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Original Article

Correlation between Body Mass Index and Waist Hip Ratio in Adult Stroke Population

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ABSTRACT

Introduction: Obesity is one of the main leading causes of death worldwide. Obesity increases the risk of many conditions like Cardio vascular disease (CVD), Cerebro-Vascular Accident (CVA), Diabetes Mellitus (DM), Hypertension (HTN). But still direct role of obesity in occurrence of CVA is not clear. Body Mass Index (BMI) and Waist Hip Ratio (WHR) are simple measures of obesity which are evaluating it in different way.

There is a strong link between Waist Circumference (WC) and WHR and occurrence of Metabolic Syndrome in all ethnic populations. These are the measures for evaluating central obesity. The aim of present study was to determine and correlate BMI and WHR in adult stroke population.

Methods: Convenience samples of 115 stroke patients were taken with age above 30 years and both gender were included. Basic demographic data like: Name, Age, Gender, Address and contact detail along with type and date of occurrence of stroke were collected. BMI was calculated as the weight (Kg) divided by square of height (m). Waist Circumference (Cm) was taken at the end of several consecutive natural breaths at a level parallel to the floor, midpoint between the top of the iliac crest and the lower margin of the last palpable rib in mid Axillary line. Hip Circumference (Cm) at a level parallel to the floor, at the largest circumference of buttocks. Pearson correlation coefficient was used to find out the correlation between BMI and WHR in Indian adult stroke population.

Results: There is a positive correlation present between BMI and WHR in an Indian adult's stroke population which was significant among male subjects.

Conclusion: Present study supports our study hypothesis and presence of correlation between BMI and WHR. Fat distribution at level of abdomen is not the only indicator of risk for CVA and BMI level can be used as a risk indicator, diagnostic and prognostic tool in Indian population.

KEYWORDS: BMI, Central Obesity, Indian Stroke population, WHR.

INTRODUCTION

According to WHO Obesity is defined as abnormal or excessive fat accumulation that present a risk to health. Obesity can lead to severe chronic condition like diabetes mellitus, cancer, gall bladder disease, Cardio Vascular Disease (CVD), Cerebro Vascular Accident (CVA). Obesity leading Metabolic Syndrome in south Asia is increasing in an alarming rate. But still role of Obesity in CVA or stroke is unclear. Estimated prevalence of stroke may be different depend on whether WHR or BMI is used to defined Obesity.[1,2.]

According to WHO, Stroke is "rapidly developing clinical sign of focal or global disturbance of cerebral function with symptoms lasting 24 hour or longer leading to death with no apparent cause other than of vascular origin". Some of the consistence risk factors for stroke incidence are tobacco smoking, hypertension, inactive life style and metabolic syndrome (MetS) which has high chance of co morbidity among human beings. Another clear reason in MetS is presence of systemic pro-inflammatory and pro-thrombotic state. In this state there is an increased chance of CVD and CVA.[1,2.]

Since obesity related diseases are highly increasing in both developed and developing countries, one of the major priorities of WHO is to control and prevention of these non-communicable diseases. Obesity measure is one the main health concern of any health care

professional in diagnostic and prognostic field of practice.

Assessment of obesity is done by various test and techniques such as: Body Mass Index (BMI), Waist circumference (WC), Waist hip ratio (WHR), Skin Fold Thickness, Neck circumference, Bioelectric Impedance, Analysis and hydrostatic weighing, Dual Energy X-ray Absorptiometry (DEXA).[2,3.]

Some of the commonest tests of obesity which is not consuming much time, financially feasible and easy to practice are BMI and WHR. Each of this tests, describe body figure in different way. BMI calculates irrespective to amount of lean body mass or total body fat of person's body and WHR mainly consider abdominal size. BMI is one of an internationally accepted gold standard for categorizing human being's body composition according to her / his body weight and height.[2,4-6.]

WHO introduced certain cut off point which explains the appropriate individual weight according to height, it is been accepted in US and European population as a gold standard but investigations proved that most of the Asian population has smaller body frame and so less amount of body mass and smaller BMI compared to European.[7.]

Due to the same reason Asians tend to have greater chance of central adiposity when compared with the same level of BMI in US or European population. It can be understood from the above statements that an Asian origin person with any BMI level will not necessary show a same level of central obesity when compared with his same BMI level of US or Europe origin.[1,4,8.]

Smaller body frames tend to have shorter height and less weight which may fall in normal BMI according to WHO estimated range but patient may present with central adiposity or excess fat deposition at abdomen level, Therefore these BMI ranges were not a good indicator for obesity, in Indian population.[6,9.]

WHO experts consultation concluded that proportion of Asian which are at high risk of type 2 diabetes mellitus and cardiovascular disease are present with lower BMI than International accepted ranges. Therefore, WHO have been advised certain values, specific for Asian pacific region which are applicable for Indians, but still categorizing of person with obesity or overweight is controversial.[1,10] So these finding suggests that WHO criteria to define overweight and obesity is not appropriate for all ethnic population.

The prevalence of overweight and obesity among 14 countries of Asia pacific regions is rising considerably and since health related risk factors associated with obesity occur in lower BMI. This could be another reason for WHO to announce new ranges applicable in Asian population only.[1,3,4.] Investigations shows that South Asians mostly Indians have greater total abdominal and visceral fat compare to those with similar value of BMI in other ethnic places, therefore same person may fall in risk spectrum of different disease in spite of having normal BMI and due to high central adiposity.[1,11,12.]

According to perspective study which was held on Feb 2000 and coordinated by diabetes institute and WHO collaboration, the new ranges were introduced for Asian pacific region:

BMI cut off point for Asians	
Healthy	$<23 Kg/m^2$
Over weight	$23\text{-}24.9 Kg/m^2$
Obese	$\geq 25 Kg/m^2$

WHR and WC are different measures of obesity which are easy to administer and are good indicators of central obesity. WC is a useful method to measure an individual's waist size and compare it with the accepted normal value for either male or female. WC is a good risk indicator of metabolic disease. The normal value of WC of Asian male considered as ≤90 centimeter and for female ≤ 80 centimeter. Importance of WHR as a sensitive measurement among anthropometric parameter of person has been reported in many studies. High level of WHR in an individual in different ethnic group is one of the risk factor for many chronic, metabolic, systemic diseases. The normal value of WHR for male is ≤0.95 and for female is ≤0.80.[2,3,10]

There are different conclusions on comparison of WC and WHR, with the aim of recognizing a better indicator of central obesity in different population. But still there is no tool to find out or diagnose the risk of the same among healthy individual at very initial stage of weight gain in Asian population.[2,5,10,11,13.]

Wide investigations suggests prevalence of stroke defined by BMI and Central Obesity with different strength toward each indicators, some agreed with overlap of both indicators and some did not find correlation as such.[14-16.]

There are evidences which reported mismatch between WHR and BMI level in Asian; on other hand some evidences are available to present a direct correlation between both indicators in Asians when compared to validated ranges for this population. Although WHO published specific ranges for BMI and WHR as an indicator of obesity among Asians, but yet there is need of study about these measures in different population of disease in Asia for establishment of validated cut off point and explain the correlation of both measure of obesity in that particular population.[17-22.]

According to WHO; stroke is caused by the interruption of the blood vessel burst or is blocked by a clot. This cuts off the supply of oxygen and nutrients; can cause damage to the brain. Well established risk factors for stroke include hypertension, diabetes mellitus and smoking. There are evidences which supports chances of association between hemorrhagic stroke and lean individual, but still incidence of stroke among obese

individual or person with high WHR is high and there is no specific study based on correlation of BMI and WHR level among stroke population in India which is one of the main cause of chronic disability with high chance of mortality among human beings.[14-16]

Obesity, measured by BMI (general adiposity) and WHR (abdominal adiposity) are well documented risk factor for Metabolic Syndrome, CHD.[1,13,22] Association of these two measures with Stroke in Asians, are less characterized. Still there is not a direct reasoning behind presence of obesity and increase incidence of stroke, but it is clear that obesity is associated with elevated level of prothrombotic factor, such as: fibrinogen, plasminogen and inflammatory biomarkers such as: C-reactive protein, interleukin-6 which are an important contributor to development of stroke. There are evidences which support occurrence of many obesity related disease in lower level of BMI, among Asian population. Association of stroke incidence with abdominal obesity is well defined in many Asian ethnicities, but role of BMI level among stroke population is not certain yet. This is important to find out the exact impact of obesity pattern among stroke population according to these two measures of obesity.[14-16,23,24]

Since there is not clear association between BMI and WHR among Asian stroke population, we aimed to find the correlation between these two obesity indicators among different gender of study population. Baseline parameter like age, gender, type and date of occurrence of stroke, weight, height, WC, HC, weight awareness, BMI level and WHR were taken at the time of assessment.

MATERIALS AND METHODS

Total 115 stroke Patients admitted in M. S. Ramaiah Hospital, Bangalore, Karnataka, India were included in study. Stroke patient in acute stage were considered for the study. The purpose of study was explained and an informed consent was obtained from the subjects. The procedure was explained with assurance of no harm to the subjects. Ethical clearance was obtained from Institutional Ethical Committee of M. S. Ramaiah Medical College & Hospital.

INCLUSION CRITERIA

- Any type of stroke.
- Both the Genders.
- Age above 30 year.

EXCLUSION CRITERIA

- History of previous stroke.
- Traumatic stroke.

MATERIALS USED

- Weighing Machine.
- Measurement Tape.
- Fixed Stadiometer.

PROCEDURE OF DATA COLLECTION

Basic demographic data like: Name, Age, Gender, Address and contact detail along with type and date of occurrence of stroke were collected. Wight was measured in light clothing without shoe after emptying bowel and bladder, before meal. Height was measured as the distance from top of the head to bottom of the feet without shoe using fixed stadiometer. BMI was calculated as the weight (Kg) divided by square of height (m). Waist Circumference (Cm) was taken at the end of several consecutive natural breaths at a level parallel to the floor, midpoint between the top of the iliac crest and the lower margin of the last palpable rib in mid Axillary line. Hip Circumference (Cm) at a level parallel to the floor, at the largest circumference of buttocks.[3,5] All the measurement were taken in standing posture and repeated twice to assurance of accuracy.

STATISTICAL ANALYSIS

Pearson's correlation coefficient was used to find out the correlation between BMI and WHR in stroke population. The statistical software (SPSS package version 16.0) was used for the analysis of the data and Microsoft Word and Excel were used to generate graphs and tables.

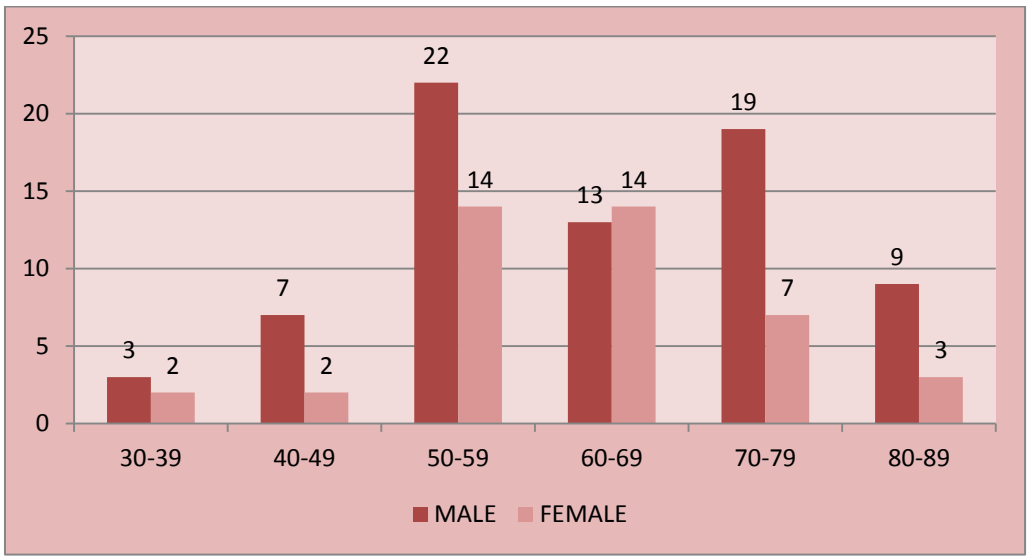

Fig 1: Age wise distribution of subjects.

Table 1: Descriptive Statistics.

Gender	Number	Min Age	Max age	Mean Age
MALE	73	38	87	64.47
FEMALE	42	30	84	61.66

Table 2: Values of BMI and WHR in present study.

	Min BMI	Max BMI	Mean BMI	Min WHR	Max WHR	Mean WHR
Male	16.99	39.19	24.90	0.87	1.23	1.03
Female	20.13	34.85	26.65	0.83	1.20	1.05

Table 3: Correlation Test between BMI and WHR in Male Subjects.

CORRELATION		BMI	WHR
BMI	**Pearson Correlation**	1	0.543*
	Sig(2-tailed)		0.000
	N	73	73
WHR	**Pearson Correlation**	0.543*	1
	Sig(2-tailed)	0.000	
	N	73	73

*correlation is significant at the 0.01 level (2-tailed).

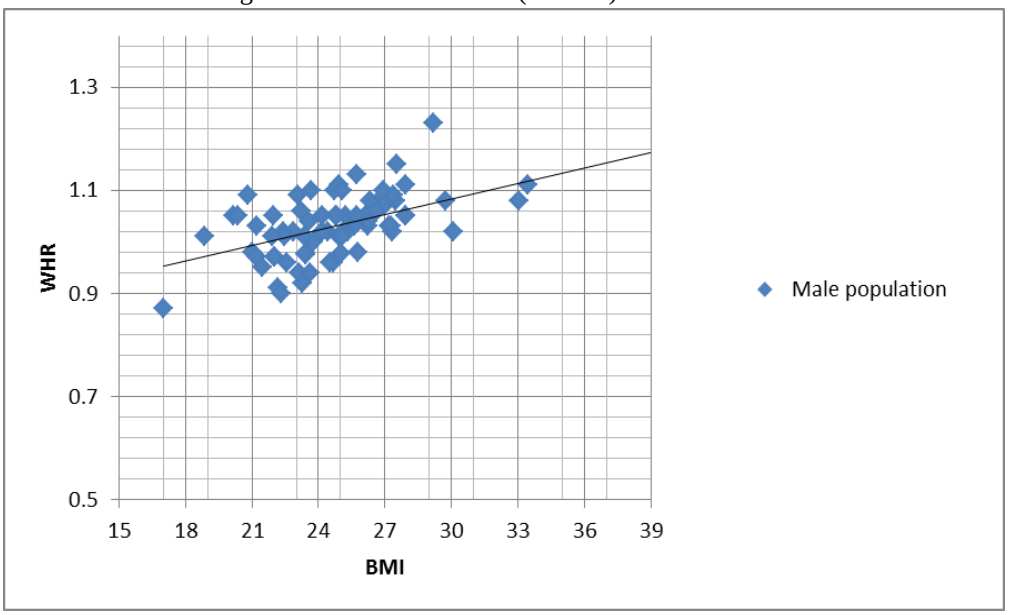

Fig 2: Correlation between BMI and WHR in stroke male subjects.

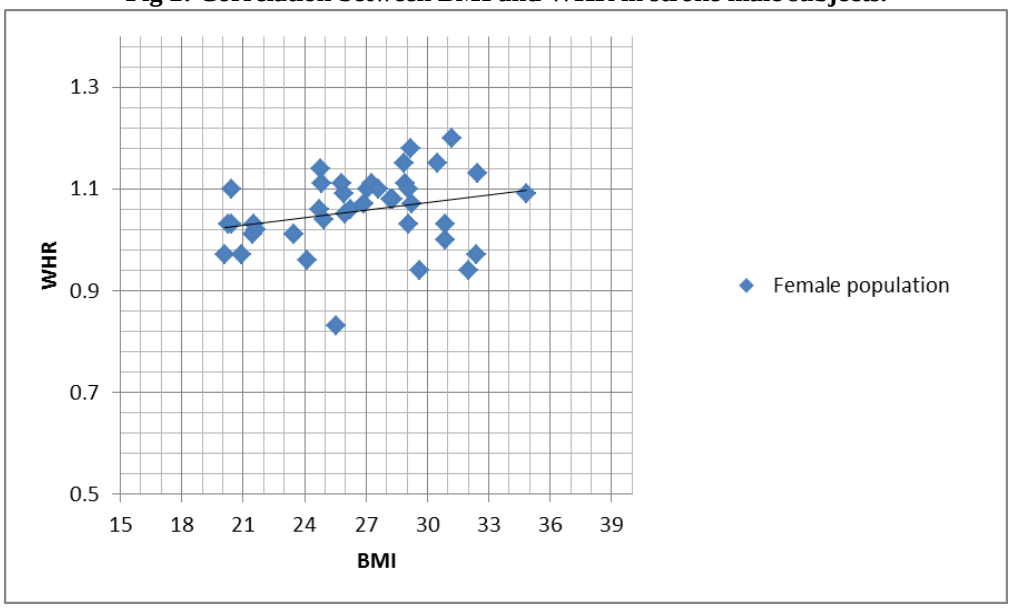

Fig 3: Correlation between BMI and WHR in stroke female subjects.

Table 4: Correlation Test between BMI and WHR in female subjects.

CORRELATION		BMI	WHR
BMI	Pearson Correlation	1	0.264
	Sig(2-tailed)		0.092
	N	42	42
WHR	Pearson Correlation	0.264	1
	Sig(2-tailed)	0.092	
	N	42	42

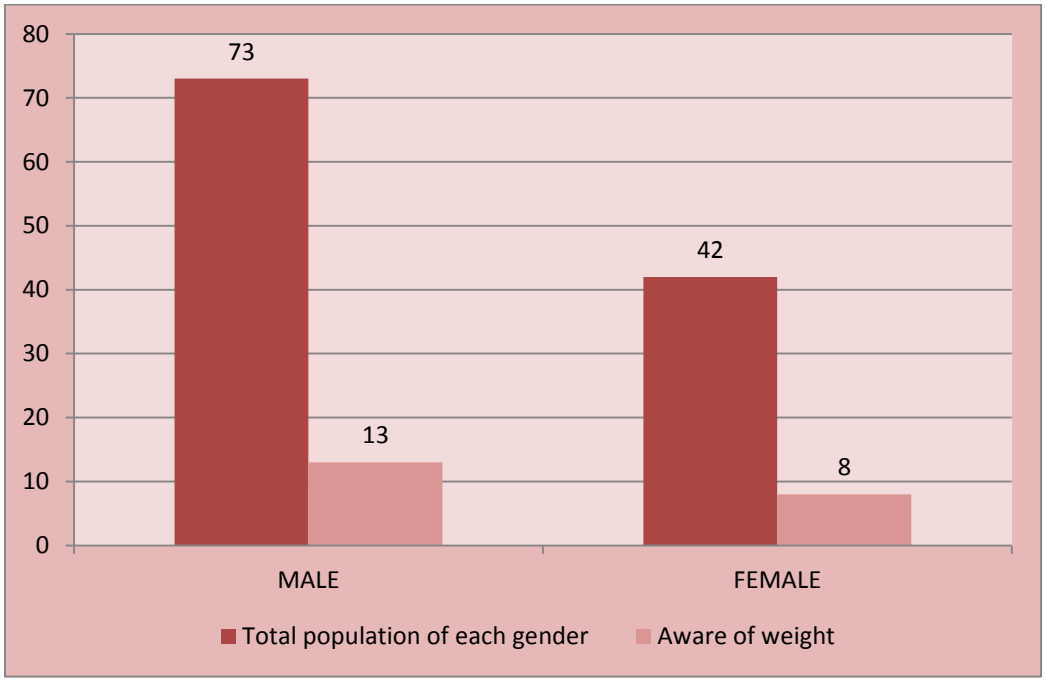

Fig 4: Weight Awarness.

RESULTS

Table 3 represents moderate positive correlation between BMI and WHR in males with stroke which is statistically significant. Table 4 represents poor positive correlation between BMI and WHR in females' stroke population which is not significant statistically. Fig 4 represent the total number of each gender in study group and number of person who is aware of his/her own weight.

DISCUSSION

Obesity is one the main worldwide concern of all health care professional at present. Role of obesity in many fatal conditions is certain. There is a strong link between obesity and metabolic syndromes like Diabetes mellitus. Central obesity is one of the leading factors toward increasing chance of metabolic disorders. The abdominal fat will act like as an exocrine gland and lead to release certain hormone like leptin and angiotensinogen and proinflammatory substance that can cause damage to endothelial layer of smooth vessel wall. Another complication of obesity is increase arterial resistance and increase blood pressure in obese person.[1,5,25,26]

One of the methods to measure central obesity is WHR, which is a good risk indicator of many diseases for human being. BMI is another measure of obesity, but there are some limitations to use this measure in clinical practice for different ethnicities. Asian population tends to have smaller body frame and skeleton structure when compare with their same age person in US or Europe. Since this measure is stature dependent in person with short leg, BMI is higher, apart from this BMI cannot distinguish between mass due to fat or due to muscle. This means person with high amount of lean body mass may categorize as overweight or obese with BMI.[2,8,25,26]

Since the finding based on correlation of both measure are not sufficient to finalized the presence of correlation between BMI and WHR among diseased population of Asian pacific region, there is a need to apply the same in different ethnic group of Asia. Role of obesity in occurrence of stroke is not clear yet and there is not a good obesity risk indicator for stroke.[16,17,27,28]

This study was undertaken to assess the correlation between BMI and WHR in adult stroke population. Convenience sampling of 115 adult stroke patient of both gender who met the inclusion and exclusion criteria were taken up for study.

According the obtained results, WHR and BMI in study population are well correlating. Since from the present study it was concluded that BMI and WHR correlate

with each other, BMI also can be used as a predictor of risk factor in adult stroke population. It was practically difficult to use WHR as measure of assessing of central obesity in this population; BMI could be used as an alternative measure of assessment for adult stroke population.

Pearson's Correlation test was used to find out the correlation between BMI and WHR among different gender of our study population. There were 115 participants in the study and out of it, there were 73 male and 42 female. There was a correlation among BMI and WHR in both gender of subjects but the correlation among male participants were statistically significant. In our study due to larger male sample size we could find a significant correlation between these two obesity indicators in stroke population. The positive correlation observed in males age group ranging from 50-69 and in females population observed in age group 60-69.

The maximum stroke incidence was found in 7^{th} decade in male and 5^{th} decade in female. We may relate this incidental finding among female to their early menopause stage and alter in steroids level which is linked to fat accumulation and can lead to increase in WC, hence increase risk of CVA, CVD among females.

One of the concerns during our data collection was the level of awareness of each individual about their weight. According to our findings only 18% of total participant were aware of their weight and remain population were either not aware or wrong in giving the value. This clearly explains the need of our society for more awareness regarding common diseases and their risk factor, and it is possible with a cooperative program among health care professional in any stage as a care giver or specialist level of practice.

LIMITATION OF THE STUDY

- Small sample size.
- Unequal distribution of genders.
- Activity level was not considered in the study.

CONCLUSION

In the present study, as we hypothesized there was a correlation between BMI and WHR in Indian Adult Stroke population of both gender. It was statistically significant among male subjects. BMI and WHR of each subject in both gender was more or less present in risk spectrum of validated ranges for Asian population. This suggests the validity of both measure as a prognostic method and risk detection for CVA. In can also be suggested that occurrence of stroke is not dependent on fat distribution among Indian Asian and correlation of BMI and WHR can be due to the less percentage of lean body mass in this population. At the end we can conclude that, there is a correlation of BMI and WHR among stroke population and both can be used as measure of risk for CVA.

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