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ANTHROPOMETRIC MEASUREMENTS - PREDICTORS OF MAJOR ADVERSE EVENTS IN NON-ST ELEVATION MYOCARDIAL INFARCTION PATIENTS AND THEIR SURVIVAL - A COHORT STUDY

Sher Bahadar Khan[1], Zohaib Ullah Zahid[2], Muhammad Saad Jibran[3], Sajjad Ali[4], Syed Atif Gillani[5]

[1-5]Department of Cardiology, Lady Reading Hospital, Peshawar - Pakistan

Address for Correspondence:

Zohaib Ullah Zahid
Department of Cardiology, Lady Reading Hospital, Peshawar - Pakistan

Emails: drzohaibullahzahid@gmail.com

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Contribution

SBK conceived the idea, planned the study and drafted the manuscript. ZUZ, MSJ, SA, SAG collected data, did statical analysis and critically reviewed manuscript. All authors contributed significantly to the submitted manuscript.

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ABSTRACT

Objective: To determine the anthropometric measurement that best associated with angiographic severity and best predictor of major adverse cardiovascular and cerebrovascular event in patients who are successfully re-vascularized after non-ST elevation myocardial infarction.

Methodology: This is a prospective cohort study done in Cardiology unit, Lady Reading Hospital, Peshawar from 1st July, 2016 to 31st November, 2017. Cohort was selected on the basis of complete revascularization with DES after non-ST elevation MI in the first 6-months period and were followed over a period of 12 months with a 3-months clinical and monthly telephonic follow-up, to observe for any major adverse cardiovascular and cerebrovascular events (MACCE). Raised level of BMI, waist, wrist, neck circumferences and waist-to-hip ratio were defined as >25 kg/m^2, >102cm and >88cm, >20cm and >18cm, $\geqslant$40cm and $\geqslant$37cm for male and female, and $\geqslant$0.55 ratio respectively. Chi-square test used to correlate anthropometric values with angiographic severity and incidence of MACCE. Logistic regression model was applied for prediction of MACCE. Kaplan-Meier curve used for survival of these patients through one year.

Results: Total of 73 patients having successful revascularization after NSTEMI, with a mean age of 59.25 $\pm$ 10.34 years were enrolled in the study. Of these 47.9% were males, 31 (42.4%) patients had triple vessel disease. Neck circumference was best correlated with angiographic severity (X^2=22.59) followed by BMI (X^2= 22.2) with significant p-value for all except for waist circumference. Similarly, all were associated with incidence of MACCE, with wrist as the best (X^2= 16.12) followed by neck circumference. Relative risk for occurrence of MACCE was with NC (RR=4.5). Kaplan Meier curves showed significant correlation of raised anthropometric values with incidence of MACCE i.e. all patients who had MACCE had raised anthropometric values except for two cases who had normal wrist circumference.

Conclusions: Raised anthropometric values are significantly associated with angiographic severity and incidence of MACCE in NSTEMI patients, with the neck circumference as its best predictor. Follow-up of these patients show similar significant results for MACCE occurrence.

Key Words: Anthropometric measurements, Angiographic severity, MACCE, Non-ST elevation MI.

INTRODUCTION

The leading cause of death and disability has been established to be cardiovascular disease (CVD) world widely.[1] As estimated by World Health Organization (WHO) in 2012, 7.4 million deaths were due to heart attacks (Myocardial infarctions), out of 17.5 million CVD deaths globally.[1] Cardiovascular deaths represented 30 percent of all global deaths, with 80 percent of those deaths taking place in low- and middle-income countries.[1] Recently, American College of Cardiology National Cardiovascular Database Registry reported that 42% of NSTEMI patients hadmulti-vessel CAD.[18]

The mortality due to coronary heart disease is higher in South Asians as compared with native majority White populations, in cross-sectional and prospective studies.[2-4] This may be either as a consequence of higher incidence of coronary disease in South Asian populations or a worse prognosis of already manifested coronary disease.[5]

Body obesity is associated with an increased risk of developing metabolic syndrome, type 2 diabetes (T2DM), and hypertension and is considered a major risk factor for cardiovascular disease (CVD) events and early mortality.[6] Excessive adiposity is involved in the pathogenesis of coronary heart disease (CHD), since it is closely associated with the development of hypertension, dyslipidemia, and T2DM.[6]

In addition to obesity, the distribution of body weight is considered to be an important aspect of metabolic syndrome, and is a stronger predictor of cardiovascular risk. The preferential accumulation of body fat in specific regions is related to disease risk.[7] Generally, visceral and subcutaneous fat are associated with insulin resistance.[8] Previous studies have established the relationship between central obesity and the development of CVD.[9,10]

Cardiovascular risk is conferred by specific fat distribution patterns, particularly upper body adiposity, which is as a strong determinant in the population and more strongly associated with glucose intolerance, hyperinsulinemia, diabetes, hypertriglyceridemia, and gout than is lower-body obesity.[11] Neck circumference (NC), has been evaluated as an index for the distribution of upper-body subcutaneous adipose tissue in relation to cardiovascular risk factors and insulin resistance, and has also been shown to correlate positively with biochemical components of the metabolic syndrome. [12,13] In a study by Zhou, NC was significantly correlated with all outcomes of cardio-metabolic risk in both sexes.[14] In the Cardio-metabolic Risk in Chinese study of a population of apparently healthy Chinese adults, significant associations were found between high NC and increased risk of insulin resistance and various CVD risk factors.[15] The incidence of non-fatal CVD events were 14.08% in the low-NC cohort (<33cm for women and <36cm for men), 16.65% in the medium-NC cohort (33-36 cm for women and 36-39cm for men), and 25.51% in the high-NC cohort ($\geqslant$ 37cm for women and $\geqslant$ 40cm for men) with the significant p-value of 0.001.[17]

The ratio of waist circumference to height ratio has been proposed as a better predictor of cardiovascular risk, mortality and intra-abdominal fat distribution. [19-21] The waist-to-height ratio was first used in the Framingham Study [22]. Several studies of children and adults have concluded that this ratio is more strongly associated with cardio vascular risk factors than the body mass index (BMI; in kg/m2). [23,24]

The objectives of this study is to determine the anthropometric measurement that best associated with angiographic severity and best predictor of major adverse cardiovascular and cerebrovascular event in patients who are completely re-vascularized after non-ST elevation myocardial infarction and to follow these patients for any MACCE for a period of 12 months. This information will enable us to predict MACCE in NSTEMI patients by recording a simple anthropometric measure.

METHODOLOGY

This is a prospective cohort study done in Cardiology unit, Lady Reading Hospital from 1st July, 2016 to 31st November, 2017. All the patients presenting to the cardiology unit with signs and symptoms of acute coronary syndrome with troponin positive and no ST elevation on ECG were included in the study. Patients with previous histories of acute STEMI, angioplasty or by-pass surgery, congenital heart defects, cardiomyopathy, heart failure, chronic liver or kidney disease, anemia, malignancy, neck deformity, goiter, other neck masses, and pregnancy were excluded from the study.

Cohort was selected on the basis of complete revascularization with DES after non-ST elevation MI in the first 6-months period between 1st July to 31st December, 2016. These patients were followed over a period of 12 months with a 3-months clinical and monthly telephonic follow-up with 4 patients lost to follow-up.

Patients were observed for any major adverse cardiovascular and cerebrovascular events (MACCE) i.e. myocardial infarction, cerebrovascular accident (CVA), peripheral arterial disease and sudden cardiac death during this 12 months period.

Baseline variables including age, sex, co-morbid conditions, lipid profile was recorded. Height in cm and weight in Kgs were measured. Body Mass Index (BMI) was calculated. NC was measured with an inelastic tape at the level of cricoid cartilage with patient in standing position, head erect and eyes facing forward. Wrist circumference was also measured. Waist circumference was calculated with patient in standing position at the level of iliac crest. Ratio of W/H circumference was calculated.

Angiographic severity was defined on basis of extent of CAD i.e. Single, Double or Triple vessel disease with ⩾ 70% stenosis in 1, 2 or 3 major epicardial arteries. Anthropometric measures which shows marker of obesity are shown in Table 1.

All the data was recorded in a predesigned proforma and analyzed in SPSS version 20. Mean ± S.D was calculated for continuous variables. Frequency and percentages were calculated for categorical variables. Chi-square test was used to find association of anthropometric measures with angiographic severity and major adverse events. Logistic regression model was applied to show the predictive value of raised anthropometric values i.e. marker of obesity, in occurrence of MACCE. Kaplan Meier survival curves were drawn to show the incidence of MACCE in the 12 months period. $P < 0.05$ was taken as significant.

RESULTS

Total of 73 patients with a mean age of 59.25 ± 10.34 years were enrolled in the study. Of these 47.9% were males. Baseline characteristics including co-morbidities and demographic variables are listed in Table 2.

Table 1: Anthropometric Values for Marker of Obesity Statistical Analysis

	BMI (kg/m2)	Waist C. (cm)	Wrist C. (cm)	Neck C. (cm)	Waist/ Height
Normal	≤ 25	Male; ≤ 102	Male; ≤ 20	Male; ≤ 40	< 0.55
		Female; ≤ 88	Female; ≤ 18	Female; ≤ 37	
Raised	≥ 25	Male; > 102	Male; > 20	Male; ≥ 40	≥ 0.55
		Female; > 88	Female; > 18	Female; ≥ 37	

Table 2: Baseline Characteristics of Study Population (n=73)

Variables	Mean ± S.D	Frequency (%age)
Age	59.25 ± 10.34	---
Gender (male)	---	35 (47.9%)
Smokers	---	15 (20.5%)
DM	---	35 (47.9%)
HTN	---	48 (65.8%)
CAD Family Hx	---	15 (20.5%)
Systolic B.P (mmHg)	134.38 ± 23.1	39 (53.4%)
Diastolic B.P (mmHg)	86.02 ± 15.6	38 (52.1%)
Creatinine (mg/dl)	0.98 ± 0.45	20 (27.4%)
Fasting glucose (mg/dl)	145.3 ± 47.6	45 (61.6%)
Hs-Troponin T	778.4 ± 752.8	---
Triglyceride (mg/dl)	194.1 ± 71.5	58 (79.5%)
Total Cholesterol (mg/dl)	201.8 ± 62.4	39 (53.4%)
TIMI score	2.57 ± 1.25	---
Ejection Fraction	56.36 ± 10.4	29 (39.7%)
ST-T changes		
1 mm ST depression	---	24 (32.9%)
>1 mm ST depression	---	35 (47.9%)
T wave inversion	---	14 (19.2%)
Anthropometric values		
BMI (kg/m^2)	25.94 ± 6.3	35 (47.9%)
Waist circumference (cm)	100.75 ± 17.6	44 (60.3%)
Wrist circumference (cm)	17.64 ± 2.2	20 (27.4%)
Neck circumference (cm)	39.84 ± 4.9	50 (68.5%)
Waist-to-Height	0.62 ± 0.11	44 (60.3%)
Angiographic severity		
Single vessel disease	---	06 (8.2%)
Double vessel disease	---	36 (49.3%)
Triple vessel disease	---	31 (42.4%)

Association of five different anthropometric values with angiographic severity and incidence of MACCE was determined using chi-square test as shown in Table 3.

Table 4 shows logistic regression model for predicting occurrence of MACCE with the determination of relative risk for various anthropometric measurements.

Figure 1 shows number of major adverse cardiovascular and cerebrovascular events in 1-year follow-up in successfully revascularized patients after NSTEMI. And Kaplan Meier survival curve of these patients has been shown in Figure 2.

Table 3: Correlation of Anthropometric Measurements with Angiographic Severity and MACCE (n=73)

Anthropometric	Angiographic Severity		Major adverse CV and Cerebral event	
Variables	X^2-value	p-value	X^2-value	p-value
BMI	22.2	0.0001	12.58	0.0001
Waist circumference	4.9	0.176	7.64	0.006
Writ circumference	12.2	0.007	16.12	0.0001
Neck circumference	22.59	0.001	15.3	0.0001
Waist-to-height	11.59	0.009	7.64	0.006

Table 4: Logistic Regression Model For Prediction of Major Adverse Cardio and Cerebrovascular Events (n=73)

Variables	B	DF	Exp (B)	C.I.	p-value
BMI	1.8	1	1.2	1.02 - 1.38	0.004
Waist	1.5	1	1.17	1.02 - 1.32	0.001
Wrist	3.7	1	1.7	1.33 - 2.07	0.001
NC	4.5	1	1.58	1.45 - 1.71	0.0001
WHtR	2.1	1	1.5	1.21 - 1.79	0.002

Figure 1: Major Cardiovascular and Cerebrovascular Events in 1 Year Followup

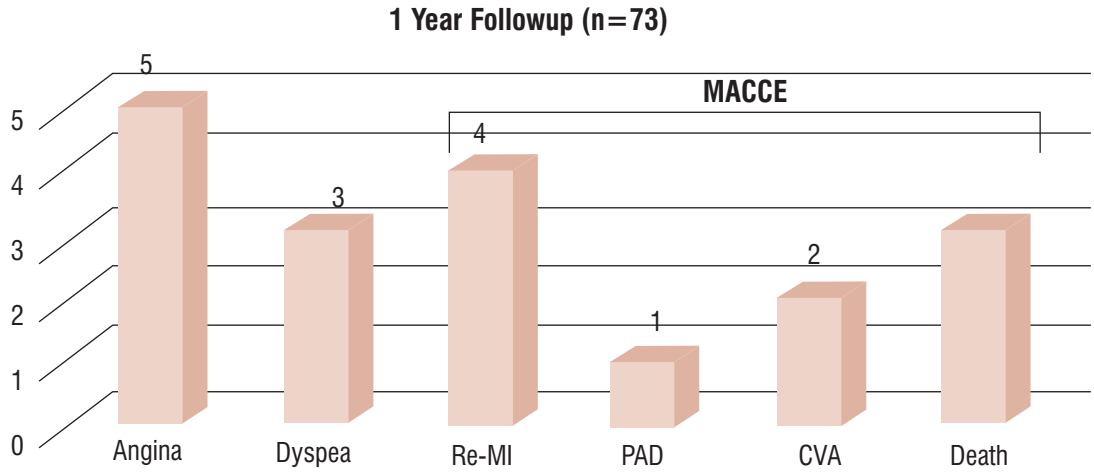
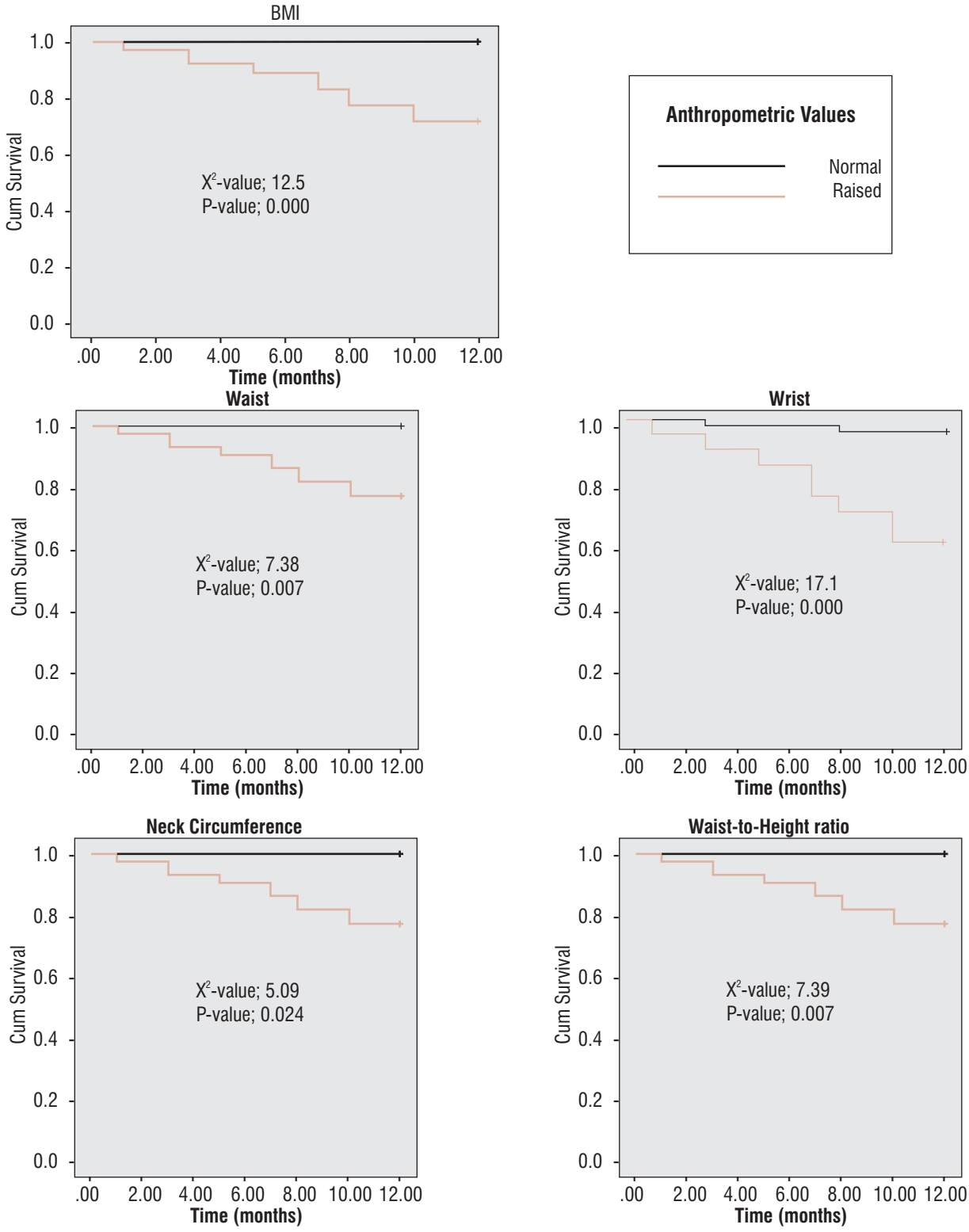


Figure 2: Kaplan Meir Curve For Survival With Different Anthropometric Measurments (n=73)



DISCUSSION

Regional fat distribution has been found as a contributory factor to CVD risk. So far waist circumference, hip circumference and waist hip ratio were taken as measures of obesity and emphasis was focused upon correlation of raised WHR with CVD. Britton et al demonstrated the association between visceral fat and cancer and CAD.[33] In recent years a number of studies focuses on the measure of NC as upper body fat, its association with obesity and cardiovascular diseases risk. But none had assessed the ability of NC to predict angiographic severity in non-ST elevation MI.

In our study, angiographic severity in NSTEMI patients had significant positive correlation with anthropometric measurements i.e. body mass index (BMI), wrist, neck circumference, and waist-to-height ratio which has been shown in previous studies.[25-29] Gelber et al. found WHtR had the strongest relation in association with the incidence of IHD.[30] But in contrary to these studies, we found neck circumference as the anthropometric variable that best correlates with angiographic severity in NSTEMI patients, followed by BMI. Interestingly waist circumference was not related to angiographic severity in this cohort of NSTEMI patients.

The association of these obesity values with the occurance of major adverse cardiovascular and cerebrovascular events (MACCE) was significant for all five of them with largest value for wrist circumference followed by NC and BMI. This means upper body fats or obesity strongly correlated with future MACCE. The reason for this may be that upper body fats releases free fatty acids more than lower body fats.[34]

Previously, Schneider et al. and other studies found that WHtR was a strong predictor of CVD events than BMI.[19, 31, 32] Similarly, Gelber et al. also proved strong relationship for WHtR.[30] But they didn't consider other anthropometric measures. In our study, the best predictor of major CV event was NC followed by wrist circumference and WHtR with the relative risk of 4.5, 3.7 and 2.1 respectively.

During 1-year follow-up of these patients who had completely revascularization after NSTEMI, five patients were experiencing angina and three had continuing dyspnea symptoms. Ten patients had MACCE with four having second episode of MI, three had cardiac death, two experienced ischemic stroke, and one developed peripheral arterial disease. It was found that all patients with MACCE had raised anthropometric measures except two patients who has normal wrist circumference and raised other four measures. One of these two patients had ischemic CVA and other had acute anterior MI. the three patients (72 and 60 years females and 60 years male) who died in this cohort were at 1st, 3rd, and 8th month of percutaneous coronary intervention.

LIMITATIONS

The limitations of the study are that it was conducted in one center and the sample size was small as well. Second, hip circumference and waist-to-hip ratio were not measured and considered for correlation and prediction of MACCE. Third, patients were only followed for one year which is a short period for such results.

CONCLUSION

Neck circumference is the best anthropometric variable that correlates with angiographic severity in NSTEMI patients, followed by BMI. However, waist circumference was not related to angiographic severity. All five anthropometric measures were associated with incidence of MACCE, with wrist circumference as the best predictor followed by neck circumference.The best predictor of major CV event was NC followed by wrist circumference and WHtR.All patients with MACCE had raised anthropometric measures except two patients who had normal wrist circumference.

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