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Postpartum Pelvic Floor Dysfunction and Subsequent Anorectal Symptoms: A Cohor t Study Based on Routine Postpartum Screening

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Abstract

Objective

To determine whether early postpartum pelvic floor functional status provides a more proximal indicator of subsequent anorectal symptoms than conventional obstetric exposures.

Study design:

This retrospective cohort study included 382 women who underwent routine pelvic floor screening at approximately 42 days postpartum within a regional maternal healthcare network. Pelvic floor function was classified using standardized clinical criteria based on muscle strength, endurance, and maximal contraction pressure. Anorectal symptoms were assessed at 6–12 months postpartum using standardized structured questionnaires. Multivariable logistic regression models were applied with adjustment for demographic, clinical, and obstetric factors, and model performance was evaluated with bootstrap internal validation.

Results

During follow-up, 209 women (54.7%) reported at least one anorectal symptom. Abnormal pelvic floor function was independently associated with increased odds of symptoms (adjusted OR 2.85, 95% CI 1.64–4.94), whereas conventional obstetric factors, including delivery mode and second-stage duration, were not significant after adjustment. Associations were more pronounced for fecal incontinence (adjusted OR 4.79, 95% CI 2.01–8.45) and defecatory difficulty (adjusted OR 4.32, 95% CI 2.10–9.02) than for constipation. The multivariable model demonstrated acceptable calibration but modest discrimination (optimism-corrected AUC 0.66), and individual screening parameters showed limited predictive performance.

Conclusion

Postpartum pelvic floor dysfunction identified through routine clinical screening was more strongly associated with subsequent anorectal symptoms than traditional obstetric exposures. These findings support a function-oriented perspective in which early postpartum functional status represents a clinically relevant intermediate pathway linking childbirth to later anorectal morbidity. While predictive accuracy at the individual level remains limited, integrating functional assessment into routine postpartum care may improve risk stratification and inform targeted intervention strategies.

1. Introduction

Pelvic floor dysfunction (PFD) represents a substantial and often under-recognized component of women's health, with consequences that may extend well beyond the immediate postpartum period. Population-based evidence indicates that pelvic floor disorders—including urinary, defecatory, and support-related symptoms—affect a considerable proportion of women and are closely associated with childbirth history and long-term functional burden [1, 2]. Although childbirth is widely regarded as a key initiating factor, the mechanisms through which early postpartum changes translate into subsequent functional symptoms remain incompletely understood.

Traditionally, PFD has been characterized primarily by urogenital manifestations such as urinary incontinence and pelvic organ prolapse. In contrast, anorectal symptoms—including constipation, defecatory difficulty, and fecal incontinence—have received comparatively less attention in postpartum research, despite their significant impact on quality of life. Increasing evidence suggests that this separation reflects an overly compartmentalized view of pelvic floor disorders. In reality, the pelvic floor and anorectal systems function as an integrated unit, in which continence and defecation depend on coordinated interactions among pelvic floor musculature, anal sphincters, rectal function, and neural control pathways [3, 4].

Recent advances in pathophysiological understanding have further clarified that anorectal dysfunction cannot be explained by structural injury alone. Fecal incontinence has been linked to impairments in sphincter integrity and neuromuscular control [5], whereas defecatory disorders are increasingly understood as disturbances in coordination between rectal propulsion and pelvic floor relaxation. Moreover, contemporary research in gastrointestinal physiology has emphasized that chronic constipation and functional anorectal disorders arise from interactions among multiple physiological systems rather than from a single isolated abnormality [6]. These findings collectively support a shift from an exposure-based model toward a function-oriented framework, in which the persistence and degree of functional impairment play a central role in symptom development.

Despite these conceptual advances, most existing evidence has been derived from studies using specialized diagnostic techniques, such as anorectal manometry and balloon expulsion testing. These approaches provide detailed physiological characterization but are largely confined to tertiary care settings and selected patient populations, thereby limiting their applicability in routine clinical practice [7]. In contrast, simplified pelvic floor screening methods—including assessments of muscle strength, endurance, and pressure—are widely incorporated into postpartum care and offer a more accessible approach to functional evaluation.

However, whether these routinely collected screening parameters can meaningfully reflect the risk of subsequent anorectal dysfunction remains unclear. This question is particularly important given that pelvic floor function is inherently multidimensional, encompassing strength, endurance, coordination, and neuromuscular control [8]. As such, reliance on isolated indicators may be insufficient, and integrated functional assessment may be required to capture clinically relevant impairment.

In addition, the relationship between pelvic floor function and symptom development may be influenced by real-world behavioral factors. Postpartum physical activity, for example, has been associated with subsequent pelvic floor support and symptom trajectories, suggesting that functional outcomes should be interpreted within broader lifestyle and clinical contexts [9]. Understanding these relationships in routine care populations is therefore essential for translating mechanistic insights into practical clinical strategies.

Against this background, the present study was designed to examine whether pelvic floor functional status assessed at approximately 42 days postpartum provides a more proximal and clinically relevant indicator of subsequent anorectal symptoms than conventional obstetric exposures in a real-world clinical setting. Rather than focusing solely on delivery-related factors, this study adopts a function-oriented perspective by evaluating the extent to which routinely collected pelvic floor screening data capture clinically meaningful risk for later bowel-related morbidity.

By integrating longitudinal follow-up with routinely available clinical information, we aimed to assess whether early postpartum functional assessment reflects an intermediate stage in the pathway from childbirth-related exposures to later anorectal outcomes. In doing so, this study seeks to provide a more clinically applicable framework for understanding postpartum pelvic floor disorders and to explore the potential role of routine screening in improving risk identification and informing postpartum care strategies.

2. Methods

2.1. Study design and setting

This retrospective cohort study was conducted at Nankai University Hospital, Tianjin, China. The cohort was derived from women receiving antenatal care at the study institution, with postpartum clinical data obtained through linkage to the regional maternal healthcare network.

The study aimed to examine the temporal association between early postpartum pelvic floor functional status and subsequent anorectal symptoms under real-world clinical conditions. All data were based on routinely collected clinical records and follow-up assessments rather than a predefined research protocol. All participating institutions followed standardized protocols within the regional maternal healthcare network, ensuring consistency of pelvic floor screening procedures and data recording.

2.2. Study population

The study population consisted of women who received antenatal care at Nankai University Hospital before 28 weeks of gestation between January 2021 and December 2025. Since deliveries and postpartum pelvic floor screening were conducted outside the study institution, these women subsequently delivered and underwent routine pelvic floor screening at approximately 42 days

postpartum at external hospitals within the regional maternal healthcare network. Their postpartum pelvic floor screening data were retrospectively collected for analysis through linkage to the regional maternal healthcare database via a shared clinical information system.

Among 438 eligible women in the source population, 420 were successfully linked to postpartum records. Of these, 408 women completed pelvic floor screening with complete baseline information and were eligible for follow-up. Follow-up was conducted at 6–12 months postpartum to assess anorectal outcomes. During this period, 16 women were lost to follow-up, 6 were excluded due to incomplete follow-up data, and 4 were excluded because of missing outcome information, resulting in a final analytic sample of 382 women.

The derivation of the study cohort and participant flow are illustrated in Figure 1.

Women with a history of major anorectal surgery, pelvic floor reconstructive procedures, or known organic gastrointestinal diseases were excluded.

2.3. Data collection and variable definitions

Baseline data were obtained from the hospital electronic medical record system and the pelvic floor screening database. Variables included age, education level, occupation, body mass index (BMI), parity, delivery mode, neonatal birth weight, duration of the second stage of labor, and pre-pregnancy hemorrhoid history, selected based on their clinical relevance.

Pelvic floor screening at approximately 42 days postpartum was treated as the baseline assessment (time zero) for the cohort. The screening protocol included standardized assessments of pelvic floor muscle function, comprising muscle strength grading of type I and type II muscle fibers (0–5 scale), evaluation of muscle fatigue, and measurement of maximal vaginal contraction pressure (cmH_2O).

Pelvic floor dysfunction was classified according to standardized clinical criteria routinely applied within the regional maternal healthcare network, consistent with internationally recognized frameworks for pelvic floor assessment and terminology [10,11]. Specifically, participants were categorized as having abnormal pelvic floor function when one or more predefined screening domains (muscle strength, endurance, or contraction pressure) fell below the standardized clinical threshold. This composite classification reflects routine clinical decision-making and was used as the primary exposure variable.

In addition to the composite classification, maximum pelvic floor contraction pressure was analyzed as a continuous variable in exploratory predictive analyses to assess its individual discriminative performance.

2.4. Outcome assessment

Follow-up was conducted within a predefined window of 6–12 months postpartum via standardized telephone interviews or electronic questionnaires. This time window was selected to capture the period during which postpartum pelvic floor recovery stabilizes and anorectal symptoms become clinically relevant.

A standardized symptom assessment instrument was used across all participants, with predefined criteria applied for each symptom to ensure consistency between data collection modes. The assessment covered a range of anorectal symptoms, including constipation, fecal incontinence, defecatory difficulty, incomplete evacuation, hemorrhoidal symptoms, and perineal pain.

For each symptom, participants were classified as positive based on predefined symptom-specific criteria, and the presence of at least one symptom was used to define the composite outcome of anorectal morbidity.

All interviews followed a structured protocol, and data collection procedures were standardized across investigators to minimize measurement variability. Interviewers were not involved in the baseline pelvic floor screening and were unaware of participants' screening results at the time of follow-up assessment.

2.5. Statistical analysis

All statistical analyses were performed using SPSS (version 26.0; IBM Corp., Armonk, NY, USA). A two-sided P value <0.05 was considered statistically significant.

Baseline characteristics were compared using Student's t-test or Mann–Whitney U test for continuous variables and χ^2 test or Fisher's exact test for categorical variables, as appropriate.

Logistic regression models were used to examine associations between pelvic floor dysfunction and anorectal symptoms. Variables with $P < 0.10$ in univariate analyses, together with clinically relevant covariates identified a priori, were included in multivariable models. Adjusted odds ratios (ORs) and 95% confidence intervals (CIs) were reported. Separate models were constructed for individual symptom outcomes.

Model assumptions and performance were assessed prior to interpretation, including multicollinearity, goodness-of-fit, discrimination, and calibration. Internal validation was performed using bootstrap resampling.

Sensitivity analyses were conducted by excluding women with a pre-pregnancy history of hemorrhoids. Stratified analyses according to delivery mode were performed, and an interaction term was included to assess effect modification.

Receiver operating characteristic (ROC) curve analysis was used to evaluate the discriminative ability of maximum pelvic floor pressure, with the optimal cut-off determined using the Youden index.

3. Results

3.1. Baseline characteristics

A total of 382 women were included in the final analysis, of whom 209 (54.7%) reported at least one anorectal symptom during follow-up.

Baseline characteristics according to symptom status are summarized in Table 1.

Table 1. Baseline characteristics of participants according to anorectal symptom status

Variable	Category	No symptoms (n=173)	Symptoms (n=209)	P value
Continuous variables				
Age, years	—	31.7 ± 4.9	32.4 ± 4.6	0.169
BMI, kg/m²	—	22.4 ± 2.6	23.1 ± 2.6	0.019
Birth weight, g	—	3383.0 ± 395.1	3404.4 ± 375.3	0.590
Maximum pressure, cmH_2O	—	27.5 ± 7.6	24.1 ± 7.2	<0.001
Categorical variables				
Occupation	**Teacher**	93 (53.8)	113 (54.1)	0.921
	Student	23 (13.3)	25 (12.0)	
	Resident	57 (32.9)	71 (34.0)	
Education	**Bachelor**	61 (35.3)	90 (43.1)	0.077
	Master	81 (46.8)	74 (35.4)	
	Doctor	31 (17.9)	45 (21.5)	
Delivery mode	**Vaginal**	90 (52.0)	130 (62.2)	0.134
	Cesarean	79 (45.7)	75 (35.9)	
	Assisted	4 (2.3)	4 (1.9)	
Parity	**Primipara**	144 (83.2)	151 (72.2)	0.015
	Multipara	29 (16.8)	58 (27.8)	
Hemorrhoid history	**No**	140 (80.9)	145 (69.4)	0.014
	Yes	33 (19.1)	64 (30.6)	
Pelvic floor screening	**Normal**	134 (77.5)	101 (48.3)	<0.001
	Abnormal	39 (22.5)	108 (51.7)	<0.001

Legend: Data are presented as mean ± standard deviation (SD) for continuous variables and n (%) for categorical variables. P values were calculated using Student's t-test or Mann–Whitney U test for continuous variables and χ^2 test or Fisher's exact test for categorical variables, as appropriate. BMI, body mass index.

Women who reported anorectal symptoms had a higher body mass index (BMI) (23.1 ± 2.6 vs 22.4 ± 2.6 kg/m², P = 0.019) and lower maximum pelvic floor pressure (24.1 ± 7.2 vs 27.5 ± 7.6 cmH_2O, P < 0.001) compared with those without symptoms. Age and neonatal birth weight did not differ between groups.

With regard to categorical variables, multiparity (27.8% vs 16.8%, P = 0.015) and pre-pregnancy hemorrhoid history (30.6% vs 19.1%, P = 0.014) were more frequent among women with symptoms. Abnormal pelvic floor screening was markedly more prevalent in the symptom group (51.7% vs 22.5%, P < 0.001). No statistically significant differences were observed for occupation or delivery mode, while educational level showed a non-significant imbalance (P = 0.077).

3.2. Factors associated with anorectal symptoms

Univariate logistic regression analyses are presented in Table 2.

Table 2. Univariate logistic regression analysis of factors associated with anorectal symptoms

Variable	OR	95% CI	P value
Age (per year)	1.03	0.99–1.08	0.166
BMI (per kg/m²)	1.1	1.01–1.19	0.020
Vaginal delivery (vs cesarean/assisted)	1.5	0.99–2.27	0.053
Multiparity (vs primipara)	1.91	1.16–3.15	0.012
Hemorrhoid history (yes vs no)	1.87	1.16–3.03	0.010
Maximum pressure (per cmH2O)	0.94	0.91–0.97	<0.001
Pelvic floor dysfunction (abnormal vs normal)	3.67	2.35–5.75	<0.001

Legend: OR, odds ratio; CI, confidence interval. ORs are presented per unit increase for continuous variables. Reference categories: cesarean/assisted delivery for delivery mode, primipara for parity, and absence of hemorrhoid history. P values were derived from logistic regression models.

Higher BMI (OR 1.10, 95% CI 1.01–1.19, P = 0.020), multiparity (OR 1.91, 95% CI 1.16–3.15, P = 0.012), and pre-pregnancy hemorrhoid history (OR 1.87, 95% CI 1.16–3.03, P = 0.010) were associated with increased odds of anorectal symptoms. Maximum pelvic floor pressure showed an inverse association with the outcome (OR 0.94, 95% CI 0.91–0.97, P < 0.001). Abnormal pelvic floor screening demonstrated a strong association (OR 3.67, 95% CI 2.35–5.75, P < 0.001), whereas vaginal delivery showed only a borderline relationship (OR 1.50, P = 0.053). Age was not associated with the outcome.

Multivariable logistic regression results are presented in Table 3, with adjusted effect estimates and confidence intervals illustrated in Figure 2.

Table 3. Multivariable logistic regression analysis of factors associated with anorectal symptoms

Variable	Adjusted OR	95% CI	P value
Pelvic floor dysfunction (abnormal vs normal)	2.85	1.64–4.94	<0.001
Age (per year)	0.98	0.93–1.04	0.515
BMI (per kg/m²)	1.07	0.98–1.18	0.141
Vaginal delivery (vs cesarean/assisted)	1.26	0.48–3.35	0.641
Second stage duration (per min)	1.00	0.99–1.01	0.822
Hemorrhoid history (yes vs no)	1.38	0.82–2.33	0.228
Multiparity (vs primipara)	1.65	0.94–2.90	0.080

Legend: OR, odds ratio; CI, confidence interval. Adjusted for age, body mass index (BMI), delivery mode, duration of the second stage of labor, parity, and pre-pregnancy hemorrhoid history. Reference categories: cesarean/assisted delivery for delivery mode and primipara for parity. P values were derived from multivariable logistic regression models.

Table 4. Multivariable logistic regression analyses of pelvic floor dysfunction and individual anorectal symptoms

Outcome	Variable	Adjusted OR	95% CI	P value
Constipation	Pelvic floor dysfunction (abnormal vs normal)	2.52	1.35–4.72	0.004
	Age (per year)	1.00	0.94–1.06	0.963
	BMI (per kg/m²)	1.10	0.98–1.23	0.097
	Vaginal delivery (vs cesarean/assisted)	2.22	1.15–4.28	0.017
	Hemorrhoid history (yes vs no)	1.16	0.65–2.08	0.613
Fecal incontinence	Pelvic floor dysfunction (abnormal vs normal)	4.79	1.41–16.23	0.012
	Age (per year)	1.07	0.96–1.20	0.221
	BMI (per kg/m²)	0.97	0.79–1.18	0.757
	Vaginal delivery (vs cesarean/assisted)	0.85	0.29–2.53	0.770
	Hemorrhoid history (yes vs no)	1.18	0.45–3.06	0.741
Defecatory difficulty	Pelvic floor dysfunction (abnormal vs normal)	4.32	1.93–9.67	<0.001
	Age (per year)	0.98	0.91–1.06	0.581
	BMI (per kg/m²)	0.94	0.82–1.08	0.360
	Vaginal delivery (vs cesarean/assisted)	0.86	0.40–1.87	0.703
	Hemorrhoid history (yes vs no)	1.35	0.69–2.66	0.382

Legend: OR, odds ratio; CI, confidence interval. Models were adjusted for age, body mass index (BMI), delivery mode, duration of the second stage of labor, parity, and pre-pregnancy hemorrhoid history. Pelvic floor dysfunction was defined based on routine postpartum screening at approximately 42 days. Separate models were constructed for each symptom outcome.

After adjustment for potential confounders, abnormal pelvic floor screening remained independently associated with anorectal symptoms (adjusted OR 2.85, 95% CI 1.64–4.94, P < 0.001). In contrast,

conventional obstetric variables—including delivery mode and second stage duration—were not independently associated with the outcome. Age, BMI, and pre-pregnancy hemorrhoid history were also not significant after adjustment. Multiparity showed a borderline association (adjusted OR 1.65, 95% CI 0.94–2.90, P = 0.080).

Taken together, these findings indicate that pelvic floor functional status, as captured by routine screening, shows a stronger and more consistent association with subsequent anorectal symptoms than conventional obstetric exposures.

3.3. Model diagnostics and performance

To ensure the robustness and interpretability of the primary findings, additional model diagnostics and validation analyses were performed. No evidence of problematic multicollinearity was observed among the included covariates, with all tolerance values exceeding 0.50 and all variance inflation factor (VIF) values below 2.0 (Supplementary Table S5).

Model performance metrics are summarized in Supplementary Table S6.
The multivariable model was significantly better than the null model (likelihood ratio test, P < 0.001), and the Hosmer–Lemeshow test indicated no evidence of poor fit ($\chi^2 = 6.45$, df = 8, P = 0.597). Discrimination was modest, with an area under the receiver operating characteristic curve (AUC) of 0.691 and a Brier score of 0.221. The Nagelkerke R^2 was 0.144, indicating moderate explanatory contribution.

Calibration analysis demonstrated good agreement between predicted and observed risks. The apparent calibration intercept and slope were 0.000 and 1.000, respectively. However, bootstrap internal validation (200 resamples) indicated mild optimism, with an optimism-corrected AUC of 0.664 and a calibration slope of 0.853.

Further assessment across deciles of predicted risk showed close correspondence between observed and expected event rates (Supplementary Table S7).

3.4. Sensitivity and subgroup analyses

The robustness of the primary findings was assessed in sensitivity analyses excluding women with a pre-pregnancy history of hemorrhoids (Supplementary Table S1).

In this restricted analysis, abnormal pelvic floor screening remained strongly associated with anorectal symptoms (adjusted OR 3.32, 95% CI 1.71–6.44, P < 0.001). Multiparity was also significantly associated with the outcome (adjusted OR 2.19, 95% CI 1.10–4.35, P = 0.026).

Stratified analyses according to delivery mode demonstrated consistent associations across subgroups. In the cesarean subgroup, abnormal pelvic floor screening was associated with increased odds of anorectal symptoms (adjusted OR 2.93, 95% CI 1.18–7.27, P = 0.021) (Supplementary Table S2).

Similarly, in the vaginal/assisted delivery subgroup, the association remained significant (adjusted OR 2.97, 95% CI 1.46–6.05, P = 0.003) (Supplementary Table S3).

Formal interaction analysis showed no evidence of effect modification by delivery mode (P for interaction = 0.983), indicating that the association between pelvic floor dysfunction and anorectal symptoms was consistent across delivery types (Supplementary Table S4).

3.5. Secondary and predictive analyses

Associations between pelvic floor dysfunction and individual anorectal symptoms are presented in Table 4.

After adjustment, abnormal pelvic floor screening was independently associated with constipation (adjusted OR 2.52, 95% CI 1.35–4.72, P = 0.004), fecal incontinence (adjusted OR 4.79, 95% CI 1.41–16.23, P = 0.012), and defecatory difficulty (adjusted OR 4.32, 95% CI 1.93–9.67, P < 0.001). The magnitude of association was greater for fecal incontinence and defecatory difficulty than for constipation.

Among covariates, vaginal delivery was independently associated with constipation (adjusted OR 2.22, 95% CI 1.15–4.28, P = 0.017), whereas other variables did not show consistent associations across symptom-specific models.

Additional analyses for other symptom categories, including incomplete evacuation, hemorrhoidal symptoms, and perineal pain, are provided in Supplementary Table S8.

Table 4. Multivariable logistic regression analyses of pelvic floor dysfunction and individual anorectal symptoms

Outcome	Variable	Adjusted OR	95% CI	P value
Constipation	Pelvic floor dysfunction (abnormal vs normal)	2.52	1.35–4.72	0.004
	Age (per year)	1.00	0.94–1.06	0.963
	BMI (per kg/m²)	1.10	0.98–1.23	0.097
	Vaginal delivery (vs cesarean/assisted)	2.22	1.15–4.28	0.017
	Hemorrhoid history (yes vs no)	1.16	0.65–2.08	0.613
Fecal incontinence	Pelvic floor dysfunction (abnormal vs normal)	4.79	1.41–16.23	0.012
	Age (per year)	1.07	0.96–1.20	0.221
	BMI (per kg/m²)	0.97	0.79–1.18	0.757
	Vaginal delivery (vs cesarean/assisted)	0.85	0.29–2.53	0.770
	Hemorrhoid history (yes vs no)	1.18	0.45–3.06	0.741
Defecatory difficulty	Pelvic floor dysfunction (abnormal vs normal)	4.32	1.93–9.67	<0.001
	Age (per year)	0.98	0.91–1.06	0.581
	BMI (per kg/m²)	0.94	0.82–1.08	0.360
	Vaginal delivery (vs cesarean/assisted)	0.86	0.40–1.87	0.703
	Hemorrhoid history (yes vs no)	1.35	0.69–2.66	0.382

Legend: OR, odds ratio; CI, confidence interval. Models were adjusted for age, body mass index (BMI), delivery mode, duration of the second stage of labor, parity, and pre-pregnancy hemorrhoid history. Pelvic floor dysfunction was defined based on routine postpartum screening at approximately 42 days. Separate models were constructed for each symptom outcome.

3.6. Predictive performance of individual screening parameters

Given the observed association between pelvic floor function and anorectal outcomes, additional analyses were performed to evaluate the predictive performance of individual screening parameters.

As shown in Figure 3, maximum pelvic floor pressure alone demonstrated limited discriminative ability (AUC = 0.63). The optimal cut-off value of 24.4 cmH_2O yielded a sensitivity of 56.0% and a specificity of 67.1%, indicating that single physiological parameters provide only modest predictive value. These findings indicate that single physiological indicators have limited value for individual-level prediction, whereas composite assessments of pelvic floor function may better capture clinically relevant risk.

4. Discussion

In this cohort, we observed that postpartum anorectal symptoms were more closely associated with pelvic floor functional status than with conventional obstetric exposures. This finding does not negate the role of obstetric factors; rather, it suggests that their influence may be expressed through subsequent alterations in pelvic floor function. Viewed in this way, childbirth-related exposures may contribute to later anorectal outcomes primarily by shaping the trajectory of functional recovery. This pathway-based interpretation offers a plausible explanation for the attenuation of obstetric variables after adjustment and may help reconcile inconsistencies reported in prior studies examining delivery characteristics and long-term pelvic floor disorders [12–14].

From a physiological perspective, this pattern is consistent with the integrated nature of the pelvic floor and anorectal system. Continence and defecation depend on coordinated interactions among pelvic floor musculature, anal sphincters, rectal compliance, and neural control pathways, and disruption at any level can manifest as a spectrum of anorectal symptoms rather than discrete disease entities [15–17]. The symptom-specific associations observed here provide further support for this view. The stronger associations with fecal incontinence and defecatory difficulty are in line with the central role of neuromuscular coordination in maintaining continence and facilitating evacuation, whereas constipation appears to reflect a broader interplay of physiological and behavioral influences [18]. Taken together, these findings suggest that postpartum anorectal symptoms may represent different expressions along a shared functional continuum.

The diminished role of obstetric variables in the adjusted models is clinically informative. While exposures such as vaginal delivery and pelvic floor trauma are well-recognized contributors to structural and functional impairment [19, 20], their longer-term effects on anorectal outcomes may not operate independently but instead through intermediate functional states. This distinction matters in practice. Obstetric history is fixed, whereas pelvic floor functional status is dynamic and, to some extent, modifiable. In this context, routine postpartum functional assessment may offer a more proximal indicator of risk. This interpretation is consistent with clinical approaches that emphasize functional

evaluation as a core component of postpartum pelvic floor care [21], and it supports a gradual shift toward function-based risk assessment in postpartum populations.

The findings also have implications for how postpartum care is organized in routine clinical settings. Although specialized anorectal physiological testing provides detailed mechanistic information, its use is often constrained by limited availability and accessibility [7]. In contrast, structured pelvic floor screening represents a more feasible approach for identifying women with persistent functional impairment. Previous work has highlighted gaps in the recognition and management of postpartum pelvic floor disorders [22], and recent reviews have emphasized the importance of integrating evaluation, treatment, and prevention strategies across the postpartum continuum [23]. In parallel, cohort studies suggest that systematic assessment can reveal a substantial burden of symptoms that might otherwise go unnoticed [24, 25]. Screening, however, is only meaningful if it leads to action. Conservative interventions, including pelvic floor muscle training, have been shown to improve symptoms and functional outcomes [26, 27], supporting a care model in which early identification is linked to timely, targeted management.

The performance of the multivariable model provides additional context for interpreting these findings. Although calibration was acceptable, discrimination remained modest, and individual physiological indicators showed limited predictive ability. This pattern is not unexpected. Associations observed at the population level do not necessarily translate into accurate individual-level prediction, particularly in conditions with multifactorial etiologies. Pelvic floor disorders are shaped by interactions among structural, functional, and behavioral factors, which are unlikely to be fully captured by a limited set of clinical variables. This interpretation aligns with previous literature describing the multidimensional nature of pelvic floor disorders [28–30], as well as systematic reviews reporting modest performance of existing postpartum prediction models [31]. In this setting, routine screening may be more appropriately viewed as a tool for population-level risk identification and clinical stratification, rather than precise individual prediction.

The relatively high prevalence of anorectal symptoms observed in this cohort further emphasizes their clinical relevance. Although the use of a composite outcome may have contributed to this estimate, it is unlikely to fully account for the magnitude observed. Longitudinal studies indicate that pelvic floor dysfunction may persist beyond the early postpartum period and contribute to sustained symptom burden [32]. This suggests that current postpartum care pathways may not fully capture ongoing functional impairment. In practice, symptom burden may be underestimated when follow-up is limited or focused primarily on obstetric exposures rather than functional recovery.

The present findings also underscore the importance of linking assessment with both preventive and therapeutic strategies. Interventional studies have shown that pelvic floor muscle training can improve functional outcomes and reduce symptom burden [33], while preventive approaches during the postpartum period may help mitigate longer-term dysfunction [34]. Advances in imaging and functional assessment offer additional opportunities to refine evaluation. For example, total pelvic floor ultrasound

enables more detailed characterization of defecatory function and may support more tailored diagnostic and treatment approaches [35]. Future research will likely benefit from integrating clinical, functional, and behavioral dimensions, including modifiable factors such as physical activity, which have been increasingly recognized as relevant to postpartum pelvic floor health [36].

The performance of the multivariable model provides additional context for interpreting these findings. Although calibration was acceptable, discrimination remained modest, and individual physiological indicators showed limited predictive ability. This pattern is consistent with the multifactorial nature of pelvic floor disorders, in which structural, functional, and behavioral components interact in complex and often non-linear ways. As such, associations observed at the population level are not expected to translate directly into precise individual-level prediction. In this context, routine pelvic floor screening may be better understood as a tool for risk stratification and clinical orientation rather than as a standalone predictive instrument.

Several limitations should be considered when interpreting these findings. The retrospective design precludes causal inference and leaves the possibility of residual confounding, particularly with respect to behavioral factors that were not fully captured. Outcome assessment relied on self-reported symptoms, which may introduce measurement variability despite the use of standardized procedures. In addition, estimates for symptom-specific outcomes, particularly fecal incontinence, should be interpreted with caution given the wider confidence intervals observed in subgroup analyses. Finally, although the study reflects real-world clinical practice, the single-center design may limit generalizability to other populations or healthcare settings.

5. Conclusion

In this hospital-based cohort study, pelvic floor dysfunction identified through routine postpartum screening was independently associated with subsequent anorectal symptoms and showed a stronger relationship with outcomes than conventional obstetric exposures. These findings suggest that early postpartum functional status may represent a clinically relevant intermediate stage linking childbirth-related exposures to later anorectal morbidity, highlighting the potential value of function-oriented assessment in postpartum care.

Although the predictive performance of individual screening parameters remains limited, routinely collected functional measures appear to capture meaningful risk information in real-world settings. Integrating pelvic floor assessment into postpartum care pathways may therefore support earlier identification of women at risk and facilitate more targeted and timely management strategies.

Declarations

Ethics approval and consent to participate

This study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of Nankai University (Approval No. NKUIRB2026124). It utilized retrospectively collected clinical data and follow-up information obtained via telephone or electronic questionnaires. Informed consent was waived for retrospectively collected clinical data, whereas verbal or electronic informed consent was obtained from participants involved in follow-up. All data were anonymized prior to analysis.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and/or analyzed during the current study are not publicly available due to institutional data protection policies and the inclusion of potentially identifiable clinical information. De-identified data are available from the corresponding author upon reasonable request for academic purposes, subject to approval by the institutional ethics committee and compliance with data protection regulations.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Yang Shi and Hui Tao contributed equally to this work and share first authorship. Yang Shi contributed to study conceptualization, design, and statistical analysis; Hui Tao contributed to data collection, interpretation, and manuscript drafting; Qian Gu contributed to data collection, statistical analysis, and manuscript revision; Jing Xiang contributed to study design, statistical analysis, manuscript drafting, and critical revision.

All authors read and approved the final manuscript.

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Figures

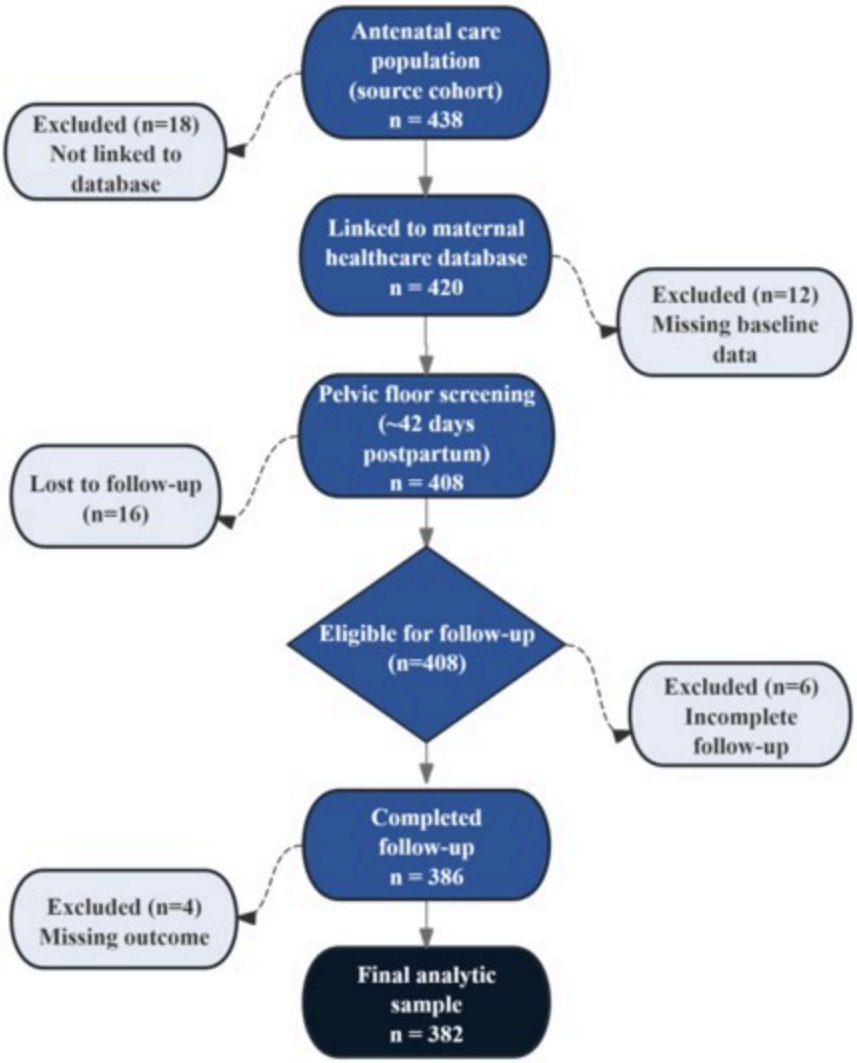


Figure 1

Flow diagram of cohort derivation and participant selection.
Legend: Women were identified from the antenatal care population and linked to the regional maternal healthcare database. Pelvic floor function was assessed at approximately 42 days postpartum, and follow-up was conducted at 6–12 months postpartum. The final analytic sample consisted of 382 women.

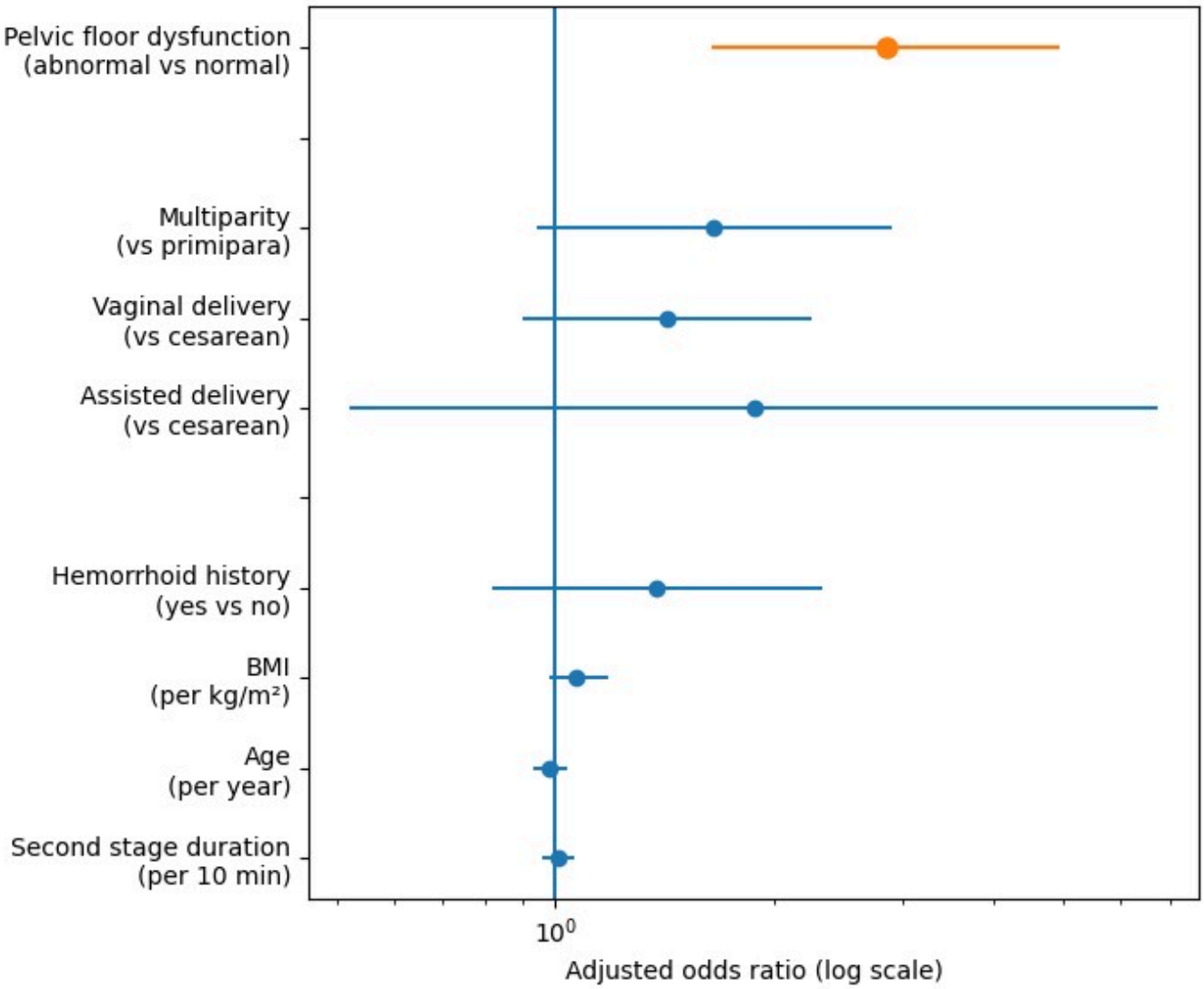


Figure 2

Adjusted associations between pelvic floor dysfunction and anorectal symptoms.

Legend: Multivariable logistic regression analysis showing adjusted odds ratios (ORs) and 95% confidence intervals (CIs) for factors associated with composite anorectal symptoms. Pelvic floor dysfunction was defined based on routine postpartum screening at approximately 42 days. The vertical dashed line indicates an OR of 1. Variables were adjusted for age, body mass index, delivery mode, parity, hemorrhoid history, and second stage duration.

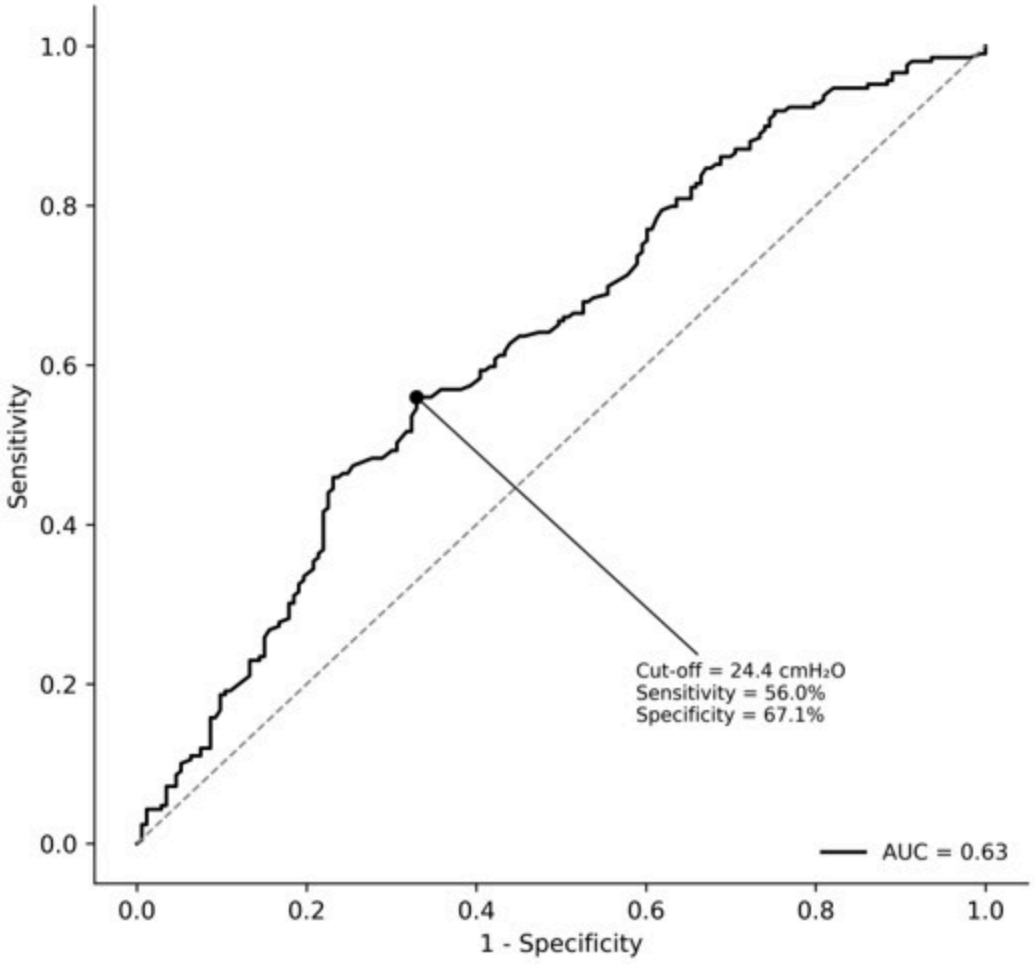


Figure 3

Receiver operating characteristic (ROC) curve of maximum pelvic floor pressure for predicting anorectal symptoms.

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