Chapter 7

Summary and Conclusion
Current trend in Public Health research have created demand for relevant information from Biological Anthropology, in particular, and Social Sciences. World health is in transition. Epidemiologically, many low and middle-income countries are now experiencing a double burden of Communicable and Non-Communicable Disease(s) (NCDs) disease. The burden of NCDs in developing countries already outweighs that of communicable diseases, both in countries with high and low mortality. NCDs, specially Cardiovascular Disease (CVD), Type 2 Diabetes Mellitus (T2DM) and cancer account for 53% and 44% of all deaths and Disability Adjusted Life Year(s) (DALYs) respectively in India.

The term diabetes mellitus, specially T2DM describes a metabolic disorder of multiple etiologies including both genetic and environmental influence. India leads the world with largest number of diabetic subjects earning the dubious distinction of being termed the "diabetes capital of the world". The term "risk factor" is commonly used to describe factors that are positively associated with the risk of development of a disease. According to World Health Organization (1999) and American Diabetes Association (2004; 2006), age, family history of diabetes, race/ethnicity are some of the non-modifiable risk factors, while overweight, habitual physical inactivity, Impaired Fasting Glucose (IFG) or Impaired Glucose Tolerance (IGT), Hypertension (HT), High Density Lipoprotein (HDL) cholesterol ≤ 35 mg/dl and/or a triglyceride level ≥ 250 mg/dl are some of the modifiable risk factors for T2DM.

In view of the above consideration, the present study attempted to evaluate the relationships of anthropometric variables with some physiological risk factors, such as Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP) including HT and metabolic risk factors, including Fasting Plasma Glucose (FPG), 2 hour Postload Plasma Glucose (2-h
Excluding individuals having known disease or under medication two hundred and three (203) adult Bengalee Hindu males from Barasat, the District town of North 24 Parganas, West Bengal, India was incorporated in the present cross-sectional study. Data collection was done following STEPS approach (WHO, 2005), with substantial modifications relevant to NCDs such as T2DM. Data on demographic and socio-economic characteristics were collected from each participant by specially prepared schedule, which includes information on age, religion, marital status, number of family member, educational status, occupational status, and monthly household income. Information on weekly or monthly average consumption of different foods item along with number of times per day have been collected by an open ended food frequency schedule. Number of times of taking meal per day was also collected from the participants. Information on tobacco use and alcohol consumption was collected from all participants by using the schedule. Information on regular morning or evening walk and engagement in regular physical exercise were also collected from each participant. Information on sleep duration in working days and off-days were collected by the schedule. Data on family history of diabetes, if any was also collected from each participant.

Anthropometric measurements were taken following standard techniques (Lohman et al., 1988), which includes Stature (ST), Weight (WT), Mid Upper Arm Circumference (MUAC), Abdominal Circumference (AC), Minimum Waist Circumference (WC), Maximum Hip Circumference (HC), Mid Thigh Circumference (MTC), Biceps Skinfold Thickness (BSF), Triceps Skinfold Thickness (TSF), Sub-Scapular Skinfold Thickness (SSSF), Abdominal Skinfold Thickness (ASF), Suprailliac Skinfold Thickness (SISF),
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Medial Calf Skinfold Thickness (MCSF) and Total Body Fat (TBF). The following ratios and indices were derived by using standard equations on the basis of different anthropometric measurements, namely, Body Mass Index (BMI in kg/m²), Conicity Index (CI), Waist Hip Ratio (WHR), Waist Stature Ratio (WSR), Abdominal Hip Ratio (AHR), Abdominal Triceps Skinfold Ratio (ATSR), Sub-scapular Triceps Skinfold Ratio (STSR), Centripetal Fat Ratio (CPFR), Sub-scapular Suprailliac Triceps Biceps Skinfold Ratio (SSi-TBSFR), Sum of Truncal Skinfolds (STSF), Sum of Peripheral Skinfold (SPSF) and Sum of Truncal and Peripheral Skinfold Ratio (STPSFR).

Resting SBP and DBP were measured following standard techniques (Weiner and Lourie, 1981). FPG and 2-h PG were measured following WHO guideline (WHO, 1999). FTG was measured following ATP III (NIH, 2002). HT (SBP ≥140 mmHg and/or DBP ≥90 mmHg) was defined according to the JNC-7 recommendation (Chobanian et al, 2003). IGT (2-h PG ≥ 140-199 mg/dl) was defined according to the ADA criteria (ADA, 2004). HTG (FTG level ≥ 250 mg/dl) was defined according to the ADA criteria (ADA, 2004).

All anthropometric, physiological and metabolic variables were checked for normality and the variables not in normal distributions were log-transformed. Stepwise multiple regression analysis was undertaken to examine the effects of different variables, like socioeconomic and demographic characteristics, food habits, tobacco use and alcohol consumption, physical exercise, sleep duration, and family history of diabetes on blood pressures, blood glucoses and blood triglyceride variables, and subsequently effects of the significant variables were removed from blood pressures, blood glucoses and blood triglyceride level. These adjusted blood pressure, blood glucose and triglyceride variables were used for inferential statistics. Pearson correlation analyses were utilized to examine the relationship of anthropometric variables with blood pressures, blood glucoses and blood...
triglyceride. Owing to the existence of multicolinearity, Principal Component Analysis (PCA) was done; and for components, eigenvalues greater than 1 was considered and used as predictors for blood pressure, blood glucose and blood triglyceride level in multiple regression analysis. PCA revealed four components. The first component defined as overall adipose tissue distribution component; second component, defined as subcutaneous adipose tissue distribution component; third component, defined as central obesity component and the fourth component, defined as overall body shape component. These principal components were used in stepwise multiple regression analysis as predictors of adjusted blood pressure, blood glucose and blood triglyceride level. Similarly, multiple logistic regression analysis were undertaken to identify significant predictors of HT, IGT and HTG. Receiver Operating Characteristic (ROC) curve analysis was undertaken to compare the ability of different anthropometric variables within the significant principal component predictors to assess HT, IGT and HTG.

The mean age of the studied participants was 44.58 years (SD ± 9.65 years), and most of the participants belonged to the ages between 35 years to 54 years. The mean SBP and DBP of studied participants were 117.79 ± 0.91 mmHg and 75.45 ± 0.70 mmHg, respectively. The prevalence of HT was 10.71%. However, the mean FPG and 2-h PG were 106.15 ± 1.32 mg/dl and 130.65 ± 2.58 mg/dl, respectively. About 27.84% of the studied population identified to have IGT. The mean FTG was 192.76 ± 8.57 mg/dl. The prevalence of HTG was found to be 21.05% among the Bengalee males. So far the risk factors concerned, such as physiological in terms of HT and metabolic risk factors in terms of IGT and HTG revealed interesting picture related to significantly (p< 0.001) higher metabolic disorder namely, higher IGT and HTG than physiological disorder as HT.
Since, little is known about the genetics of diabetes other than that, there is a gene-environment interaction with multiple genes involved and genetic factors combine with environmental factors to cause diabetes; therefore, after adjusting significant effects of demographic characteristics including age; socio-economic characteristics including monthly average income, occupation etc.; lifestyle related variables including food habits, smoking etc. and family history of diabetes from these T2DM risk factors, specific relationships of anthropometric variables with T2DM risk factors considered in the present study.

To understand the relationships of anthropometric variables with the physiological risk factors of T2DM, such as SBP, DBP and HT revealed that, all central obesity measures (WC, AC, AHR, WST and CI) were significantly \((p < 0.05)\) and positively correlated with SBP. On the other hand, all skinfold measurements, along with STSF and SPSF were positively and significantly \((p < 0.05)\) correlated with DBP. Further, WT, HC and MTC were also revealed significant \((p < 0.05)\) positive correlation, but only with DBP. Furthermore, MUAC, WC, AC, ASF, BMI, WSR, TBF were positively and significantly \((p < 0.05)\) correlated with both SBP and DBP. However, the significant \((p < 0.05)\) predictor of SBP was central obesity component, and relating to DBP, the significant \((p < 0.05)\) predictor was overall adipose tissue distribution component. The cardinal feature was that, only central obesity component was the significant predictor of HT. Further more, in order to understand the assessment ability of HT, Area Under the ROC Curve(s) (AUCs) for significant \((p < 0.05)\) variables of central obesity component were WSR, CI and AHR, with a diminutive higher assessment ability of WSR and CI.

In order to understand the relationships between anthropometric variables and the metabolic risk factors of T2DM, i.e. FPG, 2-h PG and IGT revealed that, FPG was significantly \((p < 0.05)\) and positively correlated with all central obesity measures. In
addition, ASF, STSF, STPSFR, ATSR and TBF were also significantly \((p < 0.05)\) correlated with FPG. However, the significant \((p < 0.05)\) predictors of FPG were central obesity and subcutaneous adipose tissue distribution component. Pertaining to 2-h PG, almost all adipose tissue distribution measures were significantly \((p < 0.05)\) and positively correlated with 2-h PG, while, central obesity component, along with overall adipose tissue distribution component significantly \((p < 0.05)\) predicted 2-h PG. Moreover, central obesity and overall adipose tissue distribution component not only significantly predicted 2-h PG, but also IGT among adult Bengalee Hindu males with a slightly higher Odd Ratio (OR) of central obesity component for IGT. However, among the variables of the central obesity component and overall adipose tissue distribution component, WC and TBF demonstrated diminutive higher assessment ability for IGT compared to other variables.

The relationships between anthropometric variables and another metabolic risk factor of T2DM, such as FTG and HTG revealed that, all central obesity measures like WC, WHR, WSR, AHR and CI were significantly \((p < 0.05)\) and positively correlated with FTG. Moreover, TBF was also significantly \((p < 0.05)\) and positively correlated with FTG levels. However, the only subcutaneous adipose distribution measure associated significantly \((p < 0.05)\) and positively with FTG was STPSFR. On the other hand, the only significant \((p < 0.05)\) predictor of FTG was central obesity component. Central obesity component also significantly \((p < 0.05)\) predicted HTG. Nevertheless, among the variables of the central obesity component, the assessment ability of WSR was found to be significant \((p < 0.05)\) for HTG.

In general, along with central obesity component, subcutaneous adipose tissue distribution component and overall adipose tissue distribution component were also significant predictors of blood pressure and blood glucose variables. In addition to that, the
cardinal feature of the present study was that, the central obesity component was not only the significant predictor of blood pressure and blood glucose variables, but also significantly predicted plasma triglyceride variables. Furthermore, central obesity component was found to be the only variable, which significantly predicted major physiological risk factor, such as HT and fundamental metabolic risk factors namely, IGT and HTG for T2DM.

The results of the Area Under the ROC Curves(s) (AUCs) demonstrated that, numbers of anthropometric measures of adipose tissue distribution have the ability to assess significantly and independently the crucial physiological and metabolic risk factors of T2DM, such as, HT, IGT and HTG respectively. However, the cardinal feature of the present study vindicated that only WSR, as a measure of central obesity, not only significantly but have consistent ability to assess fundamental physiological and metabolic risk factors of T2DM.

Thus, the present study on general, free living adult Bengalee Hindu males indicated strong association between different anthropometric variables with blood pressure, blood glucose and blood triglyceride level, and the prevalence of major risk factors such as Hypertension (HT), Impaired Glucose Tolerance (IGT) and High Triglyceride (HTG) as well for Type 2 Diabetes Mellitus (T2DM). Nevertheless, among all anthropometric variables, central obesity measures demonstrated comparatively stronger association with the fundamental physiological and metabolic risk factors of T2DM. Furthermore, among different anthropometrically derived central obesity measures, Waist Stature Ratio (WSR) vindicated significant and consistent ability to assess major physiological and metabolic risk factors of Type 2 Diabetes Mellitus.