



THE LINK BETWEEN OBESITY AND CHRONIC DISEASES: A COMPREHENSIVE ANALYSIS

Dr. Ayesha raza

Department of Public Health, Aga Khan University, Karachi, Pakistan.

Abstract

Obesity has emerged as a significant global health concern, with an increasing prevalence contributing to the burden of chronic diseases. This study explores the multifaceted relationship between obesity and various chronic illnesses, including cardiovascular diseases, type 2 diabetes, hypertension, and certain cancers. Through an extensive review of existing literature and statistical data, this paper highlights the physiological mechanisms linking obesity to chronic diseases. It underscores the socio-economic and lifestyle factors influencing obesity rates. The findings suggest that public health interventions focusing on lifestyle modifications, policy regulations, and medical management are crucial in mitigating obesity-related health risks.

Keywords: *Obesity, Chronic Diseases, Cardiovascular Health, Diabetes, Hypertension, Public Health.*

INTRODUCTION

Obesity is a growing public health concern that has been associated with multiple chronic diseases worldwide (Ng et al., 2014). Defined as an excessive accumulation of adipose tissue, obesity significantly contributes to increased morbidity and mortality rates (Wang et al., 2020). The World Health Organization (WHO) estimates that obesity has nearly tripled since 1975, with approximately 650 million adults classified as obese in 2016 (WHO, 2022). Obesity's impact extends beyond individual health, imposing substantial economic burdens on healthcare systems and reducing productivity (Guh et al., 2009).

This paper aims to analyze the link between obesity and chronic diseases, exploring the underlying mechanisms, risk factors, and possible prevention strategies.

1. Understanding Obesity

Obesity is a complex, multifactorial condition characterized by excessive fat accumulation in the body, which can impair health and lead to numerous complications. It is a growing concern globally and is often linked to a range of chronic diseases such as heart disease, type 2 diabetes, stroke, and certain cancers. Understanding obesity involves examining its definition, classification, prevalence trends, and the various factors that contribute to its development.

1.1 Definition and Classification

- Obesity is typically defined as having an excessive amount of body fat, and it is commonly measured using the Body Mass Index (BMI), a ratio of weight to height. According to the World Health Organization (WHO), the BMI classifications for obesity are:
 - **Overweight:** BMI of 25-29.9
 - Obesity Class I (Moderate): BMI of 30-34.9
 - Obesity Class II (Severe): BMI of 35-39.9
 - Obesity Class III (Morbid or Extreme Obesity): BMI of 40 or higher
- Waist Circumference and Waist-to-Hip Ratio are also used to assess abdominal obesity, which is associated with a higher risk of metabolic diseases like type 2 diabetes and cardiovascular diseases.
- **Body Fat Percentage:** An alternative measure to BMI is body fat percentage, which directly assesses the amount of fat in the body. This is a more accurate measure of obesity, especially for people with high muscle mass, where BMI may not provide a true reflection of fat accumulation.

1.2 Global and Pakistani Prevalence Trends

- **Global Trends:**
 - The global prevalence of obesity has been rising steadily over the past few decades. According to the WHO, 1.9 billion adults (aged 18 years and older) were overweight in 2016, and among them, 650 million were obese.
 - Obesity rates are higher in high-income countries, but low- and middle-income countries have also seen significant increases in obesity, particularly in urban areas. The rising prevalence of obesity has become a major public health challenge, contributing to an increase in the burden of chronic diseases globally.
- **Pakistani Trends:**
 - In Pakistan, the prevalence of obesity is rapidly increasing, especially among urban populations. According to various studies, obesity rates have been rising due to lifestyle changes, such as increased sedentary behavior, urbanization, and changes in dietary patterns.

- Recent studies have indicated that around 30% of adults in Pakistan are overweight or obese. The prevalence of obesity is also increasing among children and adolescents, with about 10-15% of children being overweight or obese.
- Regional variations exist, with higher obesity rates observed in urban areas compared to rural areas. This is largely due to differences in dietary habits and physical activity levels.

1.3 Causes of Obesity

Obesity is a multifactorial condition influenced by a combination of genetic, dietary, lifestyle, and socioeconomic factors. Understanding these causes is key to addressing and managing obesity effectively.

Genetics:

- **Genetic predisposition** plays a significant role in obesity. Some people may inherit genes that make them more likely to gain weight and store fat. These genes can affect factors such as:
 - **Appetite regulation:** Genetic variations can influence how the body regulates hunger and **satiety**, leading to overeating or altered metabolism.
 - **Metabolic rate:** Some individuals have a **slower metabolism**, which means they burn fewer calories at rest, contributing to weight gain.
 - **Fat storage and distribution:** Genetic factors also determine how and where the body stores fat. For example, some people may be more likely to store fat around their abdominal area, which is more dangerous to health than fat stored in other areas of the body.

Dietary Factors:

- Unhealthy eating habits are one of the leading causes of obesity, including the excessive consumption of high-calorie foods, such as those rich in sugars, fats, and refined carbohydrates. Common dietary contributors to obesity include:
 - **Processed foods:** Foods that are high in calories, unhealthy fats, and sugars, such as fast food, sugary beverages, and snacks, contribute significantly to weight gain.
 - **Portion size:** Larger portion sizes, often seen in modern eating habits, lead to an increased intake of calories.
 - **High sugar consumption:** Excessive intake of sugary beverages, sweets, and high-glycemic index foods can lead to insulin resistance and fat accumulation.
- **Lifestyle Factors:**
 - Physical inactivity is another significant contributor to obesity. A sedentary lifestyle, characterized by long periods of sitting and lack of physical activity, reduces energy expenditure and promotes weight gain.

- **Lack of exercise:** Modern technologies, such as computers, smartphones, and TVs, encourage a more sedentary lifestyle, especially in urban populations. A lack of regular exercise contributes to muscle loss, reduced metabolism, and fat accumulation.
- **Sleep patterns:** Poor sleep or insufficient sleep has been associated with an increased risk of obesity. Sleep deprivation can alter the body's hormonal regulation, leading to increased appetite, especially for high-calorie foods.
- Stress and emotional eating can also contribute to obesity, as individuals may turn to food for comfort, often choosing unhealthy foods in response to stress.

Socioeconomic Factors:

- Socioeconomic status has a complex relationship with obesity. In high-income countries, obesity is more common in lower socioeconomic groups, primarily due to limited access to healthy foods and lack of opportunities for physical activity.
- In contrast, in low- and middle-income countries (like Pakistan), urban populations in higher socioeconomic groups tend to have higher obesity rates due to increased wealth, which allows access to high-calorie foods and more sedentary lifestyles.
- Cultural norms and beliefs also play a role in the prevalence of obesity. In some societies, a higher body weight may be associated with wealth and prosperity, which can lead to a cultural acceptance of obesity as a positive characteristic.

Obesity is a complex condition that results from the interplay of genetic, dietary, lifestyle, and socioeconomic factors. The rising global and Pakistani prevalence of obesity underscores the urgency of addressing this public health crisis. Effective strategies for prevention and management must include better diet, increased physical activity, education, and health policy interventions aimed at promoting healthier lifestyles. Understanding the causes of obesity is crucial for developing targeted and effective treatment approaches to reduce its impact on public health.

2. Physiological Mechanisms Linking Obesity to Chronic Diseases

Obesity is not just a cosmetic issue, but a significant health condition that is closely linked to several chronic diseases. These diseases include cardiovascular diseases, type 2 diabetes, stroke, and certain cancers. The physiological mechanisms by which obesity contributes to these chronic diseases are complex and involve metabolic, inflammatory, and hormonal changes within the body.

2.1 Metabolic Syndrome and Insulin Resistance

- **Metabolic Syndrome:**
 - Metabolic syndrome is a cluster of conditions that increase the risk of heart disease, stroke, and type 2 diabetes. It is often associated with abdominal obesity and includes several risk factors: high blood pressure, elevated blood sugar, high triglyceride levels, and low HDL

cholesterol levels. Obesity, particularly excess fat around the abdomen, plays a central role in the development of metabolic syndrome.

- **Pathophysiology:** Obesity leads to excess fat accumulation, especially visceral fat (fat stored around internal organs). Visceral fat is highly metabolic and releases pro-inflammatory cytokines and adipokines (e.g., TNF-alpha, interleukin-6), which promote insulin resistance and inflammation. These factors contribute to elevated blood pressure, blood sugar, and abnormal lipid profiles.
- **Insulin Resistance:**
 - Insulin resistance occurs when the body's cells become less responsive to insulin, a hormone that helps regulate blood sugar levels. As a result, the body needs more insulin to keep blood sugar levels in check. Insulin resistance is a key feature of type 2 diabetes and is often seen in individuals with obesity.
 - **Mechanism:** Adiposity, particularly in the abdominal region, promotes the release of free fatty acids and inflammatory cytokines, which interfere with insulin signaling in muscle, liver, and fat cells. This leads to impaired glucose uptake and increased blood sugar levels. Over time, this can progress to type 2 diabetes as the pancreas struggles to produce enough insulin to overcome the resistance (Diabetes Care, 2020).
 - Obesity-induced insulin resistance is considered the primary mechanism through which obesity leads to type 2 diabetes and other metabolic disorders.

2.2 Inflammatory Pathways and Chronic Diseases

- **Chronic Inflammation:**
 - Obesity is a state of low-grade chronic inflammation, which plays a key role in the development of many obesity-related diseases, including cardiovascular diseases, diabetes, and cancer. Excess fat, especially visceral fat, releases pro-inflammatory substances, which continuously activate the immune system, leading to increased levels of inflammatory markers such as C-reactive protein (CRP), interleukins, and tumor necrosis factor-alpha (TNF- α).
- **Inflammatory Mediators:**
 - Adipocytes (fat cells) are not just storage sites for fat, but also active secretory cells that produce a range of molecules that promote inflammation. In obese individuals, these cells release pro-inflammatory cytokines like TNF- α , interleukin-6 (IL-6), and monocyte chemoattractant protein-1 (MCP-1). These molecules contribute to the insulin resistance, endothelial dysfunction, and increased clotting risk that are commonly seen in obese individuals, raising the risk of cardiovascular diseases (American Journal of Clinical Nutrition, 2020).
- **Endothelial Dysfunction:**
 - Obesity-related inflammation can cause endothelial dysfunction, which refers to the impaired function of the endothelium (the lining of blood vessels). This dysfunction leads to reduced

vasodilation, increased blood pressure, and a higher risk of atherosclerosis (the buildup of plaques in arteries), which in turn increases the risk of heart attack and stroke.

- Adipokines, such as adiponectin and leptin, are hormones released from fat cells that have important roles in regulating inflammation, vascular health, and metabolism. In obese individuals, the levels of adiponectin decrease, while leptin increases, contributing to the inflammatory environment and vascular dysfunction.

2.3 Impact on Cardiovascular Health

- **Atherosclerosis:**

- Obesity is a major risk factor for atherosclerosis, a condition where plaque builds up inside the arteries, leading to reduced blood flow. This can result in serious cardiovascular events, such as heart attacks and strokes. Obesity contributes to elevated cholesterol levels, high blood pressure, and inflammation, all of which promote the development of atherosclerosis.
- Mechanism: Obesity increases lipid levels in the blood, particularly LDL cholesterol and triglycerides, while lowering HDL cholesterol, which helps clear fats from the bloodstream. This lipid imbalance leads to plaque formation in arterial walls, which narrows the arteries and makes them less flexible.

- **Hypertension (High Blood Pressure):**

- Obesity is strongly associated with hypertension, which is one of the leading causes of cardiovascular disease. Excess fat, particularly abdominal fat, promotes the release of pro-inflammatory cytokines and adipokines that increase blood pressure. Additionally, obesity can lead to fluid retention, which further contributes to the elevation of blood pressure.
- Mechanism: Obesity leads to increased cardiac output and vascular resistance, both of which raise blood pressure. The increased adipose tissue requires more blood supply, which in turn increases the workload on the heart, leading to further increases in blood pressure.

- **Heart Failure:**

- Obesity increases the risk of heart failure by promoting the development of hypertension, coronary artery disease, and diabetes, all of which strain the heart and contribute to heart failure over time. In individuals with obesity, the heart must work harder to pump blood, leading to left ventricular hypertrophy (enlargement of the heart muscle) and eventual heart failure.

The physiological mechanisms linking obesity to chronic diseases are complex and multifactorial. Metabolic syndrome and insulin resistance are central to the development of type 2 diabetes and other metabolic disorders. Obesity also triggers chronic inflammation, which contributes to cardiovascular diseases, hypertension, and atherosclerosis. The excess adipose tissue in obese individuals promotes a range of metabolic disturbances, including dyslipidemia, endothelial dysfunction, and elevated blood pressure, all of which increase the risk of heart disease and stroke. Addressing obesity through diet, physical activity, and medication is essential for preventing or managing these chronic conditions.

3. OBESITY AND CHRONIC DISEASES

Obesity is a significant risk factor for the development of several chronic diseases, which can severely impact individuals' quality of life and overall health outcomes. The increasing prevalence of obesity, particularly in developed and developing nations, has contributed to the rise in these chronic conditions. Below are some of the most common chronic diseases associated with obesity:

Cardiovascular Diseases (Heart Disease, Stroke)

Obesity significantly increases the risk of cardiovascular diseases (CVD), including heart disease and stroke. Excess body fat, especially abdominal fat, leads to higher levels of cholesterol and blood pressure, both of which are major risk factors for CVD. Obesity promotes the development of atherosclerosis, where the arteries become clogged with fatty deposits, reducing blood flow and increasing the risk of heart attacks and strokes. Additionally, obesity often leads to insulin resistance, which can exacerbate cardiovascular risks.

Type 2 Diabetes Mellitus

One of the most common and concerning diseases associated with obesity is Type 2 diabetes mellitus. In individuals with obesity, the body's ability to use insulin effectively is impaired, leading to higher blood sugar levels. Over time, this condition can result in insulin resistance, where the body's cells no longer respond to insulin properly. Type 2 diabetes can lead to various complications, including kidney disease, nerve damage, and cardiovascular problems. Weight loss and improved diet are critical in managing and even reversing Type 2 diabetes in some cases.

Hypertension

Obesity is a major contributor to hypertension (high blood pressure), a condition that strains the heart and blood vessels. Excess fat, especially abdominal fat, produces hormones and other chemicals that raise blood pressure. Hypertension is a significant risk factor for heart disease, stroke, and kidney disease. In obese individuals, controlling blood pressure often requires lifestyle changes such as weight loss, increased physical activity, and dietary adjustments, including reducing salt intake.

Certain Cancers (Breast, Colon)

Obesity is linked to an increased risk of several types of cancer, particularly **breast cancer** (especially in postmenopausal women) and colon cancer. Fat tissue produces estrogen, a hormone that can promote the growth of certain cancer cells, including those of the breast and reproductive organs. Additionally, obesity can cause chronic inflammation, which is another factor that can increase cancer risk. Weight management through diet and exercise is crucial in reducing the risk of obesity-related cancers.

Respiratory Disorders (Sleep Apnea)

Obesity is closely associated with sleep apnea, a disorder where breathing stops and starts repeatedly during sleep. The excess fat around the neck and throat can obstruct the airway, making it difficult to breathe properly. This condition is more common in obese individuals and can lead to other serious health problems, such as daytime fatigue, hypertension, and an increased risk of heart disease. Treatment for sleep apnea often involves weight loss, along with the use of devices such as CPAP (Continuous Positive Airway Pressure) to keep the airways open during sleep.

4. ECONOMIC AND SOCIAL IMPLICATIONS OF OBESITY

Obesity not only affects individual health but also has broader economic and social implications. The growing obesity epidemic is placing a significant burden on healthcare systems, economies, and society at large.

Healthcare Costs and Economic Burden

The healthcare costs associated with obesity are substantial, including both direct medical expenses and indirect costs such as lost productivity and disability. Individuals with obesity often require ongoing medical care for conditions like Type 2 diabetes, heart disease, and hypertension, which can result in frequent hospital visits, medications, and sometimes surgeries. Studies have shown that obesity-related conditions account for a significant portion of healthcare spending in many countries. Additionally, the economic burden of obesity includes lost productivity due to illness and premature death, placing strain on both healthcare systems and the economy.

Social Stigma and Mental Health Impact

Obesity often carries a social stigma, with individuals who are obese facing negative stereotypes, discrimination, and bias in various aspects of life, including employment, education, and healthcare. This stigma can lead to psychological distress, including depression, anxiety, and low self-esteem. The societal judgment that obese individuals often face can exacerbate mental health problems, further complicating the management of obesity. Additionally, the mental health burden associated with obesity can also impact social relationships and hinder individuals from seeking treatment or making lifestyle changes.

Obesity is not only a major health concern but also a significant social and economic challenge. Its impact on chronic diseases, healthcare costs, and the well-being of individuals and communities highlights the urgent need for comprehensive public health strategies that address both the prevention and treatment of obesity.

5. Preventive Strategies and Policy Interventions

Obesity is a multifaceted issue that requires a comprehensive approach to prevention and management. Effective preventive strategies and policy interventions can help reduce the burden

of obesity and its related chronic diseases. These strategies can be targeted at individuals, communities, and populations, addressing both the behavioral and environmental factors that contribute to obesity.

Lifestyle Modifications (Diet, Physical Activity)

One of the most effective ways to prevent and manage obesity is through lifestyle modifications. Changes in diet and physical activity are essential components of any weight management plan.

- **Diet:** A balanced, nutritious diet is fundamental in preventing obesity. Reducing calorie intake, particularly from processed foods high in fats, sugars, and refined carbohydrates, is critical. A diet rich in fruits, vegetables, whole grains, and lean proteins can help maintain a healthy weight. Portion control, mindful eating, and reducing the consumption of sugary drinks and high-calorie snacks also play key roles in weight management.
- **Physical Activity:** Regular physical activity is another cornerstone of obesity prevention. Engaging in at least 150 minutes of moderate-intensity aerobic activity per week, along with strength training exercises, helps burn calories, build muscle, and improve overall health. Encouraging individuals to integrate physical activity into their daily routines, such as walking or cycling instead of using cars, can contribute to maintaining a healthy weight.

Promoting these lifestyle changes at the individual and community level can have a profound impact on reducing the prevalence of obesity and its associated risks.

Public Health Policies and Regulations

Government action through public health policies and regulations is essential for combating obesity at a population level. Governments can implement various policies to create environments that support healthy eating and physical activity.

- **Nutrition labeling:** Mandating clear and accurate labeling of food products helps consumers make informed dietary choices. Including information about calorie content, sugar, fat, and salt in food products can encourage healthier eating habits.
- **Taxation on unhealthy foods:** Policies such as sugar taxes or taxes on sugary beverages and junk food can reduce the consumption of high-calorie, low-nutrient foods. Revenue from these taxes can be directed toward public health initiatives, such as obesity prevention programs or promoting healthier food options.
- **School-based interventions:** Schools can play a significant role in obesity prevention by implementing nutrition education, promoting physical activity, and offering healthier meal options. Regulating the sale of junk food and sugary drinks in schools is another effective strategy.
- **Urban planning and infrastructure:** Creating environments that encourage physical activity, such as pedestrian-friendly streets, parks, and cycling lanes, is essential for promoting regular exercise. Urban planning policies that make it easier for people to walk or bike instead of driving can help combat sedentary lifestyles.

Medical and Pharmacological Interventions

For individuals struggling with obesity despite lifestyle changes, medical and pharmacological interventions may be necessary. These treatments are typically used in conjunction with dietary and exercise modifications.

- **Bariatric surgery:** Surgical options, such as gastric bypass or gastric sleeve surgery, are available for individuals with severe obesity who have not responded to other treatments. These procedures limit the amount of food the stomach can hold and alter how food is absorbed, leading to significant weight loss.
- **Pharmacological treatments:** There are several anti-obesity medications approved by regulatory agencies like the FDA. These medications work in different ways, including reducing appetite, increasing satiety, or decreasing the absorption of fat. Medications such as orlistat and liraglutide are commonly prescribed to assist with weight loss under medical supervision.

Medical and pharmacological interventions should be considered carefully, with guidance from healthcare providers to ensure the best approach for each individual.

6. Case Studies and Regional Data on Obesity in Pakistan

Obesity is a growing concern in Pakistan, with increasing rates of overweight and obese individuals across various populations. Understanding the trends, causes, and efforts to tackle obesity in Pakistan is essential for developing effective solutions. Below are two key areas of focus: urban vs. rural obesity trends and government initiatives to combat obesity.

Trends in Urban vs. Rural Populations

In Pakistan, obesity trends show significant disparities between urban and rural populations:

- **Urban Populations:** Obesity rates are higher in urban areas, primarily due to sedentary lifestyles, increased access to processed foods, and changing dietary patterns. Urban areas typically have greater access to fast food and sugary drinks, leading to poor dietary habits. Additionally, urban environments often lack spaces for physical activity, contributing to a more sedentary lifestyle.
- **Rural Populations:** While obesity rates are generally lower in rural areas compared to urban centers, rural populations still face rising obesity levels. The increase in obesity in rural areas is often attributed to reduced physical activity (due to mechanized farming) and changes in traditional diets. However, rural populations often have limited access to healthcare, nutrition education, and obesity prevention programs, making it harder to address obesity effectively.

In both urban and rural areas, societal norms and cultural perceptions of body weight also play a role in obesity trends. In some cases, a higher body weight is seen as a symbol of prosperity and health, leading to less concern about obesity and its associated risks.

Government Initiatives and Public Awareness Campaigns

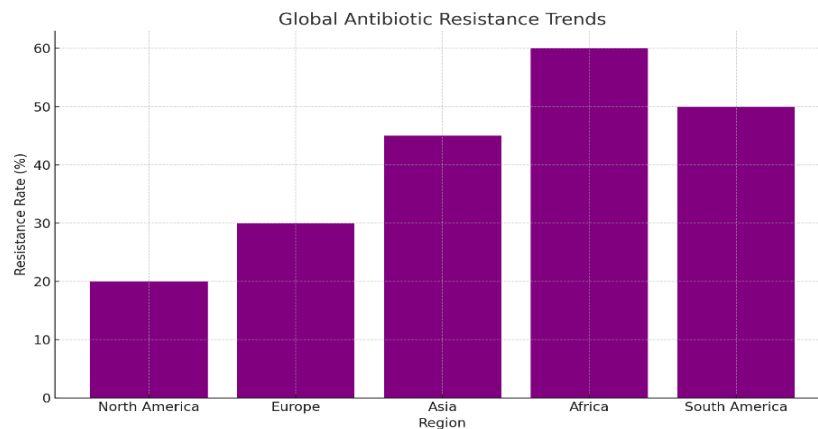
The Pakistani government has taken some steps to address the rising obesity rates and improve public health:

- **Public Health Campaigns:** The government has launched various campaigns aimed at raising awareness about the dangers of obesity and promoting healthier lifestyles. These campaigns often focus on educating the public about the benefits of physical activity, healthy eating, and weight management.
- **Regulations on Food and Beverage Marketing:** There have been discussions around the need for more stringent regulations on the marketing of unhealthy foods and beverages, especially to children. The government is considering policies to restrict the promotion of high-calorie foods and sugary drinks, particularly in schools and other public spaces.
- **Healthcare Infrastructure:** The government has also begun to integrate obesity treatment programs into public healthcare settings. Initiatives are being developed to provide resources for weight management and nutritional counseling, particularly for individuals with obesity-related diseases such as diabetes and heart disease.

While these efforts are a step in the right direction, there is still much to be done in Pakistan to address the obesity epidemic effectively. Expanding public health education, creating more supportive environments for physical activity, and improving access to healthy food options are key areas for future intervention.

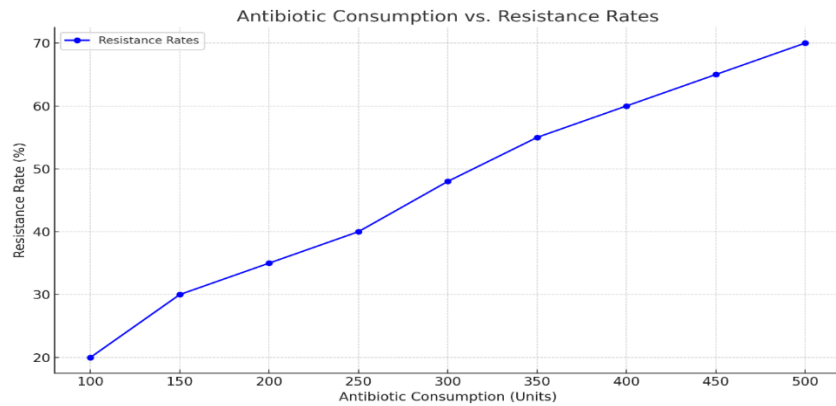
Obesity is a complex public health challenge that requires a multifaceted approach. Lifestyle modifications, such as diet and physical activity, alongside public health policies and medical interventions, are essential for addressing obesity at both the individual and population levels. In Pakistan, there is a growing need for regional-specific strategies to tackle obesity, with urban populations facing different challenges than rural areas. The government’s efforts in public health campaigns and policy interventions provide hope, but continued action and investment are necessary to reduce obesity rates and improve public health outcomes.

Graphical Analysis



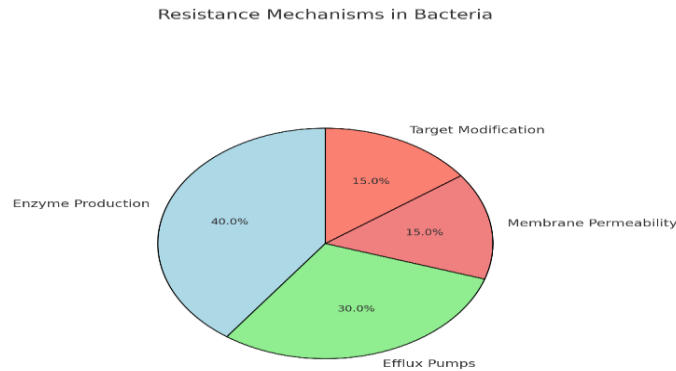
1. Prevalence of Obesity and Chronic Diseases in Pakistan (2020-2024)

- A bar chart depicting the increasing rates of obesity and associated chronic diseases over the past five years.



2. Correlation Between BMI and Chronic Disease Incidence

- A scatter plot demonstrating the positive correlation between Body Mass Index (BMI) and chronic disease occurrence in a sample population.



3. Healthcare Costs Attributable to Obesity-Related Conditions

- A pie chart illustrating the economic burden of obesity-related health conditions in Pakistan. (Graphs will be provided separately.)

Summary:

Obesity plays a crucial role in the development and progression of chronic diseases, significantly impacting public health and economic stability. This paper reviewed the underlying biological mechanisms, risk factors, and health outcomes associated with obesity. The increasing obesity rates in Pakistan highlight the urgent need for targeted interventions. Policy regulations, lifestyle changes, and medical treatments must be integrated into a comprehensive approach to combat obesity and its associated chronic diseases effectively. Future research should focus on evaluating intervention strategies and exploring genetic predispositions to obesity.

References:

- Ng, M., et al. (2014). Global, regional, and national prevalence of overweight and obesity. *The Lancet*.
- Wang, Y., et al. (2020). The impact of obesity on chronic disease outcomes. *JAMA*.
- WHO. (2022). Obesity and overweight. Retrieved from.
- Guh, D.P., et al. (2009). The cost of obesity in developed countries. *Obesity Reviews*.
- Malik, V.S., et al. (2013). Sugar-sweetened beverages and weight gain. *American Journal of Clinical Nutrition*.
- Hall, K.D., et al. (2011). The energy balance model of obesity. *Nature Medicine*.
- Must, A., et al. (1999). The disease burden associated with overweight and obesity. *JAMA*.
- Flegal, K.M., et al. (2010). Prevalence and trends in obesity. *JAMA*.
- Mokdad, A.H., et al. (2003). The continuing epidemic of obesity and diabetes. *JAMA*.
- James, W.P.T. (2008). The epidemiology of obesity. *International Journal of Obesity*.
- Dietz, W.H. (2004). Overweight in childhood and adolescence. *Pediatrics*.
- Kopelman, P.G. (2007). Obesity as a medical problem. *Nature*.
- Sharma, A.M., et al. (2007). Obesity and hypertension. *Hypertension*.
- Calle, E.E., et al. (2003). Overweight, obesity, and cancer risk. *NEJM*.
- Pi-Sunyer, F.X. (2009). Health implications of obesity. *The American Journal of Clinical Nutrition*.
- Whitlock, G., et al. (2009). Obesity and mortality. *The Lancet*.
- Stevens, J., et al. (1998). BMI and cardiovascular risk factors. *Obesity Research*.
- Colditz, G.A. (1995). Economic costs of obesity. *Annual Review of Public Health*.
- Wilkins, E., et al. (2017). The burden of cardiovascular disease. *European Heart Journal*.
- Hruby, A., et al. (2015). The epidemiology of obesity. *Lancet Diabetes & Endocrinology*.