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Original Research

Pelvic Floor Dysfunction in People with Eating Disorders and the Acute Effect of Different Interventions – A Retrospective Cohort Study

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Abstract

Background: Studies suggest that there is an association between eating disorders and pelvic floor dysfunction (PFD), although the contribution of PFD toward symptomatology and interventions to improve these symptoms in the eating disorder population is poorly understood. This study seeks to describe common symptoms of PFD in an eating disorder cohort, as well as the effect of interventions on pelvic floor symptomatology. **Methods**: In this retrospective case-control study, 193 patients who completed the Pelvic Floor Distress Inventory (PFDI-20) upon admission and discharge were included in the study. There were 84 subjects in the control group and 109 in the intervention group, with assignment based on the patient's willingness to participate in additional interventions for PFD. Those subjects in the intervention group received one of several interventions aimed at improving functioning of the pelvic floor muscles (education, bladder retraining/pelvic floor stretches, internal assessment of the pelvic floor muscles with intervention aimed at improving coordination of these muscles, and biofeedback). **Results**: Participants at admission reported a mean pelvic organ prolapse distress inventory (POPDI-6) score of 24.44, a mean colorectal-anal distress inventory (CRAD-8) score of 31.28, and a mean urinary distress inventory (UDI-6) score of 23.03, for a total PFDI-20 score of 78.75. The control group saw improvement in the total PFDI-20 score as well as each of the subscales; however, bladder training and incorporation of pelvic floor stretches resulted in improvement above that seen in the control group for each of the subscales, biofeedback resulted in improvement above that seen solely in the control group in the POPDI-6 score, and internal assessment of the pelvic floor muscles with active intervention resulted in improvement in the UDI-6 score above that seen solely in the control group. Patients with anorexia nervosa binge-eating/purging subtype reported higher PFDI symptoms than patients with the restricting subtype of anorexia nervosa, as reflected by higher scores on the POPDI-6 and CRAD-8 subscales. **Conclusions**: Patients with eating disorders report an increased level of pelvic floor symptomatology. Studied interventions had a positive effect in reducing these symptoms. Future studies are warranted to better describe the etiology of the PFD in those with eating disorders and how PFD contributes to eating disorder behaviors and gastrointestinal symptoms.

Keywords: eating disorders; anorexia nervosa; pelvic floor dysfunction; pelvic floor interventions; purging behaviors

1. Introduction

The pelvic floor consists of a group of muscles spanning the bottom of the pelvis that helps to support the bladder, urethra, vagina, uterus, prostate, bowel, rectum, and anus, with abnormalities in tone or contractile properties of these muscles resulting in pelvic floor dysfunction (PFD). Risk factors for development of PFD have traditionally included pregnancy and vaginal delivery, obesity, older age, and others [1]; however, one study also found a high prevalence of pelvic floor symptoms in a large cohort of nulliparous women [2]. PFD can cause common urogenital complications such as urinary disturbances, prolapse of organs, colorectal-anal disorders including anal incontinence and/or constipation, and chronic pelvic pain. In the general population, pelvic floor dyssynergia (commonly used interchangeably with PFD) is also associated with functional gastrointestinal (GI) disorders, prolonged gastric emptying times (gastroparesis), and feelings of incomplete stool evacuation [3–5]. PFD in people with eating disorders, whom experience a high prevalence of these GI symptoms and other medical complications, is relatively under-studied [6–8]. Eating disorders are characterized by a disturbance of eating or related behaviors that results in the altered consumption of food or absorption of food and that disrupts physical health and/or psychosocial functioning [9]. One of the most common eating disorders is anorexia nervosa (AN), which is defined by a restriction of energy intake due to a fear of weight gain and that results in a significantly low body weight. Anorexia nervosa can be further classified into one of two types: the binge-eating/purging subtype

of anorexia nervosa (AN-BP) is associated with recurrent episodes of binge eating or purging behaviors, which is absent in the restricting subtype (AN-R). Avoidant/restrictive food intake disorder (ARFID), another commonly encountered eating disorder, is defined as an eating or feeding disturbance manifested by persistent failure to meet appropriate nutritional needs that cannot be better attributed to cultural practices, another psychiatric condition, or a separate medical condition.

Chiarioni *et al*. [10] reported that five patients in a small cohort of twelve individuals (41.7%) with anorexia nervosa had PFD based on abnormalities on anorectal manometry. Silvernale *et al*. [11] found individuals with both eating disorders and PFD to suffer from increased GI symptoms compared to individuals with only eating disorders. Similarly, Abraham *et al*. [12] found greater symptom burden, including the commonly reported symptoms of bloating and abdominal distension, in people with eating disorders who also met Rome II criteria for pelvic floor dyssynergia. Low body mass index (BMI) seems to be a risk factor for development of PFD in this population [11,13–15], although 8.4 kg of weight gain in an eating disorder cohort also failed to show resolution of PFD [10]. Nonetheless, it also seems there is a bidirectional relationship between PFDs and eating disorders as fear of rectal prolapse and PFD-associated constipation also contribute to restriction and purging behaviors [16].

The purpose of this paper is therefore to describe the prevalence and specific pelvic floor symptoms experienced in a population of patients with severe eating disorders. This study also seeks to describe the impact of various interventions aimed at improving pelvic floor symptomatology in this patient population.

2. Methods

ACUTE Center for Eating Disorders and Severe Malnutrition (ACUTE) is an inpatient hospital unit in Denver, CO, USA that specializes in the medical stabilization of patients with severe eating disorders and other forms of malnutrition. Upon admission to ACUTE, patients are assessed by a multidisciplinary team of doctors, registered dieticians, psychologists, psychiatrists, social workers, physical therapists, and occupational therapists. Average length of stay on this unit is 3–4 weeks, and patients average 1.9 kg of weight gain/week. Height is obtained on admission by a nursing assistant, daily blinded weights in a gown are obtained at the same time every morning after voiding, and the Pelvic Floor Distress Inventory (PFDI-20) is one of the standards of care questionnaires provided to patients. In this retrospective case-control study, females aged 18–65 years old who were admitted to ACUTE between May 2022 and June 2023 were eligible for enrollment if they completed all questions of the PFDI-20 at both admission and discharge.

The PFDI-20 is a short-form questionnaire, assessing both symptom inventory and degree of distress caused by pelvic floor symptoms, that has been adapted and validated from the original USA version into multiple languages, and it is highly recommended for the evaluation of pelvic floor symptoms by the International Consultation on Incontinence [17–19]. The PFDI-20 consists of 20 questions: six measuring pelvic organ prolapse distress (pelvic organ prolapse distress inventory (POPDI-6)), eight measuring colorectal-anal distress inventory (CRAD-8), and six measuring urinary distress (urinary distress inventory (UDI-6)). Each question asks the responder to answer whether they experience a symptom and on a scale from one to four, how much they are bothered by the symptom. The mean scores of the answered items within each subscale are then multiplied by 25, and the three subscale scores are added together for a total score from 0 to 300.

The control group consisted of patients with little to no pelvic floor dysfunction on the PFDI-20 or patients who were unwilling to otherwise participate in the treatment of their PFD. The control group received no interventions besides the standard of care provided to all patients admitting to ACUTE, which consists of participation in occupational therapy services centered around various mindfulness and relaxation techniques to help regulate their nervous system, including education on the benefits of diaphragmatic breathing for GI symptoms, PFD, and distress tolerance.

Patients in the case cohort participated in at least one of several pelvic floor interventions at the discretion of the unit occupational therapist whom also has three years of pelvic health experience. The cohorts were developed based on the clinical expertise of an occupational therapist specializing in pelvic floor rehabilitation. The type of interventions and number of sessions were at the discretion of the occupational therapist and were also dependent on the duration of the patient's hospitalization, with all sessions being 30 minutes in duration. Patients in the "Education" group received one 30-minute session detailing information about the pelvic floor muscles including their purpose, causes of PFD, the relationship between the diaphragm and the pelvic floor, typical bladder norms, information to help bowel and bladder emptying, and/or urge suppression techniques. Patients in the "Active retraining" group underwent one 30-minute educational session along with one training session providing bladder training and pelvic floor stretches. Bladder training consists of increasing the time in between urinary voids to decrease urinary frequency, either through the education provided or through the use of a voiding log to understand one's patterns. The pelvic floor stretches consisted of deep squat, butterfly position, child's pose, and happy baby (**Supplementary Fig. 1**). The purpose of these stretches was to open the pelvic floor and engage the subject in coordinating effective diaphragmatic breathing and movement of their pelvic floor muscles. Individuals in the "Pelvic floor muscle assessment" group underwent one educational session and received an internal assessment of their pelvic floor musculature. This

Table 1. Demographic and Clinical Characteristics.

	Overall (N = 193)
Gender	
Female	193 (100%)
Age	
Mean (SD)	32.7 (13.4)
Missing	1 (0.5%)
ED Diagnosis	
Anorexia Nervosa-Binge Purge	82 (42.5%)
Anorexia Nervosa-Restricting	88 (45.6%)
Avoidant/Restrictive Food Intake Disorder	14 (7.3%)
Unspecified Feeding Eating Disorder	4 (2.1%)
Other Specified Feeding Eating Disorder	3 (1.6%)
Other	2 (1.0%)
Admission BMI	
Mean (SD)	14.1 (11.5)
Median [Min, Max, IQR]	12.8 [7.9, 13.4, 3.1]
Discharge BMI	
Mean (SD)	16.1 (4.36)
Median [Min, Max, IQR]	15.3 [10.9, 71.1, 1.955]
Duration of Illness	
Mean (SD)	15.0 (11.3)
Median [Min, Max, IQR]	12.0 [0.500, 52.0, 14]
Missing	17 (8.8%)

Abbreviations: BMI, body mass index; IQR, interquartile range; SD, standard deviation; ED, eating disorder.

Table 2. PFDI-20 Subscale Scores by Eating Disorder Diagnosis.

Eating Disorder Diagnosis	PFDI-20 Score Mean (SD)	POPDI-6 Score Mean (SD)	CRAD-8 Score Mean (SD)	UDI-6 Score Mean (SD)
AN-BP	89.17 (53.41)	29.67 (21.81)	36.09 (20.47)	23.43 (21.79)
AN-R	72.29 (50.34)	20.5 (18.15)	28.13 (19.3)	23.63 (22.82)
p-value	0.036	0.003	0.010	0.953

PFDI-20, Pelvic Floor Distress Inventory; POPDI-6, pelvic organ prolapse distress inventory; CRAD-8, colorectal-anal distress inventory; UDI-6, urinary distress inventory; AN-BP, the binge-eating/purging subtype of anorexia nervosa; AN-R, the restricting subtype of anorexia nervosa.

consisted of the use of one digit intravaginally palpating the bilateral superficial and second layers of the pelvic floor muscles to understand the tone and improve the coordination of the muscles.

Surface electromyography-assisted biofeedback (Pathway MR-20, Prometheus software®, Dover, NH, USA) is a non-invasive tool to help patients become more aware of and regain control over the pelvic floor muscles. Based on the visual feedback displayed on the graph, patients can learn how to relax or contract the pelvic floor muscles more effectively. Two external electrodes (active) were placed on bilateral levator ani muscles on either side of the anal sphincter and one electrode was placed on the adductor muscle (ground). The display graph then provides objective feedback of a patient's baseline tone of the pelvic floor muscles, coordination patterns, and the ability to contract and relax the pelvic floor muscles. Different pelvic floor positioning techniques (sitting *vs.* squatting) were used to understand how the tone of the pelvic floor musculature may be impacting PFD.

Baseline demographic and clinical data are presented in tabular form. Univariate statistics, including frequencies, percentages, ranges, means/medians, and standard deviations, are used to describe the sample. Pearson correlations and linear regressions were used to examine baseline associations between PFDI-20 scores and other patient attributes. Paired-samples *t*-tests were used to examine differences in admission and discharge scores within each group. Because they are robust to unequal sample sizes, Welch's *t*-tests were used to examine differences in admission scores, and differences in changes across treatment groups. p values of <0.05 were considered statistically significant, and all analyses were completed using R version 4.3.1 (R Core Team, 2023, Vienna, Austria). The study was

Table 3. Means and Standard Deviations of Changes in each Score by Cohort.

Group (N)	Intervention	PFDI-20 Score Mean (SD)	POPDI-6 Mean (SD)	CRAD-8 Mean (SD)	UDI-6 Mean (SD)
Control Change (n = 84)	Standard of care interventions (mindfulness, relaxation techniques, diaphragmatic breathing)	–16.98*** (34.22)	–3.85** (13.68)	–6.66*** (14.66)	–6.40*** (15.94)
Education Change (n = 26)	Provided education about the pelvic floor muscles	–11.54 (49.65)	–3.85 (19.75)	–4.21 (17.56)	–2.87 (21.18)
Biofeedback Change (n = 3)	Visual feedback teaches patients how to more effectively contract and relax the pelvic floor muscles	–77.09 (59.58)	–29.17* (7.22)	–35.42* (12.63)	–12.5 (39.75)
Pelvic Floor Muscle Assessment Change (n = 13)	Internal assessment of the pelvic floor musculature with the goal of improving coordination of the pelvic floor muscles	–47.76** (40.08)	–13.72* (16.36)	–15.39* (20.83)	–16.35*** (13.34)
Active Retraining Change (n = 67)	Provided bladder training and pelvic floor stretches	–38.23*** (49.94)	–11.57*** (18.03)	–12.83*** (19.95)	–13.87*** (25.05)
Overall Change (N = 193)		–26.71*** (44.80)	–7.62*** (16.85)	–9.50*** (17.97)	–9.28*** (20.77)

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$. Paired samples *t*-tests were used for all inferential tests. Differences in statistical significance of changes should be interpreted with caution due to the high variability in group sizes. PFDI-20, Pelvic Floor Distress Inventory; POPDI-6, pelvic organ prolapse distress inventory; CRAD-8, colorectal-anal distress inventory; UDI-6, urinary distress inventory.

evaluated and approved by the Colorado Multiple Institutional Review Board (COMIRB # 23-1926).

3. Results

There were a total of 193 female patients who completed the PFDI-20 at both admission and discharge. Mean age was 32.7 years (standard deviation (SD) = 13.4), and the mean duration of their eating disorder diagnosis was 15.0 years (SD = 11.3). A majority of the patients were diagnosed with anorexia nervosa-restricting type (n = 88, 45.6%), followed by anorexia nervosa-binge purge type (n = 82, 42.5%) and avoidant/restrictive food intake disorder (n = 14, 7.3%). Historical purging behaviors within the last three months before admission to ACUTE consisted of 56 patients (29%) who engaged in vomiting, 53 patients (27%) who engaged in laxatives, and 11 patients (6%) who abused diuretics, with a majority of the patients engaging in more than one method of purging. The median admit BMI was 14.1 kg/m^2, and the median discharge BMI was 16.1 kg/m^2. Table 1 documents basic demographics of the cohort.

PFDI-20 symptoms at admission were unrelated to duration of illness (r = 0.10, p = 0.17) or BMI (r = 0.04, p = 0.56). Patients reported a mean score of 31.28 on the CRAD-8 subscale, 24.44 on the POPDI-6, and 23.03 on the UDI-6. PFDI-20 symptoms at admission were higher for patients with anorexia nervosa-binge purge (mean (M) = 89.17, SD = 53.41) than patients with anorexia nervosa-restricting (M = 72.29, SD = 50.34; t = 2.12, p = 0.036). At admission, PFDI-20 subscales POPDI-6 (t = 2.97, p = 0.003) and CRAD-8 (t = 2.61, p = 0.010) were significantly higher for patients with anorexia nervosa-binge purge (POPDI-6: M = 29.67, SD = 21.81; CRAD-8: M = 36.09, SD = 20.47) than patients with anorexia nervosa-restricting (POPDI-6: M = 20.50, SD = 18.15; CRAD-8 M = 28.13, SD = 19.30). At admission, PFDI-20 subscale UDI-6 (t = 0.06, p = 0.953) was not significantly different between patients with anorexia nervosa-binge purge (M = 23.43, SD = 21.79) and patients with anorexia nervosa-restricting (M = 23.63, SD = 22.82). Changes in PFDI-20 and all three subscales were not significantly different between patients with anorexia nervosa-binge purge and patients with anorexia nervosa-restricting (all $p \geq 0.41$). Method of purging (laxatives vs non-laxative use) was also not significantly associated with overall PFDI-20 score or subscales (all $p \geq 0.29$). See Table 2.

The control cohort consisted of 84 patients, the education cohort consisted of 26 patients, 67 patients were in the active retraining group, 13 patients were in the internal pelvic floor muscle assessment group, and 3 patients received biofeedback. For those in the internal pelvic floor muscle assessment group, one individual underwent three internal assessment sessions, three individuals participated in two internal assessment sessions, and eight individuals participated in one internal assessment session. As for biofeedback, one individual participated in 3 sessions whereas the other two underwent 1 session. Only six patients from the entire cohort (3.1%) documented a PFDI-20 score of 0, with the remainder of the patients reporting PFD symptomatology on admission. No differences on admission were found between any cohort on the PFDI-20, POPDI-6, CRAD-8, or UDI-6; therefore, only admission-

Table 4. Comparisons of Change amongst Groups.

PFDI Score			
Group 1 (N)	Group 2 (N)	t-statistic	*p*-value
Control Change (84)	Education Change (26)	–0.51	0.612
Control Change (84)	Active Retraining Change (67)	2.97	0.004
Control Change (84)	Pelvic Floor Muscle Assessment Change (13)	2.62	0.019
Control Change (84)	Biofeedback Change (3)	1.74	0.222
POPDI			
Group 1 (N)	Group 2 (N)	t-statistic	*p*-value
Control Change (84)	Education Change (26)	0.02	0.986
Control Change (84)	Active Retraining Change (67)	2.87	0.005
Control Change (84)	Pelvic Floor Muscle Assessment Change (13)	2.05	0.059
Control Change (84)	Biofeedback Change (3)	5.70	0.017
CRAD			
Group 1 (N)	Group 2 (N)	t-statistic	*p*-value
Control Change (84)	Education Change (26)	–0.65	0.523
Control Change (84)	Active Retraining Change (67)	2.97	0.004
Control Change (84)	Pelvic Floor Muscle Assessment Change (13)	1.46	0.168
Control Change (84)	Biofeedback Change (3)	3.85	0.053
UDI			
Group 1 (N)	Group 2 (N)	t-statistic	*p*-value
Control Change (84)	Education Change (26)	–0.67	0.510
Control Change (84)	Active Retraining Change (67)	2.12	0.036
Control Change (84)	Pelvic Floor Muscle Assessment Change (13)	2.43	0.026
Control Change (84)	Biofeedback Change (3)	0.27	0.815

Welch's *t*-tests were used to compare differences between change scores. Differences in statistical significance of changes should be interpreted with caution due to the high variability in group sizes.

discharge changes are presented and compared in the Tables to maximize interpretability. Table 3 documents the improvement of the PFDI-20 scores and subscales for each intervention, along with statistical significance. Table 4 showcases the inferential tests and statistical significance comparing each intervention arm across the PFDI-20 and POPDI-6, CRAD-8, and UDI-6 subscales. There was improvement in the control group with regards to the PFDI-20 score and each of the three subscales. Education alone did not result in a meaningful improvement in PFD symptoms. The POPDI-6 score showed improvement above that seen solely in the control group with biofeedback and active retraining of the pelvic floor muscles, the CRAD-8 score improved above that seen solely in the control group by active retraining of the pelvic floor muscles, and the UDI-6 score improved over that seen solely in the control group by pelvic floor muscle assessment and active retraining of the pelvic floor muscles.

4. Discussion

This study investigated pelvic floor symptomatology in a severe eating disorder population, finding an overall high level of symptoms due to PFD. Biofeedback and active retraining of the pelvic floor muscles resulted in improvement in the POPDI-6 score, active retraining of the pelvic floor muscles resulted in improvement in the CRAD-8 score, and pelvic floor muscle assessment and active retraining of the pelvic floor muscles resulted in improvement in the UDI-6 score.

The reason for the improvement in pelvic floor distress in the control group is unclear but could be related to several factors. Weight restoration alone may impact the integrity of the pelvic floor musculature as malnutrition can significantly weaken the musculoskeletal system, although admit BMI did not correlate with PFDI-20 symptomatology. The atrophy of muscles along with decreased estrogen and collagen production can lead to PFD, specifically pelvic organ prolapse and urinary incontinence [20,21]. All patients were taught diaphragmatic breathing which is a useful tool to manage GI distress, calm the nervous system, and can directly impact the pelvic floor musculature, thereby impacting PFD symptomology. Indeed, the pelvic floor muscles work in tandem with the respiratory diaphragm and other abdominal cavity muscles [22]. Future studies need to examine the impact of weight loss toward the functioning of the pelvic floor muscles.

Psychological factors including anxiety and depression, common comorbidities in those with eating disorders, can also largely impact PFD, and improvements in these comorbidities may have impacted improved scores in the control group [23]. Mazi *et al.* [24] reported a higher prevalence of depressive symptoms and lower quality of

life among those with PFD. Individuals experiencing these mental health conditions often exhibit a heightened nervous system, influencing muscle tension (including posture) and stress-related physiological responses. Posture also likely impacts the functioning of the autonomic nervous system and thereby the function of the diaphragm muscle [25].

The other interventions of biofeedback, pelvic floor muscle assessment, and active retraining not only bring an individual's awareness to their pelvic floor muscles, but they also help to coordinate the functioning between the diaphragm and the pelvic floor muscles during respiration, which are often skewed [26]. Furthermore, biofeedback allows a person to visualize and achieve neuromuscular retraining of their pelvic floor musculature. The pelvic floor stretches are designed to work on the mind-body connection by utilizing diaphragmatic breathing in various stretches to connect the patient to feel movement within their pelvic floor [27]. As for the pelvic floor muscle assessment, trigger point release with the palpating digit and utilization of effective diaphragmatic breathing to decrease tenderness within the pelvic floor musculature likely contributes to improved symptoms. Strength and endurance of the pelvic floor muscles can also be assessed leading to improved range of motion within the pelvic floor [28]. Pelvic floor dysfunction can largely be impacted by the tone of the pelvic floor musculature whether the muscles exhibit increased or decreased tone [29]. Addressing the mind-body connection and undergoing neuromuscular retraining with a variety of tools is an effective way in managing and improving pelvic floor symptomology in this population. Future studies are warranted to know exactly how these interventions improve pelvic floor symptomatology.

Interestingly, increased abdominopelvic and GI symptoms, as assessed by the CRAD-8 and POPDI-6 subscales, were associated with a diagnosis of anorexia nervosa-binge purge, unlike the UDI-6 subscale, which solely assesses urinary distress. Although one could suggest that purging behaviors cause PFD, it is more likely that increased pelvic floor symptomatology contributes to the use of purging behaviors. Studies have indeed shown that increased somatic symptoms are associated with purging behaviors [30,31]. Constipation is also a common cause for laxative use, and gastroparesis, which is associated with PFD, is also associated with increased purging behaviors [32]. Future studies need to investigate whether these reported somatic symptoms are of a functional nature or truly related to pathophysiologic changes to the pelvic floor musculature.

Limitations of this study include potential patient errors with using self-assessment questionnaires. We did not randomize patients to the treatment groups, although baseline symptoms were similar amongst groups. Patients were provided interventions at the recommendation of the unit's occupational therapist and patient's willingness to participate; it is also possible that the number of pelvic floor treatment sessions may have impacted clinical outcomes. Another limitation is that the study may have been under-powered to detect some differences in the intervention groups due to the small cohorts for some of these groups. This cohort also consisted of individuals with severe forms of eating disorders and may not be generalizable to a cohort of individuals with less severe eating disorders. We also did not control for the impact of comorbid mental health diseases and sexual trauma toward pelvic floor symptomatology. Finally, these patients did not undergo any additional diagnostic testing, such as imaging or urodynamic studies, to actually assess for pelvic floor pathophysiology. Future studies are warranted to understand the impact of functional symptoms, mental health illnesses, and pelvic floor tonicity versus weight loss as contributors to their reported pelvic floor symptoms. The use of additional diagnostic tools would be pertinent to know the true prevalence of pelvic floor dysfunction in this population. Finally, the impact of PFD toward development of GI symptoms as well as better understanding the potential bidirectional relationship between eating disorders and PFD warrant further studies.

5. Conclusions

Individuals with severe eating disorders report high levels of pelvic floor symptomatology. Pelvic floor interventions aimed at improving these symptoms, including improved coordination of the internal pelvic floor muscles, habit re-training, pelvic floor stretches, and biofeedback have a positive effect in reducing pelvic floor symptomatology per self-reported symptoms on the PFDI-20 questionnaire. Future studies are warranted to better understand the relationship between pelvic floor dysfunction and eating disorders.

Availability of Data and Materials

The data that support the findings of this study are available on request from the corresponding author. The data is not publicly available due to privacy or ethical restrictions.

Author Contributions

MW and DG collaborated on conceptualization. MW collected the data and performed the methodology. DB analyzed the data and performed formal analysis. MW, DB, MF, PSM and DG helped with interpretation of data. All authors contributed to editorial changes, read, and approved the final manuscript.

Ethics Approval and Consent to Participate

Subjects did not give informed consent as this is a retrospective study. This protocol met research standards by the Colorado Multiple Institutional Review Board (COMIRB, No: # 23-1926).

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Conflict of Interest

The authors declare no conflict of interest.

Supplementary Material

Supplementary material associated with this article can be found, in the online version, at https://doi.org/10.31083/j.ceog5105116.

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