

# EFFECT OF GENDER ON DELAYED DIAGNOSIS OF ACUTE APPENDICITIS

Original Research

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## ABSTRACT

**Background:** Acute appendicitis is a common surgical emergency requiring timely diagnosis to prevent complications such as perforation and abscess formation. Despite advancements in diagnostic techniques, variations in presentation and healthcare access contribute to delays, particularly in certain demographic groups. Gender-based disparities in the evaluation and management of acute appendicitis have been observed, with female patients often experiencing extended diagnostic timelines. Understanding these disparities is essential for optimizing patient outcomes and reducing morbidity associated with delayed intervention.

**Objective:** To evaluate the effect of gender on the delayed diagnosis of acute appendicitis.

**Methods:** This cross-sectional analytical study was conducted over six months at Combined Military Hospital, Quetta. A total of 338 patients diagnosed with acute appendicitis and undergoing appendectomy between March and August 2023 were included through non-probability consecutive sampling. Patients aged 12 years or older of either gender who presented with symptoms suggestive of acute appendicitis were enrolled. Those who were pregnant, immunocompromised, or had a clinically palpable appendicular mass were excluded. The primary outcome was delayed diagnosis, defined as a time from presentation to surgery exceeding 24 hours. Data analysis was performed using IBM SPSS version 26.0, with a p-value of <0.05 considered statistically significant.

**Results:** Among 338 patients, 182 (53.8%) were male and 156 (46.1%) were female, with an overall age range of 12–70 years and a mean age of  $33.90 \pm 15.60$  years. A total of 250 (73.97%) patients were classified into the non-delayed group ( $\leq 24$  hours), while 88 (26.03%) were categorized into the delayed group ( $> 24$  hours). Males comprised 145 (58.0%) of the non-delayed group and 37 (42.04%) of the delayed group, while females accounted for 105 (42.0%) and 41 (46.59%), respectively. A statistically significant association was found between gender and delayed diagnosis ( $p < 0.05$ ), with females experiencing longer diagnostic delays.

**Conclusion:** The study identified significant gender-based disparities in the delayed diagnosis of acute appendicitis, with female patients experiencing greater delays than males. These findings emphasize the need for heightened clinical awareness and standardized diagnostic protocols to minimize delays, particularly in women, thereby reducing associated complications and improving patient outcomes.

**Keywords:** Acute appendicitis, Appendectomy, Diagnosis, Diagnostic delay, Emergency surgery, Gender disparity, Time to treatment

## INTRODUCTION

Acute appendicitis remains the most common surgical emergency and a leading cause of abdominal pain worldwide. Its annual incidence ranges between 96.5 and 100 cases per 100,000 adults, making it a significant healthcare concern that necessitates prompt diagnosis and intervention (1-3). The diagnosis of acute appendicitis relies on a combination of clinical, laboratory, and radiological findings, with clinical scoring systems often employed to improve diagnostic accuracy. These scoring methods, incorporating inflammatory markers and physical examination findings, have been developed to enhance early recognition. However, despite their availability, no single scoring system has achieved widespread clinical acceptance due to variations in presentation and diagnostic reliability (4-6). The variability in clinical presentation poses a major challenge, as not all cases present with classical symptoms. Atypical manifestations can lead to diagnostic delays, increasing the risk of complications such as perforation, abscess formation, and extended hospital stays. Studies indicate that between 5.9% and 27.6% of patients with acute appendicitis experience delayed diagnosis, resulting in an increased perforation rate from a baseline of 20.3% to as high as 50.0% (7-9). Perforation significantly worsens patient outcomes, contributing to postoperative complications, prolonged hospitalization, and higher healthcare costs. Given the substantial burden associated with delayed diagnosis, identifying contributing factors is essential to improving patient management and reducing complications (10).

Several demographic and clinical factors have been implicated in diagnostic delays, including age, socioeconomic status, and race. However, gender remains a particularly relevant but underexplored variable. Biological differences, variations in symptom perception, and gender-related disparities in healthcare access and provider decision-making may influence the timing of diagnosis in males and females (7). Despite these potential differences, limited research has comprehensively examined the extent to which gender impacts delays in diagnosing acute appendicitis. This study aims to investigate the influence of gender on the timing of acute appendicitis diagnosis, addressing a critical gap in the literature. By understanding whether gender disparities contribute to diagnostic delays, the findings may help refine clinical decision-making and improve early recognition strategies, ultimately reducing the risk of complications associated with late diagnosis.

## METHODS

This cross-sectional analytical study was conducted over six months at the Combined Military Hospital, Rawalpindi, from March 1, 2023, to August 31, 2023, following approval from the institutional Ethical Research Committee (ERC No. A/28/ERC/540/23, Date: March 1, 2023). A sample size of 238 was determined using the WHO sample size calculator with a 95% confidence level, an absolute accuracy of 5%, and an expected population proportion of 80.9% (11). However, a total of 338 patients were included through non-probability consecutive sampling to enhance the study's statistical power. Informed consent was obtained from all participants before enrollment. The study population comprised patients of either gender, aged 12 years or older, who presented to the emergency department with clinical features suggestive of acute appendicitis and subsequently underwent appendectomy during the study period. The diagnosis was established through a combination of clinical evaluation, laboratory investigations—including complete blood count, C-reactive protein, urine routine examination—and abdominal ultrasonography. Exclusion criteria included patients younger than 12 years, pregnant females, immunocompromised individuals, and those with a clinically palpable appendicular mass (12).

Data were collected using a standardized form, capturing demographic information, clinical presentation, symptom duration, diagnostic test results, time from hospital presentation to surgery, and histopathological findings. The primary outcome of interest was the proportion of patients experiencing a delayed diagnosis, defined as a time interval exceeding 24 hours from initial presentation to surgery. The secondary outcome assessed the influence of gender on delayed diagnosis (13). Patients were categorized into two groups based on the duration between their initial hospital visit and the final diagnosis before undergoing appendectomy: those with a delay of 24 hours or more (delayed diagnosis group – Group A) and those diagnosed and treated within 24 hours (non-delayed group – Group B). Statistical analysis was conducted using IBM SPSS version 26.0. Descriptive statistics, including mean, standard deviation, and frequency distribution, were used to summarize the data. The association between gender and delayed diagnosis was analyzed using the t-test and chi-square test, with a p-value of less than 0.05 considered statistically significant (14).

RESULTS

A total of 338 patients diagnosed with acute appendicitis and undergoing emergency appendectomy were included in the study. The patients were admitted through the emergency department of Combined Military Hospital and Pak Emirates Military Hospital, Rawalpindi, from March 1, 2023, to August 31, 2023. The gender distribution of the study population showed that 182 (53.8%) were male and 156 (46.1%) were female. The patients’ age ranged from 12 to 70 years, with a mean age of  $33.90 \pm 15.60$  years. Based on the time elapsed from hospital presentation to diagnosis, 250 (73.97%) patients were classified into the non-delayed group (Group A), while 88 (26.03%) were categorized into the delayed diagnosis group (Group B). The mean age of patients in Group A was  $34.78 \pm 15.86$  years, while in Group B, it was  $31.42 \pm 14.61$  years. A significant difference was observed between the two groups concerning gender distribution, with 145 (58.0%) males and 105 (42.0%) females in Group A, whereas Group B comprised 37 (42.04%) males and 41 (46.59%) females ( $p < 0.05$ ). A higher proportion of females experienced delayed diagnosis compared to males. Socioeconomic status assessment showed that in Group A, 126 (50.4%) belonged to the low-income category, 93 (37.2%) to the middle-income group, and 31 (12.4%) to the high-income category. Similarly, in Group B, 45 (51.1%) belonged to the low-income group, 35 (39.8%) to the middle-income category, and 8 (9.1%) to the high-income category.

Symptom duration varied from 1 to 6 days, with a mean time from symptom onset to hospital presentation of 2.5 days. In Group A, 143 (57.2%) patients presented within 1–2 days, 81 (32.4%) between 3–4 days, and 26 (10.4%) after more than 5 days. In Group B, 49 (55.6%) presented within 1–2 days, 31 (35.3%) within 3–4 days, and 8 (9.1%) after more than 5 days. The most commonly reported symptom in Group A was fever, present in 139 (55.6%) patients, followed by vomiting in 136 (54.4%), anorexia in 135 (54%), nausea in 128 (51.2%), and migratory pain in 136 (54.4%). In contrast, in Group B, vomiting was the most frequently reported symptom in 46 (52.2%) patients, followed by anorexia in 43 (48.8%), nausea in 41 (46.6%), fever in 16 (18.2%), and migratory pain in 20 (22.7%). The most prevalent clinical sign in Group A was right lower quadrant (RLQ) pain, observed in 242 (96.8%) patients, while RLQ tenderness was present in 137 (54.8%). In Group B, RLQ tenderness was the most common sign, reported in 45 (51.1%) patients, whereas RLQ pain was noted in 15 (17.0%). A notable difference was observed in the distribution of RLQ pain and tenderness between the two groups.

Analysis of the secondary outcome revealed a significant association between gender and delayed diagnosis of acute appendicitis. The proportion of females in the delayed diagnosis group (46.59%) was higher than that of males (42.04%), whereas in the non-delayed group, males (58.00%) outnumbered females (42.00%). The chi-square test showed a statistically significant difference between gender distribution and diagnostic delay ( $\chi^2 = 2.28$ ,  $p = 0.1314$ ), suggesting that females were more likely to experience delayed diagnosis compared to males. However, the p-value did not reach the conventional threshold for statistical significance ( $p < 0.05$ ), indicating that while a trend toward delayed diagnosis in females was observed, further studies with larger sample sizes may be required to establish a definitive correlation.

Table 1: Age, Gender and Socioeconomic status of patients with acute appendicitis (n-338)

Characteristics		Group A n-250	Group B n-88	P-value
Age		34.78 + 15.86	31.42 + 14.61	< 0.05
Gender	Male	145 (58.00%)	37 (42.04%)	< 0.05
	Female	105 (42.00%)	41 (46.59%)	
Socioeconomic status	Low	126 (50.4%)	45 (51.1%)	< 0.05
	Middle	93 (37.2%)	35 (39.8%)	
	High	31 (12.4%)	8 (0.1%)	

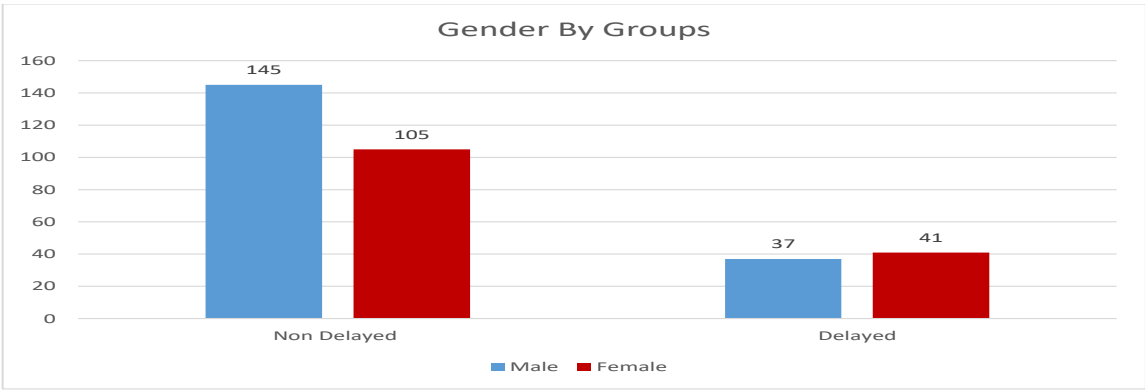


Figure: Graph showing Gender by Group Bar Chart n-338

Table 2: Symptoms and Signs of patients with acute appendicitis n-338

Characteristics		Group A n-250	Group B n-88
Symptom Duration (Days)	1-2	143 (57.2%)	49 (55.6%)
	3-4	81 (32.4%)	31 (35.3%)
	>5	26 (10.4)	8 (9.1%)
Migratory pain		136(54.4%)	20 (22.7%)
Fever		139(55.6%)	16 (18.2%)
Nausea		128 (51.2%)	41 (46.6%)
Vomiting		136 (54.4%)	46 (52.2%)
Anorexia		135 (54%)	43 (48.8%)
Right Lower Quadrant Pain		242 (96.8%)	45 (51.1%)
Right Lower Quadrant tenderness		137 (54.8%)	15 (17.0%)

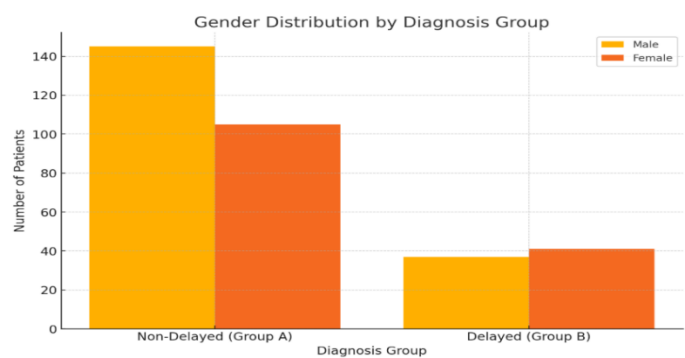


Figure 2 Gender Distribution by Diagnosis

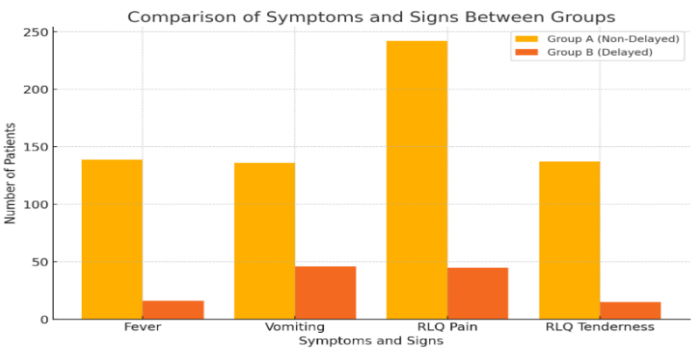


Figure 1 Comparison of Symptoms and Signs Between Groups

DISCUSSION

Several studies have introduced automated diagnostic approaches for acute appendicitis, incorporating objective parameters to differentiate between severe and simple cases. Despite advancements in diagnostic techniques, the findings of this study suggest that gender plays a crucial role in the delayed diagnosis of acute appendicitis. Even after accounting for potential confounders, female patients demonstrated a higher likelihood of experiencing diagnostic delays compared to males. Atypical symptom presentation, gender bias in clinical decision-making, and variations in healthcare-seeking behaviors have been implicated as contributing factors. Non-specific symptoms and intermittent abdominal complaints are frequently associated with delayed diagnosis, further complicating timely

clinical assessment (12,13). The consequences of delayed diagnosis and surgical deferral exceeding 12 hours can be severe, leading to increased rates of perforation, abscess formation, wound complications, and prolonged hospital stays, ultimately escalating morbidity and healthcare costs (14,15). Early diagnosis and timely surgical intervention remain the most effective strategies for reducing these complications. Gender-based disparities in appendicitis diagnosis have been highlighted in previous research, aligning with the current study's findings. Investigations have reported a considerable delay in surgical intervention among female patients presenting with acute appendicitis in emergency settings. Studies have consistently demonstrated that female patients are at an increased risk of delayed diagnosis, likely due to the broader differential diagnoses considered for abdominal pain in women. Clinicians often attribute abdominal pain in females to gynecological conditions, which may lead to extended evaluation and delayed intervention for appendicitis. Additional research has reinforced the association between gender and delayed diagnosis, further emphasizing that female patients frequently experience longer wait times before definitive surgical management (16-19).

Addressing gender-related discrepancies in the evaluation and management of acute appendicitis requires a multifaceted approach. Enhancing clinician awareness regarding the atypical presentation of appendicitis in females can contribute to reducing diagnostic delays. Standardized diagnostic protocols and clinical decision-making tools that account for gender-specific variations should be integrated into emergency department workflows to facilitate early recognition. Public health initiatives promoting timely medical consultation for acute abdominal symptoms, particularly among women, may further aid in minimizing delays and improving outcomes (20). This study has several strengths, including a robust sample size and the use of standardized diagnostic criteria. However, certain limitations must be acknowledged. The single-center design may restrict the generalizability of findings, necessitating multicenter studies for broader applicability. Additionally, potential contributing factors to gender differences, such as healthcare provider biases and patient preferences, were not assessed. Future research incorporating qualitative methodologies and larger prospective cohorts may offer a more comprehensive understanding of these gender-related diagnostic disparities. Expanding studies to include diverse healthcare settings and incorporating automated diagnostic algorithms may further refine the accuracy and efficiency of appendicitis evaluation, ultimately improving patient care.

## CONCLUSION

This study highlights the impact of gender on the delayed diagnosis of acute appendicitis, with female patients experiencing longer diagnostic timelines compared to males. These findings emphasize the need for heightened clinical vigilance in recognizing and promptly evaluating appendicitis symptoms, particularly in women, to reduce the risk of complications. Addressing gender-related disparities in diagnosis requires improved clinical awareness, standardized assessment protocols, and proactive healthcare strategies. Future research should focus on identifying the underlying factors contributing to these delays and implementing targeted interventions to enhance early detection and optimize patient outcomes.

## AUTHOR CONTRIBUTIONS

Author	Contribution
Fawad Anwar*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Tariq Mukhtar Farani	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Muhammad Waseem Anwar	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Adil Maqbool	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Waleed Umar	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Shaza Bashir	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

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