

The Impact of Body Mass Index on Clinical Characteristics and Treatment Outcomes in Endometrial Cancer Patients: A Comprehensive Analysis

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Introduction: This study investigates the influence of Body Mass Index (BMI) on clinical characteristics, the choice of treatment modalities, and their potential impact on treatment response and prognosis in endometrial cancer.

Materials and Methods: This retrospective cohort study analyzed individuals diagnosed with endometrial cancer who underwent gynecological surgical interventions. BMI was calculated as weight (kg) divided by height (m) squared and categorized into four subgroups: overweight (BMI 25-29.9), obesity class 1 (BMI 30-34.9), obesity class 2 (BMI 35-39.9), and obesity class 3 (BMI ≥ 40). Demographic and clinical data were extracted from medical records.

Results: Menopausal status differed across subgroups ($p=0.013$), with obesity class 3 showing a higher proportion of premenopausal women. Diabetes mellitus prevalence was higher in class 3 ($p=0.044$). The usage of radiotherapy, brachytherapy, chemotherapy, and radiochemotherapy were similar across subgroups, as were relapse rates. The most commonly performed surgery was TAH+BSO+PPLND across all subgroups, with the highest percentage in the obesity class 3 (68.4%). The distribution of surgery types showed no difference across BMI subgroups ($p=0.569$).

Conclusion: Our study highlights the potential influence of BMI on menopausal status and surgical treatment strategies in endometrial cancer patients. The findings emphasize the importance of considering BMI in managing endometrial cancer, given the rising global prevalence of obesity.

Keywords: BMI, endometrial cancer, treatment outcomes, surgical interventions

Introduction

The rising prevalence of obesity has spurred significant research interest in understanding its implications for various aspects of health (1). The Body Mass Index (BMI) (2), as an indicator of adiposity, has been widely employed to categorize individuals into different weight status groups (3). These categories, ranging from overweight to severe obesity, provide

insights into the potential health risks associated with differing degrees of adiposity (4). Given strongly increasing global prevalence of obesity, it is crucial to comprehensively explore its impact on various demographic and clinical characteristics and its potential influence on the medical intervention and the treatment outcomes (4, 5).

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Endometrial cancer, a prevalent gynecologic malignancy, poses a significant public health concern worldwide (6). It accounts for a substantial proportion of cancer-related morbidity and mortality among women (7). While various risk factors have been identified for endometrial cancer, BMI, an established measure of adiposity, has emerged as a critical player in its aetiology (8). Obesity has reached epidemic proportions, and its association with endometrial cancer risk has garnered considerable attention due to its potential to contribute to the increasing incidence of this malignancy (9). Obesity, characterized by excess fatty tissue, disrupts hormonal balance, leading to chronic inflammation, insulin resistance, and altered sex hormone production (10). These metabolic perturbations have been implicated in the pathogenesis of endometrial cancer, particularly in postmenopausal women (11). As a result, investigating the relationship between BMI and endometrial cancer has become a focal point in clinical and epidemiological research (7, 11, 12).

The complexity of endometrial cancer management extends beyond its initial diagnosis, encompassing surgical, medical, and radiotherapeutic interventions (13). The effectiveness of these treatments can be influenced by BMI (14). An in-depth analysis of how BMI affects the choice of treatment modalities and its impact on treatment response and prognosis is essential for tailoring therapeutic approaches to the unique needs of individual patients (15). By investigating the influence of BMI, we aim to contribute valuable insights that can inform evidence-based clinical decision-making. This study aims to evaluate the relationship between BMI and endometrial cancer treatment outcomes.

Materials and Methods

Study design

This retrospective cohort study investigates the intricate interplay between BMI subgroups

and a range of demographic and clinical variables in a cohort of individuals diagnosed with endometrial cancer who underwent gynaecological surgical interventions. We analysed clinical characteristics of individuals across different BMI subgroups.

Ethical Statement

This retrospective analysis was conducted following the Declaration of Helsinki and approved by the Hospital's Institutional Review Board (Date: 03/11/2022 – Approval: 10-01). All patient data were anonymized to ensure privacy and confidentiality.

Data Collection

Demographic and clinical data were extracted from medical records, including age, height, weight, parity, mode of delivery, menopausal status, marital status, employment status, monthly income, smoking history, diabetes mellitus, ECOG (Eastern Cooperative Oncology Group) score, comorbidity, and education level. BMI was calculated as weight (kg) divided by height (m) squared and categorized into four subgroups: overweight (BMI 25-29.9), obesity class 1 (BMI 30-34.9), obesity class 2 (BMI 35-39.9), and obesity class 3 (BMI ≥ 40). The types of operations were recorded: total abdominal hysterectomy+bilateralSalpingooophorectomy (TAH+BSO), total abdominal hysterectomy + bilateral salpingo-oophorectomy +pelvic lymph dissection (TAH+BSO+PLND), total abdominal hysterectomy+bilateral Salpingooophorectomy para-aortic lymph node dissection (TAH+BSO+PPLND), total laparoscopic hysterectomy+bilateral salpingooophorectomy (TLH+BSO), total laparoscopic hysterectomy + bilateral salpingo-oophorectomy with pelvic lymph node dissection (TLH+BSO+PLND), and total laparoscopic hysterectomy + bilateral salpingo-oophorectomy + para-aortic lymph node dissection (TLH+BSO+PPLND).

Statistical Analysis

Categorical variables were presented as numbers and percentages, while continuous

variables were summarized using means $\pm$ SD. As appropriate, comparisons between BMI subgroups were performed using the chi-square test or Fisher's exact test for categorical variables and one-way analysis of variance (ANOVA) or the Kruskal-Wallis test for continuous variables. All tests were two-sided; p -value <0.05 was considered significant. All the statistical analyses were conducted using [SPSS, IBM, USA].

Results

As seen in Table-1, there are no differences among the subgroups concerning age and height ($p=0.718$ and $p=0.061$, respectively). Examining reproductive history, parity did not differ across the subgroups ($p=0.879$). Additionally, the mode of delivery did not significantly differ among the subgroups ($p=0.268$). In terms of menopausal status, our analysis reveals a difference across the subgroups ($p=0.013$), with a higher percentage of premenopausal women in the obesity class 3 subgroup compared to other subgroups. We observed no marital and employment status differences among the subgroups ($p=0.738$ and $p=0.312$, respectively). There were no differences in monthly income and smoking habits across the subgroups ($p=0.559$ and $p=0.455$, respectively). We noted that diabetes mellitus was more prevalent in the obesity class 3 ($p=0.044$). However, there were no differences in the prevalence of comorbidity and ECOG ($p=0.236$). Education levels among the subgroups did not differ either ($p=0.079$).

As seen in Table-2, the usage of radiotherapy was higher in the obesity class 3 compared to others, but the difference was not significant ($p=0.155$). The proportion of patients receiving brachytherapy was slightly lower in the obesity class 2, with no difference among subgroups ($p=0.194$). The application of chemotherapy and radiochemotherapy were similar among the subgroups, with no distinctions ($p=0.982$ and $p=0.481$, respectively). Relapse rates were

similar across the BMI subgroups, with only the overweight and obesity class 2 having any relapses ($p=0.322$). Regarding grading, the obesity class 2 had a higher proportion of grade 3 patients. However, the differences were not significant ($p=0.093$).

The most commonly performed surgery across all subgroups was TAH+BSO+PPLND, with the highest percentage observed in the obesity class 3 subgroup (68.4%). This surgery was chosen in more than half of the individuals in each subgroup, ranging from 55% in obesity class 1 to 68.4% in obesity class 3. Conversely, TAH+BSO was the least performed surgery among the subgroups, with the lowest percentage in the class 3 and overweight subgroups, at 10.5%. Similarly, TLH+BSO+PLND and TLH+BSO+PPLND were infrequently performed across all subgroups. Interestingly, no individual in the obesity class 2 subgroup underwent TLH+BSO+PLND and no individuals in the overweight and class 3 experienced TLH+BSO+PLND. We found no difference when comparing the distribution of surgery types across the BMI subgroups ($p=0.569$).

Discussion

Our retrospective comprehensive analysis of the relationship between BMI subgroups and endometrial cancer treatment outcomes offers several key insights into the intricate interplay between BMI, characteristics, and treatment strategies for endometrial cancer patients. This study underscores the importance of considering BMI as a critical factor in managing endometrial cancer, given its potential influence on characteristics and treatment outcomes.

Novel studies have explored the connection between obesity and outcomes in treatment of endometrial cancer. In research by Kokts-Porietis et al. (16), obese endometrial cancer survivors faced higher recurrence risks. Ward et al. (17) found that cardiovascular diseases were the most common cause of death among women diagnosed with endometrial cancer.

Table-1. Demographic and clinical characteristics of individuals across different BMI subgroups

Variables		Subgroups	Overweight [n:38]	Obesity <i>Class 1</i> [n:40]	Obesity <i>Class 2</i> [n:34]	Obesity <i>Class 3</i> [n:19]	P value
Age (years)			58±9	59±8	58±9	56±11	0.718
Height (cm)			161±6	159±5	157±6	159±7	0.061
Weight (kg)			71±6	81±6	90±7	110±11	0.0001
BMI			27.7±1.4	32±1.4	36.8±1.2	43.3±2.3	0.0001
Parity	0		4 (10.5%)	3 (7.5%)	1 (2.9%)	1 (5.3%)	0.879
	1		5 (13.2%)	5 (12.5%)	6 (17.6%)	3 (15.8%)	
	2		29 (76.3%)	32 (80%)	27 (79.4%)	15 (78.9%)	
Mode of Delivery	No childbirth		4 (10.5%)	3 (7.5%)	1 (2.9%)	1 (5.3%)	0.268
	Vaginal		28 (73.7%)	31 (77.5%)	28 (82.4%)	12 (63.2%)	
	Cesarean		5 (13.2%)	5 (12.5%)	5 (14.7%)	3 (15.8%)	
	Both		1 (2.6%)	1 (2.5%)	0 (0%)	3 (15.8%)	
Menopausal Status	Premenopausal		9 (23.7%)	6 (15%)	13 (38.2%)	10 (52.6%)	0.013
	Postmenopausal		29 (76.3%)	34 (85%)	21 (61.8%)	9 (47.4%)	
Marital Status	Single		3 (7.9%)	3 (7.5%)	1 (2.9%)	0 (0%)	0.738
	Married		30 (78.9%)	30 (75%)	30 (88.2%)	15 (78.9%)	
	Divorced		3 (7.9%)	3 (7.5%)	2 (5.9%)	1 (5.3%)	
	Widowed		2 (5.3%)	4 (10%)	1 (2.9%)	3 (15.8%)	
Employment Status	Housewife		29 (76.3%)	32 (80%)	31 (91.2%)	17 (89.5%)	0.312
	Working		2 (5.3%)	2 (5%)	1 (2.9%)	2 (10.5%)	
	Retired		7 (18.4%)	6 (15%)	2 (5.9%)	0 (0%)	
Monthly Income	Low		32 (84.2%)	34 (85%)	32 (94.1%)	17 (89.5%)	0.559
	Medium		6 (15.8%)	6 (15%)	2 (5.9%)	2 (10.5%)	
	High		0 (0%)	0 (0%)	0 (0%)	0 (0%)	
Smoking	No		33 (86.8%)	37 (92.5%)	33 (97.1%)	17 (89.5%)	0.455
	Yes		5 (13.2%)	3 (7.5%)	1 (2.9%)	2 (10.5%)	
Diabetes Mellitus	No		30 (78.9%)	24 (60%)	21 (61.8%)	8 (42.1%)	0.044
	Yes		8 (21.1%)	16 (40%)	13 (38.2%)	11 (57.9%)	
Comorbidity	Yes		17 (44.7%)	19 (47.5%)	22 (64.7%)	5 (26.3%)	0.069
ECOG Score	0		12 (31.6%)	12 (30%)	7 (20.6%)	1 (5.3%)	0.236
	1		26 (68.4%)	27 (67.5%)	25 (73.5%)	17 (89.5%)	
	2		0 (0%)	1 (2.5%)	1 (2.9%)	1 (5.3%)	
Education	Illiterate		4 (10.5%)	8 (20%)	2 (5.9%)	1 (5.3%)	0.079
	Primary		24 (63.2%)	19 (47.5%)	18 (52.9%)	6 (31.6%)	
	Secondary		7 (18.4%)	10 (25%)	3 (8.8%)	0 (0%)	

Abbreviations. BMI: Body Mass Index, ECOG: Eastern Cooperative Oncology Group Score. The table presents demographic and characteristics of individuals across various Body Mass Index (BMI) subgroups: overweight (BMI 25-29.9), obesity class 1 (BMI 30-34.9), obesity class 2 (BMI 35-39.9), and obesity class 3 (BMI ≥40). The data are expressed as the mean ± standard deviation for continuous variables and as numbers (n) and percentages (%) for categorical variables. The P-value indicates the significance of the differences among subgroups, with a P-value below 0.05 considered significant. The ANOVA test was employed to analyze continuous variables, while the Chi-square or Fisher's exact test was used for categorical variables.

Table-2. Distribution of Treatment Methods and Outcomes by Obesity Class in Patients

Variables	Subgroups	Overweight [n:38]	Obesity Class 1 [n:40]	Obesity Class 2 [n:34]	Obesity Class 3 [n:19]	P value
Radiotherapy	No	28 (73.7%)	33 (82.5%)	28 (82.4%)	11 (57.9%)	0.155
	Yes	10 (26.3%)	7 (17.5%)	6 (17.6%)	8 (42.1%)	
Brachytherapy	No	14 (36.8%)	21 (52.5%)	21 (61.8%)	10 (52.6%)	0.194
	Yes	24 (63.2%)	19 (47.5%)	13 (38.2%)	9 (47.4%)	
Chemotherapy	No	35 (92.1%)	37 (92.5%)	31 (91.2%)	17 (89.5%)	0.982
	Yes	3 (7.9%)	3 (7.5%)	3 (8.8%)	2 (10.5%)	
Radiochemotherapy	No	37 (97.4%)	40 (100%)	34 (100%)	19 (100%)	0.481
	Yes	1 (2.6%)	0 (0%)	0 (0%)	0 (0%)	
Relapse	No	37 (97.4%)	40 (100%)	32 (94.1%)	18 (94.7%)	0.322
	Yes	1 (2.6%)	0 (0%)	2 (5.9%)	1 (5.3%)	
Grade	1	15 (39.5%)	13 (32.5%)	16 (47.1%)	6 (31.6%)	0.093
	2	21 (55.3%)	26 (65%)	13 (38.2%)	13 (68.4%)	
	3	2 (5.3%)	1 (2.5%)	5 (14.7%)	0 (0%)	
Operation	TAH+BSO	3 (7.9%)	8 (20%)	4 (11.8%)	2 (10.5%)	0.569
	TAH+BSO+PLND	8 (21.1%)	6 (15%)	7 (20.6%)	2 (10.5%)	
	TAH+BSO+PPLND	21 (55.3%)	22 (55%)	19 (55.9%)	13 (68.4%)	
	TLH+BSO	3 (7.9%)	1 (2.5%)	3 (8.8%)	1 (5.3%)	
	TLH+BSO+PLND	1 (2.6%)	2 (5%)	0 (0%)	0 (0%)	
	TLH+BSO+PPLND	2 (5.3%)	1 (2.5%)	1 (2.9%)	1 (5.3%)	

Abbreviations. TAH+BSO: Total Abdominal Hysterectomy+Bilateral Salpingo-Oophorectomy; TAH+BSO+PLND: Total Abdominal Hysterectomy with Bilateral Salpingo-Oophorectomy and Pelvic Lymph Node Dissection; TAH+BSO+PPLND: Total Abdominal Hysterectomy with Bilateral Salpingo-Oophorectomy and Paraaortic and Pelvic Lymph Node Dissection; TLH+BSO: Total Laparoscopic Hysterectomy with Bilateral Salpingo-Oophorectomy; TLH+BSO+PLND: Total Laparoscopic Hysterectomy with Bilateral Salpingo-Oophorectomy and Pelvic Lymph Node Dissection; TLH+BSO+PPLND: Total Laparoscopic Hysterectomy with Bilateral Salpingo-Oophorectomy and Paraaortic and Pelvic Lymph Node Dissection. The P-value indicates the significance of the differences among subgroups, with a P-value below 0.05 considered significant. The Chi-square test was used for variables.

They observed a poorer preoperative health status with a BMI>30, indicative of existing chronic health issues. Onstad et al. (18) argued that performing surgery on obese patients with endometrial cancer could be more complex due to the technical aspects of the procedure. However, the choice of surgical procedures was not affected by obesity. This finding mirrors those of Gabala et al. (19) as well as Erkanli et al. (20). This is in contrast to findings by Bouwman et al. (21), who reported that obese patients undergoing laparotomy were at higher risk for postoperative complications. Factors such as patient characteristics, the surgeon's experience, and the equipment used might account for the discrepancies (15). Interestingly, our study found no differences among the BMI

subgroups regarding age, height, parity, mode of delivery, marital and employment status, smoking habits, comorbidity, and ECOG.

Notably, diabetes mellitus was more prevalent in the obesity class 3, suggesting that higher BMI may be associated with an increased risk of comorbid conditions such as diabetes. This finding aligns with previous research that has established a link between obesity and type-2 diabetes mellitus. It highlights the importance of carefully managing diabetes in endometrial cancer, as it can affect treatment outcomes. Regarding menopausal status, our analysis revealed a higher proportion of premenopausal women in the obesity class 3 compared to other subgroups. Obesity can influence hormonal balance and contribute to alterations in sex

hormone production, which may, in turn, affect menopausal status and reproductive history in endometrial cancer patients (4,20,22). Obesity-associated chronic inflammation and insulin resistance have been implicated in endometrial carcinogenesis, particularly in postmenopausal women (11, 19). Thus, our finding underscores the potential influence of BMI on endometrial cancer risk and the importance of considering menopausal status in endometrial cancer management.

Regarding treatment modalities, we observed no differences in the use of radiotherapy, brachytherapy, chemotherapy, radio-chemo therapy, and relapse rates across the BMI subgroups. However, distribution of surgical procedures revealed that the most commonly performed surgery across all subgroups was TAH+BSO+PPLND, with the highest percent observed in the obesity class 3 subgroup. Notably, TAH+BSO was the least performed surgery among the subgroups, with the lowest rate in the obesity class 3 and overweight subgroups. This may suggest that individuals with higher BMI may be more likely to undergo more extensive surgical procedures, possibly due to the increased complexity of their cases. However, we found no differences in the surgery types across the BMI subgroups.

There are some limitations. The retrospective nature of our analysis may introduce selection bias, and the data may not be entirely representative of the broader population. Additionally, our study's sample size may limit our findings' generalizability. More extensive prospective studies are needed to validate our findings and further explore the impact of BMI on endometrial cancer treatment outcomes.

Conclusion

Our analysis offers valuable insights into the relationship between BMI and endometrial cancer treatment outcomes. While we observed no differences among the BMI subgroups regarding most demographic and clinical

characteristics, our study highlights potential influence of BMI on menopausal status and surgical treatment strategies in endometrial cancer. Considering the increasing global prevalence of obesity, our findings underscore the importance of considering BMI as a critical factor in managing endometrial cancer. Further research is needed to elucidate the complex interplay between BMI, demographic and clinical characteristics, and treatment outcomes in endometrial cancer patients.

Conflict of Interest

The author declares no conflict of interest.

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