Original Article

Body Mass Index and Surgical Diagnosis of Endometriosis: Do Obese Patients Experience an Operative Delay?

Melissa A. Markowitz*, Molly Doernberg, Howard J. Li, Yonghee K. Cho

Department of Obstetrics, Gynecology and Reproductive Sciences, Yale School of Medicine, New Haven, Connecticut, USA

Abstract

Objectives: The objective of this study was to quantify the time to diagnosis of endometriosis by laparoscopy for patients of varying body mass index (BMI), as well as the safety of laparoscopy for endometriosis by BMI.

Materials and Methods: We performed a retrospective cohort study of reproductive-age women receiving a primary laparoscopic diagnosis of endometriosis at an academic tertiary hospital from January 2017 to December 2020. Patients excluded were those undergoing repeat laparoscopy, with previously histologically diagnosed endometriosis, asymptomatic endometriosis, an unknown first gynecologic encounter, or an unknown initial BMI. Our primary outcome was time to surgical diagnosis of endometriosis by BMI class. Our secondary outcome was the evaluation of peri/postoperative risk of laparoscopy for endometriosis.

Results: A total of 152 patients received a primary surgical diagnosis of endometriosis, including 44% normal or underweight patients, 29% overweight patients, and 27% obese patients. Obese patients experienced a delay from gynecologic presentation to diagnostic laparoscopy (18.4 months, interquartile range [IQR] 3.1–42.8) compared to overweight patients (9.0 months, IQR 2.5–23.2) and normal and underweight patients (3.8 months, IQR 1.1–17.0) ($P = 0.02$). Although a higher percentage of overweight and obese patients was Hispanic and non-Hispanic Black, multiple linear regression maintained a significant relationship between time to surgery and BMI ($P = 0.03$). Perioperative and postoperative complications did not differ by BMI class. There were no differences in repeat laparoscopy for endometriosis within 3 years by BMI ($P = 0.99$).

Conclusion: BMI is independently associated with time to surgical diagnosis of endometriosis in our retrospective study. Diagnostic laparoscopy appears safe in obese patients, without significant perioperative morbidity.

Keywords: Body mass index, diagnostic laparoscopy, health disparities, pelvic pain

Introduction

Endometriosis is a debilitating disease affecting over 190 million reproductive-age women globally.[1,2] Rates of endometriosis vary widely from 1.6% to 16.2% of populations, as clinicians require a high clinical suspicion of endometriosis to move toward diagnostic surgery.[3,4] Patients in the United States (US) may wait an average of 4.4 years to reach a diagnosis, and nearly 60% of endometriosis cases still go undiagnosed, leading to stigmatization and undertreatment of pain.[1,5-7] Body mass index (BMI) and endometriosis historically share an inverse relationship, with endometriosis diagnosed less frequently in overweight and obese individuals,[8,9] yet little is known about the time to surgical diagnosis of endometriosis for patients of varying BMI.

Data supporting an inverse correlation between endometriosis and BMI originate from cross-sectional studies and meta-analyses.[10-13] Several mechanisms have been

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Address for correspondence: Dr. Melissa A. Markowitz, Department of Obstetrics, Gynecology and Reproductive Sciences, Yale-New Haven Hospital, 20 York St, New Haven, Connecticut 06510, USA.
E-mail: melissa.markowitz@yale.edu

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proposed to explain the relationship between endometriosis and BMI,[14-17] although are limited by small sample sizes of Class II and III obese patients, self-reported cases of endometriosis, animal models, and diagnostic bias. While a lower prevalence of endometriosis has been observed in overweight and obese patients, this may be due to diagnostic delay or underdiagnosis of endometriosis in patients with elevated BMI, as endometriosis is diagnosed histologically. With over 40% of the US population and 13% of the world's adult population classified as obese,[18,19] it is critical to understand if there is a disparity in the surgical diagnosis of endometriosis in obese patients.

Our study's primary aim was to quantify the time to surgical diagnosis of endometriosis for patients of varying BMI through retrospective chart review at a tertiary academic institution. Our secondary aim was to evaluate the safety of laparoscopy for endometriosis by BMI by evaluating perioperative and postoperative risks.

Materials and Methods

Study design

The study was determined exempt by the Yale University Institutional Review Board (no. 2000033017; determination date 9/7/2022) and was conducted in accordance with the Declaration of Helsinki, Ethical Principles and Guidelines for the Protection of Human Subjects of Research. The patient consent was waived by the IRB. We performed a retrospective chart review of all reproductive-age women receiving a primary laparoscopic diagnosis of endometriosis at an academic tertiary hospital for 4-year period (from January 2017 to December 2020). Medical records were identified by the institution's joint data analytics team using International Classification of Diseases (ICD) Ninth/Tenth Revision codes for pelvic pain (ICD-9 625, ICD-10 R10.2, N94), dysmenorrhea (ICD-9 625.3, ICD-10 N94.6), dyspareunia (ICD-9 625.0, ICD-10 N94.10, N94.11, N94.12, N94.19), and suspected endometriosis (ICD-9 617, ICD-10 N80) in patients who had undergone diagnostic laparoscopy for any indication (Current Procedural Terminology (CPT) 49320, 58662, 49321) by a gynecologic surgeon.

Patients included were those with a new diagnosis of pathology-confirmed endometriosis during the study period. Initial encounter to a gynecologic surgeon was defined as the first visit for pelvic pain, dysmenorrhea, or dyspareunia, as detailed in the assessment or plan. Patients excluded from the study were those undergoing repeat laparoscopy, with previously histologically diagnosed endometriosis, without symptoms of endometriosis (i.e., undergoing diagnostic laparoscopy for infertility), with an unknown first encounter to a gynecologic surgeon for pelvic pain, dysmenorrhea, or dyspareunia, or with an unknown initial BMI. Only primary diagnostic laparoscopies for the identification of endometriosis were included in the study.

Three authors conducted a manual chart review of the clinical characteristics of each encounter. Age, race/ethnicity, and BMI at initial encounter stratified by class (underweight BMI: <18.5, normal weight BMI: 18.5–24.9, overweight BMI: 25.0–29.9, obese Class I BMI: 30.0–34.9, obese Class II BMI: 35.0–39.9, obese Class III BMI: ≥40.0) were collected. The primary outcome time to surgical diagnosis from the initial encounter to a gynecologic surgeon (with pelvic pain, dysmenorrhea, or dyspareunia) was collected through chart review. The medical management of endometriosis (number of medications prescribed and frequency of emergency department visits for pelvic or abdominal pain within 5 years before surgery) and surgical factors associated with diagnostic laparoscopy (need for preoperative clearance and additional indications for surgery) was assessed. The secondary outcome, the safety of laparoscopy for endometriosis by BMI, was analyzed by collecting perioperative risks (Mallampati class, intubation attempts, conversion to laparotomy, visceral injury, or vascular injury) and postoperative risks (respiratory complications, seroma, hematoma, skin and soft-tissue infection, venous thromboembolism, and intensive care unit admission) based on risks outlined by the American College of Obstetricians and Gynecologists for obese women undergoing gynecologic surgery.[20] In addition, the rate of repeat laparoscopy for endometriosis was collected within 3 years from the time of initial surgery. The study was determined exempt by the university's institutional review board and was conducted in accordance with the Ethical Principles and Guidelines for the Protection of Human Subjects of Research.

Statistical analysis

We performed descriptive statistics to analyze patient characteristics and time to surgical diagnosis of endometriosis by BMI class. We compared continuous, nonparametric variables using Kruskal–Wallis tests. Nonparametric data were log transformed for linear regression and comparative multiple linear regression. Categorical variables were compared using Pearson's Chi-squared tests or Fisher's exact tests. Statistical analysis was conducted using GraphPad Prism 9 and reviewed by a departmental statistician.

Results

Patient characteristics

Chart identification yielded 1073 patient encounters with CPT codes for diagnostic laparoscopy, ICD-9 or ICD-10 codes for symptoms of endometriosis, and surgical pathology consistent with endometriosis [Figure 1]. Following the application of the

exclusion criteria, the final sample consisted of 152 patients, with 67 (44.1%) normal or underweight patients, 44 (28.9%) overweight patients, and 41 (27.0%) obese patients. Of patients with obesity, 20 (13.2%) were Class I, 10 (6.6%) were Class II, and 11 (7.2%) were Class III.

The median patient age at the initial gynecologic encounter for symptoms of endometriosis was 32 years with an interquartile range (IQR) of 25–38 years [Table 1]. Fifty-four percent of patients had private, managed care, or other insurance, whereas 45.4% had public insurance, were uninsured, or self-pay. Patients were seen by both gynecologic generalists and specialists. No significant differences in age, insurance status, or type of gynecologic surgeon at the initial encounter were observed by BMI class. The majority of each BMI class consisted of non-Hispanic white patients, although the percentage of Hispanic and non-Hispanic Black patients significantly increased in overweight and obese classes ($P = 0.03$).

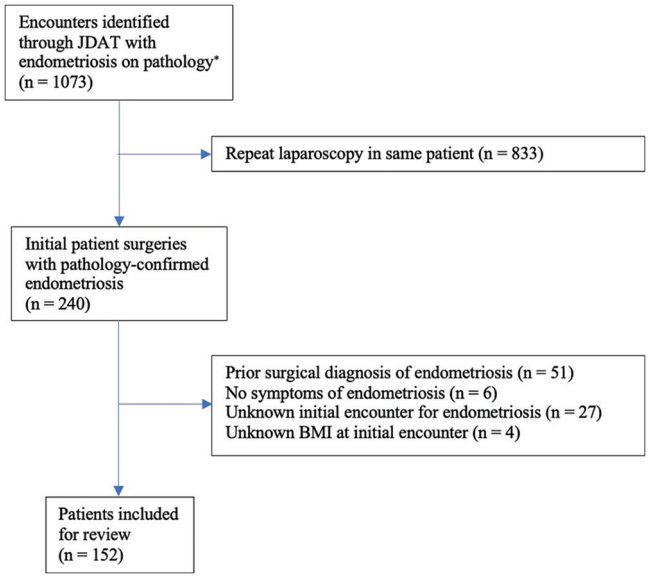

Figure 1: Chart review process for patient inclusion. A total of 1073 encounters were reviewed. Following inclusion and exclusion criteria, 152 patients were included for analysis. JDAT: Joint data analytics team

Medical management of endometriosis by body mass index

Before the surgical diagnosis of endometriosis, there was no difference in the number of classes of conservative treatments prescribed for endometriosis by patient BMI ($P = 0.55$), including nonsteroidal anti-inflammatory drugs, progestins, combined estrogen progestins, gonadotropin-releasing hormone agonists/antagonists, and pelvic floor physical therapy [Table 2]. Emergency department visits for pelvic pain within 5 years before diagnostic surgery did not differ by BMI class ($P = 0.44$), with an average of 1.2 visits +/-2.3 in the entire cohort.

Surgical diagnosis of endometriosis by body mass index

Our primary outcome time from initial presentation to a gynecologic surgeon to diagnostic laparoscopy for endometriosis was significantly longer for obese patients (18.4 months, IQR 3.1–42.8) compared to overweight patients (9.0 months, IQR 2.5–23.2) and normal and underweight patients (3.8 months, IQR 1.1–17.0) ($P = 0.02$) [Figure 2]. Linear regression demonstrated a significant relationship between log time to surgery and BMI ($P = 0.02$, $R^2 = 0.03$) [Figure 3]. Multiple linear regression incorporating race/ethnicity maintained a significant relationship between log time to surgery and

Table 1: Characteristics of the study population at initial presentation by body mass index*

Characteristics	Overall (*n*=152)	Under/normal weight (*n*=67)	Overweight (*n*=44)	Obese (I/II/III) (*n*=41)	*P*†
Age, median	32.0 (25.0–38.0)	30.0 (23.0–38.0)	32.0 (25.0–36.0)	32.0 (25.0–40.0)	0.36
Race/ethnicity, *n* (%)					
Hispanic	40/152 (26.3)	12/67 (17.9)	17/44 (38.6)	12/41 (29.3)	0.03
Non-Hispanic Black	16/152 (10.5)	3/67 (4.5)	6/44 (13.6)	7/41 (17.1)	
Non-Hispanic white	76/152 (50.0)	40/67 (59.7)	17/44 (38.6)	19/41 (46.3)	
None of the above	20/152 (13.2)	12/67 (17.9)	4/44 (9.1)	3/41 (7.3)	
Insurance, *n* (%)					
Private	83/152 (54.6)	38/67 (56.7)	20/44 (45.5)	25/41 (61.0)	0.32
Public/uninsured	69/152 (45.4)	29/67 (43.3)	24/44 (54.5)	16/41 (39.0)	
Gynecologic surgeon‡, *n* (%)					
Generalist	33/152 (21.7)	16/67 (23.9)	10/44 (22.7)	7/41 (17.1)	0.14
MIGS	44/152 (28.9)	12/67 (17.9)	17/44 (38.6)	15/41 (36.6)	
GYN/ONC	42/152 (27.6)	19/67 (28.4)	11/44 (25.0)	12/41 (29.3)	
REI, FPMRS, PAG	33/152 (21.7)	20/67 (29.9)	6/44 (13.6)	7/41 (17.1)	

*Underweight and normal weight are combined for low sample size, as are obesity class I, II, and III. All percentages do not add to 100.0% due to rounding, †Continuous variables are compared with Kruskal–Wallis tests, categorical variables are compared with Pearson's Chi-squared tests, ‡Gynecologic surgeon include generalists (nonspecialized), MIGS, GYN/ONC, REI, FPMRS, and PAG, subspecialists. REI, FPMRS, and PAG specialists are combined for low sample size. MIGS: Minimally invasive gynecologic surgery, GYN/ONC: Gynecologic oncology, REI: Reproductive endocrinology and infertility, FPMRS: Female pelvic medicine and reconstructive surgery, PAG: Pediatric and adolescent gynecology

Table 2: Medical, surgical, and peri/postoperative management of endometriosis by body mass index*

Characteristics	Under/normal weight (n=67)	Overweight (n=44)	Obese (I/II/III) (n=41)	P†
Medical management				
Total classes of conservative treatments, mean	1.10±0.97	1.07±1.0	1.27±0.95	0.55
ED visits, mean	0.85±1.5	1.7±3.6	1.1±1.4	0.44
Surgical management				
Time to surgical diagnosis of endometriosis (months)	3.8 (1.1–17.0)	9.0 (2.5–23.2)	18.4 (3.1–42.8)	0.02
Age at surgical diagnosis of endometriosis, median	31 (24.0–39.0)	33.0 (26.0–39.0)	35.0 (28.0–42.0)	0.17
Need for preoperative clearance‡	3/67 (4.5)	1/44 (2.3)	5/39 (12.8)	0.73
Additional indication for surgery	39/67 (58.2)	20/44 (45.5)	23/41 (56.1)	0.40
Peri/postoperative management Mallampati class§				
1 or 2	66/67 (98.5)	37/44 (84.1)	33/41 (80.5)	0.01
3 or 4	1/67 (1.5)	4/44 (9.1)	8/41 (19.5)	
Intubation attempts, mean	1.05±0.27	1.02±0.15	1.07±0.26	0.44
Conversion to laparotomy	0/67 (0.0)	0/44 (0.0)	0/41 (0.0)	NAC‖
Organ or vascular injury¶	0/67 (0.0)	0/44 (0.0)	1/41 (2.4)	>0.99
Wound complication**	0/67 (0.0)	1/44 (2.3)	0/41 (0.0)	>0.99
Venous thromboembolism	0/67 (0.0)	0/44 (0.0)	0/41 (0.0)	NAC
Postoperative respiratory complications††	0/67 (0.0)	0/44 (0.0)	0/41 (0.0)	NAC
Repeat laparoscopy for endometriosis within 3 years	13/67 (19.4)	9/44 (20.5)	8/41 (19.5)	0.99

*Underweight and normal weight are combined for low sample size, as are obesity Class I, II, and III at the initial presentation. All percentages do not add to 100.0% due to rounding, **Wound complication included hematoma, seroma, abdominal infection, or skin and soft-tissue infections. Due to the rare occurrence, Fisher's exact test was performed between underweight/normal weight patients and overweight/obese patients, †Continuous variables are compared with Kruskal–Wallis tests, categorical variables are compared with Pearson's Chi-squared tests or Fisher's exact tests, ‡Due to the rare occurrence, Fisher's exact test was performed between underweight/normal weight patients and overweight/obese patients, §Mallampati classes are combined for low sample size and not all percentages equal to 100.0%, as not all providers documented preoperative Mallampati class, ‖Not able to calculate given lack of occurrence, ¶Injuries assessed include bowel, bladder, ureteral, uterine, and pelvic and abdominal vessel injury. Due to the rare occurrence, Fisher's exact test was performed between underweight/normal weight patients and overweight/obese patients, ††Respiratory complications included reintubation, respiratory indication for intensive care unit admission, postoperative oxygen use on the floor, or pneumonia. ED: Emergency department, NAC: Not able to calculate

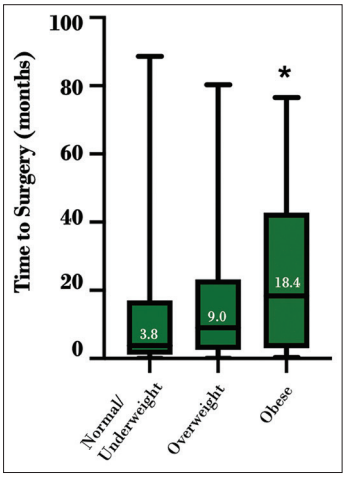

Figure 2: Time to surgical diagnosis of endometriosis by body mass index. Time from gynecologic presentation to primary diagnostic laparoscopy for endometriosis was significantly longer for obese patients (18.4 months, interquartile range [IQR] 3.1–42.8) compared to overweight patients (9.0 months, IQR 2.5–23.2) and normal and underweight patients (3.8 months, IQR 1.1–17.0). *P = 0.02

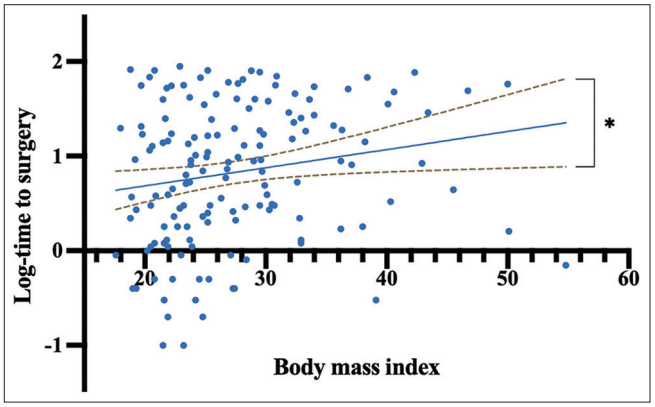

Figure 3: Linear regression of log time to surgery as a function of body mass index (BMI). A significant relationship between log time to surgery and BMI was demonstrated by linear regression (P = 0.02, R^2 = 0.03)

BMI (P = 0.03). No difference was seen in age at diagnostic surgery by BMI (P = 0.17), although a trend toward older age was observed in obese patients (35 years old [IQR 28.0–42.0]) versus underweight/normal weight patients (31 years old [IQR 24.0–39.0]). The need for preoperative clearance by a primary care provider or subspecialist did not differ by BMI class (P = 0.73), although the analysis was limited by rare occurrence. No difference in additional indications for surgery, including uterine fibroids, ovarian cysts, hydrosalpinx, or pelvic masses, was seen by BMI (P = 0.40).

Peri/postoperative risks of surgery for endometriosis by body mass index

Perioperatively, higher Mallampati scores were recorded in obese patients (P = 0.01); however, no difference in the number of intubation attempts was observed (P = 0.44). No cases

were converted to laparotomy. One case involved a visceral or vascular injury (cystotomy and broad ligament injury during hysterectomy in an obese patient) ($P > 0.99$).

Postoperatively, one wound complication occurred in an overweight patient (pelvic hematoma requiring embolization) ($P > 0.99$) and no venous thromboembolisms occurred. No respiratory complications occurred. Two patients were admitted to the intensive care unit (one overweight patient following embolization of a pelvic hematoma as above and one obese patient for hemodynamic monitoring following broad ligament injury as above) ($P = 0.50$). Repeat laparoscopy for persistent or recurrent symptoms of endometriosis within 3 years was similar between all BMI classes ($P = 0.99$).

Discussion

Surgical diagnosis and management of endometriosis are critical for symptomatic improvement, infertility management, and psychosocial well-being.[21] Studies of patients without a diagnosis of endometriosis have demonstrated dismissal of pain symptoms by providers, prompting patients to conceal or minimize their symptoms.[21] In patients with limited support for endometriosis, the exacerbation of biologic and psychosomatic components of endometriosis described as the endometriosis-stress-stigma syndemic worsens the burden of endometriosis.[22] Our retrospective study demonstrated that obese patients with endometriosis may be subject to this sequelae, as their diagnosis is delayed an average of 18 months, compared to <4 months for underweight or normal weight patients. This delay was neither influenced by the need for preoperative clearance, nor by other patient characteristics, including race/ethnicity. Healthcare-seeking behavior did not differ by BMI class, as similar rates of preoperative conservative therapies and presentations to the emergency department for pelvic or abdominal pain were observed.

An inverse correlation between endometriosis and elevated BMI has been demonstrated in large cohort studies and two high-quality meta-analyses.[10,12] However, a paucity of data exists for patients with symptoms of endometriosis who experience a prolonged interval until their surgical diagnosis and is likely to go uncounted in these prevalence estimates. Etiologies for a delay in diagnosis of endometriosis for overweight and obese patients are unknown, although may be due to diagnostic bias and a reluctance to recommend surgery. Systematic reviews demonstrate obesity to be associated with gastrointestinal disorders, including gallbladder disease and irritable bowel syndrome, as well as fibromyalgia and musculoskeletal pain[23-25] in the setting of increased mechanical pressure, behavioral deconditioning, and a proinflammatory milieu.[23] Given the overlapping symptomatology of endometriosis with chronic musculoskeletal and gastrointestinal disorders, clinicians may negate endometriosis as a likely etiology of pain in obese individuals, particularly among literature that associates endometriosis with underweight and normal-weight individuals.[8,9]

Professional guidelines detail an increased risk of complications from laparoscopic surgery in obese patients, including the risk of ventilatory compromise with steep Trendelenburg, difficult entry with potential for injury, and risk of conversion to laparotomy.[20] These factors may contribute to an elevated threshold for gynecologists to recommend diagnostic surgery in obese patients. However, recent case–control studies have demonstrated no difference in the perioperative risks of laparoscopic surgery in obese patients, potentially as surgeons have become increasingly well trained in minimally invasive surgery.[26] In our analysis, no significant differences were seen in perioperative or postoperative risks for obese patients.

Clinical presentations for endometriosis are often based on studies of normal weight, white, and English-speaking women and may not be valid beyond such patient populations.[27] As obese patients have historically experienced undertreatment for chronic pain,[28] standardized longitudinal pain scores in patients undergoing medical and surgical management of endometriosis are needed to combat implicit bias in treating patients of varying BMI. Validated surveys have been used in clinical trials for endometriosis-related pain and may improve the clinical care of patients of all BMIs.[29]

The strengths of this study include the use of a diverse, urban cohort of over 55% overweight or obese patients with endometriosis with data for 4-year period. As an adjunct to studies on endometriosis prevalence, this study uniquely examines diagnostic delay as a crucial factor that may contribute to lower rates of surgically diagnosed endometriosis in patients with an elevated BMI. Our study may in fact underestimate surgical disparities in care, as it does not include obese patients with chronic pelvic pain who have never received a pathologic diagnosis of endometriosis.

Our study is limited by its sample size, with wide confidence intervals in time to surgical diagnosis. A power analysis could not be calculated due to the inherent lack of data on time to surgical diagnosis of endometriosis by BMI before our study. Diagnostic delay to surgery was shorter than observed in prior studies, which estimated a mean of 4.4 years from presentation to surgery.[6] This is likely due to our study's evaluation of time from presentation to a gynecologic surgeon, rather than any provider, until surgery, and thus, must be interpreted independently. Our study analyzed surgical pathology, the

gold standard for the diagnosis of endometriosis; however, physical examination and transvaginal ultrasound also strongly correlate to a primary diagnosis of endometriosis,[30] although are limited at detecting superficial peritoneal disease. Therefore, our sample consisted of patients with histologically diagnosed endometriosis to avoid excluding patients with Stage I or II disease. While bias may be a driving force for delay in surgical diagnosis of endometriosis for obese patients, other factors including patient preferences to perform or avoid surgery, surgeon scheduling conflicts, or hospital operational limits are unknown. However, repeat laparoscopy for endometriosis was similar for all BMI classes in our study, potentially pointing to a removal of clinician bias once a histologic diagnosis of endometriosis was established. Qualitative studies to better understand physician perceptions of endometriosis in patients of all BMIs are recommended for future research.

Conclusion

Obese patients experience a 14-month disparity in time to surgical diagnosis of endometriosis compared to underweight and normal-weight individuals. Although population studies have demonstrated an inverse correlation between BMI and incidence of endometriosis, such studies negate individuals who were never surgically diagnosed or underwent extreme operative delays. Clinicians aiming to close this gap in care must combat tropes of endometriosis as a disease of normal-weight individuals and manage pain early and aggressively in obese patients to prevent undertreatment. Moreover, this retrospective study suggests diagnostic laparoscopy to be safe for obese patients. Future qualitative research is needed to characterize obese patients' presentations of chronic pelvic pain to prevent delayed or missed diagnoses of endometriosis.

Author contributions

All authors contributed to the study design, statistics and writing of this manuscript.

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Data availability statement

The datasets generated during or analyzed during the current study are available from the corresponding author on reasonable request.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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