The Professional Medical Journal
www.theprofesional.com

DOI: 10.17957/TPMJ/16.3423

ORIGINAL PROF-3423

BMI TO BLOOD PRESSURE;

RELATIONSHIP OF BMI TO BLOOD PRESSURE AND ETHNICITY A LOCAL SUBURBAN POPULATION OF KARACHI

faiza.samad@gmail.com

Dr. Faiza Samad[1], Muhammad Faisal Fahim[2], Waqas Ahmed Farooqui[3]

1. MBBS, MCPS, FCPS
Associate Professor of Medicine
Al Tibri Medical College,
Isra University, Karachi Campus
2. Statistician
ISRA Ophthalmic Research & Development CenterAl-Ibrahim Eye Hospital,
Isra Postgraduate Institute of Ophthalmology
3. M.Sc., Phil Scholar
Lecturer of Biostatistics & Research Associate
Coordinator for Postgraduate Theses Defense
Office of Research Innovation & Commercialization (ORIC)
Department of Research
Dow University of Health Sciences

Correspondence Address:
Dr. Faiza Samad
MBBS, MCPS, FCPS
Associate Professor of Medicine
Al Tibri Medical College
G-10, Rehman Square next to Baradari 13 D Gulshan e Iqbal
Karachi
faiza.samad@gmail.com

Article received on:
26/04/2016
Accepted for publication:
21/06/2016
Received after proof reading:
08/08/2016

ABSTRACT… Objectives: To establish association of BMI**,** hypertension and ethnicity. **Study Design:** Observational cross sectional survey. **Setting:** Patients attending medical OPD of Jinnah Medical College Hospital Korangi, Karachi. **Period:** April 2014 to December 2014. **Methods:** Blood pressure was measured and BMI calculated. The WHO recommended BMI cut off points for South Asians were applied, overweight or obese were with a BMI of >23 kg/m^2 or >27.5 kg/ m^2 respectively. Cardiometabolic risk factors Diabetes and hypertension were recorded. SPSS Version 20 was used to analyze data. **Results:** Of n= 420 (100%) patients n= 130 (31%) were males and n=290 (69%) females. Mean age was 36.37 SD±12.98 years (CI 35.13-37.61) Overweight (BMI 23-<27 kg/m^2) were n=124(29.5%), and obese (BMI>27.5 kg/m$^{2)}$) were n=83 (19.8%). There were 6 major ethnic groups. Mean BMI>24kg kg/m^2 was present in females of all ethnic groups. Normal diastolic blood pressure in females was higher than males in all ethnic groups except Urdu speaking p-value 0.000 Hypertension prevalence n= 98(23.3%) showed significant differences (p-value 0.039) in ethnic groups, with highest prevalence in Sindhl n=10(30%) Urdu speaking n=27(27.8%), Punjabi n=14(26.9%), of these n=66(69.3%) were overweight and n=37 (41.1%) obese p-value 0.000. There was a significant relationship between BMI and hypertension in overweight and obese males and females' p-value 0.000 and 0.028 respectively. **Conclusion:** Significant relationship of BMI to hypertension and ethnic differences in prevalence of hypertension exists. Mean BMI in females is in the overweight category. Females have significant higher diastolic blood pressure than males in all groups except Urdu speaking; Intervention for prevention of obesity and reducing chronic disease burden needs to be urgently addressed.

Key words: ethnicity, cardiometabolic risk, BMI

Article Citation: Samad F, Fahim MF, Farooqui WA. BMI to blood pressure; Relationship of BMI to blood pressure and ethnicity; a local suburban population of Karachi. Professional Med J 2016;23(8):939-947. **DOI:** 10.17957/TPMJ/16.3423

INTRODUCTION

Pakistan belongs to the Indian subcontinent which includes India, Bangladesh, Bhutan, Sri Lanka, and Nepal. The multiple ethnicities therein are referred to as South Asians. Their migration to North America and change in their life style has lead to an increase in obesity and cardiovascular disease as compared to other ethnic groups.[1] This phenomenon is also seen in the Middle East.[2] Several studies[3,4] have confirmed that South Asians are at increased risk for cardiovascular diseases compared to the white population in spite of a lower Basal Metabolic Index (BMI).

The World Health Organization Expert Consultation settled the issues by recommending different cut off points for BMI in South Asian populations, as overweight or obese Asians are at a higher risk for diabetes mellitus and cardiovascular disease than Europeans of similar age, sex, and BMI.[5,6]

The recommendation being a BMI of 18.5 to 23 kg/m^2 increased but acceptable risk, a BMI of ≥23 kg/m^2 representing increased risk, and a, BMI of≥27.5 kg/ m^2 representing high risk.

Cardiovascular disease is a leading cause of morbidity and mortality throughout the world and strikes the population when they are most productive.[11] BMI is used to measure cardiovascular risk factors because it is simple, practical and economical to use[6], however

distribution of visceral fat or the proportion of fat to lean muscle is not taken into account.[7,8] WHO describes Obesity as an accumulation of fat to the extent that health and well being are affected[9] this in turn leads to hypertension, hyperlipidemia and diabetes and increased risk of cardiovascular disease[9,10]

Prevalence of these diseases varies between different nations and ethnic groups[12,13,14] this in turn maybe influenced by genetic factors[15] or by the environment.[16] Migration of population to a large city like Karachi for livelihood and subsequent affluence may lead to different prevalence of BMI and hypertension as compared to their home province[17]

Korangi is a large suburb of Karachi and home to a large number of ethnic groups belonging to a low socioeconomic group. This study was undertaken to see if there was a relationship of BMI to blood pressure and hypertension and ethnicity.

MATERIALS AND METHODS

Four hundred and twenty males and non-pregnant females aged 21-50 years were selected randomly from the outdoor department of Jinnah Medical &Dental Hospital during April 2014 to December 2014 at Korangi Karachi. The ethnicity of all participants was identified using their mother tongue and were classified as Urdu speaking, Punjabi, Sindhi Pashto, Bengali and Others.

Height without shoes (in meters) and weight (in kilograms) was taken and BMI was calculated as weight divided by height in meters squared (kg/m^2)[18], WHO's Asian criteria was used to classify them into BMI categories.[12]

Individuals were taken as underweight if their BMI was found to be <18.5(kg/m^2), and increased but acceptable if BMI was 18.5 to 23 kg/m^2, overweight if BMI>23 kg/m^2 and obese if BMI 27.5 kg/m^2 or more and represented high risk.
Blood pressure was measured using standard procedure with the patient in sitting position, on the right arm using mercury sphygmomanometer with appropriate cuff size. Hypertension was defined as a systolic BP greater than or equal to 140mmHg and/or diastolic BP greater than or equal to 90mmHg according to the criteria of The Joint National Committee on Hypertension 7.[20]

Cardio metabolic risk factor assessment was done by asking participants history of known hypertension (yes/no) and diabetes diagnosed by a doctor (yes/no). Demographics included sex, age, marital status, household income, and address All patients with chronic and debilitating diseases were excluded.

Statistical analysis

Data was analyzed through the software SPSS version 20.0. The continuous variables (Age, Height, Weight, and Systolic and Diastolic Blood Pressure) were presented in Mean Standard Deviation. All categorical variables (Gender, BMI, Ethnic group, Diabetes Mellitus & Hypertension) were presented in frequencies and percentages. To see the significance one way ANOVA, ANCOVA or Chi Square test was applied for different variables. P-value < 0.05 was considered to be statistically significant. . All participants volunteered to participate in this anonymous study and ethical approval was taken from the ethical committee of Jinnah Medical and Dental College and Hospital.

RESULTS

There were 5 major ethnic groups with a sixth group categorized as others. (Figure-1) The characteristics of the sample population are represented in Table-I. A total of n= 420(100%) patients were studied of whom n= 130 (31%) were males and n=290 (69%) females. Mean age was 36.37±12.98(CI 35,13-37.69) BMI was categorized using the WHO recommended South Asian cut off values[12] The mean BMI of the total group was 23.63 SD±0.56 (CI 23.58-23.69) and 22.73 SD±0.39 (CI 22.6-, 22.8) in males and 24.01 SD±0.47 (CI 23.96-24.06) in females.

Underweight participants (BMI<18.5kg/m^2) were n=54(12.9%), healthy18.5-<23kg/m^2 n=159(37.9%) overweightatrisk (BMI23-<27kg/

m^2) n=124(29.5%), obese (BMI>27.5kg/$m^{2)}$ n=83 (19.8%). The participants were mostly in the low socioeconomic group n=316 (75.2%) p-value<0.001.

BMI when compared to ethnicity showed that females had a higher value than males in all groups and were in overweight category BMI>24kg/$m.^2$ (Figure-2)

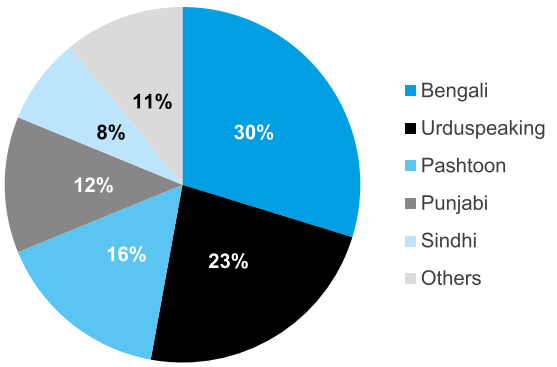
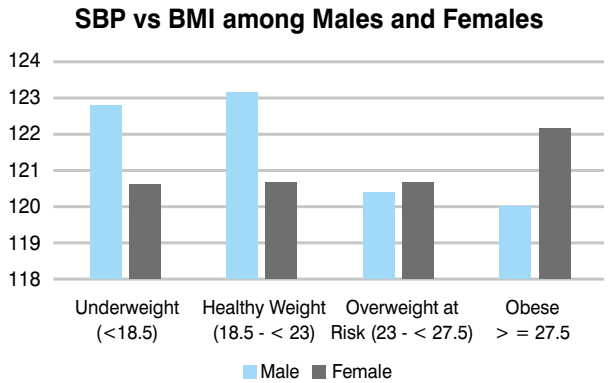
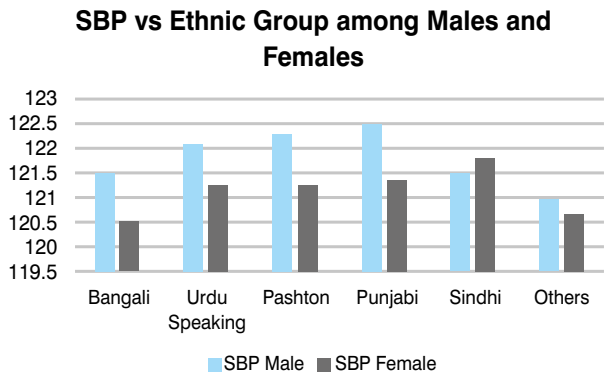
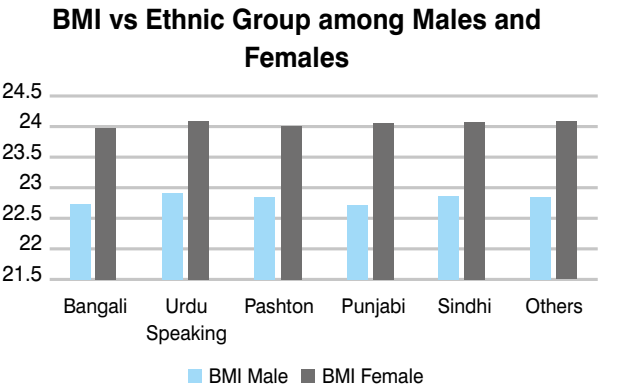
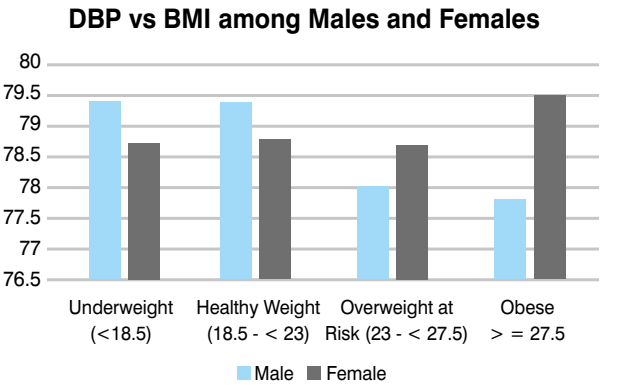


Figure-1. Distribution of Ethnic groups









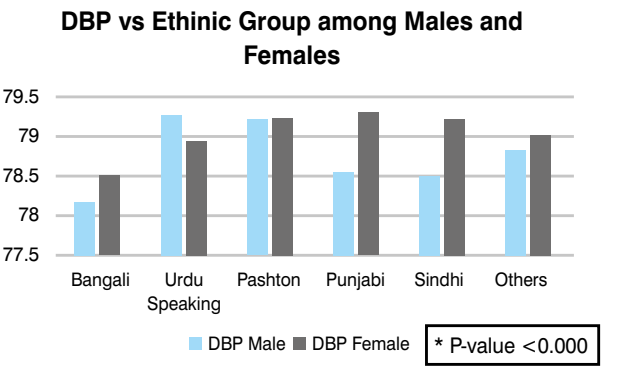


Figure-2. Relationship of BMI with blood pressure and ethnic groups

The mean systolic blood of the group as a whole was 121.4 SD ± 3.95 (CI 121.0 -121. The mean diastolic blood of the group as a whole was 78.95 SD±2.16 (CI 78.75-79.16).

Mean systolic blood and diastolic blood pressure was highest in the Punjabi males and females. Mean diastolic blood pressure was higher in females in all groups irrespective of ethnicity except the Urdu speaking group

	Weighted Frequency	Ethnic Group						Total (n = 420)	P-value
		Bengali; n=125 (%)	Urdu Speaking; n=97 (%)	Pashto; n=67 (%)	Punjabi; n=52 (%)	Sindhi; n=33 (%)	Others; n=46 (%)		
Sex	Male	38 (30.4%)	25 (25.8%)	30 (44.8%)	15 (28.8%)	12 (36.4%)	10 (21.7%)	130 (31%)	0.087
	Female	87 (69.6%)	72 (74.2%)	37 (55.2%)	37 (71.2%)	21 (63.6%)	36 (78.3%)	290 (69%)	
BMI Category (Kg/m2 - Asian)	Underweight (<18.5)	21 (16.8%)	11 (11.3%)	6 (09%)	6 (11.5%)	4 (12.1%)	6 (13%)	54 (12.9%)	0.168
	Healthy Weight (18.5 - <23)	57 (45.6%)	34 (35.1%)	24 (35.8%)	22 (42.3%)	11 (33.3%)	11 (23.9%)	159 (37.9%)	
	Overweight at Risk (23 - <27.5)	30 (24%)	27 (27.8%)	26 (38.8%)	15 (28.8%)	12 (36.4%)	14 (30.4%)	124 (29.5%)	
	Obese >=27.5	17 (13.6%)	25 (25.8%)	11 (16.4%)	9 (17.3%)	6 (18.2%)	15 (32.6%)	83 (19.8%)	
Socioeconomic	Low	123 (98.4%)	53 (54.6%)	49 (73.1%)	36 (69.2%)	19 (57.6%)	36 (78.3%)	316 (75.2%)	$1.12 \times 10^{-12**}$
	Middle	2 (01.6%)	44 (45.4%)	18 (26.9%)	16 (30.8%)	14 (42.4%)	10 (21.7%)	104 (24.8%)	
Diabetes diagnosed by doctor	-	13 (10.4%)	20 (20.6%)	3 (04.5%)	8 (15.4%)	4 (12.1%)	6 (13%)	54 (12.9%)	0.065
Hypertension diagnosed by doctor	-	30 (24%)	27 (27.8%)	15 (22.4%)	14 (26.9%)	10 (30.3%)	2 (04.3%)	98 (23.3%)	0.039*
Hypertension / Diabetes	-	35 (28%)	33 (34%)	16 (23.9%)	15 (28.8%)	12 (36.4%)	7 (15.2%)	118 (28.1%)	0.207
Age - years (Mean ± SD, 95 % CI)	-	39.0 ± 13.3 (36.7 - 41.4)	35.8 ± 12.8 (33.2 - 38.4)	34.6 ± 13.1 (31.4 - 37.7)	37.3 ± 12.7 (33.8 - 40.8)	36.0 ± 12.8 (31.6 - 40.4)	35.3 ± 12.8 (31.5 - 39.0)	36.37 ± 12.98 (35.13 - 37.61)	0.272
Systolic Blood Pressure (Mean ± SD, 95 % CI)	Overall (n = 420)	120.8 ± 4.08 (120.1 - 121.5)	121.5 ± 3.92 (120.8 -122.3)	121.6 ± 4.01 (120.6 - 122.6)	121.7 ± 3.89 (120.6 - 122.8)	121.7 ± 3.89 (120.4 - 123.1)	120.8 ± 3.91 (119.7 - 122.0)	121.4 ± 3.95 (121.0 - 121.8)	0.569
	Male (n = 130)	121.5 ± 3.99 (120.2 - 122.8)	122.1 ± 3.75 (120.6 - 123.6)	122.3 ± 3.78 (121 - 123.7)	122.5 ± 3.74 (120.6 - 124.4)	121.5 ± 3.69 (119.4 - 123.7)	121.0 ± 3.75 (118.7 - 123.4)	121.8 ± 3.78 (121.2 - 122.5)	0.873
	Female (n = 290)	120.5 ± 4.21 (119.6 - 121.4)	121.3 ± 4.06 (120.4 - 122.2)	121.3 ± 4.11 (119.9 - 122.6)	121.4 ± 4.03 (120.1 -122.7)	121.8 ± 4.04 (120.1 - 123.6)	120.7 ± 4.05 (119.4 - 122.0)	121.2 ± 4.08 (120.7 - 121.6)	0.656
Diastolic Blood Pressure (Mean ± SD, 95 % CI)	Overall (n = 420)	78.42 ± 2.22 (78.03 - 78.81)	78.99 ± 2.15 (78.56 - 79.42)	79.24 ± 2.19 (78.72 - 79.77)	79.08 ± 2.13 (78.5 - 79.66)	79.01 ± 2.13 (78.28 - 79.74)	78.98 ± 2.14 (78.36 - 79.6)	78.95 ± 2.16 (78.75 - 79.16)	0.186
	Male (n = 130)	78.16 ± 2.21 (77.45 - 78.87)	79.27 ± 2.08 (78.45 -80.09)	79.21 ± 2.1 (78.45 - 79.97)	78.55 ± 2.09 (77.48 - 79.61)	78.53 ± 2.06 (77.36 - 79.71)	78.82 ± 2.1 (77.51 - 80.13)	78.76 ± 2.1 (78.39 -79.12)	0.392
	Female (n = 290)	78.53 ± 2.27 (78.05 - 79.01)	78.93 ± 2.2 (78.42 - 79.44)	79.25 ± 2.21 (78.53 - 79.96)	79.3 ± 2.17 (78.6 - 80)	79.21 ± 2.18 (78.27 - 80.14)	79 ± 2.18 (78.29 - 79.72)	79.04 ± 2.2 (78.78 - 79.29)	0.454
Body Mass Index (Mean ± SD, 95 % CI)	Overall (n = 420)	23.52 ± 0.58 (23.42 - 23.62)	23.65 ± 0.56 (23.54 - 23.77)	23.65 ± 0.57 (23.51 -23.78)	23.63 ± 0.56 (23.48 - 23.78)	23.68 ± 0.56 (23.49 - 23.87)	23.66 ± 0.56 (23.5 - 23.82)	23.63 ± 0.56 (23.58 - 23.69)	0.448
	Male (n = 130)	22.67 ± 0.41 (22.54 - 22.8)	22.82 ± 0.39 (22.67 - 22.98)	22.77 ± 0.39 (22.62 - 22.91)	22.64 ± 0.39 (22.44 - 22.83)	22.76 ± 0.38 (22.54 - 22.98)	22.74 ± 0.39 (22.5 - 22.99)	22.73 ± 0.39 (22.67 -22.8)	0.672
	Female (n = 290)	23.97 ± 0.49 (23.87 - 24.07)	24.03 ± 0.47 (23.93 - 24.14)	23.98 ± 0.47 (23.83 - 24.13)	24.02 ± 0.46 (23.87 - 24.17)	24.02 ± 0.46 (23.82 - 24.22)	24.04 ± 0.46 (23.89 - 24.19)	24.01 ± 0.47 (23.96 - 24.06)	0.956

Table-I. Characteristics of the study population

ANCOVA Chi-Square

**Significant at 0.05*

***Significant at 0.001*

(Figure-2) p-value 0.000

Hypertension was present in n= 98(23.3%) with highest prevalence in the Sindhl n=10(30%) Urdu speaking community n=27(27.8%) followed by the Punjabi n=14(26.9%) p value 0.039 of n=98(23.3%) with hypertension, n=66(69.3%) were overweight and n=37 (41.1%) were obese p value was 0.000. (Table-II) In males hypertension was present in n=19(14.6%). Overweight subjects were n=5(12.2%) and obese n=10(58.8%) p-value 0.000.

Gender	Body Mass Index	Hypertension		Total	
		Yes	No		P-Value
Male	Underweight <18.5	1	17	18	0.000
		5.6%	94.4%	100.0%	
	Healthy weight (18.5--23)	3	51	54	
		5.6%	94.4%	100.0%	
	Over weight (23.1--27.5)	5	36	41	
		12.2%	87.8%	100.0%	
	Obese (>=27.6)	10	7	17	
		58.8%	41.2%	100.0%	
	Total	19	111	130	
		14.6%	85.4%	100.0%	
Female	Underweight <18.5	6	32	38	0.028
		15.8%	84.2%	100.0%	
	Healthy weight (18.5--23)	22	83	105	
		21.0%	79.0%	100.0%	
	Over weight (23.1--27.5)	24	50	74	
		32.4%	67.6%	100.0%	
	Obese (>=27.6)	27	46	73	
		37.0%	63.0%	100.0%	
	Total	79	211	290	
		27.2%	72.8%	100.0%	
Total	Underweight <18.5	7	49	56	0.000
		12.5%	87.5%	100.0%	
	Healthy weight (18.5--23)	25	134	159	
		15.7%	84.3%	100.0%	
	Over weight (23.1--27.5)	29	86	115	
		25.2%	74.8%	100.0%	
	Obese (>=27.6)	37	53	90	
		41.1%	58.9%	100.0%	
	Total	98	322	420	
		23.3%	76.7%	100.0%	

Table-II. Relationship of hypertension of ethnicity

Hypertensive females were n=79(27.2%). Overweight were n=24(34.4%) and obese n=27(37.0%) p-value 0.028. Diabetes n=54(12.9%) prevalence was more in the overweight and obese categories. Highest prevalence of diabetes n=20(20%) was in the Urdu speaking group but p-value was not significant. Either hypertension or diabetes diagnosed by a doctor was present in n=118(28.1%). Diabetes was present in n=54 (12.9%) with highest prevalence n=20 (20.6%) in the Urdu speaking community and lowest in

Pashtu n=3(04.5%).

DISCUSSION

Obesity is a global epidemic and a risk factor for cardiovascular disease.[9] In this study it was seen that 29.5% were overweight at risk (BMI>23kg/m^2) and 19.8% obese (BMI>27.5kg/m^2) i.e. 49.3% almost half the population is at risk. A study conducted by Jafar et al 2006[21] showed that 10.3% Pakistani population was obese using Asian specific BMI cutoff value of 27 kg/m2 The percentage of obesity is higher in this study.19.8%, as compared to 10.3% A study conducted in Peshawar[22] showed that the prevalence of obesity in males was 7% and overweight 34%, again at risk being 41%. Pashtun had an obesity prevalence of 16.4% in this study more than twice of that in their home province. Obesity leads to increased BMI and in the Framingham Offspring Study,[23] 78% of cases of hypertension in men and 64% of cases in women were obese, BMI is thus a predictor of hypertension incidence.

The mean BMI in females in all ethnic groups was overweight. This is similar to reports from other studies[24,25] wherein the female gender is more at risk due to remaining at home and leading a sedentary lifestyle. Prevalence was more in females than males in both rural and urban Pakistan.[25] The prevalence rate of obesity increases after 30 years age in both males and females. The urban population of Pakistan showed a greater prevalence than the rural, 37.5% urban and 15.2% rural,[21] of 19.8%, obesity prevalence was highest in the Urdu speaking n=25(25.8%), followed by Sindhi n=6(18.2%) Punjabi n=9(17.3%) Pashto n=11(16.4%), Bengali n=47(13.6%) and others n=15(32.6%) This trend is almost similar to the study by Jafar et al[21] according to which the ethnic group Muhajir (34.5%), had the highest prevalence, for other groups the values were Baluch (30.1%) Pashtu (27.2%), Punjabi (24.3%), Sindhi (20.6 %). The Urdu speaking group was comparatively affluent and had a 50% middle class.

The normal mean systolic and diastolic blood pressure was highest in Punjabi group. The mean diastolic blood pressure was significantly higher in females in all ethnic groups except the Urdu speaking and was related to their higher BMI as compared to the males.

In the INTERSALT study[26] in which 52 centers over the world participated and the relationship of electrolytes and normal blood pressure was studied BMI was related to blood pressure. An increase in weight of 10kg lead to an increase of 3.0 mmHg in systolic pressure in both men and women and in 2.00 mmHg increase in diastolic pressure in women between ages 40–59 years and to 2.7 mmHg in men aged 20–39.

Hypertension prevalence (23.3%) was significant with, 69.3% being overweight and 41.1% obese. Male hypertensive were 14.6%., with overweight 12.2% and obese. 58.8% Hypertensive females were 27.2%, 32.4% being in overweight and 37.0% in obese categories thus a high BMI leads to hypertension. These results were significant as were the prevalence of differences in different ethnic groups.

According to The National Health Survey of Pakistan (PHNS) hypertension.[27] was present in 18% of adults and 33% of adults above 45 years old.[28] In Baluchistan, data was limited. Prevalence reported in Baluch was 30.1% by Jafar et al.[21] There were only 3 Baluchis in this study, Prevalence of Diabetes was 12.9% in the overweight and obese categories. Highest values were in Urdu speaking group but values were not significant. The Urdu speaking group reflects the trend of obesity in urban population and has the highest BMI in obese category but migrants from other provinces in this suburb have a higher BMI and hypertension prevalence compared to the study prevalence rate of hypertension for the different provinces of Pakistan.[25]

The Pakistan National Health Survey (PNHS) showed that in the urban population the hypertension prevalence was higher than rural population and higher in females in both urban and rural populations.[27,28,29] Prevalence in urban

areas was 21.5% and in Rural 16.2 %.[29] In the study by Jafar et al[21] prevalence of Hypertension were 46.3% and Diabetes mellitus 50.8%. The community-based prevalence of hypertension in a low socioeconomic in a 2004 study.[30] was 26% the prevalence was higher among males in this study.

South Asians have a greater percentage of body fat than white people, and although being at a lower BMI, have an increased risk of diabetes, hypertension and coronary artery disease[17], hence the recommendation for a lower BMI cutoff point to identify the overweight and obese and prevent cardiovascular disease[18,19] Migration to other lands and to large cities leads to affluence, giving up of indigenous diet and adoption of high calorie diets and subsequent obesity. Long working hours, driving instead of walking leads to a sedentary life style and contributes to obesity.[2] There is a large migrant population in Canada and studies[31,32] have shown that cardiovascular risk factors vary among different ethnic groups especially those of South Asian, Filipino and the black race, in South Asians obesity is 19. 3% almost similar to this study where the settlers are migrants from other provinces, and higher than Arabs, Japanese Koreans and Chinese races[32] not only this the mean BMI has increased over the past nine years in all ethnic groups except the Japanese, Filipino and Chinese. Preventive steps are being taken to detect and prevent hypertension and diabetes in this groups.[32]

Although the participants in this study were mostly in the low socioeconomic group 75.2%, the prevalence of overweight and obesity was almost half of the study participants of whom 19.8% were obese. A higher BMI leads to hypertension and diabetes[25] as observed in this study that 23.3% had hypertension, and 12.9% diabetes. There was a significant relationship of BMI to hypertension. This situation parallels that of the migrants in North America and the Gulf States where the South Asians are at a higher risk for cardiometabolic disease in spite of having a lower BMI than the white race. Rapid urbanization with an altered lifestyle is rapidly increasing and we are now in the midst of an obesity explosion.

CONCLUSION

There was a significant relationship between BMI and hypertension and BMI was in the overweight category in females in all ethnic groups. There were differences in prevalence of hypertension in all ethnic groups and results were significant. As ethnic groups come to represent a larger proportion of the Karachi population, and obesity becomes more prevalent there is an urgency to bring about changes in lifestyle and reduce the burden of chronic cardiometabolic disorders like hypertension, diabetes and coronary artery disease.

LIMITATIONS

The relationship of risk factors and disease was not established as this was a cross sectional study. All ethnic groups were not studied as some of them were very few in numbers. Results of each of the six ethnic groups presented in this study are the results of a combination of genetic factors, lifestyle modifications and socio-economic status.

REFERENCES

1. Gupta M, Singh N, Verma S. **South Asians and Cardiovascular Risk What Clinicians Should Know.** Circulation. 2006. DOI: 10.1161/CIRCULATIONAHA.105.583815.

2. Shah SM, Loney T, Sheek-Hussein M, El Sadig M, Al Dhaheri S, El Barazi I, et al. **Hypertension prevalence, awareness, treatment, and control, in male South Asian immigrants in the United Arab Emirates: a cross-sectional study.** BMC Cardiovascular Disorders. 2015 May 07; 15(30). DOI: 10.1186/s12872-015-0024-2.

3. Chiu M, Austin PC, Manuel DG, Tu JV. **Comparison of cardiovascular risk profiles among ethnic groups using population health surveys between 1996 and 200.** Canadian Medical Association Journal. 2010 May 18; 182(8). DOI:10.1503/cmaj.091676.

4. Liu R, So L, Mohan S, Khan N, King K, Quan H. **Cardiovascular risk factors in ethnic populations within Canada: results from national cross-sectional surveys.** Open Medicine. 2010; 4(3).

5. Samaha FF. **New International Measuring**

Stick for Defining Obesity in Non-Europeans. Circulation. 2007; 115: p. 2089-2090**.** DOI: 10.1161/CIRCULATIONAHA.107.696260.

6. Hsu WC, Araneta MRG, Kanaya AM, Chiang JL, Fujimoto W. **BMI Cut Points to Identify At-Risk Asian Americans for Type 2 Diabetes Screening.** Diabetes Care. 2015 January; 38(1): p. 150-158. DOI: 10.2337/dc14-2391.

7. Wang J ,Thornton JC, Russell M, Burastero S, Hemysfield S, Pierson RN Jr. **Asians have lower body mass index (BMI) but higher percent body fat than do whites: comparisons of anthropometric measurements.** Am J Clin Nutr. 1994; 60(1): p. 23-28.

8. Hayashi T, Boyko EJ, McNeely MJ , Leonetti DL , Kahn SE , Fujimoto WY. **Visceral adiposity, not abdominal subcutaneous fat area, is associated with an increase in future insulin resistance in Japanese Americans.** Diabetes. 2008 May; 57(5): p. 1269-75.

9. Organization, World Health. **Obesity: Preventing and Managing the Global Epidemic.** WHO Technical Report Series 894. WHO; 2000. Report No.: 92 4 120894 5.

10. Razak F, Anand SS, Shannon H, Vuksan V, Davis D, Jacobs R, et al. **Defining obesity cut points in a multiethnic population.** Circulation. 2007 Apr; 115(16): p. 2111-8.

11. Abbas, S Kitchlew AR, Abbas S. **Disease Burden of Ischemic Heart Disease in Pakistan and its Risk Factors.** Annals of Pakistan Institute of Medical Sciences. 2009; 5(3): p. 145-150.

12. WHO Expert Consultation. **Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies.** Lancet. 2004 January; 363(9403): p. 157-163.

13. Deurenberg-Yap M, Chew SK, Deurenberg P. **Elevated body fat percentage and cardiovascular risks at low body mass index levels among Singaporean Chinese, Malays and Indians.** Obesity Reviews. 2002 August; 3(3): p. 209-215.

14. Wen CP, David Cheng TY, Tsai SP, Chan HT, Hsu HL, Hsu CC, Eriksen MP. **Are Asians at greater mortality risk for being overweight than Caucasians? Redefining obesity for Asians.** Public Health Nutrition. 2009 April; 12(4): p. 497-506. doi: 10.1017/S1368980008002802.

15. Cooper R, Rotimi C. **Hypertension in blacks. American Journal of Hypertension.** 1997 July; 10(7 Pt1): p. 804-12.

16. Opie LH, Seedat YK. **Hypertension in Sub-Saharan African Populations.** Circulation. 2005; 112(3535): p. 3562-3568.doi:10.1161/CIRCULATIONHA.105.539569.

17. Madrigal L, Brady J, Raxter M, Ruiz E, Otarola F, Blell M. **Obesity, hypertension, and migration: a meta-analysis of populations of the South Asian diaspora.** Human Biology. 2011 February; 83(1): p. 71-86. doi: 10.3378/027.083.0105.

18. Must A, Anderson S. **Body mass index in children and adolescents: considerations for population-based applications.** International Journal of Obesity. 2005; 30(4): p. 590-4. doi:10.1038/sj.ijo.0803300.

19. Hu FB, Wang B, Chen C, Jin Y, Yang J, Stampfer M, et al. **Body mass index and cardiovascular risk factors in a rural Chinese population.** American Journal of Epidemiology. 2000 January; 151(1): p. 88-97.

20. National Institutes of Health. **Reference Card From the Seventh Report of the Joint National Committee on Prevention,Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7).** National Institutes of Health, U.S. Department Of Health And Human Services; 2003.

21. Jafar T, Chaturvedi N, Pappas G. **Prevalence of overweight and obesity and their association with hypertension and diabetes mellitus in an Indo-Asian population.** Canadian Medical Association Journal. 2006 October; 175(9): p. 1071–7.

22. Asif SA, Iqbal R, I, Hussain H, Nadeem S. **Prevalence of obesity in men and its relationship with diet and physical activity.** Gomal Journal of Medical Sciences. 2009 January-June; 7(1): p. 35-38.

23. Garrison R, Kannel W, Stokes J, Castelli W. **Incidence and precursors of hypertension in young adults: the Framingham Offspring Study.** Preventive Medicine. 1987; 16(2): p. 235-51.

24. Aziz KU. **Evolution of Systemic Hypertension in Pakistani Population.** Journal of the College of Physicians and Surgeons Pakistan. 2015; 25(4): p. 286-291.

25. Dennis B, Aziz K, She L, Faruqui AMA, Davis CE, Manolio TA, et al. **High rates of obesity and cardiovascular disease risk factors in a lower middle class community in Pakistan.** The Metroville Health Study JPMA. 2006 June; 56(6): p. 267-72.

26. Dyer A, Elliott P, Shipley M. **Body mass index versus height and weight in relation to blood pressure. Findings for the 10,079 pe sons in the INTERSALT Study.** American Journal of Epidemiology. 1990; 131: p. 589–96.

27. Council PMR. **Health Survey of Pakistan 1990–1994.** 1998.

28. Saleem F, Hassali A, Shafie A. **Letters: Hypertension in Pakistan: time to take some serious action.** British Journal of General Practice. 2010; 60(575): p. 449-450.

29. Farooqi A. **Editorial. Pakistan Heart Journal.** 1997; 30(3-4).

30. Safdar, S., Omair, A., Faisal U, Hasan, H. **Prevalence of Hypertension in a low income settlement of Karachi, Pakistan.** JPMA. 2004; 54(506').

31. Nie J, Ardern C. **Association between Obesity and Cardiometabolic Health Risk in Asian-Canadian Sub-Groups.** PLOS ONE. 2014; 9(9).

32. Liu R, So L, Mohan S, Khan N, King K, Quan H. **Cardiovascular risk factors in ethnic populations within Canada: results from national cross-sectional surveys.** Open Medicine. 2010; 4(3). Doi: 10. 1371/ journal.pone.0107548.

"Don't go through life, grow through life."

Eric Butterworth

AUTHORSHIP AND CONTRIBUTION DECLARATION

Sr. #	Author-s Full Name	Contribution to the paper	Author=s Signature
1	Dr. Faiza Samad	Concept and design of proforma, manuscript writing and revision	
2	Muhammad Faisal Fahim	Statistical analysis and manuscript revision	
3	Waqas Ahmed Farooqui	Statistical analysis and manuscript revision	