ORIGINAL ARTICLE ASIAN JOURNAL OF MEDICAL SCIENCES

Waist: Hip ratio is a more reliable risk assessment tool for acute myocardial infarction: A hospital based case – control study among rural Maharashtra, India

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Submitted: 23-01-2017 Revised: 30-01-2017 Published: 01-03-2017

ABSTRACT

Background: Worldwide, incidence of Acute Myocardial Infarction (AMI) has been increasing over the years and now reflected as the leading cause of death universally. **Aims and Objectives:** To determine the strength and degree of association between obesity indices and serum lipid profile with incidence of AMI in rural Indian population. **Materials and Methods:** Hospital based case-control study was conducted among newly diagnosed cases of AMI and matched controls. A total of 40 patients admitted in ICCU at rural tertiary care centre and equal number of healthy age/sex controls were enrolled in the study. Over the period of three months, by employing personal interview, anthropometric, clinical and laboratory examination information was obtained. Data were analysed by using SPSS version17 and results were expressed on Mean ± SD, Chi-Square test and Odds ratio. **Results:** Mean age of cases and controls was 58.5 and 60 yrs respectively with mean difference of 1.5 years. Maximum, 47.5% cases were in age 60-69 yrs and shown 1.5 times risk of getting AMI. The Overweight, Waist- Hip ratio and hyperlipidemia (cholesterol, H:L ratio and triglycerides) were significantly associated with AMI ($p < 0.05$ at 95% CI) and risk predicted by odd's was of 9.3, 3.4, 2.4, 4.8, and 9.4 respectively. Every unit rise in overweight, Waist:Hip ratio, serum cholesterol, LDL and triglycerides; the risk of occurrence of AMI increases by 1.7, 2.8, 1.02, 1.01 and 1.03 times respectively. **Conclusion:** Study demonstrated, W:H ratio is a more valid, single, reliable risk assessment tool for AMI could be practiced at health care institutions as well as community surveillance.

Key words: Acute Myocardial Infarction, Obesity indices, Lipid profile, Odd's ratio

Access this article online
Website:
http://nepjol.info/index.php/AJMS
DOI: 10.3126/ajms.v8i2.16459
E-ISSN: 2091-0576
P-ISSN: 2467-9100

INTRODUCTION

The worldwide incidence of Acute Myocardial Infarction (AMI) has been increasing over the years and has become the leading cause of premature death and disability. AMI is a global health problem and responsible for 10% of DALYs lost in low- and middle-income countries and 18% in high income countries. DALYs lost per 1000 population, age-standardised estimates for 2002 was 20-29 in India.[1] Coronary heart disease is decreasing in many developed countries, but is increasing in developing and transitional countries, partly as a result of increasing longevity, urbanization, and lifestyle changes. More than 60% of the global burden of coronary heart disease occurs in developing countries.[2]

The modifiable risk factors viz; smoking, obesity, lack of physical exercise accounted to be the cause of about 36%,

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20% and 7-12% of coronary artery disease respectively.[3,4] Diabetes mellitus, hypertension, dyslipidemia and obesity (body mass index or waist-hip ratio) have all been linked to AMI.[5,6] The incidence of AMI in India was 27,040,912 cases in year 2002 which increased to 46,968,695 cases by 2010. Incidence toll of AMI in urban and rural Indian population was 54.37% and 45.48% respectively in year 2000; however in year 2010, incidence toll of AMI was higher in rural Indian population (52.56%) as compared to urban (47.43%) indicating AMI is now public health threats to rural Indian.[7,8]

The study aimed to determine the strength of association between obesity and hyperlipidemia indices with incidence of AMI in rural Indian population. It is known that BMI and W/H ratio is routinely used to assess the risk of AMI however, it is not yet described which is best and unit rise leads to what folds the risk increases. Study can provide new information to health professionals, physical fitness trainers and general people about risk of getting AMI in context to anthropometric and laboratory parameters for necessary information and practical application to reduce the problem of AMI in Indian population by utilizing cost effective, easily accessible, affordable, applicable, acceptable and scientific sound tool.

MATERIAL AND METHODS

A hospital based case-control study was conducted among newly diagnosed cases of AMI and matched controls with respect to age and sex. A sample size includes 80 subjects, of which 40 were AMI patients (25 males and 15 females) admitted in Intensive Cardiac Care Unit (ICCU) at rural tertiary care centre located in western Maharashtra, India. The equal numbers of healthy controls were selected from same hospital as relatives and visitors. This study was conducted over the period of three months; March – May 2015.

Case definition

AMI diagnosed on the basis of history of chest pain lasting for up to 3 hours, Electrocardiographic (ECG) changes (ST elevation of 2 mm or more in at least two leads), and elevation in the enzymatic activities of serum creatine phosphokinase and aspartate amino transferase.[9]

Matching

Cases and controls were matched with respect to number, age, sex and residence to avoid possible bias.

Ethical consideration

Study design was pre-approved by the Medical Director followed by Institutional Ethical Committee. The informed consent was obtained from all the study participants. Data were collected by principal investigator under the supervision of cardiologist in ICCU department. The personal interview, anthropometric, clinical and laboratory information was obtained from all study participants as per pre-tested structured proforma within 24 hours of admission of the patients.

Anthropometric examination

The anthropometric examination measurement of height in cm (H), weight in kg (W), waist circumference in cm (WC), hip circumference in cm (HC), waist-hip ratio (W/H ratio), was done using standardised procedures. Height was measured to the nearest 0.1 cm by a stadiometer and weight was measured to the nearest 0.1 kg using a calibrated spring balance. Supine waist girth was measured at the level of umbilicus, with a person breathing silently, and standing hip girth was measured at the inter-trochanteric using a measuring tape. Stretch-resistant tape was positioned midway between the lowest rib margin and the iliac crest to measure WC, and the widest point of the hip/proximal thigh, just below the gluteal fold, was used to obtain the hip circumference; measurements were to the nearest 1 mm.W/H Ratio was derived by dividing WC to hip circumference. BMI was calculated as weight over squared height (kg/m^2).

Blood parameters

Serum lipid profile was assessed in a biochemistry laboratory certified by NABL. Blood was obtained by trained laboratory technician under aseptic precautions in a plain bulb by venepuncture and send to lab.

Body mass index

Overweight and obesity are defined conventionally as having a body mass index (BMI) of $\geq$25 kg/m^2 and $\geq$30 kg/m^2, respectively.[10]

Serum lipid profile

Lipid profile ratio is a useful indicator in predicting the risk of myocardial infarction. High risk of AMI when total cholesterol level $\geq$ 200mg/dl, total triglycerides level $\geq$ 150mg/dl, total HDL level $\leq$ 40mg/dl, total LDL level $\geq$ 100mg/dl, HDL: LDL ratio $\leq$ 0.4.[11]

Waist hip ratio

Waist:Hip ratio is an indicator to complement the measurement of BMI, to identify individuals at increased risk of obesity-related morbidity due to accumulation of abdominal fat. A WHR > 0.9 in men or > 0.8 in women indicates abdominal obesity.[12,13]

Statistical analysis

All statistical analyses were performed using Microsoft Excel 2010, using SPSS 17 statistical software and the results were expressed on Mean ± SD, Chi-Square test, Odds ratio and Logistic Regression. For all analysis, $P < 0.05$ at 95% confidence interval was considered as statistically significant.

RESULTS

A total of 80 participants include 40 cases of AMI and equal number of controls were interviewed and examined in this study. The gender distribution showed 50 males and 30 females with lower and upper age is of 44 and 82 years respectively. The mean age of cases and controls was 58.5 and 60 years respectively with mean difference of 1.5 years.

Maximum, 47.5% cases were in age group 60-69 yrs and as age increases from 40 to 69 years, risk of getting AMI also increases but thereafter even though age increases, risk of AMI decreases as indicated by odd's ratio ranges from 0.4 to 1.5 with confidence interval (CI) of 0.04 – 5.6 respectively. Risk of getting AMI is peak, 1.5 times in a age group of 60- 69 yrs (Table 1).

The proportion of overweight was significantly higher in cases,70% as compared to controls, 20% (χ^2 = 18.23, p= 0.0001) and it is reflected that risk of developing AMI in overweight person is of 9.3 times higher as compared to normal weight individual as indicated by odd's ratio. In context to gender, the risk of developing AMI is of 12.6 times significantly higher in overweight males whereas it is of 6 times seen in females. It is reflected that risk of AMI is significantly higher in males as compared to females (Table 2).

The overall W/H ratio > 90 are significantly higher in cases (χ^2 = 6.06, p= 0.0138) as compared to controls as indicated by odd's of 3.4 with confidence interval of 1.3 to 8.6 suggested that W/H ratio > 90 is a risk factor for AMI. Even though there is no significant association existed between W/H ratio in context to gender, but the chances of getting AMI is of higher in males, 2.9 times as compared to females, 2.2 respectively (Table 3).

The risk of developing AMI is of 2.4 times higher in cases as compared to the controls when overall serum cholesterol level increases above 200 mg/dl, however it is of 2.9 and 1.6 folds in male and females respectively. The overall H: L ratio >0. 4 are significantly associated with AMI (χ^2 = 9.85, p= 0.001) as indicated by odd's of 4.8 with CI of 1.8-12.6. Considering gender, males have shown the risk of 12.2 times of developing AMI whereas in females it is of 2.4. Serum triglyceride level as of >150 are significantly associated with AMI (χ^2 = 17.06, p= 0.001) as indicated

Table 1: Association between age and AMI (n=80)

Age (years)	Cases (%)	Controls (%)	Total (%)	Odd's	CI	χ^2	p
40 – 49	2 (5.0)	4 (10.0)	6 (7.5)	reference	-	-	-
50 – 59	11 (27.5)	13 (32.5)	24 (30.0)	0.789	0.30 – 2.06	0.06	0.80
60 – 69	19 (47.5)	15 (37.5)	34 (42.5)	1.508	0.62 – 3.68	0.46	0.49
70 – 79	7 (17.5)	6 (15.0)	13 (16.2)	1.202	0.37 – 3.96	0.09	0.76
80 – 89	1 (2.5)	2 (5.0)	3 (3.7)	0.487	0.04 – 5.61	0.34	0.55

Table 2: Association between BMI and AMI

BMI (kg/m²)	Cases (%)	Controls (%)	Total (%)	Odd's	CI	χ^2	p
Total≥25, overweight	28 (70.0)	8 (20.0)	36 (45)	9.3	3.3 – 26.1	18.23	0.0001*
<25, normal	12 (30.0)	32 (80.0)	44 (55)				
Male≥25, overweight	19 (67.8)	5 (62.5)	24 (48)	12.6	3.3 – 48.5	13.54	0.0002*
<25, normal	6 (50.0)	20 (62.5)	26 (52)				
Female≥25, overweight	9 (32.2)	3 (37.5)	12 (40)	6.0	1.1 – 30.7	3.47	0.0624
<25, normal	6 (50.0)	12 (37.5)	18 (60)				

*Very significant value (p<0.0001)

Table 3: Association between W:H ratio and AMI

W:H ratio	Cases (%)	Controls (%)	Total (%)	Odd's	CI	χ^2	p
Total							
Overall>0.90	27 (67.5)	15 (37.5)	42 (52)	3.4	1.3 – 8.6	6.06	0.0138*
Overall<0.90	13 (32.5)	25 (62.5)	38 (48)				
Male							
>0.90	19 (76.0)	13 (52.0)	32 (64)	2.9	0.8 – 9.7	2.17	0.1407
<0.90	6 (24.0)	12 (48.0)	12 (36)				
Female							
>0.85	10 (66.6)	7 (46.6)	17 (57)	2.2	0.5 –10.0	0.54	0.4612
<0.85	5 (33.3)	8 (53.3)	13 (43)				

by odd's of 9.4 with CI of 3.2 -27.7. However, the risk of getting AMI in male and females is of 16.6 and 4.3 times as indicated by odd's ratio and CI respectively (Table 4). Univariate analysis showed significant risk for AMI with BMI, W:H ratio and Serum lipid profile (total cholesterol, H: L ratio and serum triglycerides).

It is evident as per the above Table 5, for every unit (1 kg/m^2) increase in BMI in overweight individual, the risk of getting AMI increases by 1.7 times. Similarly, as every unit increase in Waist:Hip ratio, the risk of developing of AMI also increased by 2.8 times. For serum lipid profile, every unit (1mg/dl) rise in serum cholesterol, LDL and serum triglycerides, the risk of getting AMI increases by 1.02, 1.01 and 1.03 times respectively.

In the present study multivariate logistic regression analysis showed BMI, W/H ratio and Lipid Profile (total cholesterol, LDL and serum triglycerides) have been significantly associated with AMI. The gradual increment in odds ratio is evident of association.

DISCUSSION

The study aimed to determine the obesity and other indices with higher degree of agreement in association with AMI which could be used in the clinical settings and epidemiological studies. Study revealed maximum, 75% cases were in age group 50-70 years and as age increases, risk of getting AMI also increases by age of 69 yrs and thereafter risk decreases even though age increases, showing maximum risk of 1.5 times in a age group 60-69 years. A similar findings have also reported by Oda E et al[14] among Japanese population, however, maximum risk, 4.9 times was seen among age group 40-49 yrs. Age is universally accepted non-modifiable risk factors for AMI, but high socio-economic status, standard of living, food fads and other modern life style factors could be responsible for high risk of getting AMI among younger Japanese population.

Overweight was significantly associated with AMI with risk of 9.3 times higher in cases as compared to controls

Table 4: Association between serum lipid profile and AMI

Lipid profile	Cases (%)	Controls (%)	Total (%)	Odd's	Confidence interval	χ^2	p
Cholesterol (mg/dl)							
Overall>200	12 (30)	6 (15)	18 (22)	2.4	0.8 – 7.3	1.79	0.180
Overall<200	28 (70)	34 (85)	62 (78)				
Male							
>200	9 (75)	4 (66)	13 (26)	2.9	0.7 – 11.3	1.66	0.197
<200	16 (57)	21 (62)	37 (74)				
Female							
>200	3 (25)	2 (33)	5 (17)	1.6	0.2 – 11.4	0.24	0.624
<200	12 (43)	13 (38)	25 (83)				
H: L ratio							
Overall>0.4	26 (65)	11 (28)	37 (46)	4.8	1.8 – 12.6	9.85	0.001*
Overall<0.4	14 (35)	29 (72)	43 (54)				
Male							
>0.4	19 (73)	7 (64)	26 (54)	12.2	3.0 – 48.9	12.27	0.005*
<0.4	5 (27)	18 (62)	23 (46)				
Female							
>0.4	7 (23)	4 (36)	11 (37)	2.4	0.5 – 11.1	0.57	0.448
<0.4	9 (27)	11 (38)	20 (63)				
Triglyceride (mg/dl)							
Overall>150	34 (85)	15 (37)	49 (61)	9.4	3.2 – 27.7	17.06	0.001*
Overall<150	6 (15)	25 (63)	31 (39)				
Male							
>150	21 (62)	6 (40)	27 (54)	16.6	4.0 – 68.0	15.78	0.001*
<150	4 (67)	19 (76)	23 (73)				
Female							
>150	13 (38)	9 (60)	22 (46)	4.3	0.7 – 26.5	1.53	0.215
<150	2 (33)	7 (34)	9 (27)				

Table 5: Multiple logistic regression analysis

Variables	B	SE	Wald	DF	SIG	Exp B	Confidence interval
BMI	0.542	0.123	19.330	1	0.001	1.719	1.35 – 2.19
W:H ratio	7.953	3.355	5.618	1	0.018	2.843	1.046– 3.96
Cholesterol	0.025	0.009	7.461	1	0.006	1.025	1.01 – 1.04
H:L ratio	-9.246	3.244	8.124	1	0.004	0.011	0.00 – 0.06
Triglyceride	0.035	0.008	20.372	1	0.001	1.035	– 1.05

in developing AMI. The Jun Zhu[15] and Khalili AA[16] also observed similar association between overweight and AMI, however risk reported was 1.2 and 2 times respectively. The study reported the risk of getting AMI was of 12.6 and 6 times higher in cases in context to male and female subjects. Similar observations also reported by Oda E et al[14] among Japanese population and Tavani A[17] among Italy population. However, risk reported was less as compared to study population and difference could be due to study sample size or environmental conditions, genetic and Indian life style factors.

The Waist- Hip ratio was significantly associated with AMI observed in the study with risk of getting AMI 3.4 times higher in cases as compared to controls. In context to gender, risk was of 2.9 in males and of 2.2 in females. Study conducted by Zodpey S[18] among Indian population and Avezum A[19] among Brazil people also reported similar findings. A prior study has reported that waist to hip ratio is a dominant, independent, and predictive variable of CVD and CHD deaths in Australian men and women.[16] It has been argued that the assessment of obesity by waist-hip ratio would be a better predictor of MI than waist circumference, which in turn, is a better predictor than BMI which was reported by our study. The recognition of central obesity is clinically important, as life style intervention is likely to provide significant health benefits.

Hyperlipidemia was significantly associated with AMI as indicated by odd's of 2.4 with CI of 0.8-7.3 for cholesterol, 4.8 with CI of 1.8-12.6 for H:L ratio and 9.4 with CI of 3.2 -27.7 for triglycerides respectively. Hyperlipidemia and risk of developing AMI was among male was higher in males as compared to females. Similar findings have also reported by Tavani A among Italian population[17] and Avezum A in Brazilian people.[19] A study conducted by Kumar A[20] among south Asian population has reported high levels of cholesterol, H: L ratio and triglycerides significantly associated with AMI. Thus the increased levels of serum lipid would indicate an increased risk of developing atherosclerosis, a risk factor for AMI in study population.

It is evident that every unit (1 kg/m^2) increase in BMI in overweight individuals and Waist:Hip ratio, the risk of getting AMI increases by 1.7 and 2.8 times respectively indicate that W:H ratio is more sensitive indicator for AMI reported by present study. A recent literature published by Richard G[21] and Huxley R[22] mentioned that one unit rise in BMI and W:H ratio, the risk of AMI increases by 17% and 5% in developed world and this difference could be due to biological, genetic, ecological, environmental, life style factors. A study conducted by Price GM also reported that W:H ratio is more sensitive indicator for prediction of AMI.[23] In context to serum lipid profile, every unit (1mg/dl) rise in serum cholesterol, LDL and serum triglycerides, risk of getting AMI increases by 1.02, 1.01 and 1.03 times respectively. Considering the results clinicians, epidemiologist, dieatitins could focus on the unit value of W:H ratio, BMI and serum lipid profile to increase the knowledge as well as practice of prevention and control of CHDs in the community.

CONCLUSION

This study demonstrates that increased BMI, WHR and lipid profile showed a significant association with AMI among rural dwellers. W:H ratio is a more sensitive indicator to predict AMI with unit rise in parameter increases the risk by 2.8 times. As these parameters are simple and quick to obtain, they should be routinely recorded in the primary care setting and in population-based health screening in order to assess future AMI risk and design appropriate interventions.

Limitations

The limitation of our study was the wide confidence interval for some of the Odd Ratios for which more data from a large sample may be required to generate robust evidence.

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Authors Contribution:
RVM - Concept and study design, manuscript preparation, statistical analysis and interpreted; **VRM -** Review of literature and helped in preparing draft of manuscript; **MFF -** Data collection and helped for manuscript preparation; **MIA -** Data collection; **MFS -** Data collection; **MF -** Review of literature of study.

Source of Support: Nil, **Conflict of Interest:** None declared.