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Relationship between Body Mass Index and in-hospital Outcomes of Acute Myocardial Infarction Patients at a Selected Critical Care Unit of a University Hospital - Egypt.

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Abstract

Myocardial infarction (MI) is acute and catastrophic event. It is one of the leading causes to morbidity and mortality worldwide. Multiple risk factors were found to be responsible for the occurrence of MI; among these factors are overweight and obesity. Therefore, **the aim of the present** study is to study the relationship between body mass index (BMI) and in-hospital outcomes among acute myocardial infarction patients at a selected critical care unit of a university hospital. Two **research questions** were formulated:1- What is the body mass index profile of acute myocardial infarction patients admitted to a selected critical care unit of a university hospital?; and 2: What is the relationship between body mass index and different in-hospital outcomes of acute myocardial infarction patients admitted to a selected critical care unit of a university hospital?. A **descriptive exploratory research design** was utilized. The current study was conducted at **a selected critical care unit of a university hospital, in Egypt**. **A sample of convenience** including 60 adult male and female patients was included in the current study. **Two tools** were developed by the researcher and utilized to collect data pertinent to the current study: **Socio-demographic and medical data sheet** which covers data about patients' age, gender, diagnosis, body weight, height, length of ICU stay, past medical history, current or recent smoking, and at home medications; and **Patient's assessment sheet** which was developed based on Acute Coronary Treatment and Intervention Outcomes Network (ACTION) Registry-Get with the Guidelines (GWTG). It covers data such as: patients' presentation; laboratory findings; reperfusion strategy; medications within 24 hours of admission and at discharge; discharge intervention and in- hospital outcomes. **Results:** males represented the great majority (90%) of the studied sample. They had different BMI categories: overweight, grade I, and grade II obesity, in percentages of 33.3%, 30%, and 25% respectively, with a mean BMI of 31.52$\pm$ 4.96. No significant statistical relationship was found between BMI and gender. The studied group admitted as a result of acute anterior MI, acute inferior MI, and acute unspecific MI, in percentages of 45%, 30%& 25% respectively. No significant statistical relationship was found between BMI and diagnosis. Around two thirds of the studied group (58.2%) experienced different in hospital problems/outcomes: recurrent MI attacks (26.7%), cardiogenic shock (18.3%), C.V.S (6.6%), and Death (6.6%). High significant statistical relationship was found between BMI and in-hospital outcomes (Chi square = 46.13 at $p \leq 0.004$). Based on findings of the present study **it can be concluded** that the majority of acute myocardial infarction patients had above normal BMI values ranging from over weight to the third grade obesity (in the current study), and obviously was significantly related to the adverse in hospital outcomes. Therefore, the current study **recommends**, the important role of the critical care nurse in monitoring myocardial infarction patients' nutritional status through assessing their body mass index, thus providing individualized in hospital / at discharge instructions, which could enhance patients' outcomes, and reduce complications.

Key words: Acute Myocardial Infarction, Body Mass Index, Risk factors, In- hospital patients' outcomes.

1. Introduction:

Coronary heart disease (CHD) is a major cause of morbidity and mortality worldwide. Within the spectrum of CHD, is acute coronary syndrome (ACS) (World Health Organization, 2007 & Reddy, 2007). ACS describes any condition characterized by signs and symptoms of sudden myocardial ischemia. Both unstable angina and myocardial infarction (MI) come under the umbrella of ACS (Overbaugh, 2009). More specifically, acute myocardial infarction (AMI) is one of the leading causes of morbidity and mortality in adults (Rosamond, Flegal, Friday, Furie, Go, Greenlund, 2007 In Kyung-Hyun, Shin, Baek, & Kim, 2009, and American Heart Association, 2009). It occurs when myocardial ischemia exceeds a critical threshold and overwhelms myocardial cellular repair mechanisms designed to maintain normal operating function and homeostasis. Myocardial ischemia can occur as a result of increased myocardial metabolic demand, and decreased oxygen and nutrients delivery to the myocardium via the coronary circulation (Cotran, Kumar, Robbins (eds), 1994, in Bolooki & Askari, 2013).

Myocardial infarctions can be subcategorized on the basis of anatomic and morphologic standpoint as being anterior, inferior, or posterior, depending upon the location of the infarcted area of the heart muscle. Infarcts can be further classified as being transmural and non-transmural. A transmural MI (Non Q-Wave MI) is characterized by ischemic necrosis of the full thickness of the affected muscle segment(s), extending from the endocardium through the myocardium to the epicardium. However, a non-transmural MI is defined as an area of ischemic necrosis that does not extend through the full thickness of myocardial wall segment, and involves only a partial thickness of the heart muscle **(**Rubin, Farber (eds), 1995 In Bolooki & Askari, 2013, and Brookside Associates, 2012**)** . A more common clinical diagnostic classification is based on electrocardiographic findings as a means of distinguishing between two types of MI: ST segment elevation (STEMI) and Non STEMI. Management practice guidelines often distinguish between STEMI and non-STEMI (Anderson, et al., 2007).

According to Overbaugh (2009), different risk factors predispose to MI, and can be categorized as non modifiable and modifiable. Non modifiable risk factors include age, sex, family history, and ethnicity or race. However, modifiable risk factors include elevated levels of serum cholesterol, low-density lipoprotein cholesterol (LDL), and triglycerides; lower levels of high-density lipoprotein cholesterol (HDL); type 2 diabetes, cigarette smoking, hypertension, stress and obesity. Concerning obesity, it was established as an independent risk factor for the development of coronary artery diseases and ACS (Wolk, Berger, Lennon, Brilakis & Somers, 2003, In Wells, Gentry, Ruiz-Arango Dias & Landolfo, 2006). Moreover, increased body weight was evident to be associated with increased overall mortality (Yusuf, et al, 2005, Lopez-Jimenez, et al, 2008, in Kang etal, 2012). However, limited and conflicting data existed regarding outcomes in obese patients with acute coronary syndrome (Kaplan, Heckbert, Furberg, Psaty 2002, Rana, Mukamal, Morgan, Muller, & Mittleman, 2004, in Wells, Gentry, Ruiz-Arango, Dias, & Landolfo, 2006). As well, there are few available data on the prognostic impact of weight change on clinical outcomes, in patients with AMI (Kennedy et al 2006, Fadl, 2007, Lopez-Jimenez, et al, 2008, In Kang, 2012). Consequently, despite previous researches, controversy remains regarding the relationship between body mass index (BMI) and the occurrence of acute myocardial infarction.

BMI is an anthropometric (measurement of human dimensions) index of nutritional status (Lamon-Fava, Wilson, Schaefer, 1996, in Palomoa, Torresb, Alarcóna, Maragañoc, Leivaa & Mujicac, 2006). It is expressed as body weight in kilograms divided by height square in meters (kg/m2), and is used as a measure of body fatness in large epidemiological studies. Moreover, BMI has been demonstrated to be a predictor of mortality in acutely ill adult patients, and the increased risks were found among underweight patients (body mass index < 18.5 kg/m) (Pickkers, etal, 2013). As well, the BMI value is still useful for estimating overall health risks of obesity (Hamdy & Smith, 2010, in Andreoli, Benjamin, Griggs,Wing, 2010). Consequently, as indicated by Valencia-Flores, et al (2000), although published researches do not reach a consensus about the effect of obesity on in-hospital course of critically ill patients, obese patients are more susceptible to co-morbid respiratory complications such as aspiration pneumonia, pulmonary thrombo-embolism, sleep apnea and / or obesity hypoventilation. In addition, there are practical difficulties in caring for class III obese patients who are critically ill that may affect the in-hospital outcomes, such as prolonged immobility, difficulty obtaining venous access, or inability to perform indicated diagnostic or therapeutic procedures because of equipment weight restrictions (Nasraway, Albert, Donnelly, Ruthazer, Shikora, Saltzman, 2006).

2. Significance of the study:

The rise in the number of individuals having AMI continues and seems to be a growing trend among critically ill patients worldwide. This category of patients requires intensive collaborative care to save their lives especially where they are at risk for several consequences. These consequences in turn may have negative impacts on patients' physical and psychological conditions and are expected to prolong patients' hospital stay, and increase hospital costs (Powell, et al 2003, Reeves, Ascione, Chamberlain & Angelini, 2003, and Minutello, et al, 2004, in Delaney, Daskalopoulou, Brophy, Steele, Opatrny, & Suissa, 2007). However, scattered researches were done in this area especially on the national level. In Egypt, during the years 2012 -2013 (Starting from June 2012 – June 2013) 131 critically ill patient was admitted to an intensive care unit (at El- Manial university hospital) as a result of acute myocardial infarction, and obviously noticed to have above normal body weight. This raised the researcher's interest to monitor their progress during their stay in the intensive care unit, and to study if different values of body mass index have impact on their in-hospital outcomes. Therefore, this research could provide health professionals with a base line evidence based data, and in depth understanding about this category of patients. As well, it can promote nursing practice and research; and emphasize the important role of the critical care nurses in assessing critically ill patients, monitoring their nutritional status, and their progress/ recovery during their stay in the ICU.

Operational definition: In–hospital outcomes in the current study refer to: recurrent MI; cardiogenic shock; Congestive Heart Failure (CHF); Cerebro vascular stroke (CVS); major bleeding; death; and length of ICU stay.

2. Subjects and Method:
2.1. Aim of the study: To study the relationship between body mass index (BMI) and selected in-hospital outcomes among acute myocardial infarction patients admitted to a selected critical care unit of a university hospital, in Egypt.
2.2. Research questions: To fulfill the aim of this study the following two research questions were formulated:
Q1: What is the body mass index profile of acute myocardial infarction patients admitted to a selected critical care unit of a university hospital in Egypt?
Q2: What is the relationship between body mass index and selected in-hospital outcomes among acute myocardial infarction patients admitted to a selected critical care unit of a university hospital in Egypt?

2.3. Research design: A descriptive exploratory research design was utilized in the current study.
2.4. Setting: The current study was conducted at a selected critical care unit of El- Manial university hospital, Egypt.

2.5. Sample: A sample of convenience including 60 adult male and female patients who admitted to the selected critical care unit as a result of acute myocardial infarction (during the year 2012-2013) was included in the current study, with the following **inclusion criteria:** age ranged between 20 - ≤ 65 years, of both sex, and **Exclusion criteria:** Patients with malignancy, autoimmune disease & receiving immunosuppressive drug.
2.6. Tools of data collection: Two tools were developed by the researcher, and utilized to collect data pertinent to the current study.
2.6.1. Socio-demographic and medical data sheet: It covers data about patients' age, gender, diagnosis, body weight, height, length of ICU stay, past medical history, current or recent smoking, and at home medications.
2.6.2. Patient's assessment sheet: This sheet was developed based on Acute Coronary Treatment and Intervention Outcomes Network (ACTION) Registry-Get with the Guidelines (GWTG). It is a national performance improvement initiative of the American Heart Association (AHA) created by a merger of the American College of Cardiology Foundation's National Cardiovascular Data Registry (NCDR), (ACTION) Registry and the American Heart Association's to improve guidelines adherence in patients hospitalized with CAD, HF, and Stroke (Peterson, et al. 2010, Roe et al, 2010, Chin CT, et al. 2010, & Peterson ED, et al, 2009, in Das et al, 2011). It covers data such as: **patients' presentation** (vital signs such as heart rate, systolic blood pressure; heart failure; shock; number of diseased vessels; electrocardiographic findings; and left ventricular ejection fraction)**; laboratory findings (**HDL, LDL, cholesterol, triglycerides, Hemoglobin, serum creatinine); **reperfusion strategy** (thrombolytic therapy; primary PCI; arrival to primary PCI (min); CABAG; arrival to CABAG /h); **medications within 24 hours of admission and at discharge**, counseling, and referral strategy; **discharge intervention (** smoking cessation, diet modification counseling, cardiac rehabilitation referral, and exercise counseling; and **In – hospital clinical outcomes such as** recurrent MI, cardiogenic shock, death, CHF, stroke, major bleeding.

3. Tools validity: The developed tools were examined by a panel of five experts in the field of Critical Care Medicine, and Critical Care and Emergency Nursing to test their clarity and objectivity and to estimate the needed time for data collection and if they are suitable to achieve the aim of the study.

4. Pilot study: A pilot study was done on (10) patients to test clarity, applicability, and objectivity of the data collection tools, and to estimate the needed time to complete each tool. No modifications were done in the data collection tools, and the pilot study sample was not included in the current study.

5. Protection of human rights: The current study was approved by human research, and ethical committees at the faculty of nursing – Cairo University. Official permissions to conduct the study were obtained from medical and nursing directors of ICUs. Written consents were obtained from the involved patients after informing them about the purpose and nature of the study. Confidentiality and anonymity of each patient were assured through data coding.

6. Procedure:
After extensive literature review, selection and preparation of the data collection tools were done. Then obtaining managerial agreements and actual implementation of the study were carried out. On daily basis, the investigator obtained a list of newly admitted patients diagnosed as having acute myocardial infarction from the responsible nursing supervisors. Then patients were selected considering the inclusion criteria. Each patient was interviewed individually, and full explanation of the purpose and nature of the study was done, then the researcher obtained written consents from patients who agreed to participate in the study. The data collection

tools were filled out by the investigator, and other needed data were collected from patients' files, within a period of 20-30 minutes for each patient.

Patients' assessment required obtaining certain anthropometric (measurement of human dimensions) data about nutritional status such as height and weight. Determining body mass index was done by dividing body weight in kilogram by height square in meter (Weight (kg)/ height in m2). No problem was found in calculating BMI for patients who knew their heights and body weight. However, for those who didn't know their body weight, and height; were unable to stand and those with limited physical activity their height was obtained measuring their ulnar length (the distance between Olecranon process of the elbow and the Styloid process of wrist), then the measured ulnar length was compared to that in the table of Malnutrition Universal Screening Tool (BAPEN, 2003). Body mass index (BMI) was estimated based on specifying mid upper arm circumference (MUAC) at the midpoint between the acromion process of the shoulder and the olecranon process of elbow. If MUAC is < 23.5 cm, BMI is likely to be <20 kg / m2. However if MUAC is > 32.0 cm, BMI IS likely to be >20 kg / m2. Body mass index was divided into clinically relevant categories on the basis of National Heart, Lung, and Blood Institute criteria (2011) as underweight (BMI <18.5 kg/ m2), normal weight (BMI ranges from 18.5 kg/ m2 - 25 kg/ m2), overweight (BMI ranges from 25 kg/ m2 -30 kg/ m2), class I obesity (BMI ranges from 30 kg/ m2 - 35 kg/ m2), class II obesity (BMI ranges from 35 kg/ m2 - 40 kg/ m2), and class III obesity (BMI > 40 kg/ m2).

7. Results:

7.1. Figure (1): Shows the relationship between BMI and gender of the studied sample. It clarifies that males represented the great majority (90%) of the studied sample. They had different BMI categories: overweight, grade I, and grade II obesity, in percentages of 33.3%, 30%, and 25% respectively, with a mean BMI of 31.52± 4.96. No significant statistical relationship was found between BMI and gender.

7.2. Figure (2): clarifies the relationship between diagnosis and BMI. It reveals that the studied group admitted as a result of acute anterior MI, acute inferior MI, and acute unspecific MI, in percentages of 45%, 30%& 25% respectively. No significant statistical relationship was found between BMI and diagnosis.

7.3. Figure (3): shows percentage distribution of the studied sample according to their past medical history. It indicates that, hypertension in addition to other past medical histories (Diabetes, prior MI, atrial fibrillation/ flutter, peripheral artery diseases) were most frequently noticed, in percentages of 40%, 26.7%, and 18% respectively. As well around one third of the studied sample (35%) had a combination of risk factors to MI: smoking, prior MI, and diabetes mellitus.

7.4. Figure (4) clarifies the relationship between BMI and number of diseased vessels. It indicates that slightly less than half (45%) of the studied sample had one diseased vessel, while one third (30%) had two diseased vessels. High significant statistical relationship was noticed between BMI and number of diseased vessels (Chi square = 28. 5 at P≤ 0.005).

7.5. Figure (5): shows the relationship between BMI and hemoglobin values. It reveals that anemia was commonly noticed among approximately two thirds (61.7%) of the studied sample. High significant statistical relationship was found between hemoglobin value and BMI (Chi square = 18.35, at p≤ 0.001).

7.6. Figure (6): clarifies the relationship between BMI and serum cholesterol values. It indicates that approximately two thirds (61.7%) of the studied sample had abnormally high cholesterol level. High significant statistical relationship was noticed between serum cholesterol and BMI (Chi square =21.96, at p≤ 0.005).

7.7. Figure (7): shows the relationship between BMI and serum LDL values. It reveals that more than half (51.6%) of the studied sample had high LDL level. High significant statistical relationship was found between serum LDL and BMI (Chi square: Value: 29.7, at p≤ 0.003).

7.8. Figure (8): clarifies the relationship between BMI and serum Triglycerides values. It shows that, high serum Triglycerides values were noticed among more than two thirds (66.7%) of the studied sample. High significant statistical relationship was noticed between BMI and Serum Triglycerides values (Chi square =26.75, at p≤ 0.001).

7.9. Table (1): clarifies the relationship between BMI and reperfusion strategies. It reveals that one half (50%) of the studied sample undergone thrombolytic therapy, while approximately the other half (45%) undergone percutaneous intervention. Reperfusion strategies didn't differ significantly in relation to BMI.

7.10. Table (2): shows the relationship between BMI and ejection fraction among the studied sample. It clarifies that one half (50%) of the studied sample had below normal ejection fraction. The great majority of this group (n=27 / 90%) were overweight and had different grades of obesity (over weight: 26.7%; grade I obesity: 26.7%, grade II obesity: 30%, and grade three obesity: 6.7%). However, ejection fraction didn't significantly differ in relation to BMI.

7.11. Table (3): shows the relationship between BMI and in-hospital outcomes / complications that happened during ICU stay.

It clarifies that more than half of the studied group (58.2%) experienced different problems (recurrent MI attacks: 26.7%, Cardiogenic shock: 18.3%, C.V.S: 6.6%, and Death: 6.6%). High significant statistical relationship was found between BMI and in-hospital outcomes (Chi square = 46.13 at $p \leq 0.004$).

7.12. Table (4): shows correlation between BMI and certain factors in the current study. It reveals no significant correlation between BMI, age and ICU stay. However, ICU stay was negatively correlated with hemoglobin value, and positively correlated with LDL. In addition LDL was positively correlated with systolic blood pressure.

8. Discussion

As apparent from the present study, and based on assessing nutritional status, the studied group had different BMI categories ranging from normal or acceptable weight for height to the third grade obesity, with highest frequency among the overweight group (more than one third); followed by the first grade obesity group (approximately one third); then the second grade obesity group (one quarter), and a minority was in the third grade obesity. The overall percentage indicates that the great majority of the studied sample had above normal BMI values. This could be the answer for the first research question which was concerned with the BMI profile of the studied sample. In this regards Horwich & Fonarow, (2008) revealed that overweight and obesity have become increasingly common worldwide. As well, Akinnusi, Pineda & El Solh (2008) indicated that obesity is a chronic disease and represents a major health problem due to its causal relationship with serious medical diseases, increased morbidity and mortality, and substantial economic effect. Moreover, overweight and obesity represent major risk factors for a number of chronic diseases, including diabetes, and cardiovascular diseases. Once considered a problem only in high income countries, overweight and obesity are now dramatically on the rise in low-and middle-income countries, particularly in urban settings. More specifically, Egypt is ranked as the second obese Arab country and the fifth obese country on the world level, with an estimated mean BMI of 28.4 kg/ m2 (WHO 2013& Fouad, 2013).

Concerning diagnosis, slightly less than half of the studied group admitted as a result of acute anterior MI, while more than half had acute inferior MI, and acute unspecific MI. The dominance of acute inferior MI was noticed among the first grade obesity group, while acute anterior MI was dominant among the overweight group. However, the relationship between BMI, gender and diagnosis didn't reach the level of significance. Findings of the present study were similar to that of Das et al (2011), who studied the impact of body weight and extreme obesity on the presentation, treatment, and in-hospital outcomes of patients with ST-segment elevation MI, and revealed that three quarters of the studied sample had above normal BMI values, with the highest frequency among the overweight group. In this regards studies suggest that obesity may alter myocardial metabolism leading to compromised cardiac function and tolerance to ischemia. It may promote cardiac lipid accumulation leading to insulin resistance (Poirier et al. 2006, and Lopaschuk, Folmes, Stanley, 2007, in Clark, Smith, Lochner, & Du Toit 2011). Ischemic hearts rely on glucose as the primary fuel to produce ATP through glycolysis with insulin resistance compromising the heart's ability to tolerate an ischemic event (Lopaschuk, Rebeyka, Allard, 2002, in Clark, Smith, Lochner, & Du Toit 2011).

Gender was not found to have a significant relationship to BMI/obesity in the current study. This may be due to having the great majority of the studied sample males. According to Mehelli et al. (2002), Bae & Zhang (2005), Gabel, Walker, London, Stenbergen, Korach, Murphy (2005), and Wang, Crisostomo, Wairiuko & Meldrum (2006) in Clark, Smith, Lochner, & Du Toit (2011) some studies revealed that females' myocardium is more resistant to ischemic/reperfusion injury than males' myocardium, however, the effect of obesity on myocardial tolerance to ischemia in both males and females remains unresolved. Consequently, Overbaugh (2009) indicated that one woman or man experiences a coronary artery disease event about every 25 seconds, despite the time and resources spent educating about its risk factors, symptoms, and treatment. Men (especially those above the age 45) have a higher risk than women; women older than age 55; and anyone with a first-degree male or female relative who developed coronary artery disease before age 55 or 65, are also at increased risk. This is in agreement with findings of the current study where the mean age of the studied group is 52.4+ 6.3 years. The same author expected the mean age of the population to increase in the future, and a larger percentage of patients are expected to be presented with MI above the age 65.In this regards Bolooki & Askari, (2013) revealed that, the incidence of MI increases with age; and is dependent on predisposing risk factors for atherosclerosis.

Consequently, Cotran, Kumar, Robbins (eds), (1994), in Bolooki & Askari, (2013) directed the attention to six primary risk factors responsible for development of atherosclerotic coronary artery disease and thus MI. These factors are hyperlipidemia; diabetes mellitus; hypertension; tobacco use; male gender; and family history of atherosclerotic arterial disease. The presence of any risk factor is associated with doubling the relative risk of developing atherosclerotic coronary artery disease. Moreover, Coatmellec-Taglioni, Dausse, Giudicelli, Ribière (2003), and Cordero et al (2009) announced about obesity induced insulin resistance and subsequent diabetes. However, Ryo et al. (2004), and Costacou et al (2005) correlated obesity induced insulin resistance to the male gender. They referred to the adiponectin which is an adipocytokine that is elevated in women's serum. It improves insulin sensitivity of insulin sensitive organs (Yamauchi et al. 2001, Kubota et al. 2002, Stefan et al. 2002, in Clark, Smith, Lochner, & Du Toit 2011), decreases hepatic glucose production and may consequently protect the heart against ischemic/reperfusion injury (Batterham et al. 2002). Similarly, the estrogen hormone was found to improve lipid profiles, protect against hyperglycemia and so, be cardio-protective for women during ischemia (Pedersen, Kristensen, Hermann, Katzenellenbogen, Richelsen 2004, Louet, Lemay, Mauvais-Jarvis, 2004, and Wang, Crisostomo, Wairiuko & Meldrumn 2006).

In addition to obesity, the studied group had diabetes mellitus as a co-morbidity disease, in addition to hypertension, peripheral artery diseases, and previous cardiac surgeries (CABG).

As revealed by Fahmy (2013), based on the report of the World Federation of Diabetes (2012), diabetes and its complications are responsible for death of more than 65 thousand Egyptians each year. This in addition to hypertension which affects around one quarter of the Egyptians, contributing to greatest risk for cerebrovascular diseases, heart failure, renal failure, and so death (Ibrahim, 2011). As well, slightly less than half of the studied sample had one diseased coronary vessel; while one third of the studied sample had two diseased vessels, and a minority had three diseased vessels indicating that cumulatively more than three quarters of the studied sample had diseased vessels. High significant statistical relationship was noticed between BMI and number of diseased vessels. In this regards Brookside Associates, (2012) revealed that among the great majority of AMI, the imbalance is preceded by atherosclerosis and decreased blood flow in the coronary arteries. Inadequate blood flow results in decreased oxygen delivery to the heart muscle, which causes ischemia, injury, and death of a portion of the myocardium (infarction).

In attempt to identify why acute myocardial infarction was found among a considerate percentage of the studied group (16.7%) who had no diseased vessels, Fournier, Sanchez, Quero, Fernandez-Cortacero, Gonzales-Barbero, (1996), in Da Costa, Isaaz, Faure, Mourot, Cerisier & Lamaud (2001) revealed that AMI is generally associated with obstructive coronary artery diseases, however, myocardial infarction with normal epicardial coronary arteries has also been documented. They added that the overall prevalence rate of myocardial infarction with a normal coronary angiogram is low (approximately 3%), but appears to vary with age, with higher rates in young age patients. However, the studied group was older, where their mean age was above 50 years old. In this regards, one cannot neglect the degenerative effects of increased age on the elasticity of the blood vessels, in addition to other predisposing factors to AMI. Smoking was another risk factor to AMI in the current study among more than one third of the studied group. In this regards Shaban (2013) revealed that, according to the Egyptian Ministry of Health statistics (2013) smokers account for about 13 million in Egypt, representing approximately 21% of the Egyptian population. The same author revealed that, added to its carcinogenic effects, smoking is one of the main causes of many chronic diseases and is responsible for the death of one person every 13 seconds. It was found to be responsible for the occurrence of myocardial infarction (78% of patients), and angina among (70% of patients), because it results in hardening of the arteries/ blood vessels.

Consequently, added to the previous risk factors to MI, is abnormally high cholesterol level, high serum Triglycerides values and high LDL level among approximately two thirds of the studied sample. High significant statistical relationship was noticed between serum cholesterol; serum LDL; Serum Triglycerides values and BMI. In this regards Tuunanen et al. (2006) and Lopaschuk, Folmes, Stanley (2007) in Clark, Smith, Lochner, & Du Toit (2011) revealed that elevated circulating lipids may promote increased myocardial fatty acid uptake and utilization which could decrease both myocardial efficiency and tolerance to ischemia under normoxic conditions. Free fatty acids are also potentially detrimental as they inhibit glucose oxidation (Tuunanen et al. 2006). As well, excessive myocardial free fatty acid utilization during ischemia requires more oxygen for ATP production when compared to glucose (Wallhaus et al. 2001). In addition, LDL was positively correlated with systolic blood pressure, indicating that the greater the LDL value, the higher the systolic blood pressure. This of special concern especially where the maximum systolic blood pressure of the studied sample was 170 mmHg, with a mean of 120.5 +22.95 mmHg. In this regards the National Heart, Lung, and Blood Institute (2009) in Bolooki & Askari, (2013), revealed that high blood pressure (BP) has consistently been associated with an increased risk of MI.

Therefore, control of hypertension with appropriate medications, and lifestyle modifications has been shown to significantly reduce the risk of MI. In addition, Bolooki & Askari, (2013), revealed that most myocardial infarctions are caused by a disruption in the vascular endothelium associated with an unstable atherosclerotic plaque that stimulates the formation of an intracoronary thrombus, which results in coronary artery blood flow occlusion. If such an occlusion persists for more than 20 minutes, irreversible myocardial cell damage and cell death will occur. The development of atherosclerotic plaque occurs over a period of years to decades. The two primary characteristics of the clinically symptomatic atherosclerotic plaque are a fibro-muscular cap and an underlying lipid-rich core. The loss of structural stability of a plaque often occurs at the juncture of the fibro-muscular cap and the vessel wall, a site otherwise known as the shoulder region. Disruption of the endothelial surface can cause the formation of thrombus via platelet-mediated activation of the coagulation cascade. If a thrombus is large enough to occlude coronary blood flow, an MI can result. The same authors added that, the death of myocardial cells first occurs in the area of myocardium most distal to the arterial blood supply which is the endocardium. As the duration of the occlusion increases, the area of myocardial cell death enlarges, extending from the endocardium to the myocardium and ultimately to the epicardium. The area of myocardial cell death then spreads laterally to areas of watershed or collateral perfusion. Generally, after a 6- to 8- hour period of coronary occlusion, most of the distal myocardium will be died. The extent of myocardial cell death defines the magnitude of the MI. If blood flow can be restored to at-risk myocardium, more heart muscle can be saved from irreversible damage or death.

In attempt to identify the impact of BMI on post myocardial infarction patients, Hassan (2008) studied the effect of body mass index on coronary arteries and left ventricular functions in patients with post myocardial infarction angina, and revealed that obesity has been linked to a spectrum of cardiovascular changes ranging from a hyperdynamic circulation, through sub-clinical cardiac structural changes to overt heart failure. The increased metabolic demand imposed by the expanded adipose tissue and augmented fat free mass in obese results in a hyperdynamic circulation with increased blood volume. As well, obese patients have an increased total body blood volume, higher filling pressures, and increased sympathetic activation, which lead to increased stroke volume and heart rate; increased cardiac work, and this may be accentuated at very elevated levels of adiposity seen in class III obese patients. In addition to the increased preload, left ventricular (LV) afterload is also elevated in obese individuals due to both increased peripheral resistance and greater conduit artery stiffness (Anderson, et al 1997, Sandstead & Klevay, 2000, and Alaejos et al, 2000, in Hassan 2008). Cardiac structural changes in class III obesity include markedly increased LV mass, known to be a risk factor for increased ventricular arrhythmias and sudden cardiac death (Lavie, Milani &Ventura 2009). Heart failure occurs frequently in obese patient and appears to be the predominant cause of death in grossly obese subjects (Roeback et al, 1991, in Hassan 2008).

This is of special concern especially where around half of the studied sample had below normal ejection fraction, and the great majority of this group had above normal BMI (overweight and different grades of obesity). However, the relationship between BMI and ejection fraction didn't reach the level of significance in the current study. In this regards Braunwald, et al, (2000) & the American Heart Association (AHA) (1999) in Lopez-Jimenez, et al (2004) revealed that, current guidelines for the management of patients with MI emphasized the importance of LVEF assessment before discharge. As well, Badheka1, et al, (2010) indicated that left ventricular ejection fraction (EF) in post-myocardial infarction patients is a strong predictor of adverse cardiovascular events. Knowledge of left ventricular ejection fraction (LVEF) after AMI helps to stratify risk, and guides the use of evidence based treatment such as angiotensin-converting enzyme (ACE) inhibitors, beta blockers and revascularization (Zaret, et al.1995, Singh, et al. 2002, & Ryan, et al.1996, In Lopez-Jimenez, et al. 2004). Moreover, Braunwald, et al, (2000) indicated that, monitoring LVEF measurement among patients with MI was underscored as a quality-of-care indicator in the report of AHA /(ACC) American College of Cardiology (2000).

Consequently, obesity is characterized by a series of physiologic changes that may impair the ability to adapt to the stresses of critical illness. The presence of diabetes, cardiovascular strains, and respiratory dysfunction poses significant challenges that may affect intensive care unit (ICU) survival. However, the influence of obesity on outcomes among critically ill patients remains a focus on controversy (Akinnusi, Pineda & El Solh, 2008). Concerning the in-hospital outcomes among the studied sample, around two thirds of the studied sample experienced different problems (recurrent MI attacks: more than one quarter; cardiogenic shock: around one fifth; and equal percentage for C.V.S and Death among a minority). High significant statistical relationship was found between BMI and in-hospital outcomes. These findings represent the answer of the second research question which was concerned with identification of the in-hospital outcomes among the studied group.

In this regards the World Health Organization, (2007), and Dinon (2010) revealed that cardiovascular diseases including high blood pressure, heart failure, stroke, angina and heart attack are the number one cause of mortality in both men and women. Despite some contradictory results, studies have demonstrated U- shaped curves (bimodal occurrence) relating BMI to mortality, suggesting increased mortality at both extremes of body weight (Pi-Sunyer, et al 1998, & Troiano, 1996, in Tremblay & Bandi, 2003).

Also, Das et al (2011) found, a U-shaped association with BMI categories for both mortality and major bleeding. They found rates of adverse outcomes high among normal-weight patients, lower in overweight and mild to moderately obese patients, and then increased in patients with class III obesity. As well, Powell et al, (2003), Reeves, Ascione, Chamberlain & Angelini, (2003), and Minutello, et al, (2004), in Delaney, Daskalopoulou, Brophy, Steele, Opatrny, & Suissa (2007) noticed adverse events and adverse outcomes with increased risk among underweight and morbidly obese patients, but a lower risk was noticed among over and normal weight patients. Inspite of being a minority, the proportion of death in the class II obesity tripled that in the overweight group in the current study. However, Allison, et al (1997), in Akinnusi, Pineda & El Solh (2008) found that the proportion of death was high for class III obese patients as compared to class I obese patients. Conversely, Horwich & Fonarow (2008) indicated inverse correlation between BMI and mortality in patients with acute myocardial infarction.

The current study revealed that the mean length of ICU stay (LOS) was 7.8 + 3.39, with a minimum period of two days and a maximum period of 18 days. ICU stay was not correlated with BMI in the current study. However, ICU stay was negatively correlated with hemoglobin value, and positively correlated with LDL in the current study. This refers to that prolonged ICU stay could have a negative impact on the hemoglobin value, indicating that the greater the ICU stay, the less the hemoglobin value and that the higher the LDL values, the greater the ICU stay. Contradicted with the current study finding is that of Akinnusi, Pineda & El Solh (2008) who conducted a meta-analysis study about effect of obesity on intensive care morbidity and mortality and revealed that, the mean length of ICU stay ranged from 2.1 to 19.4 days in the obese group as compared to 2.6 to 12.0 days in the non obese group.The same authors had another point of view indicating that, although mild and moderate obesity may be protective during critical illness, morbid obesity (in their study) did not have an adverse effect on patients' outcome. However, they found obese patients to have increased morbidity as measured by duration of mechanical ventilation and LOS.

In addition, the current study revealed that around half of the studied sample undergone thrombolytic therapy, while approximately the other half undergone percutaneous intervention. Reperfusion strategies didn't differ significantly in relation to BMI. In agreement with these findings were that of Das et al (2011) who indicated that reperfusion was attempted in the great majority of patients across all BMI categories, and found no differences in the proportion of patients receiving fibrinolytic therapy, or percutaneous interventions according to BMI, even among those with extreme obesity. As well, the same authors revealed approximately the same findings in the current study, where they found that in-hospital use of evidence-based medical therapies was high overall and similar across BMI groups. As well, prescription of evidence-based therapies at hospital discharge, including aspirin, clopidogrel, betablockers, and angiotensin-converting enzyme inhibitors or angiotensin II receptor blockers, did not differ across BMI groups, including class III obesity.

Thus, findings of the present study reveals that all patients irrespective of their body weight category received the needed medical as well as nursing management according to GWTG protocols. This of special concern especially where approximately one third of the studied sample had no negative in-hospital outcomes/ problems. This could reflect the effectiveness of medical as well as nursing intervention. In agreement with the current study findings were that of Das et al (2011) who found that, the processes and quality-of-care measures did not differ in a clinically meaningful way for obese patients, including class III obese patients. In this regards, Leon, etal (2005), & Taylor, et al (2004), in Contractor, *(*2011) emphasized the importance of cardiac rehabilitation. They described it as coordinated, multifaceted interventions designed to optimize a cardiac patient's physical, psychological, and social functioning to reduce the risk of death or recurrence of the cardiac event through education about, exercise, risk factor modification and counseling. As well, Brookside Associates, (2012) emphasized that nursing management of a patient with AMI is intensive in nature, and requires close monitoring of the patient's status and progress, along with concurrent patients' education. The nursing staff as a member of the multidisciplinary team should have the ability to develop an individualized patients' rehabilitation plan or MI protocol of care ranging from complete bed rest during the first days of having MI to several weeks later after discharge from the hospital. This can help in maintenance of patients' physical functioning as well as prevention of subsequent coronary events or recurrence.

9. Conclusion: Based on findings of the current study, it can be concluded that body mass index was an important factor in classifying myocardial infarction patients into different categories ranging from acceptable weight for height to the third grade obesity. Cumulatively, the majority of the studied group had above normal BMI values, and their in-hospital outcomes were significantly related to their body mass index.

10. a. Recommendations: Based upon findings of the current study, the followings are recommended:

- Integrating nutritional assessment in the classification and management of critically ill patients.
- Providing individualized post myocardial infarction instructions considering patients' nutritional assessment data.

10. b. Recommendation for further research:

- Findings of the present study do not represent the total population, is limited to a selected CCU. Therefore, the current study is recommended to be repeated on a large probability sample including all MI patients at different critical care units.

11. Acknowledgement: The author would like to express his sincere gratitude to critically ill patients who accepted to participate in this study. As well, great thanks and appreciation is to the efforts of the hospital administrating team, medical as well as the nursing staff who helped in facilitating conduction of this study. The author also acknowledges the expertise of Critical Care Medicine and Critical Care Nursing staff for their efforts in revising the data collection instruments.

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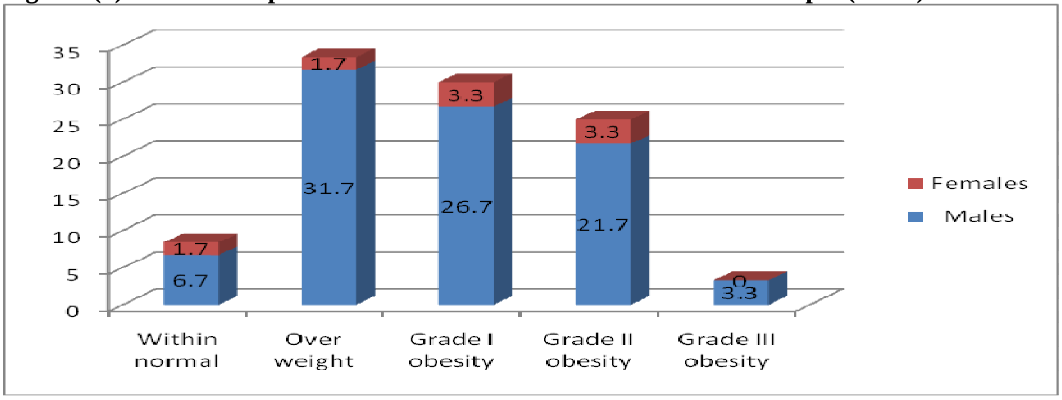
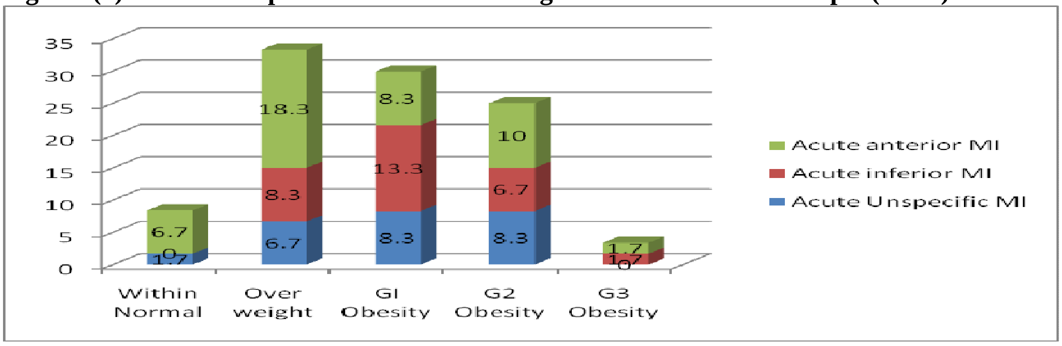
Notes: List of tables and figures

Figure: (1): Relationship between BMI and Gender of the Studied Sample (N=60).



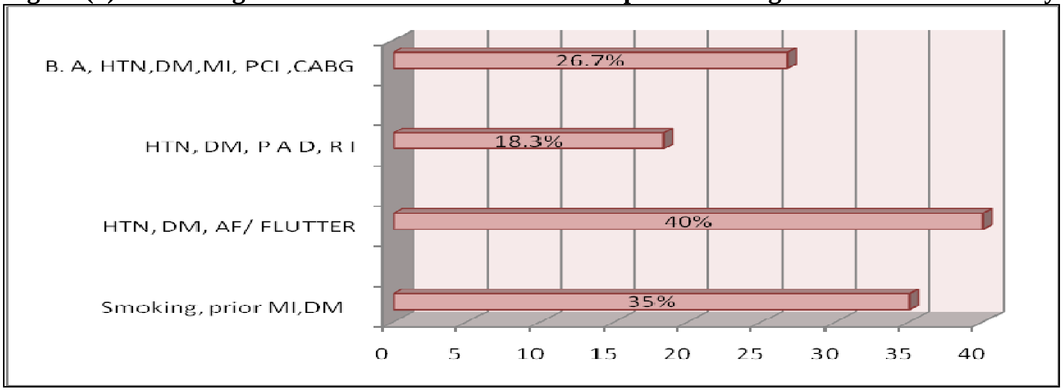
Chi square: 1.54 p≤ 0.8 Ns (Not significant) Mean BMI = 31.52 ± 4.96

Figure: (2): Relationship between BMI and Diagnosis of the Studied Sample (N=60).



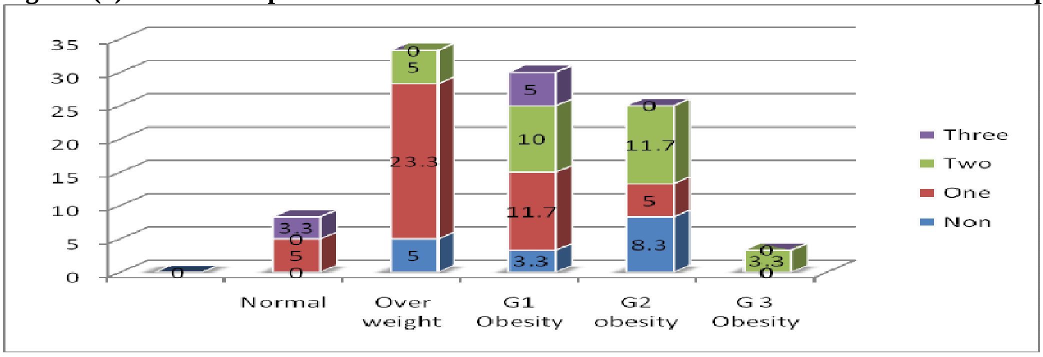
Chi square: 7.55 p≤ 0.5 NS (Not significant)

Figure (3): Percentage Distribution of the Studied Sample According to Past Medical History (N=60).



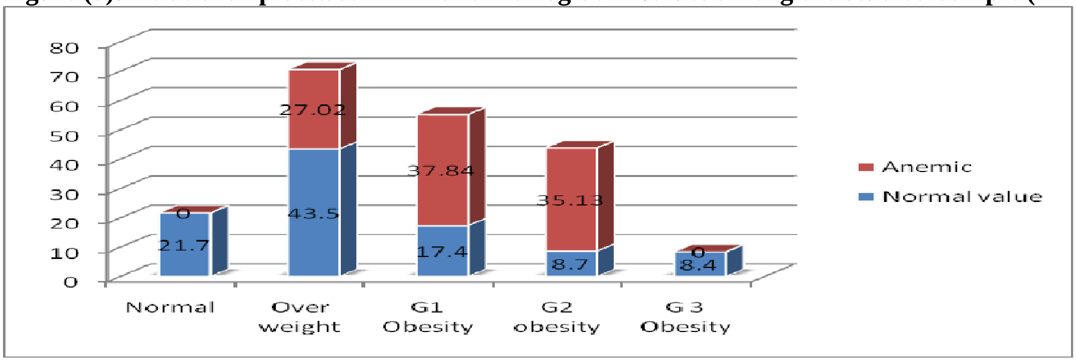
Responses are not mutually exclusive.

Figure: (4): Relationship between BMI and Number of Diseased Vessels of the Studied Sample (N=60).



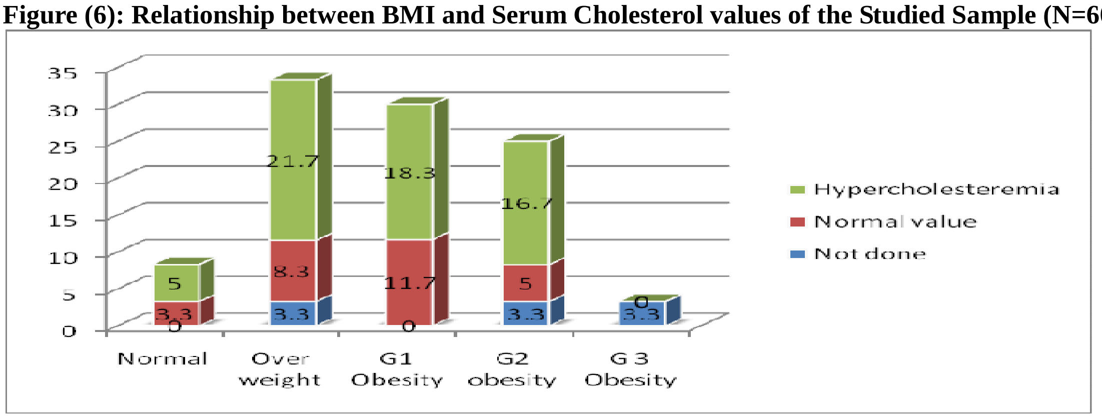
Chi square value: 28. 5 ** High significant statistical relationship at P≤ 0.005

Figure (5): Relationship between BMI and Hemoglobin Values among the Studied Sample (N=60).



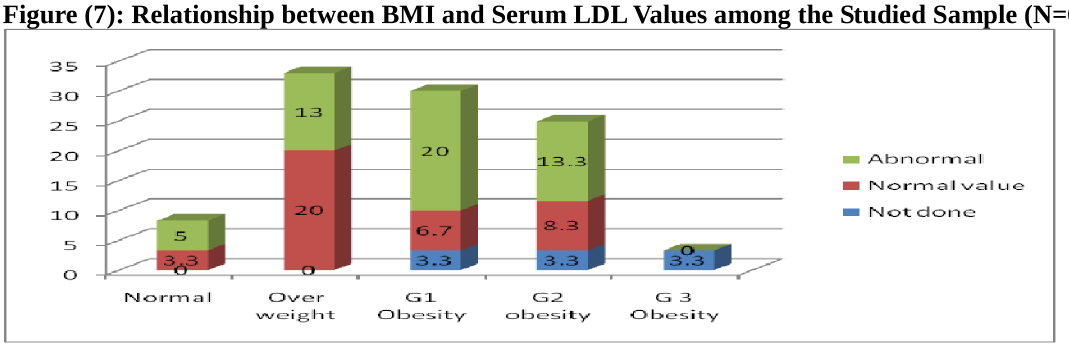
Chi square value: 18.35 **High significant statistical relationship, at P≤ 0.001

Figure (6): Relationship between BMI and Serum Cholesterol values of the Studied Sample (N=60).



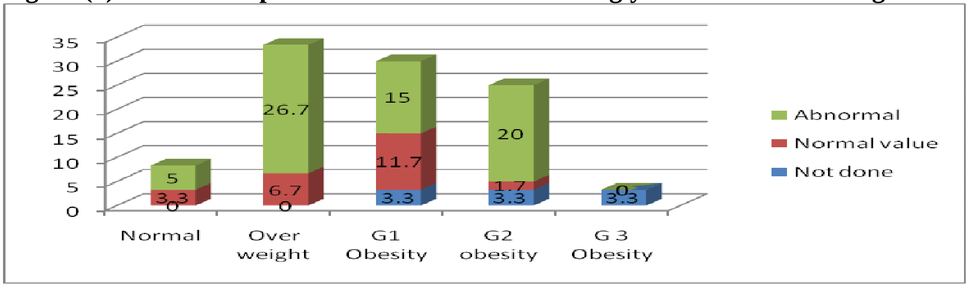
Chi square: 21.96 ** High significant statistical relationship at p≤ 0.005

Figure (7): Relationship between BMI and Serum LDL Values among the Studied Sample (N=60).



Chi square: Value: 29.7, ** High significant statistical relationship at p≤ 0.003

Figure (8): Relationship between BMI and Serum Triglycerides values among the Studied Sample (N=60).



BMI category		Reperfusion strategy				Total
		Thrombolytic therapy	PCI	CBAG	Coronary angiography	
Normal (20-25)	N %	5 100.0%	0 0.0%	0 0.0%	0 0.0%	5 8.33%
Over weight (25-30)	N %	6 30.0%	14 70.0%	0 0.0%	0 0.0%	20 33.33%
G1 Obesity (30 -35)	N %	9 50.0%	6 33.3%	2 11.1%	1 5.6%	18 30%
G2 obesity (35-40)	N %	8 53.3%	7 46.7%	0 0.0%	0 0.0%	15 25%
G 3 Obesity (> or = 40)	N %	2 100.0%	0 0.0%	0 0.0%	0 0.0%	2 3.33%
Total	N %	30 50.0%	27 45.0%	2 3.3%	1 1.7%	60 100.0%
Chi square		18.615 $p \leq 0.09$ NS (Not significant)				

Chi square: 26.75, ** High significant statistical relationship at $p \leq 0.001$

Table (1): Relationship between BMI and Reperfusion Strategies for the Studied Sample (N=60).

Left ventricular Ejection Fraction		BMI Category					Total
		Normal	Over wt.	GI Obesity	G2 Obesity	G3 Obesity	
More than 50% (Within normal)	N %	2 40.0%	7 35	3 35.0%	6 40%	0 0.0%	18 30.0%
40-50 % (Below normal)	N %	3 60.0%	8 40	8 40.0%	9 60%	2 100.0%	30 50.0%
25-40 % (Low)	N %	0 0.0%	5 25	7 25.0%	0 0%	0 0.0%	12 20.0%
Total	N %	5 100.0%	20 100%	18 100.0%	15 100.0%	2 100.0%	60 100.0%
Chi-Square	Value: 12.27 P≤.0.14 NS (Not significant)						

Table (2): Relationship between BMI and Ejection fraction among the Studied Sample (N=60).

BMI Category		In Hospital Outcome							Total
		Recurrent MI	Cardiogenic shock	CVS Stroke	CHF	Death	Major bleeding	Non	
Normal	N %	0 0.0%	1 20.0%	0 0.0%	0 0.0%	0 0.0%	1 20.0%	3 60.0%	5 100.0%
Over wt.	N %	2 10%	2 10%	1 5%	1 5%	1 5%	0 0%	13 65%	20 100%
GI Obesity	N %	8 44.4%	2 11.1%	3 16.7%	0 0%	0 0%	0 0.0%	5 .27.8%	18 100.0%
G2 Obesity	N %	4 26.7%	6 40%	0 0%	0 0.0%	3 20%	0 0.0%	2 13.3%	15 100.0%
G3 Obesity	N %	2 100.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	2 100.0%
Total	N %	16 26.7%	11 18.3%	4 6.6%	1 1.7%	4 6.6%	1 1.7%	23 38.3%	60 100.0%
Chi square:	Value : 46.13 p≤0.004, Linear-by-Linear Association value = 12.95 at p≤ 000**								

Table (3): Relationship between BMI and In- Hospital Outcome among the Studied Sample (N=60).
** High significant statistical relationship at p≤_0.001

Variables		Age	BMI	ICU stay	HB	S. Cholesterol	HDL	LDL
BMI	**r** **p.**	.107 .414						
ICU stay	**r** **p.**	-.049 0.713	-.151 .248					
HB	**r** **p.**	-.179 .172	- .363* .004	-.265* .041				
LDL	**r** **p.**	.163 .212	-.110 .404	.277* .032	.053 .686	.703* .000	.440** .000	
Serum creatinine	**r** **p.**	-.138 .294	- .240* .055	.072 .586	-.170 .193	-.199 .127	-.119 .364	- .270* .037
HR	**r** **p.**	.096 .468	.039 .770	-.145 .270	.383* .003	-.006 .964	-.004 .974	.144 .272
SBP	**r** **p.**	-.100 .448	-.011 .931	-.075 .567	.163 .213	.173 .187	.166 .204	.282* .029

Table (4): Correlations Matrix between Body Mass Index and Selected variables (N=60).

** High significant statistical relationship at $p \leq 0.001$, * A significant statistical relationship at $p \leq 0.05$.