

# **Prevalence of Risk Factors of Non-Communicable Diseases at Chandpur District**

*A Research Paper Submitted to the Department of Pharmacy for the Partial  
Fulfillment of the Degree of Bachelor of Pharmacy.*

**Submitted By**

Shamim Samad

ID: 2013-3-70-073



**Department of Pharmacy  
East West University**

## **DECLARATION BY THE RESEARCH CANDIDATE**

I, Shamim Samad, ID: 2013-3-70-073, hereby declare that the dissertation entitled **“Prevalence of risk factors of Non-Communicable diseases at Chandpur district”** submitted to the Department of Pharmacy, East West University, in the partial fulfillment of the requirement for the degree of Bachelor of Pharmacy is a genuine & authentic research work carried out by me. The contents of this dissertation, in full or in parts, have not been submitted to any other institute or University for the award of any degree or Diploma of Fellowship.

---

**Shamim Samad**

ID: 2013-3-70-073

Department of Pharmacy,

East West University

Dhaka, Bangladesh.

## **CERTIFICATION BY THE SUPERVISOR**

This is to certify that the dissertation, entitled **“Prevalence of risk factors of Non-Communicable diseases at Chandpur district”** is a bona fide research work done by Shamim Samad, ID: 2013-3-70-073, in partial fulfillment of the requirement for the degree of Bachelor of Pharmacy under my supervision.

---

**Nigar Sultana Tithi**

Senior Lecturer and Supervisor

Department of Pharmacy

East West University

Dhaka, Bangladesh

## **ENDORSEMENT BY THE CHAIRPERSON**

This is to certify that the dissertation, entitled “**Prevalence of risk factors of Non-Communicable diseases at Chandpur district**” is a bona fide research work done by Shamim Samad, ID: 2013-3-70-073, under the guidance of **Ms. Nigar Sultana Tithi**, Senior Lecturer, in partial fulfillment of the requirement for the degree of Bachelor of Pharmacy.

---

**Dr. Chowdhury Faiz Hossain**

Professor & Chairperson  
Department of Pharmacy  
East West University  
Dhaka, Bangladesh

## ACKNOWLEDGEMENTS

Above all, I express my gratitude to Almighty for all the bounties granted to me and only with HIS guidance and help this achievement has become possible.

It is my pleasure and proud privilege to express my heartiest regards and gratitude to my respected teacher and supervisor **Ms. Nigar Sultana Tithi**, Senior Lecturer, Department of Pharmacy, East West University, for her expert supervision, constructive criticism, valuable advice, optimistic counseling, constant support & continuous backup and encouragement throughout every phase of the project as well as to prepare this dissertation.

I would also like to put forward my most sincere regards and profound gratitude to **Dr. Chowdhury Faiz Hossain**, Professor and Chairperson, Department of Pharmacy, East West University, for giving me the opportunity to conduct such an interesting project and for facilitating a smooth conduction of my study.

I would also like to put forward my most sincere regards and profound gratitude to **Dr. ShamsunNahar Khan**, Associate Professor, Department of Pharmacy, East West University for her appreciation.

I would also like to thank first my dear friends **Shahnewaz Sharif Biddut, Abu Hasan Tamal, Nasib Rahman Arafat, Kamrul Hasan Joy, Rakibul Hasan Shakil, Md Yusuf Madbar**, dear brothers **Dhruvo Khan, Md Sayed, Rajib Ahmed, Foysal Ahmed, Siam Khan**, dear sisters **Mehedi Mala Mitu, Nusrat Jahan , Shamima Sultana**, and lastly and up most importantly my dear brother **Abu Sayer Patwary** and dear sister **Kulsuma Akhter Sweety** who helped me instantaneously when I needed the most while working on this research paper.

And at the end, I would like to thank my family for their endless inspiration, support and care during my research work.

## **DEDICATION**

This research paper is dedicated to my beloved parents **Dr. Abdus Samad Patwary** and **Mrs. Kohinur Begum** and my beloved brother **Abu Sayer Patwary** for their unconditional support.

## TABLE OF CONTENTS

<b>Serial No.</b>	<b>Chapter</b>	<b>Page No.</b>
	List of Figures	I-II
	List of Tables	III
	List of Abbreviations	IV
	Abstract	V
<b>CHAPTER ONE: INTRODUCTION</b>		<b>1-33</b>
1.1	Non communicable diseases	1
1.2	Overview	1
1.3	Global conditions of NCD	2
1.4	List of Non-communicable diseases	5
1.5	The major list of non-communicable disease that is occurring Globally	6
1.5.1	Diabetes	6
1.5.1.1	Type 1 diabetes	6
1.5.1.1.1	Causes of type 1 diabetes	7
1.5.1.2	Type 2 diabetes	7
1.5.1.2.1	Causes of type 2 diabetes	8
1.5.1.3	Gestational diabetes	8
1.5.1.4	Secondary diabetes	9

1.5.1.5	Prediabetes	9
1.5.1.6	Symptoms of diabetes	9
1.5.1.7	Diagnosis of diabetes	10
1.5.1.8	Diabetes treatment and management	11
1.5.2	Hypertension	12
1.5.2.1	The AHA recommendation for healthy blood pressure	13
1.5.2.2	Risk factors of high blood pressure	14
1.5.2.3	Consequences of high blood pressure	14
1.5.2.4	Causes of hypertension	15
1.5.2.5	Possible contributing factors	16
1.5.2.6	Specific causes of hypertension	17
1.5.2.7	Secondary hypertension	17
1.5.2.8	Symptoms of hypertension	18
1.5.2.9	Prevention and treatment	18
1.5.2.10	Drug treatments of hypertension	19
1.5.2.11	Recent developments on hypertension treatment	19
1.5.3	Hyperlipidemia	20
1.5.3.1	Risk factors	21
1.5.3.2	Causes of hyperlipidemia	21
1.5.3.3	Sign and symptoms hyperlipidemia	22
1.5.3.4	Buildup of different disease due to hyperlipidemia	22
1.5.3.5	Laboratory testing	23



1.5.3.6	Life style modification/prevention	24
1.5.3.7	Treatment via medication	25
1.5.3.8	Recent developments on hyperlipidemia treatment	26
1.5.3.9	Advice	26
1.5.4	Obesity	27
1.5.4.1	Causes of obesity and overweight	27
1.5.4.2	Consequences of obesity and overweight	27
1.5.4.3	Control of obesity and overweight	28
1.6	Other conditions	29
1.7	Risk factors of NCD	30
1.7.1	Modifiable behavioral risk factors	31
1.7.2	Metabolic/physiological risk factors	31
1.8	Socioeconomic impacts of NCDs	31
1.9	Prevention and control of NCDs	32
1.10	WHO response	33

**CHAPTER TWO: LITERATURE REVIEW** **34-41**

**Significance of the Study** **39**

**Aims and Objectives of the Study** **41**

**CHAPTER THREE: METHODOLOGY** **42-43**

3.1	Type of the study	42
3.2	Study Area	42
3.3	Inclusion Criteria	42
3.4	Exclusion Criteria	42
3.5	Study Population	42
3.6	Study Period	42
3.7	Questionnaire Development	43
3.8	Sampling Technique	43
3.9	Data Analysis	43

**CHAPTER FOUR: RESULTS** **44-59**

4.1	Age Distribution of the Respondents	44
4.2	Gender of the Respondents	44
4.3	Educational Qualifications of the Respondents	45
4.4	Occupational Qualifications of the Respondents	45
4.5	Marital Status of the Respondents	46
4.6	Residential Status of the Respondents	47
4.7	Monthly Family Incomes of the Respondents	47
4.8	Body Mass Index (BMI) Status of the Respondents	48

4.9	Waist Circumference Status of the Respondents	49
4.10	Sleeping Habit of the Respondents	50
4.11	Blood Pressure Status of the Respondents	50
4.12	Status of Respondent's Current Medical Condition	51
4.13	Status of Respondent's about the Disease Condition	52
4.14	Status of Respondent's about Family History of the Disease Condition	52
4.15	Knowledge about Factors Causing Health Problems	53
4.16	Status of Respondent's Tobacco Product Use	54
4.17	Status of Fruit Intake Habit of the Respondents	54
4.18	Status of Vegetable Intake Habit of the Respondents	55
4.19	Status of Eating Meals Habit of the Respondents	56
4.20	Habit of Adding Salt or Salty Sauce in the Food	56
4.21	Habit of Eating Processed Food High in Salt	57
4.22	Physical Activity Status of the Respondents	58
4.23	Doctors' Advice to the Respondents	59
<b>CHAPTER FIVE: DISCUSSION &amp; CONCLUSION</b>		<b>60-62</b>
5.1	Discussion	60
5.2	Conclusion	62
<b>CHAPTER SIX: REFERENCES</b>		<b>63-66</b>

## **List of Figures**

Serial No.		Page No.
Figure 1.1	Symptoms of Diabetes	10
Figure 4.1	Age Distribution of the Respondents	53
Figure 4.2	Gender of the Respondents	54
Figure 4.3	Educational Qualifications of the Respondents	55
Figure 4.4	Occupational Qualifications of the Respondents	56
Figure 4.5	Marital Status of the Respondents	57
Figure 4.6	Residential Status of the Respondents	58
Figure 4.7	Monthly Family Incomes of the Respondents	59
Figure 4.8	Body Mass Index (BMI) Status of the Respondents	60
Figure 4.9	Waist Circumference Status of the Respondents	61
Figure 4.10	Sleeping Habit of the Respondents	62
Figure 4.11	Blood Pressure Status of the Respondents	63
Figure 4.12	Status of Respondent's Current Medical Condition	64
Figure 4.13	Status of Respondent's about the Disease Condition	65
Figure 4.14	Status of Respondent's about Family History of the Disease Condition	66
Figure 4.15	Knowledge about Factors Causing Health Problems	67
Figure 4.16	Status of Respondent's Tobacco Product Use	68
Figure 4.17	Status of Fruit Intake Habit of the Respondents	69
Figure 4.18	Status of Vegetable Intake Habit of the Respondents	70

Figure 4.19	Status of Eating Meals Habit of the Respondents	71
Figure 4.20	Habit of Adding Salt or Salty Sauce in the Food	72
Figure 4.21	Habit of Eating Processed Food High in Salt	73
Figure 4.22	Physical Activity Status of the Respondents	74
Figure 4.23	Doctors' Advice to the Respondents	75

## **List of Tables**

Serial		Page No.
Table 1.1	Non communicable diseases list	5
Table 1.2	Blood pressure chart	13

### **List of Abbreviations**

CDC	Center for Disease Control
NCD	Non communicable Disease
HHS	Human Health Service

## Abstract

Increase in non-communicable diseases' (NCDs) prevalence and death rates can be accounted for by emerging NCD epidemics in developing countries. Bangladesh has been facing a dual burden of existing infectious diseases and escalating rise of NCDs. The aim of the study was to determine the distribution of the risk factors of NCDs, prevalence of NCDs and to determine the awareness of the population about the risk factors through face to face interview. A total of 305 respondents from Chandpur district of Bangladesh of different spheres of life participated in the study. Around 10.25% of hypertension, 3.73% of diabetes mellitus were found as current medical conditions among the respondents and the major concerning issue was 12.46% of the people having Hypertension 1 and 4.92% had hypertension 2. Within the study population family history of smoking (38.03%) and smokeless (40%) tobacco use, hypertension (33.77%), diabetes mellitus (18.03%) and asthma (30.82%) were prominent. Of the study population 42.93 % were having obese waist circumference while 15.74% were overweight and 3.28% were obese according to their BMI. About 75.41% respondents followed standard physical activity. Regarding the fruit and vegetables intake 20.66% and 68.85% of the respondents gave satisfactory answer, respectively. Majority of the respondents added salt or salty food at their regular meal. Within the study 35.74% of the respondents used tobacco which was alarming though they have knowledge about the risk. At this point, promoting health awareness programs and increasing awareness about guidelines related to the risk factors of NCDs things might provide a good solution.

**Keywords-** *Non-communicable disease, Biological risk factors, Behavioral risk Factors, Bangladesh, Hypertension.*





# **Chapter 1**

## **Introduction**

## **1.1 Non-communicable diseases**

Non-communicable diseases (NCDs), also known as chronic diseases, are not passed from person to person. They are of long duration and generally slow progression. The 4 main types of non-communicable diseases are cardiovascular diseases (like heart attacks and stroke), cancers, chronic respiratory diseases (such as chronic obstructed pulmonary disease and asthma) and diabetes. NCDs already disproportionately affect low and middle income countries where nearly three quarters of NCD deaths (28 million) are occurs (Lim *et al.*, 2010).

## **1.2 Overview**

Chronic, non-communicable diseases (NCDs) are the number one cause of death and disability in the world. The term NCDs refers to a group of conditions that are not mainly caused by an acute infection, result in long-term health consequences and often create a need for long-term treatment and care. These conditions include cancers, cardiovascular disease, diabetes and chronic lung illnesses. Many NCDs can be prevented by reducing common risk factors such as tobacco use, harmful alcohol use, physical inactivity and eating unhealthy diets.

Many other important conditions are also considered NCDs, including injuries and mental health disorders. Human Health Service (HHS) works with US government and international partners, including the World Health Organization, to address these and other important chronic health conditions (Global Health Topics. 2015).

NCDs share several common, modifiable risk factors are tobacco use, alcohol use, physical inactivity and unhealthy diets. Mitigating the effects of these common risk factors is critical to combat NCDs worldwide (Psi.org, 2016).

Non-communicable diseases are by far the leading cause of death in the world. Of the 57 million global deaths in 2008, 36 million, or 63 percent, were due to NCDs. By 2030, non-communicable diseases will account for 66 percent of the global disease burden's some 80 percent of all NCD deaths occur in low- and middle-income countries. Non-communicable diseases are the most frequent causes of death in all regions of the world except Africa, where such diseases are rising rapidly and are projected to cause almost three quarters as many deaths as communicable, maternal, prenatal and nutritional diseases by 2020 and to exceed them as the most common causes of death by 2030. Of

the approximately 36 million people who die annually from NCDs, one-quarter are aged less than 60 years, and regarded therefore as premature and largely preventable deaths. As these diseases take lives, they also diminish opportunities. Poverty grinds on. Development stalls. Struggling communities weaken even further. Families are decimated by the loss of loved ones or and potentially catastrophic expenditures for treatment. The rapidly growing magnitude of such diseases is driven in part by population aging, the impact of urbanization and the globalization of trade and marketing. It is fuelled by the persistent increase in non-communicable disease-related risk factors, namely, tobacco use, an unhealthy diet, lack of physical activity and harmful alcohol use, particularly in low- and middle-income countries.

The leading causes of NCD deaths in 2008 were cardiovascular diseases (17 million deaths, or 48 percent of all NCD deaths), cancers (7.6 million, or 21 percent of all NCD deaths), and respiratory diseases, including asthma and chronic obstructive pulmonary disease (4.2 million). Diabetes caused another 1.3 million deaths. (Note: diabetes rarely is listed as the cause of death on a death certificate. Many people with diabetes die of a heart attack or stroke and their deaths are reflected in cardiovascular disease statistics (Hunter and Reddy, 2013).

The World Health Organization estimates that NCDs account for 60 percent (more than 35 million) deaths annually. Roughly 80 percent of NCD related deaths occur in low- and middle-income countries, where fragile health systems often struggle to meet the population's most basic health needs. WHO estimates that 48 percent of NCD deaths in low- and middle-income countries occur before 70 years old, compared with 26 percent in high income countries. In 2012, all United Nations member countries committed to achieving a 25 percent reduction in premature mortality from NCDs by 2025 (the 25 x 25 target) (Psi.org, 2016).

### **1.3 Global Conditions of NCD**

Non-communicable diseases have been established as a clear threat not only to human health, but also to development and economic growth. Claiming 63% of all deaths, these diseases are currently the world's main killer. Eighty percent of these deaths now occur in low- and middle-income countries. Half of those who die of chronic non-communicable diseases are in the prime of their productive years, and thus, the disability imposed and

the lives lost are also endangering industry competitiveness across borders (Bloom *et al.*, 2011).

Non-communicable diseases are the leading health concerns of the modern era, accounting for two-thirds of global deaths, half of all disability, and rapidly growing costs. To provide a contemporary overview of the burdens caused by non-communicable diseases, we compiled mortality data reported by authorities in forty-nine countries for atherosclerotic cardiovascular diseases; diabetes; chronic respiratory diseases; and lung, colon, breast, cervical, liver, and stomach cancers. From 1980 to 2012, on average across all countries, mortality for cardiovascular disease, stomach cancer, and cervical cancer declined, while mortality for diabetes, liver cancer, and female chronic respiratory disease and lung cancer increased. In contrast to the relatively steep cardiovascular and cancer mortality declines observed in high-income countries, mortality for cardiovascular disease and chronic respiratory disease was flat in most low- and middle-income countries, which also experienced increasing breast and colon cancer mortality. These divergent mortality patterns likely reflect differences in timing and magnitude of risk exposures, health care, and policies to counteract the diseases. Improving both the coverage and the accuracy of mortality documentation in populous low- and middle-income countries is a priority, as is the need to rigorously evaluate societal-level interventions. Furthermore, given the complex, chronic, and progressive nature of non-communicable diseases, policies and programs to prevent and control them need to be multifaceted and long-term, as returns on investment accrue with time (Ali *et al.*, 2015).

The international community is very concerned about the effect of NCDs on families, communities, and nations. From July 10-11, 2014, the United Nations (UN) reviewed and assessed progress made since the 2011 UN General Assembly high-level meeting on NCDs, including on developing voluntary global targets and recommending ways to work across all of society to prevent and manage NCDs. The meeting also identified gaps and challenges, and laid out actions to enhance work to reduce the burden of non-communicable diseases. In May 2014, the 67th World Health Assembly agreed on a Global Coordination Mechanism to help coordinate activities by governments, civil society and the private sector and support implementation of the 2013 Global Action Plan on NCDs (Global Health Topics. 2015).

In May 2013, the 66th World Health Assembly adopted a set of measures to tackle the global NCDs challenge. They endorsed a new Global Action Plan on NCDs containing suggested actions for WHO, countries, and international partners. These actions included working to improve multi-stakeholder collaboration and adopting the global monitoring framework. The framework lays out 25 indicators of progress and nine voluntary global targets to cut avoidable, premature deaths from the leading NCDs by 25 percent.

Decrease leading behaviors that increase the risk of NCDs, namely tobacco use, harmful alcohol use, physical inactivity, and eating unhealthy diets including consuming excess salt/sodium. Stop the rise in diabetes and obesity, and reduce population levels of raised blood pressure. Encourage access to essential medicines and technologies for NCDs and promote appropriate use of drug therapy to reduce heart attacks and strokes.

In September 2011, the United Nations (UN) General Assembly held a high-level meeting on NCD prevention and control. UN Member States adopted a political declaration calling on the World Health Organization (WHO) to develop a global monitoring framework and recommend voluntary global targets to prevent and control these diseases. Countries also committed to strengthen their national responses to NCDs and to increase international collaboration, working across government, civil society and the private sector.

HHS contributes in many ways to preventing and controlling NCDs around the world. HHS supports basic, clinical, and applied research that builds knowledge about effective NCD approaches. HHS supports health systems strengthening activities such as training and workforce development that better equip providers with the skills needed to prevent and manage chronic illnesses. HHS also partners with multilateral institutions to develop, promote, and implement evidence-based health policies. International partners work together toward shared goals of better preventing NCDs and addressing the needs of people living with chronic illness. OGA, under HHS, leads multilateral efforts on global NCD issues. They work with partners including the World Health Organization and the Pan-American Health Organization. OGA also helps facilitate the international work of HHS's divisions and institutes (Global Health Topics. 2015).

## 1.4 List of Non-communicable Diseases

In this, we will give some examples of non-communicable disease and a non-communicable diseases list. Genetic diseases are caused by hereditary factors passed down by parents to children and also along extended generational lines. Chromosomal errors passed on to offspring result in a long list of recognized clinical diseases. Environmental diseases often are the result of the interplay between a combination of environmental exposures, lifestyle factors, diet and occupational hazards.

**Table 1.1:** Non communicable diseases list

Genetic Diseases	Environmental Diseases
<ul style="list-style-type: none"> <li>• Achondroplasia</li> <li>• Albinism</li> <li>• Bardet-Biedl syndrome</li> <li>• Bipolar disorder</li> <li>• Canavan disease</li> <li>• Color blindness</li> <li>• Cystic fibrosis</li> <li>• Down's syndrome</li> <li>• Fragile X syndrome</li> <li>• Galactosemia</li> <li>• Hemophilia</li> <li>• Krabbe disease</li> <li>• Muscular dystrophy</li> <li>• Neurofibromatosis</li> <li>• Noonan syndrome</li> <li>• Osteogenesis</li> <li>• Patau syndrome</li> <li>• Sickle-cell disease</li> <li>• Tay-Sachs disease</li> <li>• Triple X syndrome</li> <li>• Turner syndrome</li> <li>• Usher syndrome</li> <li>• Von Hippel-Lindau syndrome</li> <li>• Waardenburg syndrome</li> <li>• Wilson's disease</li> <li>• Xeroderma pigmentosum</li> </ul>	<ul style="list-style-type: none"> <li>• Appendicitis</li> <li>• Anorexia nervosa</li> <li>• Arteriosclerosis</li> <li>• Asthma</li> <li>• Carpal tunnel syndrome</li> <li>• Chronic obstructive pulmonary diseases</li> <li>• Emphyema</li> <li>• Fetal alcohol syndrome</li> <li>• Glaucoma</li> <li>• Fibromyalgia</li> <li>• Hyperthyroidism</li> <li>• Hypothyroidism</li> <li>• Irritable Bowel Syndrome</li> <li>• Liver cirrhosis</li> <li>• Narcolepsy</li> <li>• Osteoporosis</li> <li>• Sudden infant death syndrome (SIDS)</li> <li>• Tick paralysis</li> </ul>

(Wma.net, 2016)

## **1.5 Major Non-communicable diseases**

### **1.5.1 Diabetes**

Diabetes limits the body's ability to process glucose normally. Type 1 diabetes which is present from birth causes the pancreas to be destroyed by the immune system, causing glucose to build up in the bloodstream. Type-2 diabetes is developed over time causing the cells to resist the effects of insulin, causing unhealthy levels of glucose in the bloodstream. Risk factor of Type 2 diabetes is being overweight or obese. Patients with high blood sugar will typically experience polyuria (frequent urination), they will become increasingly thirsty (polydipsia) and hungry (polyphagia) (MacGill, 2016).

#### **1.5.1.1 Type-1 Diabetes**

The body does not produce insulin. Some people may refer to this type as insulin-dependent diabetes, juvenile diabetes, or early-onset diabetes. People usually develop type 1 diabetes before their 40th year, often in early adulthood or teenage years. Type 1 diabetes is nowhere near as common as type-2 diabetes. Approximately 10% of all diabetes cases are type 1.

Patients with type 1 diabetes will need to take insulin injections for the rest of their life. They must also ensure proper blood-glucose levels by carrying out regular blood tests and following a special diet.

Between 2001 and 2009, the prevalence of type 1 diabetes among the under 20s in the USA rose 23%, according to SEARCH for Diabetes in Youth data issued by the CDC (Centers for Disease Control and Prevention).

In type 1 diabetes, the pancreas is unable to produce any insulin, the hormone that controls blood sugar levels. Insulin production becomes inadequate for the control of blood glucose levels due to the gradual destruction of beta cells in the pancreas. This destruction progresses without notice over time until the mass of these cells decreases to the extent that the amount of insulin produced is insufficient.

Type 1 diabetes typically appears in childhood or adolescence, but its onset is also possible in adulthood. When it develops later in life, type 1 diabetes can be mistaken initially for type-2 diabetes. Correctly diagnosed, it is known as latent autoimmune diabetes of adulthood (MacGill, 2016).



#### **1.5.1.1.1 Causes of type 1 diabetes**

The gradual destruction of beta cells in the pancreas that eventually results in the onset of type 1 diabetes is the result of autoimmune destruction. The immune system turning against the body's own cells is possibly triggered by an environmental factor exposed to people who have a genetic susceptibility.

Although the mechanisms of type 1 diabetes etiology are unclear, they are thought to involve the interaction of multiple factors:

- Susceptibility genes - some of which are carried by over 90% of patients with type 1 diabetes. Some populations - Scandinavians and Sardinians, for example - are more likely to have susceptibility genes.
- Autoantigens - proteins thought to be released or exposed during normal pancreas beta cell turnover or injury such as that caused by infection. The autoantigens activate an immune response resulting in beta cell destruction.
- Viruses - coxsackievirus, rubella virus, cytomegalovirus, Epstein-Barr virus and retroviruses are among those that have been linked to type 1 diabetes.
- Diet - infant exposure to dairy products, high nitrates in drinking water and low vitamin D intake have also been linked to the development of type 1 diabetes.

#### **1.5.1.2 Type-2 diabetes**

The body does not produce enough insulin for proper function, or the cells in the body do not react to insulin (insulin resistance). Approximately 90% of all cases of diabetes worldwide are type 2.

Some people may be able to control their type 2 diabetes symptoms by losing weight, following a healthy diet, doing plenty of exercise, and monitoring their blood glucose levels. However, type 2 diabetes is typically a progressive disease it gradually gets worse and the patient will probably end up have to take insulin, usually in tablet form.

Overweight and obese people have a much higher risk of developing type 2 diabetes compared to those with a healthy body weight. People with a lot of visceral fat, also known as central obesity, belly fat, or abdominal obesity, are especially at risk. Being overweight/obese causes the body to release chemicals that can destabilize the body's cardiovascular and metabolic systems. (MacGill, 2016).

### **1.5.1.2.1 Causes of type 2 diabetes**

Insulin resistance is usually the precursor to type 2 diabetes a condition in which more insulin than usual is needed for glucose to enter cells. Insulin resistance in the liver results in more glucose production while resistance in peripheral tissues means glucose uptake is impaired. The impairment stimulates the pancreas to make more insulin but eventually the pancreas is unable to make enough to prevent blood sugar levels from rising too high.

Genetics plays a part in type 2 diabetes relatives of people with the disease are at a higher risk, and the prevalence of the condition is higher in particular among Native Americans, Hispanic and Asian people. Obesity and weight gain are important factors that lead to insulin resistance and type 2 diabetes, with genetics, diet, exercise and lifestyle all playing a part. Body fat has hormonal effects on the effect of insulin and glucose metabolism.

Once type 2 diabetes has been diagnosed, health care providers can help patients with a program of education and monitoring, including how to spot the signs of hypoglycemia, hyperglycemia and other diabetic complications. As with other forms of diabetes, nutrition and physical activity and exercise are important elements of the lifestyle management of the condition. (MacGill, 2016).

### **1.5.1.3. Gestational diabetes**

This type affects females during pregnancy. Some women have very high levels of glucose in their blood, and their bodies are unable to produce enough insulin to transport all of the glucose into their cells, resulting in progressively rising levels of glucose.

The majority of gestational diabetes patients can control their diabetes with exercise and diet. Between 10% to 20% of them will need to take some kind of blood-glucose controlling medications. Undiagnosed or uncontrolled gestational diabetes can raise the risk of complications during childbirth. The baby may be bigger than he/she should be.

Scientists from the National Institutes of Health and Harvard University found that women whose diets before becoming pregnant were high in animal fat and cholesterol had a higher risk for gestational diabetes, compared to their counterparts whose diets were low in cholesterol and animal fats (MacGill, 2016).

#### 1.5.1.4. Secondary Diabetes

Secondary diabetes this is when diabetes is caused as the result of another condition, e.g. inflammation of the pancreas, or by the use of certain medication such as diuretics or steroids (the most common cause) (Henriksen, Nielsen and Beck-Nielsen, 2015).

#### 1.5.1.5. Prediabetes

The vast majority of patients with type 2 diabetes initially had prediabetes. Their blood glucose levels were higher than normal, but not high enough to merit a diabetes diagnosis. The cells in the body are becoming resistant to insulin. Studies have indicated that even at the prediabetes stage, some damage to the circulatory system and the heart may already have occurred (MacGill, 2016).

#### 1.5.1.6. Symptoms of Diabetes

The most common symptoms are related to hyperglycemia (high blood sugar levels), especially the classic symptoms of diabetes: frequent urination and thirst. Fatigue related to dehydration and eating problems can also be related to high blood sugars. The International Diabetes Foundation highlights four symptoms that should prompt someone to get checked for diabetes as soon as possible.

- **Frequent urination-**When there is too much glucose (sugar) in blood urination will occur more often. If insulin is ineffective, or not there at all, kidneys cannot filter the glucose back into the blood. The kidneys will take water from blood in order to dilute the glucose - which in turn fills up bladder.
- **Disproportionate thirst** - If urination occurs more than usual, need to replace that lost liquid. Drinking will become more than usual.
- **Intense hunger-** As the insulin in blood is not working properly, or is not there at all, and cells are not getting their energy, body may react by trying to find more energy from food that may induced hunger.
- **Unusual weight loss-** This is more common among people with Diabetes Type 1. As the body is not making insulin it will seek out another energy source (the cells aren't getting glucose). Muscle tissue and fat will be broken down for energy. As Type 1 is of a more sudden onset and Type 2 is much more gradual, weight loss is more noticeable with Type 1.

- **Increased fatigue-** If insulin is not working properly, or is not there at all, glucose will not be entering y cells and providing them with energy. This will make feel tired and listless.
- **Blurred vision-** This can be caused by tissue being pulled from eye lenses. This affects eyes' ability to focus. With proper treatment this can be treated. There are severe cases where blindness or prolonged vision problems can occur.
- **Cuts and bruises don't heal properly or quickly-** When there is more sugar (glucose) in body, its ability to heal can be undermined.
- **More skin and/or yeast infections-** When there is more sugar in body, its ability to recover from infections is affected. Women with diabetes find it especially difficult to recover from bladder and vaginal infections (MacGill, 2016).

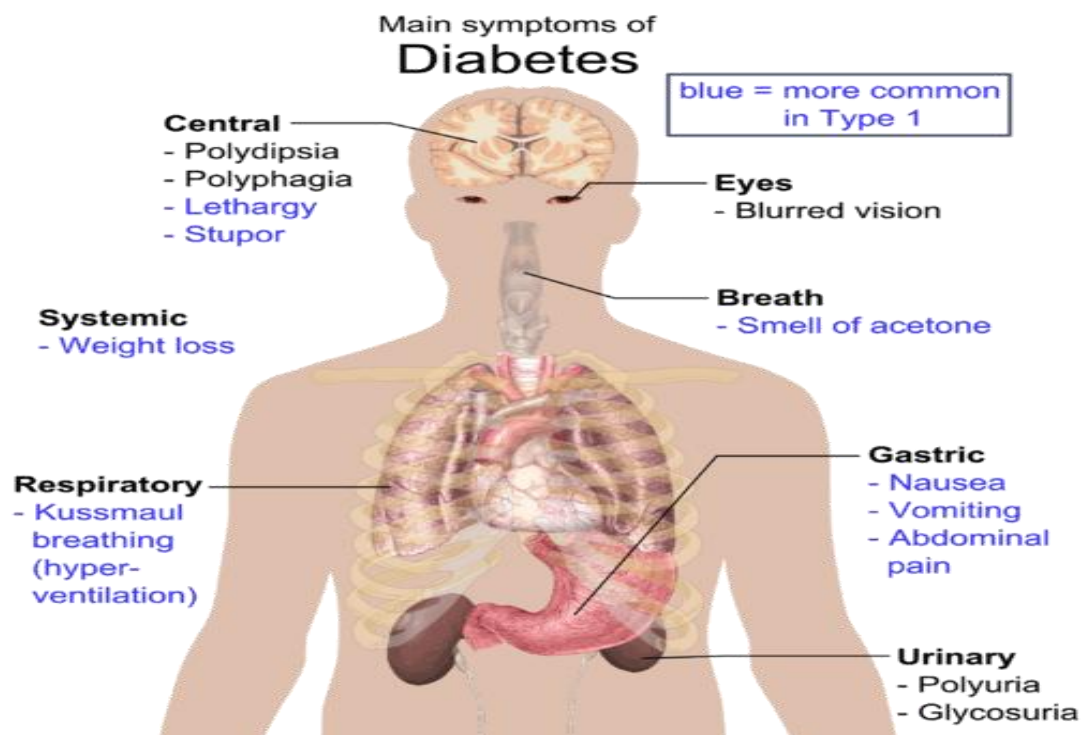


Figure 1.1: Symptoms of Diabetes (MacGill, 2016)

### 1.5.1.7. Diagnosis of Diabetes

#### Glucose tolerance test

During this test, a glucose drink is given containing a standard amount of glucose (75g). Blood samples are taken before the drink is given and two hours later. The test is done after an overnight fast. The following parameters are used to confirm a diagnosis of diabetes after a glucose tolerance test:

- A two hour blood glucose level above 11.1 mmol/L is a diagnosis of diabetes.
- A level below 7.8 mmol/L is normal.

### **The A1C test**

- At least 6.5% means diabetes.
- Between 5.7% and 5.99% means prediabetes.
- Less than 5.7% means normal.

### **The FPG (fasting plasma glucose) test**

- At least 126 mg/dl means diabetes.
- Between 100 mg/dl and 125.99 mg/dl means prediabetes.
- Less than 100 mg/dl means normal.

An abnormal reading following the FPG means the patient has impaired fasting glucose (IFG)

### **The OGTT (oral glucose tolerance test)**

- At least 200 mg/dl means diabetes.
- Between 140 and 199.9 mg/dl means prediabetes.
- Less than 140 mg/dl means normal.

An abnormal reading following the OGTT means the patient has impaired glucose tolerance (IGT). (MacGill, 2016)

### **1.5.1.8. Diabetes Treatment and Management**

People with diabetes who are overweight need to incorporate weight loss as part of their treatment.

- A combination of healthy diet and exercise – aim to reduce dietary intake of fat, salt, and sugar, increase intake of fruit and vegetables, and consume mainly low glycemic index foods. A minimum of 150 minutes of moderate intensity exercise should be undertaken each week.
- Medication with tablets and/or insulin.
- Managing Blood sugar levels.
- Managing Diabetes By routine Checkups and Annual Checkups.

## **Complications of diabetes mellitus**

Type 1 and type 2 diabetes both carry a risk of complications, but this risk is dramatically reduced if diabetes, blood pressure and cholesterol levels are well controlled and if abstain from smoking. The acute complications of diabetes include:

- low glucose level (called a hypoglycemic attack or 'hypo'), caused by treatment with insulin or oral hypoglycemic drugs that increase insulin secretion from the pancreas.
- Diabetic ketoacidosis, a life-threatening condition caused by the lack of insulin. This occurs mainly in type 1 diabetes, but a similar high-glucose emergency can occur in Type 2.
- Retinopathy (eye disease), this causes blindness in rare cases.
- Diabetic kidney disease, which can lead to kidney failure.
- Diabetic neuropathy (nerve disease), which can cause foot ulcers and infections.
- Atherosclerosis (hardening of the arteries), this happens in smokers, particularly, and those with high blood pressure and abnormal fat levels in the blood

The main factors that increases the risks are-

- Smoking.
- high blood pressure.
- Raised levels of fats such as cholesterol in the blood.

By taking measures to address these issues, you will reduce your chance of developing complications such as heart disease (Henriksen, Nielsen and Beck-Nielsen, 2015).

### **1.5.2 Hypertension**

Blood pressure is the force exerted by the blood against the walls of blood vessels, and the magnitude of this force depends on the cardiac output and the resistance of the blood vessels. This is caused when an individual consistently has a blood pressure reading over 140/90. This can be caused by diabetes, smoking, excessive salt intake, obesity or kidney disease. This means the systolic reading (the pressure as the heart pumps blood around the body) is over 140 mmHg (millimeters of mercury) or the diastolic reading (as the heart relaxes and refills with blood) is over 90 mmHg.

While this threshold has been set to define hypertension, it is for clinical convenience and because achieving targets below this level brings benefits for patients. But rather than being marked by a particular cut-off point, the medical expert committees on the condition actually see high blood pressure as having a continuous relationship to cardiovascular health. They believe that, to a point (down to levels of 115-110 mmHg systolic, and 75-70 mmHg diastolic) the lower the blood pressure the better (MacGill and Webberley, 2016).

**Systolic:** The top number, which is also the higher of the two numbers, measures the pressure in the arteries when the heart beats (when the heart muscle contracts).

**Diastolic:** The bottom number, which is also the lower of the two numbers, measures the pressure in the arteries between heartbeats (when the heart muscle is resting between beats and refilling with blood).

#### 1.5.2.1. The AHA recommendation for healthy blood pressure

This blood pressure chart reflects categories defined by the American Heart Association (AHA).

Table 1.2: Blood pressure chart

Blood Pressure Category	Systolic mm Hg (upper #)		Diastolic mm Hg (lower #)
Normal	less than 120	and	less than 80
Prehypertension	120 - 139	or	80 - 89
High Blood Pressure (Hypertension) Stage 1	140 - 159	or	90 - 99
High Blood Pressure (Hypertension) Stage 2	160 or higher	or	100 or higher
Hypertensive Crisis (Emergency care needed)	Higher than 180	or	Higher than 110

(American Heart Association, 2014)

### **1.5.2.2. Risk Factors of High Blood pressure**

High blood pressure is a symptomless disease except in its most extreme cases known as hypertensive crisis. Individuals whose blood pressure is higher than 140/90 mm Hg (140 systolic or above OR 90 diastolic or above) often become patients treated for serious cardiovascular problems.

Risk increases even more if you have high blood pressure along with other risk factors:

- Age
- Heredity (including race)
- Gender (male)
- Overweigh or obesity
- Smoking
- High cholesterol
- Diabetes
- Physical inactivity (American Heart Association, 2014)

### **1.5.2.3. Consequences of High Blood Pressure**

Uncontrolled high blood pressure (HBP) can injure or kill you. It's sometimes called "the silent killer" because HBP has no symptoms, so you may not be aware that it's damaging your arteries, heart and other organs. Possible health consequences that can happen over time when high blood pressure is left untreated include:

- Damage to the heart and coronary arteries, including heart attack, heart disease, congestive heart failure, aortic dissection and atherosclerosis (fatty buildups in the arteries that cause them to harden) – HBP can damage arteries that can become blocked. HBP can cause the heart to enlarge and fail to supply blood to the body.
- Stroke- HBP damage arteries that burst or clog more easily.
- Kidney damage- HBP can cause arteries around the kidneys to narrow and weaken or harden so that kidneys lose their ability to filter blood.
- Vision loss- HBP can strain the vessels in the eyes.
- Erectile dysfunction- HBP leads to erectile dysfunction because of reduced blood flow throughout the body.
- Memory loss.



- Fluid in the lungs.
- Angina.
- Peripheral artery disease (American Heart Association, 2014).

#### 1.5.2.4. Causes of hypertension

- **Family history-** Height, hair and eye color runs in families so can high blood pressure. If parents or close blood relatives have had HBP, more likely to develop it, too. It might also pass that risk factor on to children. That's why it's important for children as well as adults to have regular blood pressure checks. None can't control heredity, but can take steps to live a healthy life and lower risk factors. Lifestyle choices have allowed many people with a strong family history of HBP to avoid it themselves.
- **Advanced age-** As we age, we all develop higher risk for high blood pressure and cardiovascular disease. Blood vessels lose flexibility with age which can contribute to increasing pressure throughout the system.
- **Gender-related risk patterns-** A higher percentage of men than women have HBP until 45 years of age. From ages 45 to 54 and 55 to 64, the percentages of men and women with HBP are similar. After that, a much higher percentage of women have HBP than men.
- **Lack of physical activity-** Physical activity is good for your heart and circulatory system. An inactive lifestyle increases the chance of high blood pressure, heart disease, blood vessel disease and stroke. Inactivity also makes it easier to become overweight or obese. Give yourself the gift of improved health and lower blood pressure with regular, moderate-to-vigorous physical activity.
- **Poor diet, especially one that includes too much salt-** To care for our bodies, we all need good nutrition from a variety of food sources. A diet that's high in calories, fats and sugars and low in essential nutrients contributes directly to poor health as well as to obesity. In addition, there are some problems that can happen from eating too much salt. Some people are "salt sensitive," meaning a high-salt (sodium) diet raises their high blood pressure. Salt keeps excess fluid in the body that can add to the burden on the heart. While too much salt can be dangerous, healthy food choices can actually lower blood pressure. Learn about enjoying a heart-healthy diet.

- **Overweight and obesity-** Being overweight increases your chances of developing high blood pressure. A body mass index between 25 and 30 is considered overweight. A body mass index over 30 is considered obese. About two-thirds of U.S. adults are overweight or obese. About one in three U.S. children ages 2 to 19 are overweight or obese. Excess weight increases the strain on the heart, raises blood cholesterol and triglyceride levels, and lowers HDL (good) cholesterol levels. It can also make diabetes more likely to develop. Losing as little as 10 to 20 pounds can help lower blood pressure and heart disease risk. To successfully and healthfully lose weight and keep it off most people need to subtract about 500 calories per day from their diet to lose about 1 pound per week. Calculate your body mass index and learn how to manage your weight.
- **Drinking too much alcohol-** Heavy and regular use of alcohol can increase blood pressure dramatically. It can also cause heart failure, lead to stroke and produce irregular heartbeats. Too much alcohol can contribute to high triglycerides, cancer and other diseases, obesity, alcoholism, suicide and accidents (American Heart Association, 2014).

#### 1.5.2.5. Possible contributing factors:

There is some connection between blood pressure and these factors but science has not proven that they actually cause high blood pressure.

- **Stress-** Being in a stressful situation can temporarily increase your blood pressure, but science has not proven that stress causes high blood pressure. Some scientists have noted a relationship between coronary heart disease risk and stress in a person's life, health behaviors and socioeconomic status. For example, people under stress may overeat or eat a less healthy diet, put off physical activity, drink, smoke or misuse drugs.
- **Smoking and second-hand smoke-** Smoking temporarily raises blood pressure and increases your risk of damaged arteries. The use of tobacco can be devastating for health, especially if already at risk for high blood pressure. Secondhand smoke exposure to other people's smoke increases the risk of heart disease for nonsmokers. (American Heart Association, 2014).

### **1.5.2.6. Specific causes of hypertension**

Primary hypertension is unlikely to have a specific cause but multiple factors, including blood plasma volume and activity of the renin-angiotensin system, the hormonal regulator of blood volume and pressure - and primary hypertension are affected by environmental factors, including the lifestyle-related ones above.

Secondary hypertension has specific causes - that is, it is secondary to another problem. One example, thought to be the most common, is primary aldosteronism, a hormone disorder causing an imbalance between potassium and sodium levels and so high blood pressure.

Common reversible causes are excessive intake of alcohol and use of oral contraceptives, which is a cause a slight rise in blood pressure; hormone therapy for menopause is also a culprit. Other secondary hypertensions are caused by:

- Kidney disease
- Pheochromocytoma (a cancer)
- Cushing syndrome (which can be caused by use of corticosteroid drugs)
- Congenital adrenal hyperplasia (disorder of the adrenal glands, which secrete the hormone cortisol)
- Hyperthyroidism (overactive thyroid gland) (MacGill and Webberley, 2016).

### **1.5.2.7. Secondary hypertension**

In 5-10 percent of high blood pressure cases, the HBP is caused by a pre-existing problem. This type of HBP is called secondary hypertension because another problem was present first. Factors that may lead to secondary hypertension include:

- Kidney abnormality, including a tumor on the adrenal gland, which is located on top of the kidneys.
- A structural abnormality of the aorta (the large blood vessel leaving the heart) that has existed since birth.
- Narrowing of certain arteries.

High blood pressure is just one condition that increases your risk of heart disease and stroke (American Heart Association, 2014).

### 1.5.2.8. Symptoms of hypertension

High blood pressure itself is usually experienced by patients without any symptoms at all (asymptomatic). It can do its damage silently. Hypertension can lead to problems in the organs affected by high blood pressure. Long-term hypertension can lead to the following complications via arteriosclerosis, which causes narrowing of blood vessels by forming plaques:

- An enlarged or weakened heart, to a point where it may fail to pump enough blood (heart failure).
- Aneurysm - an abnormal bulge in the wall of an artery.
- Blood vessel narrowing - in the kidneys, leading to possible kidney failure; also in the heart, brain and legs, leading to potential heart attack, stroke or amputation, respectively.
- Blood vessels in the eyes may rupture or bleed, leading to vision problems or blindness (hypertensive retinopathies, which can be classified by worsening grades one through four) (MacGill and Webberley, 2016).

### 1.5.2.9. Prevention and Treatment:

Lifestyle changes are important for both treatment and prevention of high blood pressure, and they can be as effective as a drug treatment. The added advantage is that there are wider effects on heart health. The lifestyle measures that are recommended by experts and shown to reduce blood pressure are:

- **Salt restriction** - typical salt intake is between 9 and 12 g a day and modest blood pressure reductions can be achieved even in people with normal levels by lowering salt to around 5 g a day with a bigger effect in hypertensive people.
- **Moderation of alcohol consumption** - expert guidelines say moving from moderate to excessive drinking is associated both with raised blood pressure and with an increased risk of stroke.
- **High consumption of vegetables and fruits and low-fat** - the Mediterranean diet has been found to be protective, and people with high blood pressure are advised to eat fish at least twice a week and between 300 and 400 g of fruit and vegetables a day.
- **Reducing weight and maintaining it** - hypertension is closely correlated with excess body weight, and weight reduction is followed by a fall in blood pressure.

- **Regular physical exercise** - guidelines say hypertensive patients should participate in at least 30 min of moderate-intensity dynamic aerobic exercise (walking, jogging, cycling or swimming) on 5 to 7 days a week.

Smoking can also raise blood pressure, and because of its wider heart and other health risks, too, giving up is also a lifestyle measure people with blood pressure can benefit from (MacGill and Webberley, 2016).

#### **1.5.2.10. Drug treatments for Hypertension**

Doctors will prescribe medication alongside lifestyle measures to lower blood pressure in people with a level above 140 over 90, although lifestyle measures are usually pursued first. Drugs are usually started as monotherapy (just one drug) and at a low dose initially. If there are any side-effects associated with drugs, they are usually minor. A number of different classes of drug are available and all are suitable for lowering blood pressure:

- Diuretics (including thiazides, chlorthalidone and indapamide), which have been a cornerstone of treatment since 1977.
- Beta-blockers.
- Calcium antagonists.
- Angiotensin-converting enzyme (ACE) inhibitors.
- Angiotensin receptor blockers.

The choice of drug depends on the individual and any other conditions they may have. While a single drug is usually tried in monotherapy first, a combination of at least two antihypertensive drugs is usually required (MacGill and Webberley, 2016).

#### **1.5.2.11. Recent developments on hypertension Treatment:**

- **Vitamin D 'ineffective as treatment for hypertension'**-Supplementation cannot lower blood pressure and should not be used as an antihypertensive agent, study concluded.
- **Folic acid may reduce risk of first stroke in people with hypertension**-Folic acid supplementation and hypertension medication combined reduced the risk of a first stroke among adults with high blood pressure.
- **Acupuncture may reduce high blood pressure**-A new study suggests that a form of acupuncture may benefit patients with high blood pressure and lower their risk of stroke and heart disease (MacGill and Webberley, 2016).

### 1.5.3 Hyperlipidemia

Hyperlipidemia is characterized by elevated concentrations of circulating lipids, increasing the risk of atherosclerosis and other serious conditions. Specific classes of hyperlipidemia include hyperlipoproteinemia, elevated very low-density lipoprotein (VLDL) and low-density lipoprotein (LDL) levels, hypercholesterolemia (elevated cholesterol levels), and hypertriglyceridemia (elevated triglyceride levels).

High concentrations of total and LDL cholesterol and low levels of high-density lipoprotein (HDL) cholesterol predict cardiovascular risk in both men and women. High triglyceride levels have been associated with greater risk in women only. The risk of cardiovascular disease increases by an average of 2% for each corresponding 1% rise in total cholesterol. Any excess cholesterol that is not used by the body can negatively affect our arteries over time. This fatty material begins to adhere as plaque to the walls of the arteries. Like badly rusted plumbing pipes, arteries can become dangerously clogged with plaque, and then blood has a harder time flowing.

These risk factors include an improper diet high in saturated fats and cholesterol, obesity, and inactivity. Medical conditions such as diabetes mellitus, hypothyroidism, kidney disease, liver disease, alcoholism, as well as certain medications, can cause elevated lipid levels. Also, a family history of high cholesterol may mean that a person is genetically at risk for high lipids.

High lipid levels can speed up a process called atherosclerosis, or hardening of the arteries. Your arteries are normally smooth and unobstructed on the inside, but as you age, a sticky substance called plaque forms in the walls of your arteries. Plaque is made of lipids and other materials circulating in your blood. As more plaque builds up, your arteries can narrow and stiffen. Eventually, enough plaque may build up to reduce blood flow through your arteries.

Lifestyle changes like exercising and eating a healthy diet can also lower your lipid levels and are often the first step in treatment. In general, there are two broad types of cholesterol that can be measured:

- LDL or the "bad" cholesterol is the fraction of the total cholesterol that forms the plaque that can clog the arteries. Optimal LDL level is less than 130mg per dL, or less than 100 per dL in high risk individuals.

- HDL or the "good" cholesterol keeps cholesterol from building up in our arteries. Optimal HDL level is greater than 40 mg per dL in men and greater than 50 mg per dL in women (Nutritionmd.org. 2016).

### **1.5.3.1. Risk Factors**

Although hyperlipidemia is a frequent finding in all demographic groups that follow western diets, it occurs somewhat more commonly in men. Additional risk factors include:

- Family history.
- Diets high in total fat, saturated fat, and cholesterol (see Nutritional Considerations).
- Diabetes mellitus and metabolic syndrome: Hyperinsulinemia is associated with low HDL levels and hypertriglyceridemia.
- Chronic renal failure is associated with hypertriglyceridemia.
- Nephrotic syndrome: Decreased vascular oncotic pressure due to proteinuria leads to increased lipoprotein production by the liver.
- Hypothyroidism.
- Hypopituitarism.
- Obesity: Obesity is associated with increased total cholesterol, LDL, VLDL, and triglycerides, as well as with decreased levels of HDL.
- Physical inactivity.
- Alcoholism.
- Steroid use.
- Oral contraceptives.
- Smoking: Cigarette smoking lowers HDL levels and is an independent risk factor for cardiovascular disease (Nutritionmd.org. 2016).

### **1.5.3.2. Causes of Hyperlipidemia**

The causes of hyperlipidemia are either genetic (familial or primary hyperlipidemia) or from a poor diet and other specific factors (secondary hyperlipidemia). When the body cannot utilize or remove the excess fat, it accumulates in the blood. Over time, the buildup damages the arteries and internal organs. This process contributes to the development of heart disease. In familial hyperlipidemia, the high cholesterol has nothing to do with poor habits but is caused by a genetic disorder.

A mutated gene passed down from either the mother or father causes a missing or malfunctioning LDL receptor. The LDL accumulates to dangerous amounts in the blood. Certain ethnic groups such as French Canadians, Christian Lebanese, South African Afrikaners, and Ashkenazi Jews are at a higher risk of hereditary hyperlipidemia. Other causes of hyperlipidemia may include excessive drinking of alcohol, obesity, side effects of medications such as hormones or steroids, diabetes, kidney disease, underactive thyroid gland, and pregnancy. Most hyperlipidemia is caused by lifestyle habits or treatable medical conditions. Lifestyle contributors include obesity, not exercising, and smoking. Conditions that cause hyperlipidemia include diabetes, kidney disease, pregnancy, and an underactive thyroid gland (Davis, 2015).

#### **1.5.3.3. Signs and symptoms of Hyperlipidemia**

With familial hyperlipidemia, a person could show signs of high cholesterol with yellowish fatty growths (xanthomas) around the eyes or the joints. Otherwise, hyperlipidemia has no signs or symptoms, and unless picked up with the fasting lipid profile, the high cholesterol would remain undetected. An individual could have a heart attack or stroke, and later learn it was precipitated by hyperlipidemia.

Excessive fat in the blood accumulates over time, forming plaques on the walls of the arteries and blood vessels. This will narrow the openings, producing turbulent blood flow through the vessels, and cause the heart to use more force to get the blood through the constricted areas (Robertson, 2009).

#### **1.5.3.4. Buildup of different disease conditions due to Hyperlipidemia**

At healthy levels, lipids are involved in important bodily functions, but they can cause problems if they are present in excess. A raised blood lipid level can cause accelerated hardening of the arteries or atherosclerosis. In healthy individuals, the insides of arteries are smooth and unobstructed, but as we age, plaque accumulates in the artery walls until they narrow and stiffen. Plaques are composed of lipids and several other materials that circulate in the blood. Eventually, plaque can accumulate enough to reduce the flow of blood through the arteries. This can reduce the amount of oxygen-rich blood that is received by the heart, which increases the risk of vascular events such as stroke and heart attack.

It may be possible for individuals to slow the progression of atherosclerosis if they can bring their blood lipid level down. This involves making lifestyle changes such as



exercising and eating healthily as the first treatment approaches, but, depending on a patient's overall risk, medication may be prescribed in combination with these lifestyle changes. Higher levels of high-density lipoproteins (HDL) or good cholesterol are associated with a reduced risk of heart disease and stroke because HDL "mops up" cholesterol from the arteries, slowing the buildup of plaque.

Low-density lipoprotein (LDL) cholesterol, on the other hand, is considered "bad" cholesterol because it can lead to obstructed arteries. It transports cholesterol around the body and builds up in the artery walls, making the vessels hard and narrow. Another type of lipoprotein is very-low-density lipoprotein (VLDL), which contains triglycerides, a type of fat that VLDL delivers to bodily tissues. VLDL increases the size of LDL, causing narrowing of the blood vessels (Robertson, 2009).

#### **1.5.3.5. Laboratory Testing**

Patients must fast for at least 12 hours before blood sampling, because chylomicron clearance can take up to 10 hours. However, a fasted sample is not required for simple cholesterol screening.

- **Total cholesterol-** According to NCEP guidelines, total cholesterol concentrations below 200 mg/dL are "desirable." A borderline high concentration is 200 to 239 mg/dL, and hypercholesterolemia is defined as greater than 240 mg/dL. However, epidemiological evidence suggests that stricter standards may be appropriate. Risk of cardiac events decreases as total cholesterol levels fall until plateauing at total cholesterol of approximately 150 mg/dL. For children, total cholesterol should be less than 180 mg/dL.
- **Triglyceride** - Normal triglyceride concentration is less than 150 mg/dL. Borderline is 150 to 199 mg/dL, and high is 200 to 499 mg/dL. Concentrations of 500 mg/dL or higher are considered very high.
- **HDL cholesterol** - Concentrations of 60 mg/dL or higher are optimal. In general, an HDL concentration below 40 mg/dL is considered a major risk factor for coronary heart disease (CHD), although women's risk of CHD increases marginally with HDL cholesterol < 50. However, HDL is often interpreted in the context of total cholesterol and LDL concentrations, and may be less significant when LDL is low.

- **LDL cholesterol-** According to the NCEP, LDL cholesterol concentrations below 100mg/dL are considered optimal. A range of 100 to 129 mg/dL is near optimal. Borderline is 130 to 159 mg/dL. High is 160 to 189 mg/dL. However, increasing evidence supports stricter standards, including reductions below 70 mg/dL for very high-risk patients. Studies of hunter-gatherer populations and normal neonates have modified the concept of "normal" cholesterol levels. Normal human LDL cholesterol concentration may be as low as 50 to 70 mg/dL, approximately half the US adult population mean. Coronary heart disease risk decreases as LDL cholesterol concentration decreases, reaching a nadir at approximately 40 mg/dL. NCEP classification and treatment guidelines have changed to reflect revised normal values and risk estimates (Nutritionmd.org. 2016).

#### 1.5.3.6. Life Style Modification/Prevention

If a patient is diagnosed with hyperlipidemia, the lifestyle changes they can make and medications they can use to improve their lipid profile are described below:

- **Lose weight-** A body mass index (BMI) of 30 or higher increases the risk of high cholesterol and losing just 5 to 10 pounds can help to lower cholesterol. Being overweight can lower your levels of HDL (good) cholesterol and weight loss can decrease the LDL level. Extra weight around the abdominal area increases the risk of heart disease more than extra weight carried around the thighs, bottom and hips.
- **Healthy diet-** A diet that is high in cholesterol-rich foods such as full fat dairy and red meat increases the total cholesterol level, whereas a diet that is rich in fiber and contains cholesterol-lowering foods can be as successful as a statin at bringing the cholesterol level down. People trying to lower their cholesterol should ensure that no more than 10% of their daily calories come from saturated fat. Monounsaturated fats found in foods such as canola oils and peanuts are a healthier option. Some types of fish such as halibut and tuna contain less saturated fat and cholesterol than red meat and poultry and herring, salmon and mackerel are rich in omega-3 fatty acids, which can lower triglycerides. Trans-fats, which are found in foods such as margarine and commercially baked cakes, cookies and crackers should be eliminated from the diet because they increase LDL and lower HDL. Certain nutrients found in whole-grain foods such as whole-grain bread,

whole-wheat pasta, flour and brown rice promote heart health and fruits and vegetables can help lower cholesterol.

- **Exercise**-Exercise helps to boost HDL, while it lowers LDL and triglycerides. A lack of exercise can therefore increase the risk of high cholesterol. A doctor may advise walking for at least 30 minutes a day on most days of the week to help reduce cholesterol.
- **Quitting smoking**-Cigarette smoke can damage vessel walls, making them more susceptible to the accumulation of fatty deposits, hardening and narrowing. Smoking can also lower HDL and people with hyperlipidemia should quit as soon as they are diagnosed (Robertson, 2009)

#### **1.5.3.7. Treatment via Medication**

The mainstay of treatment for hyperlipidemia is dietary and lifestyle modification, followed by drug therapy, as necessary. Hyperlipidemia should not be considered refractory to dietary treatment if the therapeutic regimen included animal products or more than minimal amounts of vegetable oils. Such diets do not lower LDL cholesterol concentrations as effectively as high-fiber, low-fat diets that exclude animal products.

Regular exercise can improve lipid concentrations. Low to moderate amounts of physical activity such as walking lower triglyceride concentrations by an average of 10 mg/dL, while raising HDL by 5 mg/dL/ (these numbers are means drawn from large groups). More strenuous activity may have greater effects. Patients with familial hypercholesterolemia typically require medication starting in early childhood.

HMG CoA reductase inhibitors (statins) decrease cholesterol production in the liver, and are first-line agents in the treatment of elevated LDL cholesterol. Statins also have important effects on cardiovascular risk aside from their ability to reduce lipid concentrations, and may be indicated for high-risk patients even when lipid targets can be achieved without drug therapy. Potential side effects include myopathy and increased liver enzymes. Some statins may also lower HDL to a below-goal level.

Bile acid sequestrants (eg, cholestyramine, colestipol) are second-line agents for the treatment of elevated LDL cholesterol. These medications can produce gastrointestinal distress, constipation, and impaired absorption of other drugs.

Fibrates (eg, gemfibrozil, fenofibrate) are used as first-line treatment for elevated triglyceride concentrations and may be prescribed in combination with the above drug classes. Gallstones, dyspepsia, and myopathy may occur. Myopathy risk may be particularly high when fibrates are combined with statins.

Nicotinic acid (niacin) is a second-line therapy for all lipid disorders. Niacin is often combined with statins, but is also effective as a single agent. Its use is often limited by skin itching or burning. Other side effects include GI distress, hepatotoxicity, hyperglycemia, and gout.

Ezetimibe and colesvelam decrease GI cholesterol absorption, and have emerged as a favored second-line therapy due to their effectiveness, safety, and lack of side effects. They lower LDL and often raise HDL, and are particularly effective when combined with statins (often achieving lipid targets at lower statin doses). Ezetimibe has emerged as the more effective drug (Nutritionmd.org. 2016).

#### **1.5.3.8. Recent developments on Hyperlipidemia treatment**

- **Pycnogenol boosts endothelial function in a range of borderline conditions-** Pycnogenol appears to improve endothelial function in individuals with borderline hypertension, hyperglycemia or hyperlipidemia, according to the results of an Italian study reported recently in the Journal of International Angiology.
- **FDA advisory panel approves novel cholesterol-lowering drug-**An advisory committee for the Food and Drug Administration has recommended the approval of a novel, injectable cholesterol-lowering drug called alirocumab, though many committee members have noted certain restrictions for its use and have requested further data on the drug's ability to reduce the risk of heart problems (Davis, 2015).

#### **1.5.3.9. Advice**

Hyperlipidemia is a common preventable contributor to atherosclerosis. Both cholesterol and triglyceride concentrations can be reduced through restriction of saturated fat, cholesterol, Trans fatty acids, and total fat. Increasing dietary fiber, soy foods, and exercise can make these measures more effective. The patient's family may also be at risk for hyperlipidemia and other cardiovascular diseases. Their adoption of the same diet and

lifestyle changes being made by the patient, including smoking cessation, will encourage patient adherence and improve family members' health (Nutritionmd.org. 2016).

#### **1.5.4 Obesity**

Overweight and obesity are defined as abnormal or excessive fat accumulation that may impair health. Body mass index (BMI) is a simple index of weight-for-height that is commonly used to classify overweight and obesity in adults. It is defined as a person's weight in kilograms divided by the square of his height in meters ( $\text{kg/m}^2$ ). The WHO definition is:

- BMI greater than or equal to 25 is overweight.
- BMI greater than or equal to 30 is obesity.

BMI provides the most useful population-level measure of overweight and obesity as it is the same for both sexes and for all ages of adults. However, it should be considered a rough guide because it may not correspond to the same degree of fatness in different individuals (World Health Organization. 2016).

##### **1.5.4.1. Causes of obesity and overweight**

The fundamental cause of obesity and overweight is an energy imbalance between calories consumed and calories expended. Globally, there has been:

- An increased intake of energy-dense foods that are high in fat; and
- An increase in physical inactivity due to the increasingly sedentary nature of many forms of work, changing modes of transportation, and increasing urbanization.

Changes in dietary and physical activity patterns are often the result of environmental and societal changes associated with development and lack of supportive policies in sectors such as health, agriculture, transport, urban planning, environment, food processing, distribution, marketing and education (World Health Organization, 2016).

##### **1.5.4.2. Consequences of overweight and obesity**

Raised BMI is a major risk factor for non-communicable diseases such as:

- Cardiovascular diseases (mainly heart disease and stroke), which were the leading cause of death in 2012.

- Diabetes.
- Musculoskeletal disorders (especially osteoarthritis - a highly disabling degenerative disease of the joints).
- Some cancers (endometrial, breast, and colon).

The risk for these noncommunicable diseases increases, with an increase in BMI. Childhood obesity is associated with a higher chance of obesity, premature death and disability in adulthood. But in addition to increased future risks, obese children experience breathing difficulties, increased risk of fractures, hypertension, and early markers of cardiovascular disease, insulin resistance and psychological effects (World Health Organization. 2016).

#### **1.5.4.3. Control of Overweight and Obesity**

Overweight and obesity, as well as their related non-communicable diseases, are largely preventable. Supportive environments and communities are fundamental in shaping people's choices, making the healthier choice of foods and regular physical activity the easiest choice (accessible, available and affordable), and therefore preventing obesity. At the individual level, people can:

- Limit energy intake from total fats and sugars.
- Increase consumption of fruit and vegetables, as well as legumes, whole grains and nuts.
- Engage in regular physical activity (60 minutes a day for children and 150 minutes per week for adults).

Individual responsibility can only have its full effect where people have access to a healthy lifestyle. Therefore, at the societal level it is important to:

- Support individuals in following the recommendations above, through sustained political commitment and the collaboration of many public and private stakeholders.
- Make regular physical activity and healthier dietary choices available, affordable and easily accessible to all - especially the poorest individuals.

The food industry can play a significant role in promoting healthy diets by:

- Reducing the fat, sugar and salt content of processed foods.
- Ensuring that healthy and nutritious choices are available and affordable to all consumers.
- Practicing responsible marketing especially those aimed at children and teenagers.
- Ensuring the availability of healthy food choices and supporting regular physical activity practice in the workplace (World Health Organization. 2016).

## **1.5 Other conditions**

- **Osteoporosis**

This condition causes a decrease in bone mass which can make the bones brittle and at higher risk for damage. Around 80 percent of people who have osteoporosis are women. Additional factors which increase the risk of this disease are the presence of diseases such as rheumatoid arthritis, inactivity, low sex hormone levels or smoking.

- **Alzheimer's**

This condition causes dementia in those in advanced age, or over 60 years old. Symptoms of this condition can vary but often include getting lost, memory loss, difficulty managing daily tasks or managing money, personality changes, loss of bodily control or delusions.

- **Heart Disease**

This is a very broad category of diseases which impact the circulatory system or heart. This can include congenital heart disease, rhythm irregularities, heart failure, heart attack, unstable angina, mitral valve prolapsed, aortic regurgitation, cardiogenic shock or endocarditis.

- **Fibromyalgia**

This disease causes damage to soft tissue in the body. It can lead to sleep disturbance patterns, widespread pain, exhaustion or irregular heartbeat. With time the symptoms can progress causing cognitive or memory difficulties, jaw pain, nasal congestion, headaches or irritable bowel syndrome.

- **Lung Cancer**

Lung cancer causes malignant cell growth in the lung tissue, often as a result of exposure to pollutants or the use of tobacco products. As many as 90 percent of lung cancer cases are caused by smoking with non-smokers having a very small risk of this disease.

- **Leukemia**

Leukemia causes the body to produce abnormal blood cells that then release malignant cells into the bloodstream. Since the bloodstream carries these malignant cells throughout the body they can affect other tissues such as the nervous system, skin or liver. While this disease is often associated with children, most patients are actually men over 60.

- **Skin Cancer**

Skin cancer is caused when ultraviolet rays damage the skin cells. This can appear anywhere on the body but is most common on the skin. Those that have low pigmentation in the skin such as redheads, blondes or those with blue eyes tend to be at higher risk for this disease. Limiting direct skin exposure can significantly reduce the risk of developing skin cancer and with early detection this disease is 95 percent curable.

- **Seizures or Epilepsy**

Seizures are caused by a neurologic malfunction that causes abnormal electrical activity within the brain. These can be localized or cause symptoms such as numbness that stems from an explosive firing of nerves in the brain. Tumors or brain damage can cause someone to develop this disease. There is no cure for epilepsy but medications can help to reduce the frequency of seizures (Ali *et al.*, 2015).

## **1.6 Risk Factors of NCD (Non- communicable Disease)**

All age groups and all regions are affected by NCDs. NCDs are often associated with older age groups, but evidence shows that 16 million of all deaths attributed to non-communicable diseases (NCDs) occur before the age of 70. Of these "premature" deaths, 82% occurred in low- and middle-income countries. Children, adults and the elderly are all vulnerable to the risk factors that contribute to non-communicable diseases, whether from unhealthy diets, physical inactivity, exposure to tobacco smoke or the effects of the harmful use of alcohol. These diseases are driven by forces that include ageing, rapid unplanned urbanization, and the globalization of unhealthy lifestyles. For example,



globalization of unhealthy lifestyles like unhealthy diets may show up in individuals as raised blood pressure, increased blood glucose, elevated blood lipids, and obesity. These are called 'intermediate risk factors' which can lead to cardiovascular disease, a NCD (Lim, 2010).

### **1.7.1 Modifiable Behavioral Risk Factors**

Tobacco use, physical inactivity, unhealthy diet and the harmful use of alcohol increase the risk of NCDs.

- Tobacco accounts for around 6 million deaths every year (including from the effects of exposure to second-hand smoke), and is projected to increase to 8 million by 2030.
- About 3.2 million deaths annually can be attributed to insufficient physical activity.
- More than half of the 3.3 million annual deaths from harmful drinking are from NCDs.
- In 2010, 1.7 million annual deaths from cardiovascular causes have been attributed to excess salt/sodium intake (Lim *et al.*, 2010).

### **1.7.2 Metabolic/Physiological Risk Factors**

These behaviors lead to four key metabolic/physiological changes that increase the risk of NCDs: raised blood pressure, overweight/obesity, hyperglycemia (high blood glucose levels) and hyperlipidemia (high levels of fat in the blood).

In terms of attributable deaths, the leading metabolic risk factor globally is elevated blood pressure (to which 18% of global deaths are attributed) followed by overweight and obesity and raised blood glucose. Low- and middle-income countries are witnessing the fastest rise in overweight young children (Lim *et al.*, 2010).

## **1.8 Socioeconomic Impacts of NCDs**

NCDs threaten progress towards the UN Millennium Development Goals and post-2015 development agenda. Poverty is closely linked with NCDs. The rapid rise in NCDs is predicted to impede poverty reduction initiatives in low-income countries, particularly by increasing household costs associated with health care. Vulnerable and socially disadvantaged people get sicker and die sooner than people of higher social positions,

especially because they are at greater risk of being exposed to harmful products, such as tobacco or unhealthy food, and have limited access to health services. In low-resource settings, health-care costs for cardiovascular diseases, cancers, diabetes or chronic lung diseases can quickly drain household resources, driving families into poverty. The exorbitant costs of NCDs, including often lengthy and expensive treatment and loss of breadwinners, are forcing millions of people into poverty annually, stifling development.

In many countries, harmful drinking and unhealthy diet and lifestyles occur both in higher and lower income groups. However, high-income groups can access services and products that protect them from the greatest risks while lower-income groups can often not afford such products and services (Mozaffarian *et al.*, 2014).

### **1.9 Prevention and Control of NCDs**

To lessen the impact of NCDs on individuals and society, a comprehensive approach is needed that requires all sectors, including health, finance, foreign affairs, education, agriculture, planning and others, to work together to reduce the risks associated with NCDs, as well as promote the interventions to prevent and control them. An important way to reduce NCDs is to focus on lessening the risk factors associated with these diseases. Low-cost solutions exist to reduce the common modifiable risk factors (mainly tobacco use, unhealthy diet and physical inactivity, and the harmful use of alcohol) and map the epidemic of NCDs and their risk factors.

Other ways to reduce NCDs are high impact essential NCD interventions that can be delivered through a primary health-care approach to strengthen early detection and timely treatment. Evidence shows that such interventions are excellent economic investments because, if applied to patients early, can reduce the need for more expensive treatment. These measures can be implemented in various resource levels. The greatest impact can be achieved by creating healthy public policies that promote NCD prevention and control and reorienting health systems to address the needs of people with such diseases.

Lower-income countries generally have lower capacity for the prevention and control of non-communicable diseases. High-income countries are nearly 4 times more likely to have NCD services covered by health insurance than low-income countries. Countries with inadequate health insurance coverage are unlikely to provide universal access to essential NCD interventions (Mozaffarian *et al.*, 2014).

## **1.10 WHO Response**

Under the leadership of the WHO more than 190 countries agreed in 2011 on global mechanisms to reduce the avoidable NCD burden including a Global action plan for the prevention and control of NCDs 2013-2020. This plan aims to reduce the number of premature deaths from NCDs by 25% by 2025 through nine voluntary global targets. The nine targets focus in part by addressing factors such as tobacco use, harmful use of alcohol, unhealthy diet and physical inactivity that increase people's risk of developing these diseases.

The plan offers a menu of “best buy” or cost-effective, high-impact interventions for meeting the nine voluntary global targets such as banning all forms of tobacco and alcohol advertising, replacing trans fats with polyunsaturated fats, promoting and protecting breastfeeding, and preventing cervical cancer through screening.

In 2015, countries will begin to set national targets and measure progress on the 2010 baselines reported in the Global status report on non-communicable diseases 2014. The UN General Assembly will convene a third high-level meeting on NCDs in 2018 to take stock of national progress in attaining the voluntary global targets by 2025 (Mozaffarian *et al.*, 2014).

# **Chapter 2**

## **Literature Review**

Non-communicable disease, especially cardiovascular disease (CVDS), as a public health problem became evident in developed and developing countries in this century. Iran is an example of countries in the eastern Mediterranean region undergoing a nutritional transition. This article reviews 3 national surveys: "National health and disease", in 1999, "National Food consumption", in 1995, and "Analytical report on edible oils situation", in 2002. The results show that 34.8% of deaths were due to CVD in 2000. Hypertension affected 10.2% of the total population. This rate reached to 27% and 41.4% in 45-69 and +70 age groups respectively. In addition Hyperlipidemia prevalence ( $\geq$  200mg/dl) was 25.7%. Diabetes prevalence based on personal given history was 1.5%. The prevalence of overweight and obesity was as high as 50% among men and 66% among women in 40-69 age groups. Fat and carbohydrate consumption were 30% and 40% more than recommended amounts respectively. 80-90% of edible oils were hydrogenated oil. Mean elaidic acid levels (Tran's fatty acid) in hydrogenated oils were 30%, 23.8% and 27.2% in 1999-2001. This rate was reported 38.3% in 2002. Mean trans fatty acid intake (15.6-30gr/day) was far away from recommended amount ( $\leq$  5gr/day). The population's sedentary life style was also becoming as a public health problem, with 70-80% being physically inactive. Non-communicable diseases and their related morbidity and mortality are becoming a significant serious public health problem in Iran. Development and implementation of national policies to modify food consumption patterns is highly recommended to decrease the risks of NCDs (Sheikholeslam *et al.*, 2004).

Sub-Saharan Africa (SSA) has a disproportionate burden of both infectious and chronic diseases compared with other world regions. Current disease estimates for SSA are based on sparse data, but projections indicate increases in non-communicable diseases (NCDs) caused by demographic and epidemiologic transitions. Surveyor reviewed the literature on NCDs in SSA and summarize data from the World Health Organization and International Agency for Research on Cancer on the prevalence and incidence of cardiovascular diseases, diabetes mellitus Type 2, cancer and their risk factors. It was searched the PubMed database for studies on each condition, and included those that were community based, conducted in any SSA country and reported on disease or risk factor prevalence, incidence or mortality.

They found few community-based studies and some countries (such as South Africa) were over-represented. The prevalence of NCDs and risk factors varied considerably between countries, urban/rural location and other sub-populations. The prevalence of

stroke ranged from 0.07 to 0.3%, diabetes mellitus from 0 to 16%, hypertension from 6 to 48%, obesity from 0.4 to 43% and current smoking from 0.4 to 71%. Hypertension prevalence was consistently similar among men and women, whereas women were more frequently obese and men were more frequently current smokers. The prevalence of NCDs and their risk factors is high in some SSA settings. With the lack of vital statistics systems, epidemiologic studies with a variety of designs (cross-sectional, longitudinal and interventional) capable of in-depth analyses of risk factors could provide a better understanding of NCDs in SSA, and inform health-care policy to mitigate the oncoming NCD epidemic (Dalal *et al.*, 2011).

Global energy imbalances and related obesity levels are rapidly increasing. The world is rapidly shifting from a dietary period in which the higher-income countries are dominated by patterns of degenerative diseases (whereas the lower- and middle-income countries are dominated by receding famine) to one in which the world is increasingly being dominated by degenerative diseases. This article documents the high levels of overweight and obesity found across higher- and lower-income countries and the global shift of this burden toward the poor and toward urban and rural populations. Dietary changes appear to be shifting universally toward a diet dominated by higher intakes of animal and partially hydrogenated fats and lower intakes of fiber. Activity patterns at work, at leisure, during travel, and in the home are equally shifting rapidly toward reduced energy expenditure. Large-scale decreases in food prices (eg, beef prices) have increased access to supermarkets, and the urbanization of both urban and rural areas is a key underlying factor. Limited documentation of the extent of the increased effects of the fast food and bottled soft drink industries on this nutrition shift is available, but some examples of the heterogeneity of the underlying changes are presented. The challenge to global health is clear (Popkin, 2006).

The Tehran Lipid and Glucose Study (TLGS) is a long term integrated community-based program for prevention of non-communicable disorders (NCD) by development of a healthy lifestyle and reduction of NCD risk factors. The study begun in 1999, is ongoing, to be continued for at least 20 years. A primary survey was done to collect baseline data in 15005 individuals, over 3 years of age, selected from cohorts of three medical health centers. A questionnaire for past medical history and data was completed during interviews; blood pressure, pulse rate, and anthropometrical measurements and a limited physical examination were performed and lipid profiles, fasting blood sugar and 2-hours-

postload-glucose challenge were measured. A DNA bank was also collected. For those subjects aged over 30 years, Rose questionnaire was completed and an electrocardiogram was taken. Data collected were directly stored in computers as database software-computer assisted system. The aim of this study is to evaluate the feasibility and effectiveness of lifestyle modification in preventing or postponing the development of NCD risk factors and outcomes in the TLGS population.

In phase II of the TLGS, lifestyle interventions were implemented in 5630 people and 9375 individuals served as controls. Primary, secondary and tertiary interventions were designed based on specific target groups including schoolchildren, housewives, and high-risk persons. Officials of various sectors such as health, education, municipality, police, media, traders and community leaders were actively engaged as decision makers and collaborators. Interventional strategies were based on lifestyle modifications in diet, smoking and physical activity through face-to-face education, leaflets & brochures, school program alterations, training volunteers as health team and treating patients with NCD risk factors. Collection of demographic, clinical and laboratory data will be repeated every 3 years to assess the effects of different interventions in the intervention group as compared to control group. This controlled community intervention will test the possibility of preventing or delaying the onset of non-communicable risk factors and disorders in a population in nutrition transition (Azizi *et al.*, 2009).

This White Paper highlights the developmental period as a plastic phase, which allows the organism to adapt to changes in the environment to maintain or improve reproductive capability in part through sustained health. Plasticity is more prominent prenatally and during early postnatal life, i.e., during the time of cell differentiation and specific tissue formation. These developmental periods are highly sensitive to environmental factors, such as nutrients, environmental chemicals, drugs, infections and other stressors. Nutrient and toxicant effects share many of the same characteristics and reflect two sides of the same coin. In both cases, alterations in physiological functions can be induced and may lead to the development of non-communicable conditions. Many of the major diseases – and dysfunctions – that have increased substantially in prevalence over the last 40 years seem to be related in part to developmental factors associated with either nutritional imbalance or exposures to environmental chemicals. The Developmental Origins of Health and Disease (DOHaD) concept provides significant insight into new strategies for research and disease prevention and is sufficiently robust and repeatable across species,

including humans, to require a policy and public health response. This White Paper therefore concludes that, as early development (in utero and during the first years of postnatal life) is particularly sensitive to developmental disruption by nutritional factors or environmental chemical exposures, with potentially adverse consequences for health later in life, both research and disease prevention strategies should focus more on these vulnerable life stages (Barouki *et al.*, 2012).

We propose an innovative, integrated, cost-effective health system to combat major non-communicable diseases (NCDs), including cardiovascular, chronic respiratory, metabolic, rheumatologic and neurologic disorders and cancers, which together are the predominant health problem of the 21st century. This proposed holistic strategy involves comprehensive patient-centered integrated care and multi-scale, multi-modal and multi-level systems approaches to tackle NCDs as a common group of diseases. Rather than studying each disease individually, it will take into account their intertwined gene-environment, socio-economic interactions and co-morbidities that lead to individual-specific complex phenotypes. It will implement a road map for predictive, preventive, personalized and participatory (P4) medicine based on a robust and extensive knowledge management infrastructure that contains individual patient information. It will be supported by strategic partnerships involving all stakeholders, including general practitioners associated with patient-centered care. This systems medicine strategy, which will take a holistic approach to disease, is designed to allow the results to be used globally, taking into account the needs and specificities of local economies and health systems (Bousquet *et al.*, 2011).

South Asians are at higher risk than White Caucasians for the development of obesity and obesity-related non-communicable diseases (OR-NCDs), including insulin resistance, the metabolic syndrome, type 2 diabetes mellitus (T2DM) and coronary heart disease (CHD). Rapid nutrition and lifestyle transitions have contributed to acceleration of OR-NCDs in South Asians. Differences in determinants and associated factors for OR-NCDs between South Asians and White Caucasians include body phenotype (high body fat, high truncal, subcutaneous and intra-abdominal fat, and low muscle mass), biochemical parameters (hyperinsulinemia, hyperglycemia, dyslipidemia, hyperleptinemia, low levels of adiponectin and high levels of C-reactive protein), procoagulant state and endothelial dysfunction. Higher prevalence, earlier onset and increased complications of T2DM and CHD are often seen at lower levels of body mass index (BMI) and waist circumference



(WC) in South Asians than White Caucasians. In view of these data, lower cut-offs for obesity and abdominal obesity have been advocated for Asian Indians (BMI; overweight  $>23$  to  $24.9 \text{ kg m}^{-2}$  and obesity greater than or equal to  $25 \text{ kg m}^{-2}$ ; and WC; men greater than or equal to 90 cm and women greater than or equal to 80 cm, respectively). Imbalanced nutrition, physical inactivity, perinatal adverse events and genetic differences are also important contributory factors. Other differences between South Asians and White Caucasians include lower disease awareness and health-seeking behavior, delayed diagnosis due to atypical presentation and language barriers, and religious and sociocultural factors. All these factors result in poorer prevention, less aggressive therapy, poorer response to medical and surgical interventions, and higher morbidity and mortality in the former. Finally, differences in response to pharmacological agents may exist between South Asians and White Caucasians, although these have been inadequately studied. In view of these data, prevention and management strategies should be more aggressive for South Asians for more positive health outcomes. Finally, lower cut-offs of obesity and abdominal obesity for South Asians are expected to help physicians in better and more effective prevention of OR-NCDs (Mishra and Khurana, 2010).

Despite concerns regarding a diabetes epidemic in the Middle East, internationally published data on national estimates of prevalent type 2 diabetes in Iran do not exist. With this article, we document a dramatically high prevalence of diabetes in Iran.

Their data were based on the results of the first Survey of Risk Factors of Non-Communicable Diseases of Iran, 2005. In this national cross-sectional survey, 70,981 Iranian citizens aged 25–64 years were recruiting.

They found that 7.7% of adults aged 25–64 years, or 2 million adults, have diabetes, among which one-half are undiagnosed. An additional 16.8%, or 4.4 million, of Iranian adults have impaired fasting glucose. The high prevalence of diabetes in working-age adults is an ominous sign for this developing nation. As the relatively young Iranian population ages in the future and urbanization continues or accelerates, the prevalence of diabetes will likely escalate (Esteghamati *et al.*, 2007).

## Significance of the study

Non-communicable diseases are by far the leading cause of death in the world. Of the 57 million global deaths in 2008, 36 million, or 63 percent, were due to NCDs. By 2030, non-communicable diseases will account for 66 percent of the global disease burden's some 80 percent of all NCD deaths occur in low and middle income countries. Non-communicable diseases are the most frequent causes of death in all regions of the world except Africa, where such diseases are rising rapidly and are projected to cause almost three quarters as many deaths as communicable, maternal, perinatal and nutritional diseases by 2020 and to exceed them as the most common causes of death by 2030 (Hunter and Reddy, 2013).

Roughly 80 percent of NCD related deaths occur in low and middle income countries, where fragile health systems often struggle to meet the population's most basic health needs. WHO estimates that 48 percent of NCD deaths in low and middle income countries occur before 70 years old, compared with 26 percent in high income countries (Psi.org, 2016).

NCDs already disproportionately affect low and middle income countries where nearly three quarters of NCD deaths (28 million) are occur (Mozaffarian *et al.*, 2014).

The underlying cause of NCD epidemic is the increase in lifestyle related risk factors resulting from social and economic changes. In many countries the increasing impact of globalization has given momentum to this process. Currently neighboring India is also experiencing an epidemic of NCDs attributed to lifestyle changes resulting from urbanization (Bangladesh Society of Medicine, 2011).

Among the modifiable risk factors unhealthy diet, physical inactivity, alcohol and tobacco use are categorized into primary risk factors and overweight, raised blood pressure, raised total cholesterol levels and raised blood glucose are categorized as intermediate risk factors. Most population has been experiencing an increased prevalence of both primary and intermediate risk factors (Bangladesh Society of Medicine, 2011).

NCD associated risk factors are largely modifiable. Therefore, by identifying and preventing the risk factors, NCDs such as coronary heart disease and stroke would be prevented by 80%, cancer by 40% and type 2 diabetes by 90%. Projections by experts estimate that an annual reduction of chronic disease death rates by 2% in the next 10

years will account for 36 million lives be saved. In addition, one third of all cancers could be prevented by eating healthy food, maintaining normal weight and being physically active throughout the lifespan (Bangladesh Society of Medicine, 2011).

Major non-communicable diseases (NCDs) such as cardiovascular diseases, cancer, diabetes, or chronic respiratory disease have already become major public health problems in Bangladesh. According to the Global Status Report on NCDs 2014 of the World Health Organization (WHO), the estimated probability of premature deaths between ages 30 and 70 from any of the aforesaid NCDs is 17.5 %. The total number of deaths in 2012 was 277,500 due to NCDs giving rise to a death rate of 564.1 per 100,000 in males and 531.9 per 100,000 in females. Nearly half (49 %) of deaths were due to NCDs. WHO has initiated the worldwide STEP wise approach to Surveillance (STEPS) of risk factors for NCDs. STEPS focuses on the periodic collection of data on key risk factors associated with major NCDs which is indispensable for designing community based interventions to reduce risk factors in the population (Bangladesh Society of Medicine, 2011).

The emerging pandemic of non-communicable diseases (NCDs) creates a new frontier for health professionals globally. Most of the forecasted increase in NCD prevalence and death rates can be accounted for by emerging NCD epidemics in developing countries. Bangladesh has been facing a dual burden of existing infectious diseases and escalating rise of NCDs. For getting prepared for the challenge of these diseases, information regarding their distribution and determinants is indispensable. Their control could well be addressed through their common risk factors. A few studies have so far reported prevalence of individual risk factors such as hypertension, smoking and dietary habit, from urban and rural populations. However few of them are done recently and showed a significantly increasing gradient in NCD prevalence (Zaman *et al.*, 2015).

Therefore it is of prime importance to conduct a survey on NCD risk factors taking into account of national representatives. The study was also done to determine the knowledge or awareness of the population about the risk factors (Biological and Behavioral markers means lifestyles).

### **Aims and Objective of the Study**

The main objectives of the study are –

- To determine prevalence estimation of NCD risk factors of mass people for male respondents of  $\geq 18$  years.
- To determine the Behavioral factors associated with non-communicable disease.
- To determine the Biological factors associated with non-communicable disease.
- To determine the knowledge and awareness regarding the Risk factors.

# **Chapter 3**

## **Methodology**

### **3.1 Type of the Study**

It was a survey based study.

### **3.2 Study Area**

The survey was conducted in different areas inside Chandpur district which includes some rural and urban areas also.

- Chandpur Sadar
- Hajigong Bazar
- Rajargoan Village
- Sreepur Village
- Menapur Village
- Mohamaya Village
- Korbanda Village
- Dolaitali Village
- Ichapura Village
- Pipiya Village

### **3.3 Inclusion Criteria**

- Respondents more than or equal to 18 years.
- Both male and female respondents

### **3.4 Exclusion Criteria**

Respondents who are unwilling to conduct the survey.

### **3.5 Study Population**

In this study, a total number of 305 respondents out of mass people were surveyed.

### **3.6 Study Period**

The duration of the study was about six months starting from July,2016 to June, 2017.

### **3.7 Questionnaire Development**

The pre-tested questionnaire was specially designed to collect the simple background data and the needed information. The questionnaire was written in simple English in order to avoid unnecessary semantic misunderstanding. The questionnaire was pilot tested to ensure it was understandable by the participants to assess the awareness and knowledge about prevalence and risk factors of non-communicable diseases.

### **3.8 Sampling Technique**

In this study convenient sampling technique was followed.

### **3.9 Data Collection and Analysis**

Informed consent was obtained from the eligible participants before interviewed and participants who agreed to join the study provided the required information for the studies. After collecting, the data were checked and analyzed with the help of Microsoft Excel 2010. The result was shown in bar, pie and column chart and calculated the percentage of the awareness and disease regarding Non-communicable diseases among the peoples.

# **Chapter 4**

## **Results**



#### 4.1 Age Distribution of the Respondents

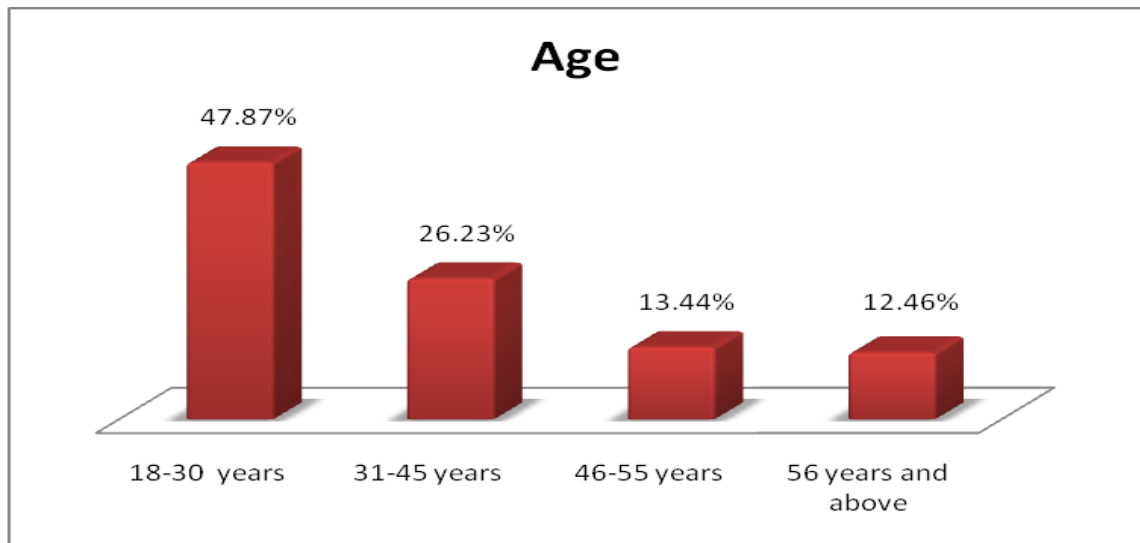


Figure 4.1: Age distribution of the respondents

During this study it was found that about 47.87% populations were in between 18 to 30 years, whereas, 26.23% were within the range of 31 to 45 years. However, only 13.44% populations were in between 46 to 55 years of age. Around 12.46% populations were within 56 years and above of age.

#### 4.2 Gender of the Respondents

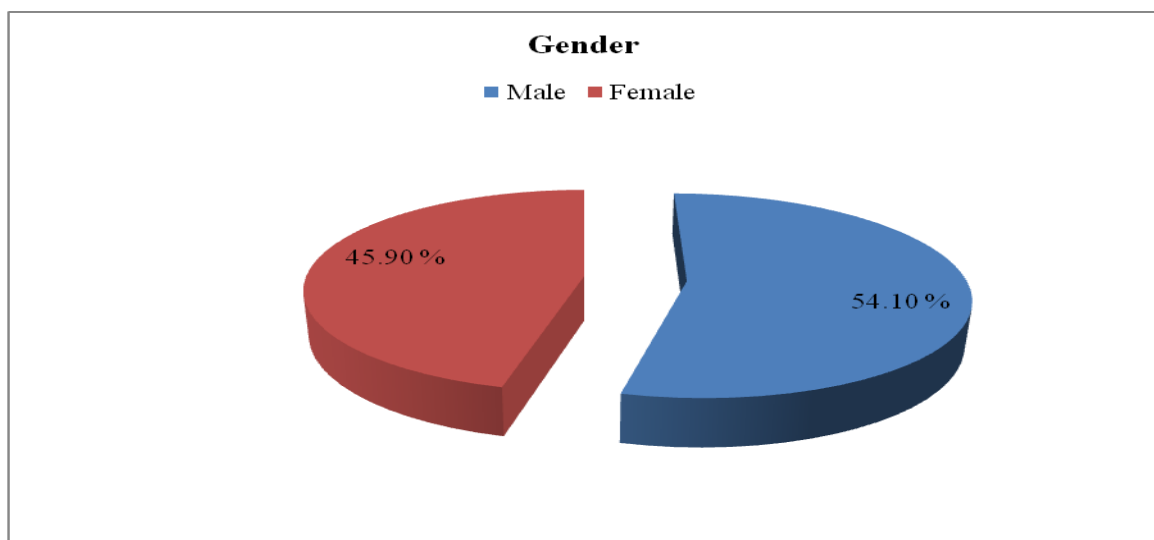


Figure 4.2: Gender of the respondents

In this study, 45.90% respondents were female and rest of the population which includes 54.10% was male respondents.

### 4.3 Educational Qualifications of the Respondents

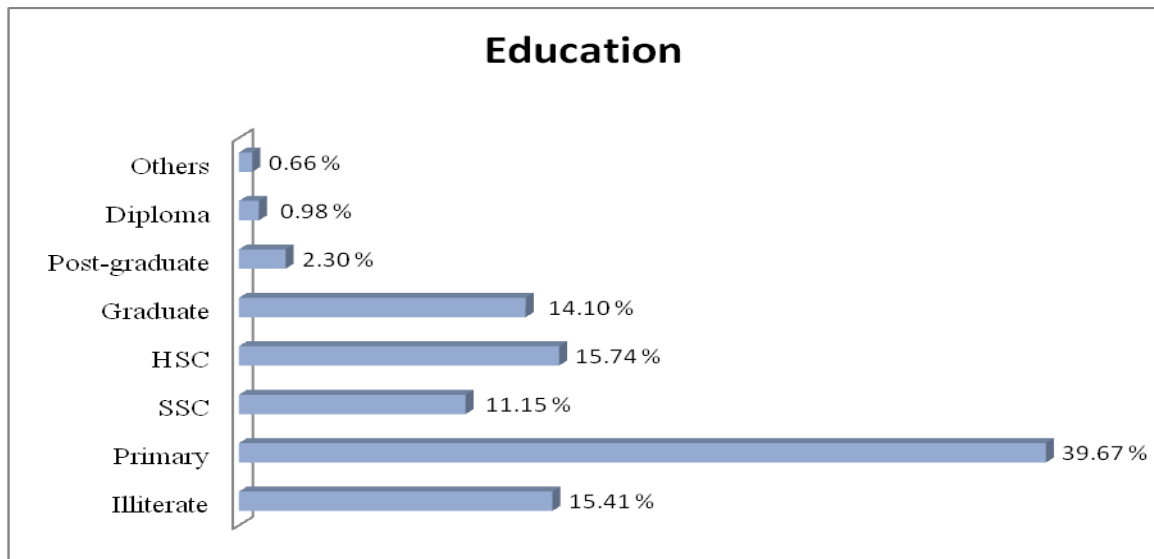


Figure 4.3: Educational qualifications among respondents

Regarding their educational status about 39.67% of the population were passed primary level, whereas, 15.41% were Illiterate. Around 11.15% populations were passed SSC level and 15.74% populations were passed HSC level. This study found that 14.10% people were graduates, 2.30% were post graduate. Only few people, which include 0.98% were in diploma level and 0.66% were others degree.

### 4.4 Occupational Qualifications of the Respondents

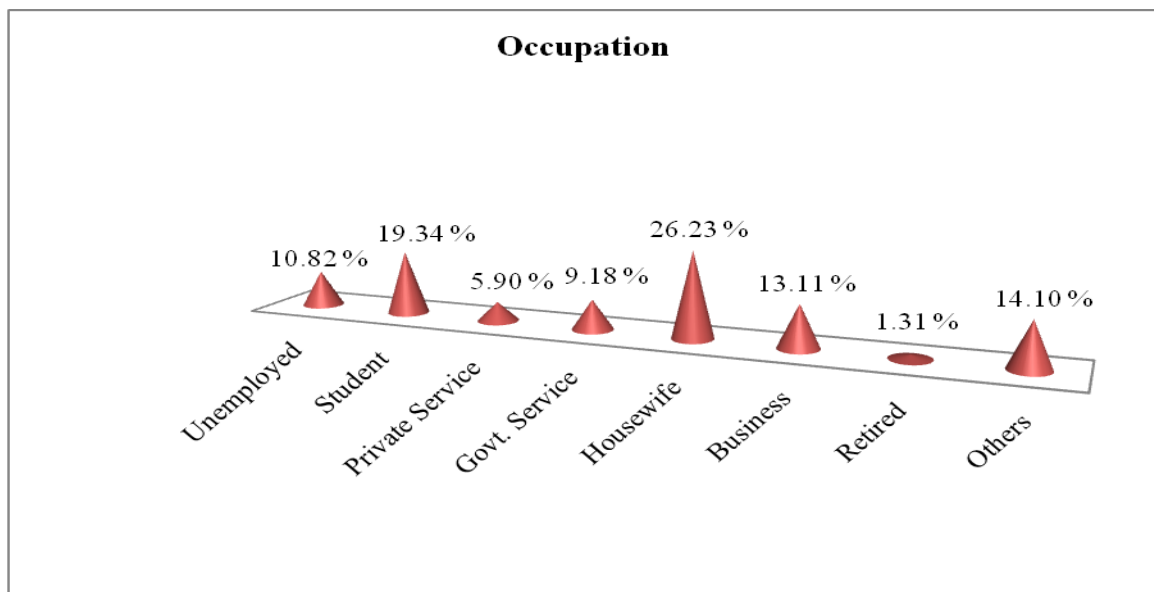


Figure 4.4: Occupational qualifications of the respondents

Throughout this study it was found that 26.23% of the respondents were housewife, whereas, 19.34% were student. Around 5.90% are working in the private sectors and 9.18% are the GOVT. service holders. Among the respondents 13.11% were businessmen and 10.82% was unemployed. The rest of the population which includes 1.31% was retired and 14.10% populations are pursuing other means for living.

#### 4.5 Marital Status of the Respondents

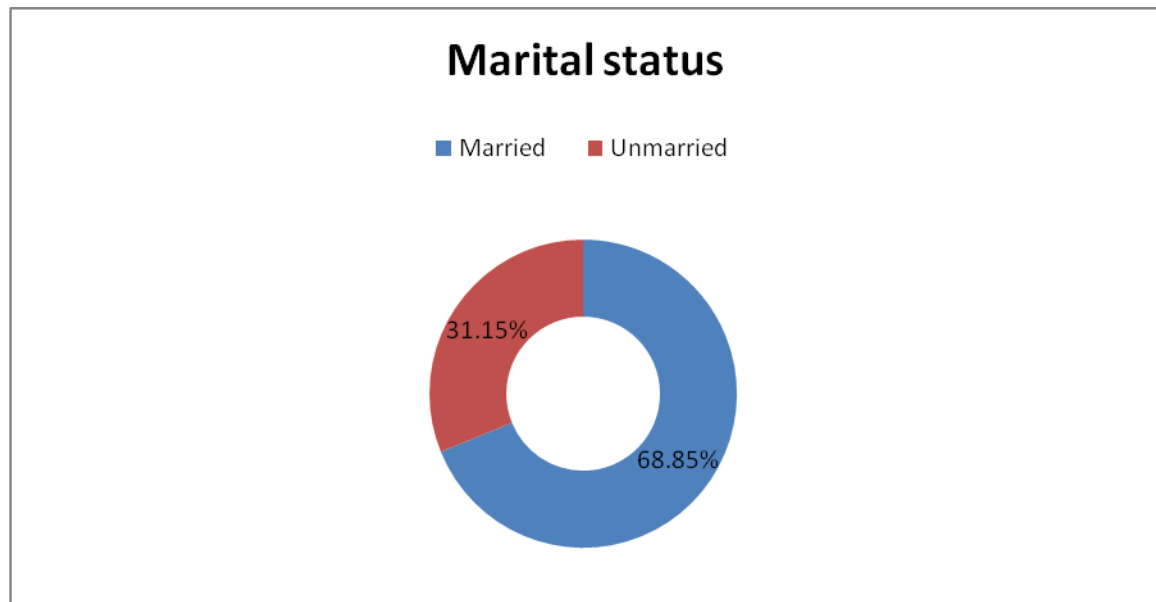


Figure 4.5: Marital status of the respondents

Among the respondents among 68.85% of the population were married upon which the study was conducted, whereas, 31.15% were unmarried.

#### 4.6 Residential Status of the Respondents

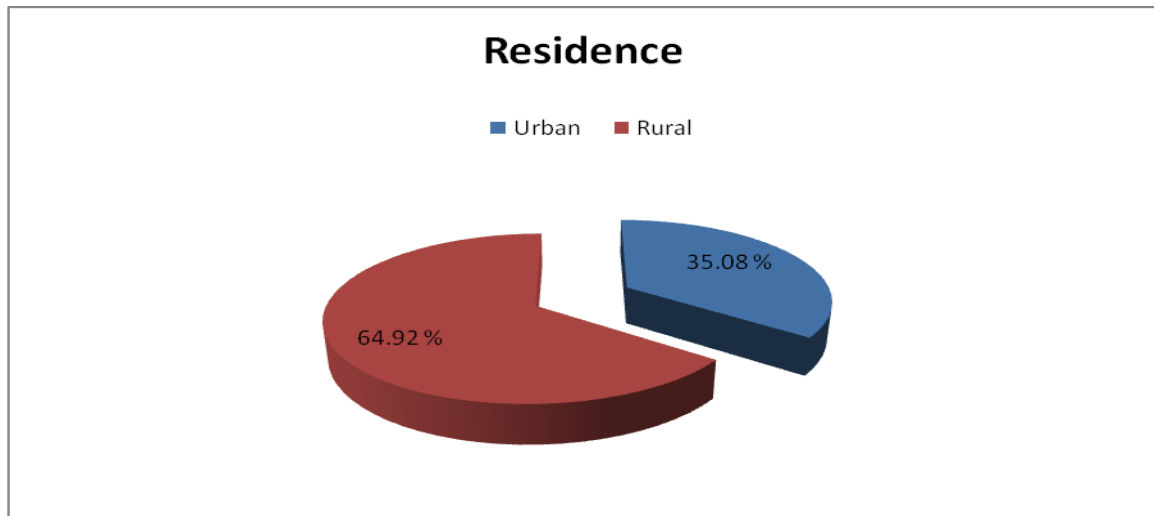


Figure 4.6: Residential status of the respondents

In this study, 64.92% respondents were living in the urban areas and the rest of the populations were living in rural region includes around 35.08%.

#### 4.7 Monthly Family Incomes of the Respondents

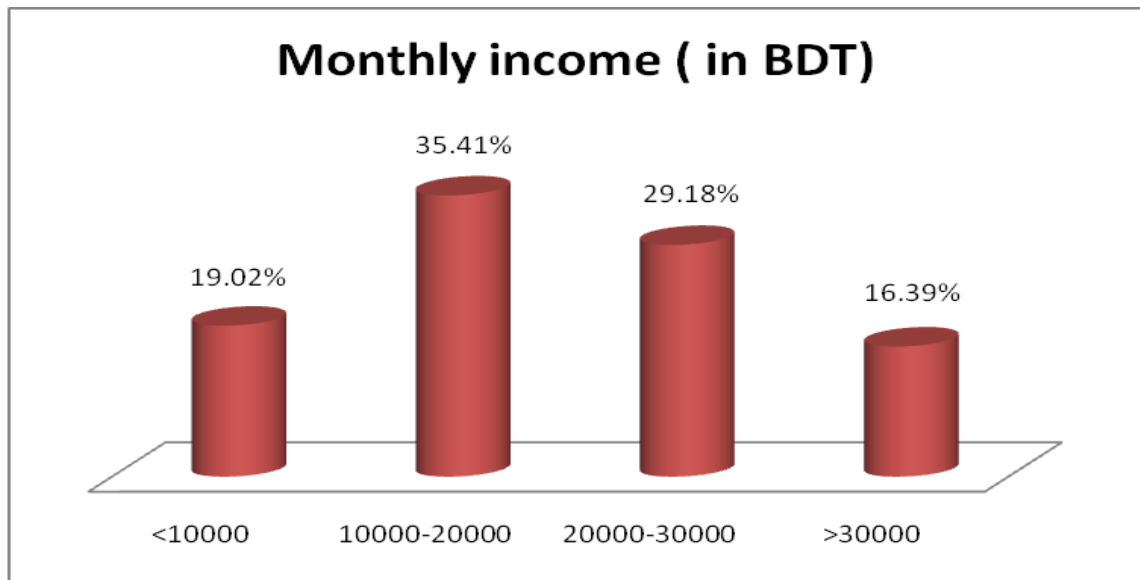


Figure 4.7: Monthly family income of the respondents

This study found that around 35.41% population had monthly family income 10000-20000 taka , whereas, 29.18% had earnings of 20000-30000 taka. Around 16.39% population had >30000 taka monthly income and rest of the population which includes 19.02% had <10000 taka as their monthly income.

#### 4.8 Body Mass Index (BMI) Status of the Respondents

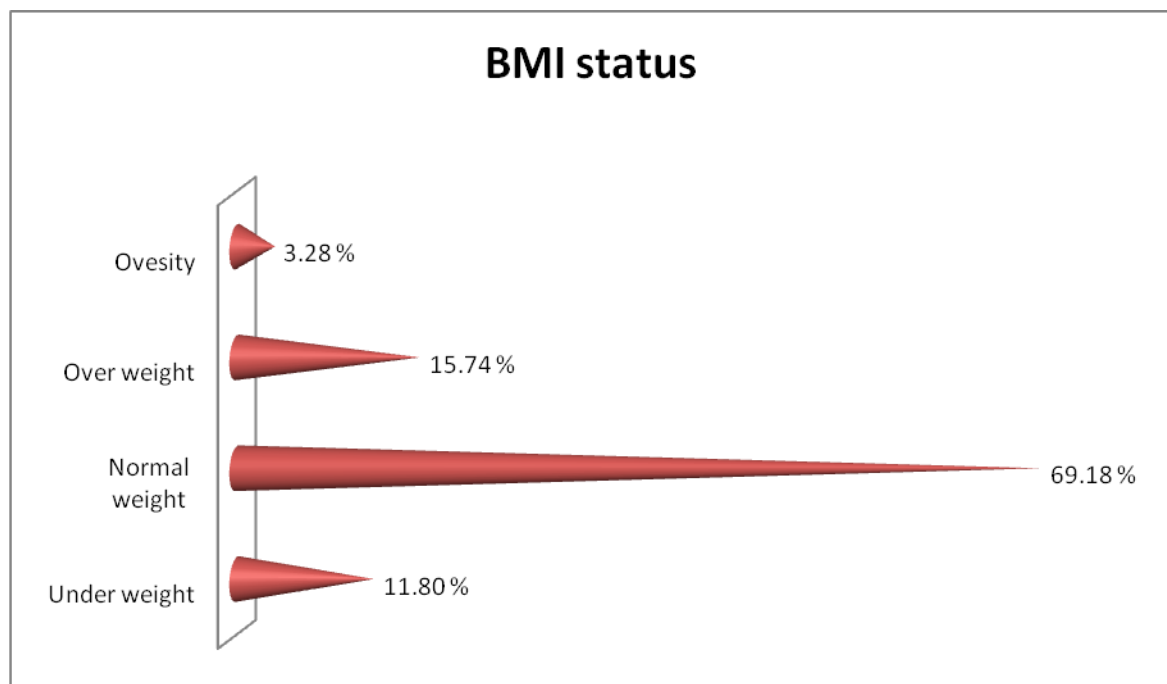


Figure 4.8: BMI (Body Mass Index) status of the respondents

Height, Weight and Waist circumference of each of the respondents were taken properly and it was then calculated with the BMI Calculator to signify the obesity in the studied population. From the results, we can see that 69.18% of the population had a normal weight whereas 11.80% of the populations were underweight. But it was found that 15.74% of the population were within the range of overweight and had greater risk of obesity in the near future. On the other hand 3.28% of the populations were already in the range of obesity so they were in greater risk of suffering from different kinds of non-communicable diseases.

#### 4.9 Waist Circumference Status of the Respondents

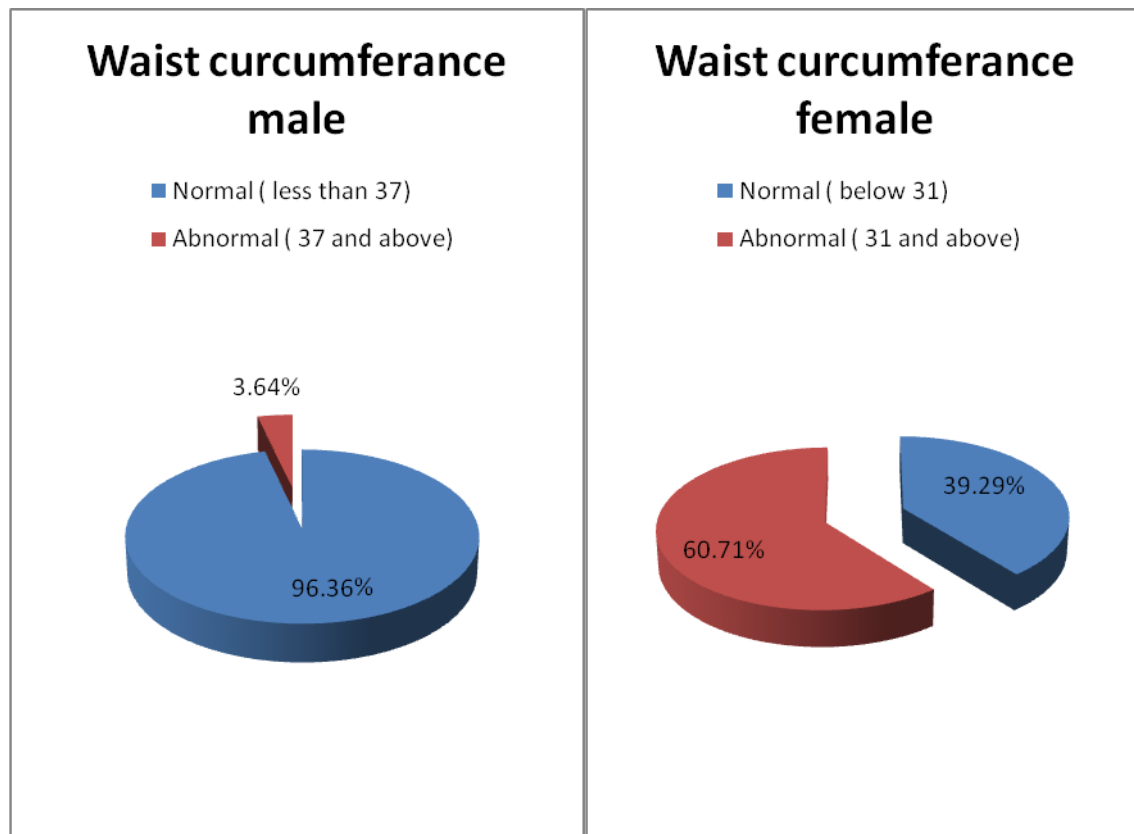


Figure 4.9: Waist circumference status of the Male respondents and Female respondents

In our study among 305 respondents 165 were male and 140 were female. The standard of waist circumference for male and female is quite different. For male 37 inches or less ( $\geq 94$  cm) is a standard and on the other hand for female  $\leq 31$  inches (80 cm) is considered as normal waist circumference. By analyzing our data we have found that 96.36% of male population had normal waist circumference and 3.64% had abnormal waist circumference. On the other hand, only 39.29% of the female respondents had normal waist circumference and a large percentage of female respondents had abnormal waist circumference which is 60.71%. So, in this case we may say that according to our study female respondents has more chance to face non-communicable disease in future than male respondents.

#### 4.10 Sleeping Habit of the Respondents

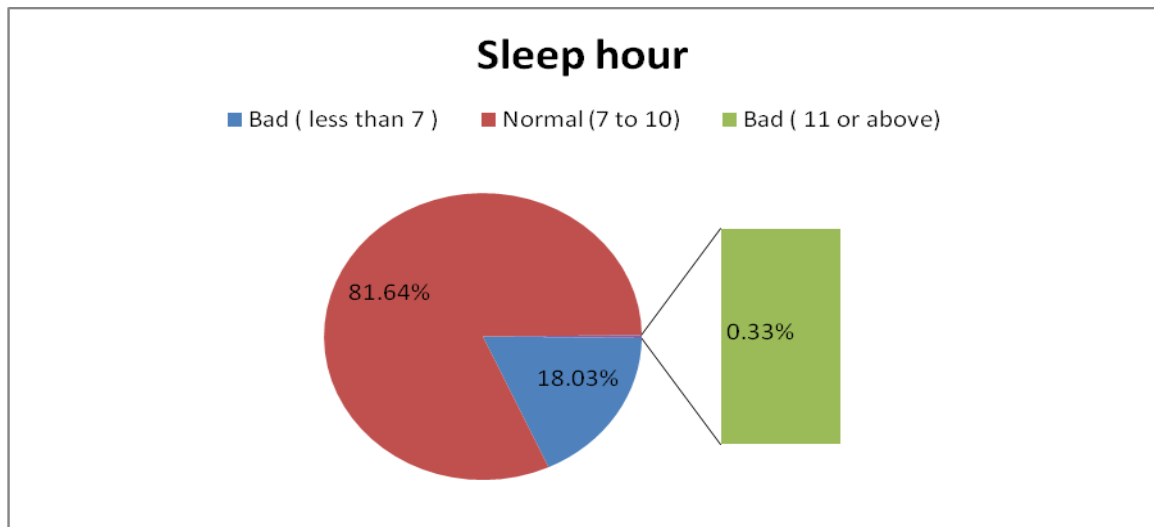


Figure 4.10: Sleeping habits of respondents

Normally a healthy person needs 7-10 hours of sleep. In our study among 305 respondents we have found that 81.64% population had normal sleeping habit. The person with 0-6 hours' sleep is not sufficient whereas the rest of the population which includes 18.36% of the people had a sleeping duration of above 11 hours a day which means those people are not sufficiently physically active and they have a high risk of non-communicable disease.

#### 4.11 Blood Pressure Status of the Respondents

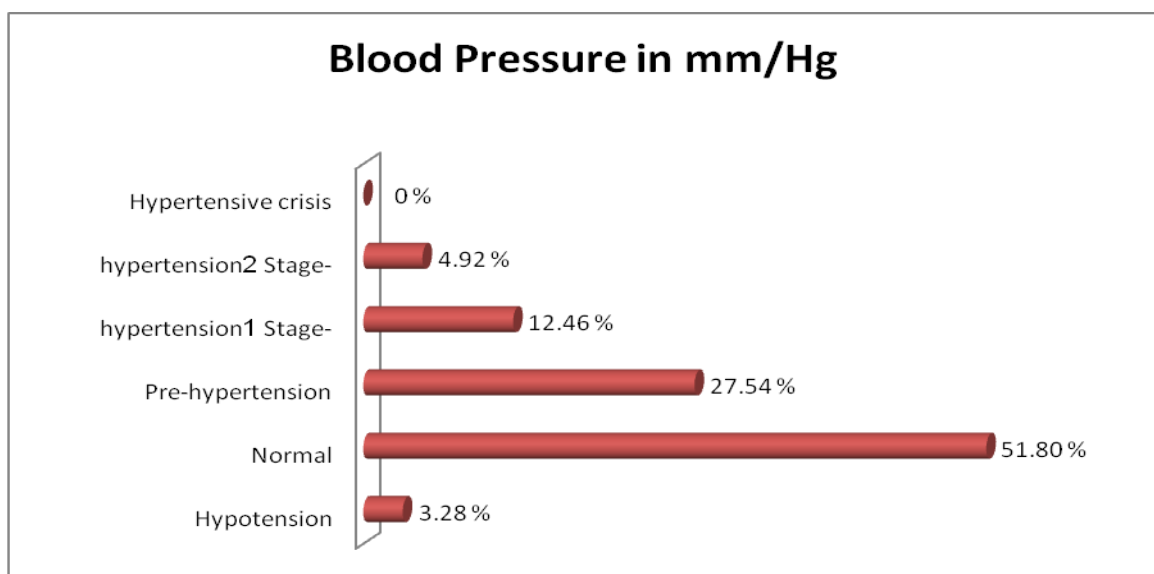


Figure 4.11: Blood pressure status of the respondents

Blood pressure played an important role in the study and when we took the blood pressure of the respondents made sure that they were in the resting condition and we took blood pressure two times with 10 minutes differences. During this, when the pressure of each of the respondents were measured it was seen through analysis that 3.28% of the respondent had hypotension and 51.80% of the people had normal blood pressure conditions. But the major concerning issue was that 27.54% of the people having prehypertension, 12.46% of the people having hypertension-1 and rest of the population had 4.92% hypertension-2 which may lead to further complications. No one was found in the stage of hypertension crisis that may lead to serious health damage.

#### 4.12 Status of Respondent’s Current Medical Condition

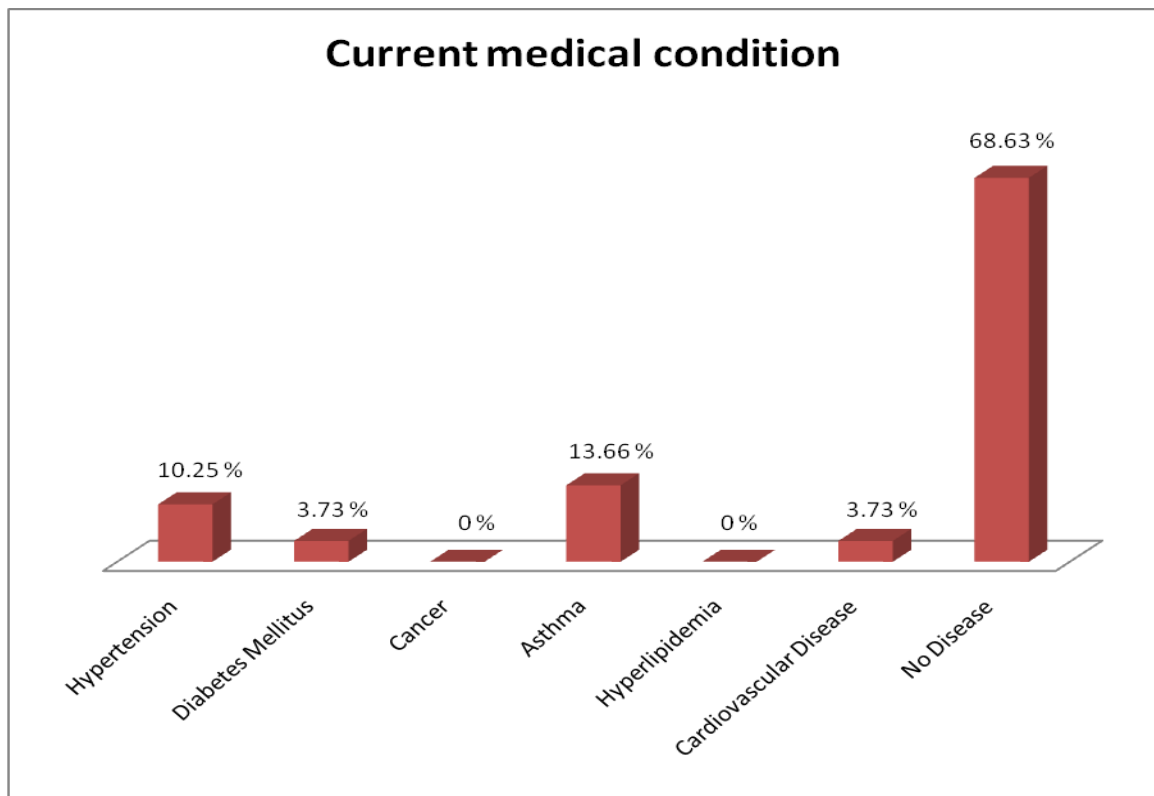


Figure 4.12: Current medical condition of the respondents

When the respondents were asked whether they were suffering from any of the medical conditions than 10.25% of the people answered that they were suffering from hypertension. Other respondents included 13.66% from asthma, 3.73% from Diabetes Mellitus, 3.73 % from cardiovascular diseases and no count for hyperlipidemia and cancer. But 68.63% of the populations were not suffering from any of the conditions out of 305 respondents.



#### 4.13 Status of Respondent's about the Disease Condition

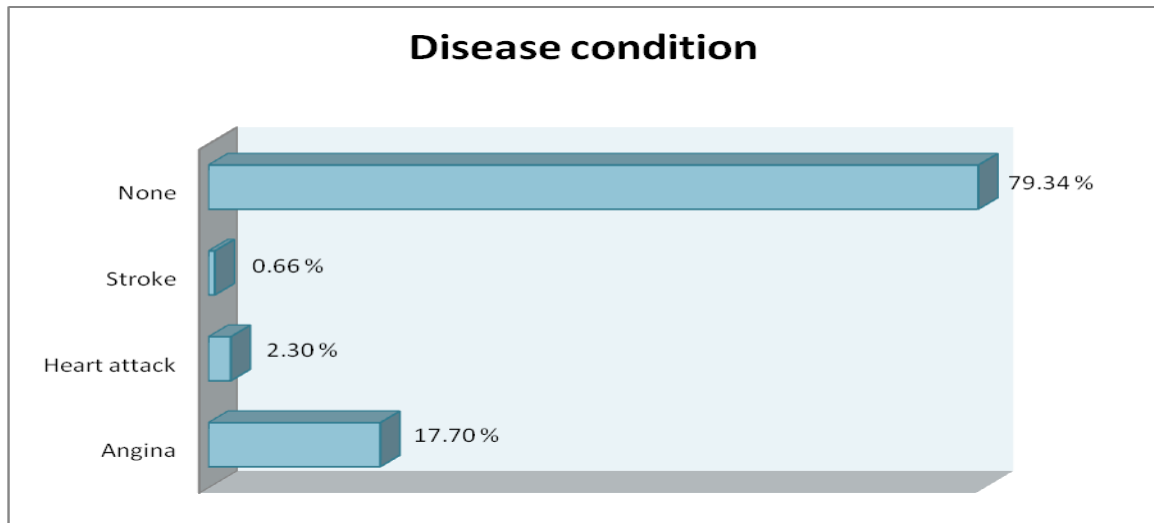


Figure 4.13: Status of respondents about suffering from any conditions.

When the respondents were asked whether they were suffering from any of the medical conditions than 17.70% answered that they were sometimes suffer from angina. 2.30% people suffered from heart attack and stroke caused in 0.66% people also. But 79.34% people were not suffering in any of these following conditions.

#### 4.14 Status of Respondent's about Family History of the Disease Condition

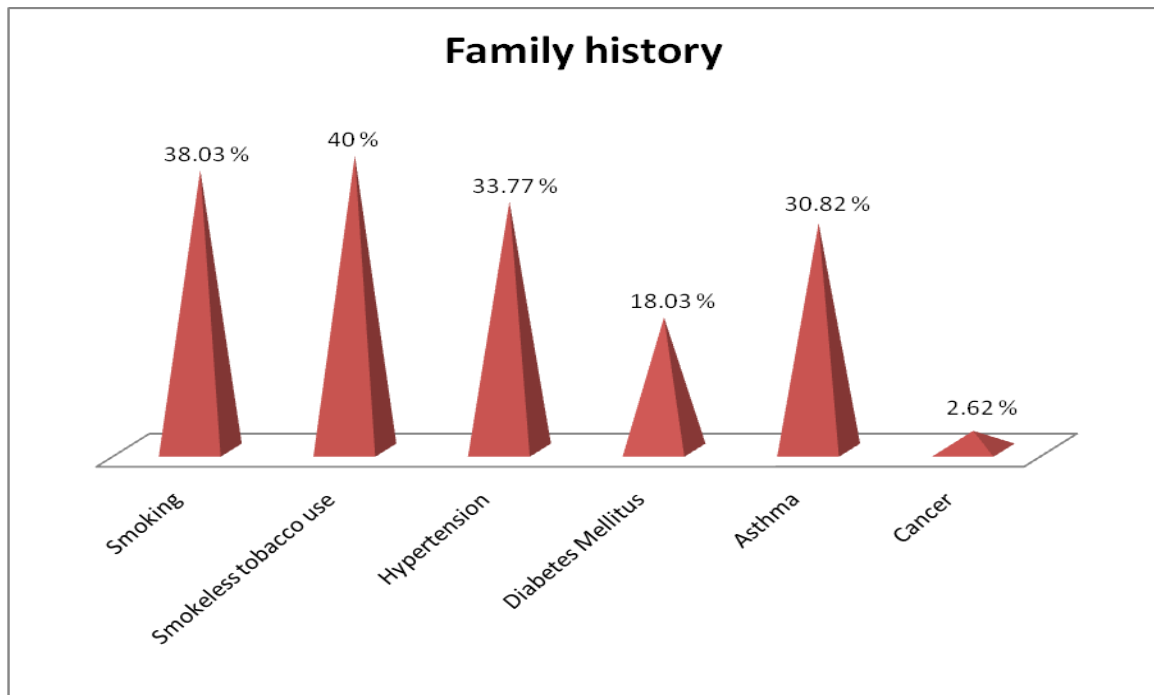


Figure 4.14: Status of respondents about family history of the disease conditions

Every year 2.5 lakh Bangladeshis die due to tobacco and the rate of death is 28 per hour, according to a report of World Health Organization (WHO). Our study found that among 305 respondents 38.03% had family history of smoking and 40% had family history of smokeless tobacco use. However, 33.77% answered that their family history had hypertension and 18.03% had diabetes mellitus. The rest of the conditions regarding asthma and cancer 30.82% and 2.62% provided affirmative answers about family history.

#### 4.15 Knowledge about Factors Causing Health Problems

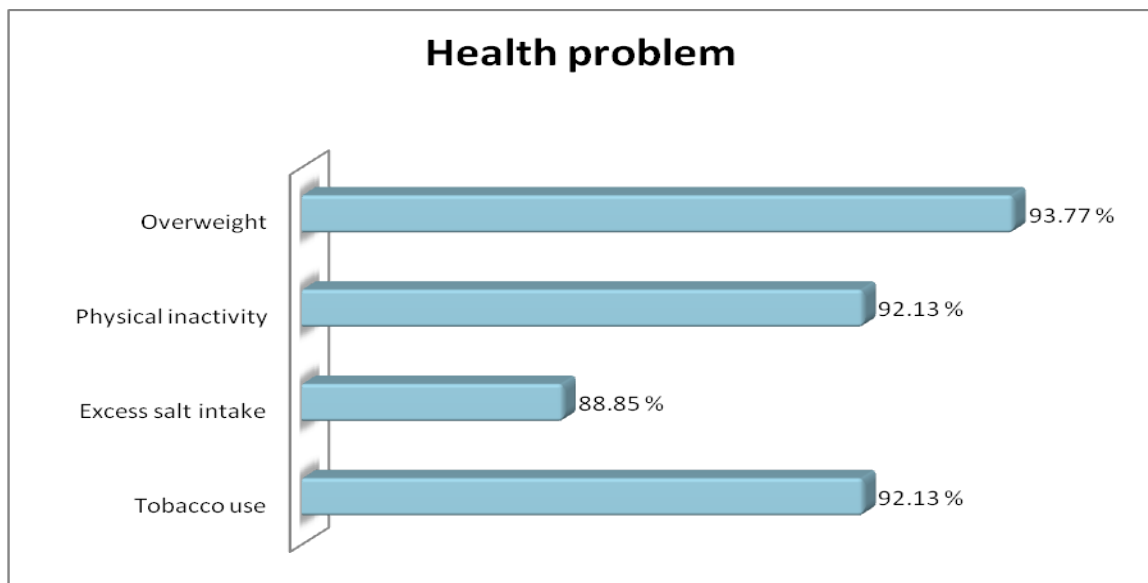


Figure 4.15: Knowledge of the respondents about tobacco use, excess salt intake, physical inactivity and overweight.

When the respondents were asked whether Tobacco use causes health problem then about 92.13% of the population knew that tobacco use can cause health problem. In case of their knowledge about excess salt intake, 88.85% of the population knew that excess salt intake may cause health problem especially for them who have hypertension. When the respondents were asked about their knowledge in physical inactivity 92.13% gave positive answer. In case of overweight, 93.77% of the total population thought that overweight may cause serious health problem. But others population did not think that they can cause any type of health issues.

#### 4.16 Status of Respondent's Tobacco product use

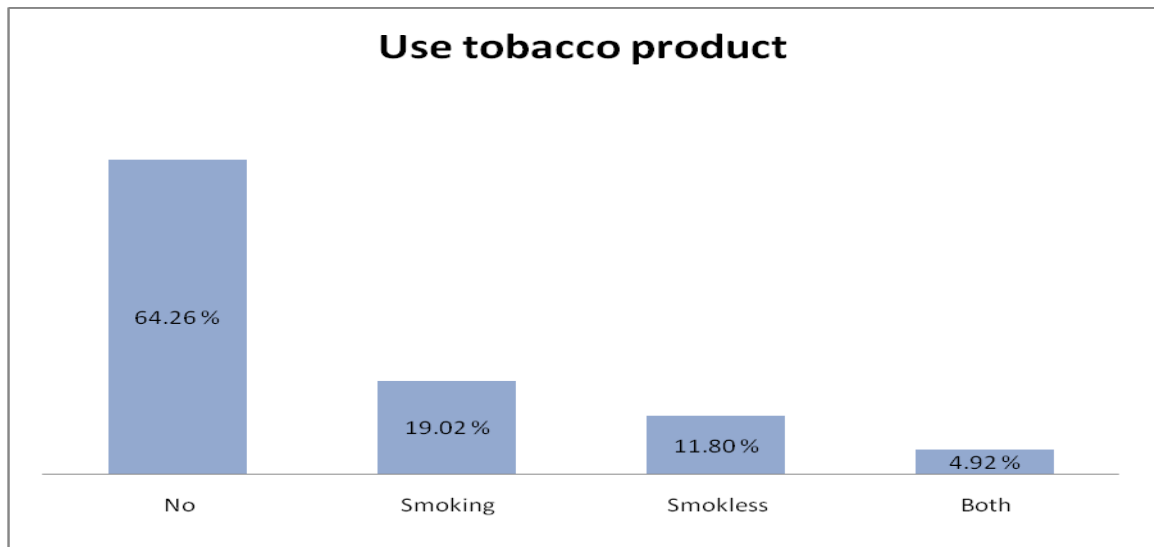


Figure 4.16: Status of respondents tobacco product use

When the respondents were asked about the use of tobacco in their daily life then 64.26% people provided negative answer. Whereas 19.02% people taken cigarettes, pipes or biri and 11.80% people taken chewing, snuff, gul, jorda, pan-masala or any other types of smokeless product. Around 4.92% of the total respondents taken both smoking and smokeless products.

#### 4.17 Status of Fruit Intake Habit of the Respondents

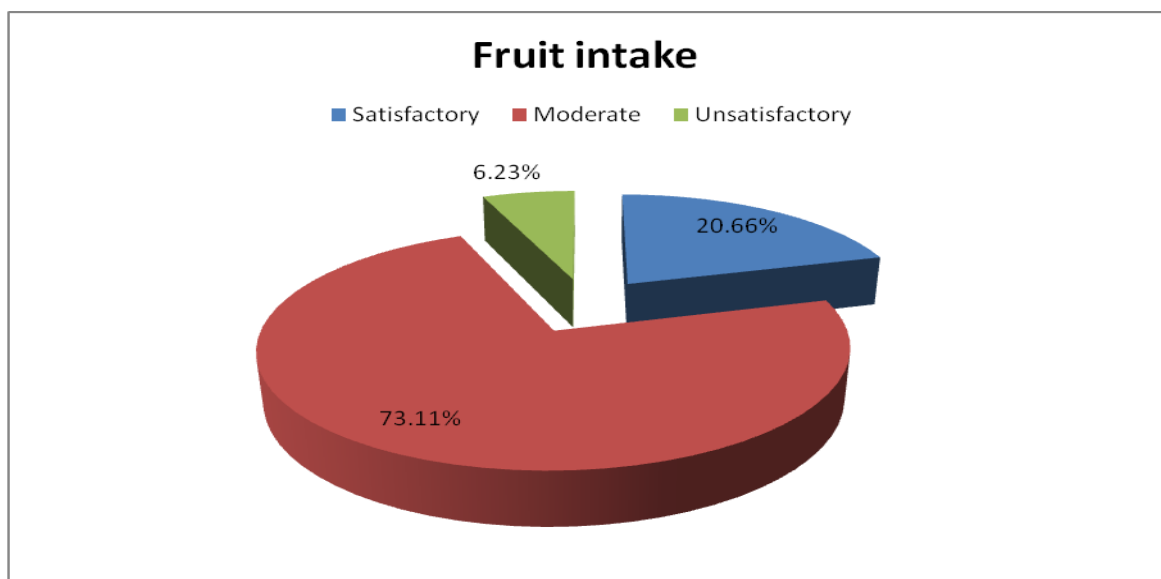


Figure 4.17: Status of respondents about dietary habit (fruit eating)

Normally the people who have taken fruits at least 5-7 days in a week that person is considered as in the satisfactory level and those who have taken fruits at least 1-4 days in a week that person is in the unsatisfactory level. In our study, we have found that among 305 of the total respondents 20.66% people are in the satisfactory level and 73.11% people are in the unsatisfactory level. About 6.23% of the total respondents do not take fruits at all.

#### 4.18 Status of Vegetable Intake Habit of the Respondents

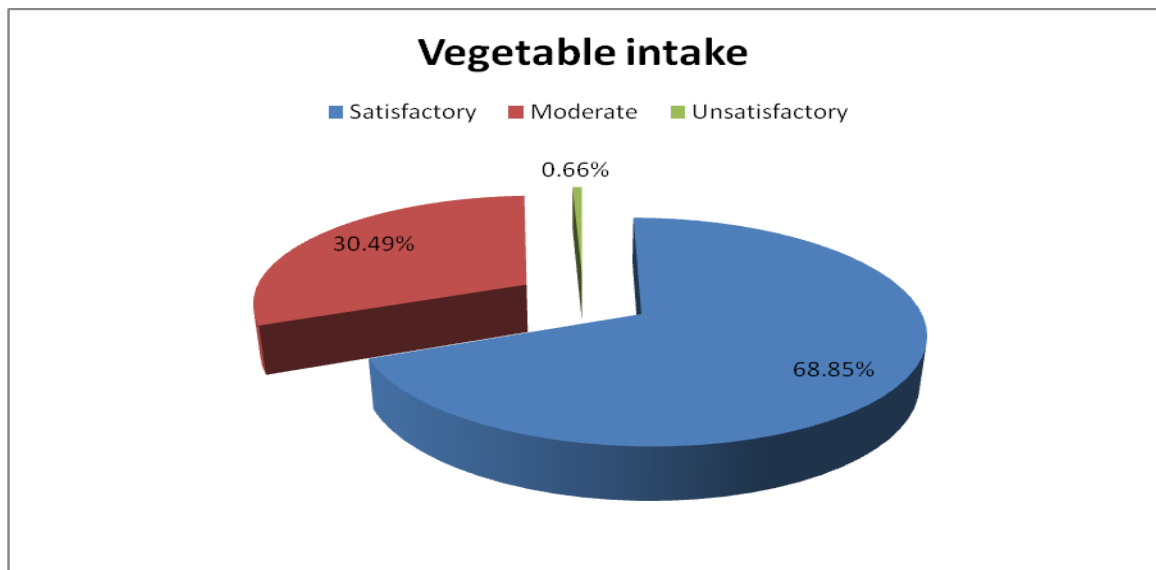


Figure 4.18: Status of respondents about dietary habit (vegetable eating)

Normally the people who have taken vegetables at least 5-7 days in a week that person is considered as in the satisfactory level and those who have taken fruits at least 1-4 days in a week that person is in the unsatisfactory level. In our study, we have found that among 305 of the total respondents 68.85% people are in the satisfactory level and 30.49% people are in the moderate level. About 0.66% of the total respondents do not take vegetables at all.

#### 4.19 Status of Eating Meals Habit of the Respondents

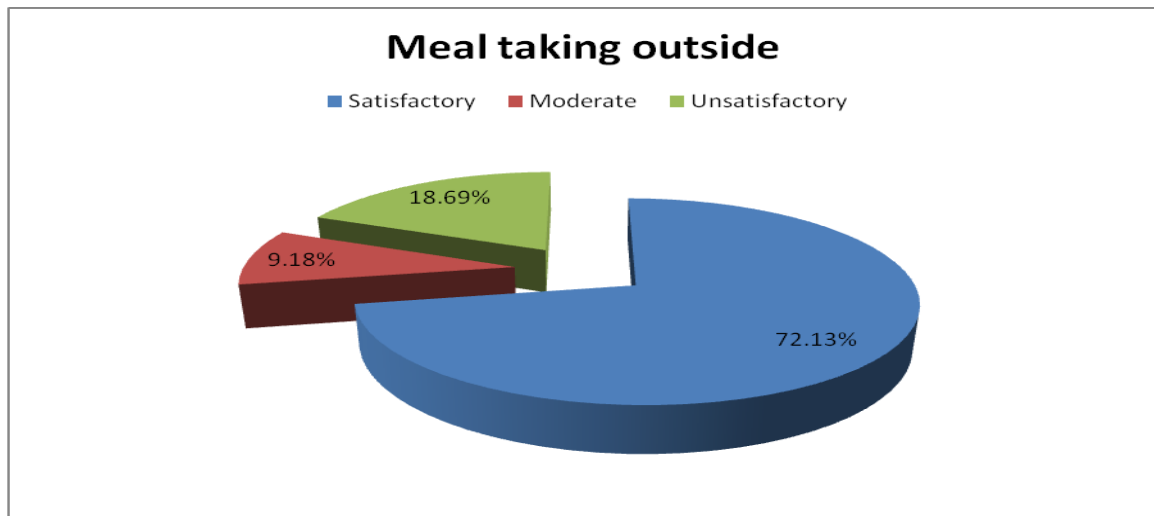


Figure 4.19: Status of respondents about dietary habit (eating meal outside)

Eating meal outside is a greater threat for non-communicable diseases occurrence. Habit of eating meals is an important parameter in this study. The eating habits of this study population were analyzed about how many meals they take within home and how many they take outside. On the basis of that it was found that 72.13% of the people didn't take a single meal outside which is satisfactory in nature. Whereas 18.69% of the population take meal outside and this people have a high risk to cause non communicable diseases in future. The rest of the population 9.18% take a meal prepared outside the home at least 3-4 days per week which is moderate in nature.

#### 4.20 Habit of Adding Salt or Salty Sauce in the Food

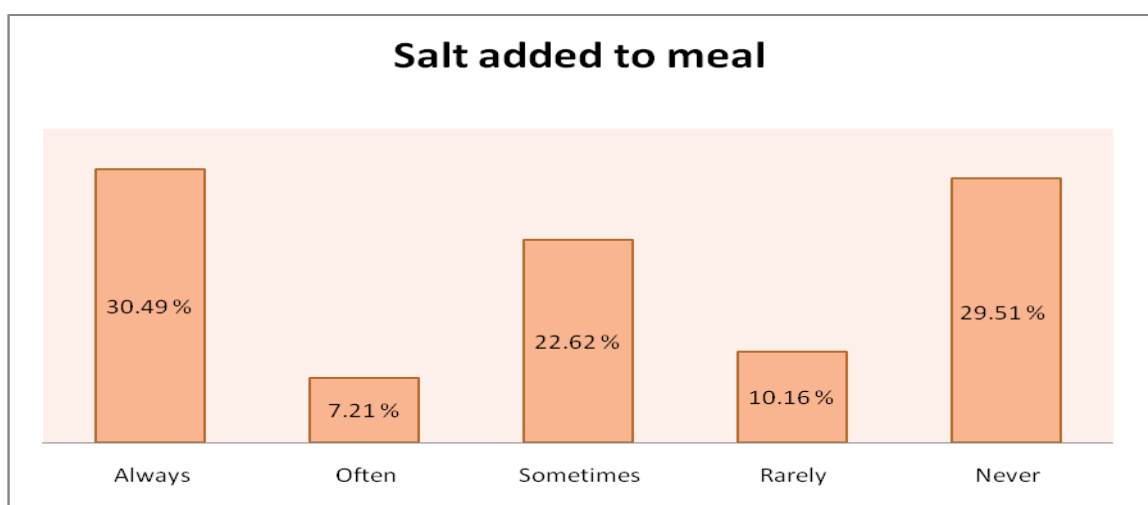


Figure 4.20: Habit of adding salt or salty sauce in the food

After analysis of this data of 305 respondents, 30.49% of the total population taken salt or add salty sauce in their food. Whereas 7.21% people often add salt or salty sauce in their food and 22.62% of the population sometimes added it. Out of the 305 respondents, 10.16% people rarely use salt or salty sauce in their food. Around 29.51% of the total population never added salt or any types of salty sauce in their food.

#### 4.21 Habit of Eating Processed Food High with Salt

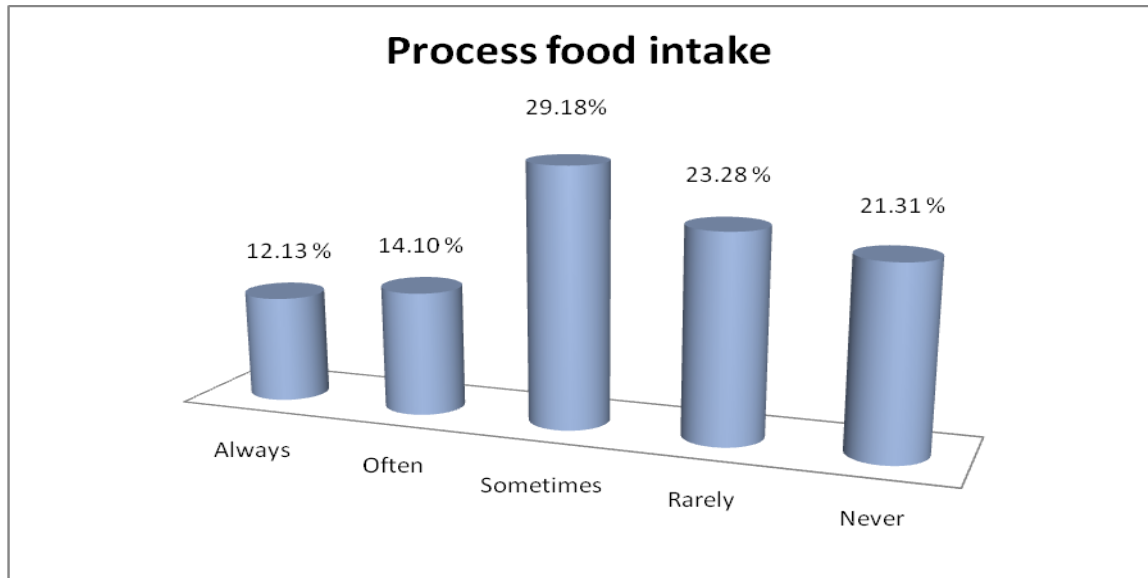


Figure 4.21: Habit of eating processed food high with salt

When the respondents were asked about if they eat processed food high in salt content 12.13% gave positive answer. On the other hand 14.10% of the people often ate processed food high in salt content and 29.18% of the sometimes ate this type of food. Out of the 305 respondents 23.28% rarely and 21.31% never ate processed food high in salt content. Upon analyzing it can be easily said that major portion of the study population sometimes eats such kind of food which increases the risk of suffering from non-communicable diseases.

#### 4.22 Physical Activity Status of the Respondents

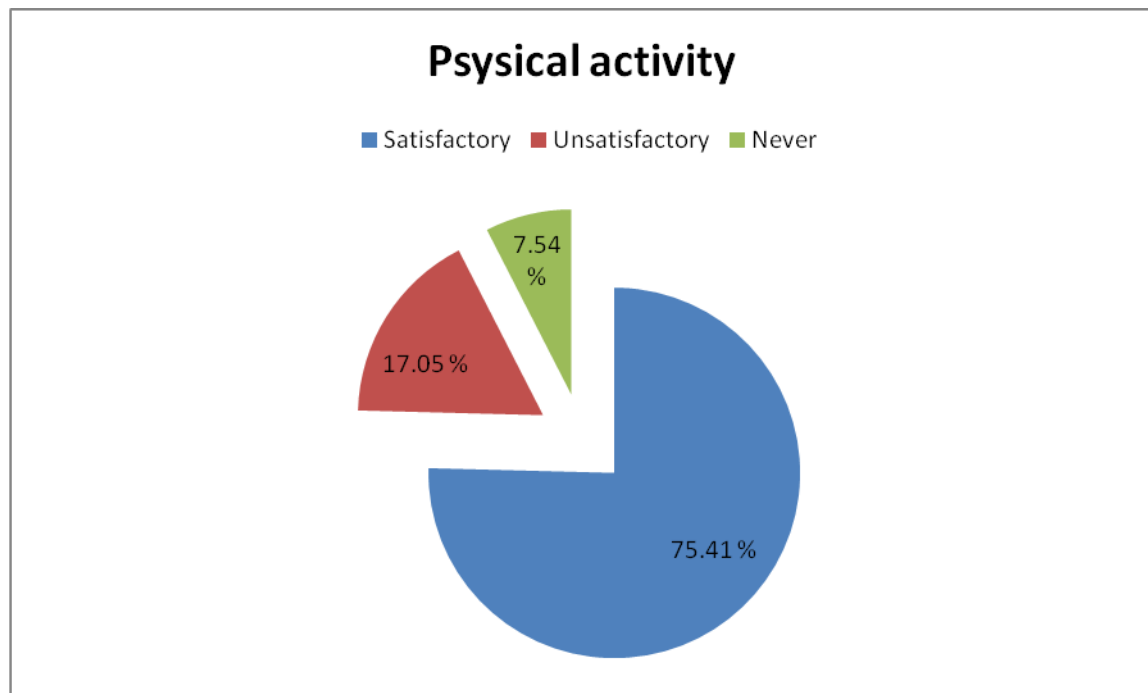


Figure 4.22: Physical activity status of the respondents

In our study we collect data from 305 respondents in case of physical study on the basis of that increases respiration rate or heart rate and which is usually done for 10 minutes continuously. Generally physical activity for 150 minutes or more per week is considered as satisfactory level and in our study we found that 75.41%. Physical activity for less than 150 minutes per week is considered as unsatisfactory level and in this study we found that 17.05%. But a large amount of population which is 7.54% avoids physical activity. Upon analyzing this it can be said that the majority of the study population do not comply with the physical activity standard which increases their chances for suffering from non-communicable diseases.

#### 4.23 Doctor's Advice to the Respondents

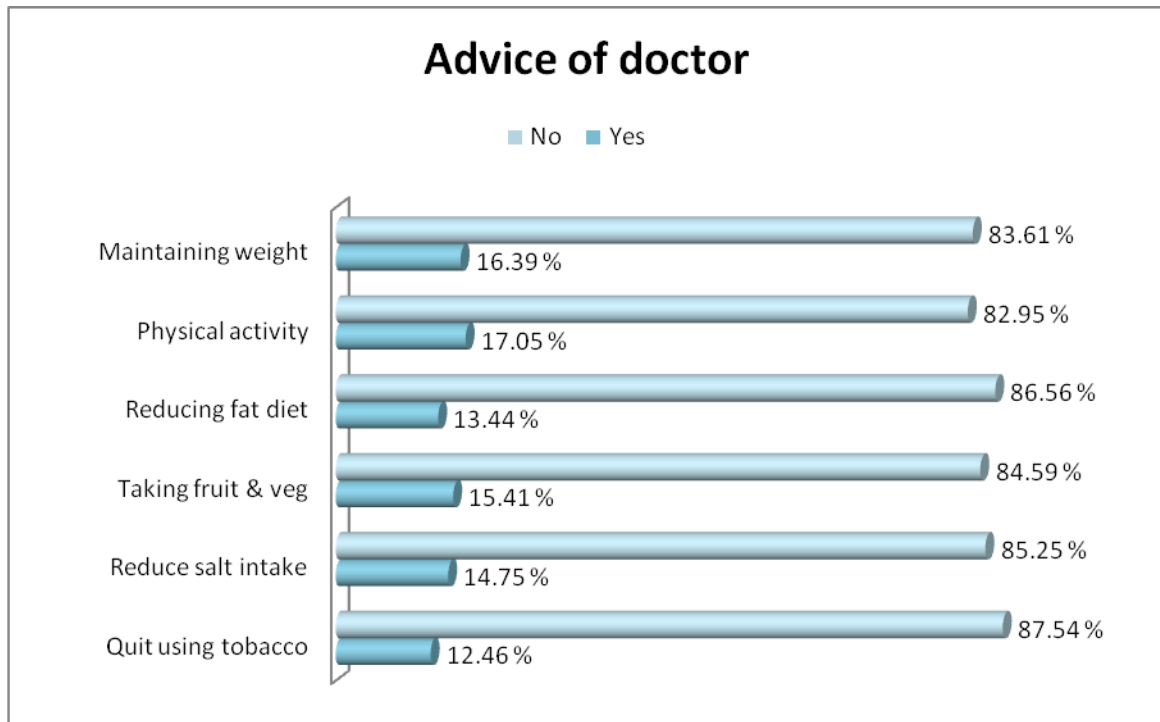


Figure 4.23: Doctor's Advice to the Respondents

Out of 305 respondents when they were asked about whether their doctors ever gave them any advices regarding their behavioral modifications on lifestyles regarding quit smoking tobacco 12.46% of the total respondents gave positive answer. 14.75% people were advised by the doctor to reduce salt in their diet and 15.41% were advised to eat five fruit servings each day. 13.44% of the population answered that they were advised by the doctor to reduce their fat and 17.05% people said that doctor suggest them to start physical activity. Among 16.39% of the total respondents said that they were advised by the doctor to maintain a healthy body weight.



# **Chapter 5**

## **Discussion & Conclusion**

## 5.1 Discussion

The study was conducted on 305 respondents among which 47.87% were in between the age of 18-30 years and 26.23% were within 31-45 years and the respondents where 54% are male and 46% are female. Regarding their educational status about 39.67% of the population passed primary level, 15.74% passed HSC whereas 14.10% were Graduates.

The major portion of the respondents (68.39%) was not suffering from any of the asked medical conditions although some of them were suffering from hypertension (10.25%), diabetes mellitus (3.73%) and asthma (13.66%). Among the respondents 51.80% had normal blood pressure, 27.54% had pre-hypertension and 12.46% had stage-1 hypertension according to our measurement which is quite similar with a study conducted by Zaman *et al.* (2015) that showed 20.7% respondents were having hypertension while 45.16% had normal blood pressure, 24.52% having Hypertension 1 and 3.87% having hypertension 2. It also showed that 5.4% of their survey population was having diabetes mellitus which was also quite similar to our study as 3.73% of our respondents were suffering from diabetes.

Having positive family history of smoking (38.03%), smokeless tobacco use (40%), hypertension (33.77%), diabetes mellitus (18.03%), asthma (30.82%) and cancer (2.62%) were mentioned by the respondents which indicates a greater chance of suffering from this non-communicable disease conditions as they are biological markers.

Majority of the male respondents (96.36%) had normal waist (<37 inch) while 3.64% of the male respondents had overweight waist and about 32.29% of female respondents had normal waist circumference (<31 inch) while 60.71% of the female respondents had overweight which is very alarming.

Based on BMI we can see that 69.18% of the population had a normal weight whereas 15.74% were overweight and 3.28% were already obesity. So they were in greater risk of suffering from different kinds of non-communicable diseases. Our results were quite similar with the study of Zaman *et al.* (2015) where 19.6% were overweight and 4.1% were obese.

About 75.41% of respondents followed the standard of physical activity (150 minutes a week) which is not similar with a study conducted by Zaman *et al.* (2015) because of their low level of physical activity.

During this study when respondents were asked about their sleeping habit 81.64% population had a sleeping habit of 7-10 hours a day. Around 18.03% of the population had a sleeping duration of 0-6 hours a day. The rest of the population which includes 0.33% of the people had a sleeping duration of above 11 hours a day. The respondents were inactive for most of the time of a day.

According to STEPS taking fruits and vegetables 5 Servings a day is standardized. But during our study we didn't use this parameter rather we opted for if a respondent takes fruits or vegetables 5 days a week is quite satisfactory. On that standard 20.66% and 68.85% of the respondent follow this habit, respectively. But 73.11% and 30.49% of the respondents takes fruits and vegetables but doesn't comply with the standard. Again 6.23% and 0.66% of the respondent do not take fruits and vegetables at all. The result was found similar to the study clustering of non-communicable diseases risk factors in Bangladeshi adults, 2013 where in spite of a satisfactory frequency, neither fruit nor was vegetables consumption adequate in quantity. Considering the minimum recommended amount, 92.4% did not consume adequate fruit or vegetables on an average day (Zaman *et al.*, 2015).

Habit of taking meals outside plays an important role to increasing the NCDs chances. On that contrary 72.13% of the people didn't take a single meal outside which is satisfactory in nature. On the other hand 9.18% of the people took meal outside of home at least 3-4 days a week. The rest of the population took at least a meal prepared outside home.

Out of the 305 respondents 30.49% always and 22.62 % sometimes added salt or salty sauce in their food and 12.13% always and 29.18% sometimes ate processed food high in salt content. As majority of the study populations added salt or salty sauce there is greater risk of hypertension.

Regarding the respondents' tobacco use within last 30 days 64.26% of the people answered in a negative manner which is promising. The respondents said that they used smoking product (19.02%) and smokeless (11.80%) respectively, which result was quite different with a study conducted by Zaman *et al.* (2015) where manufactured cigarette users were 33.2% and smokeless tobacco users were 28.5%.

In this study when the respondents were asked whether they know the factors that causing health problems, 92.13% mentioned tobacco use, 88.85% mentioned excess salt intake,

92.13% mentioned physical inactivity and 93.77% mentioned obesity means majority of the population gave affirmative answer. The rest of the population think or don't know that these parameters could cause any health problems and have higher chances of suffering from NCDs.

For behavioral modifications on lifestyles the doctors advised 16.39% respondents regarding healthy body weight or lose weight, 17.05% for starting or doing more physical exercise, 13.44% to reduce fat in the diet, 15.41% to take five servings of fruits/vegetables each day, 14.75% to reduce salt intake and 12.46% for quitting tobacco use. From the above analysis we can easily see that less number of the study population are asked to change their life style or behavioral modifications. If they don't follow the advice they may suffer from NCD.

## **5.2 Conclusion**

Based on all the facts, it can be concluded that prevalence of NCDs were quite low among the study population and distribution of the risk factors were also moderate. Most of the respondents knew about the risk factors and what can be the consequences if they do not pay heed. The minority of the respondents was advised by the doctor to maintain their health conditions but they were not up to the mark in following up the guidelines. After the analysis it was seen that there was clustering of the risk factors means some of the respondents of the population were having more than one risk factor which was alarming. At this point, the only way to remedy is to promote health awareness programs and much other awareness guidelines related to the risk factors of NCDs things. It is however need to mention that this research was conducted on a very small group of population. Therefore, it is suggested that if a conclusive result about the awareness of distribution of the risk factors of non-communicable diseases is desired, further large scale researches should be conducted.

# **Chapter 6**

## **References**

Ali, M., Jaacks, L., Kowalski, A., Siegel, K. and Ezzati, M. (2015). Noncommunicable Diseases: Three Decades Of Global Data Show A Mixture Of Increases And Decreases In Mortality Rates. *Health Affairs*, 34(9), p.1444-1455.

Azizi, F., Ghanbarian, A., Momenan, A., Hadaegh, F., Mirmiran, P., Hedayati, M., Mehrabi, Y. and Zahedi-Asl, S. (2009). Prevention of non-communicable disease in a population in nutrition transition: Tehran Lipid and Glucose Study phase II. *Trials*, 10(1), p.5.

Bangladesh Society of Medicine, (2011). *Non-Communicable Disease Risk Factor Survey Bangladesh 2010*. [online] Dhaka: WHO. Available at: [http://www.who.int/chp/steps/2010\\_STEPS\\_Report\\_Bangladesh.pdf](http://www.who.int/chp/steps/2010_STEPS_Report_Bangladesh.pdf) [Accessed 25 May. 2017]

Barouki, R., Gluckman, P., Grandjean, P., Hanson, M. and Heindel, J. (2012). Developmental origins of non-communicable disease: Implications for research and public health. *Environmental Health*, 11(1), p.42.

Bloom, D.E., Cafiero, E.T., Jané-Llopis, E., Abrahams-Gessel, S., Bloom, L.R., Fathima, S., Feigl, A.B., Gaziano, T., Mowafi, M., Pandya, A., Prettner, K., Rosenberg, L., Seligman, B., Stein, A.Z., and Weinstein, C. (2011). The Global Economic Burden of Noncommunicable Diseases. Geneva: World Economic Forum.

Bousquet, J., Anto, J., Sterk, P., Adcock, I., Chung, K., Roca, J., Agusti, A., Brightling, C., Cambon-Thomsen, A., Cesario, A. *et al.* (2011). Systems medicine and integrated care to combat chronic noncommunicable diseases. *Genome Medicine*, 3(7), p.43.

Dalal, S., Beunza, J., Volmink, J., Adebamowo, C., Bajunirwe, F., Njelekela, M., Mozaffarian, D., Fawzi, W., Willett, W., Adami, H. and Holmes, M. (2011). Non-communicable diseases in sub-Saharan Africa: what we know now. *International Journal of Epidemiology*, 40(4), p.885-901.

Esteghamati, A., Gouya, M., Abbasi, M., Delavari, A., Alikhani, S., Alaedini, F., Safaie, A., Forouzanfar, M. and Gregg, E. (2007). Prevalence of Diabetes and Impaired Fasting Glucose in the Adult Population of Iran: National Survey of Risk Factors for Non-Communicable Diseases of Iran. *Diabetes Care*, 31(1), p.96-98.

Global Health Topics. (2015). *Office of Global Affairs (OGA)*. [online] Available at: <http://www.hhs.gov/about/agencies/oga> [Accessed 25 May. 2017].

Henriksen, J., Nielsen, O. and Beck-Nielsen, H. (2015). *Diabetes overview*. [online] Netdoctor. Available at: <http://www.netdoctor.co.uk/conditions/diabetes/a826/diabetes-overview/> [Accessed 25 May. 2017].

Hunter, D. and Reddy, S. (2013). Noncommunicable Diseases. *The New England Journal of Medicine*, [online] pp.1336-1343. Available at: <http://www.nejm.org/doi/pdf/10.1056/nejmra1109345> [Accessed 25 May. 2017]

Just-health.net. (2016). *Lists of Non-Communicable Diseases | Just-Health.net*. [online] Available at: <http://www.just-health.net/Non-Communicable-Diseases-List.html> [Accessed 25 May. 2017].

Kim, H. and Oh, S. (2013). Noncommunicable Diseases: Current Status of Major Modifiable Risk Factors in Korea. *Journal of Preventive Medicine & Public Health*, 46(4), p.165-172.

Lim, S. S., Vos, T., Flaxman, A. D., Danaei, G., Shibuya, K. and Adair-Rohani, H. *et al.*,(2010). A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study. *Lancet*, 380(9859), p.2224-2260.

MacGill, M. (2016). *Diabetes: Symptoms, Causes and Treatments*. [online] Medicalnewstoday.com. Available at: <http://www.medicalnewstoday.com/info/diabetes> [Accessed 25 May. 2017].

MacGill, M. and Webberley, D. (2016). *Hypertension: Causes, Symptoms and Treatments*. [online] Medical News Today. Available at: <http://www.medicalnewstoday.com/articles/150109.php> [Accessed 24 May. 2017].

Misra, A. and Khurana, L. (2010). Obesity-related non-communicable diseases: South Asians vs White Caucasians. *international journal of obesity and related metabolic disorders*, 35(2), p.167-187.

Moneta, G. (2016). *Hyperlipidemia* / *Society for Vascular Surgery*. [online] Vascular.org. Available at: <https://vascular.org/patient-resources/vascular-conditions/hyperlipidemia> [Accessed 24 May. 2017].

Mozaffarian, D., Fahimi, S., Singh, G. M., Micha, R., Khatibzadeh, S., Engell, RE., Lim, S. *et al.*,(2014). Global sodium consumption and death from cardiovascular causes. *The New England Journal of Medicine*. 371(7):624–34. Doi: 10.1056/NEJMoa1304127.

Nhs.uk. (2016). *Diabetes - NHS Choices*. [online] Available at: <http://www.nhs.uk/Conditions/Diabetes/Pages/Diabetes.aspx> [Accessed 23 May. 2017].

Nutritionmd.org. (2016). *Hyperlipidemia: Diagnosis and Treatment*. [online] Available at: [http://www.nutritionmd.org/health\\_care\\_providers/cardiovascular/hyperlipidemia\\_diagnosis.html](http://www.nutritionmd.org/health_care_providers/cardiovascular/hyperlipidemia_diagnosis.html) [Accessed 24 May. 2017].

Popkin, B. (2006). Global nutrition dynamics: the world is shifting rapidly toward a diet linked with noncommunicable diseases<sup>1,2,3</sup>. *American Society for Clinical Nutrition*, 84(2), p.289-298.

Psi.org. (2016). *Non-Communicable Diseases*. [online] Available at: <http://www.psi.org/health-area/non-communicable-diseases/#about> [Accessed 23 May. 2017].

Robertson, S. (2009). *Hyperlipidemia Treatment*. [online] News-Medical.net. Available at: <http://www.news-medical.net/health/Hyperlipidemia-Treatment.aspx> [Accessed 25 May. 2017].

Sheikholeslam, R., Mohamad, A., Mohammad, K. and Vaseghi, S. (2004). Non communicable disease risk factors in Iran. *Asia Pacific Journal of Clinical Nutrition*, 4, p.1-2.

Wilson, P., Hoeg, J., D'Agostino, R., Silbershatz, H., Belanger, A., Poehlmann, H., O'Leary, D. and Wolf, P. (1997). Cumulative Effects of High Cholesterol Levels, High Blood Pressure, and Cigarette Smoking on Carotid Stenosis. *New England Journal of Medicine*, 337(8), p.516-522.



Wma.net. (2016). *Non-Communicable Diseases*. [online] Available at: <http://www.wma.net/en/20activities/30publichealth/10noncommunicablediseases/> [Accessed 23 May. 2017].

World Health Organization. (2016). *Obesity and overweight*. [online] Available at: <http://www.who.int/mediacentre/factsheets/fs311/en/> [Accessed 25 May. 2017].

Zaman, M., Bhuiyan, M., Karim, M., MoniruzZaman, Rahman, M., Akanda, A. and Fernando, T. (2015). Clustering of non-communicable diseases risk factors in Bangladeshi adults: An analysis of STEPS survey 2013. *BMC Public Health*, 15(1).