CHAPTER-2

REVIEW OF LITERATURE

The more you know about your topic,
The more effectively you can tackle your own research problem,
It all starts with the literature review!!!

The basic purpose of any research investigation is either to prove a hypothesis generated on the basis of existing theories and generalization or to explore new and unexplored fields, to contribute to the knowledge and generate fields for further research. Whether a study has to be conducted with the former or the later aim, a review of literature concerning the previous and current work is essential for a clear enunciation of the research objectives. This in fact forms the basis for hypothesis formulation and the research strategy to be adopted. In fact, a clear understanding of the problem, which is going to be investigated, is in itself a major step towards its solution.

Review of literature simply means what is already known about the particular topic. It is a prelude to further research. Hence, the available literature related to various aspects of the present study has been reviewed and presented under the following broad headings.

2.1 Global burden of non-communicable diseases
2.2 National burden of non-communicable diseases
2.3 Risk factors of non-communicable diseases

2.1: GLOBAL BURDEN OF NCDs

As defined by World Health Organization, non-communicable diseases (NCDs) or chronic diseases are tend to be of long duration, preventable and occurs
due to a combination of factors viz, biological/genetic, environmental and behavioural factors. Four main diseases are generally considered to dominate NCD mortality and morbidity: cardiovascular diseases (including heart disease and stroke), diabetes, cancers and chronic respiratory diseases (including chronic obstructive pulmonary disease (COPD) and asthma).

Last two decades had seen dramatic transitions in the health needs of the world’s populations. Among these health transitions, the most pervasive change has been the rising burden of non-communicable diseases (NCDs). Around 80% of the world’s population is living in developing countries. In these developing regions, non-communicable diseases (such as cardiovascular diseases and depression) are fast replacing the traditional enemies such as infectious diseases and malnutrition, as the leading causes of disability and premature death. By 2020, it is expected that injuries, both intentional and unintentional along with non-communicable diseases could rival communicable diseases as a source of ill health worldwide.

These changes are happening due to demographic and epidemiological transitions. Demographic changes take place when a change in the population dynamics of a country occurs as it moves from high fertility and mortality rates to low fertility and mortality rates. This result in increase in numbers of adults relative to children, and the health problems of children give way to adult’s health issues. This shift in the disease pattern of a population as mortality falls, acute infectious diseases are reduced, while chronic degenerative diseases increase.

Globally, the burden of non-communicable diseases (NCDs)—chronic metabolic, heart, cancerous and psychological illnesses, and injuries that are not transmittable by contact—is rising. Between 1990 and 2010, deaths from NCDs rose by nearly 8 million, and these conditions now account for two of every three deaths (34.5 million) per year worldwide. In 2010, 8 million people died from cancer—38% more than in 1990. Coronary heart disease (CHD) and stroke together accounted for one in four deaths in 2010, compared with one in five deaths in 1990, and resulted in 12.9 million deaths globally in 2010. In 2010, 1.3 million deaths were due to diabetes, twice as many as in 1990.
A total of 57 million deaths occurred in the world during 2008; 36 million (63%) were due to NCDs, principally cardiovascular diseases, diabetes, cancer and chronic respiratory diseases. Nearly 80% of these NCD deaths (29 million) occurred in low- and middle-income countries. NCDs are the most frequent causes of death in most countries in the Americas, the Eastern Mediterranean, Europe, South-East Asia, and the Western Pacific. In the African Region, there are still more deaths from infectious diseases than NCDs. Even there, however, the prevalence of NCDs is rising rapidly and is 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.

In South-East Asia region of WHO, NCDs claims lives at younger age as compared to other regions. In 2008, the proportion of NCD deaths occurring among people under the age of 60 was 34% in SEAR, compared to 23% in the rest of the world.

WHO projections show that NCDs will be responsible for a significantly increased total number of deaths in the next decade. NCD deaths are projected to increase by 15% globally between 2010 and 2020 (to 44 million deaths). The greatest increases will be in the WHO regions of Africa, South-East Asia and the Eastern Mediterranean, where they will increase by over 20%. In contrast, in the European Region, WHO estimates there will be no increase. In the African Region, NCDs will cause around 3.9 million deaths by 2020. The regions that are projected to have the greatest total number of NCD deaths in 2020 are South-East Asia (10.4 million deaths) and the Western Pacific (12.3 million deaths).

According to Global Health Observatory Data, NCDs, principally cardiovascular diseases, diabetes, cancers and chronic respiratory diseases were responsible for 63% of total global deaths in 2008 and this burden increased to 67.8% in 2012 to 70% of total global deaths in 2015.

The leading causes of NCD deaths in 2015 were CVDs (17.7 million deaths), cancers (8.8 million), & respiratory diseases, including asthma & chronic obstructive
pulmonary disease (3.9 million). Diabetes caused another 1.6 million deaths. (WHO's Global Health Observatory Data)

Over 80% of cardiovascular and diabetes deaths, and almost 90% of deaths from COPD, occurred in low- and middle-income countries. Behavioural risk factors, including tobacco use, physical inactivity, and unhealthy diet, are responsible for about 80% of coronary heart disease and cerebrovascular disease.

In terms of attributable deaths, the leading NCD risk factor globally is raised blood pressure (to which 13 % of global deaths are attributed), followed by tobacco use (9%), raised blood glucose (6%), physical inactivity (6%), and overweight & obesity (5%). WHO (2010)

Cardiovascular diseases:

CVDs are the number one cause of death globally: more people die annually from CVDs than from any other cause. An estimated 17.7 million people died from CVDs in 2015, representing 31% of all global deaths. Of these deaths, an estimated 7.4 million were due to coronary heart disease and 6.7 million were due to stroke. Over three quarters of CVD deaths take place in low- and middle-income countries. Out of the 17 million premature deaths (under the age of 70) due to non communicable diseases in 2015, 82% are in low- and middle-income countries, and 37% are caused by CVDs.

Most cardiovascular diseases can be prevented by addressing behavioural risk factors such as tobacco use, unhealthy diet and obesity, physical inactivity and harmful use of alcohol using population-wide strategies. People with cardiovascular disease or who are at high cardiovascular risk (due to the presence of one or more risk factors such as hypertension, diabetes, hyperlipidaemia or already established disease) need early detection and management using counseling and medicines, as appropriate.

Cancer:

Cancer is one of the leading causes of morbidity and mortality worldwide, with approximately 14 million new cases in 2012. The number of new cases is expected to rise by about 70% over the next 2 decades. Cancer is the second leading
cause of death globally, and was responsible for 8.8 million deaths in 2015. Globally, nearly 1 in 6 deaths is due to cancer. Approximately 70% of deaths from cancer occur in low- and middle-income countries. Around one third of deaths from cancer are due to the five leading behavioral and dietary risks: high body mass index, low fruit and vegetable intake, lack of physical activity, tobacco use, and alcohol use.

Tobacco use is the most important risk factor for cancer and is responsible for approximately 22% of cancer deaths. Cancer causing infections, such as hepatitis and human papilloma virus (HPV), are responsible for up to 25% of cancer cases in low- and middle-income countries.

Late-stage presentation and inaccessible diagnosis and treatment are common. In 2015, only 35% of low-income countries reported having pathology services generally available in the public sector. More than 90% of high-income countries reported treatment services are available compared to less than 30% of low-income countries. The economic impact of cancer is significant and is increasing. The total annual economic cost of cancer in 2010 was estimated at approximately US$ 1.16 trillion. Only 1 in 5 low- and middle-income countries have the necessary data to drive cancer policy.

**Chronic obstructive pulmonary disease (COPD):**

Chronic obstructive pulmonary disease (COPD) is a progressive life threatening lung disease that causes breathlessness (initially with exertion) and predisposes to exacerbations and serious illness. The Global Burden of Disease Study reports a prevalence of 251 million cases of COPD globally in 2016. Globally, it is estimated that 3.17 million deaths were caused by the disease in 2015 (that is, 5% of all deaths globally in that year). More than 90% of COPD deaths occur in low and middle income countries.

The primary cause of COPD is exposure to tobacco smoke (either active smoking or secondhand smoke). Other risk factors include exposure to indoor and outdoor air pollution and occupational dusts and fumes. Exposure to indoor air pollution can affect the unborn child and represent a risk factor for developing COPD later in life. Some cases of COPD are due to long-term asthma. COPD is likely to
increase in coming years due to higher smoking prevalence and aging populations in many countries.

Many cases of COPD are preventable by avoidance or early cessation of smoking. Hence, it is important that countries adopt the WHO Framework Convention on Tobacco Control (WHO-FCTC) and implement the MPOWER package of measures so that non-smoking becomes the norm globally. COPD is not curable, but treatment can relieve symptoms, improve quality of life and reduce the risk of death.

**Diabetes:**

The number of people with diabetes has risen from 108 million in 1980 to 422 million in 2014. The global prevalence of diabetes among adults over 18 years of age has risen from 4.7% in 1980 to 8.5% in 2014. Diabetes prevalence has been rising more rapidly in middle- and low-income countries. Diabetes is a major cause of blindness, kidney failure, heart attacks, stroke and lower limb amputation. In 2015, an estimated 1.6 million deaths were directly caused by diabetes. Almost half of all deaths attributable to high blood glucose occur before the age of 70 years. WHO projects that diabetes will be the seventh leading cause of death in 2030.

Healthy diet, regular physical activity, maintaining a normal body weight and avoiding tobacco use are ways to prevent or delay the onset of type 2 diabetes. Diabetes can be treated and its consequences avoided or delayed with diet, physical activity, medication and regular screening and treatment for complications.

**2.2: NATIONAL BURDEN OF NCDs**

The rapidly increasing burden of non-communicable diseases is now posing a major threat not only to the health of the populations but also to the country's economic growth and development. According to WHO, 53 percent of the total deaths in 2008 were due to NCDs in India. Cardiovascular disease (CVDs) alone accounted for 24 percent of all deaths. Chronic respiratory diseases (CRDs), cancers and diabetes accounted for 11%, 6% and 2% of all deaths respectively. *Chakma J. K. & Gupta S. (2014)*
India is experiencing a rapid health transition from communicable to non-communicable diseases. An Indian today has over twice the odds of dying of a non-communicable disease than a communicable disease, according to the **World Health Organization**. In 2010, NCDs contributed to around 53% of total deaths in India, which was increased to 5.87 million deaths that account for 60% of all deaths in India in 2014. India shares more than two-third of the total deaths due to NCDs in the South-East Asia Region (SEAR) of WHO. Cardiovascular diseases contribute to 45% of all NCD deaths followed by chronic respiratory diseases (22.0%), cancers (12%) and diabetes (3%).

South Asia is the most densely populated region. As home to one-quarter of the world's population, South Asia is a high-priority region for many public health concerns. The region is also in the midst of an epidemiological transition. Since the 1970s, South Asia has experienced significant reductions in premature death and disability from communicable and nutritional diseases such as pneumonia, diarrheal diseases and malnutrition. Still, infectious disease, maternal health and nutritional deficiencies remain prevalent and contribute to disease burdens. Meanwhile, NCDs have been emerging as leading causes of death as individuals are living longer and as globalization and urbanization are exposing individuals to concentrated risk factors. NCDs account for sizeable proportions (from one third to two thirds) of all death and disability in the region, casting increasing attention upon NCDs among public health researchers and practitioners. In considering the context of these NCD challenges and responses, it should be noted that the region consists of a wide variety of countries at varying stages of economic development, about half of each country's population lives below the poverty line (earning <US$2 per day), and access to health care is generally limited. [Siegel KR. et al. (2014)]

Moreover, the burden of infectious disease still remains high in India, with communicable, maternal, perinatal, and nutritional conditions accounting for 37% of all mortality, compared with just 7% in a most populous country like China. India is very soon to be the world's most populous country keeping behind China in the population growth. While China has made good progress with regard to successful infectious disease control but India still continues to face a double
burden of diseases. On the other hand, the 'Emerging Infectious Diseases ' in India is another challenge to the present infectious disease control programmes and strategies in the public health system and threaten to devastate health and economic development unless a strategic vision and an effective plan of action are developed to combat these.

The major NCDs in India are Cardiovascular diseases (CVDs), Cancer, Diabetes and Chronic obstructive pulmonary disease (COPD) and the great concern is that NCDs have over taken the communicable diseases and become the leading cause of death and Disability. Non-communicable diseases (NCDs) contribute to around 5.87 million deaths that account for 60 % of all deaths in India and 44% of disability adjusted life years (DALYs) lost and projections indicate a further increase to 67% of total deaths by 2030. CVD is the major contributor to this burden, attributable to 52% of NCD associated deaths and 29% of total death. Moreover, a substantial proportion of these deaths are in the productive age-group and all of them are preventable in nature. But, the rising challenge due to NCDs is that it increasingly affecting the younger populations.

As per the report “India: Health of the Nation’s States”, India had 33% of the total DALYs from communicable, maternal, neonatal, and nutritional diseases, 55% from NCDs, and 12% from injuries in 2016. In 1990, this was 61%, 30%, and 9% of DALYs, respectively. The proportion of all deaths in India due to communicable, maternal, neonatal, and nutritional diseases reduced from 53.6% in 1990 to 27.5% in 2016, those due to NCDs increased from 37.9% to 61.8%, and those due to injuries changed from 8.5% to 10.7%.

In 1990, non-communicable diseases (NCDs) accounted for 37.9% of all deaths—causing about four in ten deaths in India. In 2016, the share of non-communicable diseases had risen up to 61.8%—causing six in ten deaths in India, an increase of 23.9 percentage points from 1990.

There are wide variations between health indicators of different states. The eight under-developed states in the Empowered Action Group (EAG)–Madhya Pradesh, Uttar Pradesh, Uttarakhand, Rajasthan, Jharkhand, Chhattisgarh, Orrisa,
Bihar– and Assam and northeastern states–still had a high burden of infectious diseases. More developed states such as Kerala, Goa and Tamil Nadu had a higher burden of non-communicable diseases.

In 2016, the death rate from ischemic heart disease–the top cause of death in India–was twice as much as the next biggest cause of death–chronic obstructive pulmonary disease (COPD). The other NCDs that caused the most deaths included stroke, diabetes, and chronic kidney disease.

In 1990, diarrhoeal disease and lower respiratory infection were the top two causes of DALYs, but in 2016, the top two causes were ischemic heart disease and COPD, moving up from the sixth and eighth place, respectively.

Diabetes moved from the 35th place to the 13th. The number of DALYs caused by ischaemic heart disease rose by 104% from 19.7 million DALYs to 40.2 million DALYs between 1990 and 2016, while those caused by diabetes rose by 174% from 3.8 million DALYS to 10.4 million DALYS.

2.3 RISK FACTORS OF NON-COMMUNICABLE DISEASES

The World Health Report 2002 defined risk as “a probability of an adverse outcome, or a factor that raises this probability”.

People everywhere are exposed all their lives to an almost limitless array of risks to their health, whether in the shape of communicable or non communicable disease, injury, consumer products, violence or natural catastrophe. Sometimes whole populations are in danger such as any epidemic, at other times only an individual is involved as at the time of accident. Most risks cluster themselves around the poor.

Risks never occur in isolation, many risks have their roots in complex chains of events extending over long periods of time. Each risk has its own cause, some may be multicausal.

Most epidemiologists accept that six key sets of “risk factors” are responsible for a major share of adult non-communicable morbidity and premature mortality (Litvak J. et al 1987).
These six sets of risk factors are as follows:

1. Cigarette use and other forms of smoking

2. Alcohol abuse

3. Failure or inability to obtain preventive health services (e.g. for hypertension control, cancer detection, management of diabetes).

4. Life style changes (e.g. dietary pattern, physical activity)

5. Environmental risk factors (e.g. occupational hazards, air and water pollution, and possession of destructive weapons in case of injuries.


Basically, World Health Report 2002 identified eight major risk factors for non-communicable diseases, under two broad categories namely; behavioural and biological/metabolic risk factors.

The major (modifiable) behavioural risk factors identified in the World Health Report 2002 are:

- Tobacco use
- Harmful alcohol consumption
- Unhealthy diet (low fruit and vegetable consumption)
- Physical inactivity

The major biological risk factors identified in the World Health Report 2002 are:

- Overweight and obesity
- Raised blood pressure
- Raised blood glucose
- Abnormal blood lipids and its subset raised total cholesterol.
1. **Smoking and Oral tobacco use:**

   Tobacco use and exposure comes in both smokeless and smoking forms. Smokeless tobacco is consumed in un-burnt forms through chewing or sniffing and contains several carcinogenic, or cancer-causing, compounds. Smokeless tobacco has been associated with oral cancer, hypertension, heart disease and other conditions. Smoking tobacco, by far the most commonly used form globally, contains over 4000 chemicals, of which 50 are known to be carcinogenic.

   Tobacco is cultivated in many regions around the world and can be legally purchased in all countries. The dried leaf of the plant *nicotiana tabacum* is used for smoking, chewing or snuff. Comparable data on the prevalence of smoking are not widely available and are often inaccurate, especially when age-specific data are required. More importantly, current prevalence of smoking is a poor proxy for the cumulative hazards of smoking, which depend on several factors including the age at which smoking began, duration of smoking, number of cigarettes smoked per day, degree of inhalation, and cigarette characteristics such as tar and nicotine content or the type of filter.

   There were large increases in smoking in developing countries, especially among males, over the last part of the 20th century. This contrasts with the steady but slow decreases, mostly among men, in many industrialized countries. Smoking rates remain relatively high in most former socialist economies. While prevalence of tobacco use has declined in some high income countries, it is increasing in some low and middle income countries, especially among young people and women.

   Smoking causes substantially increased risk of mortality from lung cancer, upper aero-digestive cancer, several other cancers, heart disease, stroke, chronic respiratory disease and a range of other medical causes. As a result, in populations where smoking has been common for many decades, tobacco use accounts for a considerable proportion of mortality. While cigarette smoking causes the majority of the adverse health effects of tobacco, chewing is also hazardous, causing oral cancer in particular, as does tobacco smoking via cigars or pipes. *(World Health Report 2002)*
As revealed in the Global status report on NCDs 2010, tobacco is the fourth most common risk factor for disease and the second major cause of death worldwide. Tobacco use is an important modifiable risk factor common to major non-communicable diseases (NCDs) - cancer, cardiovascular diseases, chronic respiratory diseases and diabetes, causing 1 in 6 of all NCD deaths. Tobacco kills up to half of its users. Tobacco kills more than 7 million people each year. More than 6 million of those deaths are the result of direct tobacco use while around 890,000 are the result of non-smokers being exposed to second-hand smoke. By 2020, this number will increase to 7.5 million, accounting for 10 million deaths. Nearly 80% of the world's more than 1 billion smokers live in low- and middle-income countries.

Data from several studies indicate that tobacco smokers have 2-3 fold higher relative risk of coronary heart disease (CHD), 1.5 times for stroke, 1.4 times for chronic obstructive pulmonary disease (COPD) and 12 fold risks for lung cancer. These risks have an age-gradient with higher relative risk (5-6 times) in the younger age groups, and are similar for men and women and decreases rapidly after quitting smoking. Even exposure to second-hand smoke (SHS) increases the risk of developing and progression of atherosclerosis. Tobacco smoke has synergistic action with other risk factors. [Thakur JS., Garg R. et al. (2011)]

Smokers have markedly increased risk of multiple cancers, particularly lung cancer, and are at far greater risk of heart disease, stroke, Chronic Obstructive Pulmonary Disease (COPD), diabetes, and other fatal and non-fatal diseases. People who chew tobacco risk cancer of the lip, tongue and mouth. Intra Uterine Growth Retardation, spontaneous miscarriages and low birth weight babies are known outcomes of smoking during pregnancy.

In fact, the single most important lifestyle factor as risk for diseases is tobacco use. It is a strong and independent risk factor for CVDs among individuals lining in high incidence population where there is a significant background of coronary and peripheral atherosclerosis. Globally, tobacco accounts for 27.8% of all cardiovascular deaths, 13.6% of all lung cancer deaths, 6.6% of upper aero-digestive cancer deaths, 6.6% of other cancer deaths, 27.2% of deaths due to COPD and 12.8% of other
respiratory death. Worldwide, tobacco use causes 4.9 million deaths (8.8%), loss of 59.1 million DALYs (4.1%) and estimated economic loss of $200 billion per year.

It has also been shown that non-smokers exposed to second hand smoke have a 25% to 35% increased risk of suffering acute coronary diseases, and increased frequency of chronic respiratory conditions. Small children whose parents smoke at home have an increased risk of suffering lower tract respiratory infections, middle ear infection and Sudden Infant Death Syndrome (SIDS). [WHO (2008)]

Tobacco use is a serious public health problem in the South East Asia Region (including India) where use of both smoking and smokeless form of tobacco is widely prevalent. The region has almost one quarter of the global population and about one quarter of all smokers in the world. Smoking among men is high in the Region and women usually take to chewing tobacco.

More than 40% of the world’s smokers live in just two countries i.e. China and India. India only has around 10% of world’s smokers. Tobacco is one of the major causes of deaths and diseases in India, accounting for over eight lakh deaths every year (one fifth of the worldwide tobacco deaths). The variety of forms of tobacco use is unique to India. Apart from the smoked forms that include cigarettes, bidis and cigars, a plethora of smokeless forms of consumption exist and they account for about 35 percent of the total tobacco consumption. [Chethana KV, & Ramesh (2016)]

A 2000 report estimated that productive assets equal to 1% or more of global GDP are lost each year due to smoking. Applying this result to global GDP for 2005 suggests that over US$ 600 thousand million in productive assets may be lost annually. Many studies have shown that in the poorest households in some low-income countries as much as 10% of total household expenditure is on tobacco. In addition to its direct health effects, tobacco leads to malnutrition, increased health care costs and premature death. The World Bank estimates that in high-income countries, smoking-related healthcare accounts for between 6 and 15 percent of all annual health-care costs. [WHO (2008)]

In India, tobacco consumption is responsible for half of all the cancers in men and a quarter of all cancers in women. [WHO (1997)]
Tobacco use is also a risk factor for cardiovascular diseases and chronic obstructive pulmonary diseases (Gupta 1997, Padmavati 2002). India also has one of the highest rates of oral cancer in the world, partly attributed to high prevalence of tobacco chewing.

Forms of tobacco chewing include pan (piper betel filled with sliced areca nut, lime, catechu, and other spices chewed with or without tobacco), pan-masala or gutkha (a chewable tobacco containing areca nut), and mishri (a powdered tobacco rubbed on the gums as toothpaste). [Rani M. et al. (2003)]

In India, tobacco use in any form is to extent of 57% in men, while in women it is 10.8%. Prevalence of current smoking is 32.7% in men and 1.4% in women. 36.5% men and 8.4% women use smokeless tobacco. The tobacco use is more prevalent among both men and women with no education. 78% of men and 18% of women with no education use tobacco, compared to 38% of men and 1% of women with 12 or more years of education use tobacco. About 44% of men in the age group 35-49 years smoked cigarette/bidi compared to 33% in the age group 15-19 years. About 4 out of every 10 men living in rural areas chew tobacco compared to 3 out of 10 urban men. One in every 10 women in rural areas chews tobacco. Higher prevalence of tobacco consumption is seen among poor and vulnerable section. (NFHS-3, 2005-2006)

The World Health Organization predicts that tobacco deaths in India may exceed 1.5 million annually by 2020 (Murray and Lopez, 1996). However, considerable research is required to comprehend the actual trends.

Krishnan et al. (2008) reported prevalence of daily smoked and smokeless tobacco use in men was 41.0% and 7.1% respectively in a rural area of Haryana. The same for women was 13.0% and 1.2% respectively. Smoked tobacco use was highest in 45-54 years age group, whereas smokeless tobacco in the forms of khaini, gutkha, snuffed and chewed tobacco was most prevalent in 25-34 years age group. There was a steep rise in daily smoking of tobacco after 24 years of age from 9.4% in 15-24 years age group to 46.6% in 25-34 years age group. Thereafter there was a gradual rise to a peak of 72.2% at 45-54 years age group. The prevalence then showed a
decline in the late age group. For women both smoked and smokeless tobacco use was more common in the older age group of 55-64 years.

A study conducted in a district of Gujarat reported that only four women in the survey gave history of smoking in both urban and rural areas. However, the use of smokeless tobacco was reported by 5.5% and 19.8% of the women in urban and rural area respectively. High prevalence of smoking and the use of smokeless tobacco was observed among rural men compared to urban men in all age-groups, except in 15-24 years age-group (which was 1.6% in urban and 0.5% in rural area). Overall the prevalence of smoking and smokeless tobacco use was 6.6% and 14.2% among the study subjects. [Bhagyalaxmi A. et al. (2008)]

Thankappan et al. (2010) reported the use of tobacco in rural population of Kerala in India to the extent of 24.3% and it was 22.6% among urban population.

Global Adult Tobacco Survey, (2009-10) conducted among the adults aged 15 years or more reveals that current smoked tobacco use among male and female was 24.3% and 2.9% respectively. Overall smokeless tobacco use was 25.9%, while among male and female it was 32.9% and 18.4% respectively. (WHO 2017)

2. Alcohol use:

Alcohol has been consumed in human populations for millennia, but the considerable and varied adverse health effects, as well as some benefits, have only been characterized recently. (English DR et al, 1995)

Alcohol consumption has health and social consequences via intoxication (drunkenness), dependence (habitual, compulsive, long-term heavy drinking) and other biochemical effects. Intoxication is a powerful mediator for acute outcomes, such as car crashes or domestic violence, and can also cause chronic health and social problems. Alcohol dependence is a disorder in itself. There is increasing evidence that patterns of drinking are relevant to health as well as volume of alcohol consumed, binge drinking being hazardous. (World health report, 2002)

As reported by World Health Organization, alcohol use caused 3.2% of deaths (1.8 million) worldwide and 4% of the global disease burden in 2000. Alcohol
consumption is the leading risk factor for disease burden in low mortality developing countries and the third largest risk factor in developed countries.

Worldwide, alcohol causes more harm to males (6.0% of deaths, 7.4% of DALYs) than females (1.1% of deaths, 1.4% of DALYs) reflecting differences in drinking habits, both in quantity and pattern of drinking. Besides the direct loss of health due to alcohol addiction, alcohol is responsible for approximately 20% of deaths due to motor vehicle accidents, 30% of deaths due to oesophageal cancer, liver cancer, epilepsy and homicide, and 50% of deaths due to liver cirrhosis. Heavy alcohol use increases the risk of cardiovascular disease and stroke.

The harmful use of alcohol is a major risk factor for premature deaths and disabilities in the world. Hazardous and harmful drinking was responsible for 2.3 million deaths worldwide in 2004. That amounts to 3.8% of all deaths in the world. More than half of these deaths occurred as a result of NCDs, including cancers, cardiovascular disease and liver cirrhosis. An estimated 4.5% of the global burden of disease – as measured in DALYs – is caused by harmful use of alcohol. Cancers, cardiovascular disease and liver cirrhosis are responsible for a quarter of this burden.

There is a direct relationship between higher levels of alcohol consumption and rising risk of some cancers, liver diseases and cardiovascular diseases. The relationship between alcohol consumption and ischaemic heart and cerebrovascular diseases is complex. It depends on both the amount and the pattern of alcohol consumption.

Some epidemiological data, generated mainly in high-income countries, suggest that low-risk patterns of alcohol consumption may have a beneficial effect on selected disease outcomes and in some segments of populations, but these effects tend to disappear if the patterns of drinking are characterized by heavy episodic drinking.

Although alcohol consumption is deeply embedded in the cultures of many societies, an estimated 45% of the global adult population has never consumed alcoholic beverages in their lives. An estimated 55% of women never consumed alcohol.
Global alcohol consumption has increased in recent decades, with most or all of this increase occurring in developing countries. Both average volume of alcohol consumption and patterns of drinking vary dramatically between sub regions. Average volume of drinking is highest in Europe and North America and lowest in the Eastern Mediterranean and SEAR-D. Patterns are most detrimental in EUR-C, AMR-B, AMR-D and AFR-E. Patterns are least detrimental in Western Europe (EUR-A) and the more economically established parts of the Western Pacific region (WPR-A).

Overall, there are causal relationships between average volume of alcohol consumption and more than 60 types of disease and injury. Most of these relationships are detrimental, but there are beneficial relationships with coronary heart disease, stroke and diabetes mellitus, provided low-to-moderate average volume of consumption is combined with non-binge patterns of drinking. For example, it is estimated that ischaemic stroke would be about 17% higher in AMR-A, EUR-A and WPR-A sub regions if no-one consumed alcohol. (WHO, 2002)

Alcohol consumption has been identified as a component cause for more than 200 health conditions covered by ICD-10 disease and injury codes. Most notably, new evidence points to a causal link between alcohol and infectious diseases such as tuberculosis and pneumonia (Rehm et al., 2009b; Samokhvalov et al., 2010a). Also, it is important to note that alcohol consumption can contribute to more than one type of disease or injury in the drinker. Following are the effects what alcohol has on health of humans.

**Neuropsychiatric conditions:** Alcohol use disorders are the most important neuropsychiatric conditions caused by alcohol consumption. Epilepsy is another disease causally impacted by alcohol, over and above withdrawal-induced seizures (Samokhvalov et al., 2010b). Alcohol consumption is associated with many other neuropsychiatric conditions, such as depression or anxiety disorders (Kessler, 2004; Boden and Fergusson, 2011), but the complexity of the pathways of these associations currently prevents their inclusion in the estimates of alcohol-attributable disease burden (Rehm et al., 2010a).
Gastrointestinal diseases: Liver cirrhosis (Rehm et al., 2010b) and pancreatitis (both acute and chronic; Irving et al., 2009) are causally related to alcohol consumption. Higher levels of alcohol consumption create an exponential increase in risk.

Cancers: Alcohol consumption has been identified as carcinogenic for the following cancer categories (International Agency for Research on Cancer, 2012) cancer of the mouth, nasopharynx, other pharynx and oropharynx, laryngeal cancer, oesophageal cancer, colon and rectum cancer, liver cancer and female breast cancer. In addition, alcohol consumption is likely to cause pancreatic cancer. The higher the consumption, the greater the risk for these cancers, with consumption as low as one drink per day causing significantly increased risk for some cancers, such as female breast cancer (Seitz et al., 2012; Rehm & Shield, 2013; Nelson et al., 2013).

Intentional injuries: Alcohol consumption, especially heavy drinking, has been causally linked to suicide and violence.

Unintentional injuries: almost all categories of unintentional injuries are impacted by alcohol consumption. The effect is strongly linked to the alcohol concentration in the blood and the resulting effects on psychomotor abilities. Higher levels of alcohol consumption create an exponential increase in risk (Taylor et al., 2010).

Cardiovascular diseases (CVD): The relationship between alcohol consumption and cardiovascular diseases is complex. The beneficial cardio-protective effect of relatively low levels of drinking for ischaemic heart disease and ischaemic stroke disappears with heavy drinking occasions. Moreover, alcohol consumption has detrimental effects on hypertension, atrial fibrillation and hemorrhagic stroke, regardless of the drinking pattern (Roerecke & Rehm, 2012).

Fetal alcohol syndrome (FAS) and preterm birth complications: alcohol consumption by an expectant mother may cause these conditions that are detrimental to the health of a newborn infant.
**Diabetes mellitus:** A dual relationship exists, whereby a low-risk pattern of drinking may be beneficial while heavy drinking is detrimental.

**Infectious diseases:** Harmful use of alcohol weakens the immune system thus enabling development of pneumonia and tuberculosis. This effect is markedly more pronounced when associated with heavy drinking, and there may be a threshold effect, meaning that disease symptoms manifest mainly if a person drinks above a certain level of heavy drinking.

As per **NFHS – 3**, one-third of men drink alcohol, and as is true among women, men from schedule tribes partake alcohol in a higher proportion than do men from other castes or tribes. Half of men from schedule tribes and 42% of men from schedule castes consume alcohol. Urban and rural men are about equally likely to consume alcohol. 43% of men with no education consume alcohol; while only one-quarter of men with the highest levels of education do so. Not only does the proportion of men who consume alcohol steadily decrease with increasing education, but the proportion who drink almost every day also decreases. Among alcohol drinkers, the percentage of men who drink almost every day decreases from 14% among those with no education to 5% among men with 12 or more years of education. Alcohol consumption shows the same association with the wealth index as it does with education, with decreasing proportions of men consuming alcohol with increasing wealth status. 27% of men in the highest wealth quintile drink alcohol, while 41% of men with no education drink alcohol. The proportion of alcohol drinkers who drink almost every day also decreases with increasing levels of education, from 12% of men in the lowest wealth quintile to 6% of men in the highest wealth quintile. The majority of men who drink alcohol (64%), drink less than once a week.

By religion, the proportion of men who drink alcohol is highest among Christian men (46%). Alcohol use is less common, yet still substantial among Sikh men (42%), Buddhist/Neo-Buddhist men (38%), and Hindu men (34%). The proportion of men who drink alcohol is lowest among Muslim (11%). Only 2% of women drink alcohol. Overall, drinking alcohol is clearly not a common behavior
among women, and the majority of women who drink alcohol do so once a week or less than once a week.

3. **Overweight, obesity and central obesity:**

   Obesity is a complex condition, one with serious social and psychological dimensions, that affects virtually all age and socioeconomic groups and threatens to overwhelm both developed and developing countries. In 1995, there were an estimated 200 million obese adults worldwide and another 18 million under-five children classified as overweight. As of 2000, the number of obese adults has increased to over 300 million. Contrary to conventional wisdom, the obesity epidemic is not restricted to industrialized societies; in developing countries, it is estimated that over 115 million people suffer from obesity-related problems.

   Obesity is an epidemic of the 21st century, and is a major causative factor for many other metabolic disorders. According to a global estimate by the World Health Organization (WHO), in 2005 there were about 1.6 billion overweight persons aged 15 years and above and among them at least 400 million adults were obese. The revision of definition of obesity to adjust for the racial differences, by the WHO, has resulted in a higher prevalence of 1.7 billion people classified as overweight. The WHO further projects that by 2015, approximately 2-3 billion adults will be overweight and more than 700 million will be obese. [Ramachandran A. & Snehalatha C. (2010)]

   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 (kg/m²). WHO criteria define overweight as a BMI of at least 25 kg/m² and obesity as a BMI of at least 30kg/m². In Asians, the cut-offs for overweight (>23kg/m²) and obesity (>25kg/m²) are lower than the WHO global criteria. These markers provide common benchmarks for assessment, but the risks of disease in all populations increase progressively from BMI levels of 20–22 kg/m².

   Overweight and obesity lead to adverse metabolic effects on blood pressure, cholesterol, triglycerides and insulin resistance. Risks of coronary heart disease,
ischaemic, stroke and type 2 diabetes mellitus increase steadily with increasing body mass index (BMI). Raised BMI also increases the risk of cancer of the breast, colon/rectum, endometrium, kidney, oesophagus (adenocarcinoma) and pancreas. Mortality rates increase with increasing degrees of overweight, as measured by BMI. To achieve optimal health, the median BMI for adult populations should be in the range of 21 to 23 kg/m\(^2\), while the goal for individuals should be to maintain a BMI in the range 18.5 to 24.9 kg/m\(^2\). There is increased risk of co-morbidities for BMIs in the range of 25.0 to 29.9 kg/m\(^2\), and moderate to severe risk of co-morbidities for a BMI greater than 30 kg/m\(^2\). \textbf{WHO, 2002}

In 2008, 35% of adults aged 20 years and older were overweight (BMI $\geq$ 25 kg/m\(^2\)) (34% men and 35% of women). The worldwide prevalence of obesity has nearly doubled between 1980 and 2008. In 2008, 10% of men and 14% of women in the world were obese (BMI $\geq$30 kg/m\(^2\)), compared with 5% for men and 8% for women in 1980. An estimated 205 million men and 297 million women over the age of 20 were obese in 2008 – a total of more than half a billion adults worldwide.

The prevalence of overweight and obesity were highest in the WHO Region of Americas (62% for overweight in both sexes, and 26% for obesity) and lowest in the WHO Region for South-East Asia (14% overweight in both sexes and 3% for obesity). In the WHO European Region, the Eastern Mediterranean and the Region for the Americas, over 50% of women were overweight. For all three regions, roughly half of overweight women are obese (23% of women in Europe, 24% in the Eastern Mediterranean, 29% in the Americas). In all WHO regions, women were more likely to be obese than men. In the African, South-East Asian and Eastern Mediterranean Regions, women had roughly double the obesity prevalence of men.

The prevalence of raised BMI increases with income level of countries, up to upper-middle-income levels. The prevalence of overweight in high-income and upper-middle-income countries was more than double that of low- and lower-middle-income countries. For obesity, the difference more than triples from 7% obesity in both sexes in lower-middle-income countries to 24% in upper-middle income countries. Women's obesity was significantly higher than men’s, with the exception of high
income countries where it was of similar prevalence. In low- and lower-middle-income countries, obesity among women was approximately double that among men.

The prevalence of obesity in India is increasing continuously and recent data shows that between 13% to 50% of the urban population and 8% to 38.2% of the rural population suffers from obesity. Obesity is more commonly seen in women compared to men and is increasing in children and adolescents. The state of Punjab (North India) has the highest prevalence of 30% in women and 22% in men. The main contributors to this rise are adoption of sedentary lifestyle and consumption of energy dense foods. [Behl S. & Misra A. (2017)]

The percentage of ever-married urban women aged 15-49 years who were overweight or obese (BMI >25.0 kg/m²) has been increased from 24.6 in NFHS – 3 (2005-06) to 27.1% in NFHS – 4 (2015-16). The overall prevalence of overweight or obesity reported by NFHS – 4 was 12.5% and 16.5% among men and women respectively, which was 7.3% and 9.2% in the NFHS – 3.

According to NFHS – 3, overweight and obesity are more than three times higher in urban than in rural areas. Women have higher rates of both overweight and obesity than men. The prevalence of overweight and obesity is three times higher among women with 12 or more years of schooling than those with no education.

A study conducted in Gujarat titled “Prevalence of Risk Factors of Non-communicable Diseases in a District of Gujarat, India” has shown the prevalence of overweight (BMI >25.0 kg/m²) among urban men was 30.8% and while among women it was 29.7 %, respectively.

Sidhu S. and Kumari K. (2006) studied the urban and rural males of Amritsar to estimate the prevalence of overweight and obesity. According to global BMI classification (WHO 1998), out of 500 urban males 19.8%, 8.2%, 3.8% and 0.8% were in the overweight, obese grade I, obese grade II and obese grade III categories. The overall combined prevalence of overweight and obesity in urban and rural males is 32.6% and 16.8%, respectively. Urban males show higher prevalence rate of overweight and obesity than rural males. On using the lower cut-off values of BMI recommended by WHO (2000) for Asians, percentage prevalence of overweight
and obesity becomes 55.8% in urban males and 36.4% in rural males. It is evident from this study that the overall prevalence of overweight and obesity among Punjabi adult men, according to WHO (1998) classification, is 24.7%, but according to WHO (2000) classification it becomes 46.1%.

**Srivastava S and Chakravartey A. (2010)** carried out a study on 350 women aged 15-49 years titled “correlation between anthropometric measurements and nutrient intake of different weight status of women” and found that Fourteen percent of the women were classified as overweight. 30.29% and 5.71% of the women were identified as obese I and obese II categories, respectively. This showed that half of the women of this study were either overweight or obese.

It is not just the amount of fat but also its distribution that determines the risk associated with obesity. Abdominal or visceral fat is associated with the cardiovascular risk factors of the Metabolic Syndrome. These include type 2 diabetes, impaired glucose tolerance, hypertension and dyslipidaemia (high triglyceride, low LDL cholesterol). It is the mass of visceral adipose tissue which leads to these abnormalities.

Although BMI is commonly employed as the measure of general or overall adiposity, growing evidence suggests that a central (abdominal) fat distribution pattern, as reflected by a higher waist circumference (WC) or waist-to-hip ratio (WHR), may be a better measure of risk than elevated body weight particularly among older adults. For example, individuals with a higher proportion of abdominal fat have a greater risk of developing CHD, T2DM, and cardiovascular disease (CVD) than those with less abdominal fat.

Using WC data from the National Health and Nutrition Examination Survey (NHANES), Li and colleagues observed that the prevalence of abdominal obesity has increased continuously over the past 15 years. Abdominal obesity, as reflected by WHR, presumably contributes to the risk of CVD through its mediated effects on other cardiovascular risk factors, such as hypertension, dyslipidemia, insulin resistance or glucose intolerance, and adipocyte regulation of coagulation and inflammatory pathways. [Must A. & McKeown M. (2012)]
Some researchers have suggested that WC or WHR are better predictors of obesity-related health risk than BMI. [Wang YF. et al. (2005), Janssen I. et al. (2004), See R. et al. (2007)] However, both general adiposity, captured by BMI, and abdominal adiposity, captured by WC or WHR, are independent risk factors for certain diseases; each measure may thus contribute distinct information about health risks associated with overweight and obesity. Nevertheless, both general and abdominal obesity arise as a consequence of weight gain, and, conversely, both respond to weight loss. [Lamon-Fava S. et al. (1996), Borkan GA. et al. (1986)]

It has also been noted that for a given BMI, Asians have higher body fat percentage compared with Caucasians. Higher insulin resistance and an increased risk of diabetes may be partially attributed to this feature. The differences in anthropometric characteristics are evident even in Asian children who are shown to have higher body fat percentage at lower levels of body weight and also a tendency for abdominal obesity.

Pradeepa R. et al (2015) reveals in the study “Prevalence of generalized & abdominal obesity in urban & rural India- the ICMR-INDIAB study (Phase-i) [icmr-indiab-3]” that the prevalence of general obesity (GO) was 24.6, 16.6, 11.8 and 31.3 per cent among residents of Tamil Nadu (TN), Maharashtra (MH), Jharkhand (JH) and Chandigarh (CH), while the prevalence of Abdominal Obesity (AO) was 26.6, 18.7, 16.9 and 36.1 per cent, respectively. The prevalence of GO, AO and CO (combined obesity) was significantly higher among urban residents compared to rural residents in all the four regions studied. The prevalence of overweight was 15.2, 11.3, 7.8 and 15.9 per cent among residents of TN, MH, JH and CH, respectively.

Asian Indians have a greater predisposition to abdominal obesity and accumulation of visceral fat and this has been termed as “Asian Indian phenotype”. In a study conducted in urban north India (New Delhi), the overall prevalence of generalized obesity was 50.1 per cent, while that of abdominal obesity was 68.9 per cent. The Chennai Urban Rural Epidemiology Study (CURES) conducted in Chennai city in Tamil Nadu reported age standardized prevalence of generalized obesity to be 45.9 per cent, while that of abdominal obesity was 46.6 per cent.
Thankappan KR. et al. (2010) conducted a study in Kerala to estimate the risk factors of non-communicable diseases with the thought that Kerala State is a harbinger of what will happen in future to the rest of India in chronic non-communicable diseases (NCD). They reported the prevalence of overweight (25%) and abdominal obesity (34%) was high using thresholds applied in developed countries that are very conservative for South-Asian populations who are likely to have lower cut-points for these conditions. Overall, the prevalence of excess adiposity was lower than in the United States, where over 60 per cent of adults were reported to be overweight and between 40 per cent (men) to 60 per cent (women) with abdominal obesity.

A study conducted by Bhagyalaxmi A. et al (2013) attempted to identify the prevalence and distribution of risk factors of non-communicable diseases among urban and rural population in Gujarat, India reveals that 21.9% men and 54.1% women of urban areas had abdominal obesity. Compared to rural men and women, high prevalence of overweight and obesity was observed among urban men and women in all age-groups. There was no significant (p>0.05) gender difference in the mean BMI in both the areas. Women in both the areas had significantly higher prevalence of central obesity compared to men.

Similarly, a study done by Prabakaran J. et al. (2013), in urban locality of Andhra Pradesh revealed that the prevalence of abdominal obesity was 46.62% using South Asian guidelines and 48.12% obese as per BMI (≥30 kg/m²). According to a report of Government of India, almost 30-65% of adult urban Indians were reported to be either overweight (BMI ≥25) or obese (BMI ≥30) or have central obesity.

In 2016, more than 1.9 billion adults aged 18 years and older were overweight. Of these over 650 million adults were obese. In 2016, 39% of adults aged 18 years and over (39% of men and 40% of women) were overweight. Overall, about 13% of the world’s adult population (11% of men and 15% of women) was obese in 2016. The worldwide prevalence of obesity nearly tripled between 1975 and 2016. (WHO)
4. Physical Inactivity:

Ancient physicians—including those from China in 2600 BC and Hippocrates around 400 BC—believed in the value of physical activity for health. By the twentieth century, however, a diametrically opposite view—that exercise was dangerous—prevailed instead. During the early twentieth century, complete bed rest was prescribed for patients with acute myocardial infarction. And, at the time of the 100th boat race between Oxford and Cambridge in 1954, the Senior Health Officer of Cambridge University conducted a study to investigate the “alleged dangers” of exercise by comparing university sportsmen with “intellectuals”. [Lee IM. et al. (2012)]

One of the pioneers whose work helped change that tide of popular opinion was Professor Jerry Morris who conducted the first rigorous, epidemiologic studies investigating physical inactivity and chronic disease risk, published in 1953 [Blair SN. et al. (2011)]. Since then, a large body of evidence has clearly documented the many health benefits of physical activity.

WHO defines physical activity as any bodily movement produced by skeletal muscles that require energy expenditure – including activities undertaken while working, playing, carrying out household chores, travelling, and engaging in recreational pursuits.

The term "physical activity" should not be confused with "exercise", which is a subcategory of physical activity that is planned, structured, repetitive, and aims to improve or maintain one or more components of physical fitness. Beyond exercise, any other physical activity that is done during leisure time, for transport to get to and from places, or as part of a person’s work, has a health benefit. Further, both moderate- and vigorous-intensity physical activity improve health.

Opportunities for people to be physically active exist in the four major domains of their day-to-day lives: at work (especially if the job involves manual labour); for transport (for example, walking or cycling to work); in domestic duties (for example, housework or gathering fuel); or in leisure time (for example, participating in sports or recreational activities). WHO, 2002
According to World Health Organization “Insufficient physical activity is defined as less than five times 30 minutes of moderate activity per week, or less than three times 20 minutes of vigorous activity per week, or equivalent”.

Insufficient physical activity is one of the 10 leading risk factors for global mortality. People who are insufficiently physically active have a 20% to 30% increased risk of all-cause mortality compared to those who engage in at least 150 minutes of moderate intensity physical activity per week, or equivalent, as recommended by WHO.

Regular physical activity reduces the risk of ischaemic heart disease, diabetes, breast and colon cancer. Additionally, it lowers the risk of stroke, hypertension, and depression. Furthermore, physical activity is a key determinant of energy expenditure and thus fundamental to energy balance and weight control. Physical inactivity is estimated to cause around 21–25% of breast and colon cancer burden, 27% of diabetes and about 30% of ischaemic heart disease burden.

Physical activity reduces the risk of cardiovascular disease, some cancers and type 2 diabetes. These benefits are mediated through a number of mechanisms. In general, physical activity improves glucose metabolism, reduces body fat and lowers blood pressure; these are the main ways in which it is thought to reduce the risk of cardiovascular diseases and diabetes. Physical activity may reduce the risk of colon cancer by effects on prostaglandins, reduced intestinal transit time, and higher antioxidant levels. Physical activity is also associated with lower risk of breast cancer, which may be the result of effects on hormonal metabolism. Participation in physical activity can improve musculoskeletal health, control body weight, and reduce symptoms of depression. The possible effects on musculoskeletal conditions such as osteoarthritis and low back pain, osteoporosis and falls, obesity, depression, anxiety and stress, as well as on prostate and other cancers are, however, not quantified here.

In the second half of the 20th century, the proportion of people in Africa, Asia and Latin America living in urban areas rose from 16% to 50%. Urbanization creates conditions in which people are exposed to new products, technologies, and marketing of unhealthy goods, and in which they adopt less physically active types of
employment. Unplanned urban sprawl can further reduce physical activity levels by discouraging walking or bicycling.

In terms of attributable deaths, physical inactivity is the fourth leading risk factor associated with NCD, globally. The first is raised blood pressure (to which 13% of global deaths are attributed), followed by tobacco use (9%), raised blood glucose (6%), physical inactivity (6%), and overweight and obesity (5%).

The leading behavioural and metabolic risk factor associated with NCD’s in India is raised blood pressure (to which 32.5% of deaths are attributed), followed by raised cholesterol (27.1%), physical inactivity (14%), tobacco smoking (13.9%), overweight and obesity (12.9%) and raised blood glucose (10%).

Globally, 31% of adults aged 15 years or older were insufficiently active (men 28% and women 34%) in 2008. Prevalence of insufficient physical activity was highest in the WHO Region of the Americas and the Eastern Mediterranean Region. In both of these regions, almost 50% of women were insufficiently active, while the prevalence for men was 40% in the Americas and 36% in Eastern Mediterranean. The South-East Asia Region showed the lowest percentages (15% for men and 19% for women).

Globally in 2010, 23% of adults aged 18+ years were insufficiently active (men 20% and women 27%). Overall, older adults were less active than younger adults: 19% of the youngest age group did not meet the recommended level of physical activity, compared to 55% of the oldest age group. However, young women were slightly less active than middle-aged women.

The prevalence of insufficient physical activity rose according to the level of income. High income countries had more than double the prevalence compared to low income countries for both men and women, with 41% of men and 48% of women being insufficiently physically active in high income countries as compared to 18% of men and 21% of women in low income countries. Nearly every second woman in high income countries was insufficiently physically active. These data may be explained by increased work and transport-related physical activity for both men and women in the low and lower middle income countries. The increased automation of
work and life in higher income countries creates opportunities for insufficient physical activity.

According to **WHO Global Health Observatory Data (2010)** in India, the prevalence of insufficient physical activity among 18+ years adults was 13.4% [12.2-14.8] among females, 10.8% [9-12.9] among males and overall it was 16.1% [14.3-17.9].

Overall physical inactivity was estimated to cause 1.9 million deaths and 19 million DALYs globally. Physical inactivity is estimated to cause, globally, about 10–16% of cases each of breast cancer, colon and rectal cancers and diabetes mellitus, and about 22% of ischaemic heart disease. Estimated attributable fractions are similar in men and women and are highest in AMR-B, EUR-C and WPR-B. In EUR-C, the proportion of deaths attributable to physical inactivity is 8–10%, and in AMR-A, EUR-A and EUR-B it is about 5–8%.

A study conducted by **Oanh TH Trinh (2008)**, “the prevalence and correlates of physical inactivity among adults in Ho Chi Minh City” in 2005 among 1906 adults aged 25–64 years reported that a high proportion of adults were physically inactive, with only 56.2% (95% CI = 52.1–60.4) aged 25–64 years in HCMC achieving the minimum recommendation of 'doing 30 minutes moderate-intensity physical activity for at least 5 days per week'. The main contributors to total physical activity among adults were from working and active commuting. Leisure-time physical activity represented a very small proportion (9.4%) of individuals' total activity level. Some differences in the pattern of physical activity between men and women were noted, with insufficient activity levels decreasing with age among women, but not among men. Physical inactivity was positively associated with high income (OR = 1.77, 95% CI = 1.05–2.97) and high household wealth index (OR = 1.86, 95% CI = 1.29–2.66) amongst men.

People who are insufficiently physically active have a 20% to 30% increased risk of all-cause mortality compared to those who engage in at least 30 minutes of moderate intensity physical activity most days of the week. In adults, participation in 150 minutes of moderate physical activity each week (or equivalent) is estimated to
reduce the risk of ischaemic heart disease by approximately 30% and the risk of diabetes by 27%. Many studies that have examined the association between physical activity and CVDs have reported reduced risk of death from coronary heart disease and reduced risk of overall CVDs, coronary heart disease and stroke, in a dose–response fashion.

According to Non-communicable Country Profile of India, physical inactivity prevalence in males was 10.8% and in females was 17.3% (14% both). A more recent study done using cluster sampling in 6198 subjects (3426 men and 2772 women) from eleven cities across India showed that 38.8% of men and 46.1% of women were physically inactive. In 2008, 31.3% of adults aged 15 or older (28.2% men and 34.4% women) were insufficiently physically active.

The direct health expenditures attributable to physical inactivity have been estimated at approximately 2.5% of health expenditure in Canada and the United States. A Canadian study estimated that a 10% reduction in the prevalence of physical inactivity could reduce direct health-care expenditures by C$ 150 million (approximately US$ 124 million) in a year. It is clear that chronic diseases and their risk factors impose significant costs on the health systems of countries where people have good access to care.

It has been estimated that inadequate physical activity is responsible for about one-third of deaths due to coronary heart disease and type 2 diabetes. There is evidence from observational studies that leisure-time physical activity is associated with reduced cardiovascular risk and cardiovascular mortality in both men and women and in middle-aged and older individuals.

Several meta-analyses have examined the association between physical activity and cardiovascular disease. Berlin & Colditz found a summary relative risk of death from coronary heart disease of 1.9 (95% CI 1.6 to 2.2) for people with sedentary occupations compared with those with active occupations. A meta-analysis of studies in women showed that physical activity was associated with a reduced risk of overall cardiovascular disease, coronary heart disease and stroke, in a dose–response fashion.
Physical activity improves endothelial function, which enhances vasodilatation and vasomotor function in the blood vessels. In addition, physical activity contributes to weight loss, glycaemic control, improved blood pressure, lipid profile and insulin sensitivity. The possible beneficial effects of physical activity on cardiovascular risk may be mediated, at least in part, through these effects on intermediate risk factors. Physical inactivity and low physical fitness are independent predictors of mortality in people with type 2 diabetes. Overall, the evidence points to the benefit of continued regular moderate physical activity, which does not need to be strenuous or prolonged, and can include daily leisure activities, such as walking or gardening. Taking up regular light or moderate physical activity in middle or older age significantly reduces CVD and all-cause mortality, and improves the quality of life.

In SEAR (South East Asia region of WHO), 5.1% of deaths are the attributable to physical inactivity. This translates to nearly 800 000 deaths in the Region per year. In SEAR countries, the prevalence of insufficient physical activity varied from 3% to 41% among males and from 6.6% to 64% among females. The highest prevalence in both males and females was in Bhutan (41% and 64%, respectively), followed by Maldives (37% and 42%, respectively). In eight of nine SEAR countries for which data are available, prevalence of insufficient physical activity was higher among females than males. Indonesia was the only exception, where male surpasses females in terms of physical inactivity.

In a study by Ramachandran et al. on temporal changes associated with pattern of life style (1989-2003) there had been a decline in levels of physical activity. The regular use of motorized vehicles increased from 86.6% to 93.4% whereas the percentage of people watching television regularly increased to 70.1% from the baseline value of 57.2% in 1989. Moreover, fewer subjects were engaged in manual work (22.8% in 2003 vs. 80% in 1989).

A study conducted by Bhagyalaxmi A. et al. (2013), reported that majority of the rural people are engaged in agricultural and labour work, only 10-15% of them reported to have insufficient physical activity. Low physical activity observed among urban men (55.7%) and women (22.3%) was much higher as compared to rural counterparts.
Phase I of the ICMR-INDIAB study has been conducted in 4 regions namely, Tamil Nadu, Jharkhand, Chandigarh and Maharashtra. Pattern of physical activity in urban and rural areas of four above said regions was observed. Overall, in all the four regions studied inactivity was significantly more in urban areas compared to rural areas (65.0% vs. 50.0%; p<0.001). Similarly there was a significant difference between physically inactive males and females. Highly active subjects were significantly more prevalent in rural areas compared to urban areas. In Chandigarh, there was a significant difference between inactive males and females and between urban and rural residents (73.2% vs. 63.4%, p<0.001). Highly active subjects were significantly higher in rural compared to urban areas (10.8% vs. 6.5%; p<0.001). In Jharkhand, inactivity was significantly higher in urban compared to rural areas (47.8% vs. 28.9%, p<0.001), while active and highly active subjects were significantly higher in the rural areas compared to urban areas. Female subjects were more inactive compared to males in the rural areas (44.2% vs. 13.3%; p<0.001). In both urban and rural areas, males were significantly highly active than females. In Maharashtra also, inactivity was significantly higher in urban areas compared to rural areas (65.4% vs. 50.4%, p<0.001), while subjects were highly active in rural areas (17.8% vs. 10.3%, p<0.001). A significantly greater proportion of male subjects were highly active in both urban and rural areas. In Tamil Nadu as well, significantly more urban residents were inactive compared to rural residents (71.0% vs. 55.4%, p<0.001), while subjects were highly active in rural compared to urban areas (13.3% vs. 8.3%,p<0.001). In rural and urban areas, females were physically inactive than males (Rural: 62.3% vs. 48.2%, p<0.001; urban: 77.4 vs. 64.1%, p<0.001). In both the rural and urban areas, males were highly active than females.

St Kitts Steps report (2008) revealed that gender and age were notable determinants of levels of physical activity. Men were more likely to report high physical activity (51.0%) than women (21.1%). Levels of total physical activity also seemed to decline with age with older persons reporting lower levels of physical activity in each of the three activity strata. Most of the physical activity was related to work and to a lesser extent to travelling from place to place. The lowest amount of physical activity was reported in the recreation domain and probably reflects the priority accorded to leisure as well as the opportunity to participate in organized
community physical activity programmes. While a median of 107.1 minutes of total physical activity per day was reported for men, only 30 minutes was recorded for women. It is recommended that adults should accumulate 30 minutes or more of moderate physical activity over the course of most, preferably all days of the week. Of note is that a segment of the participants, especially women and older persons, were not achieving levels of physical activity that are beneficial to their health.

5. **Unhealthy diet (Low fruit and vegetable intake):**

Vegetables and fruit are extremely important in human nutrition as sources of nutrients and non-nutritive food constituents as well as for the reduction in disease risks. Vegetables and fruits are important sources of nutrients, dietary fibre, and phytochemicals.

Fruit and vegetables are important components of a healthy diet. Accumulating evidence suggests that they could help prevent major diseases such as cardiovascular diseases and certain cancers principally of the digestive system. There are several mechanisms by which these protective effects may be mediated, involving antioxidants and other micronutrients, such as flavonoids, carotenoids, vitamin C and folic acid, as well as dietary fibre. These and other substances block or suppress the action of carcinogens and, as antioxidants, prevent oxidative DNA damage.

Diet with low fruits and vegetables is ranked fifth globally among risk factors attributable to global burden of diseases, it is ranked third among attributable risk factors in east and south east Asia indicating its importance in Asian countries. Over the past few decades there has been a massive shift in dietary patterns mainly in developing countries. Economic, technological and social changes happening in these countries are the factors influencing transition of these dietary habits and these changes are more striking in the developing countries. Globally Almost 1.7 Million (2.8%) deaths and 16.0 million 1.0% disability adjusted life years are attributable to low fruit and vegetable consumption per year. Adequate consumption of fruit and vegetables can reduce the risk for cardiovascular diseases, stomach cancer and colorectal cancer.
Fruit and vegetable intake varies considerably among countries, in large part reflecting the prevailing economic, cultural and agricultural environments. The analysis assessed the levels of mean dietary intake of fruit and vegetables (excluding potatoes) in each region, measured in grams per person per day. The estimated levels varied two-fold around the world, ranging from about 189 g/day in AMR-B to 455 g/day in EUR-A.

Low intake of fruit and vegetables is estimated to cause about 19% of gastrointestinal cancer, and about 31% of ischaemic heart disease and 11% of stroke worldwide. Overall, 2.7 million (4.9%) deaths and 26.7 million (1.8%) DALYs are attributable to low fruit and vegetable intake. Of the burden attributable to low fruit and vegetable intake, about 85% was from cardiovascular diseases and 15% from cancers. About 43% of the disease burden occurred in women and 15% in EUR-C, 29% in SEAR-D and 18% in WPR-B. The estimated levels of current fruit and vegetable intake vary considerably around the world ranging from less than 100g/day in less developed countries, to about 450 g/day in Western Europe. **WHO, 2002**

A recent WHO/FAO expert consultation report on diet, nutrition and prevention of chronic diseases, sets population nutrient goals and recommends intake of a minimum of 400 g of fruits and vegetables per day for the prevention of chronic diseases such as heart diseases, cancer, diabetes and obesity. The report states that there is convincing evidence that fruits and vegetables decrease the risk for obesity, and evidence that they probably decrease the risk of diabetes. Further, there is convincing evidence that fruit and vegetables lower the risk for CVD. (The report specifies that the tubers, e.g. potatoes, cassava, should not be included in fruits and vegetables.)

A high-level international review on fruit and vegetable consumption and cancer risk, coordinated by the **International Agency for Research on Cancer (IARC)**, concluded that eating fruits and vegetables may lower the risk of cancer, particularly cancers of the gastrointestinal tract. IARC estimates that the preventable fraction of cancer due to low fruit and vegetable intake falls into the range of 5-12% and up to 20-30% for upper gastro-intestinal tract cancers world-wide.
Due to globalization and urbanization, there is a shift from a healthy traditional high fibre, low-fat, low-calorie diet containing whole grains as well as fruits and vegetables, towards calorie-dense foods that are high in saturated fats, trans fats, free sugars or salt. Foods that are high in fats and sugars promote obesity, a major risk factor for CVDs, diabetes and cancers. Consumption of adequate servings of food and vegetables on the other hand reduce the risk of heart disease and some cancers. With regards to unhealthy diet, three areas of particular concern in the Region are low intake of fruits and vegetables, high consumption of salt and widespread use of trans fat by the food industry.

Half a million deaths in the Region are attributed to low intake of fruits and vegetables. In SEAR Member countries, the prevalence of eating inadequate (less than five servings) fruits and vegetables ranges from 60% to 97% in males and 64% to 94% in females. In five of eight Member countries for which data are available, the prevalence of inadequate fruits and vegetable consumption was higher among females than males. Considering the low socioeconomic conditions and poor level of awareness in a large segment of the population in this Region, the findings that the vast majority of the population eats less than five servings of fruits and vegetables a day is not surprising. A major hindrance in shifting to a healthy diet in this Region could be the high cost of fruits and vegetables relative to the income level of the population. There is evidence of high consumption of salt in many countries. High salt consumption is associated with hypertension and adverse cardiovascular events. According to the National Heart Foundation Hospital and Research Institute, Bangladesh, an average Bangladeshi consumes around 16 g of salt per day — almost triple the recommended limit. In Thailand, the average consumption of salt per day among adults is 10.8 g. The Chennai Urban Rural Epidemiology Study (CURES) conducted on 1902 subjects showed that the mean dietary salt intake (8.5 g/d) in the population was higher than that recommended by WHO for adults (5 g or less). Subjects in the highest quintile (mean salt intake=13.8 g/d) of salt intake had a significantly higher prevalence of hypertension than those in the lowest quintile (mean salt intake = 4.9 g/d) of salt intake (48% vs 17%, p<0.0001). Subjects in the highest quintile of salt intake also had significantly higher body mass index (BMI)
and waist circumference (WC). The total calories and percentage of calories from fat also increased significantly across increasing quintiles of salt intake.

Another area of concern is that partially hydrogenated vegetable oils, which are associated with coronary heart disease are commonly used in the preparation of commercially fried, processed, bakery, ready to- eat and street foods in the Region. In India, vanaspati brands, widely available in the market used in the food industry, have 5–12 times higher trans fatty acid (TFA) levels than the 2% limit set by some developed countries. In Thailand, samples collected from supermarkets and popular bakery stores showed that shortenings (2.4 g), butter cookies (2.1 g) and margarine (1.7 g) contained highest quantities of TFA per 100 g of food. Available regional data confirm current evidence that higher intake of TFA may be associated with increased risk of coronary heart disease. A case-control study (n=3575) carried out by Singh RB. et al. (1996) in India showed that ghee (clarified butter) plus TFA in both rural and urban areas were significantly associated with coronary artery disease.

The Lyon Diet Heart Study demonstrated that a ‘Mediterranean diet’ (which is high in F AND V) substantially reduced the risk of incidence and mortality from myocardial infarction (MI) when compared with low fat diet alone. The results of Indian Experiment of Infarct Survival (IEIS) showed that consumption of low-fat diet enriched with F AND V, compared with a standard low-fat diet, was associated with about 40% reduction in cardiac events and 45% reduction in mortality after one-year. A study carried out in south India too observed higher F AND V intake explained 48% of protective effect against CVD risk factors in the studied population. While results from the Dietary Approaches to Stop Hypertension (DASH) trial suggested that changes in dietary fats do not necessarily accompany automatic increase in F AND V intake. [Sachdeva S. et al. (2013)]

According to latest National Sample Survey Office (NSSO) survey revealed that out of 1000 household in India, vegetable consumption was reported by 983 (rural) and 932 (urban) whereas fruits by 608 (rural) and 777 (urban) residents. Other recent studies on avg. consumption of F AND V amongst urban residents of Chennai and Jaipur reported as 265 gm/day and less than 3 servings by 72.6% respondents respectively.
Non-communicable disease (NCD) risk factor survey carried out in seven states using WHO ‘STEP’ approach under integrated disease surveillance project (IDSP) showed that people consumed vegetables four to seven days and fruits two to three days in a ‘week’. Fruit consumption was higher in urban areas but no difference was noticed in vegetable consumption across rural-urban divide. The proportion of respondents eating less than five servings of F AND V ranged from 76% (Maharashtra) to 99% in Tamil Nadu. Similar low consumption has been highlighted in NFHS-3 survey that rises significantly with wealth status. ‘Weekly’ consumption of fruit increases from 16% in the lowest to 72% in the highest wealth quintile. At one end of spectrum, micronutrient deficiency state is wide-spread e.g. more than 70% children, 55% adult women and 24% men having some form of anemia. While at other end, this survey on the basis of body mass index (BMI) also highlighted that 13% of women and 9% of men are overweight/obese in country with at least 20% of women being overweight/obese in Punjab, Delhi, Goa, Kerala and Tamil Nadu.

The Government of India conducted a survey to study non-communicable disease risk factors in Kerala to create baseline data. It was found that people in Kerala consumed fruits, on an average 3 days a week, whereas vegetables were consumed on 5 days. Only 13% of the population consumed five or more servings of fruits and vegetables per day. Overall, prevalence of low intake of fruits and vegetables was 87% in both the areas (urban and rural). In both the areas, females (urban: 92.5 vs. 82.1 and rural: 91.7 vs. 82.4) were consuming more fruits and vegetables as compared to male counterparts.

Integrated Disease Surveillance Project was also carried out in Madhya Pradesh (2009) to study the risk factors associated to non communicable diseases. It was reported that in a week, people consumed vegetables 5 days and fruits on an average 2 days. The mean number of days when fruits were consumed was higher for urban population (2 days) as compared to that for rural population (1 day). Only 17% of population consumed five or more servings of fruits and vegetables per day. The prevalence of less than five servings of fruits and vegetables consumed per day was 70.5% in urban areas and 88.0% in rural areas. Women as compared to men were consuming more fruits and vegetables in both urban (71.8 vs. 69.3) and rural (89.3 vs. 82.4).
Inadequate consumption of fruits and vegetables was also high in all the education level (77% among illiterate to 62% among college and above). Prevalence of low consumption was high (84%) among manual worker whereas it was varying from 60% to 68% in rest of the occupation categories. A similar pattern of inadequate consumption of fruits and vegetables was observed among rural population. Prevalence of inadequate consumption was high among all the age groups (88% in 15-24 to 92% in 55-64). Prevalence by education was varying between 79% in higher secondary to 92% in secondary with marginal differences. The low (inadequate) consumption of fruits and vegetables was high among the occupational categories of manual work (96%). It was comparatively low (79%) among agriculture category. Overall, prevalence and pattern of consumption of fruits and vegetables by age, education and occupation was high with similar pattern as recoded in rural and urban population of Madhya Pradesh.

Thakur JS. et al. (2016) conducted a study “Profile of Risk Factors for Non-Communicable Diseases in Punjab, Northern India: Results of a State-Wide STEPS Survey” on 5,127 study subjects aged 18-69 years and reported that low levels of fruits and vegetables intake was found to be high among both age groups (18-44 years and 45-69 years), both sexes as well as residence (urban and rural). Overall 95.8% (95% CI: 94.6–97.0) of participants took less than 5 servings of fruits and/or vegetables on average per day. In a typical week, fruits and vegetables were consumed on 2.5 and 5 days respectively. 12.8% of the population (95% CI: 10.5–15.2) always/often added salt before/when eating the food.

6. Hypertension or High Blood Pressure:

Blood pressure is a measure of the force that the circulating blood exerts on the walls of the main arteries. The pressure wave transmitted along the arteries with each heartbeat is easily felt as the pulse – the highest (systolic) pressure is created by the heart contracting and the lowest (diastolic) pressure is measured as the heart fills. Raised blood pressure is almost always without symptoms. However, elevated blood pressure levels produce a variety of structural changes in the arteries that supply blood to the brain, heart, kidneys and elsewhere. In recent decades it has become increasingly clear that the risks of stroke, ischaemic heart disease, renal failure and
other disease are not confined to a subset of the population with particularly high levels (hypertension), but rather continue among those with average and even below-average blood pressure. **World Health Report, 2004**

Blood pressure levels have been shown to be positively and continuously related to the risk of stroke and coronary heart disease. The risk of cardiovascular disease doubles for each increment of 20/10 mmHg of blood pressure, starting as low as 115/75 mmHg. Complications of raised blood pressure include heart failure, peripheral vascular disease, renal impairment, fundal hemorrhages, and papillodema. Treating systolic blood pressure and diastolic blood pressure to targets that are less than 140/90 mmHg is associated with a decrease in cardiovascular complications.

The main modifiable causes of high blood pressure are diet, especially salt intake, levels of exercise, obesity, and excessive alcohol intake. As a result of the cumulative effects of these factors blood pressure usually rises steadily with age, except in societies in which salt intake is comparatively low, physical activity high and obesity largely absent. Most adults have blood pressure levels that are suboptimal for health. This is true for both economically developing and developed countries, but in the European sub regions blood pressure levels are particularly high. Across WHO regions, the range between the highest and lowest average mean systolic blood pressure levels is estimated at about 20 mmHg. Globally, these analyses indicate that about 62% of cerebrovascular disease and 49% of ischaemic heart disease are attributable to suboptimal blood pressure (systolic >115 mmHg), with little variation by sex. **World Health Report, 2002**

As per the World Health Statistics 2012, of the estimated 57 million global deaths in 2008, 36 million (63%) were due to non communicable diseases (NCDs). The largest proportion of NCD deaths is caused by cardiovascular diseases (48%). In terms of attributable deaths, raised blood pressure is one of the leading behavioral and physiological risk factor to which 13% of global deaths are attributed. Hypertension is reported to be the fourth contributor to premature death in developed countries and the seventh in developing countries.
Recent reports indicate that nearly 1 billion adults (more than a quarter of the world’s population) had hypertension in 2000, and this is predicted to increase to 1.56 billion by 2025. Earlier reports also suggest that the prevalence of hypertension is rapidly increasing in developing countries and is one of the leading causes of death and disability. While mean blood pressure has decreased in nearly all high-income countries, it has been stable or increasing in most African countries. Today, mean blood pressure remains very high in many African and some European countries. The prevalence of raised blood pressure in 2008 was highest in the WHO African Region at 36.8% (34.0–39.7).

Although the prevalence of hypertension is generally higher in economically developed countries, due to larger population sizes, the absolute number of individuals with hypertension is higher in developing regions of the world. Kearney et al. estimated that 639 million hypertensive patients reside in economically developing countries compared with only 333 million in economically developed regions of the world. Hypertension has also emerged as a leading risk factor for morbidity and mortality in developing regions, responsible for over 6 million deaths in low and middle-income nations in 2001. [Kumari SMV. et al. (2014)]

The disease burden resulting from hypertension translates into a substantial economic toll. For example, in China, the estimated annual direct medical costs of chronic diseases caused by/or related to hypertension were approximately 3 billion dollars in 2003. In Brazil, the costs of direct treatment and productivity losses were as high as 72 billion dollars in 2005. Furthermore, it is likely that the negative health and economic consequences of hypertension will only increase over time in low and middle-income countries where disease patterns continue to shift from communicable to non-communicable conditions.

Globally, the overall prevalence of raised blood pressure in adults aged 25 and over was around 40% in 2008. The proportion of the world’s population with high blood pressure, or uncontrolled hypertension, fell modestly between 1980 and 2008. However, because of population growth and ageing, the number of people with hypertension rose from 600 million in 1980 to nearly 1 billion in 2008.
The prevalence of raised blood pressure was highest in the African Region, where it was 46% for both sexes combined. The lowest prevalence of raised blood pressure was in the WHO Region of the Americas, with 35% for both sexes. Men in this region had a slightly higher prevalence than women (39% and 32% respectively). In all WHO regions, men have slightly higher prevalence of raised blood pressure than women, but this difference was only statistically significant in the Region of the Americas and the European Region.

Across the income groups of countries, the prevalence of raised blood pressure was consistently high, with low-, lower-middle- and upper-middle-income countries all having rates of around 40% for both sexes. The prevalence in high-income countries was lower, at 35% for both sexes.

Raised blood pressure (BP) is a major risk factor for coronary heart disease as well as haemorrhagic stroke. High blood pressure (BP) is ranked as the third most important risk factor for attributable burden of disease in south Asia (2010). Hypertension is responsible for nearly 1.5 million deaths in SEAR (South-East Asia Region). In a majority of countries of SEAR, more than one third of the adult population is hypertensive. Males have a slightly higher prevalence of raised BP than females in almost all SEAR countries. In the 10 countries for which data were available, the prevalence of high BP ranged from 19% in DPR Korea to 42% in Myanmar.

Literature review also suggests that high BP is indeed widespread in this Region. A study conducted in 2005 in Health and Demographic Surveillance System (HDSS) sites from Bangladesh (Matlab, Mirsarai, Abhoynagar, and WATCH), India (Vadu), Indonesia (Purworejo), Thailand (Kanchanaburi) and Viet Nam (Filabavi and Chililab) revealed that a considerable proportion of the study populations, especially those in the HDSS sites from India, Indonesia and Thailand had high BP. The overall prevalence (men and women combined) ranged from around 15% to 28% of the adult population with one exception where prevalence was 9% (one of the HDSS in Bangladesh). WHO, 2011
National data from some countries indicate an increasing trend in the prevalence of raised BP. In Indonesia, percentage of adult population with raised BP increased from 8% in 1995 to 32% in 2008. [Ministry of Health, Indonesia, (2011)] In Myanmar, the Ministry of Health reported an increase in hypertension prevalence, from 18% to 31% in males and from 16% to 29% in females during 2004–2009. [Ministry of Health, Myanmar, (2011)] Rapid urbanization and transition from agrarian life to wage-earning, modern city life are reported as major contributors to increases in elevated BP in urban areas. In a study conducted in HDSS sites in Bangladesh, India, Indonesia, Thailand and Viet Nam, age appeared to be a significant determinant of high BP among both men and women and overweight was positively associated with high BP in all sites. Kusuma YS. et al. (2004)

Stroke mortality started to increase after diastolic BP≥75 mmHg. Rise in mortality was relatively steeper for incremental systolic BP (2 mmHg) than for incremental diastolic BP (1 mmHg). In a survey of 4616 persons aged 20 or more in Yangon (Myanmar) in 2003, prevalence of hypertension was 34%.

In an ICMR study in 1994 involving 5537 individuals (3050 urban residents and 2487 rural residents) demonstrated 25% and 29% prevalence of hypertension (Criteria: >=140/90 mm of Hg) among males and females respectively in urban Delhi and 13% and 10% in rural Haryana. ICMR

In South India, [Kutty VR. et al. (1993)] carried out hypertension prevalence study (criteria: >=160/95 mm of Hg) in rural Kerala during 1991 in the 20 plus age group and the prevalence was found to be 18%. Later studies in Kerala (Criteria: JNC VI) reported 37% prevalence of hypertension among 30-64 age group in 1998 ([Kutty VR. Et al. (2002)] and 55% among 40-60 years age group during 2000. A higher prevalence of 69% and 55% was recorded among elderly populations aged sixty and above in the urban and rural areas respectively during 2000. The Sentinel Surveillance Project, documented 28% overall prevalence of hypertension (criteria: =JNC VI) from 10 regions of the country in the age group 20-69 years.

In a study (2009) conducted on 167 331 persons from a rural area of Trivandrum (India), BP ≥140/90 (either) mmHg was found in 43% men and 45%
women of age 35–89 years. A seven-year average follow-up study showed an accelerated rise of all-cause mortality and ischaemic heart disease mortality in the population with systolic BP≥110 mmHg and diastolic BP≥80 mmHg. [Sauvaget C. et al. (2009)]

Singh R et al. (2011) surveyed 1083 men and women, aged 30 years and above, residing at 10 randomly selected villages of Phulwarisarif Block of Patna District of Bihar and revealed that hypertension and pre-hypertension were classified using JNC-VII criteria. Overall prevalence of hypertension was 23.73%; among them mean systolic and diastolic blood pressures were 144.8±17.14 and 89.04±9.25 mm of Hg respectively. Among those who were hypertensive, the age cluster was higher (50.6±12.7 years) than those who were normotensive (43.8±12.4 years) with a significant male preponderance. Hypertension was significantly associated with a higher body mass index, waist-to-hip ratio, along with the sedentary lifestyle.

Chythra R. Rao et al, (2012) conducted a study to identify the prevalence of hypertension in coastal Karnataka was done to estimate the prevalence and socio demographic correlates among adults above 30 years. It was a community based cross-sectional study carried out on a population of 1,239 respondents, using a two-stage stratified, probability proportional to size sampling technique. Study variables included, socio-demographic characteristics, physical activity, blood pressure and blood glucose measurements, anthropometric measurements, family history of hypertension and diabetes. The study included 1,419 subjects with a response rate of 87.3%. Among the respondents 434 (35%) were males and 805 (65%) were females. The prevalence of hypertension was found to be 43.3%. Based on JNC VII classification, pre-hypertension was noted among 41.4% of the subjects, with 43.7% individuals being in the 30-39 year age group. Advancing age, male gender, current diabetic status, central obesity, being overweight and obese as defined by BMI were identified by the multivariate logistic regression model to be associated with the presence of hypertension.

Indian Women Health Study (2012) was conducted in low and low -middle socioeconomic status women at multiple urban and rural sites in India. Prevalence of known hypertension was low and only 56.8% urban and 24.6% rural women were
aware of the condition. Of the aware hypertensive women only 38.6% were on drug therapy (rural 46.5%, urban 38.6%). Hypertension control defined by systolic BP <140 mm Hg and diastolic BP <90 mm Hg among those on treatment was extremely low and only 10.2% rural and 28.3% urban women had controlled BP values. Overall, of the 1672 hypertensive women (rural 746, urban 926) only 18.3% were on treatment (rural 13.1%, urban 22.5%) and control to target achieved in 3.9% (rural 1.3%, urban 5.9%) (p<0.05 for rural-urban difference). Significant lifestyle determinants of hypertension awareness, treatment and control showed that rural location is the most important risk factor for awareness (age -adjusted OR 3.13, CI 2.49-3.93), treatment (1.59, 1.18-2.13) as well as control (5.11, 2.22-11.74). Low educational level and spouse educational status has insignificant association respectively with awareness (age and location adjusted OR and 95% CI 1.39, 0.92-2.09 and 1.14, 0.75-1.74), treatment (0.62, 0.38-1.03 and 1.74 (0.94-3.25) as well as control (0.55, 0.21-1.42 and 0.60, 0.20-1.80). In most developed countries, hypertension awareness, treatment and control is greater among women as compared to men. This study showed that in India in both urban and rural women there is low awareness, treatment and control of hypertension and systematic strategies are required to improve blood pressure control.

A review entitled “Epidemiology of Hypertension” (2013) reported that the prevalence of hypertension in the late nineties and early twentieth century (1963 – 1999) varied among different studies in India, ranging from 2-15% in Urban India and 2-8% in Rural India. Similarly reviewing recent studies (2000 – 2012), the prevalence of hypertension has increased in both urban and rural subjects and presently is 25% in urban adults and 10-15% among rural adults.

As reported by Raghupathy A. et al. (2014), in an analysis of worldwide data for the global burden of HTN, 20.6% of Indian men and 20.9% of Indian women were suffering from HTN in 2005. The rates for HTN in percentage are projected to go up to 22.9 and 23.6 for Indian men and women, respectively by 2025. Recent studies from India have shown the prevalence of HTN to be 25% in urban and 10% in rural people in India. According to the WHO 2008 estimates, the prevalence of raised BP in Indians was 32.5% (33.2% in men and 31.7% in women). However, only about 25.6%
of treated patients had their BP under control, in a multicenter study from India on awareness, treatment, and adequacy of control of HTN.

In a meta-analysis of multiple cardiovascular epidemiological studies, it was reported that prevalence rates of coronary artery disease and stroke have more than trebled in the Indian population. In the INTERHEART and INTERSTROKE study, hypertension accounted for 17.9% and 34.6% of population attributable risk of various cardiovascular risk factors for coronary artery disease and stroke respectively. The prevalence of hypertension in the last six decades has increased from 2% to 25% among urban residents and from 2% to 15% among the rural residents in India. According to Directorate General of Health Services, Ministry of Health and Family Welfare, Government of India, the overall prevalence of hypertension in India by 2020 will be 159.46/1000 population.

In a study conducted in Northern India, it was found that there was a rising trend in the prevalence of hypertension over the last 3 decades. The people of seven villages in the age group of 17-70 years were interviewed. The prevalence of hypertension was 4.5% and was higher among females than males and only 26.3% of all hypertensive were aware of their disease and only 3.5% had regular treatment.

The prevalence of high normal blood pressure (also called pre hypertension in JNC-VII) has been seen in many recent studies and was found to be around 32% in a recent urban study from Central India. In some studies from South India (Chennai) and from Delhi prevalence of high normal blood pressure has been even higher up to 36% and 44% respectively in these regions. The prevalence of hypertension increases with age in all populations. In a recent urban study it increased from 13.7% in the 3rd decade to 64% in the 6th decade.

As reported by Gupta R. and Gupta S. (2017) in a review article, India Heart Watch study (2013) in urban populations reported prevalence of awareness, treatment, and control of hypertension middle class sites in 11 cities in India and enrolled more than 6000 subjects. An age-adjusted analysis showed that 53.8% of men and 57.3% of women were aware of hypertension. Among subjects with hypertension, 37.9% of the men and 34.5% of the women were receiving treatment for it. Controlled BP
(systolic BP < 140 mm Hg and diastolic BP < 90 mm Hg) was found in 25.6% of the men and 31.6% of the women with hypertension (28.2% overall).

Raghupathy A. et al. (2014) also reported that age, alcohol consumption, smoking and chewing tobacco, BMI, central obesity, low intakes of dietary fruits and vegetables, high intakes of dietary fat and salt and sedentary activity were significant risk factors for hypertension in India. These risk factors are consistent with findings from etiologic and interventional studies reported extensively worldwide. Lifestyle intervention strategies, such as sodium reduction and weight loss, could aid in the primary prevention of hypertension in this population.

Aung Soe Htet (2014) reported that among 25-74 year old citizens of urban area of Yangon Region, Myanmar the prevalence of hypertension was 48% with no difference between genders. The prevalence of hypertension increased with increasing age. The highest prevalence (76%) was observed among the oldest age group. About one-third of the study population had the history of hypertension (29 % in males and 37% in females). The mean systolic blood pressure was 132.0 mmHg (133.6 in males and 130.0 in females) and the mean diastolic blood pressure was 82.0 mmHg (82.6 in males and 81.4 in females).

A region-specific (urban and rural parts of north, east, west, and south India) systematic review and meta-analysis of the prevalence, awareness, and control of hypertension among Indian patients have been done by Raghupathy A. et al. (2014) and reported that overall prevalence of HTN in India, after weighting the regional population size, was 29.8% (95% CI: 26.7–33.0; \( r^2 = 79.8\% \), \( P <0.001 \)). The pooled prevalence of HTN for the rural and urban north Indian population was 14.5% (13.3–15.7) and 28.8% (26.9–30.8), respectively. There was no significant difference between the rural and urban prevalence of HTN in north India (\( P \) value = 0.07). The pooled prevalence of HTN for the rural and urban East Indian population was 31.7% (30.2–33.3) and 34.5% (32.6–36.5), respectively. There was no significant difference between the rural and urban prevalence of HTN in east India (\( P \) value = 0.98). The pooled prevalence of HTN for the rural and urban West Indian population was 18.1% (16.9–19.2) and 35.8% (35.2–36.5), respectively. There was a significant difference between the rural and urban prevalence of HTN in east India (\( P \) value = 0.05). The
pooled prevalence of HTN for the rural and urban south Indian population was 21.1% (20.1–22.0) and 31.8% (30.4–33.1), respectively. There was no significant difference between the rural and urban prevalence of HTN in south India (P value = 0.62).

Raghupathy A. et.al (2014) reviewed hypertension awareness, treatment and control status including all the recent studies in India. Overall estimate (95% confidence intervals) for awareness of hypertension in India was 41.9% (35.1-48.9) for urban and 25.1% (21.0-29.1) for rural populations. The awareness levels for hypertension were consistently above 35% in almost all studies from urban areas. In urban populations the treatment and control status of those with known hypertension was 37.6% (24.0-51.2) and control in 20.2% (11.6-28.7). While in rural populations, the treatment status for those with known hypertension was 25.1% (17.0-33.1), and control status was in 10.7% (6.5-15.0).

A study done in Northwest Ethiopia (2015) on 2200 study subjects and reported that the overall prevalence of hypertension was found to be 27.9% [95% CI 26.0, 29.8], with the proportion in the urban and rural residents being 30.7% and 25.3% respectively. The prevalence of hypertension was 29.3% for women and 26.3% for men. Out of the 598 hypertensive patients 241 (40.3%) had blood pressure measurements, and 99 (16.6%) had known hypertension and were on treatment. The proportion of systolic and diastolic hypertension in this subgroup of adults was 133(6.2%). The multivariable logistic regression analysis showed older age (AOR = 1.06; 1.05, 1.07), raised fasting glucose (AOR = 1.01; 1.001, 1.01), alcohol consumption (AOR = 1.71; 1.24, 2.36), and raised BMI (AOR =1.07; 1.04, 1.10) were significantly associated with hypertension.

“Hypertension in India: Trends in Prevalence, Awareness, Treatment and Control” conducted by Gupta R. and Gupta S. (2017) reported that hypertension (HTN) is the attributable cause for 57% of stroke and 24% of coronary heart disease deaths in India. High prevalence of hypertension has been reported from various regions of the country. Recent studies have reported that shown hypertension is present in 25-30% urban and 10-20% rural subjects in India. This translates into an approximate population burden of 100-110 million persons with high blood pressure (BP). Approximately half to two-thirds of these are stage I
hypertension (systolic BP 140-159 and/or diastolic BP 90-99 mm Hg) and the rest have stage II -III disease.

**Gupta R. & Gupta S. (2017)** reported in a review article that although hypertension is highly prevalent in India, there is low awareness, treatment and control status in Indian urban as well as rural populations. Poor control of high BP has been attributed to a variety of socioeconomic factors including women, low educational status, poverty, rural residence as well as physiological factors, eg. obesity. Awareness status of hypertension has increased in the last 30 years in India but remains very low especially in rural populations. Hypertension awareness has increased from less than 30% in 1980's among urban populations to about 60% presently and from less than 10% in rural areas in 1980's to 35-40% presently. However, treatment and control status remain low at less than 30% in urban and 20% in rural areas.

7. **Raised blood glucose:**

Diabetes mellitus (DM) is now one of the most common non-communicable diseases globally. It is the fourth or fifth leading cause of death in most high-income countries and there is substantial evidence that it is epidemic in many economically developing and newly industrialized nations. Complications from diabetes, such as coronary artery and peripheral vascular disease, stroke, diabetic neuropathy, amputations, renal failure and blindness are resulting in increasing disability, reduced life expectancy and enormous health costs for virtually every society. Diabetes is undoubtedly one of the most challenging health problems in the 21st century.

Diabetes is a chronic disease that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces. Insulin is a hormone that regulates blood sugar. Hyperglycaemia, or raised blood sugar, is a common effect of uncontrolled diabetes and over time leads to serious damage to many of the body's systems, especially the nerves and blood vessels.

Type 1 diabetes (previously known as insulin-dependent, juvenile or childhood-onset) is characterized by deficient insulin production and requires daily
administration of insulin. The cause of type 1 diabetes is not known and it is not preventable with current knowledge. Symptoms include excessive excretion of urine (polyuria), thirst (polydipsia), constant hunger, weight loss, vision changes, and fatigue. These symptoms may occur suddenly.

Type 2 diabetes (formerly called non-insulin-dependent, or adult-onset) results from the body’s ineffective use of insulin. Type 2 diabetes comprises the majority of people with diabetes around the world, and is largely the result of excess body weight and physical inactivity. Symptoms may be similar to those of type 1 diabetes, but are often less marked. As a result, the disease may be diagnosed several years after onset, once complications have already arisen. Until recently, this type of diabetes was seen only in adults but it is now also occurring increasingly frequently in children.

Gestational diabetes is hyperglycaemia with blood glucose values above normal but below those diagnostic of diabetes, occurring during pregnancy. Women with gestational diabetes are at an increased risk of complications during pregnancy and at delivery. They and their children are also at increased risk of type 2 diabetes in the future. Gestational diabetes is diagnosed through prenatal screening, rather than through reported symptoms.

Impaired glucose tolerance (IGT) and impaired fasting glycaemia (IFG) are intermediate conditions in the transition between normality and diabetes. People with IGT or IFG are at high risk of progressing to type 2 diabetes, although this is not inevitable.

Impaired glucose tolerance (IGT) is an asymptomatic condition defined by elevated (though not diabetic) levels of blood glucose two hours after a 75g oral glucose challenge. Along with impaired fasting glucose (IFG), it is now recognized as being a stage in the transition from normality to diabetes. Not surprisingly, IGT shares many characteristics with type 2 diabetes, being associated with obesity, advancing age, insulin resistance and an insulin secretory defect.

In 2003, it is estimated that approximately 314 million people worldwide, or 8.2% in the age group 20 – 79, have IGT. By 2025, the number of people with IGT is projected to increase to 472 million, or 9.0% in the adult population. The South-East
Asian Region currently has the highest number of people with IGT with some 93 million and the highest prevalence rate with 13.2%. While the Western Pacific Region is the next highest in terms of number with about 78 million, its prevalence rate of 5.7% is the lowest compared with the other regions.

As reported by **WHO (2017): factsheet on diabetes mellitus**, over time, diabetes can damage the heart, blood vessels, eyes, kidneys, and nerves. Adults with diabetes have a two- to three-fold increased risk of heart attacks and strokes. Combined with reduced blood flow, neuropathy (nerve damage) in the feet increases the chance of foot ulcers, infection and eventual need for limb amputation. Diabetic retinopathy is an important cause of blindness, and occurs as a result of long-term accumulated damage to the small blood vessels in the retina. 2.6% of global blindness can be attributed to diabetes. Diabetes is among the leading causes of kidney failure.

According to **WHO Global Health Observatory Data**, raised blood glucose was estimated to result in 3.4 million deaths in 2004, equivalent to 5.8% of all deaths. Impaired glucose tolerance and impaired fasting glycaemia are risk categories for future development of diabetes and cardiovascular disease. In some age groups, people with diabetes have a twofold increase in the risk of stroke. Diabetes is the leading cause of renal failure in many populations in both developed and developing countries. Lower limb amputations are at least 10 times more common in people with diabetes than in non-diabetic individuals in developed countries; more than half of all non-traumatic lower limb amputations are due to diabetes. Diabetes is one of the leading causes of visual impairment and blindness in developed countries. People with diabetes require at least 2-3 times the health care resources compared to people who do not have diabetes, and diabetes care may account for up to 15% of national healthcare budgets.

The prevalence of hyperglycaemia depends on the diagnostic criteria used in epidemiological surveys. Defined as a fasting plasma glucose value $\geq 7.0$ mmol/L (126 mg/dl) or on medication for raised blood glucose), the global prevalence of diabetes in 2008 was estimated to be 9%.
There was little variation in prevalence rates across WHO regions. The prevalence of diabetes was highest in the Eastern Mediterranean Region (11% for both sexes) and lowest in the WHO European Region (7% for both sexes). The magnitude of diabetes and other abnormalities of glucose tolerance will be considerably higher than the above estimates if the categories of "impaired fasting" and "impaired glucose tolerance" are included.

The prevalence of diabetes was relatively consistent across the income groupings of countries. The high income countries showed the lowest prevalence rate (7% for both sexes), possibly reflecting better dietary and other nonmedical interventions. The lower middle income countries showed the highest prevalence rate (10% for both sexes).

The number of people with diabetes has risen from 108 million in 1980 to 422 million in 2014. The global prevalence of diabetes among adults over 18 years of age has risen from 4.7% in 1980 to 8.5% in 2014. Diabetes prevalence has been rising more rapidly in middle- and low-income countries.

In 2015, an estimated 1.6 million deaths were directly caused by diabetes. Another 2.2 million deaths were attributable to high blood glucose in 2012. Almost half of all deaths attributable to high blood glucose occur before the age of 70 years. WHO projects that diabetes will be the seventh leading cause of death in 2030.

WHO estimates that, globally, 422 million adults aged over 18 years were living with diabetes in 2014. The largest numbers of people with diabetes were estimated for the WHO South-East Asia and Western Pacific Regions (96 million and 131 million, respectively), accounting for approximately half the diabetes cases in the world.

The number of people with diabetes (defined in surveys as those having a fasting plasma glucose value of greater than or equal to 7.0 mmol/L or on medication for diabetes/raised blood glucose) has steadily risen over the past few decades, due to population growth, the increase in the average age of the population, and the rise in prevalence of diabetes at each age. Worldwide, the number of people with diabetes has substantially increased between 1980 and 2014, rising from 108 million to current
numbers that are around four times higher (422 million). Forty per cent of this increase is estimated to result from population growth and ageing, 28% from a rise in age-specific prevalence, and 32% from the interaction of the two. [Global report on Diabetes (2016)]

In the past 3 decades the prevalence (age-standardized) of diabetes has risen substantially in countries at all income levels, mirroring the global increase in the number of people who are overweight or obese. The global prevalence of diabetes has grown from 4.7% in 1980 to 8.5% in 2014, during which time prevalence has increased or at best remained unchanged in every country. Over the past decade, diabetes prevalence has risen faster in low- and middle-income countries than in high-income countries. The WHO Eastern Mediterranean Region has experienced the greatest rise in diabetes prevalence, and is now the WHO region with the highest prevalence (13.7%).

It is estimated that the prevalence of diabetes in 2011 is 366 million and this number is expected to increase to 552 million by the year 2030. Among this 80% of the diabetics are contributed by low and middle income countries. in the in the year 2011 the deaths due to diabetes is estimated to be 4.6 million. There is a worldwide increase noticed in the incidence of type2 diabetes. It is estimated that 78,000 children develop type 1 diabetes per year. [Shamim Begam N. (2013)]

According to WHO reports it’s evident by the year 2030 diabetes will be the 7th leading cause of death it is also estimated that in the year 2004 diabetes and its complications killed 3.4 million people globally having more than 80% of these deaths from low and middle income countries. It is understood that modifying behavioral risk factors and maintaining adequate body weight can prevent or postpone the incidence of type-2 diabetes.

According to the Diabetes Atlas 2015 published by the International Diabetes Federation, the number of people with diabetes in India currently around 69.1 million is expected to rise to 102 million by 2030 unless urgent preventive steps are taken (IDF, 2015).
During 1972-75, ICMR, [Ahuja MMS. (1979)] carried out a large multicentric study in India, which documented 2.6% and 1.5% prevalence of diabetes (criteria: FBS>5.6mmol/l or Post 1- h glucose value>=7.8mmol/l or Post 2-h glucose value>=6.7mmol/l) among men and women in the urban areas while in rural areas had a lower prevalence: 1.8% and 1.3% respectively. Later, Gopinath N. & Chadha SN. et al. (1994, 1997) reported the prevalence of diabetes (criteria: clinical history and documented evidence of medication) to be 1.6% among males and 1.6% among females in the urban areas and 0.5% and 0% respectively in rural areas in Delhi during 1984-87. In 1994, ICMR Task force carried out a study involving more than 5000 individuals (3050 urban residents and 2487 rural residents) as part of the ICMR task force project,43 which demonstrated 14% prevalence of diabetes (criteria: FBS>126mg% or history) urban Delhi and 3% in rural Haryana.

In 1994, Wander GS. et al. reported 5% prevalence of diabetes (criteria: random venous blood glucose >180mg/dl or history) among a rural population in Ludhiana, Punjab100. Further, Gupta R. et al. from Jaipur, through three epidemiological studies carried out during 1994, 2001 and 2003 demonstrated rising trend rates of diabetes (criteria: FBS>126mg/dl or history) 1%, 13%, and 18% respectively among males and 1%, 11% and 14% respectively among females.

Similar trends were observed in other parts of the country. Ramachandran A. et al. (1992) reported a prevalence of 8.2% during 1989 in urban Chennai. Subsequent studies from urban Chennai reported the prevalence of diabetes at 11.6% in the year 1995 Ramachandran A. et al. (1997) and 14% during 2000 Ramachandran A. et al. (2001) (2-h post glucose value =>200mg/dl). Prevalence of diabetes (criteria: 2-h post glucose>=11.1 mmol/l) in the rural areas of Tamil Nadu rose sharply from 2.4% in 1989 to 6% in 2003 Ramachandran A. et al. (2004) .

Kutty VR. et al. (2000) carried out a study in Kerala during 1998-99 using the WHO criteria and the prevalence of diabetes was found to be 5.9%. Joseph et al. (2000) reported 16% prevalence in the urban areas of Trivandrum in Kerala.

In 2000, a multi centric study by Ramachandran A. et al. (2001) involving six urban cities in India (Chennai, Bangalore, Hyderabad, Mumbai, Calcutta and New
Delhi) in the country among the age group of 20 and above showed a prevalence of 14% among men and women (sample size: 5288 men; 5928 women).

The Sentinel Surveillance Project, documented 10% overall prevalence of diabetes from 10 regions of the country using the criteria (FPG > 126 mg/dl or on treatment) in the age group 20-69. (WHO)

In 2004, SM. Sadikot et al., carried out a random multistage cross-sectional population survey to determine the prevalence of type 2 diabetes mellitus in subjects aged 25 years and above in India using both 1999 WHO criteria and 1997 ADA criteria. A total of 18363 (9008 males and 9355 females) subjects were screened and the standardized prevalence rates for diabetes mellitus in the total Indian, urban and rural populations using WHO criteria was 4.3%, 5.6% and 2.7% respectively.

In 2004, SM. Sadikot et al., conducted a random multistage cross section a population survey to determine the prevalence of diabetes mellitus (DM) and impaired fasting glycemia/glucose (IFG) in subjects aged 25 years in 41270 (20,534 males and 20736 females). 21516 (10865 males and 10651 females) were from urban areas and 19754 (9669 males and 10085 females) from rural areas. The age and gender standardized prevalence rate for DM and IFG in the total Indian population was 3.3% and 3.6% respectively.

Basavana gowdappa H. et al. (2005) estimated the prevalence of diabetes mellitus and impaired fasting glucose (IFG) in Suttur village of Karnataka state. They adopted ADA 1997 criteria for diagnosis of IFG and diabetes mellitus. They reported diabetes prevalence rate of 3.77% in persons above age of 25 years. The prevalence in males was 4.58% and in females it was 2.66%. Impaired fasting glucose was 2.82% in male and 2.78% in females.

Prabhakaran D. et al. (2005) conducted a cross-sectional survey among all employees aged 20-59 years to evaluate the prevalence of CVD and its risk factors 57 among a large industrial population of northern India. A total of 2122 subjects with a mean age of 42 years were screened and the prevalence of diabetes was found to be 15.0%.
In 2006, Reddy et al. conducted a baseline cross-sectional survey as a part of CVD surveillance programme and estimated the risk factor burden using standardized tools in Indian industrial populations. A total of 10442 subjects were screened and diabetes prevalence was found to be 10.1%.

In 2007, Gupta et al. conducted a community-based epidemiological study that focused on lifestyle determinants of obesity and its correlates in migrants from Punjab was performed at a single location in Jaipur and the prevalence of diabetes was found to be 20.1%.

Kokiwar PR et al. (2007) conducted survey in rural area of Nagpur district to determine the prevalence and abnormal glucose tolerance and to study the association of various factors with abnormal glucose tolerance. This study found that there was high prevalence of diabetes (3.67%) as compared to that in the WHO report (2.4%) for rural India.

Raghupathy P. et al. (2007) have conducted a study in Vellore and nearby villages to report the prevalence of glucose intolerance and insulin profiles, and their relationship to lifestyle factors in 2218 young adults. This study found that type 2 diabetes mellitus and impaired glucose tolerance (IGT) was higher in urban than rural subjects (3.7% versus 2.1%), while prevalence of impaired fasting glycemia (IFG) was similar in urban and rural population (3.8% versus 3.4%, P=0.04).

Zargar AH. et al. (2008) carried out a study in Kashmir valley to assess the burden of type 2 diabetes mellitus and other abnormalities of glucose tolerance in young adult (20-40years) men and non pregnant women. This study reported prevalence of diabetes, impaired glucose tolerance (IGT), and impaired fasting glucose (IFG) was 2.5%, 2.0% and 11.9% respectively.

Purty AJ. et al. (2009) conducted a community based study in Puducherry to estimate prevalence of diagnosed type 2 diabetes mellitus patients. The diagnosis of diabetes was retrospectively documented by reviewing all family folders of 2667 families. The prevalence of known diabetes was estimated to be 5.6% (5.31% in males and 6.1% in females).
In 2010, Ravikumar P. et al. conducted a cross-sectional survey to assess the prevalence and risk factors associated with diabetes in the north Indian city of Chandigarh. A total of 2227 subjects aged ≥ 20 years representing urban population using 1999 WHO criteria. The age standardized prevalence of diabetes and pre diabetes was found to be 11.1% (95% CI: 9.7-12.4) and 13.2% (95% CI: 11.8-14.6).

Shaw JE. et al. (2010) reported that the world prevalence of diabetes among adults (aged 20–79 years) will be 6.4%, affecting 285 million adults, in 2010, and will increase to 7.7%, and 439 million adults by 2030. Between 2010 and 2030, there will be a 69% increase in numbers of adults with diabetes in developing countries and a 20% increase in developed countries.

In 2011, Anjana RM. et al. conducted a national study to determine the prevalence of diabetes and pre diabetes (impaired fasting glucose and/or impaired glucose tolerance) in India. A total of 363 primary sampling units (188 urban, 175 rural), in three states (Tamil Nadu, Maharashtra and Jharkhand) and one union territory (Chandigarh) of India were sampled using a stratified multistage sampling design to survey individuals aged ≥ 20 years. Of the 16607 individuals selected for the study, 14277 (86%) participated, of whom 13055 gave blood samples. The weighted prevalence of diabetes (both known and newly diagnosed) was 10.4% in Tamil Nadu, 59.8.4% in Maharashtra, 5.3% in Jharkhand, and 13.6% in Chandigarh. The prevalence of pre diabetes (impaired fasting glucose and/or impaired glucose tolerance) is 8.3%, 12.8%, 8.1% and 14.6% respectively. Projections for the whole of India would be 62.4 million people with diabetes and 77.2 million people with pre diabetes.

Gupta R. et al. (2012) conducted a study using stratified random sampling to evaluate the cardiovascular risk factors in urban middle class in Jaipur in subjects aged 20-59 years and to determine secular trends with previous cross sectional studies performed in same locations in years 2002-3 and 2004-5. The prevalence of diabetes was found to be 13.4%.

In the urban Indian middle class, more than a quarter of patients with diabetes are undiagnosed and the status of control is low (Gupta A. et al., 2015).
Cardiovascular risk factors like hypertension, hypercholesterolemia, low HDL cholesterol, hypertriglyceridemia, and smoking/smokeless tobacco use are highly prevalent. There is low awareness, treatment, and control of hypertension and hypercholesterolemia in patients with diabetes.

8. **Raised blood cholesterol:**

Cholesterol is a fat-like substance, found in the bloodstream as well as in bodily organs and nerve fibres. Most cholesterol in the body is made by the liver from a wide variety of foods, especially from saturated fats, such as those found in animal products. A diet high in saturated fat content, heredity, and various metabolic conditions such as diabetes mellitus influence an individual’s level of cholesterol. Cholesterol levels usually rise steadily with age, more steeply in women, and stabilize after middle age. Mean cholesterol levels vary moderately between regions, although never more than 2.0 mmol/l in any age group.

Cholesterol is a key component in the development of atherosclerosis, the accumulation of fatty deposits on the inner lining of arteries. Mainly as a result of this, cholesterol increases the risks of ischaemic heart disease, ischaemic stroke and other vascular diseases. As with blood pressure, the risks of cholesterol are continuous and extend across almost all levels seen in different populations, even those with cholesterol levels much lower than those seen in North American and European populations.

High cholesterol is estimated to cause 18% of global cerebrovascular disease (mostly nonfatal events) and 56% of global ischaemic heart disease. Overall this amounts to about 4.4 million deaths (7.9% of total) and 40.4 million DALYs (2.8% of total). Of this total disease burden, 27% occurred in SEAR-D, 18% in EUR-C and 11% in WPR-B. In AMR-A and Europe, 5–12% of DALYs were attributable to suboptimal cholesterol levels. In most regions, the proportion of female deaths attributable to cholesterol is slightly higher than that for men. *(World Health Report, 2002)*

Raised cholesterol increases the risks of heart disease and stroke. Globally, a third of ischaemic heart disease is attributable to high cholesterol. Overall, raised
cholesterol is estimated to cause 2.6 million deaths (4.5% of total) and 29.7 million
disability adjusted life years (DALYS), or 2.0% of total DALYS. Raised total
cholesterol is a major cause of disease burden in both the developed and developing
world as a risk factor for Ischemic heart disease and stroke. A 10% reduction in serum
cholesterol in men aged 40 has been reported to result in a 50% reduction in heart
disease within 5 years; the same serum cholesterol reduction for men aged 70 years
can result in an average 20% reduction in heart disease occurrence in the next 5 years.
In Ireland, a 30% reduction in the heart disease death rate has been attributed to 4.6%
reduction of the population mean for total cholesterol. In Finland, 50% of the decline
in IHD mortality has been explained by the reduction of population blood cholesterol
level.

In 2008 the global prevalence of raised total cholesterol among adults (≥ 5.0
mmol/l or >190 mg/dl) was 39% (37% for males and 40% for females). Globally,
mean total cholesterol changed little between 1980 and 2008, falling by less than 0.1
mmol/L per decade in men and women.

The prevalence of elevated total cholesterol among people aged 25+ years was
highest in the WHO Region of Europe (54% for both sexes), followed by the WHO
Region of the Americas (48% for both sexes). The WHO African Region and the
WHO South East Asian Region showed the lowest percentages (23.1% for African
region and 30.3% for South East Asia Region). In all the WHO regions, women had
higher prevalence of hypercholesterolemia than men except for Europe region.

The prevalence of raised total cholesterol increased noticeably according to
the income level of the country. In low income countries around a quarter of adults
had raised total cholesterol, in lower middle income countries this rose to around a
third of the population for both sexes. In high-income countries, over 50% of adults
had raised total cholesterol; more than double the level of the low-income countries.

Raised cholesterol (hypercholesterolemia) is widespread in SEAR (South East
Asia Region) and accounts for nearly 800 000 deaths annually. Raised cholesterol
increases the risk of CVDs. This was also noted in studies conducted in the Region.
For example, high levels of serum total cholesterol and low density lipoprotein (LDL)
cholesterol presented a significantly higher risk of ischaemic stroke in Bangladesh and Indonesia.

Estimates available from six SEAR Member countries (Bhutan, India, Indonesia, Maldives, Myanmar, Thailand) showed remarkable variations in raised cholesterol levels, with the highest prevalence (above 50% in both sexes) in Maldives and Thailand. Females had a higher prevalence of raised cholesterol than males in five of six SEAR Member countries (except for Bhutan). According to WHO Global Health Observatory data, the prevalence of hypercholesterolemia (≥5.0 mmol/l) in India among both the sexes was 27.9% (20.8-35.8), higher among female (29.5%) than male (26.3%).

In a rural population in Bangladesh, hypercholesterolaemia (total cholesterol ≥240 mg/dl) was found in 16% and high LDL cholesterol in 20% in the age group 20–79 years. Different ethnic groups in Indonesia were found to have varying lipid profiles. In a community in eastern Nepal, 13% had hypercholesterolemia in the age group 35–86 years.

Reddy KS. et al. (2006) conducted a cross-sectional survey (as part of a CVD surveillance programme) of industrial populations from 10 companies across India among individuals aged 20-69 years on 10,442 and reported that the prevalence of hypertriglycerideamia was 32.2 and 20.1 among men and women respectively. The prevalence of total cholesterol to HDL (≥4.5) was 45.6 and 36.2 among men and women, respectively.

Sawant AM. et al. (2008) conducted a study on 1805 Indian adults to estimate the prevalence of dyslipidemia and reported that the prevalence was higher in males than in females. Among participants who had a total Cholesterol (TC) concentration 200mg/dl, 38.7% were males and 23.3% were females. High density lipoprotein cholesterol (HDL-C) was abnormally low in 64.2% males and 33.8% in females. The increase of prevalence of hypercholesterolemia and hypertriglyceridemia was more prominent in 31-40 age groups than in ≤30 age group.

Kinra S. et al. (2010) conducted a survey in 1600 villages from 18 states to investigate the socio demographic patterning of non-communicable disease risk
factors in rural India on 1983 subjects aged 20-69 years and reported that although dyslipidaemia (Total: HDL cholesterol ratio ≥4.5) was equally prevalent between men and women, women had higher prevalence of both high total cholesterol (levels ≥5.18 mmol/l: 21.1% men v 27.8% women; P=0.01) and low HDL cholesterol (31.2% men with HDL cholesterol 65.7% women with HDL cholesterol; P<0.001).

Shah B. and Mathur P. (2010) published a paper that discusses the need and scope of cardiovascular disease risk factor surveillance in India and reported that ICMR-WHO conducted six site study to assess profile of reported behavioral, anthropometric and biochemical risk factors among men and women aged 15–64 yr in urban, rural and peri-urban/slum populations. It was reported in the study that the prevalence of total cholesterol (>200 mg/dl) as 31.7%, 19.5% and 18.1% among men of urban, rural and slum population, respectively. Similarly, the prevalence of hypercholesterolemia among women of urban, rural and slum population was 32.8%, 26.4% 23.4%, respectively.

Pandey RM. et al. (2013) conducted Indian Women Health’s Study amongst women 35–70 years in four urban and five rural locations in India and reported the prevalence of hypercholesterolemia was 27.7% and 13.5%, respectively.

A cross sectional study conducted by Guptha S. et al (2014) in 11 cities located in northern (Jammu, Chandigarh, Karnal, Bikaner), western (Ahmadabad, Jaipur), eastern (Lucknow, Patna, Dibrugarh), southern (Madurai, Hyderabad, Belgaum) and central (Indore, Nagpur) regions of India and reported that age-adjusted prevalence (%) in men and women, respectively were, total cholesterol ≥200 mg/dl 25.1 and 24.9, LDL cholesterol ≥130 mg/dl 16.3 and 15.1 and ≥100 mg/dl 49.5 and 49.7, HDL cholesterol <40/<50 mg/dl 33.6 and 52.8, total:HDL cholesterol ≥4.5 29.4 and 16.8, and triglycerides ≥150 mg/dl 42.1 and 32.9%. Cholesterol level was significantly greater in subjects with better socioeconomic status, body mass index and waist circumference while triglycerides were more among those with high socioeconomic status, fat intake, body mass index and waist circumference (p < 0.05). Hypercholesterolemia awareness (15.6%), treatment (7.2%) and control (4.1%) were low.
Phase I of the Indian Council of Medical Research–India Diabetes (ICMR-INDIAB) study was conducted in a representative population of three states of India [Tamil Nadu, Maharashtra and Jharkhand] and one Union Territory [Chandigarh] by Joshi SR. et al., (2014) and reported that of the subjects studied, 13.9% had hypercholesterolemia, 29.5% had hypertriglyceridemia, 72.3% had low HDL-C, 11.8% had high LDL-C levels and 79% had abnormalities in one of the lipid parameters. Regional disparity exists with the highest rates of hypercholesterolemia observed in Tamilnadu (18.3%), highest rates of hypertriglyceridemia in Chandigarh (38.6%), highest rates of low HDL-C in Jharkhand (76.8%) and highest rates of high LDL-C in Tamilnadu (15.8%). Except for low HDL-C and in the state of Maharashtra, in all other states, urban residents had the highest prevalence of lipid abnormalities compared to rural residents. Low HDL-C was the most common lipid abnormality (72.3%) in all the four regions studied; in 44.9% of subjects, it was present as an isolated abnormality. Common significant risk factors for dyslipidemia included obesity, diabetes, and dysglycemia.

Suryawanshi S. et al. (2014) reviewed an industry-sponsored pan-India primary prevention project and used data obtained from lipid evaluation screening camps conducted at 212 locations in urban Indian populations, as part of a primary prevention program conducted by a pharmaceutical company during the year 2012. Fasting blood samples from 46,919 subjects aged 18–96 years were obtained and revealed the prevalence of various dyslipidemias as high total cholesterol ≥200 mg/dl was observed in 26.9% (men 24.0%, women 30.8%), LDL cholesterol ≥100 mg/dl in 60.0% (men 57.6%, women 63.1%), HDL cholesterol ≤40/50 mg/dl in men/women in 56.0% (men 49.9%, women 64.5%), non-HDL cholesterol ≥130 mg/dl in 50.8 (men 49.5%, women 52.6%) and triglycerides ≥150 mg/dl in 42.6% (men 45.6%, women 38.6%).

Garg MK. et al. (2014) studied the pattern and association of dyslipidemia with cardiovascular risk factors in 300 (Male: 216; Female: 84, age: 60.9 ± 12.4 years, range: 25-92 years) angiographically proved CAD patients and observed that hypercholesterolemia, hypertriglyceridemia and low high density lipoprotein (HDL) was present in 23.3%, 63.0% and 54.6% in the total study population respectively. A
total of 41.3% had atherogenic dyslipidemia (raised triglycerides [TG] and low HDL). Percentage of patients with type-2 diabetes mellitus and hypertension were higher in subjects with atherogenic dyslipidemia. Insulin sensitivity was low; insulin and insulin resistance (IR) along with inflammatory markers were high in subjects with atherogenic dyslipidemia.

**Aung Soe Htet (2014)** done a study titled “The prevalence of selected risk factor for non-communicable diseases among 25-74 year old urban citizens of Yangon Region, Myanmar” and observed that the mean total cholesterol level was 5.43 mmol/L (5.49 mmol/L in males and 5.37 mmol/L in females). The prevalence of high total cholesterol (≥6.2 mmol/L ) was 18.1% standardized adjusted to the WHO world population. When hypercholesterolemia was defined as ≥ 5.17 mmol/L of total cholesterol, the prevalence was 56.6 % (62.7 % in males and 50.7% in females). Furthermore, high triglyceride was prevalent at 22.0%, low HDL 59.7%, and finally high HDL 4.6%. In multiple regression analysis showed high age and tobacco-use, and low education as compared with higher education, and low income as compared with high income of >5 USD per day were associated with hypercholesterolemia after adjusting for all variables.

**Gupta R. et al. (2015)** performed cross-sectional surveys in 11 cities in India to determine epidemiology of cardiovascular risk factors according to geographic distribution and macro level social development index among urban middle class subjects in India during years 2005-2009. 6198 subjects aged 20-75 years (men 3426, women 2772) were evaluated for cardiovascular risk factors. Cities were grouped according to geographic distribution into northern (3 cities, n = 1321), western (2 cities, n = 1814), southern (3 cities, n = 1237) and eastern (3 cities, n = 1826). They were also grouped according to human social development index into low (3 cities, n = 1794), middle (5 cities, n = 2634) and high (3 cities, n = 1825). Age-adjusted prevalence (95% confidence intervals) of various risk factors was hypercholesterolemia 25.0% (23.9-26.9), low HDL cholesterol 42.5% (41.3-43.7), hypertriglyceridemia 36.9% (35.7-38.1), diabetes 15.7% (14.8-16.6), and metabolic syndrome 35.7% (34.5-36.9). Compared with national average, prevalence of most risk factors was not significantly different in various geographic regions, however,
cities in eastern region had significantly lower prevalence of overweight, hypertension, hypercholesterolemia, diabetes and metabolic syndrome compared with other regions (P < 0.05 for various comparisons). It was also observed that cities with low human social development index had lowest prevalence of these risk factors in both sexes (P < 0.05).

Gupta R. et al (2017) evaluated awareness of hypercholesterolemia (total cholesterol >200 mg/dl), its treatment with statins and control (total cholesterol <200 mg/dl in patients on statins) in the Indian Heart Watch study. Awareness was in 17.5% men and 13.2% women with high cholesterol, treatment with statins was in 7.5% men and 6.7% women, while control to targets of total cholesterol <200 mg/dl was in 4.5% men and 3.7% women. There are no similar data available from the country. In clinical practices a low use of statins among patients with CHD as well as in diabetics has been reported. A study has also reported that despite widespread availability the use of statins is low in India compared to many developed countries.