

# Prehypertension: A Study in 18-20 Year Age group

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## Abstract

**Background:** Youth of 18 to 20 year age range making successfully to medical college admission represent struggling lot. Genotype, phenotype and environmental interactions that drive cardiovascular and other lifestyle diseases may be recognized meaningfully at such stage. Early detection of disease and its determinants can guide timely interventions and correction toward prevention/reduction of morbidity and mortality in modern lifestyle maladies

**Objective:** Screening of first year medical student male and female subjects for prehypertension and their comparative study with normotensive peers in particular regard to family history, clinicodemographic and biochemical characteristics

**Method:** 23 subjects (16 males and 7 females) in 18-20 year age range found to be prehypertensive upon screening were studied in comparison with 15 matched normotensive peers (10 males and 5 females). Familial, psychological behavioural, clinicodemographic and biochemical parameters were examined to define relevant associated trait of prehypertension.

**Result:** History of maternal hypertension was significant determinant of prehypertension. Dietary and physical activity profiles did not differ but psychologic morbidity was more prevalent in prehypertensives as opposed to the normotensives. Overweight/obesity and activation of sympathetic nervous system were particularly associated with prehypertension group. Hyperinsulinaemia and insulin resistance was significantly associated while changes in lipid profile and level of inflammatory marker homocystein did not differ statistically significantly in prehypertensive group versus the normotensive controls.

**Conclusion:** Screening at early age is sound approach to unravel prehypertension and metabolic syndrome, specially in subjects with family history of such disorders. Detection of risk factors would help their timely modification for prevention/reduction of full grown disease.

**Keywords:** Familial cardiovascular disease ; prehypertension; metabolic syndrome; resting heart rate ; homocystein

## I. INTRODUCTION

Hypertension is common and major health concern world over and believed to indicate atherosclerotic risk often running in families [1]. Trend of high blood pressure in childhood is often traced in grownup hypertensives [2]. Prevalence of hypertension is on rise globally [3]. Overweight and obesity constitute risk factors for development of hypertension. Obesity is also a state known to associate increased sympathetic autonomic activity and increased vascular tone [ 4,5]. Traditional notion of metabolic syndrome occurring at later age is now getting revised. In the Asian countries, high epigenetic risk from in-utero growth retardation, leaves lasting vulnerability for developmental mismatch and further, upon interaction with adverse environmental conditions, eg diet, lifestyle to development of metabolic syndrome at much younger age [6]. Hypertension constitutes 5% of total global disease burden and is implicated in 20% to 50% of all deaths [7]. High blood pressure induced cardiovascular risk rises continuously across the whole blood pressure range and plays role in coronary heart disease, stroke and widespread vascular complications. Hypertension is singularly responsible for 1.9% of life years lost and 1.4% disability adjusted life years of global humanity on average [8]. The scenario makes it pertinent that hypertension and even its likelihood be detected early to materialize timely therapeutic address to prevent/reduce its serious cardiovascular consequences.

Medical students from the first year 2009 admission batch at MGM Medical College Navi Mumbai (India), were screened for blood pressure profile to discover aberration. The notable prevalence of prehypertensive profiles deserved study in more detail to generate local clinical evidence and consider strategy for appropriate management address.

## II. SUBJECTS AND METHOD

The study protocol essentially involved interview, anthropometry and blood sampling, which was approved by superior research authority and informed consent of the students was obtained prior to their inclusion in study. Physically handicapped subjects and those on long term medication for any condition or

having suffered in preceeding one month any illness requiring not less than 3 day suspension of routine were excluded. Finally 90 subjects (48 males and 42 females) in 18 years to 20 year age range were examined.

Blood pressure was recorded in sitting position after 5 minute rest by mercury sphygmomanometer in right hand, in the quiet clinical physiology room in the Physiology Department in morning between 9am to 10 am. The reading was taken again at interval of 5 minutes. Students having systolic blood pressure above 120mm Hg to 139mm Hg and/or diastolic blood pressure above 80mm Hg to 89mmHg were identified as prehypertensives. The hypertensive cutoff was 140/90 mmHg [9]. The examination yielded 16 males (33.3%) and 7 females (16.7%), exhibiting prehypertension range of blood pressure. These formed the prehypertensive study group. Control group of normotensives was created from the rest by 10 males and 5 females chosen randomly by toss.

Detailed interview to elicit history of high blood pressure illness in mother/father or both was conducted. Anthropometric measurements (weight, height, waist and hip circumference) were performed using standardized techniques and the body mass index (BMI), was calculated as body weight in kg/height in m<sup>2</sup>. All subjects were screened on a 6 point CESD questionnaire for depression [10]. An assessment of anxiety on 5 point scale [11], was made by enquiring about quantum of sustained feeling of nervousness (i.e. never; occasionally; now and then; frequently; daily some time ;most of the time). Frequency of exercise in a

week was enquired. Using a 24 hour dietary recall, approximate daily calorie consumption was estimated using cron-o-meter software (http/cron-o-meter.com), and %fraction of calories derived from saturated fat consumption was derived.

All participants were subjected to the tests under fairly similar conditions and environment, during months of October and November. They were asked to come for test, without consuming coffee, tea and neither over-exert nor be idle than routine, over past 24 hours. Systolic and diastolic blood pressure were measured a fresh, after the subjects have been seated quietly with back supported, feet on the floor and right arm supported for five minutes. Radial pulse rate was then counted in right hand for 30 seconds as per standard procedure [12].

Blood biochemistry records were sought on fasting blood sugar; plasma insulin level; lipid profile and homocystein level. Blood sugar and lipids were analysed by central investigation lab of the college while insulin and homocystein analyses were outsourced from M/s Jariwala labs, Borivali, Mumbai. Glucose was estimated by glucose oxidase method and plasma lipids determined using enzymatic method. HDL-cholesterol measurement involved homogenous colourimetric method. LDL-cholesterol was calculated using Friedwalds formula [13]. Serum insulin measurement was by radioimmunoassay technique [14] and homocystein by HPLC technique [15]. The serum separated within an hour of withdrawing blood was frozen at -20<sup>0</sup>C and transported in dry ice for distant estimation.

### III. OBSERVATIONS AND RESULT

Table I. Clinical Information in Control and Prehypertensive Subjects

| Info. Parameter                   | Control    | Prehypertensive |
|-----------------------------------|------------|-----------------|
| Number                            | 15         | 23              |
| Age in years (mean ± SD)          | 19.2 ± 1.3 | 19.8 ± 1.5      |
| H/o Hypertension in (n)           |            |                 |
| Mother                            | 0          | 7*              |
| Father                            | 3          | 6               |
| Exercise. Twice week & more (n)   | 7          | 6               |
| > 10% calories from Satu. fat (n) | 13         | 23              |
| Anxiety score > 2 (n)             | 5          | 15*             |
| Depression score > 2 (n)          | 0          | 6*              |

\* indicate statistically significant difference (Chi square/Fishers Tests)

Table II. Anthropometric and Physical Findings in Control and Prehypertensive Subjects

| Parameters                | Control (15) | Prehypertensive (23) |
|---------------------------|--------------|----------------------|
| BMI kg/M <sup>2</sup>     | 22.7 ± 1.2   | 27.6 ± 3.8*          |
| W/H ratio                 | 0.85 ± 0.11  | 0.92 ± 0.15*         |
| Resting Heart rate/30 sec | 39.4 ± 2.2   | 42.6 ± 3.8*          |
| Blood Pressure mmHg       |              |                      |

|                  |           |             |
|------------------|-----------|-------------|
| <b>Systolic</b>  | 107 ± 9.3 | 129 ± 10.4* |
| <b>Diastolic</b> | 76 ± 4.8  | 83 ± 4.6*   |

\*Represent statistically significant difference(paired t test)

**Table III. Biochemical Findings in Control and Prehypertensive Subjects**

| <b>Parameter</b>                 | <b>Control(15)</b> | <b>Prehypertensive(23)</b> |
|----------------------------------|--------------------|----------------------------|
| <b>Fasting glucose m.mol/L</b>   | 4.5 ± 0.5          | 4.8 ± 0.54                 |
| <b>Insuline p.moles/L</b>        | 99 ± 5.4           | 212 ± 11.6*                |
| <b>Homocystein micro moles/L</b> | 9.8 ± 3.1          | 12.2 ± 5.2                 |
| <b>Triglycerides mg/dl</b>       | 105 ± 48           | 126 ± 53                   |
| <b>LDL-chole mg/dl</b>           | 84 ± 29            | 92 ± 31                    |
| <b>HDL-chole mg/dl</b>           | 52 ± 17            | 47 ± 20                    |
| <b>Total chole mg/dl</b>         | 161 ± 24           | 170 ± 25                   |

\*indicate statistically significant difference (paired t test)

As shown in table.I, prehypertensives have significant history of hypertension in mother while paternal history was not significantly different from normotensive control. Exercise practice and dietary consumption of saturated fat did not significantly differ between two groups. Significantly higher prevalence of anxiety and depression was found among prehypertensives.

Table II, shows significantly higher BMI and W/H ratios in the prehypertensives. The W/H ratio of prehypertensives was above the cut off for central obesity pattern.The systolic and diastolic blood pressure were obviously higher, even resting heart rates were significantly higher in prehypertensives.

Table III displays biochemical profiles. Although values of fasting blood glucose and serum homocystein were higher in prehypertensives than in controls, differences were not statistically significant. Fasting serum insulin levels were significantly raised in prehypertensives. This indicates relative insulin resistance among the prehypertensives.

#### IV. DISCUSSION

Urbanization of lifestyle with nutrition transition that involves increased consumption of processed energy dense food,is blamed for spread of lifestyle diseases as diabetes and hypertension [6]. Prehypertension as such does not constitute disease but leads to two fold increase in risk of coronary artery disease and cerebrovascular accidents related mortality [16]. It was found that prehypertensives without lifestyle modification or pharmacologic intervention carry double the risk of becoming hypertensive in few years [17]. Studies in other societies have yielded general prevalence of 34% to 46% of prehypertension in population [18-20]. Present study was in very restricted age group of youth, hence the difference.

Maternal hypertension was significantly associated with prevalence of prehypertension.Individuals with family history of premature atherosclerosis are at higher risk of developing atherosclerosis [21]. Family history of cardiovascular ailment encompasses genetic,biochemical and behavioural contexts and has shown influence on lipids [22]; inflammatory markers [23] and hemostatic markers [24].Greater risk associated with maternal cardiovascular disease history,may reflect phenotypic evidence that birth weights affect subsequent hypertension [25], insulin resistance [26], and diabetes [27]. The complexity of mechanisms implied in family history may need personalized rather than general interpretation.Exploration is worth in this respect to discover worthwhile targets for manipulation toward disease prevention/reduction [28].

Hypertension is well known component in metabolic syndrome wherein dietary and physical activity perspectives play role to varied extent in affected individuals. The present study subjects did not exhibit differences in respect to such factors.In contrast anxiety and depression constituting the stress disorders ,appeared to significantly associate prehypertension. Depression associates behaviours such as poor diet and physical inactivity. Depression has adverse biological impact causing systemic inflammation, endothelial and platelet dysfunction. The sympathovagal balance is disturbed leading to increased heart rate and impaired protective vagal regulation [29-31].

The average BMI among prehypertensive group,27.6kg/M<sup>2</sup> is overweight/obesity range by Indian standards [32].Even more important observation is high W/H ratio indicating central obesity pattern selectively associating prehypertension .The insulin levels too are significantly higher in prehypertensive group as compared to control,suggesting insulin

resistance. Excess visceral fat mobilizes free fatty acids in portal circulation reducing hepatic clearance of insulin and hyperinsulinaemia [33]. The scenario is suggestive of impending metabolic syndrome among the prehypertensive group, where hypertension appears to participate early than later. Overweight adolescents are reportedly more likely to develop hypertension in adulthood [34]. Obesity is also known to associate increased sympathetic activity [4,5]. The findings are in agreement with reported association of insulin resistance in prehypertension [35].

Elevated resting heart rate was significant observation among prehypertensives. Over the course of life, elevated heart rate catalyses development of atherosclerosis. It causes increase of pulsatile vascular stress and stiffening, turbulent blood flow, specially at arterial bifurcation sites. Pulsatile stress also promotes inflammatory response and endothelial dysfunction. An increase of heart rate over 70 beats per minute associates with continuous increased risk of mortality and reduction of 1 beat per minute reduced 2% mortality risk [reviewed,36]. Resting heart rate monitoring has long term prognostication value among hypertensives [11,37]. High sympathetic tone indicated by raised resting heart rate, contributes to worsening of risks relating blood pressure, glucose metabolism and plasma lipids [38]. In the present study elevated resting heart rate in prehypertensives is not found associated with worsened blood sugar and lipid profiles. It may simply indicate early march of the destined journey [39]. Heart rate and heart rate variability parameters are integrated. Increased resting heart rate implies reduced heart rate variability (Coulmel et al 1994). This is true until aging [40].

Homocystein plasma levels are shown to directly relate to BMI in boys [41]. Metabolic syndrome with hypertension generally accompanies raised blood homocystein levels that correlate directly to prevalence of cardiovascular complications [42]. Homocystein is formed from dietary amino acid methionine and plays pivotal role in folate metabolism and methy group transfer. Its concentrations are influenced by genetic and environmental factors, especially vitamins folate, B12, B6 as well as certain lifestyle factors and medications. Significance of homocystein as a cardiovascular risk factor depends on modifying factors such as, other cardiovascular risk factors, nutrition and genetic polymorphisms. Generally however, hyper-homocysteinemia is believed to contribute 10% of all cardiovascular risks [43]. Each 5 micromole/l increment in total fasting homocystein concentration is shown to associate 60 to 80% increased risk of coronary artery disease; a 50% increased risk of cerebrovascular disease and 6 fold higher risk of

peripheral vascular disease [44]. Based on studies in adolescents, 90<sup>th</sup> percentile level of homocystein (found as 8.23 micro moles/l), was proposed to be treated as cutoff for hyper-homocysteinemia [45]. Low HDL-cholesterol was considered to substantiate the cardiovascular risk of hyper-homocysteinemia.

In the present study, homocystein levels were also higher than above proposed cut off 8.23 micro moles/l. The prehypertensive individuals exhibited higher values of homocystein than controls, although short of being statistically significant. There was no significant dyslipidaemia seen in the prehypertensives, even any significant lowering of HDL-cholesterol was not seen. Insignificantly however the values indicate a march toward such fate and increased atherogenic risk.

## **V. IMPLICATIONS FOR EARLY PREVENTION**

Prehypertensive people in 45 to 65 year age range with elevation of resting heart rate were projected to suffer 50% increased risk of all cause mortality, than prehypertensives without increase in resting heart rate; coronary heart disease risk also increased by 49%, more consistently in women [46]. Behaviour and lifestyle including eating, smoking, alcohol intake and use of oral contraceptives influences risk factors. The later Bogalusa Heart study emphasized need to begin prevention of adult heart diseases in early life. Approaches suggested for prevention are to include high risk families and youngsters and a public health or population perspective. The beneficial effect of exercise training and exercise based cardiac rehabilitation, on symptom free exercise capacity, cardiovascular and skeletal muscle function, quality of life, general healthy lifestyle and reduction of depressive symptoms and psychological stress is well recognized [47]. European Association on cardiovascular prevention and rehabilitation recommendations are formulated regarding frequency, intensity, time and type of physical exercise and its safety aspects. Performance of exercise training 30 to 60 minutes daily 3 to 5 days a week in combination with resistance training 2 to 3 times a week is envisaged in the context [37]. Screening and detection of prehypertension at early stage is prerequisite for a chance to such simple measure in disease prevention and health promotion.

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