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Impact of Chemoradiotherapy on Pelvic Floor Function and Quality of Life in Women with Cervical Cancer

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ABSTRACT

Objective: Cervical cancer remains a leading cause of morbidity and mortality among women in low- and middle-income countries. While chemoradiotherapy (CRT) improves survival, it frequently results in long-term pelvic floor dysfunction (PFD) and impaired quality of life (QoL), which are often underreported in routine oncology care. This study therefore sought to assess the impact of CRT on pelvic floor function and QoL in women with cervical cancer in Tripura, India.

Methods: We conducted a prospective observational study involving 384 women with histologically confirmed cervical cancer (FIGO stages IB2–IVA), treated at the Atal Bihari Vajpayee Regional Cancer Centre, Agartala, between 2022 and 2024. Standardized and validated questionnaires, including the Pelvic Floor Distress Inventory (PFDI-20), Overactive Bladder Symptom Score (OABSS), and EuroQol-5 Dimension (EQ-5D), were administered. Associations between clinical variables and symptom prevalence were examined using chi- square tests and logistic regression analysis.

Results: Most frequently reported complications were constipation, urinary frequency, and stress urinary incontinence. Women with higher body mass index (BMI) and those who received multimodal therapy, particularly surgery combined with radiotherapy, exhibited significantly higher rates of urinary and bowel symptoms. Parity ≤2 was associated with reduced symptom prevalence. No significant associations were observed between parity and PFD scores or between FIGO stage and PFF outcomes.

Conclusion: CRT substantially impairs pelvic floor function and QoL in women with cervical cancer. with obesity and combined treatment modalities emerging as important contributors to long-term morbidity. These findings underscore the need for patient-tailored management strategies, including BMI optimization, precise radiotherapy planning, and the integration of early pelvic rehabilitation programs, to mitigate chronic pelvic dysfunction and preserve QoL in this vulnerable population.

Keywords: *chemoradiotherapy, pelvic floor dysfunction, cervical cancer, quality of life.*

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1. INTRODUCTION

Cervical cancer remains a leading cause of cancer-related morbidity and mortality among women in low- and middle-income countries such as India. Early-stage disease may be managed surgically, whereas locally advanced stages (FIGO IIB–IVA) are primarily treated with concurrent chemoradiotherapy (CCRT), the international standard of care.1 As survival improves, attention is shifting toward survivorship, with emphasis on long-term quality of life (QoL) and functional outcomes in under-characterized populations.2

Collateral injury from radiotherapy and chemotherapy to adjacent pelvic structures—including bladder, rectum, and pelvic

nerves—can result in chronic pelvic floor dysfunction (PFD)

encompassing urinary incontinence, urgency, fecal leakage, constipation, sexual dysfunction, and chronic pelvic pain, conditions that are frequently underdiagnosed and undertreated and that substantially impair daily functioning and psychological well-being.3 Multicenter evidence indicates that more than 60% of women with cervical cancer experience at least one PFD after treatment, with higher prevalence among those receiving CCRT than radiotherapy alone.4

In Tripura, a Northeastern Indian state with distinct sociodemographic characteristics and health-system constraints, the clinical behavior of cervical malignancies has been reported as aggressive, yet systematic evaluations of QoL and functional sequelae remain scarce.5 At the same time, CCRT's central role in disease control and the potential for prolonged PFD due to pelvic tissue injury underscore the importance of region-specific survivorship data.6 Local reports further suggest that many patients endure persistent physical and psychological symptoms—often silently—highlighting gaps in post-treatment rehabilitation services.7

Late toxicities likely arise from radiation-induced fibrosis and vascular injury, compounded by systemic chemotherapy effects, with cumulative sequelae that disrupt coordinated pelvic organ function.8 Consistent with this pathophysiology, moderate-to-severe PFD has been documented years after completion of CCRT, and national estimates show rising years lived with disability attributable to cervical cancer—signals of a growing survivorship burden that extends beyond tumor control.9 In Tripura, more than two-thirds of patients have reported low QoL scores within six months post-therapy, emphasizing the need for individualized follow-up in overburdened systems.10

Sexual dysfunction is both common and underreported, with radiotherapy-related vaginal atrophy, fibrosis, and loss of libido causing substantial distress, particularly among younger women.11 Psychological morbidity—including anxiety, depression, post-traumatic stress, and

body-image disturbance—adds to functional disability, yet dedicated mental-health services are often absent in routine oncology care.12 Broader inequities in screening, treatment access, and follow-up across India further magnify these survivorship gaps, particularly in resource- limited regions.13

Standardized, validated assessment tools are therefore essential to detect and manage PFD early and to generate comparable data for service planning. Pelvic floor disorders can markedly reduce physical, emotional, and social health, but remain overlooked without consistent measurement.14 Instruments such as the Pelvic Floor Distress Inventory-20 (PFDI-20), Overactive Bladder Symptom Score (OABSS), and the EuroQol-5 Dimension (EQ-5D) provide comprehensive coverage across urinary, colorectal, vaginal, and global health domains; integrating these patient-reported measures (and, where feasible, complementary objective assessments) into routine practice can strengthen surveillance and guide targeted interventions.15

Against this background, the present study evaluates the impact of CCRT on pelvic floor function and QoL among women with cervical cancer treated at the Atal Bihari Vajpayee Regional Cancer Centre, Agartala, Tripura. By focusing on an underrepresented setting and applying standardized outcome measures, this confirmatory cohort seeks to inform patient-centered survivorship strategies that extend beyond disease control to long-term functional recovery.

2. MATERIALS AND METHODS

Study Design and Setting

This was a prospective observational cohort study conducted at the Atal Bihari Vajpayee Regional Cancer Centre, Agartala, Tripura, India. The study was carried out between January 2022 and December 2024 and was designed to assess the effects of chemoradiotherapy on pelvic floor function (PFF) and health-related quality of life (QoL) outcomes among women with histologically confirmed cervical cancer. While previous Indian and international studies have addressed similar associations, this study specifically targeted an underserved population in Tripura to generate region-specific evidence on treatment outcomes. The study protocol was approved by the Institutional Ethics Committee of Agartala Government Medical College (Ref. No. F.4(6-13)/AGMC/Medical Education/IEC Approval/2022/17320). The research adhered to the principles of the Declaration of Helsinki.16 Written informed consent was obtained from all participants after a detailed explanation of study objectives, and strict confidentiality was maintained throughout the research process.

Study Population

The study enrolled 384 women aged between 18 and 80 years who had been diagnosed with cervical cancer, staged IB2 to IVA according to the International Federation of Gynecology and Obstetrics (FIGO) classification. All participants had undergone curative-intent chemoradiotherapy. Recruitment followed purposive sampling with stratification to ensure representativeness across disease stage and treatment modality. Participants were systematically selected from institutional

registries to reduce selection bias and achieve balanced representation across clinical subgroups.

Eligibility Criteria

Inclusion criteria comprised women with histologically confirmed cervical carcinoma (squamous, adenosquamous, or adenocarcinoma) who had completed external beam radiotherapy with concurrent cisplatin-based chemotherapy and brachytherapy, and who were at least six months post-treatment at the time of evaluation. Participants were required to provide written informed consent and demonstrate the ability to complete questionnaires in either English or the local language. Exclusion criteria included prior radiotherapy or pelvic surgery for other malignancies, pre-existing urological, gastrointestinal, or neurological conditions that could independently affect pelvic function, evidence of metastatic or recurrent disease at the time of assessment, and pregnancy or postpartum status within the last six months. Patients with incomplete records or unwillingness to participate were also excluded.

Sample Size

The total study population consisted of 384 women, a number consistent with the calculated sample size based on the formula for estimating proportions: $n = Z^2p(1 - p)/d^2$, where $Z = 1.96$ for a two-sided 95% confidence level, $p = 0.5$ for maximum variability, and $d = 0.05$ as the desired margin of error. Substitution of these values yielded $n = (1.96)^2 \times 0.25 / (0.05)^2 = 384.16$, which was rounded to 384 participants. This provided a ±5% margin of error at a 95% confidence interval, ensuring adequate statistical power.

Outcome Measures

Pelvic floor dysfunction and health-related QoL were assessed using three validated patient- reported outcome instruments. The Pelvic Floor Distress Inventory-20 (PFDI-20) evaluated colorectal, urogenital, and pelvic organ prolapse symptoms. The Overactive Bladder Symptom Score (OABSS) assessed urinary frequency, urgency, and incontinence severity. The EuroQol- 5D-5L (EQ-5D) provided a global measure of health status through five domains and a visual analogue scale. All questionnaires underwent translation into the local language using a forward–backward translation method and were pilot-tested in 20 patients for cultural and linguistic validation prior to administration.

Data Collection and Management

Demographic, clinical, and treatment-related data were obtained from hospital records and supplemented through structured face-to-face interviews conducted by trained research assistants in private settings to maximize accuracy and participant comfort. Completed questionnaires and data sheets were entered into an encrypted database with regular cross-checking for consistency and completeness.

Statistical Analysis

Data analysis was performed using SPSS software. Descriptive statistics summarized baseline demographic and clinical characteristics. Bivariate associations were tested using chi-square and independent t-tests. Multivariate logistic regression was applied to identify predictors of moderate-to-severe pelvic floor dysfunction, adjusting for age, body mass index (BMI), treatment duration, and menopausal status. Odds ratios (ORs) with 95% confidence intervals (CIs) were reported, and a p-value <0.05 was considered statistically significant. BMI was calculated as weight in kilograms divided by height in meters squared (kg/m²) and categorized using World Health Organization thresholds: underweight (<18.5), normal (18.5–24.9), overweight (≥25.0), and obese (≥30.0).17

3. RESULTS

Table 1. Baseline Characteristics of the Study Population (n = 384)

Characteristic	Value (%) / Mean ± SD
Age ≥ 45 years	67.0
Mean BMI (kg/m²)	24.11 ± 4.26
Obese (BMI ≥ 27)	18.0
Number of children ≤ 2	34.4
Number of children ≥ 2	64.6
Nulliparous	1.0
FIGO Stage	
I	2.8
II	39.0
III	49.2
IV	8.8
Treatment Modality	
Surgery + RT	10.0

Surgery + CRT	12.0
Chemoradiotherapy (CRT)	78.0

Table 1 indicates total of 384 women with cervical cancer (FIGO stages IB2–IVA) were evaluated. The mean age was 49.6 years, with 67% aged ≥45 years. The mean BMI was 24.1 ± 4.3 kg/m², and 18% of participants were obese (BMI ≥27). Most women (64.6%) had more than two children, and the majority presented with stage III disease (49.2%). Chemoradiotherapy (CRT) was the predominant treatment modality (78%), while 22% underwent surgery with adjuvant RT or CRT (Table 1).

Table 2. Prevalence of Pelvic Floor Dysfunction Symptoms

Symptom Category	Symptom Description	Prevalence (%)
Colorectal-Anal Distress	Fecal leakage	6.0
	Fecal urgency	9.0
	Pain with bowel emptying	2.0
	Diarrhea	5.0
	Constipation	37.0
Urinary Distress	Stress urinary incontinence	22.5
	Urge urinary incontinence	15.6
	Frequent urination	23.0
	Difficulty emptying bladder	4.0
	Leakage before bathroom	13.0
	Pain during urination	10.0
Pelvic Pain	Constant pelvic pain	9.5
	Intermittent pelvic pain	13.5

Table 2 indicates the most common pelvic floor dysfunctions were constipation (37%), frequent urination (23%), stress urinary incontinence (22.5%), and intermittent pelvic pain (13.5%). Less frequent but notable symptoms included urge incontinence (15.6%) and leakage before reaching the bathroom (13%)

Table 3. Associations Between Clinical Variables and Pelvic Floor Symptoms

Characteristic	Symptom Type	Chi² Value	p-value	Interpretation
Age (≥45 vs. <45)	Urinary symptoms	11.89	0.00056 ***	Significant
	Colorectal	10.50	0.0012 **	Significant
BMI (≥27 vs. <27)	Urinary symptoms	8.86	0.00291 **	Significant
	Colorectal	7.80	0.0054 **	Significant
Parity	Urinary symptoms	2.64	0.267	Not significant
	Colorectal	2.40	0.300	Not significant
FIGO Stage (I–IV)	Urinary symptoms	2.24	0.524	Not significant
	Colorectal	2.90	0.400	Not significant
Treatment Modality	Urinary symptoms	15.02	0.00055 ***	Significant
(Chemoradiotherapy)	Colorectal	14.10	0.0009 ***	Significant
Surgery + RT	Urinary symptoms	4.50	0.034 *	Significant
	Colorectal	0.000	1.000	Not significant
Surgery + CRT	Urinary symptoms	0.500	0.480	Not significant
	Colorectal	0.502	0.480	Not significant

Table 3 indicates significant associations emerged between older age (≥45 years) and both urinary and colorectal symptoms ($p < 0.01$). Higher BMI was also strongly correlated with increased urinary and colorectal morbidity ($p < 0.01$). By contrast, parity and FIGO stage showed no significant associations. Treatment modality exerted a marked influence: women receiving CRT or surgery plus RT reported significantly more urinary and colorectal symptoms ($p < 0.001$), while surgery plus CRT alone did not show independent associations.

Table 4. Multivariate Logistic Regression: Predictors of Clinical Outcomes

Clinical Outcome	Associated Variable	Odds Ratio (95% CI)	Interpretation
Quality of Life (EQ- 5D)	BMI (high)	1.42 (1.08–1.87)	Risk factor
	Surgery + RT	1.33 (1.12–1.65)	Risk factor
	Surgery + CRT	0.085 (0.012–0.693)	Protective
Lower Urinary Tract Symptoms (LUTS)	Surgery + RT	1.21 (1.11–1.33)	Risk factor
	Vaginal wall resection >3 cm	0.899 (0.781–1.035)	Slightly protective
Stress Incontinence	Surgery + RT	1.55 (1.10–2.19)	Risk factor
	Chemoradiotherapy	2.41 (1.19–4.91)	Risk factor
Overactive Bladder	Parity ≤ 2	0.522 (0.363–0.751)	Protective
	Chemoradiotherapy	1.61 (1.06–2.43)	Risk factor
	Extended RT duration	1.48 (1.05–2.09)	Risk factor
Defecation Distress (CRADI-8)	BMI (high)	1.019 (1.008–1.031)	Risk factor
	Surgery + RT	1.11 (1.04–1.19)	Risk factor
	Parity ≤ 2	0.892 (0.823–0.968)	Protective

EuroQol 5-Dimension instrument; CRADI-8 = Colorectal–Anal Distress

Table 4 indicates Multivariate regression confirmed BMI and surgery + RT as independent risk factors for reduced QoL (EQ-5D), urinary distress, stress incontinence, and defecation problems. Chemoradiotherapy independently increased the risk of stress incontinence (OR 2.41, 95% CI 1.19–4.91) and overactive bladder (OR 1.61, 95% CI 1.06–2.43). In contrast, parity ≤2 was protective against both overactive bladder and defecation distress. Interestingly, surgery + CRT was associated with improved QoL outcomes (OR 0.085, 95% CI 0.012–0.693), suggesting a potential protective effect in this subgroup.

4. DISCUSSION

This study assessed the long-term impact of chemoradiotherapy (CRT) on pelvic floor function (PFF) and quality of life (QoL) among 384 women with cervical cancer treated in Tripura, India. The findings revealed a high prevalence of pelvic morbidity, with constipation (37%), frequent urination (23%), and stress urinary incontinence (22.5%) emerging as the most common complications. These results reinforce the growing evidence that pelvic radiation and combined treatment

modalities significantly compromise pelvic organ function and diminish survivorship outcomes.18-20 Our data confirm that age, high BMI, and multimodality treatment (particularly CRT and surgery with adjuvant RT) are key risk factors for both urinary and colorectal dysfunction.

Conversely, lower parity (≤2) demonstrated a protective effect in regression models. These associations are consistent with prior studies showing that pelvic radiation reduces bladder compliance through fibrosis and autonomic nerve injury, leading to urinary urgency, frequency, and incontinence that persist for years.18 Similarly, bowel morbidity—chiefly constipation and fecal urgency—can be explained by radiation-induced proctitis, rectal fibrosis, and disruption of anorectal reflexes.19 The co-occurrence of urinary and bowel symptoms in this cohort supports the hypothesis that PFD reflects a shared pathophysiological mechanism involving vascular injury, neuromuscular compromise, and structural weakening of pelvic connective tissue.20 The significant relationship between obesity and PFD aligns with earlier observations that excess adiposity exacerbates radiation-related toxicity.21 Elevated intra-abdominal pressure, impaired collagen integrity, and obesity-associated vascular changes can synergize with treatment-induced tissue damage, thereby reducing pelvic support and bladder–bowel control. Unlike some studies linking multiparity with pelvic floor weakness, this analysis found no significant correlation between parity and symptoms.22 This discrepancy suggests that treatment-related injuries outweigh baseline obstetric risk factors, and the protective effect of parity ≤2 may reflect reduced cumulative strain on pelvic musculature.

Treatment modality was a critical determinant of pelvic outcomes. CRT was strongly associated with urinary and colorectal morbidity, corroborating prior evidence that, while it remains the international standard for locally advanced cervical cancer, CRT carries a considerable burden of late toxicity.23 Surgery with RT also showed increased odds of urinary morbidity, consistent with studies reporting additive risk from mechanical surgical trauma and radiation-induced fibrosis.18 Unexpectedly, surgery plus CRT was protective for overall QoL in regression analysis. This may reflect patient selection factors or improvements in surgical precision and radiotherapy planning, as suggested by recent literature advocating for optimized multimodal strategies.24 Our multivariate models highlighted symptom-specific risk patterns: CRT increased the odds of stress urinary incontinence (OR 2.41) and overactive bladder (OR 1.61), while prolonged RT exposure elevated the risk of bladder dysfunction (OR 1.48). These findings parallel prior reports of dose–duration effects in radiation toxicity [30] and underline the importance of meticulous RT planning. Importantly, symptom clustering—urinary, bowel, and pain—was observed in this cohort, a pattern increasingly recognized in survivorship research as a driver of functional decline, psychological distress, and reduced independence.25

The results have important clinical implications. First, women with high BMI constitute a high- risk subgroup and may benefit from pre-treatment optimization, weight management interventions, and closer post-treatment surveillance.26 Second, multimodality therapy, particularly surgery with RT, requires careful planning to minimize cumulative pelvic damage. Third, the observed clustering of symptoms underscores the need for multidisciplinary survivorship care integrating pelvic floor physiotherapy, dietary counselling for bowel health, and early referral to psychological support services.

This study also emphasizes the utility of validated patient-reported outcome measures such as PFDI-20, OABSS, and EQ-5D in capturing morbidity. Routine use of these tools could facilitate early detection, targeted interventions, and cross-regional comparability. Incorporating longitudinal assessments is particularly important, as certain symptoms may resolve within the first year, while others worsen.27 Furthermore, emerging advances in radiation delivery, including image-guided adaptive RT and proton therapy—may reduce collateral pelvic injury and warrant further evaluation.23 Beyond the clinical determinants, these findings also underscore broader health system challenges in low-resource oncology settings. In regions such as Tripura, structured survivorship programs, pelvic rehabilitation services, and psychosocial support remain scarce, leading to under-recognition and under-management of late toxicities. By providing rare data from Northeast India, this study helps fill an important equity gap in global literature, where most survivorship research is dominated by high-income or metropolitan populations. Importantly, sexual dysfunction—though one of the most frequent sequelae—remains underreported in conservative sociocultural contexts due to stigma surrounding open discussion of sexual health. This cultural silence not only impedes accurate clinical assessment but also leaves women unsupported in managing distressing intimate complications. Addressing these gaps requires health system strengthening that integrates routine QoL and pelvic floor assessments into follow-up protocols, expands access to rehabilitation, and develops culturally sensitive frameworks for discussing sexual health in cervical cancer survivorship care.

5. CONCLUSION

This study demonstrates that CRT significantly impairs pelvic floor function and QoL in women with cervical cancer, with obesity, older age, and multimodal therapy serving as key risk factors, while lower parity offers partial protection. The clustering of urinary, bowel, and pain symptoms highlights the multifaceted nature of pelvic morbidity. Clinical care in resource- limited settings such as Tripura must evolve beyond tumor control to embrace proactive survivorship planning,

early rehabilitation, and use of standardized outcome tools. Future research should prioritize longitudinal assessments, refined RT techniques, and culturally sensitive survivorship programs to mitigate long-term morbidity and optimize QoL for this vulnerable population. Overall, the findings demonstrate that long-term pelvic floor dysfunction is common after CRT in cervical cancer survivors, with constipation, urinary frequency, and stress incontinence being most prevalent. Age, high BMI, and multimodality treatment were the strongest risk factors, whereas lower parity conferred partial protection

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CONFLICT OF INTEREST
The authors declare no potential conflicts of interest in this study.

DATA AVAILABILITY
The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

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