ORIGINAL ARTICLE

Hypertension and Associated Cardiovascular Risk Factors in Kelantan

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Summary

Two thousand five hundred and eight subjects from the state of Kelantan in North-East Peninsular Malaysia were included in this study to determine the prevalence of hypertension and their association with cardiovascular risk factors. The overall prevalence of hypertension was 13.9%. There was no difference in the prevalence of hypertension between the males and females. The prevalence increased with age - the highest being in those above 70-years old. Subjects with hypertension also had a higher prevalence of diabetes mellitus (19.0%), obesity (39.4%) and hypercholesterolaemia (70.7%) than non-hypertensive subjects. Of the hypertensive subjects, 83.3% had 1 other risk factor for cardiovascular disease, 66.7% had 2 other risk factors and 16.7% had more than 2 risk factors. Other than age, body mass index, plasma glucose, total cholesterol and LDL-cholesterol, hypertensive subjects also had a higher mean serum urea, creatinine, uric acid and triglyceride than non-hypertensive subjects. In conclusion, hypertension is a common disease in this area and is associated with multiple risk factors for cardiovascular disease. The prevalence is likely to increase in the near future with increasing affluence and becoming a major health problem.

Key Words: Hypertension, Hypercholesterolaemia, Obesity, Diabetes Mellitus

Introduction

Hypertension is a common disease causing significant mortality and morbidity. The prevalence of this disease varies from country to country and knowledge of the prevalence is important to assess the extent of the problem for purpose of health planning and also to assess the trend of hypertension. The prevalence of hypertension varies between population. The reported prevalences in rural Africa, China and among Mexican-American men were 12.5% [1], 11.26% [2] and 24.4% [3] respectively. Malaysia is a fast developing country in the South East Asian region with a population of 22 million. There has been very few studies to determine the prevalence of hypertension in this country. Hence this study was undertaken to determine the prevalence of hypertension in the state of Kelantan and to study its' relationship with other risk factors for cardiovascular disease.

This article was accepted: 25 May 2003

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Materials and Methods

A total of 2508 subjects from all the districts of the state of Kelantan were enrolled through random cluster sampling for this study. The population of Kelantan is 1.2 million and all the towns and villages were divided into clusters and the clusters were randomly selected. Subjects from the selected clusters were chosen and they were invited to attend the local health clinics in a fasting state where they were interviewed and a physical examination was done. Blood pressure was taken from the right arm with a mercury syphmomanometer with the patient in a sitting position after a rest period of 5 minutes. If the blood pressure was found to be elevated, a second reading was done after a further 30 minutes of rest and the lower of the 2 readings was taken. Blood was taken for glucose, total cholesterol, LDL-cholesterol, HDL-cholesterol, urea, creatinine and uric acid determination. Oral glucose tolerance test was performed in all non-diabetic subjects. WHO criteria for defining hypertension, diabetes mellitus and impaired glucose tolerance [4] were used. Hypertension was defined as systolic blood pressure of $\geq$ 160 mmHg and/or diastolic blood pressure $\geq$ 95 mmHg or on antihypertensive treatment. Diabetes was defined as fasting blood glucose of $\geq$ 7.0 mmol/L or the 2-hour post-glucose load blood glucose of > 11.1 mmol/L or a history of diabetes on treatment. Impaired glucose tolerance was defined as fasting blood glucose of less than 7.0 mmol/L and a 2-hour post-glucose load blood glucose of between 7.8 to less than 11.1 mmol/L. Obesity was defined as a body mass index of more than 25 kg/m^2 and hypercholesterolaemia when the total cholesterol was more than 5.2 mmol/L.

Assays

Plasma glucose was measured by the glucose-oxidase method. Triglycerides, Total Cholesterol, High Density Lipoprotein Cholesterol assays were done by enzymatic method. Low Density Lipoprotein Cholesterol was calculated by subtracting HDL-cholesterol and VLDL cholesterol from total cholesterol. Urea and Creatinine assay was done by calorimetric method.

Statistical Analysis

Statistical analysis was done using Microstat Statistical programme on an IBM compatible computer. T-test was used to compare means and chi square test was used to compare proportions. Age adjusted prevalence was done using WHO World Standard [8].

Results

Of the 2508 subjects examined, 348 (13.9%) had hypertension (Table I). The prevalence in females was slightly higher (14.7%) than males (12.2%) but the difference was not statistically significant. The prevalence was also higher in those above 50 years of age (Table I). The age adjusted prevalence of hypertension overall was 6.9%, in males was 5.1% and in females was 7.9%. Hypertensives also had a higher prevalence of diabetes mellitus than non-hypertensive (19.0% vs 10.5% - $p< 0.001$; Fig. 1; age adjusted 8.1% vs 6.2%) but there was no significant difference in the prevalence of impaired glucose tolerance in hypertensives and non-hypertensives (18.4% vs 15.8% - p = n.s.; Fig. 2; age adjusted 11.3% vs 9.5%). There were also no significant differences in the prevalence of diabetes and impaired glucose tolerance between male hypertensives and female hypertensives. The prevalence of obesity was significantly higher in the hypertensives than the non-hypertensives (39.4% vs 25.5% - $p< 0.001$; Fig. 3; age adjusted 24.7% vs 20.4%). Female hypertensives were significantly more obese than male hypertensives (42.9% vs 30.7% - $p< 0.05$; age adjusted 25.6% vs 12.5%). There was also a significantly higher prevalence of hypercholesterolaemia in the hypertensives than the non-hypertensives (70.7% vs 57.8% - $p< 0.001$; Fig. 4; age adjusted 39.0% vs 40.2%) and female hypertensives had a significantly higher

prevalence of hypercholesterolaemia than male hypertensives (74.5% vs 61.4% - p< 0.05; age adjusted 40.3% vs 29.0%). As for smoking, the number of smokers was significantly less in the hypertensive group than in the non-hypertensive group (28.7% vs 34.5% - p < 0.05). Hypertensive subjects also had significantly higher mean age, body mass index, serum urea, creatinine, uric acid, triglyceride, total cholesterol, low density cholesterol, fasting blood glucose and 2 hours' post-glucose load blood glucose than non-hypertensive subjects (Table II).

In the hypertensive group, 83.3% of the subjects had 1 other risk factor for cardiovascular disease (diabetes mellitus, hypercholesterolaemia or smoking); 66.7% had 2 other risk factors and 16.7% had more than 2 risk factors (Fig. 5). In the non-hypertensive group, 75.3% of the subjects had 1 other risk factor for cardiovascular disease; 33.1% had 2 other risk factors and 8.5% had more than 2 risk factors. The prevalence of other risk factors in the hypertensive group were significantly higher than in the non-hypertensive group.

Table I : Prevalence of Hypertension in Relation to Age and Gender

Age Group (years)	Male	Female	Total
30 - 39	3/158 (1.9%)	33/159 (6.4%)	36/677 (5.3%)
40 - 49	17/205 (8.3%)	62/491 (12.6%)	79/696 (11.4%)
50 - 59	35/215 (16.3%)	74/376 (19.7%)	109/591 (18.4%)
60 - 69	31/156 (19.9%)	48/206 (23.3%)	79/362 (21.8%)
> 70	15/96 (15.6%)	30/86 (34.9%)	45/182 (24.7%)
Overall	101/830 (12.2%)	247/1678 (14.7%)	348/2508 (13.9%)

Table II : Mean (+S.D.) Age, Body Mass Index, Sytolic and Diastolic Blood Pressure and Biochemical Parameters in Hypertensive and Non-Hypertensive Subjects

	HYPERTENSIVE	NON-HYPERTENSIVE	P
Age (years)	54.9 ± 12.4 (n = 346)	47.5 ± 13.6 (n = 2151)	p< 0.001
BMI (kg/m2)	24.1 ± 4.8 (n = 348)	22.4 ± 5.2 (n = 2150)	p< 0.001
BP systolic (mmHg)	169.2 ± 25.4 (n = 348)	121.2 ± 15.9 (n = 2160)	p< 0.001
BP diastolic (mmHg)	98.6 ± 19.0 (n = 348)	74.6 ± 9.7 (n = 2160)	p< 0.001
Urea (mmol/l)	4.9 ± 4.1 (n = 348)	4.4 ± 2.9 (n = 2159)	p< 0.001
Creatinine (umol/l)	103.7 ± 83.2 (n = 348)	89.1 ± 42.6 (n = 2158)	p< 0.001
Uric acid (umol/l)	312.3 ± 109.5 (n = 348)	281.3 ± 97.3 (n = 2157)	p< 0.001
Triglyceride (mmol/l)	1.9 ± 1.1 (n = 348)	1.6 ± 1.1 (n = 2157)	p< 0.001
Total Cholesterol (mmol/l)	6.1 ± 2.0 (n = 348)	5.6 ± 1.5 (n = 2159)	p< 0.001
LDL- Cholesterol (mmol/l)	4.4 ± 3.3 (n = 348)	3.9 ± 2.0 (n = 2149)	p< 0.001
HDL- Cholesterol (mmol/l)	1.02 ± 0.36 (n = 348)	1.05 ± 0.37 (n = 2158)	n.s.
FBG (mmol/l)	5.9 ± 3.4 (n = 345)	5.3 ± 2.1 (n = 2139)	p< 0.001
2HBG (mmol/l)	7.9 ± 4.4 (n = 341)	6.9 ± 3.7 (n = 2119)	p< 0.001

Table III : Mean (+S.D.) Age, Body Mass Index, Sytolic and Diastolic Blood Pressure and Biochemical Parameters in Male Hypertensive and Non-Hypertensive Subjects

	HYPERTENSIVE	NON-HYPERTENSIVE	P
Age (years)	58.4 ± 10.3 (n = 100)	51.3 ± 14.1 (n = 725)	p< 0.001
BMI (kg/m2)	23.3 ± 4.6 (n = 101)	21.9 ± 3.7 (n = 726)	p< 0.01
BP systolic (mmHg)	171.2 ± 34.0 (n = 101)	123.0 ± 12.5 (n = 728)	p< 0.001
BP diastolic (mmHg)	100.5 ± 9.6 (n = 101)	75.2 ± 8.0 (n = 728)	p< 0.001
Urea (mmol/l)	5.6 ± 4.0 (n = 101)	5.1 ± 4.0 (n = 728)	n.s.
Creatinine (umol/l)	103.7 ± 83.2 (n = 101)	89.1 ± 42.6 (n = 728)	p< 0.01
Uric acid (umol/l)	374.1 ± 109.3 (n = 101)	346.3 ± 98.1 (n = 727)	p< 0.05
Triglyceride (mmol/l)	1.8 ± 1.0 (n = 101)	1.7 ± 1.1 (n = 726)	n.s.
Total Cholesterol (mmol/l)	5.8 ± 1.2 (n = 101)	5.5 ± 1.2 (n = 728)	p< 0.05
LDL-Cholesterol (mmol/l)	4.0 ± 1.1 (n = 101)	3.8 ± 1.2 (n = 724)	n.s.
HDL-Cholesterol (mmol/l)	0.99 ± 0.31 (n = 101)	0.96 ± 0.42 (n = 727)	n.s.
FBG (mmol/l)	5.8 + 4.9 (n = 101)	5.4 + 2.1 (n = 721)	n.s.
2HBG (mmol/l)	7.1 + 3.2 (n = 100)	6.5 + 3.6 (n = 709)	n.s.

Table IV : Mean (+S.D.) Age, Body Mass Index, Sytolic and Diastolic Blood Pressure and Biochemical Parameters in Female Hypertensive and Non-Hypertensive Subjects

	HYPERTENSIVE	NON-HYPERTENSIVE	P
Age (years)	53.9 ± 12.1 (n = 246)	45.8 ± 12.5 (n = 1426)	p< 0.001
BMI (kg/m2)	24.5 ± 4.7 (n = 247)	22.6 ± 4.5 (n = 1424)	p< 0.001
BP systolic (mmHg)	168.4 ± 20.9 (n = 247)	121.3 ± 13.8 (n = 1432)	p< 0.001
BP diastolic (mmHg)	104.3 ± 58.0 (n = 247)	75.0 ± 7.9 (n = 1432)	p< 0.001
Urea (mmol/l)	4.7 ± 4.1 (n = 247)	4.0 ± 2.0 (n = 1431)	p< 0.05
Creatinine (umol/l)	97.2 ± 94.0 (n = 247)	80.7 ± 39.0 (n = 1430)	p< 0.01
Uric acid (umol/l)	287.1 ± 99.3 (n = 247)	248.9 ± 77.8 (n = 1430)	p< 0.001
Triglyceride (mmol/l)	1.9 ± 1.2 (n = 247)	1.5 ± 0.9 (n = 1431)	p< 0.001
Total Cholesterol (mmol/l)	6.2 ± 2.2 (n = 247)	5.6 ± 1.7 (n = 1431)	p< 0.001
LDL-Cholesterol (mmol/l)	4.2 ± 1.4 (n = 244)	3.9 ± 1.2 (n = 1425)	p< 0.01
HDL-Cholesterol (mmol/l)	1.04 ± 0.37 (n = 247)	1.09 ± 0.33 (n = 1431)	n.s.
FBG (mmol/l)	5.9 ± 2.6 (n = 244)	5.3 ± 2.0 (n = 1418)	p< 0.001
2HBG (mmol/l)	8.5 ± 4.6 (n = 241)	7.3 ± 3.6 (n = 1410)	p< 0.001

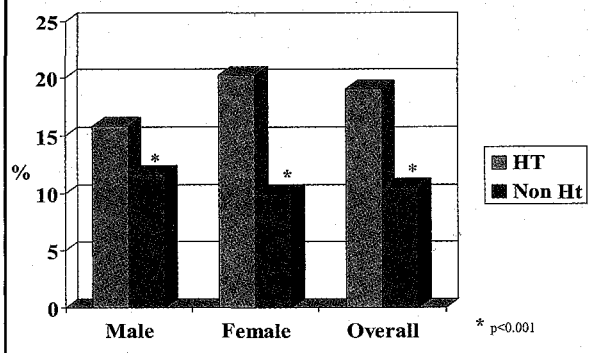

Fig. 1: Prevalence Of Diabetes Mellitus In Relation To Gender In Hypertensive And Non-Hypertensive Subjects

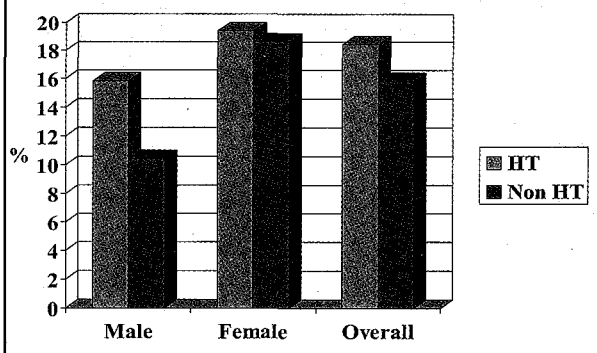

Fig. 2: Prevalence Of Impaired Glucose Tolerance In Relation To Gender In Hypertensive And Non-Hypertensive Subjects

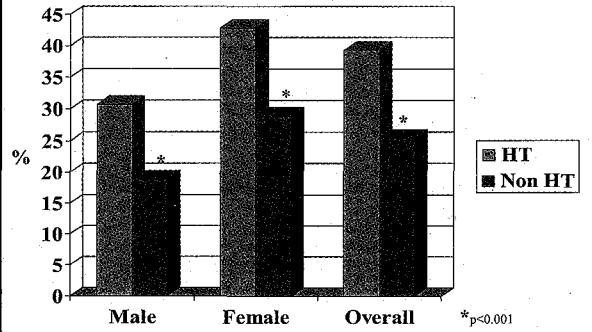

Fig. 3: Prevalence Of Obesity In Relation To Gender In Hypertensive And Non-Hypertensive Subjects

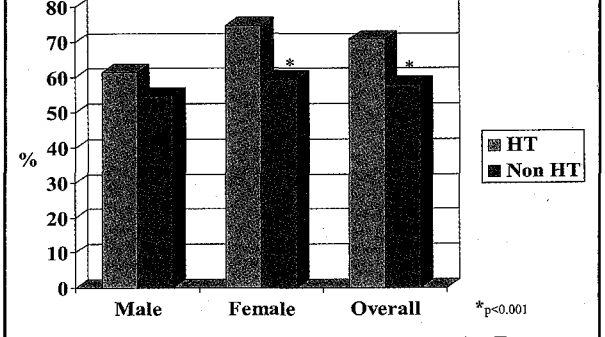

Fig. 4: Prevalence Of Hypercholesterolemia In Relation To Gender In Hypertensive And Non-Hypertensive Subjects

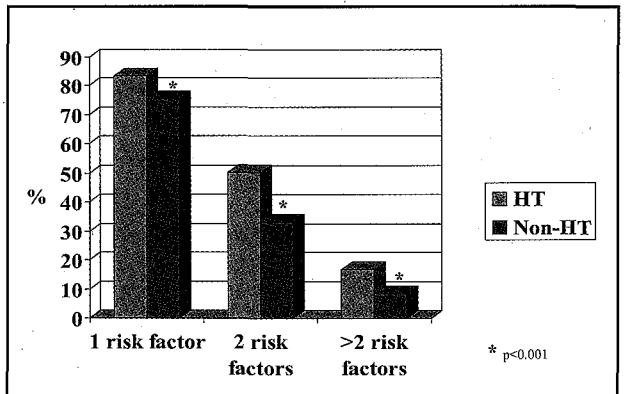

Fig. 5: Prevalence Of Cardiovascular Risk Factors In Hypertensive And Non-Hypertensive Subjects

Discussion

The overall prevalence of hypertension of 13.9% is comparable to that reported for a developing nation of between 10% - 15% [1,2,5] but lower than that in developed nations of between 20% - 25% [3,6]. In the 2nd National Health and Morbidity Survey, the overall prevalence of hypertension was 24.1% in adults aged 30 years and above [9]. The different prevalence possibly reflects different rates in different states of this country as noted in the National Survey. The prevalence for Kelantan was not stated in the report. As in other studies, we also noted an association of hypertension with age, diabetes mellitus, obesity and hypercholesterolaemia. This is consistent with hypertension being part of the Metabolic Syndrome or Syndrome X as described by Reaven [7]. The underlying factor in this syndrome is thought to be insulin resistant and hyperinsulinaemia. Plasma insulin level was not, however, measured in this study. We also found that our hypertensive subjects had higher serum urea, creatinine and uric acid. This could indicate that some of our hypertensive subjects had some degree of renal impairment as a result of hypertension. There was a significant difference in the prevalence of obesity in the male hypertensive subjects and the female hypertensive subjects. This, however, was a reflection that females were more obese than males and not peculiar to female hypertensive subjects only as the prevalence of obesity in the non-hypertensive female subjects was also higher than the non-hypertensive males. Eventhough the prevalence of hypercholesterolaemia was higher in the hypertensive subjects, it was also high in the non-hypertensive subjects. This is possibly related to the diet consumed by people in this area. It was also interesting to note that female hypertensive subjects had a higher prevalence of hypercholesterolaemia than male hypertensive subjects. Perhaps this could be explained by the higher prevalence of obesity in the female hypertensive subjects as obesity is a cause of hypercholesterolaemia. The number of smokers was, surprisingly, significantly less in the hypertensive group than in the non-hypertensive group. Perhaps, many of the hypertensive subjects were aware of the dangers of smoking especially when they had hypertension and consequently quit smoking. However, we did not have data on previous smoking history and hence, would not be able to substantiate this observation.

In conclusion, hypertension is common in this area and is associated with other risk factors for cardiovascular disease. The prevalence is likely to increase with increasing affluence and to become a major health problem causing significant morbidity and mortality in the near future.

Acknowledgement

This research was supported by an IRPA grant from the Ministry of Science, Technology and Environment. We would also like to thank Dr Ayub Hj. Sadiq for his help in the statistical analysis.

References

1. Giles WH, Pacque M, Greene BM, et al. Prevalence of hypertension in rural West Africa. Am J Med Sci 1994; 308(5): 271-75.
2. Wu X, Duan X, Gu D, et al. Prevalence of hypertension and its trends in Chinese populations. Int. J. Cardiol 1995; 52(1): 39-44.
3. Haffner S, Gonzalez Villalpando C, Hazuda HP, et al. Prevalence of hypertension in Mexico City and San Antonio, Texas. Circulation 1994; 90(3): 1542-549.
4. World Health Organisation. Report of a WHO Consultation: Definition, diagnosis and classification of diabetes mellitus. Geneva 59p WHO/NCD/NCS/99.2; 1999: 5-7.
5. Agarwal AK, Yunus M, Khan A, Ahmad J. A clinical- epidemiological study of hypertension in rural population of Jawan Block, Distt, Aligarh (UP) India. J.R. Soc. Health 1994; 114(1): 17-19.
6. Plans P, Pardell H, Salleras L. Epidemiology of cardiovascular disease risk factors in Catalonia (Spain). Eur J Epidemiol 1993; 9(4): 381-89.
7. Reaven GM. Banting Lecture: Role of insulin resistance in human disease. Diabetes 1988; 37: 1595-607.
8. BA Omar, B Cynthia, DL Alan et al. Age standardization of rates: A new WHO standard. GPE Discussion Series: No. 31, EIP/GPE/EBD World Health Organisation 2000.
9. Report of the Second National Health and Morbidity Survey Conference. Public Health Institute, Ministry of Health Malaysia 1997; 71-80.