Chapter 5

DISCUSSION
5.1 Distribution of Blood Pressure

Although the age and height were the major significators of the blood pressure the percentiles of the SBP and DBP were calculated in accordance with age but the percentiles of height could not be fitted in the expression of distribution as the correlation between the height and blood pressures was significant but not more than 0.5. Therefore, with increased percentile of height the blood pressure was not high in all cases.

Age specific, 50th, 90th, 95th and 99th percentile values of systolic and diastolic blood pressure are reported in tabular form in Table based on the first BP measurement taken on 1087 subjects (602 boys and 485 Girls). This table may clinician to decide, whether observed BP values are normal or abnormal.

The child is normotensive if the BP is below 90th percentile. If the BP is >90th percentile, the BP measurement should be repeated at that visit to verify an elevated BP. The average BP measurements between the 90th and 95th percentiles are high normal or pre-hypertension. Adolescents with BP levels >120/80 mm Hg should be considered to be pre-hypertensive even if the level is <90th percentile as with adults according to the Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents by U.S. Department of Health and Human Services; National Institutes of Health; National Heart, Lung, and Blood Institute. (182)

According to Sharma BK et al, the 90th percentile of height and weight should be taken into consideration whenever blood pressure exceeds the 90th
percentile for age and sex while planning the management of an individual. Therefore a table of the percentiles of height and weight for each gender was also prepared in the present study. \(^{(158)}\)

According to Nelson textbook of Pediatrics, “Children and young adolescents with blood pressure greater than the 90th percentile for age have a nearly threefold greater likelihood of becoming adults with hypertension than do children with blood pressure at the 50th percentile”. There is also a correlation between early childhood hypertension and early atherosclerosis. \(^{(120)}\)

In the present study, the sample group overall prevalence of hypertension (systolic and/or diastolic hypertension) was 9.2% which was less than that found by Chadha et al in 1999 (11.68%) but more than that found in the similar studies by Anand NK et al 1995 (0.46%), Anjana et al 2005 (7.5%) and Taksande et al 2008 (5.75%). The present study had a prevalence of systolic hypertension 5.06% and that of diastolic hypertension 5.89%; indicating that there were some subjects with isolated systolic and diastolic hypertension along with some individuals who had both (systolic and diastolic) hypertension. Overall prevalence in boys was 9.8% (11.9% in the similar study by Chadha et al) whereas 6.31% had SH and 5.65% had DH. In Girls, the overall prevalence of hypertension was 10.31% (Chadha et al in 1999 found it to be 11.4%); whereas 5.98% had SH and 6.19% had DH. Comparing the results of this study with some more studies done in other parts of the world, gives a higher prevalence of hypertension amongst children and adolescents in Gujarati ethnic origin. For example, Kelishadi et al in Iran found an overall prevalence of hypertension in 7.7% and for systolic
and diastolic hypertension it was 4.2% and 5.4% respectively in an age range of 6-18 years.

Furthermore, in the present study, the prevalence of hypertension was studied in three age groups i.e. 5-9 years, 10-14 years and 15-18 years. The prevalences of hypertension found in the following three age groups were not much different between boys and Girls.

Amongst the other investigators, Anand NK et al in 1995 found lowest prevalence of 0.46% in schoolchildren of 5-17 years age in Amritsar, (Punjab, North India); while in 2005 another similar study in the same area by Anjana et al found that hypertension was prevalent in 7.5 healthy children of 6-14 years. One can infer from the above mentioned two studies that the prevalence of hypertension had increased tremendously in 10 years in Amritsar.

Japanese have developed a different system of categorization of elevated BP from that of the American. Shirasawa et al (2010) categorized elevated blood pressure as high BP and hypertension (higher BP than high BP category) according to the criteria for Japanese children (Japanese Society of Hypertension Guidelines Subcommittee for the Management of Hypertension; JSH2004). They have different cut-off values for different grades in school children. There may also be a need to develop some such criteria for Indian children.

Although the studies mentioned above are not uniform in context of age groups and criteria for labeling subjects as hypertensive but, they are depicting the extent of prevalence of hypertension in children and adolescents.
in across the world and, thus need for incorporating blood pressure examination during routine health checkups of school children.

5.2 Gender Differences: Blood pressure and resting Pulse rate of boys and Girls of same age groups

All boys and all Girls:

I. In all subjects, the resting pulse rate (PR) was significantly higher in Girls than that in Boys. This seems to be a normal phenomenon as similar differences in resting pulse rate is given in the Nelson textbook of paediatrics. (120) The pulse pressure was higher in Boys within 10% confidence limit (P = .077) than that in Girls. This may be due to rise in SBP and a decrease in DBP in the boys of 15-18 years’ age group.

II. Significantly higher DBP was observed in the present study in the Girls of age group of 5-9 years than that in the boys of same age group. Pulse pressure was significantly higher in Boys than in Girls. MBP, though not of statistical significance was higher (p=<.1) in the Girls of this age group which may be due to higher diastolic pressure in Girls causing decrease in the arithmetic difference between systolic and diastolic blood pressure.
III. In the age group of 10-14 years resting pulse rate, DBP and MBP were significantly higher in the Girls than that in Boys. Pulse pressure was higher but not significantly higher in Boys (P<0.1) than in Girls.

IV. In the age group of 15-18 years resting pulse rate was significantly higher in Girls than that in Boys, and Pulse pressure was significantly higher in Boys than in Girls. DBP and MBP did not show significant differences of means in this age group.

5.3 Physical Activity and Blood Pressure

In our study, SBP of the subjects who were irregular in exercise was significantly higher than those with regular exercise. Pulse Pressure was also higher in individuals with irregular exercise but not statistically significant (P<0.1). DBP and MBP did not show significant differences of means. These results are similar to the results of study by Reiber et al (2003) and Lee et al (2010) which have suggested that children and adolescents with higher Physical Activity have a lower number of biological risk factors for CVD. Physical activity also reduces insulin resistance thereby reduce the blood pressure in even known hypertensives.
5.4 Diet and Blood Pressure

Individuals with vegetarian diet were having lesser blood pressure levels than those with mixed diet though no difference in blood pressures was found between vegetarians and eggetarians. These findings are similar to those surfaced in the studies of Margetts et al (1986) (103) and Rouse (1983) (148) although they studied the effect of diet in adults. Margetts et al studied in untreated mild hypertensives while Rouse chose normotensive subjects for studying the effect of diet. Verma et al (1995) did not find any difference in blood pressures of vegetarian and nonvegetarian school children.

5.5 Influence of Family history of Hypertension and / or Diabetes mellitus

A family history of hypertension and or diabetes may be influencing blood pressure in adults but, in our study, no significant difference in blood pressure was found in groups of subjects made on the basis of presence or absence of family history of hypertension and diabetes. This finding in the present study is in contrast with the other similar study by Verma M et al (1995), Anand NK et al (1996), Chadha SL et al in (1999) and Nichols S et al (2006) where they found a significant influence of family history of hypertension with high blood pressure in children. No influence of family history of hypertension and or diabetes on the blood pressure of Gujarati children may be owing to the fact that this is only one factor out of several other factors influencing blood pressure.
5.6 Socioeconomic Status

No effect of the socioeconomic status on resting pulse rate and blood pressures was found in our study.

5.7 Body Composition: As Analyzed by Omron HBF-306

(A) Correlations of cardiovascular parameters with BMI and RMR in all subjects (n=1087)

Because the RMR3 could not be measured in subjects below 10 years of age, only RMR1 and RMR2 were taken for analysing correlation. Both the RMR values showed more or less same relationship with the cardiovascular parameters.

RMR had a strong positive correlation with all blood pressure values (SBP, DBP, PP and MBP) but a significant negative relationship with PR. Similarly, BMI had a significant positive relationship with all blood pressure values (SBP, DBP, PP and MBP) but a significant negative correlation with PR.

Kunz et al (2000) found that RMR was more in in obese hypertensives than in obese normotensives. These findings seem to be similar to the present study in context of blood pressure in relation to RMR.
Many investigators reported a significant relationship of blood pressure with BMI in adolescents. \(^{60,64,75,79,119,142,166,168,178,186}\). BMI is considered an effective measure to assess obesity especially in children and adults. He et al (2000) in their study took BMI as a measure of obesity. \(^{64}\). Karatzi et al (2009) concluded that in children and adolescents the Z scores of BMI are the most appropriate indices of association between BP and Obesity. \(^{79}\)

\[\text{(B) Comparison of Correlations of cardiovascular parameters with BMI and RMR in boys and Girls}\]

Both BMI and RMR were positively correlated with systolic and diastolic blood pressure but Boys had more strong relationship of blood pressure with these parameters than girls.

\[\text{(C) Correlations of interpretation of body fat with PR and blood pressures in subjects of 10 years and above (including both genders n=733)}\]

The instrument interprets the body fat percentage as low, normal, slightly high and high. The minimum and cut-off values for these interpretations is different for females than males (Table 4.7.3A in chapter 4)

It was found in the present study that PR and PP had no correlation could be established with low, normal, slightly high or high body fat percentage while
SBP, DBP and MBP had significantly higher values in individuals with slightly high body fat percentage. However, the fat percentage found in this study was not having significant correlation with blood pressure (MAP in boys and girls correlated separately) which may be due to the fact that there was no separate categorization of fat percentage for boys and girls in that analysis.

(D) Correlations of BMI, body fat, FM, FFM, FMI and FFMI with blood pressures in boys of 10 years and above

In our study, the resting pulse rate (PR) had a strong positive correlation with SBP, DBP and MBP, though it had a significant negative correlation with FFM. This strong association of blood pressure with resting pulse rate support the findings of Zhou et al (2000) that a higher pulse rate in early life was associated with a higher blood pressure in later life.

SBP: had a strong relationship with DBP. The correlation of SBP was stronger for FFM than that for FM. Similarly, a stronger correlation of SBP was found with FFMI than FMI. BMI was also strongly correlated to SBP.

RMRs (Resting Metabolic rates) calculated by all three methods showed a strong positive correlation with SBP.

DBP: A Strong obvious negative correlation of DBP was observed with PP.

PP: showed strong correlated with RMR1, RMR2, RMR3, FFM and BMI.

MBP: strongly correlated with FM, RMR1, RMR2, FFM, FMI, FFMI, RMR3 and BMI. None of the above parameters showed significant relationship with body fat percentage.
Correlations of BMI, body fat, FM, FFM, FMI and FFMI with blood pressures in Girls of 10 years and above

Resting Pulse Rate (PR) had strong positive correlation with SBP, DBP, and MAP. This correlation was stronger than that found in boys (Figures 4.11 and 4.12).

The SBP had a strong correlation with DBP.

DBP: All RMRs, Fat percentage, FM, FMI, FFM, FFMI and BMI were having significant positive correlation with DBP. This Positive relationship of fat percentage of DBP in girls was not observed in the boys. However, MAP did not show a significant correlation with fat percentage in both boys and girls.

PP: RM1, RMR2, Fat % (10% confidence interval) FM, FMI (10% confidence interval) and FFM were negatively correlated with PP.

MAP: MAP had a significant positive correlation with RMR2, FM, FMI, FFM (10% confidence interval), FFMI and BMI.