**Original Article**

# CERTAIN MODIFIABLE RISK FACTORS IN ESSENTIAL HYPERTENSION: A CASE-CONTROL STUDY

## Sunil M. Sagare[1], S. S. Rajderkar[2] B. S. Girigosavi[3]

[1]Lecturer, Dept. of Community Medicine, Bharati Vidyapeeth Deemed University Medical College, Pune, [2]Dean, Govt. Medical College, Miraj, [3]Taluka Health Officer, Kavathemahankal, Maharashtra.

**Correspondence:**
Dr. Sunil M. Sagare
Dept. of Community Medicine, Bharati Vidyapeeth Deemed University Medical College,
Dhankawadi, Pune - 411043
Mobile – 09503218928, 09420123602
Email - drsmsagare@gmail.com

## ABSTRACT

Essential hypertension accounts for 90% of all cases of hypertension. Though it is a one of major risk factors for cardiovascular diseases, it is a condition with its own risk factors. Overall prevalence of hypertension is increasing over the years in India (from 3.57% in 1977 to 20-30% after 1995). Considering the public health importance of 'Essential Hypertension' the present study was conducted. The objective was to study role of certain risk factors in essential hypertension. A case control study was conducted in rural township of Tasgaon; in Sangli district of Maharashtra during 2001-2002, to study role of certain modifiable risk factors in essential hypertension in 21-60 years age group. 165 cases of essential hypertension were selected by systematic random sampling from two private hospitals & O.P.D. of RHTC, Tasgaon and 330, age & sex matched controls were selected in the ratio of 1:2. A significant association was found between essential hypertension and various risk factors including smoking, its frequency and duration, alcoholic status, leisure time physical inactivity, restless sleep, BMI, mental stress, mixed diet and salt intake. Smoking of more than 10 cigarettes or bidi had 3.23 times risk of developing hypertension than smoking up to 10 cigarettes or bidi.

**Keywords:** Hypertension, Risk factors, Leisure time physical activity, Restless sleep

## INTRODUCTION

Hypertension is prevalent all over the world. Usually it is readily detectable, easily treatable condition and if left untreated may leads to serious complications. In considerable proportion of cases the disease tends to be asymptomatic for prolonged time, hence also labeled as 'Silent Killer'[1]. Essential hypertension is the most prevalent form of hypertension accounting for 90% of all cases of hypertension[2]. High blood pressure is a major risk factor for stroke, CHD, heart or kidney failure[2]. Hypertension is also considered as an 'Iceberg' disease' because unknown morbidity far exceeds the known morbidity[2]. It ranked fourth in the world by prevalence[3].

In India, impact of hypertension was perhaps not fully regarded due to high incidence of communicable diseases. Now, as communicable diseases are getting controlled and life expectancy has increased, its importance as a public health problem is now being felt .Studies revealed vast range of risk factors in relation to essential hypertension ranging from genetic factors to lifestyle. However these studies were mainly descriptive or cross sectional barring few being analytical. Substantial research has been carried out in the natural history of hypertension as well as measures for treatment and control. These studies led to concept of evolution of risk factors. Few case control studies have been carried out on cardiovascular diseases in relation with various risk factors but seldom on hypertension as a separate entity in Maharashtra state. No such study exists in Sangli district of Maharashtra state. Hence the

study was carried out in a rural township of Tasgaon in Sangli district.

## MATERIAL AND METHODS

A case control study was carried out in rural township of Tasgaon in Sangli district of Western Maharashtra from Jan 2001 to June 2002.

**Study population:** Comprised of known cases of essential hypertension of both sexes in the age group of 21-60 years and matching controls from same town.

**Sample size**: Desired sample size of 165 was calculated by standard sample size formula for case control studies[9]. (Prevalence of hypertension ($P_0$) = 0.15% and Risk ratio (RR) = 0.34[6])

**Selection of cases and controls and collection of information**: Cases were selected from two private hospitals and OPD attending of RHTC, Tasgaon, in age group of 21-60 years by systematic random sampling. Controls were selected from neighboring houses of cases and from general population. Controls were matched for age (±2 years), sex and parity in case of females. As Case: Control proportion taken as 1:2, the study population comprised of 495 subjects with 165 cases and 330 controls fulfilling inclusion criteria.

Relevant information was collected in predesigned and pretested questionnaire. 24 hours recall and stock inventory method was used for measurement of calorie, fat and salt intake individually. Salt intake score was prepared specially for the study to measure 'Salt intake per day'. Mental stress score was also prepared to measure the strength of mental stress with help of 51 common stressful life events[12].

**Measurements and definitions used in study:**

1. **Blood Pressure Measurements:** Blood pressure readings were taken by single observer for every individual with same sphygmomanometer throughout the study as per gaudiness[10]. After taking informed consent from participants total 3 readings were performed on each participant at 10 minutes interval in sitting position. Actual blood pressure readings were noted of all. Mean of three readings of systolic blood pressure (SBP) and diastolic blood pressure (DBP) are considered as representing blood pressure of participants. When SBP and DBP fall into different categories, the higher category was selected to classify individual's blood pressure. The readings are made of the close 2mm of Hg. mark on the scale. Hypertension is considered according to criteria as SBP of 140 mm Hg or greater, DBP of 90 mm Hg or greater or taking antihypertensive medication.

2. **Height, Weight and BMI Recording:**
a) **Height:** The subject was asked to stand with the back against the wall and heels touching the ground, arms on the side and eyes in front parallel to ground. Reading coinciding the occipital edge was noted in cm. with the help of standard measuring tape.

b) **Weight:** Weight of all subjects with minimum clothes on the body was recorded in kilograms with the help of standard ISI marked weighing machine which was adjusted to 'zero' weight while measuring it.

c) **Body Mass Index (BMI) [2]:** Calculated by formula, BMI = Weight (Kg) / Height[2] (m)
The same single tape and weighing machine was used by a single person throughout the study. The weighing machine was standardized from time to time with the help of standard weight. Subjects were classified according to BMI ≤ 25 as normal and >25 as overweight and obese.

3. **Definitions:**
a) **Smoker:** A person who has been smoking at least a bidi or cigarette or any other form for at least six months from study period.

b) **Alcoholic:** A person who has been taking alcohol at least 30 ml. per day for at least six months from study period.

c) **Vegetarian:** Defined as a person who drives his food from fruits, vegetable, wheat, rice, pulses, milk and milk products.

d) **Mixed Diet:** A person who consumes eggs and meat in addition to vegetarian diet.

e) **Leisure time physical activity[11]:** Activity undertaken in the individual's discretionary free time. It includes exercise and sports.

**Data analysis:** Association between selected variables was tested for significance by using Chi-square test. Odds ratio and its confidence intervals were calculated wherever required.

## RESULTS

A total of 495 individuals were studied comprising 165 cases and 330 controls .Sex wise distribution revealed 93(56%) males and 72(44%) females in cases and 186(56%) males and 144(44%) females in controls. Two matched controls for age and sex (and parity in case of females) were taken for each case, so percentage of controls comes to same as cases in their respective age group.

Forty-one (44.09%) amongst cases and fifty (26.88%) amongst controls were smokers. Among smokers, twenty-eight (68.29%) cases and twenty (40%) controls were smoking more than 10 cigarettes or bidi per day. Twenty-five (60.98%) cases and nineteen (38%) controls were smoking for 5 years and above.

**Table 1: Age and sex wise distribution of cases and controls**

| Age wise distribution in years | Male | | Female | | Total | |
|---|---|---|---|---|---|---|
| | Cases (%) | Controls (%) | Cases (%) | Controls (%) | Cases (%) | Controls (%) |
| 21-30 | 6 (6.45) | 12 (6.45) | 4 (5.55) | 8 (5.55) | 10 (6.06) | 20 (6.06) |
| 31-40 | 22 (23.66) | 44 (23.66) | 8 (11.11) | 16 (11.11) | 30 (18.18) | 60 (18.18) |
| 41-50 | 30 (32.26) | 60 (32.26) | 20 (27.78) | 40 (27.78) | 50 (30.3) | 100 (30.3) |
| 51-60 | 35 (37.63) | 70 (37.63) | 40 (55.56) | 80 (55.56) | 75 (45.46) | 150 (45.46) |
| Total | 93 (100) | 186 (100) | 72 (100) | 144 (100) | 165 (100) | 330 (100) |

Thirty-seven (39.78%) cases and fifty-one (27.42%) controls were found alcoholic. Among alcoholics, seventeen (45.95%) cases and twenty-one (41.18%) controls were consuming alcohol for 5 years and above.

**Table 2: Distribution of cases and controls according to smoking and alcohol habit**

| Risk Factor | Case (%) | Control (%) | $\chi^2$ | P | OR (95% CI) |
|---|---|---|---|---|---|
| **\*Smoking** | | | | | |
| **a) Status** | | | | | |
| Smoker | 41(44.09) | 50(26.88) | 8.35 | 0.003 | 2.14 (1.28-3.59) |
| Non smoker | 52(55.91) | 136(73.12) | | | |
| **b) No. of Cigarette or Bidi Smoking/ day** | | | | | |
| > 10 | 28(68.3) | 20(40) | 7.23 | 0.007 | 3.23 (1.37-7.59) |
| ≤ 10 | 13(31.7) | 30(60) | | | |
| **c) Duration of Smoking** | | | | | |
| > 5 years | 25(60.98) | 19(38) | 4.76 | 0.029 | 2.54 (1.09-5.91) |
| ≤ 5 years | 16(39.02) | 31(62) | | | |
| **Alcohol Status\*** | | | | | |
| Alcoholic | 37(39.78) | 51(27.42) | 4.39 | 0.036 | 1.74 (1.03-2.95) |
| Non- alcoholic | 56(60.22) | 135(72.58) | | | |
| **Duration of Alcohol Consumption** | | | | | |
| > 5 years | 17(45.95) | 21(41.18) | 0.198 | 0.655 | 1.21 (0.52-2.85) |
| ≤ 5 years | 20(54.05) | 30(58.82) | | | |

\* Only males in present study were found to be smoker and alcoholic in both the groups

Maximum numbers of participants were not doing leisure time physical activity. Leisure time physical activity was considerably more in controls i.e. 46 (13.94%) controls compared to ten (6.06%) cases.

Distribution of participants was comparable in both the groups considering duration of sleep. i.e. 83 (50.3%) cases and 146 (44.24%) controls were taking sleep of 8 hours or less. However restless sleep was observed more in cases i.e. 39(23.63%) cases compared to 50(15.15%) controls. BMI <25 was found in majority of participants; i.e. in 134(81.22%) cases and 302 (91.51%) controls. BMI ≥ 25 was found more in cases i.e.31 (18.78%) cases compared to 28(8.49%) controls.

More or less stress was observed in most of participants. More stress (Score >200) was observed in 15(9.1%) cases and 12(3.64%) controls; however less stress (Score 41 to 200) was observed in majority of cases and controls, i.e. 133 (80.6%) cases and 253 (76.67%) controls

No person from both groups had predominantly non-vegetarian dietary pattern. 94 (56.96%) cases and 225(68.18%) controls were exclusively vegetarians.

Definitely higher and higher salt consumption was observed more in cases; i.e. 65(39.4%) cases compared to 79(23.94%) controls. Higher salt

consumption (between 5 -7 grams) was observed in 60 (36.36%) cases and 73 (22.13%) controls and definitely higher consumption (>7 grams) was observed only in 5 (3.03%) cases and 6 (1.81%) controls. Optimum salt consumption (up to 5 grams) was observed in 100 (60.61%) cases and 251(76.06%) controls.

## DISCUSSION

Amongst 165 cases, it was observed that number of cases increasing with increasing age i.e. 10 cases (6.06%) comprising of 6 males (6.45%) and 4 females (5.55%) in age group 21-30 years to 75 cases (45.46%) comprising of 35 males (37.63%) and 40 females (55.56%) were in the age group of 51-60  years. It has already been proved that the prevalence of hypertension increases with age in both genders. This can be due to natural aging process and also response to cumulative environmental factors. Similar pattern was also found by Gujrathi V.V.et al (1988)[4].

**Table 3: Distribution of cases and controls according to other risk factors**

| Risk Factor | Case (%) | Control (%) | $\chi^2$ | P | OR (95% CI) |
|---|---|---|---|---|---|
| **Leisure Time Physical Activity** | | | | | |
| No | 155(93.94) | 284(86.06) | 6.805 | 0.009 | 2.51 (1.25-5.01) |
| Yes | 10(6.06) | 46(13.94) | | | |
| **Sleep** | | | | | |
| a) Duration of Sleep | | | | | |
| ≤ 8 hours | 83(50.3) | 146(44.24) | 1.625 | 0.202 | 1.27 (0.877-1.854) |
| > 8 hours | 82(49.7) | 184(55.76) | | | |
| b) Nature of Sleep | | | | | |
| Restless | 39(23.64) | 50(15.15) | 5.37 | 0.02 | 1.73 (1.088-2.76) |
| Calm | 126(76.36) | 280(84.85) | | | |
| **BMI** | | | | | |
| > 25 | 31(18.79) | 28(8.48) | 11.12 | 0.0008 | 2.49 (1.457-4.270) |
| ≤ 25 | 134(81.21) | 302(91.52) | | | |
| **Mental Stress Score** | | | | | |
| > 40 (Stress) | 148(89.7) | 265(80.3) | 7.02 | 0.008 | 2.13 (1.218-3.742) |
| ≤ 40 (No stress) | 17(10.3) | 65(19.7) | | | |
| **Dietary Pattern** | | | | | |
| Mixed Diet | 71(43.03) | 105(31.82) | 6.03 | 0.014 | 1.61 (1.10-2.376) |
| Vegetarian | 94(56.97) | 225(68.18) | | | |
| **Salt intake** | | | | | |
| > 5 grams (Higher) | 65(39.4) | 79(23.94) | 12.73 | 0.0003 | 2.06 (1.386-3.075) |
| ≤ 5 grams (Optimum) | 100(60.61) | 251(76.06) | | | |

The present study found statistically significant association between hypertension and habit of cigarette or bidi smoking. (P= 0.003). Significant association of hypertension was also observed with smoking more than 10 cigarettes or bidis per day (P= 0.007) and smoking habit of more than 5 years (P=0.029). Odds ratio for smokers, smoking more than 10 cigarettes and smoking habit for more than 5 years were found to be 2.14, 3.23 and 2.55 respectively, indicating risk of hypertension is strongly related to habit of smoking, number of cigarettes or bidi smoked and duration in years of smoking.

It is known fact that smoking for prolonged duration over a period of time builds itself up to a threshold level, initiating vascular changes in blood vessels ultimately resulting into hypertension.  Significant association between smoking habit and hypertension in present study correlates with findings by Gopinath N. et al (1994)[5] and Gupta R. et al (1997) [7].

Clear cut dose response relation was observed in present study and the findings are supported by findings of Sally E., Mc. Nagny et al (1997)[13] who found increasing risk of hypertension with number of cigarettes smoked. Gupta R. et al (1997)[7] also found that both moderate and heavy smokers have greater hypertension prevalence and prevalence was greater in long term smokers from rural as well as urban areas.

Statistically significant association was found between hypertension and alcohol (P = 0.036). Odds ratio of 1.74 revealed that 1.74 times risk of developing risk among alcoholics than non-alcoholics. Gujrathi V. V. et al (1988)[4] and Gopinath N. et al (1994)[5] confirmed relationship of high blood pressure to alcohol use. Jiang He (1997)[8] too  mentioned about an association of

alcohol consumption and blood pressure levels in more than 60 population studies worldwide.

Risk of developing hypertension was found to be marginally more (OR= 1.21) among alcohol consumers with duration of 5 years or more. However no significant association was revealed between hypertension and duration of alcohol consumption (P=0.20) in present study.

Statistically significant association was found between hypertension and leisure time physical inactivity (P=0.009). Odds ratio was found to be 2.51 indicating that with absence of leisure time physical activity there is more than twice the risk of hypertension when compared with positive leisure time physical activity. In support to present study, Dr. Anil Pahwa (2000)[14] mentioned that long term aerobic exercise regimens have beneficial effects upon systolic blood pressure.

Restless sleep was associated with hypertension and the difference was significant statistically (P=0.02). OR=1.73 indicates that, with restless sleep there is 1.73 times more risk of hypertension when compared with calm sleep.

Statistically significant association has been observed between hypertension and BMI with cut off point of 25 (P=0.0008). Odds ratio for BMI > 25 was found to be 2.49, indicating 2.49 times more risk of developing hypertension in overweight and obese persons. Present study findings are supported by N. K. Goel et al (1996)[6] and S. Mishra et al (1997)[15] who quoted findings of Manitoba Cohort study followed for 26 years in which BMI was a significant predictor of cardiovascular diseases including hypertension. More or less stress was observed in most of cases and controls and this was found significantly associated with development of hypertension (P= 0.008). Odds ratio of 2.13 clearly specifies more than twice the risk of developing hypertension with exposure to stress of varying degrees. I. J. Perry et al (1994)[16] observed similar finding that factors inducing psychological stress contribute to development of hypertension. Statistically significant association was observed between dietary habits and hypertension (P=0.014). The Odds ratio of 1.96 was indicative of nearly two times higher risk of hypertension in persons with mixed dietary pattern as compared to vegetarians.

Among dietary factors higher salt consumption was also found to be significantly associated with hypertension (P= 0.0003). Twice the risk of developing hypertension (OR=2.06) was observed among persons consuming more than 5 grams of salt per day. The present study finding are similar to those of Goel N.K. and P. Kaur (1994)[6] and supported by findings of Paul Elliot et al (1996)[17] in 'Intersalt' study.

## CONCLUSIONS

Summarily present study found smoking, its frequency and duration, alcohol consumption, leisure time physical inactivity, restless sleep, BMI, mental stress, mixed diet and salt intake as risk factors for essential hypertension among age group of 21-60 years.

## REFERENCES

1. Kulkarni A.T.: 'Hypertension – A Silent Killer'. Indian Medical Gazette.1998 March:73-76
2. Park K.: 'Text book of Preventive and Social Medicine'. 16th edition, M. S. Banarsidas Bhanot Publishers, Jabalpur. 2000: 277-80, 297
3. The World Health Report 1998 – WHO, Geneva, 1998
4. Gujarathi V.V. et al: 'A Study of Prevalence of Hypertension and Diabetes Mellitus Amongst Government Gazetted Officers in Aurangabad City in India'. Indian Journal of Preventive and Social Medicine.1998;19(3):79-85
5. Gopinath N. et al 'Epidemiological Study of Hypertension in Young (15-24years) Delhi Urban Population' Indian Journal Med. Res.1994 January:32-37
6. Goel N. K. and Kaur P.: 'Role of Various Risk Factors in The Epidemiology of Hypertension in a Rural Community of Varanasi District'. Indian Journal of Public Health. 1996 September;40(3):71-76
7. Gupta R. et al: 'Correlation of Smoking, Blood Pressure Levels and Hypertension Prevalence in Urban and Rural Subjects'. JAPI.1997; 45(12): 919-22
8. Jiang He and Paul Whelton: 'Epidemiology and Prevention of Essential Hypertension, Part I'. Medical Clinics of North America.1997 Sept; 81(5):1077-1112
9. Raymond S. Greenberg and Michel A. Ibrahim. 'Oxford Textbook of Public Health'. 1st Indian Edition, Vol. III; Bombay Oxford University Press.1987: 130-31.
10. 'The Sixth Report of The Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure'. Arch. Intern. Med. Nov-24, 1997; Vol.157: 2413-46.
11. 'Obesity: Preventing and Managing Global Epidemic', Technical Report Series No.894, WHO Geneva, 1997
12. Gurmeet Singh et al: 'Presumptive Stressful Life Events Scale (PSLES) - A New Stressful Life Events Scale for Use in India'. Indian Journal of Psychiatry.1984; 26(2):107-14
13. Sally E., Mc Nagny et al: 'Cigarette Smoking and Severe Uncontrolled Hypertension in Inner-city African Americans'. Am. J. Medicine. August 1997; Vol.103:121-33.
14. Dr. Anil Pahwa: 'Exercise and Health Benefits'. Current Medical Journal North Zone. Jan.2002; 20(10):37-42
15. S. Mishra, H. S. Wasir: 'Obesity As a Risk Factor for Coronary Artery Disease'. JAPI.1997; 45(7):555-58
16. J. Perry et al: 'Environmental Factors in the Development of Hypertension'. British Medical Bulletin. 1994;50(2):246-55.
17. Paul Elliott et al; 'Intersalt Revisited: Further Analysis of 24 Hour Sodium Excretion and Blood Pressure Within and Across Population.' BMJ. May 1996; Vol.312:1249-5.