CHAPTER V

SUMMARY

AND

CONCLUSION
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In recent times attention is being paid by Biological Anthropologists more particularly to conduct and understand genetic epidemiological studies pertaining to certain diseases and their associated risk factors. Over the past two decades increasing interest has emerged in the epidemiological study of patterns of health and disease. Technological advancement and rapid changes in socioeconomic conditions of the population groups profoundly altered the life expectancy and ways of living while creating an unprecedented human capacity to use science to both prolong and enhance life changes. Among these health transitions, the most globally pervasive change has been the rising burden of NCDs. Epidemics of NCDs are presently emerging or accelerating both developed and developing countries. India too illustrates this health transition, which positions NCDs as a major public health challenge of growing magnitude in the 21\textsuperscript{st} century.

Several factors are responsible for the causation of NCDs. Overweight and obesity pose a major risk for chronic diseases, which include hypertension, T2DM, CVDs, stroke, musculoskeletal disorders and certain forms of cancers. The driving forces linking obesity, hypertension, and diabetes remain to be clarified due, in part, to the complex and multifactorial nature of the conditions that involve combinations of environmental, genetic, lifestyle, and behavioural confounders. Though the association of BMI with hypertension and diabetes has long been the subject of epidemiological research, it has not been sufficiently explored in many populations.

The prevalence of overweight/obesity and its related risk factors is increasing globally with high rates in developing nations, particularly in India. The prevalence rates vary widely between populations, reflecting differences in both environmental influences and genetic susceptibility. Populations or endogamous groups of India showed differences or affinities with respect to some genetic markers and there is a
variation in their cultural practices and lifestyle pattern too. Thus, population
differences could be observed with respect to the prevalence of noncommunicable
diseases such as hypertension, diabetes mellitus, CVDs, cancer etc. Hence, from
anthropological perspective, it is indeed necessary to have in-depth epidemiological
studies.

India being multiethnic and multilingual, with its unique population structure
based on the caste system and there is an extensive disparity in their cultural practices
and lifestyle patterns, population differences observed with respect to the prevalence of
NCDs. For this reason, there is a dire need to have data on overweight and obesity and
its association with blood pressure and diabetes mellitus risk factors. The populations of
Andhra Pradesh also show a wide variation in the lifestyle patterns due to economic
shift and urbanization. Therefore, a differential pattern of BMI and its association with
blood pressure and blood glucose levels could be expected. Hence, the present study
has been undertaken to examine and assess the current levels of risk factors in both
urban and rural populations.

The main aim of the current study is to assess the body mass index and its
association with blood pressure and blood glucose levels in urban and rural habitats.

The specific objectives of the study are: to understand the demographic and
lifestyle characteristics of the urban and rural populations, to assess the body
composition and the prevalence of overweight and obesity in both the urban and rural
populations, to examine the systolic and diastolic blood pressure levels and the
prevalence of the hypertension, to estimate the blood glucose levels and identification
of hyperglycemic subjects in both the population groups, to decipher the effect of
demographic and lifestyle characteristics in the predisposition of overweight and
obesity, to know the effect of the body mass index in the elevation of blood pressure
and blood glucose levels in the study populations and to see the comparative evaluation
of the confounding factors between urban and rural population.
The materials selected for the present study belong to heterogenous population inhabiting with different socioeconomic and cultural milieu of Chittoor District. The sample drawn for the present study is 1520 healthy adults, of which 802 are from urban centres (males: 421 and females: 381) and 718 are from rural villages (males: 382 and females: 336) of Chittoor District, Andhra Pradesh State, India.

The data for urban population are collected from Tirupati and Chittoor towns of Chittoor District and the data for rural population are collected from 20 randomly selected villages of Chittoor District. A simple random sampling technique is employed in selecting the subjects. The objectives of the study are explained to all of the subjects before their consent is given. Written informed consent is obtained from all the participants. The age range of the population is between 30 and 65 years.

A structured and standardized questionnaire is used to collect the data on the demography, socioeconomic status, physical activity, smoking and alcohol habits and lifestyles via face-to-face in depth interviews. Data on subject’s anthropometric measurements like height, weight, waist and hip circumferences are taken. Subject’s blood pressure is recorded as per the standard procedure. Further, fasting blood sample is obtained from the all the subjects and fasting blood glucose is estimated as per the standard procedure. Statistical analysis is carried out via SPSS – 16.0 and alpha levels are set at p<0.05. Suitable statistical tools are applied to draw the conclusions.

The age range in the present study is 30-70 years. Illiteracy is more in rural than urban areas. Subjects with employment are dominating in urban than rural habitat. Heavy manual labor is greater in both the genders of rural habitat and sedentary physical activity is greater in urban. Habit of smoking and alcoholism is noticed only male gender in both habitats.

Age adjusted descriptive statistics for anthropometry, blood pressure and blood glucose levels show that urban population are characterized by elevated body mass index, blood pressure and blood glucose levels than rural populations. Obese-I is noticed to an extent of 19 to 22% in urban males and females and 8 to 12% in rural
males and females. The percentage of hypertensives are more in urban than rural. Hyperglycemia is present among 17% of males and 15% of females in urban whereas, the frequency in rural males and female are 10.47% and 7.44% respectively.

Age effects are noticed in WHR, pulse rate and blood pressure in urban population and WHR, blood pressure and blood glucose in rural population. Level of education in both urban and rural populations does not show any significant impact in the mean body mass index, systolic and diastolic blood pressure and fasting blood glucose levels. Urban population involved in business and employment are characterized by higher mean body mass index. Whereas, in rural population occupational levels do not show any significant variation in the mean levels of body mass index, waist-hip ratio, pulse rate and fasting blood glucose.

Subjects with sedentary activity are characterized by higher levels of mean body mass index, systolic blood pressure, diastolic blood pressure, and fasting blood glucose in urban and rural populations. Habit of smoking and alcoholism elevated the mean levels of body mass index, systolic blood pressure and fasting blood glucose in urban population when compared to smokers in rural areas.

Bivariate analysis indicates a positive correlation between confounding factors in both sexes of urban and rural populations. However, the degree of relation is greater in urban than rural. In both urban males and females weight of the subjects gradually increased from normal weight to obese. Women dominated men in the BMI categories. Mean waist-hip ratio is greater in men than women with no significant differences within the BMI categories. Systolic and diastolic blood pressure levels increased from normal weight to obese in both males and females. Fasting blood glucose levels significantly elevated in obese subjects than normal weight subjects. In rural population mean Systolic and diastolic blood pressure values are increased from normal weight to obese. Mean fasting blood glucose levels are greater in males than females in all the categories of BMI. Fasting blood glucose levels gradually increased from normal weight to obese.
In urban population, hypertensive males and females are characterized by elevated body mass index than normotensives. Mean values of waist and hip circumference are significantly elevated in hypertensive males and females. Mean values of fasting blood glucose levels are significantly higher in hypertensive males and females. In rural population, hypertensive subjects are heavier than normotensives in both genders. Mean values of body mass index in hypertensive males and females greatly elevated than normotensive males and females. Both the mean values of waist and hip circumference are significantly increased in hypertensives than normotensives. Mean fasting blood glucose levels are higher in hypertensives than normotensives.

In urban population, hyperglycemic males and females are heavier than normoglycemic males and females. Mean values of BMI among hyperglycemic males and females are greater than normoglycemic subjects. Both mean values of waist and hip circumferences are higher in hyperglycemics than normoglycemic subjects. In both sexes mean values of systolic and diastolic blood pressure levels are significantly higher in hyperglycemics than normoglycemic subjects. In rural population, mean weight and BMI are significantly elevated in hyperglycemics than normoglycemics. An elevation in the mean values of both waist and hip circumferences are characterized in hyperglycemic than normoglycemic subjects. Mean systolic and diastolic blood pressure levels are significantly higher in hyperglycemic males and females than normoglycemic males and females.

In urban population percentage frequency distribution of hypertensives increased gradually with age, higher education and socioeconomic status and sedentary physical activity. In rural population occupation, sedentary physical activity contributed for elevation in prevalence of hypertensives.

When compared to illiterates the odds of overweight is 1.608 (95% CI; 1.031-2.508) among the subjects with primary education in urban. The odds of overweight among smokers is 0.748 (95%CI; 0.611-0.915) when compared to nonsmokers. No significant changes in the odds of obesity is seen with socioeconomic and lifestyle
determinants. Whereas, in rural subjects odds of overweight and obesity failed to show significant changes with socioeconomic and lifestyle determinants.

Age adjusted linear regression model of the effect of the body mass index on blood pressure and blood glucose values in urban population shows that in males 18% of the variance in systolic blood pressure, 8% of the variance in diastolic blood pressure and 24% of the variance in fasting blood glucose levels is exerted by BMI. The $\beta$ coefficients are SBP: 0.435; DBP: 0.298; FBG: 0.491 respectively. In female subjects, 17% of the variance in systolic blood pressure, 10% of the variance in diastolic blood pressure and 11% of the variance in fasting blood glucose levels is explained by BMI. The $\beta$ coefficients are SBP: 0.415; DBP: 0.318; FBG: 0.338 respectively. A statistically significant increase in systolic BP (P<0.001), diastolic BP (p<0.001) and fasting blood glucose (p<0.001) is seen with increase in BMI category. In rural male subjects, 8% of the variance in systolic blood pressure, 4% of the variance in diastolic blood pressure and 16% of the variance in fasting blood glucose levels is explained by BMI. The $\beta$ coefficients are SBP: 0.333; DBP: 0.205; FBG: 0.406 respectively. In female subjects, 9% of the variance in systolic and diastolic blood pressure and 15% of the variance in fasting blood glucose levels is explained by BMI. The $\beta$ coefficients for SBP: 0.331; DBP: 0.322; FBG: 0.409 respectively. A statistically significant increase is seen in systolic BP (P<0.001), diastolic BP (p<0.001) and fasting blood glucose (p<0.001) with increase in BMI category.

In urban males, 7% of the variance in systolic blood pressure and 8% of the variance in diastolic blood pressure is explained by fasting blood glucose. The $\beta$ coefficients are SBP and DBP are 0.275 and 0.285 respectively. In female subjects, 3% of the variance in systolic blood pressure and 4% of the variance in diastolic blood pressure is explained by fasting blood glucose. The $\beta$ coefficients for SBP and DBP are 0.413 and 0.166 respectively. In rural male subjects, 3% of the variance in systolic blood pressure and 1% of the variance in diastolic blood pressure are explained by fasting blood glucose. The $\beta$ coefficients are SBP and DBP are 0.174 and 0.086 respectively. In female subjects, 17% of the variance in systolic blood pressure and
19% of the variance in diastolic blood pressure is explained by fasting blood glucose. The β coefficients for SBP and DBP are 0.377 and 0.512 respectively.

Age and sex adjusted linear regression model of the effect of body mass index on blood pressure and blood glucose levels according to BMI categories in urban population shows that normal weight exerted 2% of the variance in systolic blood pressure and the variance has been increased to 12% in overweight and has come down to 3% in obese subjects. Similarly the β coefficients have increased from 0.104 in normal weight to 0.190 in overweight with a later decrease to 0.086 in obese subjects. Normal weight has explained the variance in diastolic blood pressure to an extent of 1% and the variance increased to 10% in overweight and a later decrease in obese subjects for about 5%. The β coefficients have increased from 0.020 in normal weight to 0.172 in obese subjects. 1% of variance in fasting blood glucose levels is exerted by normal weight subjects. For about 9% of the variance in fasting blood glucose levels is explained by overweight subjects. The β coefficients have increased from 0.011 in normal weight subjects to 0.182 in obese subjects. The adjusted BMI values have significantly related to systolic BP and diastolic BP. An increase in one unit of BMI is associated with an average increase of about 0.09 mmHg, 0.172 mmHg and 0.182 mg% for systolic BP, diastolic BP and fasting blood glucose levels.

In rural population around 1-2% of variance in systolic blood pressure is exerted by normal weight, overweight and obese subjects. The β coefficients have increased from 0.087 in normal weight to 0.260 in overweight subjects. BMI categories have failed to explain the variance in diastolic blood pressure. Obese subjects have exerted 15% of the variance in fasting blood glucose levels and the β coefficients have has recorded 0.379. The adjusted BMI values have significantly related to systolic BP and diastolic BP. An increase in one unit of BMI is associated with an average increase of about 0.26 mmHg, 0.197 mmHg and 0.379 mg% for systolic BP, diastolic BP and fasting blood glucose levels.
The results of the present study reveal that body mass index is the best predictor of blood pressure and blood glucose. The composite effect of major risk factors such as age, physical activity and socioeconomic status explained only a small fraction of variation in both urban and rural populations. In urban subjects there is a raised level of NCD risk factors. These differences contrast sharply with rising NCD risk factor prevalence in urban subjects suggest either that other risk factors account for this trend or that the relationship between obesity and blood pressure and blood glucose in NCD risk may differ between the two populations.

The present study confirms many of the previous observations that obesity influences blood pressure and blood glucose levels. Most of the effects are mediated through changes in body mass index. If the hypothesis that obesity is more strongly protective of NCD is correct, then some of the benefits of lifestyle modifications aimed at preventing NCD may well be operating through altered lifestyle mechanisms.

This study reveals that the increased prevalence of NCD risk factors is more prevalent in urban population, suggesting that this group is at increased risk in developing NCD than rural counterparts. Combination lifestyle therapies i.e., enhanced physical activity and dietary modification and therapeutic intervention would help in treatment and management of overweight/obesity.

**Conclusion**

In conclusion, it is inferred that urban populations are more vulnerable towards NCD risk factors mediated by elevation in body mass index. Further, body mass index is the predominant variable to explain the variation in blood glucose and blood pressure. Socioeconomic and lifestyle transition, that are taking place in the lives of urban and rural populations, are supposed to be the causative factors for the observed escalation in the risk factor prevalence. The present analysis brings out new dimension and horizon for understanding the phenomenon of overweight/obesity and its intimate relationship with blood pressure and type 2 diabetics.
Indians are facing growing “epidemics” of overweight/obesity and related morbidities. Several factors including rapid urbanization, demographic changes, rural-to-urban migration, faulty diets, sedentary lifestyle, and sociocultural factors along with genetic predisposition have emerged as major contributory factors. Evidence is available for effective intervention programs with emphasis on nutrition, physical activity and lifestyle changes in children and also in adults for prevention of obesity, T2DM and dyslipidemia.

Present study supports the recommendations of WHO (2008), for developing countries to put emphasis on primary prevention and community programs promoting physical activity and healthy dietary habits, including the reduction of smoking and alcohol consumption, which are probably involved in the increase of overweight, obesity, hypertension and diabetes. Weight loss can be achieved through lifestyle interventions, such as, dietary adjustment and regular physical activity. These interventions are safe and are moderately effective measures with which to manage hypertension and diabetes as a result of obesity. The causal associations established in the present study can be strengthened by undertaking further studies with larger sample size are likely to be conducted at local geographical levels to plan and evaluate the results of future interventions.

The outcome of the present work is helpful for the health care providers and policy makers in many ways. First, generating local prevalence of obesity may serve to inform the local population of the seriousness of the epidemics in their communities. Second, such estimates may be of considerable interest to local media who will help to disseminate messages of the importance of maintaining a healthy weight. Third, local information may also be helpful to health care professionals in helping their patients manage their weights. Fourth, local foundations that focus on health issues in the communities they serve may also use this information to develop their priorities. Fifth, local health officials need data about their communities to help them assess the health of their communities, determine policies, and allocate resources among competing priorities.