PJC Vol 25, No. 1 & 2
January — June 2014

FREQUENCY OF DIFFERENT BODY SIZE PARAMETERS AND THEIR RISK OF ADVERSE OUTCOMES ASSOCIATED WITH CABG

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Objective: The WHO reported obesity to be an escalating worldwide epidemic. BMI is currently used in diagnosis and treatment of obesity, but multiple studies have shown that south-east Asia have a higher percentage of body fat at a low BMI. WC and WHR are now considered as better predictors in determining obesity, association and outcome in CVD patients. The objective of this study was to categorize the patients according to BMI, WC, and WHR and to determine the effect of these parameters on early outcomes.

Methods: 138 patients underwent elective CABG at N.I.C.V.D Karachi from 15th December 2008 to 15th June 2009, were included. 3 body size parameters for defining obesity i.e. BMI (by Quetelet's formula), WC and WHR by WHO criteria for South-Asian population were considered. Each patient was assessed for baseline socio-demographic profile, coronary RF, intra-operative, post-operative complications in ICU and till discharge.

Result: There were 114(82.6%) males and 24(17.4%) female with mean age 53.78 +8.6. Mohajirs were in majority. WC and WHR showed higher prevalence of obesity than BMI. There was a direct relationship seen in obesity defined by WC with BMI (p=0.0002) but not with WHR (p=0.51). Younger females showed greater prevalence of obesity when BMI was taken as a parameter (p= 0.075) and elderly males were classified obese while considering WHR (p=0.015). There was high frequency of conventional RF , morbid clinical states and post operative complications pertaining to CABG when WC and WHR were considered rather than BMI (BMI=3, WC=5, WHR=6).

Conclusion: Hence our study concluded that not only BMI, but WC, WHR can be authentic parameters in determining obesity and its associated outcomes in our population.

Key Words: obesity, CABG, gender.

PJC 2014; 25: 40-50

INTRODUCTION

Obesity was previously not considered a major health problem, but Framingham Heart Study, Nurses' Health Study, Buffalo Heart Study and Second Cancer Prevention Study showed evidences for inclusion of obesity as a major modifiable cardiovascular risk factor (CVRF).[1] The World Health Organization (WHO) reported obesity and overweight to be an escalating epidemic, worldwide.[2] Although body mass index (BMI) is currently used in diagnosis and treatment of obesity, it isn't a good index alone It does not account for variation in body fat distribution and abdominal fat mass, which can differ greatly across populations and can vary substantially within a narrow range of BMI.[3] Multiple studies have shown that Asian populations, especially in the region of south east Asia have a higher percentage of body fat at a low BMI. Waist circumference (WC) and waist to hip ratio (WHR) are now considered as better predictors in determining obesity, association, and outcome in patients with CVD. Obesity is commonly thought

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to be a RF for morbidity and mortality after cardiac surgery. However, in published articles the relationship between BMI and outcome of CABG depict conflicting results.[4] Such findings have not been confirmed in Asians' with different body size parameters.[1] So it was thought to identify the best anthropometric index in our patient population and allow enhanced screening for CVD RF and outcome in the patients under going CABG. Keeping this in view, aim of this study was to establish the frequency of obesity according to different body size parameters and their association with CVRFs, clinical profiles and early complications/outcome after CABG.

METHOD

This was a prospective, observational / descriptive study conducted with non-probability method of sampling at National Institute of Cardiovascular Diseases (NICVD) Karachi, of patients underwent elective CABG from 15th December 2008 to 15th June 2009. Patients >18 years who were consecutively listed for elective CABG at NICVD were included. Patients' who refused to participate in the study were excluded. An informed written consent was taken from eligible patients. Two cardiac surgeons, with equal expertise in CABG surgery performed operations with two assistant cardiac surgeons. All anesthetic and surgical techniques plus the complications treatment were standardized for all patients. Socio-demographic, medical characteristics, anesthetic and surgical data were recorded by two research assistants. Each patient was assessed pre-surgery for the presence of conventional coronary risk factor, body size parameters measurement and intra-operatively for anesthetic and surgical data collection, and post operatively for surgical complications and duration of stay.

Measurements

Three body size parameters were considered which included BMI, WC and WHR.BMI was calculated by Quetelet's formula[1] i.e. under weight (< 20 kg/m^2), normal (>20 and <25 kg/m^2), over weight (>25 and < 30 kg/m^2), obese (> 30 and <35 kg/m^2) and severely obese (>35 kg/m^2). The WHO[5,6] criteria for South Asian population for Waist circumference (WC) male > 90 cm and female > 80 cm; for waist to hip ratio (WHR) male (0.98) female (0.85) were taken. Waist circumference (WC) was measured at the end of a normal expiration, with the measuring tape positioned at the level of noticeable waist narrowing. When narrowing could not be determined, the circumference was measured at the level of the lower floating rib. For hip circumference, the tape was positioned around the hips at the level of the symphysis pubis and the greatest gluteus protuberance. Height was measured with participants standing on a hard surface against a wall, using a tape measure fixed to the wall. All measurements were recorded to the nearest centimeter. Weight was measured to the nearest 100 g using a calibrated balance beam scale. BMI was calculated as the ratio of weight to height squared (kg=m2). WHR was calculated as WC (cm) divided by hip circumference (cm).[6,7] S.creatinine> 1.4mg, ICU STAY>3 nights, duration of Stay> 7days, duration of anaesthesia >5.0 hr, duration of surgery > 4.0 hr, duration of cardiopulmonary bypass > 2.0 hr, duration of cross clamping >35minutes, ventilatory support >12 hrs, bleeding episode> 1000ml/hr, Hypoxia Po2 < 90mmHg, and hypotension <90 for more than 1/2 an hour SBP were considered abnormal.

Statistical Analysis

SPSS 19 was used for analysis of this data. The quantitative data is described by their mean + SD values. The qualitative data is described by their frequencies along with percentages. Chi square was used for categorized data and t-test for continuous data. P<0.05 as level of significance.

RESULTS

In this study a total of 138 patients were included. There were 114 (82.6%) males and 24 (17.4%) female with mean age 53.78 +8.6.

Baseline characteristics given in Table-1. There was high prevalence of conventional RF and morbid clinical states in the study population.

TABLE 1: BASELINE CHARACTERISTICS:

VARIABLE		FREQ (%)	Mean±
AGE(mean)(127)		53.75±8.6	53.78±8.6
GENDER (138)	MALE	114(82.6)	–
	FEMALE	24(17.4)	–
BMI (n=113)	DESIRABLE	58(42)	25.57±4.17
	OVERWEIGHT	36(26.1)	
	OBESE	19(13.8)	
WC(n=115)	NORMAL	49(35.5)	95.2±11.73
	OBESE	66(47.8)	
WHR (n=114)	NORMAL	6(4.3)	0.97±0.24
	OBESE	108(78.3)	
DM (138)		45(32.6)	–
HTN(137)		58(42)	–
DYSLIPIDAEMIA (137)		33(23.9)	–
SMOKING (136)		56(40.6)	–
F/H of IHD (135)		52(37.7)	–
PRE H/0 MI (134)		76(55.1%)	
CCS CL. IV ANGINA (135)		61(44%)	
ASA CL. IV RISK (119)		51(37%)	
ARRHYTHMIA (132)		16(11.6)	–
HYPOTENSION (129)		65(47.1)	–
HYPOXIA (128)		75(54.3)	–
DUR OF ANAESTHESIA (119)		8(5.8)	4.55±0.86
DUR OF SURGERY (120)		67(48.6)	4.12±0.62
DUR OF CPBP (119)		119(86.2)	98.55± 30.89
DUR. OF CROSS CLAMPING (132)		91(65.9)	45.56±18.44
DUR OF VENT SUPPORT (86)		14(10.1)	88.79±6.4
RE-DO (120)		14(10.1%)	
CHEST INFECTION(129)		3(2.2%)	
PRE. SUR. CREATININE (118)		3(2.2)	0.90±0.24
POST SUR. CREATNINE (124)		30(21.7)	1.3±0.5
BLEEDING (127)		14(10.1)	–
DEATH AT DISCHARGE		4 (2.9)	–
ICU STAY (>3NIGHST)		30(21.7)	3.1±2.1
DUR OF STAY (>7 DAYS) (		78.3	10.7±3.8

There were 32.6% with diabetes, 42% hypertension, 23% dyslipidemia, 40.6% smoking and 37.7% had family history of IHD. Prevalence of obesity was much higher according to WC and WHR than according to BMI. There was a direct relationship seen in obesity defined by WC with BMI (p=0.0002) but not with WHR (p=0.51), and there were 39.2% and approximately 50% obese patient according to WC and WHR respectively who were in desirable weight according to BMI shown in Table-3 Similarly there was high prevalence of post operative complications pertaining to CABG Table-1. showed arrhythmia 11.6%, hypotension 47.1%, hypoxia 54.3%, chest infection 2.2% and wound infection 1.4%, post surgery serum creatinine (21.7%), bleeding (10%), intra-operative MI(6.5%).The mean and standard deviation of ICU stay and duration of stay in hospital were 3.1+2.1 and 10.7+3.8 respectively. Their association with body size parameters was seen more with WC and WHR than BMI (Table-3). Difference between genders according to age showed that younger females presented with greater prevalence of obesity when BMI was taken as a parameter (p= 0.075) and elderly males were classified obese when classification of WHR was taken into account (p=0.015). No significant gender difference was noted according to WC Table-2.

BMI had significant association with previous

TABLE 2: ASSOCIATION OF WC AND WHR WITH BMI

WC	BMI		P Value
	Desirable % (n=)	Obese % (n=)	
Normal (n=49)	31 (60.8 %)	10 (20.4%)	0.0002
Obesity (n= 66)	20 (39.2 %)	39 (79.6%)	
WHR			
Normal (n=6)	3 (6.0%)	2 (4.1%)	0.510
Obesity (n= 108)	47(94.0%)	47 (95.9%)	

history of M.I (p= 0.019), redo surgery (p= 0.09) and post surgery creatinine (p= 0.085). WC had H/T (p=0.02), previous h/o MI (p=0.02), duration of surgery (p=0.032) and post surgery creatinine (p=0.085), need for intra aortic balloon pump

TABLE 3: ASSOCIATION OF BODY SIZE PARAMETERS TO DEMO, CLINICAL RF, AND COMPLICATIONS AFTER CABG

VARIABLE		BMI			WC			WHR		
		Desirable (Frew./%)	O.W/OBS (Freq/%)	P-value	Normal (freq. / %)	Obese (freq. / %)	p-value	Normal (freq. / %)	Obese (freq. / %)	p-value
AGE(mean)		53.2±81	52.7±9.2	.735	52.7±9.1	55.1±7.6	.436	58.3±12.2	53.5±8.9	.295
GENDER	M	47(81.0)	47 (85.5)	.530	44 (89.8)	34 (77.3)	.215	1 (16.7)	93 (86.1)	.001
	F	11 19.0)	8 (14.5)		5 (10.2)	10 (22.7)		5 (83.3)	15 (13.9)	
DIABETES		18(31.0)	17 (30.9)	.989	15 (30.6)	14 (31.8)	.930	1 (16.7)	33 (30.6)	.0667
HTN		20(34.5)	25 (45.5)	.234	17 (34.7)	31 (47.7)	.022	3 (50.0)	46 (42.6)	1.000
DYSLIPIDEMIA		12(20.7)	15 (27.3)	.412	11 (22.4)	12 (27.3)	.841	3 (4.0.)	31 (28.9)	.0.04
SMOKING		27(47.4)	19 (35.2)	.193	21 (42.9)	21 (48.8)	.247	1 (16.7)	47 (43.9)	.239
FAMILY H/O IHD		21(36.8)	23 (41.8)	.519	17 (36.2)	19 (43.2)	.265	2 (33.3)	38 (35.8)	1.000
PRE H/O MI		28(49.1)	35 (64.8)	.019	10 (25.6)	23 (56.1)	.022	3 (50.0)	59(55.7)	1.000
HYPOTENSION		31 54.4)	26 (50.0)	.647	22 (47.8)	18 (42.9)	.564	3 (50.0)	48 (47.1)	1.000
HYPOXIA		35(60.3)	32 (61.5)	.898	23 (50)	26 (63.4)	.404	3 (60.0)	59 (57.8)	1.000
DUR OF ANAS (abnormal)		4 (7.5)	1 (2.1)	.365	0(0.0)	5 (3.5)	.489	0 (0.0)	5 (5.2)	1.000
DUR OF SURG (abnormal)		33 (60)	25 (51)	.357	22 (51.2)	19 (47.5)	.032	20(25.0)	56 (56.6)	.0622
DUR OF CPBP(abnormal)		50(86.2)	48 (88.9)	.668	40 (85.1)	38 (88.4)	.171	3 (60.0)	96 (90.6)	.089
DUR OF CROSS CLAMPING (abnormal)		40(70.2)	35 (64.8)	.546	30 (65.2)	29 (67.4)	.826	2 (40.0)	72 (68.6)	.032
DUR OF VENT SUPPORT (abnormal)		6 (10.3)	6 (10.9)	.113	2 (4.1)	5 (11.4)	.304	2(1.5.)	9 (8.3)	.671
PRE SURG CR (abnormal)		1 (2)	1 (2)	.977	2 (5.0)	1 (2.5)	.572	1 (20.0)	2 (2.2)	.148
POST –S URG CR (abnormal)		9 (16.4)	15 (30.6)	.085	6 (14.0)	8 (20.5)	.085	1 (20.0)	21 (21.6)	1.000
BLEEDING		8 (14)	4 (8)	.373	7 (15.2)	3 (7.3)	.314	1 (20.0)	9 (8.8)	.394
RE DO		0 (0)	3 (5.9)	.099	7(17.1)	4(6.6)	.232	1 (25.0)	9(9.3)	.345
DEATH AT DISCHARGE		0 (0)	3 (5.5)	.112	1 (2.0)	1 (2.3)	.816	1 (16.7)	2 (1.9)	.151
I.C.U STAY AT NIGHT (> 3 nights)		14 (24.6)	11 (21.2)	.673	12 (26.7)	11 (26.2)	.452	4(2.5)	26 (25.2)	.053
DUROF STAY (> 7 days)		51(89.5)	41 (87.2)	.722	39 (86.7)	35 (94.6)	.483	2 (40.0)	90 (92.8)	.006

(p=0.027) statistically significant association. WHR showed statistical considerable association with gender (p=0.001), DM (p=0.05), dyslipidaemia, duration of cardio-pulmonary bypass (p=0.089), cross-clamping (p=0.04), duration of cardiopulmonary bypass (p=0.08) and ICU- stay (p=0.05), and duration of stay (p=0.006). On the contrary, we did not find any significant difference between obese and non-obese patients in several variables e.g. age, clinical presentation, pre surgery creatinine, arrhythmia, hypotension, hypoxia, duration of anesthesia, wound infection, chest infection and bleeding. According to gender, different body size parameters showed statistically significant associations in male patients than females and with WHR than other body size parameters. (Table-4) A total of twelve variables showed significant

TABLE 4: ASSOCIATION OF BODY SIZE PARAMETERS TO DEMO, CLINICAL RF, AND COMPLICATIONS AFTER CABG ACCORDING TO GENDER

BMI			AGE	p-Value	WC	p-Value	WHR	p-Value
M	Desirabble	mean	52.35±8.2	0.474	91.951±8.8	0.000	0.985±0.08	0.39
	Overweight	mean	54.16±9.4		98.30±10.0		0.974±0.06	
	Obese	mean	50.93±8.7		109.08±5.2		1.008±0.05	
F	Desirabl	mean	57.3	0.075	81.00±8.65	0.001	0.886±0.06	0.651
	Overweight	mean	46.0±11		93.25±9.56		0.925±0.05	
	Obese	mean	51.50±3.5		110.33±11.93		0.900±0.10	
Waist Circumference					BMI		WHR	
M	Normal	Mean	52.5±9.3	0.354	23.43±2.42	0.000	0.95±0.07	0.000
	Obese	Mean	54.2±8.6		27.3±3.76		1.00±0.06	
F	Normal	Mean	54.5±6.1	0.94	22.12±1.34	0.166	0.82±0.04	0.011
	Obese	Mean	54.9±9.5		25.71±4.77		0.95±0.09	
Waist: Hip Ration					BMI		WC	
M	Desirable	mean	75.0±8.9	0.015	81	0.141	29	0.368
	Obese	mean	53.2±8.7		96.35±10.27		25.56±3.77	
F	Desirable	mean	52.67±6.0	0.647	81.2±18.8	0.125	25.72±6.61	0.675
	Obese	mean	55..3±9.2		94.4±14.92		24.60±3.90	

association/trends with obesity and whereas rest do not. Significance level could not be achieved due to less number of patients in each category.

DISCUSSION

This study was conducted to investigate the prevalence and association of different anthropometric parameters with coronary RFs, clinical presentation, and complications in patients undergoing CABG.The mean age of patients in this study was 53.78 ±8.8 years. This corresponds with other published data in south Asia.[8] BMI has long been used as a measure of overweight and obesity and is correlated with increased prevalence of coronary RF as well as the presence of CHD and its outcome [9]Abdominal, central or visceral obesity is now considered to be more closely related with CHD and its outcome than total body obesity, as measured by BMI.[9,10] Part of this could be explained by the emerging risk resistance, a pro-inflammatory and pro-thrombotic state. South Asian population is found to be more susceptible to effects of obesity, especially abdominal obesity, with a striking increase in risk of CAD and its outcome.[9] We found that 78.3% and 35.5% exceeded the cutoff point for WHR and WC for defining obesity respectively as compared to 13.5% according to BMI. Approximately 66.0% patients were obese according to central obesity that was in desirable weight according to BMI which corresponded to other local studies.[8,11,12] But reviews of the literature conducted to assess which measure of adiposity is most strongly associated with CVD have yielded some inconsistent conclusions. [9,13,14,15,16] Body weight is often considered to influence peri-operative events and post-operative prognosis.[17,18] Ours is the first study

TABLE 5:

DUR ANAESTHESIA	p-Value	DUR SURGERY	p-Value	DUR CPBYP	p-Value	DUR CROSSCLAMP	p-Value	VENT	p-Value
4.48 ±0.735		4.221±0.617		101.9±35.02		47.27+16.43		8.30±6.05	
4.40± 0.74	0.686	3.91±0.670	0.112	92.75±27.24	0.479	39.09±17.55	0.023	8.43±5.03	0.214
4.26±1.27		4.21±0.58		97.80±36.54		55.06±27.93		12.09±8.71	
4.70±0.67		4.38 ±0.59		85.63±20.29		36.10±13.93		8.00±5.07	
4.66±0.577	0.995	3.46±0.50	0.115	83.25±28.61	0.225	46.75±16.09	0.317	6.66±0.57	0.685
4.666±0.577		4.23±0.80		115.3±44.45		46.66±6.11		5.0±4.24	
4.41±0.64	0.325	4.03+0.49	0.377	99.33±33.85	0.594	45.90±17.72	0.585	7.37±4.54	0.266
4.56±0.68		4.15±0.7		95.78±30.04		43.8±18.92		9.23±6.61	
4.50±0.57	0.51	4.0±0.42	0.646	87.6±44.14	0.566	37.0±20.8	0.423	6.25+0.95	0.656
4.91±1.16		4.19±0.78		97.57±28.29		44.57±15.0		7.44+5.05	
4.0±0.65	0.455	3.2	0.145	68	0.35	14.0	0.093	10.0	0.785
4.50±0.66		4.11±0.61		98.0±31.75		45.15±18.22		8.38±5.83	
4.33±0.57	0.398	3.9±0.45	0.519	94.5±47.75	0.976	37.0±20.80	0.423	6.00±1.00	0.633
4.92±1.11		4.2±0.75		95.0±28.94		44.57±15.00		7.4±4.76	

comparing different body size parameters to see the per-operative events. No local data is available in this regard. Study revealed a higher percentage of men (82.6%) than women undergoing CABG (17.4%).These observations are similar to that reported by other studies [8,17,23,19,20] and also showed that the frequency of abdominal obesity in patients undergoing CABG was quite high (63%) as compared to general population 10-25%[21], and highly compatible with other local studies.[11,22,8]

The average WHR in our patients was higher than reported in Caucasians.[11,12,23] The main findings of this study was high prevalence of coronary RF, and post surgical complications, but their associations were more or less similar in obese and non-obese patients according to different body size parameters.[24,25] This is an encouraging finding as obesity is considered a major RF for adverse outcome after CABG. BMI >30 in majority of studies is thought to be associated with excess surgical risks of complications.[26] Very few studies have been done taking all the other obesity indexes for comparison in CABG patients. We did not find any significant difference between obese and non-obese patients in all the body size indexes in several variables e.g. age, ethnic class, clinical presentation, arrhythmia, hypotension, hypoxia, duration of anesthesia, chest infection, pre surgery creatinine and bleeding episodes. Such findings have been seen in other studies.[26] Significant association was noted with gender, DM, HT, previous history of MI, ASA class IV risk, post surgery creatinine,duration of ventilatory support, duration of surgery,duration of cardio-pulmonary bypass, cross-clamping, ICU- stay, and duration of stay.[27,18] Significant association of obesity with the variables has long term clinical implications on morbidity and mortality. Longer ICU and hospital

TABLE 6:

CR PRE	p-Value	CR Post	p-Value	ICU STAY	p-Value	DUR STAY	p-Value
0.917±0.23		1.38±0.63		3.19±1.65		10.58±2.92	
0.92±0.28	0.853	1.31±0.37	0.849	3.09±3.16	0.980	10.0±3.06	0.005
0.96±0.19		1.39±0.41		3.20±1.37		14.3±6.95	
0.73±0.11		0.94±0.29		2.54±0.68		9.0±1.84	
0.67±0.20	0.700	1.10±0.52	0.700	5.00±3.55	0.110	10.5±2.12	0.009
0.76±0.15		1.10±0.28		4.00±2.82		2.0±	
0.93±0.29	0.747	1.27±0.54	0.513	3.47±2.9	0.155	9.80±3.11	0.010
0.91±0.92		1.34±0.36		2.80±1.45		12.0±4.46	
0.7±0.12	0.517	0.84±0.27	0.181	2.40±0.54	0.203	8.2±1.3	0.110
0.79±0.29		1.10±0.38		3.76±2.24		10.66±3.00	
1.90	0.000	1.90	0.198	3.00	0.964	2.00	0.025
0.91±0.217		1.30±0.452		3.10±2.25		11.05±3.94	
0.725±0.125	0.734	0.725±0.095	0.055	2.50±0.577	0.329	7.75±0.957	0.078
0.776±0.286		1.125±0.369		3.64±2.20		10.60±2.83	

stay in obese patients incur more expence on public sector hospitals.

Significant association was more with WC and WHR than BMI and greater in male than female patients. Despite the common use of BMI in clinical settings and higher predictive value of WC, we found that WHR was a better indicator in predicting obesity and its association with conventional coronary RF and it also may be postulated to have significant association with CABG complications as has been seen in other studies.[17,18,28,29,30] But a recent meta-analysis of 58 cohort studies concluded that BMI, WC and WHR had similar strengths of association with CVD risk.[31,29] In line with our findings, some other investigators have also reported WHR to be a better predictor of cardiovascular RF than WC and BMI especially in males, a finding that has been confirmed in Japan[32,33] and Australia.[34] Our findings could also be extrapolated to the researches conducted in our own country.[35,36] Evidence of deterioration in creatinine post CABG was found in our study in obese patients defined by BMI and WC indexes. Post CABG deterioration in renal profile has been mentioned in literature[37] and various risk factors and its prevalence have been found to be 8-10%[37,38] but our study showed deterioration in renal function in 21.7% post CABG and the trend towards deterioration in obese than non-obese, a finding which has not been shown in other studies on CABG. Future large scale studies are required to confirm this finding.

Limitations of the Study

Potential limitation in this study was its small sample size from single centre, and this study had access only to data on postoperative complications

occurring in the hospital. This limitation may underestimate the true effect of obesity on morbidity and mortality after CABG.

CONCLUSION

On the basis of this study, we concluded there is high prevalence of obesity with various adiposity anthropometric measures other than BMI being more closely related to the CVD risk factors, clinical presentations, and complications with CABG. Although overall correlations between CVD risk factors and anthropometric adiposity measures were small, they do appear to be significant. It needs to be confirmed in future by a larger scale population based study It is, therefore, highly recommended that we should combine BMI with other measures of central obesity in the assessment of morbidity risk in our patients undergoing CABG; which is superior to documenting BMI alone, and may redefine the use of additional measurements in the clinic and in research studies.

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