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RESEARCH ARTICLE

NUTRITIONAL STATUS AND MACRONUTRIENTS ADEQUACY OF SOME TRAUMATIC BRAIN INJURY PATIENTS ATTEDING A SPECIALISED UNIT IN THE STATE OF QATAR

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ABSTRACT

Objectives: The aims of this study were to assess the nutritional status and macronutrients adequacy of traumatic brain injury (TBI) patients and controls, attending treatment from a specialised unit in Qatar.

Research Design and Method: This study was conducted among male attendees follow up with Rumailah Hospital, Hamad Medical Corporation-Doha, Qatar from August 2014 to June 2015 (21 cases and 21 healthy volunteers). The attendees were consecutive patients with TBI. Demographic variables were solicited via medical records or directly from the attendees with TBI. Anthropometric measurements and dietary intake (24-hour recall method) were collected and assessed by super tracker.

Results: Half of the participants (52.4%) were of age 30 -38 years range. Approximately 23.8% of cases were classified as having 'mild TBI' while 28.6% and 47.6% were classified as moderate and severe TBI respectively. In terms of nutritional parameters, three fourth (76.2%) of the cases were at high or moderate risk of malnutrition, 23.8% of cases were underweight, while 66.7% in normal range and 9.5% were overweight. TBI patiens were noted to have deficiency in energy (30.2%), carbohydrate (43.0%), protein (24.8%), and fiber (54.1%) intake.

Conclusion: Despite the high prevalence of TBI in emerging economies such as Qatar, to our knowledge, there is dearth of studies examining the nutritional status and its correlates among the TBI population. This study indicates that TBI patients in Qatar are at a high risk of developing malnutrition, and macronutrients deficiency. Therefore, nutritional assessment, intervention and support are highly essential to improve TBI patients health status beyond the brain injury.

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INTRODUCTION

TBI can be defined as a disruption in the normal function of the brain caused by a blow or jolt to the head or a penetrating head injury (Sueur *et al.,* 2013). Traumatic brain injury (TBI) is the leading causes of deaths and disability, accounting annually for 50,000 deaths and 235,000 hospitalizations (Global Burden of Disease Pediatrics Collaboration, 2016). In USA, 5.3 million individuals are suffering from TBI-related problems (Al-Reesi *et al.,* 2013) and similar high rate has been noted to occur in other developed countries. In emerging economies such as those country in the Arabian Gulf, due to increased motorization, TBI is common due to high number of road traffic accident. Therefore, in the regions, there are urgent needs to quantify the sequel as well to contemplate remedial intervention among the victim of TBI. The first stage of cerebral injury after TBI is direct tissue damage and impaired regulation of Cerebral Blood Flow Before (CBF) and metabolism which, in turn, has direct bearing to functionality of the individual affected by the TBI Victim of TBI have been documented to incur energy and protein deficits which, in turn, has been postulated to have direct bearing on poor functional prognosis. Some studies have suggested that mechanisms specific to pathology entailed in TBI contribute energy and protein deficits (Millet *et al.* 2016; Lorenz *et al.,* 2015) while other studies have indicated that functional sequel of TBI renders the victim of TBI to be incapable to consume required energy and protein (Montalcini *et al.,* 2015). Peripheral amino acids (from skeletal muscle) and glycerol/free fatty acids (from adipose tissue) was ignites an inflammatory response that supports acute-phase functions after TBI. The total amount of visceral protein actually produced is less than the amount of skeletal muscle catabolized. Approximately 10% loss of skeletal muscle within one week, if caloric intake was inadequate for 2-3 weeks, which results in increased risk of mortality (Darbar and Aneela, 2001). The brain-injured patient also oxidizes fatty acids at an increased rate, in addition to using muscle protein stores for fuel (Stephen *et al.,* 2009). Catabolism of protein has various implications for patients with TBI, it may be affected by decreased nitrogen efficiency,

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immobility steroid administration, and decreased nutrient intake. Weight loss, muscle wasting, and lowered levels of visceral proteins (prealbumin, albumin, and transferrin) are commonly evidenced signs after TBI (Ott *et al.,* 1994; Cerra *et al.,* 1987). Previous studies have indicated that nutritional status could play an important role for heightening funcional recovery of people with TBI. To our knowledge, such studies have not been fortthcoming from arabian Gulf countries where TBI constitute a leading burdern of disability and dependency (Bener *et al.,* 2010). In order to fill the gap in the literature, the present current case control study aim to find out the link between nutrition and TBI. For this we evaluated the nutritional status, macronutrient adequacy among TBI and the influence of trauma severity on nutrient intake among patients with TBI attending Rumailah Hospital, Doha,Qatar.

METHODS

Patients

This study was conducted in rehabilitation ward at Rumailah Hospital, Doha - Qatar from August 2014 to June 2015. Twenty five post traumatic brain injury patients, aged 18 – 65 years, males, free of any chronic diseases and 21 healthy participants as control group were recruited. Comparative normal healthy subjects were recruited from the community. Cognitive assessment for all patients was conducted using the Montreal Cognitive Assessment (MOCA) (Nasreddine *et al.,* 2015). Four patients were excluded from the study due to incomplete nutritional assessment or refused to continue Figure 1.

Demographic characteristics

Demographic information, including age, sex, education level, marital and smoking status were collected using a structured questionnaire.

Weight, height and body mass index (BMI) were measured and for patients who were unable to stand, height was estimated by using knee height, ulna length and demi - span equations as detailed elsewhere (Lohman *et al.,* 1988; Cheng *et al.,* 2001; Gauld *et al.,* 2004; Bassey, 1986; Organization, 2012) Energy (Kcal), carbohydrate (gm), protein (gm), fat (gm) and fiber (gm) intakes were assessed by using the 24 – hour recall method (Lim *et al.,* 2012) through face–to–face interview with each subject. Household utensils with different portion size of common foods were used to assist the patients to report the accurate amount of food consumed. Food intake was analyzed electronically using electronic program (super - tracker) (Ahuja *et al.,* 2012).

The percentage of carbohydrate, protein, and fat was calculated as calories of each nutrient divided by the actual energy intake. Macronutrients adequacy was calculated based by dividing the actual intake by Recommended Daily Allowances (RDA) (Report of the Panel on Macronutrients, 2005).

Nutritional Status and TBI Severity

"Malnutrition Universal Screening Tool" (MUST) (Henderson *et al.,* 2008) was used to assess the nutritional status of all subjects and it was classified as: no risk, moderate risk and high risk of malnutrition when MUST score was 0, 1 and ≥ 2 respectively. Severity of TBI was classified into mild, moderate, and severe based on Glasgow Coma Scale (GCS) when it ≥ 13, 9 -12 and ≤ 8 respectively (Kondrup *et al.,* 2003).

Ethical approval

The written informed consent was obtained from each participant.The study was approved by Ethical Committee of Medical Research Center - Hamad Medical Corporation.

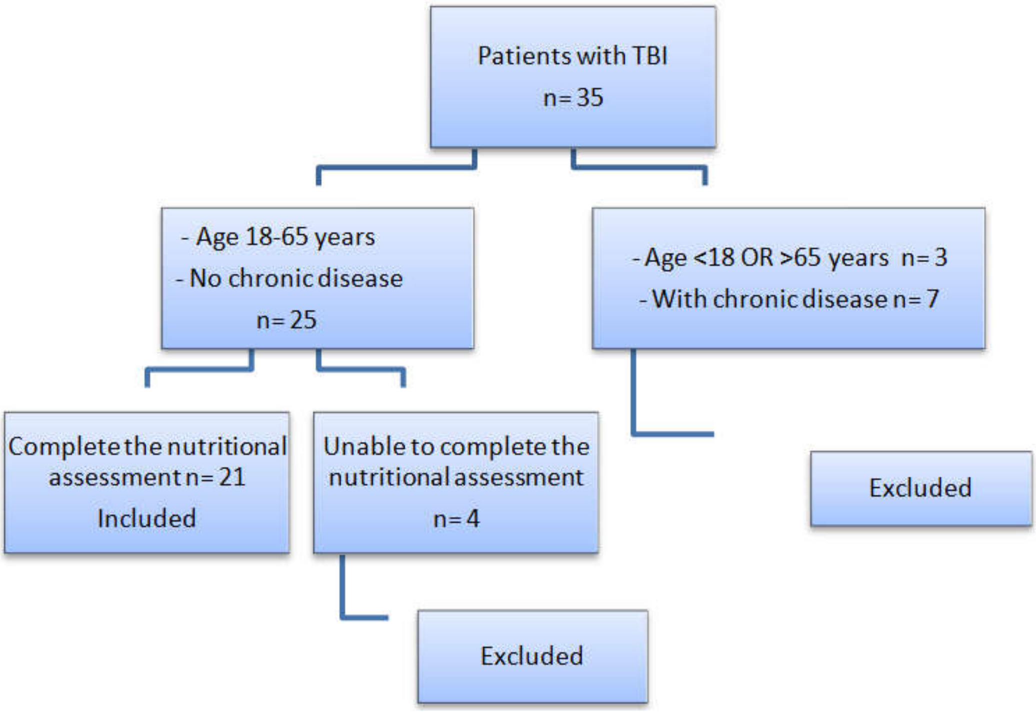

Figure 1. Flow chart of inclusion and exclusion procedure of patients with traumatic brain injury

Statistical analysis

Graph Pad Prism (version 6.0) was used for statistical analysis. Means and standard deviations (using t-tests for two means, one way ANOVA was used to compare between groups), two sided statistical significance was set at $\alpha \leq 0.05$ and Proportions were compared by using chi-square test.

RESULTS

Patient demographics and clinical characteristics

Half of the patients (52.4%) and (42.8%) of controls were aged between 29-38 years. Based on GCS 23.8% of patients were classified as mild TBI while 28.6% and 47.6% were classified as moderate and severe TBI respectively. Motor vehicle accidents were the most common cause of TBI (52.4%), followed by falls from height (47.6%). In patients 38.1% were smokers, compared with (23.8%) of control and majority of both cases and controls were had primary education and married. 23.8% of TBI patients were underweight and 9.5% were overweight and rest were in normal range.

Table 1. Demographic variable of cases and controls

variable	Case		Control	
	n	%	n	%
Education Level				
Primary	12	57.1	14	66.7
Secondary	3	14.3	2	9.5
High	6	28.6	5	23.8
Body mass index	-			
Underweight	5	23.8	-----	------
Normal	14	66.7	4	19.0
Overweight	2	9.5	13	67.0
Obese	-	----	4	19.0
Marital status				
Married	12	57.1	15	71.4
Single	9	42.9	6	28.6
Smoking status				
Yes	8	38.1	5	23.8
No	13	61.9	16	76.2

Table 2. Macronutrients Intake of TBI and Control (Mean ±SD)

	Case	Control	P-value
Energy (kcal/d)	2159±37.45	2425±45.99	0.0001
Protein (gm/d)	81.21±3.68	114.80±6.71	0.0001
CHO (gm/d	340.40±7.39	363.40±19.05	0.26
Fiber (gm/d)	25.57±2.64	20.95±1.45	0.13
Fat (gm/d)	21.43±0.85	26.05±1.10	0.002

Table 3. Inadequacy of Macronutrients of Cases and Control's

	Case			Control		
	RDA	Intake	p- value	RDA	Intake	p- value
Energy(kcal/d)	2377±48.79	2019±19.05	0.0001	2283±46.62	2572±112.3	0.02
Carbohydrate(gm/d)	253.8±3.81	340.4±7.39	0.0001	287.7±6.59	363.4±19.05	0.006
Protein (gm/d)	92.07±3.65	81.21±3.65	0.04	79.48±1.77	114.8±6.71	0.0001
Fat (gm/d)	61.68±0.58	48.17±2.19	0.0001	78.50±3,43	73.32±3.65	0.30

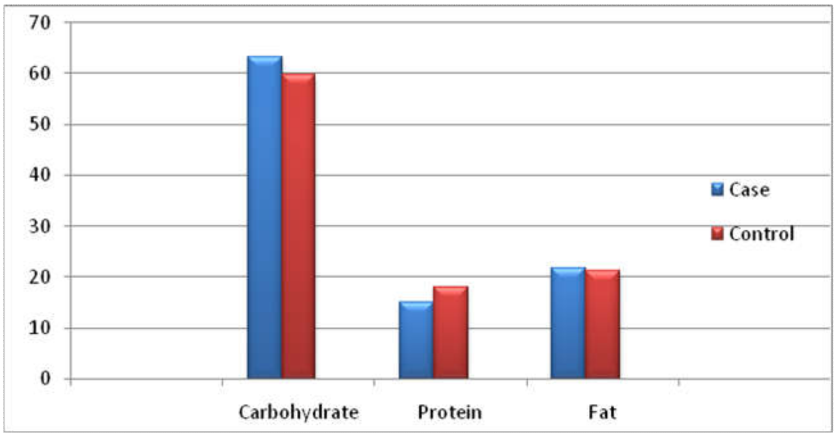

Figure 2. Comparison of Macronutrients Intake as % from Total Energy Intake Between Participant with Traumatic Brain Injury (TBI) (n=21) and control (n=21)

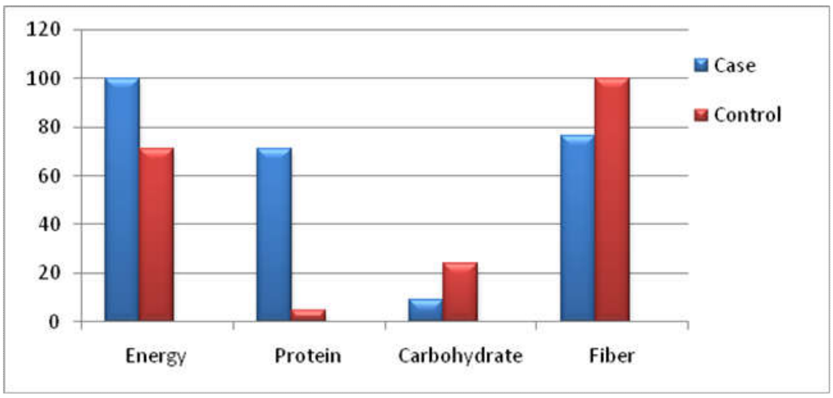

Figure 3. Percentage of Macronutrients Inadequacy among Cases and Controls

The effect of trauma severity on nutrients intake among patients with TBI

The results showed that energy and protein intake were negatively affected bythe severity of trauma ($p<0.0002$ and <0.0005 respectively) (Figure 4 & Figure 5). Protein intake is reduced in severe TBI as the whole food intake is reduced , that's might be because severe injury required more time to cure as well as mouth muscles and esophageal muscle integrity and swallowing control process have an effect on protein as well as other nutrients intake.

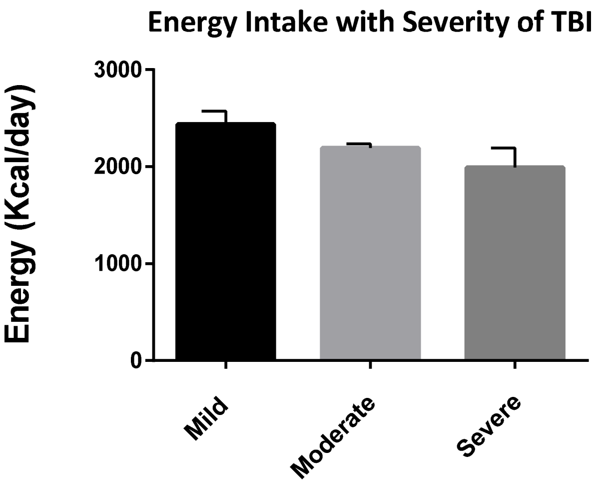

Figure 4. Energy intakes with TBI severity

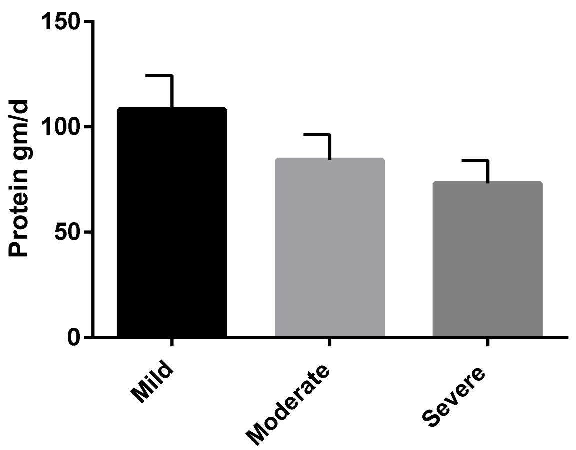

Figure 5. protein intakes with TBI severity (gm/d)

DISCUSSION

Nutritional needs for the brain at both macro and micro-levels have been well reported (Bourre, 2006; Morley, 2010) and concluded that nutrient-dense diets that supply ample levels of vitamins, minerals, antioxidants, and essential fatty acids are beneficial and should be recommended for betterment. Our study had three primary purposes: the first one was to assess nutritional status in TBI patients, the second was to measure the adequacy of macronutrients intake, and the third was to assess the effect of trauma severity on the dietary intake. To our knowledge, there are special groups that are at risk of nutritional disturbances including TBI and spinal cord injury (SCI) patients, but unfortunately there are limited data available on the dietary intakes for those groups (Tomey *et al.,* 2005; Moussavi *et al.,* 2001; Bertoli *et al.,* 2006). We believe that result of our study could give some input for better understanding of the role of nutritional status in TBI and the importance of nutritional assessment and intervention in TBI. The main reason for malnutrition development and progression in TBI could be due to insufficient dietary intake. Dietary intake might be affected by several factors including anorexia nervosa due to anxiety or depression, mouth muscle weakness, chewing difficulty, dysphagia and reduction in appetite sensation as a result of: changes in cytokines, glucocorticoids, insulin and insulin-like growth factors (Jackson, 2003). Dysphagia, or swallowing difficulty, is considered as one of the common problem following severe traumatic brain injury. It has been reported that it is as high as in adults (60%) and in pediatric patients (68%) (Mackay *et al.,* 1999; Morgan *et al.,* 2003). Several risk factors include the severity of the injury, abnormal tongue control, and presence of a tracheostomy, feeding tubes and mechanical ventilation for more than 2 weeks (Mackay *et al.,* 1999; Morgan *et al.,* 2003; Terré, 2007; Ward *et al.,* 2007) leads to dysphagia following head injury. It was reported that 62% of the severe traumatic brain patients with dysphagia aspirate on instrumental examination (Lim *et al.,* 2012). Several cognitive issues include sensory reception, memory deficit, attention span and problem solving/judgment could affect on the management of dysphagia in TBI patients (Halper *et al.,* 1999). Swallowing impairments were commonly reported as a cause of malnutrition in severe head injury patients (Krakau *et al.,* 2007). Malnutrition is a common and dangerous health problem and it can be defined as inadequate and/or imbalanced nutritional intake, with adverse effects on physiological function and clinical outcome (Stratton *et al.,* 2003). Denes *et al.,* 2004 reported that 68% of severe brain injury was developed malnutrition with its serious complications including pressure sores and infections (Denes *et al.,* 2004).

Our results showed that 76.2% of TBI patients were at moderate to high risk of malnutrition, which corroborates with previous reports (Denes *et al.,* 2004; Haynes, 1992). Reported that 58% of TBI patients were below their ideal weight, and provide further evidence for the presence of malnutrition in these patients. Brooke *et al.,* 1989 reported that 60.4% of TBI patients have a body weight of less than 90% of ideal weight (Gadisseux *et al.,* 1984). Similarly, Krakau *et al.,* 2007 found that 68% of TBI patients were malnourished within two months of head injury, according to the Malnutrition Universal Screening Tool (MUST) criteria. Another recent study also showed that 76% of TBI patients showed progressive increase malnutrition (Dhandapani *et al.,* 2007). All these reports are consistent with our current findings in our study population from Qatar. TBI patients were usually in a catabolic and hypermetabolic state. The severity and type of injury correlated to the degree of catabolic state, as categorized by Glasgow Coma Scale (GCS) score, which ranges from 15 (fully conscious) to 3 (near death) (Borzotta *et al.,* 1994). We found that 47.6% of the patients enrolled in our study were under severe TBI status, which is supported by Krakau et al 2007 (Karolina Krakau, 2007). They reported that 50% of the enrolled patients in their study were within the lowest range of GCS (3 to 5) which represents severe TBI. Another study also showed that there is a significant association with poorer admission GCS SCORE, and the clinical features of malnutrition in TBI subjects (Dhandapani *et al.,* 2007). Our results showed that protein intake was deficient (71.0%) and varies as per severity of injury in TBI patients (p <0.0001). Studies showed that protein intake of TBI subjects could be below the recommended daily intake, which is based on the severity of injury (HadisSabour, 2012), which supports our present findings. Generally, the mean recommended dietary intake of fiber is 35 g/d for men and 25 g/d for women (Tomey *et al.,* 2005). The mean fiber intake in our patient cohort was (25.6 g/d) is significantly below the adequate recommendation (p=0.001). Walter *et al.,* 2009 and Tomey *et al.,* 2005 reported similar findings in their study population. Furthermore, they recommended to nutritional education sessions to enhance fiber intake by focusing on high –fiber breakfast cereals and encouraging regular consumption of fruits and vegetables. To conclude, the traumatic brain injury patients enrolled in our study were malnourished and or at high risk of malnutrition. Here in, we have shown that the TBI patient's intake of macronutrients and fiber were deficient with regards to RDA. Energy and protein intake correlated with the severity of trauma as predicted by the GCS. Nutrition assessment upon admission of TBI patients could be a vital factor in identifying patients with malnutrition, and prevention from nutrition-related complications. The limitation of this study was inability of some participants to remember exactly his food intake for the previous day and sample size were low and this study results are not representative ones.

Conflict of Interest: None

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