



Original Research Article

Post-operative Outcome of Laparoscopic Vs Open Appendicectomy: A Cross-sectional Study

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Abstract: Background: Acute appendicitis remains one of the most common causes of emergency abdominal surgery worldwide. While both laparoscopic appendectomy (LA) and open appendectomy (OA) are standard treatments, their comparative outcomes in resource-limited settings, such as Bangladesh, require further investigation. **Methods:** A cross-sectional study was conducted on 100 patients diagnosed with acute appendicitis. Patients were divided equally into two groups: laparoscopic appendectomy (n=50) and open appendectomy (n=50). Data on operative duration, post-operative pain (VAS scale), hospital stay, complications, recovery time, and patient satisfaction were collected and analyzed using SPSS version 26.0. A p-value of <0.05 was considered statistically significant. **Results:** Laparoscopic appendectomy showed significantly better outcomes across several parameters. Operative time was shorter in the LA group ($p < 0.001$), with 30% of patients completing surgery in under 30 minutes compared to 10% in the OA group. Post-operative pain scores were significantly lower in the LA group on day 1 ($p < 0.001$). The LA group had a shorter hospital stay, with 60% discharged within one day ($p < 0.001$). Post-operative complications, such as wound infections and ileus, were less frequent in the LA group ($p < 0.001$). Additionally, 50% of LA patients returned to normal activities within three days, compared to only 10% in the OA group ($p < 0.001$). Patient satisfaction was significantly higher in the LA group ($p < 0.001$). **Conclusion:** Laparoscopic appendectomy improves pain management, recovery, complications, and patient satisfaction over open surgery, supporting its use in resource-limited settings.

Keywords: Acute Appendicitis, Laparoscopic Appendectomy, Open Appendectomy, Post-Operative Outcomes, Recovery Time.

Introduction

Acute appendicitis remains one of the most prevalent causes of emergency abdominal surgery worldwide, with a significant impact on global healthcare systems. It affects approximately 7% of the global population during their lifetime and is responsible for a substantial number of emergency surgical admissions annually.¹ According to the Global Burden of Disease Study, the worldwide

incidence of acute appendicitis increased by 63.55% from 1990 to 2019, indicating a rising global trend in disease burden.¹ Despite advancements in surgical techniques and perioperative care, acute appendicitis continues to be associated with considerable morbidity and, in severe cases, mortality, particularly due to complications such as perforation, peritonitis, and intra-abdominal abscesses.² Globally, the incidence rate of acute

appendicitis is estimated at 228 cases per 100,000 people, with a mortality rate of 0.43 per 100,000, underscoring its significant clinical and public health relevance.² In Bangladesh, acute appendicitis constitutes a notable proportion of emergency surgical cases, contributing to a substantial healthcare burden in both urban and rural settings.³ Data from various tertiary hospitals in Bangladesh highlight that appendicitis predominantly affects young adults, with most patients falling within the age range of 13 to 30 years. A study conducted at Rajshahi Medical College Hospital revealed that complications occurred in up to 32% of patients, often due to delayed presentation and diagnosis.³ Factors unique to Bangladesh, such as delayed access to healthcare, lack of diagnostic infrastructure, and limited surgical expertise, further exacerbate the risk of complications like perforation, which has been reported in up to 25% of cases in certain tertiary care hospitals.⁴ These challenges highlight the pressing need for timely intervention and improvements in surgical care infrastructure, especially in resource-limited settings. The surgical management of acute appendicitis primarily involves two standard approaches: Laparoscopic Appendectomy (LA) and Open Appendectomy (OA). Since its introduction in 1983, LA has gained widespread acceptance as a minimally invasive procedure, offering advantages such as reduced postoperative pain, shorter hospital stays, faster recovery times, and better cosmetic outcomes.^{5, 6} In contrast, OA, introduced in the late 19th century, remains a conventional approach, particularly favored in cases of complicated appendicitis or in settings where laparoscopic expertise and equipment are limited.⁶ The fundamental procedural difference lies in the surgical technique: LA involves small incisions and the use of a laparoscope for visualization and removal of the appendix, whereas OA requires a larger incision through which the appendix is directly accessed and removed.⁷ Numerous studies have consistently demonstrated that LA is associated with shorter postoperative hospital stays, fewer complications such as wound infections, and quicker resumption of normal activities compared to OA.^{8, 9} Despite the global recognition of LA's clinical advantages, there remains a significant gap in the literature regarding its application in low- and middle-income countries (LMICs) like Bangladesh. Studies conducted in

LMICs often reveal inconsistent findings, with factors such as limited surgical expertise, infrastructural challenges, and economic constraints playing a critical role in determining surgical outcomes.^{10, 11} A study conducted in Dhaka's tertiary hospitals found that although LA resulted in fewer complications and shorter hospital stays compared to OA, resource limitations often necessitated the continued use of OA in many public healthcare settings.¹⁰ Additionally, research focusing on pediatric populations has shown that LA significantly reduces postoperative pain and infection rates in children compared to OA, yet similar large-scale studies in adult populations within Bangladesh remain scarce.¹¹ From a public health and clinical perspective, assessing the postoperative outcomes of LA versus OA holds significant implications for improving patient care, especially in resource-limited settings. Evaluating outcomes such as infection rates, postoperative pain, length of hospital stay, and complication rates is essential to optimize surgical decision-making and patient management strategies.¹² Furthermore, the economic implications of surgical interventions are particularly relevant in LMICs. Studies have demonstrated that shorter hospital stays and faster recovery associated with LA can reduce healthcare costs, benefiting both healthcare systems and patients.¹³ However, despite these potential advantages, economic constraints, lack of adequate surgical infrastructure, and limited access to trained laparoscopic surgeons continue to hinder the widespread adoption of LA in many parts of Bangladesh.³ The existing literature underscores the need for region-specific studies that account for the unique socio-economic and infrastructural challenges in Bangladesh. Although several studies have compared the outcomes of LA and OA globally, there remains a lack of comprehensive research addressing these outcomes within the Bangladeshi healthcare context, especially considering local resource constraints and surgical expertise disparities.^{3, 13} Furthermore, most studies conducted within Bangladesh have focused on pediatric populations or specific patient subgroups, leaving a gap in understanding postoperative outcomes among the general adult population.¹⁴ Given these considerations, this study aims to compare the postoperative outcomes of laparoscopic versus open appendectomy in

patients treated at a tertiary care hospital in Bangladesh. By employing a cross-sectional study design, this research seeks to capture real-world data reflecting the diverse range of patient experiences and outcomes within the local healthcare infrastructure. The findings of this study are anticipated to contribute valuable insights into optimizing surgical practices in Bangladesh, potentially influencing policy decisions and improving patient care outcomes in similar resource-constrained settings.

Methods

This cross-sectional study was conducted at Department of Hepatobiliary Surgery, Rajshahi Medical College, Rajshahi, Bangladesh from January, 2023 to December, 2023 to compare post-operative outcomes between laparoscopic and open appendectomy. A total of 100 patients diagnosed with acute appendicitis and scheduled for surgery were included. Patients were divided into two groups: laparoscopic appendectomy (n=50) and open appendectomy (n=50). The selection of the surgical approach was based on surgeon preference, patient condition, and the availability of laparoscopic equipment. Pre-operative demographic data, including age, gender, and comorbidities such as hypertension and diabetes mellitus, were recorded for all participants. All patients underwent surgery under general anesthesia.

The operative time was measured from the initial skin incision to the final closure. Post-operative outcomes were evaluated based on pain scores (using the Visual Analog Scale [VAS]), length of hospital stay, post-operative complications (including wound infection, intra-abdominal abscess, and ileus), and time required to return to normal activities. Post-operative pain was assessed on the first post-operative day using the VAS scale, ranging from 0 (no pain) to 10 (worst possible pain). The length of hospital stay was recorded in days and categorized as ≤ 1 day, 2–3 days, or ≥ 4 days. Post-operative complications, including wound infections, intra-abdominal abscesses, and ileus, were documented systematically. Patients were followed until their return to normal activities and classified based on recovery time: ≤ 3 days, 4–7 days, or >7 days. Additionally, patient satisfaction with the surgical procedure was evaluated using a 4-

point Likert scale (highly satisfied, satisfied, neutral, and dissatisfied). All collected data were analyzed using SPSS version 26.0. Descriptive statistics were presented as frequencies and percentages for categorical variables, while continuous variables were summarized using means and standard deviations. Comparisons between the two groups were made using the chi-square test for categorical variables. A p-value of <0.05 was considered statistically significant.

Results

Table 1: Demographic and Baseline Characteristics (n=100)

Characteristic	Laparoscopic (n=50)	Open (n=50)	p-value
Age Group			
18-30 years	25 (50%)	22 (44%)	0.612
31-45 years	18 (36%)	20 (40%)	
>45 years	7 (14%)	8 (16%)	
Gender			
Male	28 (56%)	30 (60%)	0.685
Female	22 (44%)	20 (40%)	
Comorbidities			
Hypertension	5 (10%)	6 (12%)	0.723
Diabetes Mellitus	4 (8%)	5 (10%)	
No Comorbidities	41 (82%)	39 (78%)	

The demographic and baseline characteristics of the study population are presented in Table 1. A total of 100 patients were included, with 50 undergoing laparoscopic appendectomy and 50 undergoing open appendectomy. The age distribution between the two groups showed no statistically significant difference ($p = 0.612$). In the laparoscopic group, the majority of patients (50%) were aged between 18 and 30 years, compared to 44% in the open appendectomy group. Patients aged 31–45 years comprised 36% of the laparoscopic group and 40% of the open group, while those older than 45 years accounted for 14% and 16% in the laparoscopic and open groups, respectively. Gender distribution was also similar between the groups, with no statistically significant difference ($p = 0.685$). Males represented 56% of the laparoscopic group and 60%

of the open appendectomy group, while females comprised 44% and 40% in the respective groups. Regarding comorbidities, 10% of patients in the laparoscopic group and 12% in the open group had hypertension, while 8% and 10% of patients, respectively, had diabetes mellitus. The majority of patients had no comorbidities, with 82% in the laparoscopic group and 78% in the open appendectomy group. There were no statistically significant differences between the two groups concerning the presence of comorbidities ($p = 0.723$).

Table 2: Distribution of participants by operative duration (n=100)

Operative Time (Minutes)	Laparoscopic (n=50)	Open (n=50)	p-value
<30 min	15 (30%)	5 (10%)	<0.001**
30-60 min	28 (56%)	20 (40%)	
>60 min	7 (14%)	25 (50%)	

The distribution of participants based on operative duration is presented in Table 2. A statistically significant difference was observed between the laparoscopic and open appendectomy groups ($p < 0.001$). In the laparoscopic group, 30% of patients had an operative time of less than 30 minutes, compared to only 10% in the open appendectomy group. The majority of patients undergoing laparoscopic surgery (56%) had operative times ranging between 30 and 60 minutes, while 40% of those in the open group fell into this category. Notably, a longer operative duration exceeding 60 minutes was more frequent in the open appendectomy group, with 50% of patients compared to only 14% in the laparoscopic group.

Table 3: Post-Operative Pain Score (VAS Scale 0-10) (n=100)

Pain Score (Day 1)	Laparoscopic (n=50)	Open (n=50)	p-value
0-3 (Mild)	20 (40%)	5 (10%)	<0.001**
4-6 (Moderate)	25 (50%)	30 (60%)	
7-10 (Severe)	5 (10%)	15 (30%)	

Table 3 presents the post-operative pain scores on day 1, measured using the Visual Analog Scale (VAS). A statistically significant difference was observed between the laparoscopic and open appendectomy groups ($p < 0.001$). In the laparoscopic group, 40% of patients reported mild pain (VAS score 0–3) on the first post-operative day, compared to only 10% in the open appendectomy group. Moderate pain levels (VAS score 4–6) were experienced by 50% of patients who underwent laparoscopic surgery and 60% of those who had open appendectomy. Notably, severe pain (VAS score 7–10) was more prevalent among patients in the open appendectomy group, affecting 30% of patients, while only 10% of those who underwent laparoscopic surgery experienced severe pain.

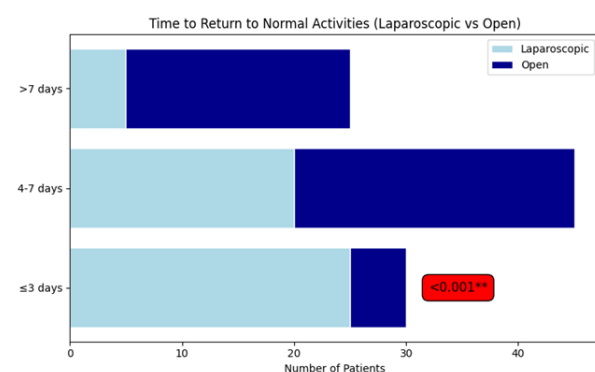
Table 4: Length of Hospital Stay (n=100)

Hospital Stay (Days)	Laparoscopic (n=50)	Open (n=50)	p-value
≤1 day	30 (60%)	10 (20%)	<0.001**
2-3 days	15 (30%)	25 (50%)	
≥4 days	5 (10%)	15 (30%)	

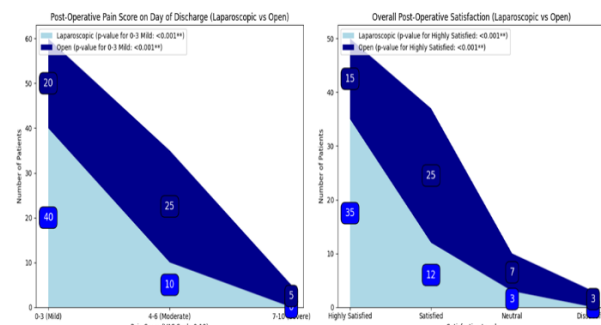
The distribution of participants based on the length of hospital stay is presented in Table 4. A statistically significant difference was observed between the laparoscopic and open appendectomy groups ($p < 0.001$). In the laparoscopic group, 60% of patients were discharged within one day, compared to only 20% in the open appendectomy group. A hospital stays of 2–3 days was reported for 30% of patients in the laparoscopic group, whereas 50% of patients in the open group required this duration. Furthermore, a longer hospital stays of 4 days or more was more common among patients who underwent open appendectomy (30%) compared to those who had laparoscopic surgery (10%).

Table 5: Post-Operative Complications (n=100)

Complication	Laparoscopic (n=50)	Open (n=50)	p-value
Wound Infection	2 (4%)	10 (20%)	0.015*
Intra-abdominal Abscess	1 (2%)	3 (6%)	0.612
Ileus	2 (4%)	7 (14%)	0.082
No Complications	45 (90%)	30 (60%)	<0.001*

**Figure 1: Time to Return to Normal Activities (n=100)**

The time taken for patients to return to normal activities is illustrated in Figure 1. A statistically significant difference was observed between the laparoscopic and open appendectomy groups ($p < 0.001$). In the laparoscopic group, 50% of patients resumed normal activities within three days, compared to only 10% in the open appendectomy group. A return to normal activities within 4–7 days was reported in 40% of the laparoscopic group, while 50% of patients in the open appendectomy group fell into this category. Notably, a longer recovery period exceeding seven days was more frequent among patients who underwent open appendectomy (40%) compared to just 10% in the laparoscopic group.

**Figure 3: Post-Operative Outcomes Comparison with Pain Score, Satisfaction, and Time to Recovery (Laparoscopic vs Open Surgery)**

For post-operative pain scores, a statistically significant difference was observed between the two groups ($p < 0.001$). In the laparoscopic group, 80% of patients reported mild pain (VAS score 0–3) on the day of discharge, compared to only 40% in the open appendectomy group. Moderate pain (VAS score 4–6) was reported by 20% of patients in the laparoscopic group, whereas 50% of those who underwent open appendectomy experienced similar levels of pain. Notably, none of the patients in the laparoscopic group reported severe pain (VAS score 7–10), while 10% of patients in the open appendectomy group did. In terms of overall post-operative satisfaction, a statistically significant difference was also observed ($p < 0.001$). A higher proportion of patients who underwent laparoscopic appendectomy reported being highly satisfied (70%) compared to only 30% in the open appendectomy group. Additionally, 24% of patients in the laparoscopic group were satisfied, compared to 50% in the open group. A neutral response was recorded for 6% of patients in the laparoscopic group and 14% in the open group. Notably, none of the patients who underwent laparoscopic surgery reported dissatisfaction, whereas 6% of patients in the open group did.

Discussion

This study highlights notable differences in post-operative outcomes between the two surgical approaches. In terms of demographic characteristics, no statistically significant differences were observed between the laparoscopic and open appendectomy groups concerning age, gender, or comorbidities. This aligns with prior research that reported comparable baseline characteristics across both groups, thereby eliminating demographic variables as confounding

factors in surgical outcome comparisons.^{15, 16} This comparability strengthens the validity of our outcome comparisons by ensuring that the surgical approach, rather than patient-specific demographic factors, primarily influenced the observed results. Our findings demonstrated that laparoscopic appendectomy was associated with a significantly shorter operative time compared to open appendectomy, with a larger proportion of laparoscopic procedures completed in less than 30 minutes. This observation contrasts with earlier studies that reported longer operative times for laparoscopic surgery due to the technical complexity of the procedure.^{17, 18} However, recent studies suggest that as surgical expertise improves and laparoscopic equipment becomes more widely available, operative times for laparoscopic procedures can decrease substantially.¹⁹ This efficiency observed in our study highlights the growing proficiency in laparoscopic techniques in our setting. The assessment of post-operative pain revealed that patients who underwent laparoscopic appendectomy experienced significantly lower pain scores on the first post-operative day compared to those who underwent open appendectomy.

This aligns with findings from previous research that consistently reported lower Visual Analog Scale (VAS) scores following laparoscopic surgery due to reduced tissue trauma and smaller incisions.^{20, 21} In particular, a larger proportion of laparoscopic patients experienced mild pain (VAS 0–3), whereas a significant percentage of patients in the open group reported severe pain (VAS 7–10), indicating a marked reduction in post-operative discomfort with the minimally invasive approach. The length of hospital stay was significantly shorter for patients in the laparoscopic group, with 60% discharged within one day compared to only 20% in the open appendectomy group. These findings are consistent with previous studies that have demonstrated shorter hospitalization durations following laparoscopic surgery due to quicker recovery and fewer complications.^{8, 22} This shorter hospital stay can have significant economic implications, reducing healthcare costs and minimizing the financial burden on both patients and healthcare facilities, particularly in resource-limited settings. The incidence of post-operative complications was notably lower in the

laparoscopic appendectomy group, with fewer cases of wound infections and ileus. These results align with previous studies reporting that laparoscopic surgery is associated with fewer post-operative complications than open surgery.^{23, 24} In our study, wound infections were significantly more frequent in the open appendectomy group, a finding supported by prior research emphasizing the benefits of minimally invasive surgery in reducing the risk of surgical site infections.²⁵ Although the rates of intra-abdominal abscesses and ileus were slightly higher in the open surgery group, the differences were not statistically significant, consistent with earlier studies suggesting that such complications are more closely linked to the severity of appendicitis rather than the surgical technique. Our findings further revealed that patients who underwent laparoscopic surgery returned to normal activities significantly faster than those who had open surgery. Approximately 50% of laparoscopic patients resumed normal activities within three days compared to only 10% in the open appendectomy group. These results are in line with previous research that highlighted the quicker recovery associated with laparoscopic surgery, emphasizing the benefits of minimally invasive techniques in reducing the physical and economic impact of post-operative recovery.²⁶ post-operative pain on the day of discharge was significantly lower in the laparoscopic group, with 80% of patients reporting mild pain compared to 40% in the open group. These findings are supported by studies that reported consistently lower discharge-day pain scores among laparoscopic appendectomy patients, reaffirming the role of laparoscopic surgery in enhancing patient comfort during early recovery.^{20, 27} In terms of patient satisfaction, laparoscopic surgery outperformed open appendectomy significantly.

Our findings showed that 70% of laparoscopic patients were highly satisfied with their outcomes, compared to 30% in the open group. This result is consistent with previous studies that have demonstrated higher satisfaction levels among patients undergoing laparoscopic surgery due to faster recovery times, reduced post-operative discomfort, and better cosmetic outcomes.²⁸⁻³⁸ Additionally, the absence of dissatisfaction in the laparoscopic group, compared to 6% in the open

group, further underscores the positive patient experience associated with minimally invasive procedures. In conclusion, the findings from this study reaffirm the clinical and patient-centered advantages of laparoscopic appendectomy over open appendectomy. These advantages are reflected in shorter operative times, reduced post-operative pain, shorter hospital stays, fewer complications, quicker return to normal activities, and higher patient satisfaction.

Conclusion

This study provides substantial evidence supporting the clinical superiority of laparoscopic appendectomy (LA) over open appendectomy (OA) in managing acute appendicitis. Our findings demonstrate that laparoscopic surgery offers significant advantages, including shorter operative time, reduced post-operative pain, shorter hospital stays, fewer complications, quicker return to normal activities, and higher patient satisfaction. These results are consistent with existing literature, further validating the efficacy and patient-centered benefits of laparoscopic surgery. In the context of Bangladesh, where healthcare resources are often limited, the adoption of laparoscopic appendectomy could significantly improve surgical outcomes, reduce hospitalization costs, and enhance overall patient recovery. Despite certain infrastructural and economic challenges that may limit access to laparoscopic facilities in some settings; this study highlights the importance of investing in minimally invasive surgical techniques to optimize patient care and outcomes. Future research should focus on larger, multi-center studies to validate these findings and explore the scalability of laparoscopic surgery in diverse healthcare environments, particularly in resource-constrained settings.

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References

1. Yang Y, Guo C, Gu Z, Hua J, Zhang J, Qian S, Shi J. The global burden of appendicitis in 204

- countries and territories from 1990 to 2019. *Clinical Epidemiology*. 2022 Dec 31;14:87-99.
2. Wickramasinghe DP, Xavier C, Samarasekera DN. The worldwide epidemiology of acute appendicitis: an analysis of the global health data exchange dataset. *World Journal of Surgery*. 2021 Jul; 45:1999-2008.
3. Islam SR, Pasha K, Rahman S, Nasir E, Hanif E, Barman A. Laparoscopic vs open appendectomy: a comparative study. *Bangladesh journal of endosurgery*. 2014 Jul 19;2(1):5-8.
4. Alam MA. A study of Burst Appendix, 200 Cases in DMCH.
5. Katkhouda N, Mason RJ, Towfigh S, Gevorgyan A, Essani R. Laparoscopic versus open appendectomy: a prospective randomized double-blind study. *Ann Surg*. 2005;242(3):439-450. doi: 10.1097/01.sla.0000179648.75373.2f
6. Li X, Zhang J, Sang L, Zhang W, Chu Z, Li X, Liu Y. Laparoscopic versus conventional appendectomy-a meta-analysis of randomized controlled trials. *BMC gastroenterology*. 2010 Dec; 10:1-8.
7. Shrivastava A, Jain A, Jain R. Laparoscopic versus conventional open appendectomy: a prospective comparative analytical study in a tertiary care set up.
8. Ranjan SK, Kumar S. Comparative Evaluation of Open Method and Laparoscopic Technique of Appendectomy. *Hospital*;38:59.
9. Kolhar BA, Lamani YP, Shekhar RM, Shankar G. Outcomes of laparoscopic versus open appendectomy: a comparative study. *Int Surg J*. 2017 Jul; 4:2185-8.
10. Biswas PK, Hossain SM, Afutuzumab M. Outcome of laparoscopic appendectomy for acute appendicitis in tertiary level hospitals. *Bangladesh Medical Journal Khulna*. 2018;51(1-2):12-5.
11. Saha N, Saha DK, Rahman MA, Islam MK, Aziz MA. Comparison of post operative morbidity between laparoscopic and open appendectomy in children. *Mymensingh Medical Journal: MMJ*. 2010 Jul 1;19(3):348-52.
12. Markar SR, Venkat-Raman V, Ho A, Karthikesalingam A, Kinross J, Evans J, Bloom I. Laparoscopic versus open appendectomy in obese patients. *International Journal of Surgery*. 2011 Jan 1;9(6):451-5.

13. Maitra TK, Ekramullah M, Mondol SK. Post-surgical outcomes of laparoscopic appendectomy observed at BIRDEM hospital. *IMC Journal of Medical Science*. 2017 Mar 22;11(1):15-8.
14. Ferdous NS, Huq AU, Hasina K, Khatun M. A Comparative Study between the Outcome of Laparoscopic Appendectomy and Open Appendectomy in Children. *Journal of Paediatric Surgeons of Bangladesh*. 2014;5(1):25-9.
15. Yaghoubian A, Kaji AH, Lee SL. Laparoscopic versus open appendectomy: outcomes analysis. *The American Surgeon*. 2012 Oct;78(10):1083-6.
16. Schmelzer TM, Rana AR, Walters KC, Norton HJ, Bambini DA, Heniford BT. Improved outcomes for laparoscopic appendectomy compared with open appendectomy in the pediatric population. *Journal of Laparoendoscopic & Advanced Surgical Techniques*. 2007 Oct 1;17(5):693-7.
17. Martin LC, Puente I, Sosa JL, Bassin A, Breslaw R, McKenney MG, Ginzburg E, Sleeman D. Open versus laparoscopic appendectomy. A prospective randomized comparison. *Annals of surgery*. 1995 Sep;222(3):256.
18. Rashid A, Nazir S, Kakroo SM, Chalkoo MA, Razvi SA, Wani AA. Laparoscopic interval appendectomy versus open interval appendectomy: a prospective randomized controlled trial. *Surgical Laparoscopy Endoscopy & Percutaneous Techniques*. 2013 Feb 1;23(1):93-6.
19. Pradhan S, Shakya YR, Batajoo H, Malla B, Joshi HN, Thapa LB, Makaju RK. Laparoscopic versus open appendectomy: a prospective comparative study. *Journal of Society of Surgeons of Nepal*. 2015;18(2):29-32.
20. Kumar S, Jalan A, Patowary BN, Shrestha S. Laparoscopic appendectomy versus open appendectomy for acute appendicitis: a prospective comparative study. *Kathmandu Univ Med J (KUMJ)*. 2016 Jul 1;14(55):244-8.
21. Naik S, Yadav N, Firoz. Laparoscopic versus open appendectomy: A comparative study. *International Journal of Applied Research*. 2017;3(8):471-4.
22. Batajoo H, Hazra NK. Laparoscopic versus open appendectomy in acute appendicitis.
23. Zhang H, Gao H, Ma X (2017) Comparison of Short-Term Outcome between Laparoscopic and Open Appendectomy in Adults: A Meta-Analysis of Randomized Controlled Trials. *Diagn Pathol Open* 2: 131. DOI: 10.4172/2476-2024.1000131
24. Aziz O, Athanasiou T, Tekkis PP, Purkayastha S, Haddow J, Malinowski V, Paraskeva P, Darzi A. Laparoscopic versus open appendectomy in children: a meta-analysis. *Annals of surgery*. 2006 Jan 1;243(1):17-27.
25. Gupta R, Sample C, Bamehriz F, Birch DW. Infectious complications following laparoscopic appendectomy. *Canadian journal of surgery*. 2006 Dec;49(6):397.
26. Cox MR, McCall JL, Toouli J, Padbury RT, Wilson TG, Wattchow DA, Langcake M. Prospective randomized comparison of open versus laparoscopic appendectomy in men. *World journal of surgery*. 1996 Mar; 20:263-6.
27. Shirazi B, Ali N, Shamim MS. Laproscopic versus open appendectomy: a comparative study. *JPM-A-Journal of the Pakistan Medical Association*. 2010 Nov 1;60(11):901.
28. Kapischke M, Friedrich F, Hedderich J, Schulz T, Caliebe A. Laparoscopic versus open appendectomy—quality of life 7 years after surgery. *Langenbeck's archives of surgery*. 2011 Jan; 396:69-75.
29. Patwari SQ. Transforming Rural Health: The Impact of Telehealth on Access and Care. *TAJ: Journal of Teachers Association*. 2021;34(2):51-56.
30. Ahasan MM, Patwari MS, Yamaguchi M. Risk of eating disorders and the relationship with interest in modern culture among young female students in a university in Bangladesh: a cross-sectional study. *BMC Women's Health*. 2023;23(1):35.
31. Patwari SQ. Public Health during the Global Pandemic Covid-19: Intervening, Perceiving and Incorporating.
32. Hasan H, Rahman MH, Haque MA, Rahman MS, Ali MS, Sultana S. Nutritional management in patients with chronic kidney disease: A focus on renal diet. *Asia Pacific Journal of Medical Innovations*. 2024;1(1):34-40.
33. Patwari SQ. Rise of E-Cigarettes: Implications for Public Health and Policy. *TAJ: Journal of Teachers Association*. 2017;30(2):43-51.

34. Mashiusjaman M, Patwari SQ, Siddique MA, Haider SM. Infant feeding pattern of employed mothers in Dhaka city of Bangladesh.
35. Patwari SQ. Assessing the Impact of School-Based Health Education Programs on Adolescent Mental Health and Well-Being. *Cuestiones de Fisioterapia*. 2022 Dec 3;51(3):270-278.
36. Haque MA, Begum MM, Rahman MS, Hasan H. Complications of Arteriovenous Fistula Surgery: A Comprehensive Study in Bangladesh. *TAJ: Journal of Teachers Association*. 2024;37(2):87-97.
37. Patwari SQ. Bridging the Gap: Impact of Race, Gender, and Socioeconomic Factors on Health Equity. *TAJ: Journal of Teachers Association*. 2015 Dec 31;28(2):51-58.
38. Mason RJ, Moazzez A, Moroney JR, Katkhouda N. Laparoscopic vs open appendectomy in obese patients: outcomes using the American College of Surgeons National Surgical Quality Improvement Program database. *Journal of the American College of Surgeons*. 2012 Jul 1;215(1):88-99.