

**Research Article**

**Association of Obesity with Stroke**

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**Abstract**

**Introduction:** Obesity is an established risk factor for cardiovascular disease, but the relationship of obesity with the risk of cerebrovascular disease to some extent, is still unclear.

**Objectives:** To assess the relationship of obesity with the risk of stroke.

**Methods:** By non probability sampling one hundred patients of stroke presented between 27th January 2008 to 26th July 2008 in emergency and outpatient medical department of Capital Development Authority Hospital, Islamabad, Pakistan were selected. Their body mass index (BMI) was calculated and its association with the type and severity of stroke was analyzed for statistical differences. Association of BMI with blood pressure, blood glucose levels and cholesterol was also measured. Statistical analysis was performed with SPSS 13. The P value of significance < 0.05 was adopted.

**Results:** Male patients were 53% and 47% were female. Mean age in females was more than males. Ischemic strokes were 72% and 28% were hemorrhagic. BMI was normal in 71% of the patients while high BMI was found in 29% patients. 56% of the patients had mild stroke, 25% had moderate and 19% had severe stroke. Hemorrhagic strokes were closely related to the severity of strokes (P value= .000). Patients with high BMI had 13.8% hemorrhagic stroke and 86.2% of ischemic stroke (P value= .034). The severity of stroke was not associated with a high BMI (P value= .914). Obesity was also found to be associated with hypertension, high blood glucose levels and high cholesterol levels.

**Conclusion:** BMI is associated with an increased risk of total and ischemic stroke but not with hemorrhagic stroke. There is no relationship between high BMI and severity of stroke.

**Keywords:** Ischemic stroke, Hemorrhagic stroke, Obesity, Body Mass Index.

**1. Introduction**

Stroke is a preventable disease with high personal and social cost. It can cause permanent neurological damage, complications and death if not promptly diagnosed and treated. It is the third most common cause of death in the United States<sup>1</sup>. It is the leading cause of adult disability in the United States and Europe. It is the number two cause of death worldwide and may soon become the leading cause of death<sup>2</sup>. Stroke can be due to ischemia caused by thrombosis or embolism, or due to a hemorrhage.<sup>3</sup>

According to World Health Organization estimates, in 2002, 5.5 million people died of stroke in 2002 and roughly 20% of these deaths occurred in South Asian Countries (India, Pakistan, Bangladesh, and Sri Lanka)<sup>4</sup>. Obesity is a well documented risk factor for a variety of diseases, including coronary heart disease, stroke, hypertension, type 2 diabetes mellitus, osteoarthritis, infertility and certain cancers.<sup>5</sup>

Obesity represent an emerging threat to public health. It affects nearly 59 million adults in the United States

alone<sup>6,7</sup>. Developing countries are increasingly vulnerable to the worldwide epidemic of obesity, which affects all segments of the population, including men, women and now children.<sup>8</sup>

As in other regions of the world, the incidence of obesity is rising rapidly in Pakistan as well. National Survey showed 25% of the Pakistani population to be overweight or obese according to the Asian-specific BMI cutoff value of 23 kg/m<sup>2</sup> and 10.3% to be obese according to the BMI cutoff value of 27 kg/m<sup>2</sup>. Almost 2.5 time greater prevalence of obesity is observed among urban residents than among rural residents.<sup>9</sup>

Obesity is an established risk factor for cardiovascular disease<sup>10</sup>, but the association between obesity and cerebrovascular disease is still to some extent unclear. There is increasing evidence that high body mass index (BMI) may increase the risk of total stroke particularly ischemic stroke<sup>11, 12</sup>. Strokes can be reduced by managing potential risk factor such as elevated BMI.

In our cross sectional study we established BMI is one of significant and independent predictor for stroke and there is association between obesity and cerebrovascular infarct. So by advocating appropriate life style modifications, this important risk factor can be minimized.

## 2. Material and Methods

This Cross-sectional study was conducted in emergency and outpatient medical department of Capital Development Authority Hospital, Islamabad, Pakistan, which is tertiary care hospital. The duration of study was six months from 27th January 2008 to 26th July 2008.

### 2.1 Data Collection Procedure

After taking permission from the concerned authorities of Capital Development Authority Hospital (Head of the Department of Medicine, Hospital Ethical Committee) data collection phase was started on 27th January 2008 to 26th July 2008.

### 2.2 Sample Size and Sampling Technique

By non probability convenient sampling one hundred patients of confirmed stroke were included.

### 2.3 Data collection

The data was collected from outpatient and emergency department of medicine.

Verbal consent was taken from all the patients after explaining the nature and purpose of the study at the beginning of the study. All the patients were handled by the same doctors to minimize bias. Patient of stroke were identified and detailed history was taken for diagnosis and fulfillment of the required selection criteria.

### 2.4 Tools

Using structured proforma, information was collected. The Information regarding baseline characteristics of patients was collected first. Their age, sex, height, weight was noted and body mass index (BMI) was calculated. By vigorous and strict criteria only patients of stroke with hypertension but without other co-morbid diseases were selected. Their BMI was measured. Based on that, patients with normal BMI (18.5 – 24.9) were segregated into one group and patients with BMI of 25 or more were segregated into another group. Severity and the type of stroke were assessed between these two groups with the help of Glasgow Coma Scale (GCS). A brain computed tomography scan was performed in all patients to differentiate between ischemic and hemorrhagic stroke. Blood pressure (BP) was also measured. A biochemical profile (renal and hepatic) and a full blood count were done as a baseline. Fasting plasma glucose and lipid profile were done to exclude diabetes and dyslipidemias. An electrocardiogram (ECG) was done in view of the high prevalence of hypertension and cardiovascular disease in obesity. Enquiries were made regarding previous treatment. Previous medical records were also checked whenever considered necessary. Patients with previous stroke, alcohol, drug abuse or taking any medications regarding obesity were not included in the study.

### 2.5 Data Analysis Procedure

The statistical package for social sciences (SPSS, version 13.0) was used to enter and analyze the data in the form of tables and graphs. Mean and standard deviation were calculated for the continuous numerical variables like age, weight, height and body mass index. Frequencies and percentages were presented for categorical variable like severity, gender, mode of presentation i-e Glasgow Coma Scale and body mass index (normal and obese).

Chi-square Test was used to compare between the difference in proportion regarding severity of stroke in patients with normal BMI (18.5- 24.9) and those with BMI of 25 or more. P value was calculated and the significance level was assumed any P value<0.05.

### 2.6 Exclusion criteria

Patients taking alcohol, history of drug abuse, Previous history of stroke, having Co-morbid diseases (e.g diabetes mellitus, Renal and hepatic dysfunctions) and taking any medications regarding obesity were excluded.

### 3. Results

One hundred patients were enrolled in this study. Male patients were 53% and 47% were female. The mean age of the patient was (63 +/- 12) years. In males, mean age (61 +/-12) years was less as compared to female (64 +/- 11) years. The mean Body weight in males was more (68 +/- 11) kilograms as compared to females (57 +/-11) kilograms with a total mean weight of (63 +/- 13) kilograms. The mean height in female was also less (1.5 +/- 7.3) meters than males (1.7 +/- 8.6) meters with a total height of (1.6 +/- 1.0) meters.

The mean BMI was (23.0 +/- 3.6) kg/m<sup>2</sup> with males having higher BMI (23.3 +/- 3.5) kg/m<sup>2</sup> than females (22.7 +/- 3.8) kg/m<sup>2</sup>.

BMI was normal in 71 patients (71%) while high BMI was in 29 patients (29%) as shown in table-1. The severity of stroke according to gender as shown in Table-2. The percentage of ischemic strokes was greater as shown in table-3. Ischemic stroke was closely related with high BMI as listed in table-4. There is no association of BMI with severity of stroke as listed in table-5. The mean systolic and diastolic blood pressure were high in high BMI as listed in table-6.

The mean fasting blood sugar was (73 +/- 13) mg/dl. It was greater in patients with high BMI (80 +/- 11) mg/dl as compared to those having normal BMI (70 +/- 13) mg/dl.

The mean serum cholesterol level is (173 +/- 28) mg/dl. In patients with normal BMI it was (169 +/- 24) mg/dl while those with high BMI it was (184 +/- 36) mg/dl.

The mean value of serum bilirubin was (0.7 +/- 0.1) mg/dl. The mean value of serum alanine aminotransferase was (25 +/- 8) u/l. The mean value of serum urea was (29 +/- 8) mg/dl. The mean value of serum creatinine was (0.7 +/- 0.1) mg/dl. The mean value of hemoglobin was (12 +/- 2) mg/dl.

Electrocardiogram (ECG) was done in the study. Normal ECG were 69% and 31% were abnormal.

**Table-1: Frequency and Percentage of BMI**

Gender	Normal BMI	High BMI
Male	37(69.8%)	16(30.2%)
Female	34(72.3%)	13(27.7%)
Total	71(71%)	29(29%)

**Table-2: Severity of stroke according to gender**

	Severity of Stroke	Frequency	Percent	Cumulative Percent
Male	Mild	30	56.6%	56.6%
	Moderate	14	26.4%	83.0%
	Severe	9	17.0%	100.0%
	Total	53	100.0%	
Female	Mild	26	55.3%	55.3%
	Moderate	11	23.4%	78.7%
	Severe	10	21.3%	100.0%
	Total	47	100.0%	

**Table-3: Association between severity and type of stroke**

Type of Stroke	Severity of Stroke			Total	P Value
	Mild	Moderate	Severe		
Hemorrhage	6 (10.7%)	8 (32.0%)	14 (73.7%)	28	0.000
Ischemic	50 (89.3%)	17 (68.0%)	5 (26.3%)	72	
Total	56	25	19	100	

**Table-4: Association between BMI and type of stroke**

Type of stroke	BMI of participant of study		Total	P Value
	Normal	High		
Hemorrhage	N=24 (33.8%)	4 (13.8%)	28	0.03
Ischemic infarct	47 (66.2%)	25 (86.2%)	72	
Total	71	29	100	

**Table-5: Association of BMI with severity of stroke**

Severity of stroke	BMI of participant of study		Total	P Value
	Normal	High		
Mild	40 (56.3%)	16 (55.2%)	56	0.914
Moderate	17 (23.9%)	8 (27.6%)	25	
Severe	14 (19.7%)	5 (17.2%)	19	
Total	71	29	100	

**Table-6: Association of BMI with Blood Pressure**

Blood Pressure	Normal BMI	High BMI	Mean Blood Pressure
systolic	148+/- 22 mmHg	167+/-30 mmHg	154+/-26 mmHg
diastolic	92+/-13 mmHg	100+/-18 mmHg	95+/-15 mmHg

#### 4. Discussion

Our study shows the association of obesity (normal and high BMI) with stroke. Obesity is listed as a potential modifiable risk factor for stroke. Obesity has significant positive association with stroke in all races and sex groups<sup>13</sup>.

Our study shows sex differences in patients suffering from stroke. There is a male to female preponderance with 53% males and 47% females in stroke patients. The age of stroke is also significantly higher in women than in men, with an average difference of three years. This finding is in accordance with a Pakistani study<sup>14</sup>. Although obesity is an established risk factor for coronary heart disease, its role as a risk factor for stroke remained controversial. As our measure of obesity we used BMI, an index of total body fat, rather than waist circumference which measures abdominal fat. Although both indices of obesity carry untoward vascular risk, BMI is thought to play a more direct role than waist circumference in the development of stroke. A study suggested that abdominal obesity as measured by the waist-to-hip ratio was a stronger predictor than BMI and had a greater effect among younger individuals.<sup>15</sup> Our study shows that the body mass index is

higher in males as compared to females with an average difference of 1 kg/m<sup>2</sup>.

Ischemic strokes are the most common in our study followed by hemorrhagic stroke. This is in accordance with a study conducted in Pakistan<sup>16</sup>. In our study, the incidence of hemorrhagic stroke is equal in both males and females but ischemic strokes occurred more in males as compared to hemorrhagic strokes.

Our study shows an association between ischemic stroke and high BMI (P = .034). This is in accordance with several studies that suggested that a high body mass index (BMI) is associated with and may increase the risk of ischemic stroke. In a Swedish study, a 2 fold increase was found in the risk for total, ischemic and undetermined stroke for men with BMI >30 kg/m<sup>2</sup> compared with men with BMI of 20.0 to 22.5 kg/m<sup>2</sup> BMI. However, the researchers did not find any association between BMI and the risk of hemorrhagic stroke.<sup>11</sup> In the Women's Health Study, BMI was a risk factor for total and ischemic stroke, but this association was highly mediated by hypertension, diabetes mellitus, and elevated serum cholesterol level.<sup>12</sup> A recent study in Greece shows that the excess weight is associated with an increased risk of acute ischemic stroke in elderly individuals independently of concurrent metabolic derangements.<sup>17</sup>

Most studies have found an increased risk of hemorrhagic stroke among lean persons.<sup>18</sup> Kim SH et al observed a three-fold increase in the risk of intracerebral hemorrhage in the highly obese group.<sup>19</sup>

Our study showed that the majority of the patients had mild stroke in which ischemic infarct is predominant over hemorrhage. In moderate stroke 68% are ischemic with 32% hemorrhagic. Severe strokes were the least to happen. (P value=.00)

Our study showed no relationship between the severity of stroke and high BMI (P value= .914). There are only a few studies that have investigated this relationship. Razinia T et al showed that the severity of stroke has no relationship with BMI and therefore stroke severity does not differ in BMI groups.<sup>20</sup>

In our study we found that the severity of stroke is much higher in hemorrhagic stroke as compared to ischemic stroke. This is in accordance with a study done in inpatients rehabilitation.<sup>21</sup> The amount of hemorrhage determines the severity of the stroke. Our study shows that the mean systolic blood pressure (SBP) is significantly higher in patients with high BMI.

Williams PT et al shows that even among normal-weight physically-active individuals, increasing BMI significantly increased the hypertension, hypercholesterolemia and diabetes in men and hypertension in women<sup>22</sup>. Hypertension due to its close relationship with obesity is included in our study as a confounding factor while diabetic patients were excluded. In a recent large, population-based study from Malmö, Sweden among normotensive men and women; BMI was a statistically significant and independent predictor for stroke.<sup>13</sup>

The mean fasting blood sugar was higher in patients with high BMI as compared to those with normal BMI. Chronic hyperglycemia secondary to obesity increases the risk of stroke. More recent data from the Atherosclerosis Risk In Communities (ARIC) Study reiterated this relationship.<sup>23</sup>

Those patients who had hepatic and renal dysfunctions were excluded from our study. We found an increase in serum cholesterol with elevated BMI. This is in accordance with a Pakistani study.<sup>24</sup>

Due to a high prevalence of hypertension and cardiovascular diseases with obesity, an electrocardiogram (ECG) was performed in every patients. We classified ECG in our study into normal and abnormal and found that 31% of the patients have an abnormal ECG.

## 5. Recommendations & Conclusions

Our study highlighted serious health problem as obesity and cerebrovascular accident are major problem of the world. Obesity is one of the preventable risk factor of stroke; and its complications can be prevented by maintaining healthy BMI.

It is important to produce awareness among people about different factors (environmental, social & genetic), which are responsible for obesity. It's complication can be reduced by using early preventive measures, physical activity and balanced diet.

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