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# "Survival of the Fittest" Does Obesity Trait Evolved Over Time Confers Survival Advantage to Critically Ill Patients?

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## Abstract

There is a steady increase in prevalence of obesity over last 2-3 decades to the extent of global epidemic. Overall 25% of world population is reported to be overweight and 10% are obese. The evolutionary origin of obesity points towards survival advantage of obese individuals, but in modern way of living, advantages of obesity are lost and hazardous effects have become more prominent including cardio-metabolic risk factors and some malignancies. There is very scanty information in medical literature about value of fat stores in critically ill patients. Available literature has pointed towards the potential benefits of fat store in combating the disease process in critically ill patients. Though obesity is known to adversely affect the overall health of individuals, its positive role in recovery of critically ill patients needs to be further evaluated.

## Introduction

Obesity refers to excess of body fat, also known as adiposity. Distribution of this excess of body fat varies from individual to individual and can be broadly classified into visceral obesity and body wall obesity. In visceral obesity, fat accumulates around abdominal viscera predominantly. It is known to correlate with adverse outcomes of obesity [1]. On the contrary, predominant accumulation of fat in abdominal wall is known to have relatively less hazardous effects [2]. There are various parameters to measure obesity, commonly used are anthropometric measures like Body Mass Index (BMI), Waist Circumference, Mid-arm Circumference and Triceps skin fold thickness [3,4]. Bioelectrical impedance is also used to measure composition of body during various physiological states [5].

## Burden and Health Hazards of Obesity

There is a steady increase in prevalence of obesity over last 2-3 decades to the extent of global epidemic [6,7]. Overall 25% of world population is overweight and 10% is obese [8]. Health hazards of obesity are well established. Obesity is known to lead to higher prevalence of cardio metabolic risk factors including diabetes mellitus, hypertension and hyperlipidemia [9,10] and certain malignancies [11,12]. It is known to be an independent risk factor for all-cause mortality [13]. Overweight and obesity are the fifth leading risk for global deaths. At least 2.8 million adults die each year as a result of being overweight or obese. In addition, 44% of the diabetes burden, 23% of the ischemic heart disease burden and between 7% and 41% of certain cancer burdens are attributable to overweight and obesity [14]. Once considered a high-income country problem, overweight and obesity are now on the rise in low- and middle-income countries, particularly in urban settings. Obesity is estimated to account for between 0.7% and 2.8% of a country's total healthcare expenditures. Furthermore, medical costs of obese individuals are approximately 30% greater than their normal weight peers [15].

## Obesity from Evolutionary Perspective

Survival of the fittest is one of the principles of most famous and accepted theory of Evolutionary origin of species by Darwin [16]. According to this principle, every individual has different set of genes that confer him/her a set of certain characteristics. New characteristic are acquired through random genetic mutations in nature. There are some characteristics that give an individual a survival advantage over others. As a result of this natural selection process, survival of these individuals is better and they get a chance to spread their genes to their offspring. According to this theory, every prevalent trait of human beings must have been acquired through this rigorous process of natural selection and must have given survival advantage at some point in the process of evolution. This is contrary to what we see about obesity in the modern age.

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Looking at evolutionary origin of obesity, it is paramount to critically analyse the survival advantage that fat stores would have conferred to individuals. Life of evolutionary less advanced species was faced with frequent and often prolonged periods of famines. Along with that, extensive physical activity was required for daily activities to survive. Individuals having energy reserves were at survival advantage. These energy reserves evolved in the form of fat stores. These fat stores turned out to be valuable energy rich body reserves for them to be utilized to combat periods of famines and provide energy to meet metabolic demands to sail through periods of famines. These were also readily available sources of energy to be supplied for exertional activities. As a result, those individuals who had adequate fat stores had survival advantage and had natural selection to transfer their genes to their offspring's. These reservoirs also gave advantage to them in better coping with physical injuries and infections as fat stores were also utilized in process of repair and regeneration in recovering from physical injuries which were not uncommon in forest life.

With modern civilization, there is progressive change in environment and physical work demand. There is increased food security and as a result famines are rare. Advancement in technology, machines have taken over a lot of physical work reducing physical work load requirements for human beings. Physical injuries and combats are also far less in civilian life. So there is change in environment, but energy conserving and fat storing genes are the same. There is excessive accumulation of fat stores. These fat stores are rarely utilized for the purpose they were evolved for, and modern day human beings are prone to get obese [17,18]. In the absence of their use, counterproductive effects of these fat stores become evident in the form of cardiometabolic risk factors and some malignancies.

## Fat Stores in Critically Ill Patients

Patients are said to be critically ill if as a result of their disease they have laboratory and clinical manifestations of systemic involvement of disease, compromised hemodynamic status, and organ dysfunction. Scoring systems have been developed to grade the illness. One of these scoring systems is Acute Physiology and Chronic Health Evaluation (APACHE) II score [19].

Trauma and infections are the two most common causes of development of critical illness [20]. Critically ill patients have increased metabolic and immune requirements as compared to those of healthy individuals. A functional repair and regeneration mechanism is required for repair process and to counter physical insults. These pathways are energy dependent and hence metabolic rate of these individuals is higher as compared to their healthy counter-parts. To meet these energy requirements, fat stores can play an important role and can be an aide for them to sail through their illness. Body requires a strong immune system to fight with infection. Immunity is also energy dependent. Energy reserves in the form of fat stores can help support the immune system. It has been seen that increased levels of leptin in the body secondary to increased fat stores is known to strengthen the immune response and is associated with better sepsis outcome [21]. Thus critically ill obese patients are at least theoretically at an advantage of having energy rich fat reserves as compared to their non-obese counterparts.

## Available Literature Evidence

A few investigators have reported impact of obesity upon outcome of critically ill patients with varying results. Some of these studies have shown that obese individuals are not at increased risk of morbidity or mortality [22,23] . Pieracci et al. [23] in retrospective review of their intensive care unit data have shown that BMI is not associated with mortality. Similar results have been shown by Saker Y et al. [22]. There are reports that have shown protective effect of obesity in critical illness [24,25]. For example Hutagalung R et al. [25] reviewed outcome of their 13000 intensive care unit admission patients over a period of five year and found that being overweight or obese was associated with decreased 60-days in hospital mortality. Similarly Piake SL et al. [24] analysed one year data of their intensive care unit patients. They found that BMI was determinant of short to medium term survival. They concluded that obesity was not associated with increased morbidity and could be protective for critically ill patients. Similarly Tafelski S et al. [26] demonstrated in their study that despite increase in mechanical ventilator requirements, obesity is not a risk factor for mortality in critically ill patients [26]. Recent study published by Shahzad N et al. [27] also supports the idea that being overweight puts critically ill patients in advantageous position [27]. It has been seen that fat utilization if obese patients is better when suffering from critical illness and this helps them conserve their muscle proteins [28].

On the other hand, there are some studies that have shown obesity to be a risk factor for increased morbidity or mortality [29]. Duchesne JC et al. [29] reviewed one hundred and four trauma patients who were admitted to intensive care unit. They found that severe obesity was significantly associated with adverse outcomes and increased resource utilization in trauma patients treated admitted to ICU. A meta-analysis of related studies was also conducted in 2008 by Akinnusi ME et al. [30]. They analysed fourteen studies having about sixty two thousand patients collectively. They found that obesity in critically ill patients is not associated with excess mortality but is significantly related to prolonged duration of mechanical ventilation and intensive care unit length of stay.

Problem with available studies evaluating impact of obesity upon outcome of critically ill patients is that most of these studies are either retrospective or are secondary analysis of data collected for some other purpose.

## Future Perspective

Meticulous knowledge of impact of obesity upon outcome of critically ill patients has important clinical implications in the management of these patients. Improved risk stratification of individual patients according to their obesity level will help in decision making especially those concerning surgical intervention. Critically ill patients are at high risk for development of intra-operative or post-operative complications, after any intervention irrespective of their level of obesity. This in turn has impact upon management of these patients.

## Conclusion

Though obesity is known to adversely affect the overall health of individuals, its positive role in recovery of critically ill patients needs to be further evaluated.

## Conflicts of Interest

The Authors declare that there is no conflict of interest.

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