKD). Additionally, it produces more cortisol and adrenaline two stress hormones that can cause systemic problems like inflammation insulin resistance and hypertension (Choi et al., 2020). Cognitive-behavioral therapy yoga mindfulness meditation and deep breathing exercises are methods that have been shown to reduce cortisol levels regulate blood pressure and aid in the preservation of renal function (Choi et al., 2020).

9.2 Impact of Stress Hormones on Kidney Function

By altering glomerular filtration, blood vessel tone, and salt balance, stress hormones such as cortisol and catecholamines can affect kidney function. Chronic kidney disease, high blood pressure, and cardiovascular risks can result from elevated levels of these hormones, which can also impair renal perfusion, induce inflammation, and interfere with endothelial function (Choi et

al., 2020). Lowering the long-term renal risk and protecting kidney function may be achieved through behavioral stress reduction strategies (Neale et al., 2023).

9.3 Substance Termination

Quitting Tobacco: Tobacco use harms the kidneys by increasing oxidative stress causing endothelial damage and hastening the onset of chronic kidney disease (CKD) (Yacoub and Habib, 2021). It is crucial to stop smoking. When they quit smoking people with CKD experienced reduced renal damage improved cardiovascular health and higher survival rates (Yacoub and Habib, 2021). Decreased Alcohol Intake: Excessive alcohol intake can harm the liver and kidneys cause metabolic issues and increase the risk of obesity. To protect renal health alcohol consumption should be minimized or completely avoided (Gansevoort et al., 2013).

9.4 Periodic Health Assessments

Since hypertension is a major contributing factor to chronic kidney disease (CKD), routine blood pressure readings are essential. Regular blood pressure checks help maintain optimum readings and prevent kidney damage (KDIGO, 2021). Regular blood pressure checks are necessary to treat hypertension, which is a major contributing factor to chronic kidney disease (CKD). Regular exams can help avoid kidney damage and maintain acceptable blood pressure levels (Centers for Disease Control and Prevention, 2023). Blood sugar monitoring is crucial due to the substantial correlation between diabetes and renal damage. By detecting and treating hyperglycemia early, routine HbA1c and blood glucose testing can help avoid diabetic nephropathy (Levey et al., 2017). Urine analysis is a simple but effective diagnostic technique for spotting early indicators of kidney disease, such as - proteinuria and hematuria, which supports kidney health and enables timely

medical intervention (United States Renal Data System, 2022). These methods of monitoring maintain kidney function and update long-term results.

9.5 Sleep Routine Management

Maintaining kidney function requires getting enough restorative sleep. During sleep the body regulates the levels of the hormone's aldosterone renin and angiotensin. Both electrolyte balance and blood pressure are regulated by these hormones. Whatever the length quality or irregularity of the sleep disturbance it can raise blood pressure the sympathetic nervous system and the risk of chronic kidney disease (Francis et al., 2024). Research has also shown that sleep deprivation is associated with elevated oxidative stress and systemic inflammation which can lead to glomerular damage and endothelial dysfunction (Francis et al., 2024). Moreover, metabolic dysregulation and insulin resistance linked to sleep deprivation exacerbate kidney damage risk factors like diabetes and obesity (Francis et al., 2024). A regular sleep-wake cycle avoiding bright light and electronics right before bed and creating a peaceful cool and dark sleeping environment are all ways to promote healthy sleep and safeguard renal function. By reducing metabolic stress minimizing sympathetic overactivity and maintaining hormonal balance proper sleep hygiene can safeguard kidney function without the need for prescription drugs (Francis et al., 2024).

9.6 Educational Interventions for Health

It's important to understand renal health and preventive strategies is crucial both at the individual and community levels.

Community-Based Awareness: The majority of public health activities are primarily used to educate communities about the risk factors for chronic kidney disease, the importance of early screening, and the adoption of good lifestyle habits. These efforts empower people to make informed decisions that benefit our kidney health (WHO, 2023).

Personal Accountability: By adopting good habits, scheduling routine checkups, and maintaining a healthy lifestyle, people can actively safeguard their kidney system. Understanding the relationship between daily routines, comorbid diseases, and kidney outcomes improves patient adherence and supports long-term renal protection (Neale et al., 2023).

Chapter 10

Conclusion

This thesis connected the responses of the health system to the burden of kidney disease with lifestyle choices. The cardiometabolic risks that dominate public health are linked to chronic kidney disease which is common and on the rise. The situation is exacerbated by Bangladesh's high disease burden and dearth of specialized resources. In light of this prevention and early detection are both required and desirable. Kidney structures are weakened by poorly controlled blood pressure and high blood sugar, and certain populations are strained by infections and immunological disorders. Because outdoor workers deal with real-world risks like dehydration and contaminated water environmental exposures are crucial. Both medical and public infrastructure are needed to address them. In practice prevention starts with lifestyle choices. Heart health and kidney decline can be lessened by low-salinity plant-based diets careful protein consumption regular exercise drinking enough water giving up tobacco and keeping blood pressure and weight within normal ranges. Although these behaviors are typical it is imperative to incorporate them into primary care through frequent follow-up clear instructions and counseling. Regular screening easy access to affordable medications and the expansion of nephrology and nutrition staff are ways that health systems can optimize these advantages. Safer water and heat protection diet and exercise programs and outdoor clinics can reverse the trend. Progress is driven by equity in prevention and care for underprivileged and rural communities. The solution lies in making sustainable and easy healthy choices.

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