"A research study necessitates the selection of appropriate design in order to obtain answers to research question. A research design is the plan, structure and strategy of investigation. Research designs are framed to enable the researcher to answer research questions as validly, objectively, accurately and economically as possible."

Kerlinger Fred (1964)

Research methods are the various procedures, schemes and algorithms used in research. All the methods used by a researcher during a research study are termed as research methods. They are essentially planned, scientific and value-neutral. They include theoretical procedures, experimental studies, numerical schemes, statistical approaches, etc. Research methods help us collect samples, data and find a solution to a problem.

Research methodology is a systematic way to solve a problem. It is a science of studying how research is to be carried out. Essentially, the procedures by which researchers go about their work of describing, explaining and predicting phenomena are called research methodology. It is also defined as the study of methods by which knowledge is gained. Its aim is to give the work plan of research.

The present study entitled “Prevalence and correlates of risk factors of non-communicable diseases in adults of urban Varanasi” was conducted with the aim of...
studying and estimating the prevalence and magnitude of risk factors of non-communicable diseases and their determinants and associated factors in the urban parts of the Varanasi district.

3.1. THE STUDY AREA

3.1.1 Country Profile:

3.1.1.1. India

India is the seventh-largest country by area, located on the Indian subcontinent in South Asia. India is the second-most populous country with over 1.2 billion people, and is also the most populous democracy in the world. India was home to the ancient Indus Valley Civilization, and is the birthplace of four world religions—Hinduism, Sikhism, Buddhism, Jainism.

3.1.1.2. Geography of India:

India lies on the Indian Plate, the northern portion of the Indo-Australian Plate, whose continental crust forms the Indian subcontinent. The country is situated north of the equator between 8°4’ to 37°6’ north latitude and 68°7’ to 97°25’ east longitude. India measures 3,214 km (1,997 mi) from north to south and 2,933 km (1,822 mi) from east to west. It has a land frontier of 15,200 km (9,445 mi) and a coastline of 7,516.6 km (4,671 mi).

It is bounded by the Indian Ocean on the south, the Arabian Sea on the southwest, and the Bay of Bengal on the southeast. It shares land borders with Pakistan to the west; China, Nepal, and Bhutan to the northeast; and Myanmar (Burma) and Bangladesh to the east. In the Indian Ocean, India is in the vicinity of Sri Lanka and the Maldives. India's Andaman and Nicobar Islands share a maritime border with Thailand and Indonesia.

3.1.1.3 Demography of India:

A. Population:

The population of India as per 2011 census was 1, 210, 193, 422 with 623, 724, 248 males and 586, 469, 174 females. India added 181.5 million to its population
since 2001, slightly lower than the population of Brazil, the fifth most populous
country in the world. The population of India, at 1210.2 million, is almost equal to the
combined population of U.S.A., Indonesia, Brazil, Pakistan, Bangladesh and Japan
put together (1214.3 million). India, with 2.4% of the world's surface area, accounts
for 17.5% of its population. Uttar Pradesh is the most populous state with roughly 200
million people. Over half of the population resided in the six most populous states of
Uttar Pradesh, Maharashtra, Bihar, West Bengal, Andhra Pradesh and Madhya
Pradesh. Of the 121 crore Indians, 83.3 crore (68.84%) live in rural areas while 37.7
crore stay in urban areas (22.12%). 45.36 crore people in India are migrants, which is
37.8% of total population.

B. Sex Ratio:

Overall Sex ratio at the National level has increased by 7 points since Census
2001 to reach 940 at Census 2011. This is the highest Sex Ratio recorded since
Census 1971 and a shade lower than 1961. Increase in Sex Ratio is observed in 29
States/UTs • Three major States (J&K, Bihar & Gujarat) have shown decline in Sex
Ratio as compared to Census 2001.

The Child Sex Ratio at India level (914) is lowest since Independence.
Increasing trend in the Child Sex Ratio (0-6) seen in Punjab, Haryana, Himachal
Pradesh, Gujarat, Tamil Nadu, Mizoram and A & N Islands. In all remaining 27
States/UTs, the Child Sex Ratio show decline over Census 2001.

C. Literacy Status:

Literacy rate has gone up from 64.83 per cent in 2001 to 74.04 per cent in
2011 showing an increase of 9.21 percentage points. The literacy rate for males and
females works out to 82.14 per cent and 65.46 per cent respectively. The increase in
literacy rate in males and females during 2001 -2011 is in the order of 6.88 and 11.79
percentage points respectively.
3.1.2 State Profile

3.1.2.1. Uttar Pradesh:

Uttar Pradesh is a state in northern India. Abbreviated as UP, it is the most populous state in the Republic of India as well as the most populous country subdivision in the world. The densely populated state, located in the northern region of the Indian subcontinent, has over 200 million inhabitants. It was created on 1 April 1937 as the United Provinces during British rule, and was renamed Uttar Pradesh in 1950. The state is divided into 18 divisions and 75 districts with the capital being Lucknow. At the 2001 census of India, about 80% of Uttar Pradesh population is Hindu, while Muslims make up around 18% of the population. The remaining population consists of Sikhs, Buddhists, Christians and Jains.

3.1.2.2: Geography of Uttar Pradesh:

Uttar Pradesh is bounded Uttarakhand on the north-west, Haryana and Delhi on the west, Rajasthan on the south-west, Madhya Pradesh on the south, Chhattisgarh and Jharkhand on southeast and Bihar on the east. Situated between 23°52'N and 31°28'N latitudes and 77°3' and 84°39'E longitudes, this is the fourth largest state in the country in terms of area, and the first in terms of population. Uttar Pradesh can be divided into three distinct hypsographical regions:

1. The Shivalik foothills and Terai in the North
2. The Gangetic Plain in the Centre - Highly fertile alluvial soils; flat topography broken by numerous ponds, lakes and rivers; slope 2 m/km
3. The Vindhya Hills and plateau in the South - Hard rock Strata; varied topography of hills, plains, valleys and plateau; limited water availability. (Uttar Pradesh State Information, 2016).

3.1.2.3. Demography of Uttar Pradesh

A. Population:

Uttar Pradesh has a population of about 199,812,3 with 104,480,510 males and 95,331,831 females as per the 2011 census. If it were a separate country, Uttar
Pradesh would be the world's fifth most populous nation, next only to China, India, the United States of America and Indonesia. Uttar Pradesh has a population more than that of Pakistan. There is an average population density of 828 persons per km² i.e. 2.146 per sq mi. The capital of Uttar Pradesh is Lucknow. In UP the religion-wise percentage of population is Hindus 79.73%, Muslims 19.3%, Sikhs 0.32, Christians 0.18%, Jains 0.11%, Buddhists 0.10% and 0.29% not stated.

B. Sex Ratio:

In Uttar Pradesh the sex ratio depicts an increasing trend. This ratio was 898 females per 1000 males during 2001 Census, which increased to 908 in Census 2011. Thus there is gain of 10 females per 1000 males from 2001 to 2011 Census. The sex ratio among the districts ranges from 1018 in Jaunpur district to 852 in Gautam Buddha Nagar district being the highest and the lowest ratio during Census 2011.

C. Literacy Status:

The total literacy rate in the state recorded in Census 2011 is 69.72% indicating a rise of 13.45% point over Census 2001. Among the districts in the state, Ghaziabad has recorded the highest literacy rate (85.0%) during Census 2011. Except five districts in the state, all the remaining districts have crossed the literacy rate of 2001 (56.72%). These districts are Sharwasti (49.13%), Bahraich (51.10%), Balrampuri (51.76%), Badaun (52.91%) and Rampur (55.08%).

3.1.3.1. Varanasi

Varanasi, also known as Benares, Banaras, or Kashi is one of the oldest living cities in the world. This city is on the banks of the Ganges in the Uttar Pradesh state. The spiritual capital of India and is the holiest in the seven sacred cities (Sapta Puri) in Hinduism and Jainism and also played a major role in the development of Buddhism.

Varanasi’s prominence in Hindu mythology is virtually unexcelled. Mark Twain, English author, who was fascinated by the sanctity and legend of the Banaras, once wrote: “Banaras is older than history, older than tradition, older even than legend and looks twice as old as all of them put together”. As per the ‘Vamana Purana’ the
Varuna and Assi River originated from the body of primordial person at the beginning of time itself. The tract of land lying between them is believed to be ‘Varanasi’, the holiest of all pilgrimages.

The word Kashi originated from the Sanskrit word ‘Kas’ which means “to shine” making Varanasi as “City of Light”, the “luminous city as an eminent seat of learning”. According to legend, Varanasi was created by God Shiva and Parvati, upon which they stood at the beginning of time. Varanasi is the microcosm of Hinduism, a city of traditional classical culture, glorified by myth and worshippers from the time immemorial.

Above all Varanasi is well known and renowned for its rich music, arts, crafts and education. Some of the world renowned exponents India has produced in these fields were schooled in Varanasi’s cultural ethos.

Figure 3.1: Varanasi district map
Luminaries apart, Varanasi abounds in the art of silk wearing, an exotic work of art which manifests itself in precious Banaras silk sarees and silk brocades, which are cherished as collector’s items across the world today.
Table 3.1: General Profile of Varanasi District:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Variables</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><strong>Geographical Location</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Longitude</td>
<td>82° 12’ - 83° 33’ East</td>
</tr>
<tr>
<td></td>
<td>Latitude</td>
<td>24° 43’ – 25° 34’ North</td>
</tr>
<tr>
<td>2.</td>
<td><strong>Area and Administrative Units</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Geographical area (sq. km)</td>
<td>1535</td>
</tr>
<tr>
<td></td>
<td>No. of Tehsils</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>No. of Community blocks</td>
<td>8 Kashi Vidyapith Cholapur Badagaon Chiraigaon Pindra Arajiline Sevapuri Harahua</td>
</tr>
<tr>
<td></td>
<td>Administrative Wards</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>Nagar Mahapalika</td>
<td>01</td>
</tr>
<tr>
<td></td>
<td>Nagar Palika</td>
<td>01</td>
</tr>
<tr>
<td></td>
<td>Nyay Panchayat</td>
<td>108</td>
</tr>
<tr>
<td></td>
<td>Gram Panchayats</td>
<td>760</td>
</tr>
<tr>
<td></td>
<td>Total revenue villages</td>
<td>1295</td>
</tr>
<tr>
<td></td>
<td>Inhibited villages</td>
<td>1258</td>
</tr>
<tr>
<td></td>
<td>Non-inhibited villages</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>Statutory Towns</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Census Towns</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>Assembly area</td>
<td>08</td>
</tr>
<tr>
<td>3.</td>
<td><strong>Demographic profile (Census 2011)</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Population</td>
<td>3,676,841</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>1,921,857</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>1,754,984</td>
</tr>
<tr>
<td></td>
<td>Sex ratio</td>
<td>913/1000</td>
</tr>
<tr>
<td></td>
<td>Urban Population</td>
<td>1,597,051</td>
</tr>
<tr>
<td></td>
<td>Rural Population</td>
<td>2,079,970</td>
</tr>
<tr>
<td></td>
<td>Density (Per sq. km.)</td>
<td>2395</td>
</tr>
<tr>
<td></td>
<td>Schedule Castes (%)</td>
<td>13.24</td>
</tr>
<tr>
<td></td>
<td>Schedule Tribes (%)</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td>Literates (%)</td>
<td>75.60</td>
</tr>
</tbody>
</table>
4. **Educational Facilities**

<table>
<thead>
<tr>
<th>Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Schools</td>
<td>1866</td>
</tr>
<tr>
<td>Senior primary Schools</td>
<td>1276</td>
</tr>
<tr>
<td>Secondary Schools</td>
<td>409</td>
</tr>
<tr>
<td>Degree Colleges</td>
<td>20</td>
</tr>
<tr>
<td>Mahavidyalaya</td>
<td>77</td>
</tr>
<tr>
<td>University</td>
<td>3</td>
</tr>
<tr>
<td>Industrial training Institute</td>
<td>5</td>
</tr>
<tr>
<td>Polytechnic</td>
<td>1</td>
</tr>
<tr>
<td>Engineering College</td>
<td>1</td>
</tr>
<tr>
<td>Medical College</td>
<td>1</td>
</tr>
</tbody>
</table>

5. **Health Facilities**

**Hospitals**

<table>
<thead>
<tr>
<th>Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allopathic</td>
<td>37</td>
</tr>
<tr>
<td>Ayurvedic</td>
<td>26</td>
</tr>
<tr>
<td>Homeopathic</td>
<td>15</td>
</tr>
<tr>
<td>Unani</td>
<td>1</td>
</tr>
<tr>
<td>Primary Health Centres</td>
<td>30</td>
</tr>
<tr>
<td>Community Health Centers</td>
<td>8</td>
</tr>
<tr>
<td>Family and Maternal Children Welfare Centers</td>
<td>42</td>
</tr>
<tr>
<td>Family and Maternal Children Welfare Sub-Centers</td>
<td>306</td>
</tr>
</tbody>
</table>

**Special Hospitals**

<table>
<thead>
<tr>
<th>Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>TB Center</td>
<td>2</td>
</tr>
<tr>
<td>Leprosy Center</td>
<td>1</td>
</tr>
<tr>
<td>Communicable Diseases</td>
<td>1</td>
</tr>
</tbody>
</table>

6. **Others**

<table>
<thead>
<tr>
<th>Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rivers</td>
<td>2 (Ganges, Varuna)</td>
</tr>
</tbody>
</table>

**Police Stations**

<table>
<thead>
<tr>
<th>Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>16</td>
</tr>
<tr>
<td>Rural</td>
<td>09</td>
</tr>
</tbody>
</table>

**Post Office**

<table>
<thead>
<tr>
<th>Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>137</td>
</tr>
<tr>
<td>Rural</td>
<td>149</td>
</tr>
</tbody>
</table>

*Source: District Statistical Magazine (2015-2016)*
3.1.3.2. GEOGRAPHY AND TOPOGRAPHY

Varanasi is situated in the agro climatic zone of eastern plain region of Uttar Pradesh, bordering the districts of Jaunpur in the North, Ghazipur in the North East, Chandauli in the east, Mairzapur in the South and Sant Ravidasnagar in the West. Varanasi is located at an elevation of 80.71 meters in the centre of the Ganges valley of North India, in the Eastern part of the state of Uttar Pradesh, along the left crescent shaped bank of the Ganges, averaging between 15 meters and 21 meters above the river. The river system consists of the mighty Ganga highly revered by Hindus since ages and Gomti, Varuna, Assi, Banganga, Chandra Prabha and Karmnasa are tributaries of the Ganga, that drain the area. Being located in the Indo-Gangetic Plains of North India, the land is very fertile because low level floods in the Ganges continually replenish the soil. The city is the headquarters of Varanasi district.

The “Varanasi Urban Agglomeration” – an agglomeration of seven urban sub-units – covers an area of 112.26 km² (approximately 43 mi²).

3.1.3.3. DEMOGRAPHY

According to Census of 2011 total population of Varanasi District is 3,676,841 (3.6 million). Out of which 43.4% lives in urban areas and remaining 56.4% belongs from rural areas. As per reports of Census India, population of Varanasi urban agglomeration in 2011 is 1,597,051; of which male and female are 845,331 and 751,720 respectively. Varanasi holds 18th rank in the state. In terms of sex ratio (913), it holds 25th rank in Uttar Pradesh. The sex ratio for urban population is 889 females per 1000 males. The overall literacy is 75.6%, out of which for male it is 83.78 % and for female it is 66.69%. Population belonging to schedule castes has been reported to be 13.24 % and schedule tribe has been <1%.

3.1.3.4. CLIMATE

Being located in the sub tropical belt, Varanasi experiences a humid subtropical climate with large variations between summer and winter temperatures. The dry summer starts in April and lasts until June with intervening monsoon season from July to September followed by winter from October to February. In the summer,
the temperature ranges between 22 and 46 °C. Winters in Varanasi are very large and with diurnal variations, with warm days and downright cold nights. Cold waves from the Himalayan region cause temperatures to dip across the city in the winter from December to February and temperatures below 5 °C are not uncommon. The average rainfall is 1,110 mm (44in). Fog is common in the winters, while hot dry winds, called *loo*, blow in the summers.

3.2 PERIOD OF STUDY

The study was carried out for a period of five years. The initial first year was devoted to literature search and finalization of research topic. During the next year finalization of study protocol, tools of the study and presentation of synopsis was done. The third year was devoted to all the field activities like data collection and blood sample collection. Last two years were utilized for data coding, data analysis, research paper writing, Pre-Ph.D. seminar defense and thesis writing.

3.3 THE STUDY DESIGN

The present study was mainly conducted to estimate the magnitude and prevalence of risk factors of non-communicable diseases. To achieve above stated aims, a community based cross-sectional research design was adopted. This research design gives a snap shot or cross-section of the population at the time of the study.

3.4 THE UNIVERSE OF STUDY

The universe of study consists of people aged 25-64 years residing in the 90 wards of Varanasi and out of them five wards were selected by following a sampling technique. The wards selected were (1) Sunderpur, (2) Pahariya, (3) Sigra, (4) Bhelupur and (5) Pandeypur.

3.4.1 SAMPLE SIZE

The sample size required for the present study to estimate the risk factors was drawn by following formula.

\[ n = z^2 P (1-P)/e^2 \]
Where:

\[ n \text{ is the sample size} \]
\[ z \text{ is the level of confidence, 95\% level (1.96)} \]
\[ P = \text{baseline level of the indicators (50\% prevalence of risk factors, most conservative, requiring the largest sample size. (WHO)} \]
\[ e \text{ is the permissible margin of error in the estimated value at 5\%} \]
\[ n = (1.96)^2 0.5 (1-0.5)/(0.05)^2 \]
\[ = 384 \]

Considering design effect at 1.5 (Multistage sampling) and 10\% non-response rate
\[ n = 384 \times 1.5 /0.9 = 640 \]

So the final sample size came out as 640.

**Sample for biochemical measurements**: Because biochemical examination is expansive and logistically challenging in such a resource poor setting, it was done to subsample. For this, out of above stated five wards two wards were randomly selected. These were come out to be namely Sunderpur and Paharaiya. In these two wards, those who gave their consent for blood sample were included for this parameter. Total 104 study subjects were selected for conducting biochemical examination.

**3.4.2 STUDY SUBJECTS**

25 to 64 years aged people in the selected area were the study subjects for the present study.

**Inclusion Criteria**

- Individuals aged 25-64 years residing in the selected area.

**Exclusion Criteria**

- Those who did not give consent to participate.
- Individuals who were unable to give response due to serious illness.
Individuals with whom anthropometry measurements can not be made (Unable to stand).

### 3.4.3 SAMPLING METHODOLOGY

A **Multi stage sampling** was used for the study. There were three stages and for each stage different sampling design was used. Following steps were involved in the selection of study subjects.

**A.** At the first stage, five wards out of 90 wards were selected by simple random sampling by generating random table in MS Excel. The wards came out to be were namely; Sunderpur, Paharia, Sigra, Bhelupur, Pandeypur.

**B.** At the second stage, selection of households was done by using systematic random sampling. Electoral list was used to form sampling frame. Those houses which consist of all members below 25 years and/or above 64 years were excluded and a list of eligible household was made. Selection of total households was done as per population proportion to size (PPS). Total number of households from each ward selected was given below.

<table>
<thead>
<tr>
<th>Ward No. and Name</th>
<th>Target household</th>
<th>Proportion of household</th>
<th>Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>(10) Sunderpur</td>
<td>2841</td>
<td>0.22</td>
<td>142</td>
</tr>
<tr>
<td>(33) Paharia</td>
<td>3196</td>
<td>0.25</td>
<td>160</td>
</tr>
<tr>
<td>(36) Pandeypur</td>
<td>3285</td>
<td>0.26</td>
<td>164</td>
</tr>
<tr>
<td>(40) Sigra</td>
<td>1610</td>
<td>0.12</td>
<td>80</td>
</tr>
<tr>
<td>(44) Bhelupur</td>
<td>1859</td>
<td>0.15</td>
<td>93</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>12,791</strong></td>
<td><strong>1.0</strong></td>
<td><strong>640</strong></td>
</tr>
</tbody>
</table>

To compute the number of individuals to be drawn from each ward, first we divided the target households of each ward by total number of households from all wards and then multiplied it with total required sample size.
Eg: 1st ward Sunderpur, number of households (2841) divided by total number of households (12,791), proportion came out to be 0.22. To calculate the sample size from this ward, 0.22 is multiplied by total number of sample size required, i.e. 640. Finally, it came out to be 142 subjects from Sundepur ward.

C. At the last stage, selection of study subjects aged 25-64 years from each selected households was done. In the presence of more than one eligible subject in a household, lottery method was used to select the study subject.

3.5 TOOLS OF THE STUDY

The success of the research investigation to a large extent depends upon the choice of appropriate tools. It is essential that the tools themselves be well standardized, reliable and valid. It should also be suitable for the sample chosen for the study. The present investigation is a kind of field study in which primary tool used was a modified and pre-tested WHO STEPS instrument. Apart from this, 24-hour recall method, food frequency questionnaire (FFQ), questions on self perceived health were also employed to assess dietary intake, dietary pattern and self reported health, respectively.

A. Interview Schedule:

☑ Modified and pre-tested WHO Steps instrument was used. The WHO STEP wise approach to surveillance (STEPS) is the WHO’s recommended tool for surveillance of chronic or non communicable diseases and their risk factors. WHO STEPS approach provides an entry point for low and middle income countries. It provide sufficient flexibility and allows for the development of such a surveillance system that can be modified and used according to the setting and resources of the country.

STEPS, as name suggests, is a sequential process and consists of three steps. Step 1st consists of gathering information on socio-demographic profile and risk factors with a questionnaire, Step 2nd involves physical measurements and the 3rd Step involves biochemical measurements.
• As per the STEP 1 of WHO STEPS approach, the first section of proforma was used to document the identification information in terms of name, address and phone number and the socio-demographic information such as age, gender, education status, marital status, occupation details and household income. It also takes into consideration the behavioral risk factors like tobacco use, alcohol consumption, fruits and vegetables consumption and physical activity. It also consists of questions regarding history of raised blood pressure, diabetes and raised blood cholesterol and use of any remedy to control such conditions.

• In the next Step of the proforma, the physical measurements of study subjects i.e. weight, height, waist circumference, hip circumference and blood pressure were recorded.

• The last part or 3rd STEP involves biochemical measurements of blood sugar and blood lipids.

24-HOUR DIET RECALL:

It is a quantitative research method used in nutritional assessment, which asks individuals to recall food and beverages they consumed in the twenty-four hours from midnight to midnight the previous day of the interview. This method is based on the principle that food consumption for a specified period of time prior to the survey can be recalled as accurately as possible. As the name suggests, the respondent recalls what and how much food consumed and when it was consumed. Study subjects were subjected to this method for the assessment of their nutrient intake. For accurate arrival at the evaluation of the dietary intake standardized utensil technique was used (Mohapatra et al., 1990). The nutritive value of food items was calculated in terms of energy, protein, carbohydrate, fat, calcium, iron, potassium, sodium, phosphorus, vitamin A and vitamin C using the reference book ‘Nutritive value of Indian foods’ (Gopalan et al., 2000).
Materials & Methods

FOOD FREQUENCY QUESTIONNAIRE (FFQ):

Dietary consumption pattern was assessed by food frequency questionnaire (Thimmayamma, 1987). FFQ was used to obtain frequency of foods and beverages over a specified period of time. It included assessment of the frequency of consumption of the major food groups: cereals, pulses & legumes, milk and milk products, egg and flesh foods, green vegetables, roots and tubers, fruits, fats and sugars, beverages, fast foods. Under these food groups specific food items according to regional availability were listed to facilitate the subject to comprehend and recall the food they consumed. Frequency of consumption of food items was addressed in:

- Daily
- Alternate day
- Twice in week
- Once per week
- Once per fortnight
- Once per month
- Occasionally
- Never

B. Libra weighing machine:

This machine was used for recording the weight of the study subjects. The accuracy of the instrument was checked time to time by using standard weights.

C. Steel Anthropometry Rod:

This was used for measuring the height of the study subjects with an accuracy of 0.1 cm.

D. Measuring Tape:

This was used for measuring the waist circumference and the hip circumference of the study subjects with an accuracy of 0.1 cm.
E. Digital Blood Pressure Measuring Instrument:

WHO recommended OMRON-HEM 7120 machine was used to record the blood pressure and to detect the high blood pressure of the study subjects.

3.6 TECHNIQUES OF THE STUDY

Following techniques were used to fulfill all the objectives of this study.

3.6.1 PREVALENCE OF RISK FACTORS OF NCDS.

A. Interview Technique:

The protocol developed by the WHO-STEPS program was used. All the study subjects were interviewed with the help of pre-tested and structured interview schedule for obtaining their socio-demographic information as well as behavioural patterns in terms of tobacco consumption, alcohol consumption, dietary intake (fruits and vegetable consumption) and physical activity. Interview was also carried out to get insights into history of high blood pressure, raised blood sugar and raised lipids of study subjects.

B. Anthropometry:

Anthropometry (the use of body measurements to assess nutritional status) is a practical and simple tool to assess the nutritional status, both at individual and at large scale. Anthropometry measurements viz, height, weight, waist circumference and hip circumference of the study subjects were measured. All the measurements were done by following WHO standard protocol.

- Weight was recorded by using Libra weighing machine without footwear, minimal clothing, stand still, face forward and both the arms on the side. Weight was recorded in kilograms and with the accuracy of 0.1 kg.

- Height was measured using steel anthropometry rod with the accuracy of 0.1 cm. Participants were asked to remove footwear, stand straight with feet together, knees straight and looking straight and not tilt their head up or down.
• Height and weight was measured to determine the BMI (Body Mass Index), which determine the prevalence of overweight or obesity in the study subjects. It was calculated by dividing weight in kg divided by height in meter square.

• Waist circumference was also measured by using non-stretchable measuring tape with the minimal clothing with the accuracy of 0.1 cm. It was measured at the end of normal expiration with the arms relaxed at the sides and at the midpoint between the lower margin of the last palpable rib and the top of the iliac crest (hip bone). It was also measured to find out to assess the obesity, particularly abdominal obesity.

• Hip circumference was also measured by non-stretchable measuring tape nearest the 0.1 cm. It was measured at the maximum circumference over the buttocks.

• Waist-to-hip ratio was calculated by dividing waist circumference by hip circumference.

C. Recording Blood Pressure:

Blood pressure was measured by OMRON electronic device that has been recommended by WHO for community-based studies. It was measured on right arms and in sitting position. Two readings with the five minutes rest in between were recorded. The average of two readings was taken. But if there was >5mmHg variation in diastolic BP and/or >10mmHg in systolic BP, then third reading was also taken and then the average of three readings was used.

D. Biochemical Measurements:

The participants were pre informed and invited to the survey site in the morning for blood sample collection. 5 ml of overnight fasting venous blood was drawn to measure fasting plasma glucose and serum triglyceride.
Materials & Methods

Blood samples were collected in the collection lipid tube containing fluoride separately in the cold boxes and transported to the G.L.P. lab, B.H.U., Varanasi, immediately for analysis. Sample collection and analysis were done by lab workers using standard automated procedures (Roche Cobas Integra 400 Plus) and appropriate commercially available kits.

3.6.2 TO MEASURE ASSOCIATION AMONG RISK FACTORS

To measure the association between all the risk factors namely socio-demographic to behavioral, socio-demographic and behavioural to anthropometric and finally socio-demographic, behavioural and anthropometric to biochemical risk factors, standard and appropriate procedures were adopted. They will be mentioned in the section of analysis of data. (3.9)

3.6.3 DIETARY INTAKE/ NUTRIENT INTAKE AND DIETARY PATTERN

A. Interview:

Nutrient intake (mean nutrients intake/day) and diet diversity (in terms of consumption of different food items from all the food groups) were also assessed by interview with the help of 24 hour diet recall method and food frequency questionnaire respectively. To assess their correlates, appropriate statistical test were applied.

3.6.4 SELF-PERCEIVED/SELF-REPORTED HEALTH

A. Interview:

Perceived health or self reported health was also assessed to obtain complete picture of health both objective as well as subjective. Few questions were framed and asked to assess the subjective health of the study subjects.
Table 3.3: Tools and Techniques of the Study

<table>
<thead>
<tr>
<th>Tools Used</th>
<th>Techniques Used</th>
<th>Parameters Measured</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHO Steps instrument modified and pre-tested.</td>
<td>Interview</td>
<td>• Socio-demographic profile</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Behavioral risk factors</td>
</tr>
<tr>
<td>Weighing machine</td>
<td>Anthropometry</td>
<td>• Height</td>
</tr>
<tr>
<td>Steel anthropometry rod</td>
<td></td>
<td>• Weight</td>
</tr>
<tr>
<td>Measuring tape</td>
<td></td>
<td>• Waist circumference</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Hip circumference</td>
</tr>
<tr>
<td>Digital BP measuring Instrument (OMRON-HEM 7120)</td>
<td>Blood Pressure Measurement</td>
<td>• Hypertension</td>
</tr>
<tr>
<td>Weighing Machine</td>
<td>Anthropometry</td>
<td>• Obesity (BMI)</td>
</tr>
<tr>
<td>Measuring Tape</td>
<td></td>
<td>• Abdominal Obesity (WHR)</td>
</tr>
<tr>
<td>Interview Schedule</td>
<td>24 Hour-Recall</td>
<td>• Dietary Intake</td>
</tr>
<tr>
<td>FFQ</td>
<td>Method</td>
<td>• Dietary Pattern</td>
</tr>
<tr>
<td></td>
<td>Food Frequency</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Questionnaire</td>
<td></td>
</tr>
<tr>
<td>Blood Glucose &amp; Triglyceride Roch Kit (Cobas Integra 400 Plus)</td>
<td>Biochemical Analysis</td>
<td>• Diabetes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Hypertriglyceridemia</td>
</tr>
</tbody>
</table>

3.7 STUDY VARIABLES

Socio-demographic variables: This section consisted of variables such as age, sex, caste, religion, marital status, education, occupation, family income, family type and composition and socio-economic status.

Age: Majority of the subjects were able to state their correct age. The age of illiterate and unaware respondents was ascertained with the help of local events.

Gender: The present study included 301 (47%) male and 339 (53%) female subjects.
Caste: There were three categories as general (others), Backward (OBC) and Schedule caste/Schedule tribes (SC/ST).

Religion: This consists of four major religions as Hindu, Muslim, Sikh & Christian.

Marital Status: This was categorized into four categories as married, unmarried, divorced or widowed.

Education: It was also recorded as reported by the respondents. It was categorized as illiterate, literate up to primary, secondary, graduate, post graduate or above.

Occupation: They were asked about the current working status and were categorized as government/private servant, self-employed, retired, homemaker, student and unemployed.

Type of family: In the present study, a family was defined as a unit comprising two or more persons related by blood, marriage or adoption and residing together in the same dwelling unit with a common kitchen. A family was considered nuclear when it consisted of husband, wife and their dependent children, and joint family defined as if it included close relatives like sons, daughters who are not dependent, father, uncle, brother etc.

Socio-economic status: Participants were asked about the total family income from any source. The socio-economic class of the subjects was determined by modified B. G. Prasad classification.

Table 3.4: B.G. Prasad Classification for Socio-economic status

<table>
<thead>
<tr>
<th>Socio-economic Class</th>
<th>1961 (Base year)</th>
<th>2000 (October)</th>
<th>Revised income categories 2014 (January)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper class</td>
<td>100 and above</td>
<td>2200 and above</td>
<td>5357 and above</td>
</tr>
<tr>
<td>Upper middle class</td>
<td>50-99</td>
<td>1100-2199</td>
<td>2652-5356</td>
</tr>
<tr>
<td>Middle class</td>
<td>30-49</td>
<td>660-1099</td>
<td>1570-2651</td>
</tr>
<tr>
<td>Lower middle class</td>
<td>15-29</td>
<td>330-659</td>
<td>812-1569</td>
</tr>
<tr>
<td>Lower class</td>
<td>&lt;15</td>
<td>Below 330</td>
<td>&lt;811</td>
</tr>
</tbody>
</table>
Materials & Methods

**Multiplication Factor = Value of price index x 4.93/100**

Social classification for October 2000:

Multiplication Factor  
= 449* x 4.93 / 100  
= 22.1379 = 22.00

[*All India Consumer Price Index for October, 2000]*

Social classification for January 2014:

Multiplication Factor  
= 237* x 4.93 / 100  
= 11.6841 = 12

[*All India Consumer Price Index for January, 2014]*


**Risk Factors:** A risk factor refers to any attribute, characteristic, exposure of an individual which increases the likelihood of developing a chronic non communicable disease. World health Organization 2002 identified eight risk factors, broadly falling into two categories namely bahavioural risk factors and metabolic risk factors.

**Behavioural Risk Factors:** These risk factors can be modified by bringing behavioural changes which may further halt the progression of risk factors to next level that is metabolic risk factors. Bahavioural risk factors include tobacco consumption, alcohol consumption, fruits and vegetables intake, and physical activity.

- **Tobacco consumption:** Study subjects were asked about the current or past status of tobacco use. Information on type of tobacco, frequency of consumption, age at which tobacco consumption started was also collected. In case of past users, age at which they stopped using tobacco was also recorded to calculate the years of exposure

- **Alcohol consumption:** Respondents were asked if they had consumed alcohol over last 30 days. Pattern and frequency of alcohol use was also asked.
Materials & Methods

- **Dietary habits:** Dietary habits were recorded basically in terms of fruits and vegetables consumption. Participants were asked about the servings of fruits and vegetables consumed in a day. Information was also sought on the number of days a week they consume fruits and vegetables. WHO recommends consuming at least 5 serving of fruits and vegetables in a day.

- **Physical activity:** Physical activity was measured in three domains i.e. activity at work, to and from places and recreational activities. The interview schedule also covered type of activity (vigorous and moderate) at work and for recreational activities. Information was also collected on the number of days a week spent on different activities and time spent in a day for each activity was also recorded. Those who were not active in any domain were defined as “inactive”, those who were vigorously active in any category were defined as “vigorously active” and rest were in “moderately active”. The sedentary hours in a day doing nothing were also asked.

**Metabolic Risk Factors:** Behavioural risk factors may result in the metabolic risk factors, which may finally result in non-communicable diseases.

- **Obesity and Abdominal Obesity:** Overweight and obesity may lead to adverse metabolic effects. WHO International and Asian guidelines for BMI were used to define CED, overweight and obesity. For abdominal obesity, waist circumference and waist-to-hip ratio were calculated. As Indian population has higher percentage of fat as compared to white people of same age, sex and BMI, therefore, WHO Asian cut-offs were used to define abdominal obesity.

- **High blood pressure/Hypertension:** Blood pressure of each participant was measured by electronic device. A JNC 7 criterion was used to define hypertension and severity of hypertension. Awareness, treatment and control of hypertension were also recorded. Awareness was defined as history of hypertension based on diagnosis by a healthcare provider. Treatment was defined as taking any medication or other treatment for hypertension in the last two weeks prior to the survey and control was defined as blood pressure < 140mmHg and < 90 mmHg in subjects who were taking medications.
• **History of hypertension, diabetes mellitus and hypercholesterolaemia:** They were asked whether they had been diagnosed by doctor over last 12 months about any of these conditions namely; hypertension, diabetes mellitus and/or hypercholesterolaemia. Any treatment (allopath, homeopath or any herbal remedy) for these conditions were also taken into account.

**Biochemical/Metabolic risk factors:**

• **High Blood Glucose/Diabetes Mellitus:** Blood sugar was examined by drawing venous blood of participants. History of diabetes or awareness of diabetes was defined as a previous diagnosis by a doctor or health care provider. Treatment was defined when subjects were on medication prescribed by a medical doctors or health workers. Controlled diabetes mellitus was defined as a fasting blood glucose level <126mg/dl among those subjects who were taking medications.

• **High Blood Triglyceride:** Blood triglyceride was also examined and history was also taken into consideration. Again history of hypertriglyceridemia was defined as previously diagnosed subjects by a health care provider or doctor, treatment was defined as those who were taking lipid lowering drugs and control were defined as those who were on treatment and had their blood triglyceride below 160mg/dl.

**3.8 DEFINITIONS OF TERMS USED IN THE STUDY (WHO):**

- Current daily smokers are defined as those who were currently smoking cigarettes, bidis or hookah daily.

- Current daily smokeless tobacco users are defined as those who were currently using chewable tobacco products, gutka, khaini, surti, gul/sunghaini or zarda paan daily.

- Current alcohol drinkers are defined as those who reported to consuming alcohol within the past one year.
• One standard drink is equivalent to consuming one standard bottle of regular beer (285 ml), one single measure of spirits (30 ml) or one medium size glass of wine (120 ml).

• One serving of vegetable is considered to be 1 cup of raw green leafy vegetables, ½ cup of other vegetables (cooked or chopped raw) or ½ cup of vegetable juice.

• One serving of fruit is considered to be 1 medium size piece of apple, banana or orange, ½ cup of chopped, cooked, canned fruit or ½ cup of fruit juice, not artificially flavored.

• Physical inactivity is defined as less than 10 minutes of activity at a stretch, during leisure, work or transport.

• Body mass index (BMI) is calculated by dividing the weight (in kilograms) by square of height (in meters). Overweight is defined as BMI ≥25 and Obesity is defined as BMI ≥30.

• JNC (7) criteria was used to define hypertension. Hypertension is defined as BP ≥ 140/≥ 90 mmHg or currently on antihypertensive drugs.

• Waist-Hip ratio ≥0.90 for males and ≥0.85 for females and waist circumference ≥102 cm for males and ≥88cm for females were considered as abdominal obesity.

• Blood sugar level ≥126 mg/dl was defined as diabetes mellitus.

• Blood triglyceride level ≥160 mg/dl was defined as hyper triglyceridaemia.

3.9 STATISTICAL ANALYSIS:

The information obtained from the survey was entered into a database developed for the study, using SPSS 16.0 program. Descriptive statistics (Mean and standard deviation) were calculated for continuous variables and frequencies and percentages were calculated to summarize qualitative data. To assess the statistical association between categorical data, chi-square test was applied. In order to test the
differences between means of continuous variables ANOVA and independent t test were applied. Logistic regression analysis was done to compute odds ratio and confidence interval (CI). These were used to examine and quantify the association between the risk factors.

3.10 ETHICAL ISSUES:

I. Consent: Ethical approval to conduct the study was taken from the Institutional Review Board, Institute of Medical Sciences, Banaras Hindu University, Varanasi. Verbal and written consent (Available in appendix) were taken from all participants.

II. The purpose, aims and the process of the research were fully explained to the participants. Awareness for their right to withdrawal from the study at any time without reprisal was ensured to every participant. Confidentiality and privacy were maintained throughout the whole process.

III. Privacy: During all the anthropometric and biochemical measurements privacy was ensured. The interview was conducted at household of the respondent, as per the convenience of the respondent. Visual and auditory privacy was strictly ensured.

IV. Confidentiality: The identity of the each participant was kept anonymous during data handling. Confidentiality of the test results was maintained and all the participants were informed about anthropometric measurements and biochemical investigation.

V. Safety: During venous blood drawing, utmost care was provided to avoid injury and infection to the subjects. The disposable sterile syringes and needles instruments were utilized and disinfection was carried out with strictness. No injury was reported during the whole blood investigation process.

Those subjects who were having any anthropometric or metabolic risks linked to health care provider in their area or to Sir Sunder lal Hospital, BHU, Varanasi, whichever they found easily accessible. Proper nutrition and life style changing advice was also given to each participant by the researcher.