REVIEW ARTICLE

# Trends and Outcomes of Cholecystectomy in Sub-Saharan Africa: A Comparative Review of Open and Laparoscopic Techniques

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## ABSTRACT

**Background:** Cholecystectomy refers to the surgical removal of the gallbladder. It is an essential modality for managing gallstones and can be performed through an open or laparoscopic approach.

This study explores cholecystectomy trends and outcomes in sub-Saharan Africa, focusing on the adoption and effectiveness of open and laparoscopic approaches.

**Methods:** We carried out a narrative review of open and laparoscopic Cholecystectomy in sub-Saharan Africa from published articles that evaluated the trends, outcomes, and factors determining the approach to Cholecystectomy and how these factors affected surgical outcomes. Data was obtained via online search engines, such as PubMed and Google Scholar, using the Keywords cholecystectomy, gallstones, laparoscopy, and open surgeries.

**Results:** Key findings indicated that laparoscopic surgeries are less prevalent due to limited resources, training, equipment, and cost. The study reviewed 3,274 cholecystectomies, with a higher prevalence of open surgeries (77.36%) than laparoscopic (22.74%). These insights aim to inform strategies for optimizing surgical treatments in resource-limited settings.

**Conclusion:** Open Cholecystectomy remains prevalent in sub-Saharan Africa due to resource constraints, lack of trained personnel, and infrastructural challenges for laparoscopic techniques. Despite the advantages of laparoscopic Cholecystectomy, its adoption is limited. The study recommends increased investment in training healthcare professionals in laparoscopic techniques and enhancing the necessary infrastructure. Future research should focus on reducing costs and improving access to laparoscopic Cholecystectomy in the region, with government and stakeholders collaborating to train more healthcare professionals. These steps could improve health outcomes and address existing disparities.

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## INTRODUCTION

Cholecystectomy, the surgical removal of the gallbladder, is one of the most common procedures performed globally. It is mainly used to manage gallstone disease and other conditions of the biliary tract. The global burden of gallstone diseases is around 6.1%, with the highest prevalence in females and South Americans. This disease creates a substantial financial burden, with countries including the United States spending 6.5 billion dollars annually on cholecystectomies.[1] Regional distribution showed that Africa has a pooled prevalence of 17%, with the highest prevalence of 74% in Somalia and the lowest of 4% in Tanzania. Two studies in Nigeria recorded a prevalence rate of 4.4% and 19.8%. Countries including Ghana, Uganda, and South Africa had a prevalence of 5.9%, 21.9%, and 8.1%, respectively, with the incidence increasing over the years.[2] Therefore, there is still a dilemma regarding the actual surgical outcome viz-a-viz, its effect on morbidity and mortality, and the financial burden of hospital costs and infrastructural costs, especially in low-income and low-middle-income countries, where a number of African countries are found.

Open Cholecystectomy (OC) is being phased out in favour of Laparoscopic Cholecystectomy (LC) as a treatment for AC. The proportion of laparoscopic cholecystectomies has increased from 0% in 1987 to 80% in 1992. Due to the progress of laparoscopic technology, the growing competence and experience of surgeons, shorter hospital stays, and a shorter period for return to regular activities, open operations have been replaced by laparoscopic methods.[3] These merits have made LC the gold standard for gallbladder removal in developed climes. The adoption of LC is hindered by challenges such as the cost of equipment, the dearth of trained laparoscopic surgeons, poor government policies, and limited infrastructures in sub-Saharan Africa. However, the most important factors differ between countries. While many studies identify cost as the most prohibitive barrier to laparoscopy utilization in low-resource settings, logbook review and workforce perception indicate that a paucity of trainers is currently the most significant obstacle in Rwanda.[4] It is, therefore, evident that some countries face infrastructural costs while others face a dearth of trainers that will enhance the sustainability of laparoscopic procedures as they train junior colleagues. A contextually appropriate long-term partnership may assist with the laparoscopic upskilling of surgeons in low- and middle-income countries. This collaboration promotes local ownership and may translate into better patient outcomes associated with laparoscopic surgery.[5] OC remains prevalent in several healthcare facilities across the region.[5]

Furthermore, existing studies have documented comparative analyses of OC and LC, primarily focusing on factors such as operative time, complications, and Length of hospital stay. However, there remains little data from sub-Saharan Africa, where the interplay of healthcare challenges and surgical advancements creates a unique landscape for research.[6]

This study aimed to explore the trends and outcomes of cholecystectomy in sub-Saharan Africa, analysing the adoption and effectiveness of open and laparoscopic approaches. Investigating these trends would provide evidence-based insights and strategies for optimizing surgical treatment in resource-limited settings, ultimately enhancing patient outcomes, reducing complications, and guiding healthcare policymaking in the region.

## METHODOLOGY

### *Study Design*

We conducted a narrative review of available research studies from sub-Saharan Africa using the PRISMA guideline (Preferred Reporting Items for Systematic Reviews and Meta-analyses).

### *Data source*

Data was obtained online via an extensive literature search with the use of electronic search engines, including PubMed, Google Scholar, and AJOL, using the keywords cholecystectomy, laparoscopic Cholecystectomy, and Africa

### *Inclusion and exclusion criteria*

To allow for more recent and representative data, we included all original studies published within 10 years from 2014 to 2024 that evaluated the outcomes of Cholecystectomy in sub-Saharan Africa. We excluded studies from outside sub-Saharan Africa and studies published in any language other than English.

### *Analytical framework*

The literature search and critical appraisal of available articles were conducted between November and December 2024. To mitigate selection bias, selected articles were reviewed independently by two different authors, and all authors reviewed the results. Using the keywords, 262 results were identified. After screening and removing duplicate records, 11 papers were selected for review, meeting our inclusion criteria. These studies either looked at LC with relevant variables or compared open and laparoscopic cholecystectomies.

Initial data from these papers were collated into a table in Microsoft Excel and identified variables were recorded. A narrative review of selected articles was done, and a comparative analysis of the results obtained from the studies was conducted. Primary outcome measures majorly involved a comparative analysis of the distribution of OC and LC, the demographics, operating time, financial burden, compilation rate, and their respective clinical outcomes regarding morbidity and mortality rate.

## RESULTS

The development of surgical techniques globally has seen an increase in laparoscopic surgeries, especially in developed countries. However, various factors, including limited access to training resources, lack of well-trained personnel, limited equipment, and cost, are mitigating the advancement and spread of laparoscopic surgery in sub-Saharan Africa.[7,8,9]

A study by the College of Surgeons of East, Central, and Southern Africa (COSECSA) conducted an extensive review of COSECSA general surgery trainees' operative case logs from January 1, 2015, to December 31, 2020. Of the 68,659 cases, only 616 (0.9%) were laparoscopic procedures.[8]

Two papers looking at laparoscopic surgery were identified, and both show that LC takes precedence over other laparoscopic procedures such as appendectomy, hernia repair, hemicolectomy, etc. LC accounted for most of the laparoscopic surgeries, with 29% and 49.6% in the two papers, and laparoscopic appendicectomy took the second position with 3% and 21%, respectively.[7,8]

Studies identified showed an upward trend in LC adoption over time, with the ratio of LC to OC increasing over the years. The average ratio of LC to OC for papers published in 2014 was found to be 1:2.94. Meanwhile, recent papers from 2021-2024 have shown an average ratio of 1:1.69 between LC and OC.

Three thousand two hundred seventy-four cholecystectomies were performed across the 11 papers cross-examined. Five papers compared open and laparoscopic Cholecystectomy with a distribution of 1118 (77.36%) and 329 (22.74%), respectively.[9, 10, 11, 12, 13, 14] In all the study populations with LC only, the female gender took a more significant percentage, with an average ratio of 4:1.[9, 10, 15, 16] The same was confirmed in studies that combined data from OC and LC, with an average ratio of 4.3:1.[6, 9, 14, 19] All studies that evaluated the mean age of presentation confirmed that the peak age of presentation is in the fourth decade of life, with a range of ages from 7 to 88.[9,10,12,14]

### Clinical Outcomes

#### *Operation times*

Most studies reported more than an hour of operation time for LC, with three studies showing 57.59 mins, 85.8 minutes, and 86.6 minutes.[9, 10, 12] Two studies confirmed that it takes a longer time to do an LC. An approximately 5-minute difference was observed in a study that compared the operation time between OC and LC with a timing of 52.96 and 57.59 minutes, respectively.[12] Another study shows a

16-minute difference, with OC taking 69.6 mins and LC taking 85.8 mins.[9]

***Complication rates***

The complication rates across studies differed, with some papers reporting close rates between OC and LC. However, all papers established that the most common complication of LC is bile duct injury. Worthy note is the conversion rate from LC to OC, which was minimal, ranging from 0.7% to 5%.[9, 12, 13, 14] Complication rates differed with the expertise of surgeons, with surgeons who are just being introduced to LC by experts or residents in training recording more complications when they perform LC independently.[9, 14]

***Conversion rate***

The table below highlights the conversion rate of laparoscopic Cholecystectomy to open Cholecystectomy, ranging from 0.7% to 6.3%.

**Table 1:** Conversion rate of LC to OC

| S/N | Study | Study type | Conversion rate |
|---|---|---|---|
| 1 | Patient-reported Outcome, perception, and Satisfaction after laparoscopic cholecystectomy in Kigali, Rwanda.[15] | Retrospective | 1.4% |
| 2 | Laparoscopic Cholecystectomy in Jos: Prospects and Perspectives.[10] | Retrospective | 6.3% |
| 3 | Development and practice of laparoscopic surgery in a Nigerian tertiary hospital.[16] | Descriptive | 0.7% |
| 4 | Trends and Outcomes of Cholecystectomy; a comparative study of open and laparoscopic cholecystectomy, a Three-Year Experience in a Teaching Hospital.[12] | Comparative retrospective cross-sectional study | 2.6% |
| 5 | A Decade of Cholecystectomy at Kenyatta National Hospital: Demographics, Patterns and Transition to Laparoscopy.[13] | Retrospective descriptive study | 5% |
| 6 | Starting A Laparoscopic Surgery Programme In The Second Largest Teaching Hospital In Ghana.[9] | Retrospective | 4% |

***Length of hospital stay***

Studies have reported a longer post-operative hospital stay following an OC as compared to LC.

**Table 2**: Post operative length of hospital-stay

| S/N | Study | Study type | Open cholecystectomy | Laparoscopic cholecystectomy |
|---|---|---|---|---|
| 1 | Starting A Laparoscopic Surgery Programme In The Second Largest Teaching Hospital In Ghana.[9] | Retrospective | 3.42 days | 2.45 days |
| 2 | 30-day outcomes in 1,000 consecutive laparoscopic cholecystectomies undertaken in four Cape metropole public hospitals.[17] | Retrospective | 6.6 days | 1.5 days |

***Resource Utilisation***

In one of the studies, patients reported some weaknesses in the laparoscopic service delivery, including the training of laparoscopic surgeons,

laparoscopic resources, infrastructure, the patient-caregiver relationship, and public awareness of the laparoscopic technique.[15] Ale et al. identified the high cost of surgery, lack of expertise, and inadequate or zero infrastructure, even with the required expertise, as key factors against resource utilization in their centre.[10]

An interesting study that looked at laparoscopic training amongst surgical trainees over 5 years was conducted by COSESCA.[8] It shows that 53.1% of MCS (PG 1&2) and 8% of FCS (PG 3,4,5) had no laparoscopic experience within that period, with just 1 (7.1%) surgeon amongst trainees that completed the 5-year training having no laparoscopic expertise. Laparoscopy usage was more prevalent in upper-middle-income (2.7%) and lower-middle-income countries (0.8%) compared with lower-income countries (0.5%). Private (1.6%) and faith-based hospitals (1.5%) showed greater laparoscopy utilization than public hospitals (0.5%).[8]

*Cost analysis*

None of the papers reviewed explicitly discussed the financial implications of running a laparoscopic suite, including the cost-effectiveness of shorter hospital stays in LC as compared to OC. Furthermore, there is an obvious shorter period of post-surgery homestay that will help prevent loss of quality economic time that also needs to be looked at.

## DISCUSSION

This narrative review shows that laparoscopic cholecystectomies accounted for most of the laparoscopic surgeries performed in Sub-Saharan Africa, showing the epidemiological prevalence of this procedure over other forms of laparoscopic procedures. LC has indeed become a gold-standard alternative to OC globally, especially in the treatment of acute cholecystitis. However, studies have shown that about 48.7% of acute cholecystitis still operates with the open technique globally.[18] This is in keeping with the results from this review that show that only about 20.9% of cholecystectomies were carried out laparoscopically, indicating a low utilization rate of LC.

All the papers that compared OC and LC have shown that OC is still much more done than LC, with an average ratio of 3.4: 1 with a cumulative sample duration from 2000-2022.[9, 10, 11, 12 13, 14] An extensive review of operative case logbooks of general surgery trainees in the COSECSA over 5 years showed that laparoscopic procedures make up 0.9% of general surgery procedures.[8] This is in contrast to what is obtained in the developed world, where LC is the preferred choice for managing gallstone disease, as it is a well-established fact that it has better outcomes than OC.[16] A Japan study comparing OC and LC over 4 years (2004-2008) showed that out of 4,916 cholecystectomy patients, there were 3,692 LC patients and 1,224 OC patients, corresponding to a ratio of 3.01:1.[19] In developing nations such as Mongolia, LC: OC ratio was around 1.3:1 in a centre.[20]

Our review shows variability in the duration of surgery with open and laparoscopic techniques, with laparoscopic techniques being associated with a faster operation time, with a mean difference ranging from 5 to 16 minutes. This was also associated with a reduction in the length of hospital stay and a significant reduction in postoperative morbidity and mortality. LC was found to be associated with a lesser complication rate compared to OC, with a minimal conversion rate of 0.7 to 5%. These findings are comparable to findings from a study that reported the mean operative time of LC to be lesser than that of OC with a mean duration of 48. 5 ± 12. 4 and 68. 5 ± 15. Three minutes respectively, and associated lesser hospital stay with LC (1.8 ± 1.2 days) compared to OC, which was 4.8 ± 1.5 days [2]. Also, LC was associated with a complication rate of 12% compared to OC at 38%, with a p-value of $\leq 0.05$ [21].

Looking at the global perspective, a meta-analysis of clinical trials that evaluated 1,248 patients showed that the postoperative morbidity rate was reduced by 50% with LC, with an associated reduction in the postoperative mortality rate.[22] Globally, there is

evidence of shortened postoperative hospital stay with the use of LC, compared to OC, with a mean difference of 4.74 days.[22]

Currently, over 80% of elective laparoscopic surgeries are performed as elective day cases, with a remarkable reduction in the length of hospital stay, as most patients are discharged within 24 hours after surgery.[23, 24] Cholecystectomy is commonly done in secondary and tertiary centres across sub–Saharan Africa, with most cases being open rather than laparoscopic. However, there is an uptrend favouring laparoscopic surgeries due to advancements in medical care across sub-Saharan Africa.[25] This surgical procedure is not without challenges, especially in low- and middle-income countries. For instance, the lower percentage of laparoscopic cholecystectomies in Nigeria could be attributed to the fact that laparoscopic surgery is expensive, the expertise is not readily available in every centre, and even when expertise is available, there is a lack of functional equipment and instruments. Ale *et al*. found that many healthcare facilities lack the equipment and infrastructure to perform laparoscopic surgery, and the significantly high cost is a significant barrier.[10]

All papers that compared complication rates had low percentages but could not establish whether LC is safer than OC.[9, 12, 13, 14] After a thorough evaluation, we found that some papers had more complications from LC than OC because of the low number of LCs done and the expertise of the surgeons. A study reported that the rate in the hands of seniors is not different from that of the literature. However, the rate in the residents' hands is significantly higher than that of the seniors, as is shown elsewhere.[14] Another study confirmed that complication rates were higher in the hands of independent surgeons in the absence of the invited experts in a teaching hospital in Ghana that just started laparoscopic surgery.[9] Additionally, patients face financial constraints that delay the early presentation of conditions such as acute cholecystitis. This increases the rate of complications, morbidity, and possibly mortality due to late presentation.[26] Furthermore, the lack of operating theatre availability and high patient volumes can impede the scheduling and performance of Cholecystectomy. Despite these challenges, some centres have successfully implemented laparoscopic cholecystectomy services. For instance, a study at Kilimanjaro Christian Medical Centre in Tanzania reported establishing a day-case laparoscopic cholecystectomy service, highlighting its feasibility in a resource-limited setting.[27]

Addressing these challenges requires investment in healthcare infrastructure, surgeon training programs, and strategies to make laparoscopic cholecystectomy more accessible and affordable for patients in sub-Saharan Africa. Moreover, there is a massive problem with sustainability, with an increase in brain drain playing a significant factor in the loss of the few surgeons with laparoscopic expertise. There needs to be a deliberate stakeholder effort to engrave laparoscopic exposure at the undergraduate level at the respective local skills laboratory and provide incentives and training funds for surgeons and residents. Drastic measures need to be taken to ensure surgeons funded with public funds ensure they train junior residents. In addition, health stakeholders need to draw out a plan to attract local graduates practicing overseas with laparoscopic expertise to give back to their home country. Furthermore, there could be collaboration amongst African colleges where exchange programs occur with centres developing residents in their area of expertise.

### *The Prospects of Laparoscopic Cholecystectomy in Sub-Saharan Africa*

Over the past years, laparoscopic surgery has advanced from an invasive diagnostic tool to an efficient instrument for surgical procedures.[28] LC is one of the most common procedures performed in sub-Saharan Africa, and it has well-outlined benefits over open surgeries, including shorter hospital stays, reduced postoperative pain, decreased infection rates, quicker recovery, and improved cosmesis.[28] To improve the quality of surgical care in sub-Saharan

Africa, laparoscopic surgeries must be widely adopted.

Despite the well-documented advantage of shorter recovery times in laparoscopic surgeries compared to open surgeries[29], some factors still hinder the wide adoption of laparoscopic surgeries in the sub-Saharan. The most common is the cost implications of purchasing the equipment needed for laparoscopic surgeries.[30] Other barriers include funding, maintenance of equipment, unavailability of experienced laparoscopic trainers, political barriers, and disorganized curriculum for trainees.[31]

Generally, the funding issue can be addressed by using low-cost box trainers for training surgeons, which has been used in Tanzania and significantly improved the trainers' assessment scores after the training.[32] Additionally, the dynamics of various stakeholders involved are significant barriers that can be addressed by engaging everyone involved simultaneously and using the same curricula. A disjointed curriculum for trainees can be addressed by ensuring the curricula align with local needs.[33]

## CONCLUSION

Despite the growing success of laparoscopic Cholecystectomy worldwide, open Cholecystectomy has remained the preferred treatment option for many healthcare facilities in sub-Saharan Africa. Various factors have been identified for the poor adoption and implementation of laparoscopic Cholecystectomy in this region, including resource constraints, a dearth of trained laparoscopic surgeons, and infrastructural challenges.

This study shows that in areas where the effects of these issues are mitigated, there is wider adoption of laparoscopic Cholecystectomy, which has improved health outcomes, including shorter hospital stays, reduced complication rates, and minimal skin scarring. Thus, post-surgery recovery and lost economic time are reduced.

These findings highlight the need for further investment in training healthcare professionals on laparoscopic techniques and providing the necessary infrastructure to carry out these surgeries. In the long run, this is a cost-effective venture.

We recommend that future research focus on the cost-effectiveness of laparoscopic surgeries, how to reduce the cost of LC, and its training in sub-Saharan Africa. Furthermore, the government should be proactive about reducing the cost of production by supporting local biomedical companies involved in the production of medical equipment or having a memorandum of understanding with foreign companies where they have tax and other incentives to operate in their home country. Centres in sub-Saharan Africa and within the same country should collaborate by having exchange programs for residents to learn laparoscopic surgeries in centres that have surgeons with the expertise. Moreover, resource utilization is mainly dependent on cost and improved health education. The government can have policies that subsidize LC for a group of people, and future research should focus on the cultural barriers to adopting LC in sub-Saharan Africa, as this will help guide future health education approaches.

## ABBREVIATIONS

1. OC - Open Cholecystectomy
2. LC - Laparoscopic Cholecystectomy
3. COSECSA - College of Surgeons of East, Central, and Southern Africa
4. MCS - Member of Council of Surgeons (PG 1&2)
5. FCS - Fellow of Council of Surgeons (PG 3,4,5)
6. PG - Postgraduate
7. AJOL - African Journals Online
8. COSECSA - College of Surgeons of East, Central, and Southern Africa

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- *Final review, Validation and Supervision*: P.A

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