Original Article

Blood Pressure and Hypertension Distribution in a lower middle class urban community in Pakistan

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Abstract

Objective: To determine the awareness level, blood pressure profile and its correlates in Metroville Health Study and to compare the results with those of Pakistan National Health Survey and National Health and Nutrition Examination Survey of USA.

Methods: Sample consisted of 400 households of Metroville, included after informed consent. Demographic data was collected and Blood pressure, Cholesterol, Blood Glucose, Height and weight were measured. Obesity was calculated as BMI. The results were compared with those of the Pakistan National Health Survey and National Health and Nutrition Examination Survey of USA.

Results: For both sexes and all age groups, hypertension was more prevalent in MHS than Pakistan National Health Survey (PNHS) and U.S. MHS hypertensives were more likely to be aware of and treated for their condition than hypertensives of PNHS, but less likely than U.S. hypertensives.

Systolic and diastolic blood pressure (DBP) rose with increased age in all three populations. Blood pressure also rose with increased body mass index (BMI) in MHS as well as PNHS and NHANES, with little differences in the degree of rise among them. A one-kg/Height (in m²) increment in BMI was associated with a 0.40-0.67 mmHg increment in systolic pressure in men and a 0.56-0.74 mmHg increment in women. The main difference between USA and two Pakistani surveys was the level of DBP, which was significantly higher in Pakistani Surveys than NHANES, for both men and women.

Conclusions: The prevalence of Hypertension in Metroville was high. It showed a quantitative relationship to increasing age and BMI. Hypertension and obesity were the major public health problems in the lower middle class community of Metroville. It is recommended that awareness should be increased and preventive measures implemented (JPMA 55:333;2005).

Introduction

Hypertension is well established as a risk factor for cardiovascular morbidity and mortality in countries with developed market economies.[1,2] The recent data from WHO and others showed hypertension and cardiovascular disease (CVD) in the developing countries to be emerging as health problems.[3]

The Pakistan National Health Survey, conducted by Pakistan Medical Research Council, had shown significant prevalence of risk factors for the coronary heart disease (CHD). The survey further showed that there was a double burden of malnutition and obesity and CHD risk factors. Hypertension was shown to be prevalent at the rate of 18% in over 15 years age of the Pakistani population. The hypertension prevalence was16.2% in the rural and significantly higher (21.6%) in the urban Pakistani population[4], a result at variance with the experience in the west where low socioeconomic groups had higher prevalence of hypertension. The urbanization in Pakistan is occuring at an annual rate of 3.7% of the population. This degree of urbanization is bringing about rural to urban migration at a large scale. This population shift is accompanied with better job availabilities and improved economy with greater power of buying. The result is changing of the life styles of these newly emerging urban communities.[5]

Available data suggest that economically developing countries are being burdened with an escalating epidemic of coronary heart disease (CHD) and stroke morbidity and mortality so that urgent steps need to be taken to treat and modify risk factors for CVD, including hypertension.[6,7] In a review of Chinese morbidity and mortality in the Sino-MONICA population samples aged 35-64 in 1984-86 and 1988-89, hypertension was reported to be the main risk factor for stroke and an important risk factor for CHD.[8] In Pakistan, increases in urbanization, per capita income and longevity, combined with rising tobacco consumption and a more sedentary lifestyle, appear to have produced marked increases in chronic diseases such as hypertension, diabetes and ischemic heart disease.[4,5]

Hypertension is well established as a major risk factor for cardiovascular morbidity and mortality in countries with developed market economics.[1,2] Obesity and behavioral factors affect blood pressure and some interventions designed to change these factors have been

effective in modifying hypertension in the USA and Europe[9,10] and to some degree in developing countries.[11-15] A study of Indian women[16] showed age; body mass index (BMI) and obesity to be strongly associated with hypertension. Truncal obesity (waist-hip ratio >0.95) measured in another Indian study of men and women found that mean values of systolic blood pressure (SBP) and diastolic blood pressure (DBP) were not significantly different in truncally obese subjects.[17] USA data from a follow-up study based on the first National Health and Nutrition Examination Survey (NHANES1, 1971-75) confirmed an association of higher truncal obesity with increased incidence of hypertension in white women.[18]

In an effort to develop preventive strategies which could be applied to the newly emerged urban communities in Pakistan, a five-year prospective study of CVD risk factor modification, Metroville Health Study (MHS) was undertaken in 1994 by the National Institute of Cardiovascular Diseases in Metroville in collaboration with the National Heart, Lung, and Blood Institute in the USA. The primary objective of the study was to determine whether known strategies for CVD risk factor modification could be implemented in the lower middle class community of Metroville, a suburb of Karachi, Pakistan.

The purpose of this paper was to determine the awareness level, blood pressure profile and its correlates in MHS population and compare the results with Pakistan National Health Survey data (PNHS), which represents the national averages, conducted by Pakistan Medical Research Council from 1990-1994.

Methods

Metroville is a newly emerged urban community in the outskirts of Karachi, a metropolis of over 15 million people and is composed of first generation rural migrants from various provinces of Pakistan. It was selected for its socioeconomic composition, ethnic diversity and willingness of its leaders to collaborate in MHS, a community-based heart disease prevention program planned to help reduce CVD. The MHS sample included 400 households living in Metroville who volunteered to participate and were randomly assigned to treatment and control groups. The invitation to register was proceeded by extensive conferences with social workers elders and religious leaders, medical personnels including hospitals personnel. Banners were put up in the whole of Metroville. This effort extended over a one year period so that the whole of Metroville was aware of the preventive nature of the study. Only households were invited and not the individuals. Intervention households participated in educational programs on heart disease and its risk factors, and on the importance of dietary modification to reduce these risk factors. Control households received education in the importance of prenatal care. These households were a convenient sample, designed to compare the effectiveness of the treatment versus the control group over extended period of six years.[19,20]

Baseline data was collected on demographic characteristics, height, weight, blood pressure, cholesterol, blood glucose and hemoglobin.[19] Blood pressure was measured by taking two readings on the right arm, using a standard sphygmomanometer; SBP and fifth phase DBP were recorded in mmHg. Hypertension was defined as SBP ≥140 mmHg or DBP ≥90 mmHg, or on blood pressure medication. Body weight was measured to the nearest kilogram using a balanced beam scale; height without shoes was measured to the nearest 0.5 centimeter. BMI was defined as weight (in kg) / Height (in m^2). Age refers to age at baseline and was obtained from the baseline interview. Information on awareness and treatment of hypertension was obtained from persons found to be hypertensive during the physical examination. Persons were considered to be aware if they were on hypertension medication or had been told by a doctor that they were hypertensive. Under treatment was defined as taking hypertension medication prescribed by a doctor.

The PNHS conducted from 1990-1994 was designed to provide accurate health statistics to the government of Pakistan for planning and policy development in the health sector. A standardized protocol that conformed to international standards was used to collect blood pressure measurements in the PNHS. Body weight and height were collected on all participants.[7]

The Public Use Data File used in the present report contained information on 39,695 persons aged 2 months and older who participated in NHANES III.[21,22]

Sample Size and Age

Sample by age group for MHS, PNHS and NHANES is shown in Table 1 for each sex. A total of 2171 subjects were examined at the baseline in the Metroville sample, 1093 were under 18 year age and 1078 were ≥ 18 year age, after exclusion 946 subjects were included for analysis. Pregnant women were excluded, other exclusion criteria were body mass index < 10 and > 80 Kg/Height (in m^2), incorrect data entries and subjects <18 year. Only subjects ≥18 year age in Metroville and PNHS and NHANES were included for analysis and comparison. NHANES was the largest sample with approximately 16,000 participants aged 18-74 years; PNHS had over 6,000 persons in this age range. MHS and PHNS were on average younger than the NHANES sample For example MHS sample had higher percentage of young persons 18-34 than NHANES (PNHS 47%, Metroville 45%, NHANES 37%) and lower percentage of older persons 55-74

year old (PNHS 19%, Metroville 11% and NHANES 33%).

Statistical Methods

Systolic and DBP by Body Mass Index BMI (in Kg) /Height (in m²) quintiles and sex were determined for Metroville and compared with PNHS and NHANES data. Comparative multiple regression analysis was made to evaluate the effect of age and BMI (kg/in m²) on SBP and DBP.

Results

Demographics of MHS

MHS was composed of 400 households while there were 4,296 Households in the Metroville area. The average number of families living in one household of MHS was a mean of 1.22 and the average number of adults were 3.9 per household. Male to female ratio was 1.06. The average monthly income per household was 8,321 rupees. The average monthly income per household was 8,321rupees (Range 1,500-90,000). Educational status showed 28% illiteracy, 28% had 4 years of school and 28% had 10 years school or college education. Forty percent women were illiterate compared to 15 percent men.

Business was owned by 10.8%, 36 percent were students and 22% housewives and 5.6 % were government employees. Unskilled labour were 1.7%, 6.3% preschoolers, 1.7% retired, 0.7% were drivers, 8.3% other jobs and in 7.3% no job description was available.

Hypertensives, awareness and treatment in MHS

The number of hypertensives, percent awareness and treatment levels are shown in Table 2. For both sexes and in all age groups, hypertension was more prevalent in the Metroville sample than in the PNHS and NHANES samples and reached statistical significance in women compared to PNHS women (P=0.018). Hypertensives as a proportion of the total population gradually increased with age in both men and women in all three surveys. In the 18-34 year age groups, less than 12.2 percent of the populations were hypertensive. These proportions rose to approximately 50% in the 55-75 years age group, with the exception of PNHS men and women where the percentages were 27.5 and 31.6, respectively. Among men, hypertensives who were aware that they had the condition ranged from 15.4 percent in PNHS to 64.6 percent in MHS. Comparable percentages among women ranged from 36 in PNHS to 80 in MHS. Among hypertensives, more women than men in both countries were aware that they had hypertension and, consequently, more women than men were under treatment. Men in NHANES were more likely than Pakistani men to be aware of and under treatment for hypertension, while MHS men were far more likely than PNHS men (P<0.0001) to be aware of and under treatment (P<0.0001) for hypertension. There were major differences in awareness and treatment levels between NHANES women and in women in the Pakistan surveys. Awareness and treatment levels were high for NHANES and MHS women, and very low for PNHS women.

Blood Pressure Distribution

With few exceptions, mean systolic blood pressure, both SBP and DBP increased with age in all three samples. Comparing the systolic blood pressure means of MHS and PNHS men, showed significantly higher systolic blood pressure for most age groups in MHS while no significant difference was noted for systolic blood pressure in women. For diastolic blood pressure in men or women, no

Table 1. Mean, standard deviation (S.D.) of SBP (mm/Hg) and DBP (mm/Hg) by age group and sex for Metroville, PNHS and NHANES samples.

		Metroville				PNHS				NHANES				P VALUES					
Sex	Age Group	N	SBP	S.D.	DBP	S.D.	N	SBP	S.D.	DBP	S.D.	N	SBP	S.D.	DBP	S.D.	P1	P2	P3	P4	P5	P6
Men	18-34	207	115.3	12	77.2	10	1425	116.4	11	79.7	9	3018	118.6	11	73.3	13	0.1889	0.0001	0.013	0.0000	0.0000	0.0000
	35-44	121	121.3	15	84.2	12	566	116.6	13	82.2	10	1506	120.9	13	78.7	10	0.0005	0.0550	0.8198	0.0000	0.0000	0.0000
	45-54	105	124.7	15	83.9	12	448	118.7	15	82.7	10	1011	126.6	16	80.4	11	0.5960	0.2890	0.3285	0.0021	0.0000	0.0002
	55-74	43	138.4	22	85.3	13	610	125.7	20	81.4	11	2429	135.5	19	78.0	11	0.0001	0.0300	0.3229	0.0000	0.0000	0.0000
	Total	476	121.0	16	81.2	11	3049	118.7	16	80.9	10	7964	124.1	15	76.6	12	0.0001	0.5600	0.000	0.0000	0.0000	0.0000
Women	18-34	222	112.6	13	73.8	11	1439	112.6	12	74.4	9	3143	108.2	10	68.1	11	1.000	0.3888	0.0000	0.0000	0.0000	0.0000
	35-44	122	121.7	19	81.7	13	600	118.4	17	78.4	11	1811	113.4	14	73.0	10	0.0820	0.0047	0.0000	0.0000	0.0000	0.0000
	45-54	68	131.2	22	83.5	11	465	124.3	21	80.3	12	1141	123.3	17	76.3	10	0.0120	0.0420	0.0003	0.0000	0.3320	0.0000
	55-74	58	137.1	28	82.0	14	550	131.4	25	81.3	14	2564	135.2	21	74.6	12	0.109	0.7048	0.4994	0.000	0.0001	0.000
	Total	470	120.7	19	78.2	21	3054	118.9	19	77.3	11	8659	118.3	18	72.1	11	0.0610	0.1065	0.0051	0.000	0.1208	0.0000

P1 = SBP Metroville vs PNHS; P2 = DBP Metroville vs PNHS; P3 = SBP Metroville vs NHANES; P4 = DBP Metroville vs NHANES; P5 = SBP PNHS vs NHANES; P6 = DBP PNHS vs NHANES.

Table 2. Hypertensives[a]: number, percent aware of condition, and percent under treatment by age group and sex, Metroville, PNHS and NHANES samples.

	Metroville			PNHS			NHANES [b]		
		Percent[d]:			Percent[d]:			Percent[d]:	
Age Group	No. (%)[c]	Aware	Under Treatment	No. (%)[c]	Aware	Under Treatment	No. (%)[c]	Aware	Under Treatment
					Men				
18-34	25 (12.1)	20.0	16.0	152 (10.7)	10.5	5.9	167 (6.0)	35.2	12.9
35-44	30 (24.8)	50.0	20.0	108 (19.1)	16.7	10.2	305 (15.0)	61.8	32.5
45-54	32 (30.5)	46.9	21.9	99 (22.1)	17.2	9.1	323 (28.5)	72.5	49.5
55-75	23 (53.5)	56.5	43.5	168 (27.5)	17.9	10.1	1278 (48.5)	69.2	53.8
Total	110 (23.1)	43.6	24.5	527 (17.3)	15.4	8.7	2073 (20.8)	64.6	44.6
					Women				
18-34	18 (8.1)	77.8	61.1	61 (4.2)	29.5	13.1	81 (1.7)	75.9	50.7
35-44	30 (24.6)	86.7	53.3	89 (14.8)	40.4	19.1	239 (10.0)	78.6	59.6
45-54	29 (42.6)	75.9	58.6	118 (25.4)	42.4	25.4	351 (24.7)	81.3	66.4
55-75	33 (56.9)	78.8	69.7	174 (31.6)	31.6	15.5	1485 (52.1)	77.0	62.5
Total	110 (23.4)	80.0	60.9	442 (14.5)	36.0	18.6	2156 (19.5)	78.0	62.5

a): SBP 140 mg/dL or DBP 90 mg/dL or on medication; b): Weighted percentages; c): Percent of N in age group; d): Percent of hypertensives.

Awareness in men: Metroville VS PNHS P< 0.0000; Metroville VS NHANES P<0.0000; PNHS VS NHANES P<0.0000;

Women: Metroville VS PNHS P<.0001; Metroville VS NHANES P=0.63; PNHS VS NHANES P<0.0000; Awareness Men VS Women: Metroville; P< 0.0000; PNHS 0.0000; NHANES 0.0000; Prevalence: Metroville VS PNHS P < 0.018; Under treatment: Metroville VS PNHS P<0.0001; Metroville VS NHANES P<0.0001; VS: Versus.

significant differences were noted between the two surveys. For men, mean SBP for all groups though higher in NHANES compared to MHS, was statistically significant only in the overall means. Comparing PNHS men with NHANES the systolic blood pressure was statistically significantly greater in NHANES in all age groups. In MHS women compared to NHANES the systolic blood pressure means were significantly higher in all groups as well as

Table 3. SBP (mm/Hg) and DBP (mm/Hg) means by BMI (kg/m2) quintile and sex, Metroville, PNHS, and NHANES samples.

		Metroville				PNHS				NHANES [a]			
Sex	BMI Quintile	N	Upper BMI cutoff	Means SBP	Means DBP	N	Upper BMI cutoff	Means SBP	Means DBP	N	Upper BMI cutoff	Means SBP	Means DBP
Men	1	97	19.5	117.5	75.8	610	18.0	113.5	77.0	1394	22.6	121.1	72.6
	2	96	22.1	118.4	78.7	610	19.5	116.6	78.7	1377	24.8	121.6	75.2
	3	93	24.3	123.2	83.7	610	21.2	117.5	79.7	1328	26.8	123.0	76.5
	4	96	26.9	120.7	82.3	610	24.0	121.6	82.9	1593	29.7	124.0	77.9
	5	94	-	125.4	85.6	609	-	124.2	86.4	1617	-	128.4	80.2
	Total	476		121.0	81.2	3049	-	118.7	80.9	7309		123.7	76.5
Women	1	95	20.4	114.8	74.5	611	17.6	112.9	72.6	1169	21.1	113.7	68.8
	2	93	23.2	118.7	76.3	611	19.6	115.8	75.1	1248	23.5	115.2	69.6
	3	95	26.2	121.0	77.3	611	21.9	118.1	76.6	1571	26.4	116.7	71.5
	4	93	29.8	123.2	80.5	611	25.6	120.9	79.2	1969	31.1	119.1	73.6
	5	94	-	125.5	82.8	610	-	127.0	83.0	2061	-	124.2	76.0
	Total	470		120.7	78.2	3054	-	118.9	77.3	8018		117.8	71.9

a): Weighted means

overall means, however in NHANES compared to PNHS women the means tended to vary in various age groups but the over all group means showed no statistically significant difference. The individual group means and over all group means of DBP in men and women were significantly higher in MHS and PNHS compared to NHANES Table I.

Comparing differences in SBP between men and women, no significant difference was noted in overall group means in MHS and PNH samples, however, the over all group means showed that men in NHANES sample had significantly higher SBP than women ($P<0.01$). The over all group means of DBP in all three surveys were significantly higher in men than women ($P< 0.01$).

Blood pressure adjusted for age and BMI

BMI, like age, was directly associated with blood pressure and could influence the prevalence of hypertension. To further examine this relationship, SBP and DBP means by BMI quintile are presented in Table 3 for men and women in Metroville. With few exceptions, SBP and DBP increase slightly as BMI increases. The increases in MHS were of similar magnitude for both sexes in PNHS and NHANES populations.

In order to determine the significance of age and BMI as correlates of SBP and DBP and to adjust for differences between samples, multiple regression was used separately for total men and total women in each survey population, with SBP and DBP as dependent variables and age and BMI as independent variables. Results showed that in MHS age and BMI in both men and women were positively and significantly associated with SBP and DBP similar correlation was noted in PNHS as well as NHANES. In men, a one-year increment in age was associated with an increment in SBP of 0.41-0.45 mm/Hg except for PNHS men for whom the increment was 0.19 mm/Hg. In women, a one-year increment in age was associated with a 0.44-0.64 mm/Hg increment in SBP. Similarly, a one-unit increment kg/Height (in m^2) in BMI was associated with an increment in SBP of 0.40-0.67 mm/Hg in men and 0.56-0.74 mm/Hg in women. Mean SBP was only slightly affected by the adjustment for age and BMI, declining in Metroville and PNHS men by 0.2 mm/Hg, and increasing in NHANES men by 0.1 mm/Hg. In women, after adjustment for age and BMI, mean SBP declined by 0.3 mm/Hg in Metroville, 0.2 mm/Hg in PNHS, and 0.1 mm/Hg in NHANES.

In DBP, a one-year increment in age was associated with an increment of 0.04-0.22 mm/Hg. The highest increment was in MHS women and the lowest was in PNHS men. A one-unit increment in BMI kg/Height (in m^2) was associated with an increment in DBP of 0.42-0.59 mm/Hg. The highest increment was in PNHS men and the lowest was in NHANES women. The adjustments increased mean DBP in Metroville Health Study and PNHS men by 0.3 mm/Hg and decreased mean DBP in MHS and PNHS women by 0.3 mm/Hg and 0.2 mm/Hg, respectively. The unadjusted means for NHANES men and women were unchanged.

Partial R^2 is the proportion of variation in SBP or DBP accounted for by age or BMI (after adjustment for the other variable). It was higher for age than BMI in most analyses, reaching a high of 0.37 for SBP in NHANES women.

Discussion

The demographic data suggested that the MHS population was economically better than the national average, most had jobs and one in ten had their own business. The education levels showed literacy rate at 54% was higher than the national average of 22.3% in urban population of PNHS. However 40% of MHS women were illiterate which was four times more as compared to men.[4]

Regarding prevalence, awareness and treatment of hypertension, several potential areas of concern are that 1) approximately one-half of Metroville Health Study and NHANES populations aged 55-75 were hypertensive, while majority of hypertensives in Metroville and PNHS were less than 54 years age 2) the percentage of hypertensives who were aware that they had the condition was relatively higher in MHS, 43.6% men and 80% women than PNHS where only 15.4 percent of hypertensive men and 36 percent of hypertensive women on average were aware; awareness levels in US men was 64.6% and 78% in women, and 3) treatment levels lagged considerably behind awareness levels in MHS and PNHS populations. The findings suggest that the MHS sample more closely resembles NHANES than PNHS in terms of prevalence, awareness and treatment of hypertension. This reflects the effect of urbanization of Metroville and confirms the findings of PNHS and others[4,23-25], so that the blood pressure profile resembled highly urbanized US population. The PNHS data showed lowest prevalence rates because the sample included both urban and rural population while MHS was purely an urban sample. The findings indicate that hypertension is a major public health problem in MHS population especially in terms of awareness and treatment of the disease. The study showed that awareness of hypertension was not followed by seeking treatment and suggested the need of programs of prevention to be applied in similar urban communities.[19]

Mean SBP and DBP increased with age for both sexes in Metroville consistent with the other two populations. This was not surprising as the positive relationship of age to blood pressure is well established. The main difference between NHANES and the two Pakistan surveys was

in the level s of DBP, which were significantly higher in the Pakistan surveys than in NHANES for both men and women. These blood pressure differences between the Pakistan and NHANES samples could be due to ethnic, behavioral, genetic, health care, kind of food consumption and other factors that are not the same between Pakistan and the USA. They could also be due to differences in sample selection methods, sample composition and blood pressure measuring techniques, although the technique of blood pressure determination was similar. The weak point of the study may be in selection of sample. Although registration of the households was done over approximately one year period with widely spread knowledge within the community about the preventive nature of the study, bias in the sample cannot be entirely ruled out and inferences for wider urban population in Pakistan may not be drawn. We believe the MHS population data does reflect urban characteristics in Pakistan. We do not believe the sample was biased towards inclusion of hypertensive patients from within Metroville because the questionnaire obtained at the baseline of 18 years or older subjects from these 400 households showed prevalence of 21% hypertensives which was similar to 21.6% for urban data of PNHS population.[4]

Conclusion

The newly emerged community of Metroville had significant prevalence of hypertension with MHS, in relatively younger age, which was significantly more than the average of PNHS, in combined rural and urban population but similar to the prevalence rate of 21.5% of urban PNHS population.[4] The study showed a quantitative linkage of blood pressure and BMI. Of concern was that the diastolic blood pressure profile of MHS population, which was higher than the US population. This suggested that with increasing migration of rural population to the urban centers, prevalence rates of hypertension would continue to rise to epidemic proportions with increasing burden of CVD. Pakistan is a developing country and has meager resources allocated to health. Thus prevention of obesity and epidemic of hypertension in the emerging urban communities should be the goal.[24] The study highlighted the need for targeting these newly emerging communities for prevention of CVD and the need to develop community social and health infrastructures in urban planning.

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