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COMPARISON OF OUTCOME BETWEEN OBESE AND NON-OBESE PATIENT FOLLOWING SEVERE TRAUMATIC BRAIN INJURY

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Abstract:

Background: The worldwide healthcare system is significantly impacted by two non-communicable diseases: obesity and traumatic brain injury. Both of the diseases have a significant risk of raising overall population mortality and morbidity. However, it is not well known how obesity affects traumatic brain injury results.

Objective: To analyze the outcome of severe traumatic brain injury in obese versus non-obese patients.

Methods: A cohort study evaluated patients between April 2022 and October 2022 who presented to the emergency department (ED) of Ziauddin Medical University Hospital Karachi with severe traumatic brain injury. A total of 120 patients were randomly distributed into obese group with body mass index (BMI) of ≥ 30 Kg/m2 and non-obese group with BMI of < 30 Kg/m2. Final hospital outcomes, complications, and outcomes on the Glasgow Outcome Score (GOS) were assessed in obese and non-obese severe traumatic brain injury patients. The obesity effect was evaluated using chi-square and independent sample t-test.

Results: Of the total, 85.0% and 88.3% of patients were male, while 15.0% and 11.7% were female, with an overall mean age of 48.3 and 44.7 years in the obese and non-obese groups, respectively. The final hospital outcome was statistically significant and higher among obese group patients than non-obese group patients: death (11.7% vs. 1.7%, p=0.028) and admission (70% vs. 50%, p=0.025). Mean length of stay in emergency (6.77 vs. 4.40 hours, p<0.001) and hospital (5.32 vs. 3.55 days, p=0.003) was significantly high among obese group than non-obese group. Rate of complications and outcomes on the GOS was also significantly higher and worse among obese group than non-obese group (p=0.031 and p=0.004).

Conclusion: It was concluded that one of the main risk factors for treating patients with severe traumatic brain injury is obesity. The obese TBI group has a considerably greater mortality rate, length of stay, complications, and worse outcomes on the GOS as compared to non-obese TBI group.

Keywords: Body mass index, morbidity, mortality, obesity, traumatic brain injury.

Introduction:

Traumatic brain injury (TBI) is one of the biggest causes of emergency department patient overload and workload for emergency physicians. Approximately one million patient with traumatic brain injury visit emergency departments worldwide each year [1, 2]. The world's elderly and paediatric populations are always more susceptible to TBI, which raises treatment costs and places additional strain on the healthcare system by increasing morbidity, mortality, and lifelong disability [3, 4]. Globally, the incidence of TBI continues to increase, and approximately 69 million cases of TBI have been reported, including higher proportion of mild TBI cases (55.9 million) and lower proportion of severe TBI cases (5.48 million) [5]. A recently published study on TBI report the higher percentage of new TBI cases (27.16 million), age-standardized incidence (346 / 100,000 population) and prevalence rates of (599 / 100,000 population) worldwide in year 2019 [6]. According to a report, Pakistan has 50 out of 100,000 cases of TBI in 2020 [7]. Additionally, TBI is strongly associated with higher health care costs and disability. TBI is a major concern for emergency physicians because it is associated with higher functional disability [5-7].

Early diagnosis and classification of TBI severity is extremely difficult and depends on the Glasgow Coma Scale (GCS) and other imaging methods. Imaging modalities include computerized tomography (CT) and Rotterdam CT of the brain, which confirms intracranial hemorrhage in the brain and is an accurate diagnostic method for TBI [8, 9]. The GCS is currently the most widely used score in the emergency department for classification of TBI severity. However, emergency physicians cannot accurately assess the severity of TBI with any single diagnostic method. Instead, a combination of clinical and diagnostic methods should be used [10, 11].

One of the major risk factors for human health is obesity, particularly for those with severe or chronic illnesses. Obesity is also directed correlated with higher likelihood of morbidity and mortality. World Health Organization (WHO) defines the obesity as an excessive accumulation of fat in the body that poses a risk to one's health. In cases where a person has a body mass index of ≥ 30 kg/m^2, they are considered obese. According to WHO, there are approximately 650 million obese people worldwide [12]. Obesity is considered as one of the key hazards that exacerbate signs and symptoms of TBI, leading to long-term damage, poor outcomes, complications, and even death [13].

This research analyze the outcome of severe traumatic brain injury in obese versus non-obese patients. The study findings will be useful in determining whether obesity is associated with worse outcomes or not in patients presenting to the ED with severe TBI. Study findings will also be helpful for emergency physicians in order to provide appropriate treatment in obese patients with severe TBI.

Methodology:

A cohort study evaluated adult patients between April 2022 and October 2022 who presented to the emergency department (ED) of Ziauddin Medical University Hospital Karachi with severe traumatic brain injury. The research includes the (1) patients of both genders (male and female), (2) patients with age of equal or greater than 18 years, (3) patients presented with severe traumatic brain injury, (4) patients in whom weight and height were measured to calculate BMI, and (5) patients ready to be a part of the study. The research excludes the patients with (1) polytrauma, (2) mild and moderate traumatic brain injury, (3) severe abdominal injuries, (4) severe chest injuries, and (5) a previous history of brain surgery.

Online available software (Open EPI) for sample size calculation was utilized to calculate sample size for this cohort study with a 95% significance level, 80% power, a ratio of sample size 1, and mortality reported in 61.9% of obese patients and 36.5% in non-obese patients presented with severe traumatic brain injury [25]. The calculated sample size from this proportion was 120. 60 severe traumatic brain injury patients were placed in the obese group having BMI of ≥ 30 Kg/m^2 and 60 in the non-obese group having BMI of < 30 Kg/m^2.

Severe traumatic brain injury patients were defined based on a Glasgow Coma Scale (GCS) score of ≤ 8 with or without intracranial bleeding on computed tomography. GCS score will be defined based on collective score of eye, verbal and motor response with score ranging from 1-4, 1-4 and 1-6 respectively. Obese group was defined on presence of BMI of ≥ 30 Kg/m2 and non-obese group with BMI of < 30 Kg/m2. Final hospital outcome was defined based on the death of an obese or non-obese patient, discharge from the ED and hospital, leave against medical advice (LAMA), admission to the ED or hospital ward, and length of stay in the ED or hospital. Complications were defined based on the presence of deep vein thrombosis (DVT), pulmonary embolism (PE), and chest and other infections. The five-point Glasgow Outcome Scale (GOS) was utilized in order to evaluate the outcome of obese and non-obese patients presenting with severe traumatic brain injury. The GOS includes score 1 (dead), score 2 (vegetative state), score 3 (severe disability; SD), score 4 (moderate disability; MD), and score 5 (good recovery; GR).

The study was approved by the Research Committee and the Ethics Committee of Ziauddin University Hospital, Karachi, through Letter No. 0000, Date: 00-00-0000. Consent for the study in written form was obtained from relatives. Patients who met the study's inclusion criteria were enrolled. We collected each patient's demographic information, medical information, and injury details. Vitals and GCS scores of each patient were clinically evaluated. Every TBI patient was taken to the ED on a stretcher. We can weigh patients on the stretcher because we have a weighing scale for each patient in the ED corridor. The final weight of the patient was determined after weighing the stretcher separately. Each patient was treated according to standards of care, which were strictly adhered to until the patient died or was discharged from the hospital. Final hospital outcomes, complications, and outcomes on the GOS were assessed in obese and non-obese severe traumatic brain injury patients. Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 25. The role of obesity was evaluated using chi-square and independent sample t-tests using p-value ≤ 0.05 as statistically significant.

RESULTS:

Of the total, 85.0% and 88.3% of patients were male, while 15.0% and 11.7% were female, with an overall mean age of 48.3 and 44.7 years in the obese and non-obese groups, respectively. Demographics and vitals were similar in both groups (obese and non-obese). A significant difference in mean height (164.20 ± 15.06 cm vs. 170.15 ± 8.26 cm, p=0.008), mean weight (90.53 ± 11.23 Kg vs. 72.18 ± 8.09 Kg, p<0.001), and mean BMI (33.80 ± 3.80 Kg/m^2 vs. 25.00 ± 2.77 Kg/m^2, p<0.001) was observed between the obese and non-obese groups. Similalrly, a significant difference in mean GCS score (3.85 ± 0.97 vs. 5.73 ± 1.65 p<0.001) was observed between the obese and non-obese groups. Whereas a non-significant difference in intent of injury (p-value=0.315), mechanism of injury (p-value=0.295), CT scan performed (p-value=0.170), and CT scan findings (p-value=0.384) was observed between the obese and non-obese groups [Table 1].

The final hospital outcome was statistically significant and higher among obese group patients than non-obese group patients: death (11.7% vs. 1.7%, p=0.028) and admission (70% vs. 50%, p=0.025), whereas most of the patients in the non-obese group were discharged from the hospital (38.3% vs. 11.7%, p=0.001) and LAMA (10.0% vs. 6.7%, p=0.509) as compared to the obese group. Mean length of stay in emergency (6.77 vs. 4.40 hours, p<0.001) and hospital (5.32 vs. 3.55 days, p=0.003) was also significantly higher among obese group than non-obese group [Table 2].

The rate of complications was significantly higher and worse among obese group than non-obese group (p=0.031). The type of complications was also statistically significant and higher among obese group patients than non-obese group patients: deep vein thrombosis (25.0% vs. 10.0%, p=0.031), pulmonary embolism (20.0% vs. 6.7%, p=0.032), and chest and other infections (16.7% vs. 5.0%, p=0.040) [Table 3].

Mean GOS score (3.50 ± 1.16 vs. 4.05 ± 1.02, p=0.007) in obese and non-obese groups. The rate of outcomes on the GOS was worse among obese group patients than non-obese group patients (p=0.004); death (11.7% vs. 1.7%), severe disability (13.3% vs. 8.3%), and moderate disability (56.7% vs. 41.7%), whereas most of the patients in the non-obese group were in a state of good recovery (38.3% vs. 11.7%), and in a vegetative state (10.0% vs. 6.7%) as compared to the obese group [Table 4].

Table 1: Demographics, Vitals and Injury Details in Obese and Non-Obese Group

Variables		Obese (n=60)	Non-Obese (n=60)	P-Value
Gender	**Male**	51 (85.0%)	53 (88.3%)	0.591
	Female	9 (15.0%)	7 (11.7%)	
Age (Years)	**Mean ± SD**	48.33 ± 17.52	44.70 ± 19.84	0.290
	≤ 50	30 (50.0%)	36 (60.0%)	0.271
	> 50	30 (50.0%)	24 (40.0%)	
Height (cm)	**Mean ± SD**	164.20 ± 15.06	170.15 ± 8.26	0.008*
Weight (Kg)	**Mean ± SD**	90.53 ± 11.23	72.18 ± 8.09	<0.001*
BMI (Kg/m^2)	**Mean ± SD**	33.80 ± 3.80	25.00 ± 2.77	<0.001*
HR (beats/min)	**Mean ± SD**	96.03 ± 17.17	92.25 ± 17.43	0.233
SBP (mmHg)	**Mean ± SD**	126.90 ± 17.45	132.12 ± 22.95	0.164
DBP (mmHg)	**Mean ± SD**	76.07 ± 14.99	78.60 ± 11.43	0.300
RR (breaths/min)	**Mean ± SD**	20.03 ± 2.99	21.65 ± 2.34	0.435
O_2 (%)	**Mean ± SD**	97.30 ± 1.42	97.58 ± 1.25	0.248
Intent of Injury	**Intentional**	0 (0.0%)	1 (1.7%)	0.315
	Unintentional	60 (100.0%)	59 (98.3%)	
Mechanism of Injury	**RTAs**	28 (46.7%)	34 (56.7%)	0.295
	Falls	32 (53.3%)	25 (41.7%)	
	Violence	0 (0.0%)	1 (1.7%)	
GCS Score	**Mean ± SD**	3.85 ± 0.97	5.73 ± 1.65	<0.001*
CT Scan Brain	**Performed**	45 (75.0%)	51 (85.0%)	0.170
	Not Performed	15 (25.0%)	9 (15.0%)	
CT Scan Brain Findings	**Remarkable**	23 (38.3%)	25 (41.7%)	0.384
	Normal	22 (36.7%)	26 (43.3%)	

SD: Standard Deviation; BMI: Body Mass Index; HR: Heart Rate; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; RR: Respiratory Rate; O_2: Oxygen Saturation; RTAs: Road Traffic Accidents.

Table 2: Final Hospital Outcome in Obese and Non-Obese Group				
Variables		**Obese (n=60)**	**Non-Obese (n=60)**	**P-Value**
Death	**Yes**	7 (11.7%)	1 (1.7%)	0.028*
	No	53 (88.3%)	59 (98.3%)	
Discharged	**Yes**	7 (11.7%)	23 (38.3%)	0.001*
	No	53 (88.3%)	37 (61.7%)	
LAMA	**Yes**	4 (6.7%)	6 (10.0%)	0.509
	No	56 (93.3%)	54 (90.0%)	
Admission	**Yes**	42 (70.0%)	30 (50.0%)	0.025*
	No	18 (30.0%)	30 (50.0%)	
Length of Stay in ED (Hours)	**Mean ± SD**	6.77 ± 2.91	4.40 ± 1.73	<0.001*
Length of Stay in Hospital (Days)	**Mean ± SD**	5.32 ± 3.34	3.55 ± 3.03	0.003*
SD: Standard Deviation; LAMA: Leave Against Medical Advice; ED: Emergency Department.				

Table 3: Complications in Obese and Non-Obese Group				
Variables		**Obese (n=60)**	**Non-Obese (n=60)**	**P-Value**
Complications	**Yes**	19 (31.7%)	9 (15.0%)	0.031*
	No	41 (68.3%)	51 (85.0%)	
Deep Vein Thrombosis	**Yes**	15 (25.0%)	6 (10.0%)	0.031*
	No	45 (75.0%)	54 (90.0%)	
Pulmonary Embolism	**Yes**	12 (20.0%)	4 (6.7%)	0.032*
	No	48 (80.0%)	56 (93.3%)	
Chest & Other Infections	**Yes**	10 (16.7%)	3 (5.0%)	0.040*
	No	50 (83.3%)	57 (95.0%)	

Table 4: Outcomes Based on the GOS in Obese and Non-Obese Group				
Variables		**Obese (n=60)**	**Non-Obese (n=60)**	**P-Value**
GOS	**Mean ± SD**	3.50 ± 1.16	4.05 ± 1.02	0.007*
Outcomes	**Dead**	7 (11.7%)	1 (1.7%)	0.004*
	Vegetative State	4 (6.7%)	6 (10.0%)	
	Severe Disability	8 (13.3%)	5 (8.3%)	
	Moderate Disability	34 (56.7%)	25 (41.7%)	
	Good Recovery	7 (11.7%)	23 (38.3%)	

Discussion:

One important medical condition whose incidence is on the rise throughout the world is obesity. Obesity is widely thought to carry a significant risk of elevated morbidity and death in the general population. Traumatic brain injury is a major cause of increased mortality in the emergency department [13-15]. Obesity exacerbates signs and symptoms, leading to long-term damage, poor outcomes, and complications in TBI patients. Both of these are non-communicable diseases that have a significant negative impact on the global health care system. But little is understood about the impact of obesity on TBI severity, prognosis, complications, and outcomes [16-18].

Therefore, this cohort study was designed to analyze the outcome of severe traumatic brain injury in obese versus non-obese patients presented at the ED of Ziauddin Medical University Hospital Karachi with severe traumatic brain injury. Research findings evaluate whether obesity and the outcome of severe TBI are significantly or not significantly correlated. It was anticipated that the study's findings will help emergency physicians choose the best life-saving treatments for obese patients who arrive at emergency rooms with severe TBI.

There was a non-significant difference in demographics, including gender (p-value=0.591) and age (p-value=0.290) between the obese and non-obese groups. In this study, male TBI patients outnumbered female TBI patients. Of the total, 85.0% and 88.3% of patients were male, while 15.0% and 11.7% were female, with an overall mean age of 48.3 and 44.7 years in the obese and non-obese groups, respectively. A study by Eagle et al. compares the association of TBI with obesity and reports that 63.7% and 64.3% of patients were male, while 36.3% and 35.7% were female, with an overall mean age of 45.4 and 40.2 years in the obese and healthy BMI groups, respectively [19]. A study by Cone et al. evaluates the impact of obesity on outcomes of TBI and reports that 65.9% of patients were male, while 34.1% were female, with an overall mean age of 58 years in all TBI patients [20]. A study by Lee et al. evaluates the impact of obesity on outcomes of TBI and reports that 53.9% of patients were male, while 46.1% were female, with an overall mean age of 71 years in all TBI patients [21]. All the studies that evaluate the association of TBI with obesity report that male patients with a higher mean age were mostly suffering from TBI.

In this study, the final hospital outcome was statistically significant and higher among obese group patients than non-obese group patients: death (11.7% vs. 1.7%, p=0.028) and admission (70% vs. 50%, p=0.025), whereas most of the patients in the non-obese group were discharged from the hospital (38.3% vs. 11.7%, p=0.001) and LAMA (10.0% vs. 6.7%, p=0.509) as compared to the obese group. A study by Cone et al. reported a 6.7% mortality rate among all TBI patients. BMI groups were significantly associated with mortality, such as underweight (9.9%), normal weight (6.4%), overweight (6.6%), obesity class 1 (7.0%), obesity class 2 (6.3%), and obesity class 3 (6.5%) [20]. A study by Lee et al. reported a mortality of 27.0% in class III obese patients and 11.0% in normal BMI TBI patients [21]. A study by Brown et al. reported a mortality of 36.0% in obese patients and 25.0% in non-obese TBI patients [22]. In contrast, a study by Mishra et al. reported a similar non-significant difference in mortality in normal and obese TBI patients [23]. All the studies that evaluate the association of TBI with obesity report that the rate of mortality was higher in obese group patients than in non-obese group patients.

In this study, the rate of complications was significantly higher and worse among obese group than non-obese group (p=0.031). The type of complications was also statistically significant and higher among obese group patients than non-obese group patients: deep vein

thrombosis (25.0% vs. 10.0%, p=0.031), pulmonary embolism (20.0% vs. 6.7%, p=0.032), and chest and other infections (16.7% vs. 5.0%, p=0.040). A study by Lee et al. reported a higher rate of complication (ventilator use) in class 3 obese group than in the normal BMI group (4.7% vs. 1.2%) [21]. A study by Cone et al. reported a higher rate of complications, including respiratory and venous thromboembolism complications, in the obese group than in the normal BMI group [20]. All the studies that evaluate the association of TBI with obesity report that the rate of complications was higher in obese group patients than in non-obese group patients.

In this study, the rate of outcomes on the GOS was also significantly higher and worse among obese group patients than non-obese group patients (p=0.004); death (11.7% vs. 1.7%), severe disability (13.3% vs. 8.3%), and moderate disability (56.7% vs. 41.7%), whereas most of the patients in the non-obese group were in a state of good recovery (38.3% vs. 11.7%), and in a vegetative state (10.0% vs. 6.7%) as compared to the obese group. A study by Eagle et al. compares the association of TBI with obesity and reports the worse functional recovery based on the Glasgow Outcome Scale-Extended (GOSE) in the obese group than in healthy BMI groups. Incomplete functional recovery was significantly higher in the obese TBI group than the healthy BMI TBI group (39.4% vs. 30.6%, p=0.04) [19]. A study by Dreer et al. also reports the worse functional recovery based on the GOSE in the obese group than in healthy BMI groups. Lower and upper good recovery was worse in obese (23.4% and 17.9%) than in healthy BMI groups, including underweight (2.5% vs. 1.3%), normal weight (38.1% vs. 42.9%), and overweight (35.9% and 37.9%) [24]. All the studies that evaluate the association of TBI with obesity report that the outcomes on the GOS was worse in obese group patients than in non-obese group patients.

The research has several limitations. First, the study was conducted at a centre with a small sample size (only 120 patients with severe TBI were included). Second, a limited time period of study and follow-up. Third, the study excluded patients diagnosed with mild and moderate TBI. Finally, patients were not followed up after discharge.

These results support the hypothesis that one of the main risk factors for treating individuals with severe TBI is obesity. Compared to the non-obese TBI group, the obese TBI group has a considerably greater mortality rate, length of stay, complications, and worse outcomes on the GOS.

Conclusion:

It was concluded that one of the main risk factors for treating patients with severe traumatic brain injury is obesity. Compared to the non-obese TBI group, the obese TBI group has a considerably greater mortality rate, length of stay, complications, and worse outcomes on the GOS.

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