Body Shape and Risk Evaluation of Myocardial Infarction

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Objective: To find if and how body shape variations are linked to risk of myocardial infarction. **Setting:** The study was conducted at Sir Ganga Ram Hospital affiliated with Fatima Jinnah Medical College Lahore and Punjab Institute of Cardiology, Lahore, Pakistan, from 1st January 2004 to 15th December 2004. Convenient sampling was done. **Study Design:** Case Control study was designed between group I patients (n = 642) who had acute myocardial infarction (MI) for the first time and compared with group II controls (n = 678) who had no history of ischemic heart disease. Both groups were matched as closely as possible for age, sex and socio-economic conditions, and were taken from the same population. **Patients and methodology:** A total of 1320 subjects (687males) with a mean age of 51.9 years (STD 10.7) and (633 females) with a mean age of 56.5 years (STD ±9.15) were studied for their body shape. 642 patients with confirmed first attack of acute myocardial infarction were admitted to Coronary Care Units at Sir Ganga Ram Hospital and Punjab Institute of Cardiology. Group 1 patients (n = 642, males 360 and females 282) who had acute myocardial infarction confirmed on history examination, electrocardiography and cardiac enzymes were compared with group II controls (n = 678, males 327 and females 351) who had no history of ischemic heart disease. Anthropometric measurements were taken. **Results:** The variables compared were; the circumferences of upper arm, thigh and calf in centimeters, the body mass index taken as weight in kg / (height in m)^2 and the waist hip and waist thigh ratios. The 'Student t Test' and 'Logistic Regression' were applied to calculate the statistical significance of individual variables and their association with the risk of myocardial infarction. **Conclusion:** This study shows that central adiposity when accompanied by thin upper arms and thin calves in both sexes is associated with myocardial infarction. Upper arm, thigh and calf measurements along with waist thigh ratio are the important variables contributing to Myocardial Infarction.
Key Words: Body shape, biometry, risk, myocardial infarction

Myocardial Infarction is a complex multi-factorial disease. It is a result of interaction of multiple risk factors with genetic predisposition and environmental modification. Epidemiological and metabolic studies over the years have shown that anthropometric variables such as waist hip ratio and body mass index may give an estimate of the amount of visceral adipose tissue that is associated with an atherogenic metabolic risk profile[1, 2].

French Physician, Dr. Jean Vague described high risk form of obesity by the term android obesity or male type (upper body) obesity. Several studies have confirmed the notion that a high proportion of abdominal fat is a major risk factor for coronary heart disease and type II diabetes. Vague reported in mid forties that complications commonly found in obese patients were closely related to where the excess fat was rather than the excess itself[3].

In this study it can be shown that the risk of coronary artery disease is not only associated with a body mass index of > 25kg/m^2 or a waist > 93 centimeters but limb measurements are statistically significant and contributory to myocardial infarction. It is generally accepted that anthropometry is different in different ethnic groups.[4, 6] There are sex and ethnic group differences in the relation of waist measurement to accumulation of visceral adipose tissue as well as to metabolic complications.[1, 4] Use of waist measurement has been widely emphasized in the United Kingdom because of the pivotal study of Lean et al.[1, 7, 8] World Health Organization had used these studies to propose cut-off points of 102 cm for men and 88 cm for women for waist measurements. We have added circumference measurements of upper and lower limbs to this body of information. This has given us a new perception in what to look for in the body shape when thinking of risk of MI in our patients.

Patients and methodology:

A total of 1320 subjects (687males) with a mean age of 51.9 years (STD 10.7) and (633 females) with a mean age of 56.5 years (STD ± 9.15) were studied for their body shape. 642 patients with confirmed first attack of acute myocardial infarction were admitted to Coronary Care Units at Sir Ganga Ram Hospital and Punjab Institute of Cardiology. Group 1 patients (n = 642, males 360 and females 282) who had acute myocardial infarction confirmed on history examination, electrocardiography and cardiac enzymes were compared with group II controls (n = 678, males 327 and females 351) who had no history of ischemic heart disease. Both groups were matched as closely as possible for age, sex, socio economic status and education. Anthropometric measurements were taken

The variables measured and compared were weight, height, and body mass index taken as weight in kg divided by (height in m)^2, waist hip ratio, waist thigh ratio and circumference of upper arm, thigh and calf in cm. All measurements were meticulously done with a standard flexible measuring tape by two observers separately to prevent any errors. In case of discrepancies in measurements the two observers took the same measurements again together to prevent any errors in these measurements. Waist was taken at the level of the

umbilicus and hip at the greater trochanter. Upper arm circumference was measured at the midpoint between the acromion and the olecranon process. Thigh circumference was taken as the midpoint between anterior superior iliac spine and upper end of the patellae. Calf measurements were approximately 15cm below the lower end of the patellae where the maximum bulk of the gastrocnemius muscle was felt. Body weight in light clothes was measured to the nearest 0.1kg with the same weight measuring scale.

Results:

The 'Student t Test' and 'Logistic Regression' were applied to calculate the statistical significance of individual variables and their association with the risk of myocardial infarction.

Three hundred and sixty male patients with acute myocardial infarction were compared with three hundred and twenty seven male controls. Similarly age and sex matched sample of two hundred and eighty two female patients was compared with three hundred and fifty one female control. In both males and females taken together Table 1 shows that difference between the circumference of upper arm ($p = 0.008$), calf ($p = 0.011$) and waist thigh ratio($p = 0.000$) are significant. In group I(MI) males the mean circumference of upper arms measures 28.63 cm compared to 30.43 cm in controls ($p = 0.002$). Mean calf circumference is 31.59 cm. in group I and 34.19 cm in control group ($p < 0.05$). Mean waist hip ratio is 0.95 in group I and 0.97 in group II ($p = .022$). In females none of these variables were statistically significant. On logistic regression analysis in males significant association was of upper arms ($p = 0.002$), calves ($p < 0.05$) and waist thigh ratio ($p = 0.005$) similarly in females upper arm ($p = 0.015$), thighs ($p = 0.002$), waist thigh ratio ($p = 0.000$) and BMI ($p = 0.037$) were significantly contributing to risk of MI. In females mean circumference of upper arms was 28.82 cm in group I compared to 29.34 cm in group II ($p = 0.42$). Mean calf circumference in group I was 30.54 cm and in group II was 30.62 cm ($p = 0.905$). Mean thigh circumference in group 1 was 45.66 cm compared to 44.22 cm in group II ($p = 0.19$). Mean waist thigh ratio was 2.11 in group I and 2.18 in group II ($p = 0.067$). In females there was no significant difference in the means of the above variables but there was a significant association of upper arm ($p = 0.015$), thigh ($p = 0.002$) and waist thigh ratio ($p < 0.05$) to myocardial infarction when put in logistic regression analysis. Body Mass Index (BMI) more than 25 kg/m^2 and waist hip ratio of more than 0.9 were prevalent in both groups. Waist/ thigh ratio ($p < 0.05$) was significantly contributing in both sexes to myocardial infarction.

Table 1: Shows the comparison of means (STD) of the different measures amongst males and females with myocardial infarction group I (n = 642) and control group II (n = 678).

Table 1 Comparison of myocardial infarction with controls

Group		N	MEAN	Std. Deviation	P value
Age	MI	642	53.94	0.70	
(Years)	Control	678	53.62	0.68	0.741
Upper	MI	642	28.71	3.945	
Arm(cm)	Control	678	29.87	5.049	0.008
Thigh	MI	642	46.238	5.25337	
(cm)	Control	678	45.138	8.13759	0.095
Calf	MI	642	31.130	3.99902	
(cm)	Control	668	32.347	5.745	0.011
Weight	MI	642	67.892	12.53870	
(kg)	Control	678	67.482	13.26423	0.739
Height	MI	642	1.5980	0.11206	
(meters)	Control	678	1.5884	0.09531	0.332
BMI	MI	642	26.779	5.4500	
(Kg/m^2)	Control	678	26.715	4.53102	0.893
Waist	MI	642	93.962	13.12449	
(cm)	Control	678	95.298	13.50450	0.294
Hip	MI	642	99.04	12.284	
(cm)	Control	678	99.18	11.555	0.896
Waist Hip	MI	642	0.8512	0.09621	
Rotation	Control	678	0.9602	0.06826	0.255
Waist	MI	642	2.0453	0.27849	
Thigh ratio	Control	678	2.1474	0.32616	0.000

Table 2: Shows the comparison of means (STD) of the different measures amongst males with myocardial infarction (Group I) (n = 360) and Group II (n = 327).

Table 2: Comparison of myocardial infarction (Group-I) with controls (Group-II) in males

Group		N	MEAN	Std. Deviation	P value
Age	MI	360	51.9	10.7	0.98
(years)	Control	327	51.5	10.9	1.05
Upper	MI	360	28.63	3.418	0.002
Arm(cm)	Control	327	30.43	5.236	
Thigh	MI	360	46.691	4.86722	0.453
(cm)	Control	327	46.127 5	6.43208	
Calf	MI	360	31.591	3.80512	0.000
(cm)	Control	327	34.193	4.981	
Weight	MI	360	70.817	11.82980	0.199
(kg)	Control	327	72.917	12.84677	
Height	MI	360	1.6626	0.09114	0.814
(meter)	Control	327	1.6600	0.07556	
BMI	MI	360	25.710	4.37104	0.196
(kg / m^2)	Control	327	25.467	4.44511	
Waist	MI	360	92.729	13.39163	0.056
(cm)	Control	327	96.211	14.03902	
Hip	MI	360	97.88	12.748	0.585
(cm)	Control	327	98.78	12.069	
Waist Hip	MI	360	0.9506	0.10237	0.048
Ratio	Control	327	97.36	0.06671	
Waist	MI	360	1.9968	0.28331	0.005
Thigh Ratio	Control	327	2.1036	0.28468	

Table 3 shows comparison of female patients between MI (n = 282) and Control (n = 351) groups.

Table 3: Comparison of myocardial infarction (Group-I) with controls (Group-II) in females

Group		N	MEAN	Std. Deviation	P value
Age (years)	MI	282	56.54	9.15	0.94
	Control	351	55.6	9.21	0.85
Upper Arm(cm)	MI	282	28.82	4.547	
	Control	351	29.34	4.833	0.424
Thigh (cm)	MI	282	45.6596	5.68256	
	Control	351	44.2179	9.38896	0.192
Calf (cm)	MI	282	30.5426	4.18051	
	Control	351	30.6282	5.89387	0.905
Weight (kg)	MI	282	64.1596	12.48574	
	Control	351	62.4188	11.57527	0.296
Height (meters)	MI	282	1.5154	0.07647	
	Control	351	1.5216	0.05468	0.494
BMI (kg/m^2)	MI	282	28.1453	6.41069	
	Control	351	26.9467	4.61661	0.116
Waist (cm)	MI	282	95.5372	12.67167	
	Control	351	94.4487	12.98945	0.541
Hip (cm)	MI	282	100.52	11.563	
	Control	351	99.56	11.093	0.544
Waist Hip Ratio	MI	282	0.9520	0.08826	
	Control	351	0.9478	0.06761	0.699
Waist Thigh Ratio	MI	282	2.1073	0.26079	
	Control	351	2.1882	0.35694	0.067

Logistic regression analysis (Combined male and female)

Variables	Beta	Standard Error.	Wald	Sig. (p value)	Odds Ratio
Upper Arm	0.128	0.038	11.243	0.001	1.136
Thigh	0.356	0.127	7.914	0.005	1.428
Calf	0.156	0.035	19.951	0.000	1.169
Weight	0.188	0.071	7.100	0.008	1.207
Height	-17.916	6.217	8.304	0.004	0.000
BMI	-0.553	0.180	9.459	0.002	0.575
Waist	-0.009	0.107	0.007	0.935	0.991
Hip	-0.200	0.098	4.172	0.041	0.819
Waist Hip Ratio	-19.863	10.195	3.796	0.051	0.000
Waist Thigh Ratio	10.845	2.843	14.549	0.000	0.513
Age	-0.009	0.011	0.760	0.383	0.991

Logistic regression analysis in males

Variables (in cm)	β	S.E (β)	P-Value	Odds Ratio
Upper Arms	0.145	0.57	***0.011***	1.156
Calf	0.262	0.058	***0.000***	1.300

Logistic regression analysis in females

Variables (in cm)	β	S.E (β)	P-Value	Odds Ratio
Upper Arm	0.150	0.062	***0.015***	1.162
Thigh	0.632	0.200	***0.002***	1.881
BMI	-0.740	0.355	***0.037***	0.477
Waist / Thigh	15.802	4.415	***0.000***	2.89

Outcome:

In the MI group the body shape at greater risk has thinner upper arms and calves. The waist measurement and waist hip ratio in both the MI group and the control group is on the higher side in the population studied. These conclusions make a very interesting body shape picture of a male who has big belly, heavy thighs, thin arms and thin calves. Such men have a greater tendency towards getting myocardial infarction. In females the body shape prone to MI appears to be similar. Waist thigh ratio has a strong association to MI in both sexes. Body shape is dependent on several factors including genetics, ethnicity, diet, exercise, climate life style etc. Our study is specifically of urban population of Punjab. It is interesting to note that in control group, BMI, waist and waist hip ratios are more than the figures considered as normal worldwide. This is true for both males and females and is probably due to the body built of the local population, age of subjects studied and other factors mentioned above.

Discussion:

Body fat distribution is an extensively studied subject with respect to its association with cardiovascular disease.[1, 5] Android fat distribution involves excess fat in the upper (central) body region particularly the abdomen.[1, 2] This is associated with increased risk compared with the gynoid pattern, in which there is increased fat in the lower body segment particularly the hips and thighs. Waist circumference measurements (waist > 94 cm for men and > 80 cm for women) and high body mass index (> $25kg/m^2$) is identified with cardiovascular disease with high degree of sensitivity and specificity.[4,6] In our study we have tried to identify a peculiar body shape which is prone to having myocardial infarction in either sexes. We recognize the differences in anthropometric measurements in relation to different ethnic groups and therefore we expected our measurements to be somewhat different from the figures obtained from western literature.[3] Indeed we found that our patients and control group both had higher waist, waist hip ratios and BMI values indicating that majority of our population has central adiposity. This is particularly true of our female population. This shows accelerated fat deposition after menopause.

One of the objectives of the study is to attach a reasonably scientific predictive value towards risk of having acute myocardial infarction by merely looking at the patient's body shape. This is important in a busy medical outpatient clinic where there is time constraint and a rush of patients. First glance predictor of acute myocardial infarction in the form of body shape observation can be of great value if there is a proven scientific data to support it. Indeed we have come upon such a conclusion as a result of this study. In comparison to the control group the significant difference is that the myocardial infarction group has thinner upper arms and thinner calves. Multivariate analysis suggests that association of waist thigh girth ratio (WTR) with lipoprotein values known to carry risk of coronary heart disease are due as much to effects of thigh girth as to deleterious effects of waist girth[8]. In both groups waist and body mass index (BMI) show no statistical difference but are on a higher side. In simple words a man or a woman who is round in the middle and has thin arms and calves is prone to myocardial infarction. Because of the ethnic

differences in anthropometric measurements these observations may or may not be reproducible amongst various ethnic groups but there appears to be some link between a body shape and tendency to MI. We suggest that similar studies be carried out amongst different ethnic groups to get a better understanding between body shape and propensity to acute myocardial infarction. A critical look at the body shape may give clues to risk of having myocardial infarction. It does not take very long to look at a person, but may go a long way in predicting myocardial infarction. This study is aimed at preventive cardiology with important lesson that although we cannot change our genetics but we can change our life style to get a desirable body shape.

Conclusion:

This study shows that central adiposity when accompanied by thin upper arms and thin calves in both sexes is associated with myocardial infarction. Upper arm, thigh and calf measurements along with waist thigh ratio are the important variables contributing to Myocardial Infarction.

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