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RELATIONSHIP BETWEEN PRE-OPERATIVE BODY MASS INDEX AND LENGTH OF OPERATION OF LAPAROSCOPIC SLEEVE GASTRECTOMY

***Running title*: Relation between BMI and Length of Laparoscopy**

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Abstract:

Background:*The BMI has been investigated as one of risk factors of perioperative and postoperative complications. However, the BMI effect on intraoperative and duration of laparoscopic Sleeve gastrectomy had not been addressed in literature.****Methods:****This study is a part of retrospective cohort conducted in (), correlation analysis was used to detect the relationship between duration of LSG and BMI. We used Kendall's tau correlation for the relationship between two non-normally distributed variables, otherwise the Pearson's correlation was used. A significant correlation is considered when P-value is less than 0.05. For pair wise comparisons of continuous variable, Mann Whitney test was used for non-parametric data otherwise, t-test was used to detect the difference between two groups.* ***Results:****Based on our results, there was no significant relationship between the BMI and length of the operation (P-value = 0.85) or whether long or short surgery based on BMI (P-value = 0.58). Furthermore, no difference in BMI between those who had intraoperative complications and those who had not (P-value = 0.57).****Conclusion:****The Body Mass Index (BMI) did not have effect on the duration of LSG and intraoperative complications.*

Keywords: *Sleeve gastrectomy, BMI, intraoperative complications, length of operation, Bariatric surgery, obesity*

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INTRODUCTION:

Obesity/overweight is a major health problem that affect over 33% of the world population [1,2]. It is estimated that if there are no plans for intervention, the prevalence of obesity will increase to be 58% by 2030 [3]. The obesity is defined as body mass index (BMI) more than or equal to 30 Kg/m^2; the BMI is considered as a global determinant of the obesity [4]. Based on BMI, the obesity is classified into three categories starting from class I (moderately obese) to class III (Very severely obese) which is BMI more than 40 Kg/m^2. The BMI is considered as a risk indicator correlated with the risk of morbidities associated with the obesity [4].

The obesity is now considered as a disease that cause decrease quality of life psychologically and physically with its associated morbidity [5]. The high BMI has multifactorial aetiologies including genetic factors evidenced by the syndromic obesity and environmental factors including the food, infections and socioeconomic factors [6-8]. Diabetes mellitus, hypertension, dyslipidaemia, cardiovascular disorders, osteoarthritis, gall stones and even certain cancers e.g. colon and oesophageal cancers were found to be co-morbid conditions found in obese individual [9,10]. Therefore, obesity has gained a wide spread attention, and call for management plans for the prevention and management of obesity.

The obesity treatment ranges from life style modification, exercises, cognitive behavioural therapy and anti-obesity drugs are mainly the main cornerstones for short term weight loss and overweight individuals [10,11]. However, these treatment options do not allow for the long-term weight reduction in severe cases of obesity. Thus, Bariatric surgery is considered the most suitable option for these cases [12,13]. It was found that bariatric surgery and was effective in decreasing mortality by 25% to 50% and morbidities as well [14].

Despite the effectiveness of bariatric surgery, there is still a specific condition that should be fulfilled for a patient to have a bariatric surgery. A complete history of weight loss should be documented for these patients, BMI more than 35 Kg/m^2 with evident co-morbidities and no risks prevents the surgery are the main indications for the bariatric surgery [15,16].

Bariatric surgeries have many types and procedures; one of the most common types is laparoscopic sleeve gastrectomy (LSG). Since 2003, the LSG has been used as a stand-alone surgery treatment for obesity [19-19]. It is the second most common type after the laparoscopic Roux-en-Y gastric bypass. The technique is simple and easily achieves the target weight and decreasing morbidities with fewer complications. In addition, the complication after the surgery is less in LSG. Since 2013, there are reports indicating that it has surpassed the laparoscopic Roux-en-Y gastric bypass [18-22].

The main mechanism in LSG depends on resection of the fundus that secrets Ghrelin resulting in significant reduction of its secretion and decreasing appetite of the patients [23,19].

Despite its effectiveness, there are reported complications including acute complications e.g. haemorrhage, abscess, and staple line leak while chronic complications include nutritional deficiency, gastroesophageal reflux and stricture [24]. One of the main risk factors of these complications is BMI of the patients. It was found that increase BMI was associated with the high risk of leakage. Furthermore, high BMI was associated with gastroesophageal reflux, one of the most common complications after LSG. There is a well-established relationship between BMI and LSG complications [25-29].

The relationship between the BMI and intraoperative complications of the LSG has not been investigated much in literature. There was no study in literature discussed the effect of BMI on the duration of LSG. Understanding the risks associated with the increase in BMI is considered crucial for the choice of suitable procedure for the patient and estimating risk/benefit relationships for obese patients.

METHODS:

This study is a part of retrospective cohort in Saudi Arabia.

Patient recruitments

All the patients consented. All the procedures were conducted based on the declaration of Helsinki.

Detailed history from each patient was obtained including marital status, nationality, history of diseases and previous cholecystectomy. Pre-operative and post-operative total bilirubin, Amylase, Lipase, Alkaline phosphatase, Cholesterol, Triglycerides, LDL, HDL and haemoglobin A1C were obtained.

Statistical techniques

We used Shapiro-Wilk test for continuous variables to check the normality distribution. The results were presented as mean ± standard deviation for continuous variables that were normally distributed or as median and interquartile range (IQR) for continuous variables whose distribution was not

normal. Categorical variables were presented as frequencies and percentages. The missing data were imputed by K nearest neighbors using K = 3. We used Kendall's tau correlation for the relationship between two non-normally distributed variables; otherwise the Pearson's correlation was used. A significant correlation is considered when *P-value* is less than 0.05. For pair wise comparisons of continuous variable, Mann Whitney test was used for non-parametric data otherwise, t-test was used to detect the difference between two groups.

Based on the relationship between the variables, a linear regression analysis was used if the scatter plots showed linear relationship between the two variables. If no linear relationship found, an appropriate regression model was used. All analyses were conducted in R 3.3.4

RESULTS:

Patients' characteristics

174 patients were included in the cohort, of them, 123 patients were female. The mean age was 31.82 years old. The median BMI was 46.15, there was no significant difference between male and females BMI (P-value = 0.54). The median duration of the surgery was 85.5 minutes; two patients had intraoperative complications while only one patient had conversion surgery. The laboratory tests were in normal range Table 1

Relationship between BMI and duration of LSG

We classified the duration of the LSG into two classes based on the median: more than 85 minutes and less than 85 minutes. We found no significant difference in the duration based on the BMI of the patients (P-value = 0.58) Figure 1. There was non-significant week correlation between BMI and duration of LSG (r = 0.014, P-value = 0.85) Figure 2. Since there is no correlation, no possible regression model could be applied.

Relationship between BMI and intraoperative complication of LSG

Two cases had intraoperative complication; one had difficult intubation and hypoxia while the other had intraoperative bleeding. There was no significant difference between the patients who had intraoperative complications and those who have not (P-value = 0.57) Figure 3.

Relationship between BMI and intraoperative conversion from bypass to LSG

One case had intraoperative conversion from bypass to LSG, there was no significant difference between the patient who had conversion and who started as LSG from the beginning (P-value = 0.86) Figure 4.

Table 1. *The characteristics of patients undergoing Laparoscopic sleeve gastrectomy*

		Overall
n		174
Age (mean (SD))		31.82 (8.91)
Sex (%)	Female	123 (70.7)
	Male	51 (29.3)
Marital status (%)	Married	77 (44.3)
	Single	97 (55.7)
Nationality (%)	Egypt	10 (5.7)
	Jordan	4 (2.3)
	Kuwait	1 (0.6)
	Non-Saudi	1 (0.6)
	Palestine	1 (0.6)
	Saudi	152 (87.4)
	Sudan	1 (0.6)
	Syria	3 (1.7)
	Yemen	1 (0.6)
Concomitant cholecystectomy (%)	No	162 (93.1)
	Yes	12 (6.9)
Intra-operative Complications (%)	No	171 (98.8)
	Yes	2 (1.2)
Conversion (%)	No	172 (99.4)
	Yes	1 (0.6)
Diabetes mellitus (%)	No	153 (88.4)
	Yes	20 (11.6)
Hyperlipidaemia (%)	No	157 (90.2)
	Yes	17 (9.8)
Hypertension (%)	No	156 (90.7)
	Yes	16 (9.3)
Previous cholecystectomy (%)	No	162 (94.2)
	Yes	10 (5.8)
Height (median [IQR])		163.00 [157.38, 169.00]
Weight (median [IQR])		127.00 [110.00, 142.50]
BMI (median [IQR])		46.15 [42.50, 52.08]
Total Bilirubin (median [IQR])		0.30 [0.30, 0.40]
Amylase (median [IQR])		43.00 [33.50, 56.00]
Lipase (median [IQR])		95.00 [28.00, 126.00]
Alkaline phosphatase (median [IQR])		90.00 [73.00, 104.75]
Cholesterol (median [IQR])		181.00 [166.00, 205.00]
Triglycerides (median [IQR])		105.00 [65.00, 142.00]
LDL (median [IQR])		123.00 [105.50, 142.50]
HDL (median [IQR])		41.00 [36.00, 50.00]
HBA1C (median [IQR])		6.10 [5.57, 6.85]
Duration of operation (mins) (median [IQR])		85.50 [70.00, 110.00]

LDL: low density lipoproteins, HDL: high density lipoproteins, HBA1C: glycated haemoglobin, BMI: body mass index

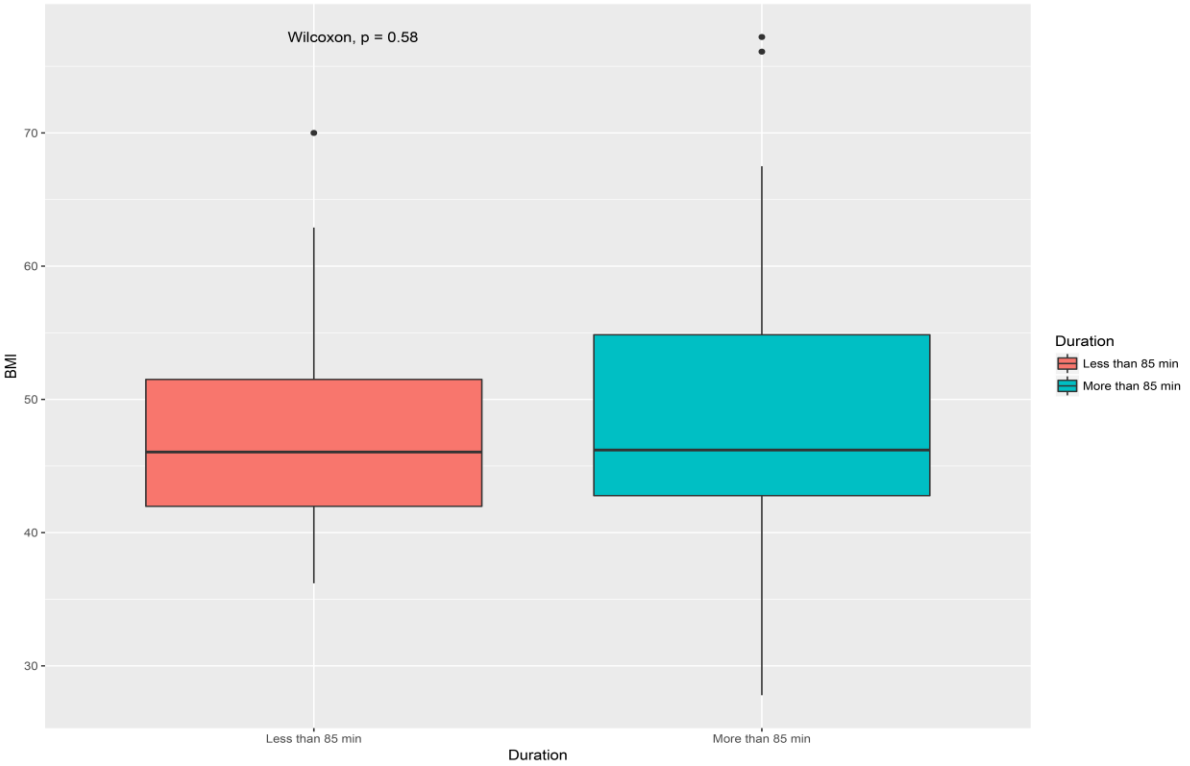

Figure 1. The comparison between BMI in the two categories of the duration of LSG.

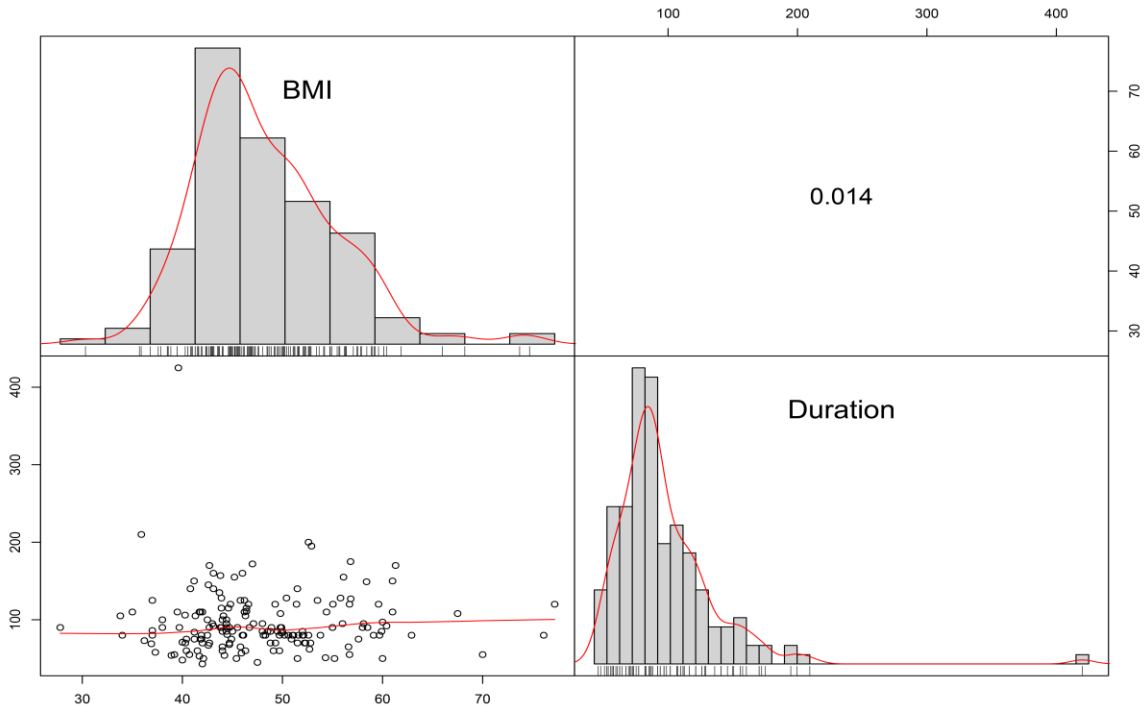

Figure 2. the scatter plot shows the correlation between the duration of LSG and BMI, the figure also shows the distribution of each variable. The regression line is considered horizontal

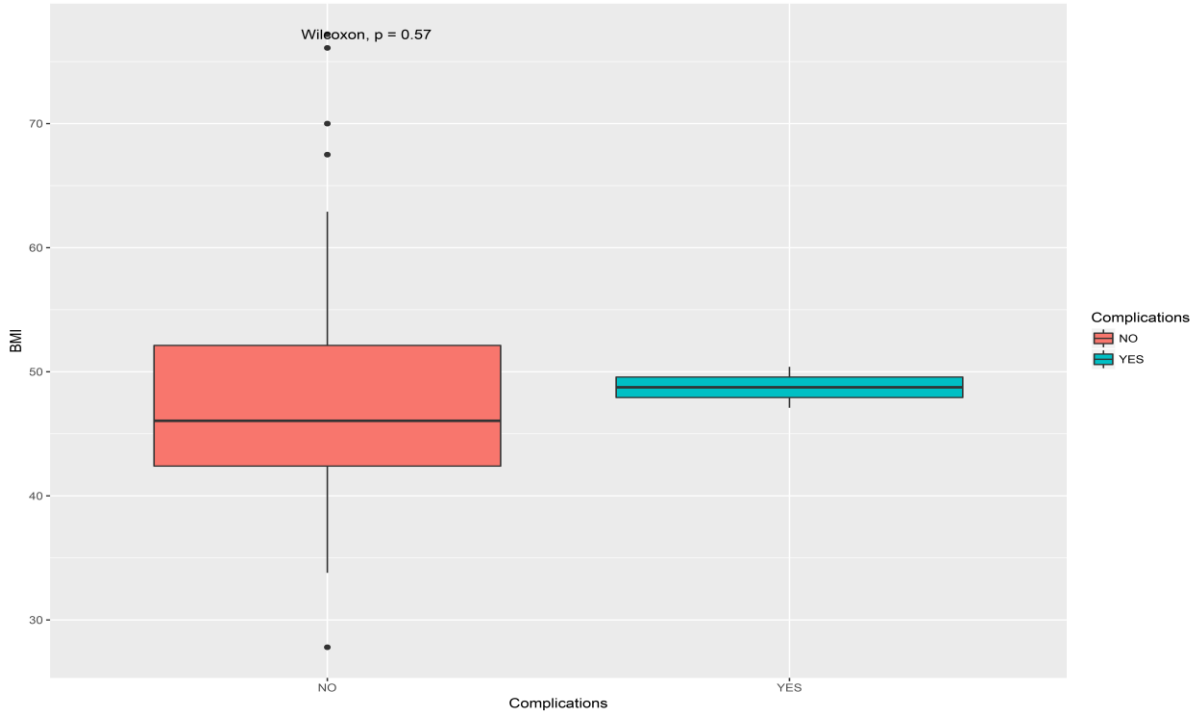

Figure 3. box plots showing the median and IQR of the BMI between patients with intraoperative complications and those who have not.

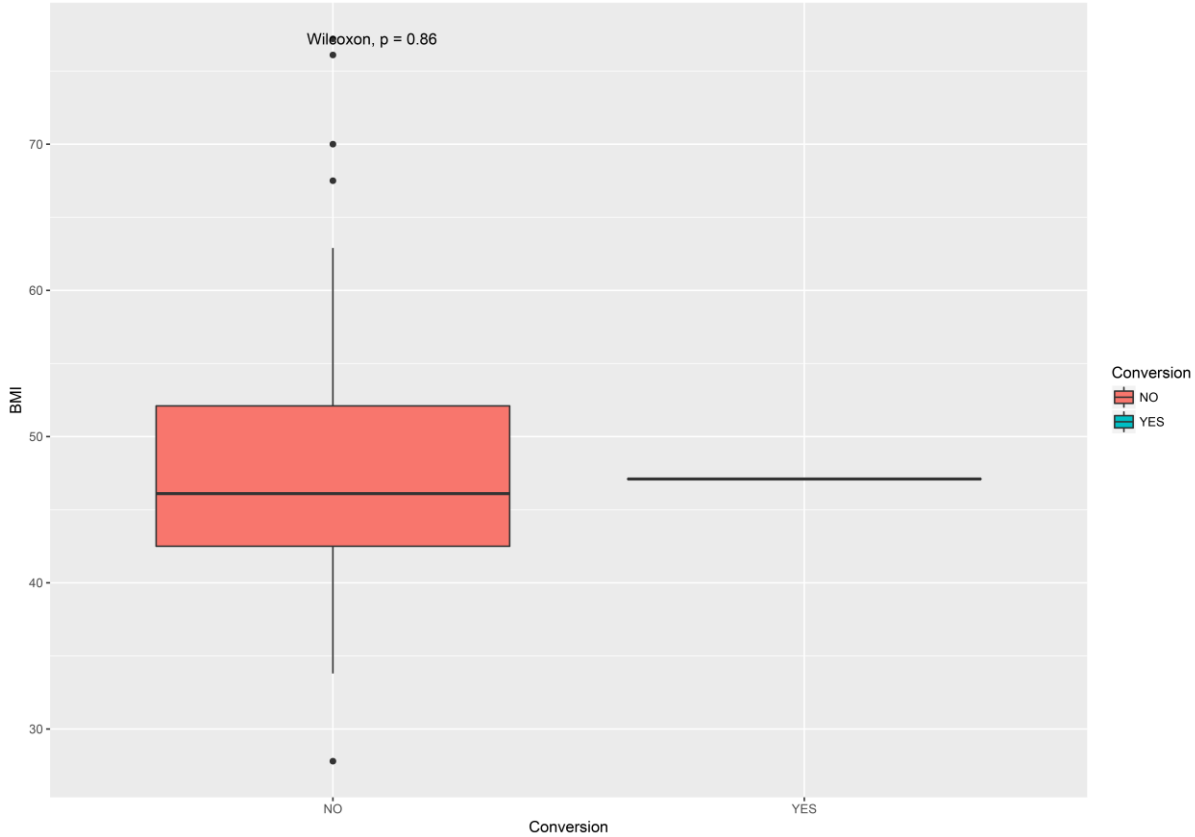

Figure 4. box plots showing the median and IQR of the BMI between patients with intraoperative conversion and those who have not.

DISCUSSION:

This study provides a new clue to the influence of BMI on the duration of the laparoscopic sleeve gastrectomy. Based on our results, there was no significant relationship between the BMI and length of the operation (P-value = 0.85). Furthermore, there was no significant difference between the long and short surgery based on BMI (P-value = 0.58). We also investigated the effect of BMI on the intraoperative complications; However, no difference in BMI between those who had complications and those who had not (P-value = 0.57).

The laparoscopic sleeve gastrectomy is mainly indicated for patients who are considered super obese (BMI>40 Kg/m^2) with risk of morbidity from the obesity [12,16]. The high BMI during this type of procedure was found to increase the morbidity and complications either perioperative and postoperative. Major et al. revealed that maximum preoperative weight and BMI on the day of operation was found to be associated with high risk of complications [30]. They found that the longer duration of LSG, the more complications will be. The surgeons should be warned that the increased duration predicted the occurrence of post-operative complications [30]. That's why we investigated the BMI as a potential determining risk factor for the duration of the procedure. Another study found that increase the duration of the LSG, increased the risk of perioperative complications by 160% [31]. The BMI is one of the determining factors of the number of stapler firing which would increase the risk of anastomotic leakage as in cases of colon cancer but unfortunately it was not investigated in LSG [32]. Major et al. found that the increased stapler firing caused increase of perioperative complications [30].

The BMI was also included as one of predictor of complications in sleeve gastrectomy in Aminian calculator [25]. Sanni et al reported that the main independent risk factor for perioperative complication is age and BMI [33]. In addition, they found that one-point increase in BMI was associated with 2% increase in post-operative complications [33]. Andreini et al. found that preoperative weight loss decreased the operative and post-operative complications [34].

We did not find a study on literature that assessed the BMI effect on the duration of the LSG. Instead, there are studies that reported the duration of the surgery and we compared it to our study. Tucker et al. found that the mean duration of the LSG was 60 minutes. The reported BMI is considered the same as our study but, yet it has less operative duration [35]. Furthermore, Kehagias et al. conducted a randomized clinical trial and they found that the mean duration of LSG was 126 minutes [36]. The BMI is considered the same as our study and still the duration of the LSG is much longer than our study. However, these results do not fully support our results due to lack of statistical tests. There are almost no studies in literature that investigated the effect of BMI on the duration of LSG. However, it is well documented in other surgeries. Klasen et al reported that there was no effect of BMI on the duration of surgery or post-operative complication [37]. The laparoscopic cholecystectomy was also found to have a longer duration with higher BMI [387]. However, it was not related to intraoperative complication rates and conversion to open type of surgery [38]. These results support our results that there was no effect of BMI on the intraoperative and conversion rate. Other studies reported the deleterious effect of BMI on the infection rate and intraoperative complications [38-43]. The duration of laparoscopic surgeries was found to be elongated in higher BMI [38, 40,41]. The effect of BMI on the duration of LSG and intraoperative complications needs to be addressed more in the literature. This is crucial to decrease intraoperative complications by decreasing pre-operative BMI.

In conclusion, the BMI did not have effect on the duration of LSG and intraoperative complications.

Limitations

The small number of intraoperative complications and conversion in our cohort did not allow for accurate estimation of the risk of BMI on the intraoperative complications.

CONCLUSION:

Based on our results, there was no significant relationship between the BMI and length of the operation and intraoperative complications.

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