The Impact of Obesity on Total Laparoscopic Hysterectomy Outcomes: A retrospective Analysis Comparing class I, II Obese Women versus Nonobese in Benha University Hospital

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Abstract

Background: Obesity is a prevalent health concern worldwide, affecting various aspects of patient care and surgical outcomes. Total laparoscopic hysterectomy (TLH) is a common gynecological procedure, but its impact on obese patients remains an area of interest. Understanding the perioperative challenges and financial implications associated with TLH in obese individuals is crucial for optimizing patient care and resource allocation.

Objectives: to assess perioperative problems and financial outcomes in obese who undergo total laparoscopic hysterectomy (TLH), in comparison to nonobese.

Patients and methods: A retrospective cohort study conducted on patients who underwent TLH at Benha university hospital and private centers over 5 years, to compare the TLH outcomes between class 1 and 2, with BMI between 30-39.9 kg/m2and nonobese with BMI 18.5 - 29.9 kg/m2.

Results: Among the 360 patients, who underwent TLH, 140 were obese (class 1 or 2) and 220 were nonobese. Surprisingly, there were no statistically significant differences in intraoperative complications between the two groups (P>0.05). However, the impact of obesity class on clinical and financial outcomes was evident. Obese patients experienced longer hospital stays, increased operative blood loss, higher drug consumption, and elevated costs. Notably, the incidence of surgical site infections and overall postoperative complications was significantly higher in obese patients (P<0.05).

Conclusion: Successful execution of TLH is feasible in obese patients, despite the higher adverse perioperative clinical and financial consequences associated in obese class 1 and 2 patients when compared to nonobese patients.

Keywords: Obese; BMI; Laparoscopic Hysterectomy; Hysterectomy.

DOI: 10.21608/SVUIJM.2024.295602.1888

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Received: 1 June,2024.

Revised: 20 June,2024.

Accepted: 22 June,2024

Published: 24 June, 2024

Cite this article as: Shreen Naguib Aboelezz Moselhy, Ahmed Kasem Mohamed Zain Eldin, Ahmed Sabra Ibrahim Mohammed Sabra.(2024). The Impact of Obesity on Total Laparoscopic Hysterectomy Outcomes: A retrospective Analysis Comparing class I, II Obese Women versus Nonobese in Benha University Hospital. *SVU-International Journal of Medical Sciences*. Vol.7, Issue 2, pp: 169-182.

Introduction

The World Health Organization (WHO) categorizes obesity into three categories according to body mass index (BMI): class 1 for a BMI extending from 30 to 34.9 kg/m2, class 2 (also known as very obese) for a BMI ranging from 35 to 39.9 kg/m2, and class 3 (referred to as seriously obese) for a BMI equal to or above 40 kg/m2. The incidence of obesity has experienced an upward trend in recent decades. The prevalence of obesity among females globally is estimated to be around 13.8% (**NCD Risk Factor Collaboration, 2017; Flegal et al., 2012; World Health Organization, 2021; Centers for Disease Control and Prevention, 2021**).

The frequency of obesity in European women ranges from 6.2% to 36.5% **(Berghofer et al., 2008)**, while in the United States, over thirty percent of the adult population (34.9%) is classified as obese **(Flegal et al., 2012; Centers for Disease Control and Prevention, 2021; Ogden et al., 2013)**, and in Canada in 2019, 22% of adult women were obese and 31% were overweight **(Statistics Canada, 2020; Health Canada, 2003)**. In Egypt according to the survey of "100 million health" 39.8% of adult Egyptian women suffered from obesity (BMI >= 30 kg/m^2). Hysterectomy ranks as the second most prevalent gynecological operation, following the caesarean section, and extensively studied **(Pickett et al., 2023; Aarts et al., 2015; Nieboer et al., 2009)**. Various approaches, including vaginal (VH), laparoscopic (LS), robotic (RH)-assisted laparoscopic hysterectomy (RTLH), and open abdominal (TAH) techniques, can be employed in general both in obese as well as non-obese **(Johnson et al., 2006; Neis et al., 2016; Gendy et al., 2011)**.

The preferred method in obese women, whatever its class continues to be a subject of controversy **(Tyan et al., 2020; Brunes et al., 2021; Guraslan et al., 2015)**. Multiple studies have provided evidence indicating that obesity is associated with an elevated incidence of significant problems in the context of LS hysterectomy, a higher likelihood of conversion to laparotomy (LT), and a longer average duration of the surgical procedure **(Capozzi et al., 2019; Blikkendaal et al., 2015; Rajadurai et al., 2022)**. However, contrasting findings have been reported by certain research, which suggest no discernible effects **(Tyan et al., 2020; Rajadurai et al., 2022)**.

The main purpose of this retrospective cohort study was to assess the occurrence of perioperative, early, and late postoperative problems mainly up to 30 days postoperatively in women with a class 1 and 2 obesity who underwent non-radical, for benign indications LS hysterectomy, namely total laparoscopic hysterectomy (TLH) at obstetrics and gynecologic department in Benha University Hospital (BUH) and private centers where the TLH performed by BUH staff members. Furthermore, the goal of this study was to appraise the incidence of problems in relation to BMI among individuals classified as class 1 obese and 2 obese who underwent TLH, in a step to quantifying impact of class 1, 2 obesity on TLH in Egyptian communities, as such studies does not exist in Egyptian literatures. Increased knowledge of perioperative morbidity in context with TLH in class 1, 2 obesity, may aid the gynecologic surgeon in making the most appropriate decision and measures for this high- risk populations to enhance surgical care afterward for those with the greatest need.

Patients and methods

This is a retrospective cohort study was conducted at Obstetrics and gynecology department, BUH, a tertiary care institution renowned for its comprehensive medical services, Benha, Egypt and some private centers. The study spanned from January 2018 to September 2023. The study was approved by the

Institutional Review Board (IRB) of Benha Faculty of Medicine (No: RC: 15-12-2023). Considering the retrospective nature of the study, the necessity for individual patient consent was ignored. However, all patient data were anonymized and de-identified to ensure confidentiality.

Patients who underwent total laparoscopic hysterectomy (TLH) during the study period were identified from the patient's medical records and relevant parameters were extricated and organized.

We Involved patients in this retrospective cohort study, if they had all the subsequent criteria: (1) patient was with BMI less than 40 Kg/m2 and more than 18.5 kg/m2, (2) patient's age were equal to or more than 18 years old, (3) patients who accomplishing of general anesthesia to do TLH, (4) patients who accomplishing of hysterectomy via laparoscopic route, (5) patients were with benign uterine illnesses, (6) patients were with clinical follow-up till completely healed or complete up to or beyond 30 days postoperatively follow up, (7) patients were with their Complete medical records available for review **(Tyan et al., 2020; Brunes et al., 2021; Guraslan et al., 2015)**.

We excluded patients from this retrospective analysis, if they had one or more of the following criteria: (1) patient were with suspected malignancy, (2) patients found to be second-degree uterine decent or more after achievement of the anesthesia, (3) patients with BMI greater than 40 Kg/m2 (morbid obese or class 3 obesity) and under than 18.5 kg/m2 (underweight) (4) patients were with incomplete medical records or missing data pertinent to the study or who unsuccessful to be shadowed until completely healed or complete 30 days postoperatively **(Rajadurai et al., 2022)**.

For each eligible patient, the following pre-intra- post-operative data were extracted from the medical records:

A)- The collected pre-operative information involved demographic details as age, height, weight, body mass index (BMI) was calculated as weight in kilograms divided on height in meters squared and was graded depending on to the WHO classification scheme including underweight (<18.5 kg/m2), normal weight (18.5−24.9 kg/ m2), overweight (25−29.9 kg/ m2),class 1 obesity (30−34.9 kg/ m2), class 2 obesity (35−39.9kg/ m2), and class 3 obesity (≥40 kg/ m2), parity, medical history as indications for hysterectomy, comorbid conditions as diabetes mellitus, hypertensive morbidity, renal disorders, orthopedics issues, hepatic disorders, and airway obstructive diseases, previous abdominal or vaginal surgery.

B)- The collected intra-operative data were surgical details as duration of surgery defined total operative room (OR) time from the entrance to the discharge from the OR including the actual surgical time from the skin incision to the skin closure, type of anesthesia in this study the anesthesia type was endotracheal controlled inhalational general anesthesia in all patients, intraoperative complications, blood loss in this study was the collected blood in suction devices after subtraction of washing saline volume, additional procedures such as bilateral salpingo-oophorectomy (BSO), bilateral salpingectomy (BS), ovarian cystectomy, restore of damaged visceral organ as urinary bladder or intestine, morcellation techniques to extract the uterine tissues either vaginally or through electromechanical morcellation or thought mini-laparotomy manual morcellation, Intra-operative complications involved major blood vessel or organ injury (including bowel, bladder and ureter) and necessity for blood transfusion.

C)- The collected post-operative information were the duration of hospital stay (LOS) defined as time from discharge from OR till the discharge from hospital, HB concentration (CBC) in gm/dl,

hematocrit value in %, return to theatre, postoperative complications as pelvic or vault hematoma, vault cellulitis, vault dehiscence, vault abscess, abdominal wound status either resulted from TLH trocar cuts or from laparotomy wound in conversion cases to abdominal route involving cellulitis, seroma collection, superficial surgical site infection, deep wound infection, organ space infection, dehiscence, length of wound maintenance , need for reoperation for wound problem, and readmission rates for wound related indications, necessity to reoperate on wound sequels, pulmonary consequences as reintubation, extended cumulative intubation of more than 48 hours, and pneumonia, thromboembolic consequences as cerebrovascular accident, pulmonary embolism (PE), and deep vein thrombosis (DVT), cardiac consequences as acute myocardial infarction (MI) and cardiac arrest, sepsis-related consequences as pelvic infection, urinary tract infection, sepsis and septic shock, renal consequences as renal insufficiency and dialysis mortality within 30 days; hospital readmission within 30 days, extended LOS, defined as hospitalization for more than 3 days after surgery, as well as other medical situations deterioration.

We categorized the expenses into three groups: admission expenses, anesthesia charges, and surgery costs. Admission expenses included fees for the hospital ward, pre- and postoperative care, and any extra costs related to complications after surgery. Anesthesia charges only included the cost of procuring the necessary medications for anesthesia during the procedure. Surgery costs covered the expenses for operating materials but did not include additional fees for elective procedures or any government payments. To estimate costs, we assessed the pricing of nearby private centers at the time of writing this document **(Pickett et al., 2023; Aarts et al., 2015; Nieboer et al., 2009)**.

Patients were then categorized based on their BMI into two groups, a)- Nonobese group (control group) (18.530 kg/m2<BMI < 30 kg/m2), included both normal and overweight b)- obese group (study group), included both class 1 obese (BMI 30.0–34.9 kg/m2) and Class 2 obese (BMI 35.0–39.9 kg/m2).Our study primary question was does obesity class 1, 2 obesity (study group) affects perioperative outcomes when compared to nonobese (control group). For this analysis, we collected and anonymized data on all women involved.

Statistical analysis

We performed statistical evaluation by IBM SPSS version 25 statistical software for Windows desktop (Armonk, NY, USA). We utilized descriptive statistics to sum up the demographic, clinical characteristics of the study population and financial expense. We present continuous variables as mean ± standard deviation (SD) and range, while the categorical variables were presented as frequencies and percentages. Comparative analyses between groups were performed by unpaired independent two samples Student's t-test to compare continuous variables and Chi-square or Fisher's exact test for categorical variables, as appropriate. A two-sided p-value of less than 0.05 was considered statistically significant.

Results

In this retrospective investigation, a total of 360 women who underwent TLH were included. Among them, 140 women were obese (BMI 30-39.9 kg/m2) (index group), while 220 women were nonobese (BMI 18.5-29.9 kg/m2) (control group). The data was collected from January 2018 to September 2023, from Benha University hospitals and private clinics.

In (**Table.1**), we present the clinical and demographic characteristics of obese & nonobese women who had undergone TLH. Women in both index and control groups were significantly different as

regards BMI, age, percentage who had hypertension (HTN), diabetes mellitus (DM), uncontrolled DM, Pre- Operative Glycated Hemoglobin A1C (POHBA1C), Length of Preoperative Administration (LOPA), American Society of Anesthesiologists (ASA2, ASA 3), Endometrial Hyperplasia (EH), which were higher in obese group (P>0.05), all this items were the primary differences between the index and the control group as by definition a BMI≥30 kg/m2 categorized as ASA2. As regards parity, percentage of Post-menopausal, Clinical uterine size (weeks), Ultrasound uterine volume (mm3), absent prior vaginal birth, preoperative hemoglobin (gm/dl), the cause for hysterectomy except EH both groups show no statistically significant differences. Also, it is well-known that higher BMI is linked more to comorbidities such as DM, HTN, uncontrolled DM, higher HBAIC which need longer preoperative hospital admission to be controlled.

Table 1. Demographic and clinical features of patients who underwent TLH in non-obese (BMI 18.5-29.9 kg/m^2) and obese (BMI 30-39.9 kg/m^2) groups

Variable	non-obese (BMI 18.5-29.9 kg/m2) (n=220)	obese (BMI 30-39.9 kg/m2) (n=140)	(95% CI)	P value
- BMI (kg/m2)	27.4 ±6.7 (18.5– 29.9)	35.3 ± 9.6 (30.5 – 39.9)	7.9 (6.21 to 9.59)	0.001
- Age (year)	43.3 ± 6.3 (37–58)	44.8 ± 7.5 (40–55)	1.5 (0.06 to 2.94)	0.04
- Parity	2.6 ± 1.6 (0 - 5)	2.9 ± 1.5 (0 – 7)	0.3 (0.03 to 0.63)	0.76
-Post-menopausal	96 (43.6%)	55 (39.3%)	4.3% (6% to 14%)	0.76
- CUS (weeks)	10.3 ± 5.5 (6–14)	11.1 ± 6.8 (6 – 14)	0.8 (0.48 to 2.08)	0.22
- USUV Cm3	90 ± 30 (70 – 150)	95 ± 140 (70 – 150)	5 (14.2 to 24.2)	0.6
- Nulliparity	15 (6.8%)	10 (7.1%)	0.3% (4% to 6%)	0.91
-Absent of prior VD	36 (16.4%)	24 (17.1%)	0.7% (6% to 8%)	0.86
- PO HB (g/dl)	10.6 ± 4.3 (9.8-12.1)	10.4 ± 3.2 (9.9-12.2)	0.2 (1.03 to 0.63)	0.63
- PO hematocrit %	36.8 ± 7.9 (30.6-40.5)	36.3 ± 7.6 (30.4-39.7)	0.5 (2.15 to 1.15)	0.55
- PO transfusions	9 (4%)	6 (4.3%)	0.3% (3% to 5%)	0.88
- Prior CS	65 (29.5%)	34 (24.3%)	5.2% (4% to 14%)	0.28
-Prior AS&VS & Type **Laparoscopy** **Midline** **laparotomy/Pfannenstiel** **LLETZ/cone/vagina** **Multiple/combination procedures**	 63 (28.6%) 32 (14.5%) 11 (5%) 11 (5%) 9 (4%)	 37 (26.4%) 19 (13.6%) 9 (6.4%) 5 (3.6%) 2 (1.4%)	 2.2% (7% to 11%) 0.9% (6% to 7%) 1.4% (3% to 7%) 1.4% (3% to 5%) 2.6% (1% to 6%)	 0.65 0.81 0.57 0.53 0.16
Comorbidity: **- HTN** **- DM** **- uncontrolled DM**	 10 (4.5%) 8 (3.6%) 4 (1.8%)	 65 (46.4%) 35 (25%) 16 (11.4%)	 41.9% (33% to 50%) 21.4% (14% to 29%) 9.6% (4% to 16%)	 0.001 0.001 0.001

-POHBA1C (%) **-LOPA (days**	6.1 ± 3.6 (4.4%-11.4%) 2.9 ± 2.3 (2-8)	8.3 ± 3.7 (4.9-12.5%) 6.5 ± 4.2 (2-10)	2.2 (1.42 to 2.97) 3.6 (2.92 to 4.27)	0.001 0.001
-ASA score : - **ASA 1** - **ASA2** - **ASA3** - **ASA4**	 105 (47.7%) 94 (42.7%) 18 (8.2%) 3 (1.4%)	 0 (0%) 102 (72.9%) 30 (21.4%) 2 (1.43%)	 47.7% (40% to54%) 30.2% (19% to 39%) 13.2% (5% to 21%) 0.03% (2% to 3%)	 0.001 0.001 0.003 0.98
- Indication for hysterectomy: **- Leiomyoma** **- AUB** **- EH** **-Adenomyosis** **- Pain/endometriosis** **-CIN** **-Genetic prophylaxis** **-Other**	 87 (39.5%) 43 (19.5%) 20 (9%) 35 (16%) 35 (16%) 13 (6%) 7 (3.2%) 14 (6.4%)	 59 (42.1%) 42 (30%) 25 (17.8%) 25 (17.8%) 15 (10.7%) 12 (8.6%) 6 (4.3%) 12 (8.6%)	 2.6% (7% to 12%) 10.5% (1% to19%) 8.8% (1% to 16%) 1.8% (5% to 10%) 5.3% (2% to 12%) 2.6% (2% to 8%) 1.1% (2% to 6%) 2.2% (3% to 8%)	 0.62 0.02 0.01 0.66 0.16 0.35 0.6 0.43
- Financials **Private** **Non private**	 140 (63.5%) 80 (36.4%)	 80 (57%) 60 (43%)	 6.5% (3% to 16%) 6.6% (3% to 16%)	 0.22 0.21

Abbreviations: TLH: Total laparoscopic Hysterectomy, BMI: Body Mass Index, HTN: Hypertension, USUV: Ultrasound uterine volume, CUS: Clinical uterine size, DM: Diabetes Mellitus, VD: vaginal delivery, PO: preoperative, CS: Cesarean section, AS: abdominal surgery, VS: vaginal surgery AUB: Abnormal uterine Bleeding, EH: Endometrial Hyperplasia, CIN: Cervical Intraepithelial Neoplasia. POHBA1C: Pre-Operative Glycated Hemoglobin A 1C, LOPA: Length of Preoperative Administration, ASA: American Society of Anesthesiologists - Values were given as mean ± standard deviation (range) or number (percent). - P<0.05: Statistically significant.

In (**Table.2**), we present the intraoperative outcomes data of obese & nonobese women who underwent TLH. THE total operative room (OR) time (min) was significantly longer (115 vs.125, P= 0.004) and operative blood loss (OBL)(ml)was significantly excess in obese group (245 vs.295, P= 0.0001). While as regards the type of anesthesia, morcellations techniques, Additional practices as BS, BSO, Debulking, Conversion to TAH, postoperative (PO) uterine weight and its category, intraoperative complications including unintended visceral injuries, as vesical injuries, intestinal injuries, ureteral injuries, vascular injuries, blood transfusion, conversion to laparotomy, total intraoperative (IO) complications, bleeding requiring conversion, anesthetic complications, retroperitoneal hematoma, there were no differences between groups (P>0.05).

Table 2. Comparison of intra-operative consequences of patients who underwent TLH in non-obese (BMI 18.5-29.9 kg/m^2) and obese (BMI 30-39.9 kg/m^2) groups

Outcome	**non-obese (BMI 18.5-29.9 kg/m2) (n=220)**	**obese (BMI 30-39.9 kg/m2) (n=140)**	**(95% CI)**	**P value**
Total OR time (min)	115 ± 30 (50–200)	125 ± 35 (50-200)	10 (3.19 to 16.81)	0.004
OBL (ml)	245 ± 90 (50-	295 ± 80 (50 -	50 (31.66 to 68.34)	0.0001

	1500)	1500)		
IO blood transfusion	11 (5%)	9 (6.4%)	1.4% (3.38% to 7.16%)	0.57
General anesthesia **Endotracheal tube**	220 (100%) 220 (100%)	140 (100%) 140 (100%)	0% (2.67% to 1.71%) 0% (2.67% to 1.71%)	
Morcellations techniques **Vaginal** **Electromechanical**	40 (18.2%) 30 (13.6%) 10 (4.5%)	30 (21.4%) 22 (15.7%) 8 (5.7%)	3.2% (5.01% to 11.97%) 2.1% (5.15% to 10.05%) 1.2% (2.36% to 6.74%)	0.45 0.58 0.61
IO complications **- vesical injuries** **- intestinal injuries** **- ureteral injuries** **- vascular injuries** **- blood transfusion** **-conversion to laparotomy** **- unintended organ injury** **- total IO complications** **- bleeding requiring conversion** **- anesthetic complications** **- retroperitoneal hematoma**	 9 (4%) 3 (1.4%) 3 (1.4%) 3 (1.4%) 7 (3.2%) 14 (6.4%) 15 (6.8%) 31 (14%) 7 (3.2%) 8 (3.6%) 3 (1.4%)	 7 (5%) 4 (2.9%) 3 (2.1%) 6 (4.3%) 8 (5.7%) 14 (10%) 14 (10%) 28 (20%) 5 (3.6%) 11 (7.9%) 4 (2.9%)	 1% (3.31% to 6.31%) 1.5% (1.63% to 5.87%) 0.7% (2.23% to 4.75%) 2.9% (0.56% to 7.74%) 2.5% (1.77% to 7.91%) 3.6% (2.05% to 10.19%) 3.2% (2.5% to 9.8%) 6% (1.78% to 14.38%) 0.4% (3.43% to 5.21%) 4.3% (0.5% to 10.2%) 1.5% (1.63% to 5.87%	 0.65 0.32 0.61 0.09 0.25 0.21 0.28 0.13 0.84 0.76 0.32
Additional practices **- BS** **- BSO** **- Debulking** **- Conversion to TAH**	 140 (63.5%) 80 (36.4%) 70 (31.8%) 14 (6.4%)	 88 (63%) 52 (37.1%) 40 (28.6%) 14 (10%)	 0.5% (9.49% to 10.74%) 0.7% (9.29% to 10.94%) 3.2% (6.66% to 12.58%) 3.6% (2.05% to 10.19%)	 0.92 0.89 0.52 0.21
-PO uterine weight(g)	110 ± 55 (60 – 300)	100 ± 45 (280 – 300)	10 (20.91 to 0.91)	0.7
-Uterus weight (category) **-Small (<100 g)** **-large (up to 300 g)**	 130 (59%) 90 (41%)	 90 (64.3%) 50 (35.7%)	 5.3% (5.03% to 15.25%) 5.3% (5.05% to 15.25%)	 0.31 0.31

Abbreviations: TLH: Total laparoscopic Hysterectomy, BMI: Body Mass Index, OR: operative room, OBL: Operative blood loss, ∟(95% CI): Point estimate difference with 95% confidence interval, BS: Bilateral salpingectomy, BSO: Bilateral Salpingo-Oophorectomy, IO: intraoperative, PO: postoperative, TAH: total abdominal hysterectomy. Values were given as mean ± standard deviation(range) or number (percent). P<0.05: Statistically significances

In (**Table.3**), we present the early and late postoperative outcomes data in our TLH in obese & nonobese retrospective review. The obese group was with significant (P<0.05) more consumption of analgesics both narcotics and non-steroidal anti-inflammatory drugs (NSAID), also more women in obese group express more PO nausea & vomiting, required more time to get out of bed, to pass flatus, to be discharged from the hospital, return to usual activity time, resumption of coitus and utilization of venous thromboembolism (VTE) prophylaxis. The

wound related consequences, surgical site infection (SSI), reoperation for wound, Total PO complications, LOS more than 3 days, return to emergency department (ED), readmission within 30 days and Estimated Costs, as admission expense, anesthesia expense, operation expense were significantly higher in obese group (P>0.05).

Table 3. Comparison of early and late postoperative consequences of patients who underwent TLH in non-obese (BMI 18.5-29.9 kg/m2) and obese (BMI 30-39.9 kg/m^2) groups.

Outcome	non-obese (BMI 18.5-29.9 kg/m2) (n=220)	obese (BMI 30-39.9 kg/m2) (n=140)	(95% CI)	P value
PO severe pain - at 6h **- at 24 h**	198 (90%) 145 (66%)	125 (89.3%) 95 (65.8%)	0.7% (5.52% to 7.73%) 0.2% (9.59% to 10.31%)	0.83 0.97
Analgesic requirements over 24h **-Total narcotic (mg)** **-Total parental NSAID (mg)**	22.8 ± 8.2 (10-50) 190 ± 85 (100-300)	28.2 ± 10.8 (10-50) 230 ± 90 (100-350)	5.4 (3.42 to 7.37) 40 (21.5 to 58.5)	0.0001 0.0001
PO nausea & vomiting	179 (81.4%)	132 (94.3%)	12.9% (6% to 19.2%)	0.0005
PO blood transfusion	8 (3.6%)	6 (4.3%)	0.7% (3.38% to 5.77%)	0.74
Perioperative BT	19 (8.6%)	15 (10.7%)	2.1% (4% to 9%)	0.5
Time to get out of bed (h)	6.5 ± 4.6 (2-15)	8.9 ± 5.6 (2-16)	2.4 (1.33 to 3.46)	0.0001
Time to flatus(h)	7.8 ±6.2 (3-24)	12.8 ± 8.8 (4-30)	5 (3.44 to 6.55)	0.0001
Absolute change in HB (g/dl)	1.3 ±0.9 (0.8-1.8)	1.5 ± 0.9 (0.9-1.9)	0.2 (0.009 to 0.39)	0.04
LOS (days)	1.7 ±0.9 (0.8-12)	2.9 ± 1.9 (1-15)	1.2 (0.9 to 1.5)	0.0001
Return to usual activity time (d)	18.6 ± 9.6 (9-50)	26.9 ± 11.9 (10-49)	8.3 (6.05 to 10.54)	0.0001
Resumption of coitus(d)	48.6 ± 23.4 (29-150)	55.5 ± 25.8 (37-120)	6.9 (1.72 to 12.07)	0.009
Febrile morbidity	90 (41%)	70 (50%)	9% (1.5% to 19.3%)	0.09
Vaginal spotting	125 (57%)	70 (50%)	7% (3.5% to 17.4%)	0.19
Pelvic cellulitis	11(5%)	14 (10%)	5% (0.43% to 11.46%)	0.07
Cystitis	80 (36.4%)	65 (46.4%)	10% (0.37% to 20.24%)	0.06
SSI within 30 d	12 (5.5%)	26 (18.6%)	13.1% (6.32% to 20.71%)	0.0001
Wound complications	18 (8.2%)	29 (20.7%)	12.5% (5.16% to 20.51%)	0.0006
Reoperation for	7 (3.2%)	11 (7.9%)	4.7% (0.02% to 10.6%)	0.05

wound				
Need for VTE prophylaxis(d)	15 (7%)	34 (24.3%)	17.3% (9.7% to 25.5%)	0.0001
Duration of VTE prophylaxis(d)	0.4 ± 0.3 (0.5-2.5)	3.9 ± 2.6 (0.5-9)	3.5 (3.15 to 3.84)	0.0001
PO vaginal length(cm)	7.9 ± 1.4 (7-10)	7.8 ± 1.6 (7-10)	0.1 (0.41 to 0.21)	0.53
Vesicovaginal fistula	2*(0.9%)	2**(1.4%)	0.5% (2.05% to 4.17%)	0.66
Ureterovaginal fistula	2*(0.9%)	3**(2.1%)	1.2% (1.52% to 5.2%)	0.34
Total PO complications	140 (63.6%)	130 (93%)	29.4%(21.22%to36.67%)	0.0001
LOS more than 3 days	25 (11.4%)	35 (25%)	13.6% (5.52% to 22.14%)	0.0008
Return to ED	68 (31%)	54 (38.6%)	7.6% (2.37% to 17.66%)	0.14
Readmission within 30 days	41 (18.6%)	39 (27.9%)	9.3% (0.47% to 18.47%)	0.04
Estimated Costs* admission expense anesthesia expense operation expense	1.6±0.4(1.4-3.9) 1.4±0.8(1.1-3.6) 4.41.2(4.2-5-5)	2.1±0.4(1.7-4.8) 2.5±1.9(1.7-3.9) 4.9±1.5(4.3-5.8)	0.5 (0.42 to 0.59) 1.1 (0.82 to 1.38) 0.5 (0.22 to 0.78)	0.0001 0.0001 0.05

Abbreviations: TLH: Total laparoscopic Hysterectomy, BMI: Body Mass Index, PO: Postoperative, ∟(95% CI): Point estimate difference with 95% confidence interval, NSAID: Non-steroidal anti-inflammatory drugs, VTE: venous thromboembolism, LOS: length of PO stay in hospital, IO: Intra-operative, SSI: surgical site infection, ED: emergency department, BT: blood transfusion, h: hours, d: days, *: costs were estimated in Egyptian currency. Values were given as mean ±standard deviation or number (percent). P<0.05: Statistically significant.

Discussion

TLH advantages over TAH for benign disorders are well confirmed and widely accepted in medical practice, as supported by previous prospective, retrospective, and meta- analytical studies **(Sehnal et al., 2022; O'Hanlan et al., 2021)**.

Also, the feasibility and safety of TLH in obese women have been well-documented by previous prospective, retrospective, and meta-analytical studies **(McMahon et al., 2014; Locher et al., 2023; Heinberg et al., 2004)**. However, some of these studies found associations between increasing BMI especially over 40 kg/m^2 and elevated rates of peri-operative clinical and financial consequences as compared to those with a body mass index (BMI) within the normal range. Moreover, these studies reported superiority of TLH over TAH in obese and morbid obese when compared with nonobese and, reported that, there is underutilization of other minimally invasive hysterectomy (MIH) as total vaginal hysterectomy (TVH) in obese and morbid obese **(Chopin et al., 2009; O'Hanlan et al., 2006; Shah et al., 2016; Fanfani et al., 2015)**.

Our retrospective cohort study was to investigate the correlation between BMI between 18.5-39.9 kg/m^2 and the associated perioperative clinical and financial consequences, including the estimated costs of TLH. Our results showed that the group classified as obese, BMI between 30-39.9 kg/m^2, when compared to nonobese, with BMI between

18.5-29.9 kg/m^2, exhibited higher perioperative adverse consequences across numerous preoperative, intraoperative, postoperative entities as well as elevated expenditures across many categories, including total admission costs, operation costs, and overall expenses encompassing readmissions **(Davenport et al., 2013)**. Our study found a correlation between obesity class 1, 2 and preoperative comorbidity as HTN, DM, uncontrolled DM, POHBA1C (%), LOPA (days), ASA 2, ASA 3 scores, Indication for hysterectomy, namely, EH as results reported across recent literatures **(Kondo et al., 2012; Le Neveu et al., 2022; Davidson et al., 2022)**. Also, our retrospective analysis found a correlation between obesity class 1, 2 and intraoperative adverse events, where obese women who underwent TLH were needed more time in operative theater and associated with more operative blood lose, literatures regrades the items were variable where some found impact obesity in general , some found that impact was limited to more higher BMI of morbid obesity, however more confounder could impact such items as surgeon experience as well operative theater facilities and personals **(Cybulsky et al., 2022; Mikhail et al., 2015; Siedhoff et al., 2012)**. A lot of postoperative events found to linked with BMI of 30-39.9 kg/m^2 in our study, including more need for analgesics both narcotics and non-steroidal anti-inflammatory drugs (NSAID), also more prevalence of PO nausea & vomiting, required more time to get out of bed, to pass flatus, to be discharged from the hospital, return to usual activity time, resumption of coitus and more utilization of venous thromboembolism (VTE) prophylaxis, prior studies in either in line with our results or limits the adverse event to obese women with higher BMI **(Brunes et al., 2021; Siedhoff et al., 2012)**. The wound related consequences, surgical site infection (SSI), reoperation for wound, Total PO complications, LOS more than 3 days, return to emergency department (ED), readmission within 30 days and Estimated Costs, as admission expense, anesthesia expense, operation expense were found to higher in association with the obese group like results of recent report concentrate on both clinical and financial consequences of TLH in Australia **(Sehnal et al., 2022)**, Canada **(Davidson et al., 2022)**, USA **(Brunes et al., 2021; O'Hanlan et al., 2021; Fanfani et al., 2015; Le Neveu et al., 2022; Cybulsky et al., 2022; Siedhoff et al., 2012)**, Europa **(O'Hanlan et al., 2021; Locher et al., 2023; O'Hanlan et al., 2006; Shah et al., 2016; Mikhail et al., 2015)** and South Africa **(Heinberg et al., 2004)**.

The extended OR duration observed in this context could potentially be attributed to various variables, including but not limited to the increased complexity associated with parenteral access, the need for meticulous patient positioning and preparation prior to surgery, specific requirements for regional anesthetic, and the process of intubation. The higher total expenses seen in the obese population can be attributed to the extended duration of total theatre time and the increased duration of set-up/transfer time within this cohort, prolonged LOPA to investigate and correct the associated comorbidities, more drugs needed for anesthesia, analgesia, controlling PO nausea and vomiting, anticoagulant and prolonged length of postoperative hospital stay as mean differences as well as percentage of women with more than three days of LOS. So, results of prior research assess the influence of higher BMI on surgical complications on TLH as a treatment approach shows inconsistent results at least in obese women under BMI of 40 kg/m^2.

The present study exhibits certain limitations. The study had a retrospective and observational design, making it vulnerable to selection bias due to the lack

of randomization of patients based on surgical method. The presence of additional surgeries, such as BS, BSO, could potentially impact the results and introduce confounding factors. The charges in the Benha university hospital aren't reported in patients records or even calculated pre patients, so we considered nearby center in estimating the costs. Also, the generalizability of the results to other institutions may be limited as the research was carried out by a singular public institution professional. Our study strengths include utilization of a TLH for performing hysterectomy in obese and nonobese, therefore, patients with a high BMI may underwent TLH when TVH is inappropriate, evaluating an item with a lack of scientific consensus regarding the relationship between BMI of class 1, 2 obesity and perioperative clinical and financial consequences, larger sample size with 140 patients in obese group, covering topic inadequately addressed in Egyptian studies, assessment of confounders as possible, as our groups cohort were comparable regarding age, previous procedures, additional surgeries and type of payment including private and nonprivate.

The success and safety of TLH in patients with a BMI between 30 to 39.9 kg/m2 in our study, could be attributed to meticulous patient positioning, preoperative optimization, a collaborative team approach involving anesthesia, which incorporated a preoperative tilt of 40 degrees of operative table initially, collective decision to flatten the table if need, deflate the abdomen, and facilitate the elimination of elevated pCO2 levels, if they were needed for women safety. The reduction of the Trendelenburg angle was deemed unnecessary, since such an adjustment would have potentially affected the surgical efficacy. Based on the present cohort of cases, it is advisable for gynecological surgeons to acquire the necessary skills to perform TLH for patients with a BMI between 30 to 39.9 kg/m2. To establish the safety and feasibility of TLH in this particular group of patients who are at a higher risk, it is recommended that prospective randomized studies be conducted to compare the outcomes.

Conclusion

The findings of this study provide evidence in favor of the concept that obesity of class 1, 2 has an impact on the perioperative clinical and financial consequences in cases undergoing TLH. There was no discernible disparity observed in perioperative c clinical and financial consequences that may not be attributed to other cause than obesity of class 1, 2. To reduce the adverse perioperative clinical and financial consequences, it is imperative to employ specific strategies while carefully considering the surgical approach efficiency and proficiency as well as preoperative programmers of weight reductions. By doing so, it is possible to mitigate the adverse perioperative clinical and financial consequences associated with TLH in class 1, 2 obese women while maintaining high standards of quality and safety.

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