Non-communicable diseases are the leading cause of death worldwide than all other causes combined. Contrary to what people generally believes, almost 80% of NCDs deaths occur in low & middle income countries. India is experiencing a rapid health transition from communicable to non communicable diseases. According to World Health Organization an Indian today has over twice the odds of dying of a non-communicable disease than a communicable disease.

An increasing trend in NCDs risk factors has been observed globally during the two decades from 1990 to 2010; blood pressure (27% increase), smoking (3% increase), alcohol use (28% increase), low fruit (29% increase), high body-mass index (82% increase), and high fasting plasma glucose (58% increase). An increase in such risk factors may lead to raised NCDs’ burden.

In order to take effective prevention measures for chronic diseases, identification of the risk factors is an essential prerequisite. There is paucity of data about the prevalence of risk factors of NCDs, especially in this region of the state. With this background, this study was conducted with the aim of assessing the prevalence and correlates of risk factors of non-communicable diseases in urban Varanasi. The specific objectives of the study were:

1. To determine the prevalence of risk factors of NCDs.
2. To measure the association between socio demographic, behavioural, anthropometric and biochemical risk factors.
3. To assess the dietary pattern of study subjects and its association with socio-demographic, behavioural, anthropometric and biochemical risk factors.
4. To assess the self- perceived health and its association with the presence of the risk factors.
Summary

This cross-sectional study was carried out among the people aged 25-64 years living in the selected area. By following appropriate sampling technique 640 study subjects were selected from urban Varanasi by adopting multistage sampling procedure. After obtaining approval by Institute Ethical Committee, Institute of Medical Sciences, Banaras Hindu University and taking consent from the participants, study subjects were interviewed for socio-demographic characteristics, which served as basis for assessing social determinants of risk factors of NCDs. A modified & pre-tested WHO Steps approach instrument was used to collect information on risk factors of NCDs. In addition to this dietary intake and dietary pattern was assessed by using 24 – Hour recall method and food frequency questionnaire (FFQ) respectively. To get a complete picture of health, self perceived health was also assessed. Both the objective and subjective measurement of health was done.

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. Other statistical tests like chi-square test and ANOVA were applied. Logistic regression was applied to identify the correlates of risk factors of NCDs. A significance level of 0.05 was used.

Following are the salient findings of the study:

7.1 Socio-demographic profile and prevalence of risk factors of NCDs

7.1.1 As much as 31.9%, 28.0%, 20.8%, 19.4% subjects belonged to the age group of 25-34 years, 35-44 years, 45-54 years and 55-64 years respectively. Female subjects were more in number than males (53% vs. 47%).

7.1.2 Caste wise general, OBC and SC/ST subjects were 48.9%, 47.7% and 3.4% respectively. Religion wise majority of them were Hindus.

7.1.3 Majority of the subjects were married (85%), followed by unmarried and widowed/divorced subjects.

7.1.4 Predominantly joint family system was seen among the subjects with the average family size of 5.6. This shows that joint families are still in vogue in the study area.
7.1.5 As much as five out of ten subjects were educated up to graduate &/or above and one out of ten was illiterate. Majority of the subjects were highly educated as the study was carried out in urban area and maximum subjects belonging to the youngest cohort.

7.1.6 Majority of the subjects were employed in government or private sector (skilled workers) followed by home-maker.

7.1.7 As much as 37%, 22%, 19%, 16% and 6% subjects were belonged to upper class, upper middle class, middle class, lower middle class and lower class respectively.

7.1.8 Family history of chronic diseases was reported by 32% subjects. Majority of the subjects reported the family history of diabetes, followed by hypertension. History of chronic diseases was highest among first degree of relatives (mother and father).

7.1.9 With regard to beahavioural risk factors of NCDs, tobacco consumption was found in almost one third (31%) of the study subjects. Majority were smokeless tobacco users. The most used smokeless tobacco product was paan (betel quid), followed by gutkha (chewing tobacco), surti (khaini) and gul/sunghani. A positive trend was observed between age and tobacco consumption.

7.1.10 The prevalence of alcohol consumption was 10%, maximum alcohol users were male subjects (22%) and only one woman reported to consume alcohol suggesting potentially beneficial influences of social mores. Age wise highest prevalence was observed in the eldest age group (13.7%) and was least in the youngest age group (6.9%).

7.1.11 The prevalence of physical inactivity was 9.5% (11.0% male and 8.0% female). Almost 90% subjects were moderately active. Out of three domains, maximum inactivity was recorded during leisure (64%) followed by during work (47%) and least during travel (29%).
7.1.12 None of the subjects were consuming at least 5 servings of fruits and vegetables a day as recommended by WHO. Mean intake among men and women were 2.84 servings and 2.79 servings per day respectively.

7.1.13 Regarding anthropometric risk factors, all the measurements except BMI namely height, weight, waist circumference and hip circumference were higher among male than female subjects. Only half of the study subjects were in the normal category, rest was either underweight (11%) or overweight (38%). On the basis of WHO global classification of BMI, the prevalence of overweight and obesity was 29% and 9% respectively. On the basis of waist circumference, the prevalence of abdominal obesity was 40%. The prevalence of overweight, obesity and abdominal obesity was higher among female than male subjects. Mean BMI (25.35 kg/m$^2$) and the prevalence of central obesity (50%) both were highest in the 45-54 years age group.

7.1.14 The prevalence of hypertension and pre hypertension was 32.96% and 41.7% respectively. The prevalence of hypertension and pre-hypertension was higher among male subjects. Mean systolic and diastolic blood pressure was 124.2 mmHg and 83.4 mmHg respectively. Overall the highest systolic BP and diastolic BP were maximum in the eldest age group (130.9 mm Hg) and the preceding eldest age group (86.1 mmHg) respectively.

7.1.15 Biochemical parameters were done on sub sample (104) due to logistic constraints. Mean fasting blood glucose was 111.28 mg/dl. The prevalence of hyperglycemia was 17% and the prevalence of diabetes was more than two times higher among male than female counterparts (26% vs. 12%). Age wise the majority of the diabetic subjects were from the 35-44 years age group (38.5%) among the male subjects and 45-54 years age group (30.8%) among females.

7.1.16 Mean fasting blood triglyceride level was 153.18 mg/dl. The prevalence of raised blood triglyceride was 9.6%. The prevalence was higher among female than male subjects (10.6% vs. 7.9%). Age wise among male 45-54 years age
group (11.1%) and among females eldest age group (30.6%) had the highest prevalence of hypertriglyceridemia.

7.2 Association between socio-demographic, behavioural, anthropometric and biochemical risk factors of NCDs

7.2.1 Gender, age, caste, marital status, education, occupation and socio-economic status were significantly associated to tobacco consumption (p<0.05). Logistic analysis revealed that being male (AOR : 9.36, CI: 4.67 – 18.76), advancing age (AOR: 3.02, CI: 1.55 – 5.88) and lack of formal education (AOR: 7.98, CI: 3.34 – 19.04) were major determinants of tobacco consumption.

7.2.2 Alcohol use was significantly higher (p <0.001) among male subjects (22.6%) than their female counterparts (0.3%) and unemployed and unskilled workers (26.5%). As one’s occupation decides one’s economic conditions, peer groups or colleagues, level of stress related to profession; therefore occupation is an important deciding factor which consequently affects the use of alcohol.

7.2.3 Physical inactivity was significantly associated to education and socio-economic status of the study subjects. The maximum prevalence of physical inactivity was observed among graduate and or above educated subjects (15.2%) and subjects from upper SES (15.8%).

7.2.4 Body mass index was significantly associated to age, caste, marital status, education, occupation, socio-economic status and dietary habits (p <0.05). Logistic analysis confirmed that female (AOR: 1.99, CI: 1.38 – 2.89) had the higher odds of being overweight and obese than males. 45-54 years age group (AOR: 4.39, CI: 2.64 – 7.30) had four times higher odds of being overweight/obese than their younger counterparts and primary educated had highest odds (AOR: 3.01, CI: 1.42 – 6.38). Though not significantly different but the prevalence of overweight and obesity was higher among tobacco and alcohol users than their non-users counterparts.

7.2.5 Abdominal obesity was also found to be significantly associated to gender, age, caste, occupation, socio-economic status, tobacco and alcohol
consumption, dietary habits and physical activity (p <0.05). Out of all these variables, being female (AOR: 8.08, CI: 4.71 – 13.87), 45-54 years age group (AOR: 2.23, CI: 1.31 – 3.80), higher socio-economic status (AOR: 4.41, CI: 1.78 – 10.95) and physical inactivity (AOR: 2.13, CI: 1.18 – 3.88) were significant predictors of abdominal obesity. Other than that tobacco and alcohol use was significantly proved to be protective factors against abdominal obesity. The reason behind this inverse association between alcohol use and abdominal obesity could be that majority of the subjects drink occasionally and that too low amount of alcohol.

7.2.6 Regarding hypertension; gender, age, marital status, occupation, education, socio-economic status, tobacco use, physical activity, overweight and obesity and abdominal obesity were significantly associated (p<0.05). Logistic analysis revealed that being male (AOR: 1.95, CI: 1.12 – 3.40), advancing age (AOR: 6.09, CI: 3.37 – 11.01), tobacco use (AOR: 1.79, CI: 1.23 – 2.61) and obesity (AOR: 2.80, CI: 1.17 – 6.67) were significant determinants of hypertension. Out of the total subjects with hypertension, around one-third of the subjects were aware of their condition. Out of those who were aware, 70% were seeking treatment. Only a third of the treated subjects with hypertension had their blood pressure adequately controlled.

7.2.7 As observed, 45-54 years age group, retired & skilled workers, alcohol users and hypertensive subjects had the highest prevalence of raised blood glucose. With each increasing risk factor the prevalence of diabetes was significantly increasing, 3.8% among no risk factors to 50.0% among more than four risk factors.

7.2.8 BMI (body mass index) and diabetes were found significantly associated to the raised blood triglyceride (p <0.05). A significant association was found between number of risk factors and raised blood triglyceride.

7.3 Dietary pattern of the study subjects and its association with socio-demographic, behavioural, anthropometric and biochemical risk factors

7.3.1 As per RDA by ICMR, insufficient dietary intake of calorie, sodium and potassium were observed in males & calorie, protein, carbohydrate, sodium,
potassium & iron were observed in females. Total calories (kcal), carbohydrates (gm) and proteins (gm) were more or less within the RDA range or less than the RDA but fat (gm) consumption was almost two times higher than recommended among both the genders.

7.3.2 Overall energy intake as percentage of RDA was 80% among males and 83% among females.

7.3.3 Nutrient adequacy for carbohydrate was 111% among men and 96% among women subjects.

7.3.4 Protein intake as percentage of RDA was 110% among men and 95% among women.

7.3.5 Fat intake was much higher than recommended; as percentage of RDA observed was 193% among men and 200% among women.

7.3.6 Calcium intake was higher than RDA; 141% and 114% among men and women respectively Sodium and potassium intake among men were 95% and 72% of RDA respectively, corresponding values for female subjects were 81% and 82% of RDA respectively.

7.3.7 Iron intake was adequate among men (108% of RDA) but it was inadequate among women subjects (82% of RDA).

7.3.9 Vitamin A intake was almost two times higher than recommended among both men and women. Intake of Vitamin C was also high among men (168%) and women (153%) both.

7.3.10 Intake of carbohydrate more than the RDA was recorded among 58% male and 25% female, protein in 45% male and 27% female, fat in 86.4% male and 86.7% female and calorie in 15% male and 29% female subjects.

7.3.11 There was significant association observed in nutrients intake with respect to caste, education and socio-economic status (p<0.05).
7.3.12 Considering association between nutrients intake and behavioural risk factors, nutrient intake was higher among alcohol users, physically inactive subjects and among those who consumed unhealthy diet.

7.3.13 Overweight and obese subjects and pre hypertensive and hypertensive subjects had higher intake of major nutrients as compared to their normal counterparts. Diabetic and subjects with raised blood triglyceride had higher intake of nutrients than their normal counterparts, but no significant difference was observed.

7.3.14 Around 41% subjects were vegetarian and 14% had fixed timing of meals.

7.3.15 78% subjects were consuming three meals a day and around 70% subjects preferred spicy and fried food.

7.3.16 Approximately 30% subjects were consuming extra salt and ghee during meals.

7.3.17 Only 10% subjects were consuming wheat flour with choker.

7.3.18 Wheat and rice consumption was very frequent (daily) by 100% and 95% subjects respectively.

7.3.19 Consumption of pulses was also very frequent among all the study subjects.

7.3.20 Consumption of milk and curd was very frequent among 47% and 21% subjects respectively. There was significant gender difference observed with respect to milk and curd consumption (p <0.001).

7.3.21 Consumption of non-vegetarian products was found once or twice a month by majority of the subjects.

7.3.22 Roots and tubers and green leafy vegetables were consumed almost daily by all the study subjects (99%) while fruits were consumed frequently only by 57% subjects. 7% subjects consumed fruits and vegetables rare or never.
7.3.23 Fast food consumption was not much frequent among the study subjects. Consumption of pizza, burger and french fries was never done by 95%, 88% and 98% subjects respectively.

7.4 **Self-perceived health and its association to the presence of risk factors**

7.4.1 Almost 80% subjects reported to perceive their health as good while 20% subjects perceived their health poor.

7.4.2 Regarding general health issues, majority of the participants reported tiredness (31%) followed by pain (22%), weakness (18%), dizziness (14%), digestive complaints (9%) and then breathlessness (3%). All the health issues were significantly higher among women than their male counterparts (p < 0.05).

7.4.3 Association between self-perceived health status and socio-demographic characteristics revealed that gender, caste, marital status, education, occupation and socio-economic status were significantly associated (p < 0.05).

7.4.4 Overall, being female (AOR: 1.96, CI: 1.02 – 3.78), being married (AOR: 3.30, CI: 1.02 – 10.63), illiteracy (AOR: 2.75, CI: 1.24 – 6.20) and unemployment (AOR: 2.68, CI: 1.01 – 7.13) were the independent determinants of poor self perceived health.

7.4.5 None of the risk factors, except hypertension & waist-hip ratio were significantly associated to self-perceived health (p <0.05). Fortunately, a majority of the factors associated with self-perceived health examined in this study are modifiable (eg, hypertension, WHR) and can be prevented or reversed with changes in lifestyle.

7.4.6 Dietary intake of all the major nutrients (carbohydrate, protein, energy) & minerals (phosphorus, sodium, iron) were significantly higher in those who perceived their health good (p <0.05).

7.4.7 A positive and significant association was observed between self reported NCDs and number of risk factors among the study subjects. Prevalence of NCDs was reported by 4.7%, 11%, 28% and 30% study subjects among no
risk, one or two risk factors, three or four risk factors and more than four risk factors respectively.

**RECOMMENDATIONS:**

Based on the conclusions drawn from the present study following recommendations were made-

**Service Recommendations:**

- As the results indicated, the prevalence of NCDs risk factors were gender related, gender sensitive preventive measures should be taken into consideration.

- A continuous national surveillance system on risk factors should be instituted by the Centre for Diseases Control and Prevention to offer up-to-date analysis of the national risk factor profile.

- Data on multiple risk factors should be used as the baseline foundation for legislation and intervention by the public health authorities and policy planners.

- Clinicians, including medical doctors, physiotherapists and nurses in both public and private health care sectors, should incorporate enquiries on modifiable health risk behaviours in order to ensure early detection at the primary health care level.

- Establishment of alternative, low cost and feasible strategies for screening and early diagnosis of NCDs for their optimal use in health system settings.

- Formulation and strengthening of policies to control the incidence of tobacco use in schools, workplaces and other public places to minimize the effects of smoking on smokers, passive smokers or the general public as a whole.

- Routine public education on awareness through educational campaigns for promoting healthy life styles.

- Establishment and strengthening of a stepwise surveillance system for NCDs to monitor the trend of the diseases over time.
Summary

- Build capacity and mechanisms for optimal utilization of collected data through timely dissemination of information, linking to policy, planning, and program implementation and providing research impetus.

Research Recommendations:

- In order to account for seasonal variation in physical activity and dietary pattern, a prospective study will be useful.

- Longitudinal assessments of social, cultural, and economic determinants of behavioral risk factors to characterize their relationship and impact to NCDs and to plan interventions accordingly.

- To study behaviour management strategies for modifying risky behaviors at individual, family, and community level.

- Further research in this area with larger sample size is needed to create baseline data of risk factors of NCDs for policy makers, especially incorporating Step 3 of the WHO STEPwise protocol to give a more comprehensive profile.

- For wider applicability it is proposed to undertake multi-centric studies on risk factors of NCDs to assist in taking preventive steps in right direction.