


Prevalence of Postoperative Unfavorable Outcome and Associated Factors in Patients with Appendicitis: A Cross-Sectional Study

Wolde Melese Ayele 

Department of Epidemiology and
Biostatistics, School of Public Health,
College of Medicine and Health Sciences,
Wollo University, Dessie, Ethiopia

Purpose: Appendicitis is surgical emergency that might need removal of the inflamed appendix. Unless treated, appendicular abscess, perforation, and even death might be the unfavorable outcomes. Hence, this study was aimed to investigate the unfavorable outcomes and associated factors among appendicitis operated patients.

Patients and Methods: A total of 300 patients who operated for appendicitis from September 1 2019 to August 30 2020 were studied using a retrospective cross-sectional study. Data were collected by using a checklist. Epi-data and SPSS version 25 were used for data entry and analysis, respectively. Binary logistic regression model was used to identify independent factors. A $p < 0.05$ was used to set the statistical significance of factors.

Results: Among 300 patients who were operated for acute appendicitis, 36 (12%) developed unfavorable outcomes. Though one death because of sepsis was recorded, wound infection was the main postoperative disorder. Female (AOR=0.49; 95% CI: 0.13–0.074), living outside the hospital setting (AOR= 0.49; 95% CI: 0.13–0.074), duration of illness before arrival at the hospital (1–3 days (AOR= 1.67; 95% CI: 1.34–8.37) and ≥ 4 days (AOR=5.38; 95% CI: 1.63–7.69)), more than 3 days hospital stay (AOR= 3.21; 95% CI: 2.06–8.10), and mass in the right lower quadrant (AOR= 6.01; 95% CI: 2.11–14.50) were the independent predictors of unfavorable outcomes of appendicitis treatment.

Conclusion: In this study, unfavorable outcome of acute appendicitis was high. More than one-tenth of appendicitis cases developed unfavorable outcomes. Living outside the hospital setting area, long duration of illness before arrival at the Hospital, more than 3 days hospital stay, and mass in the right lower quadrant were the risk factors, while females were less likely to have unfavorable outcomes of appendicitis. Therefore, closely working with patients who have abdominal pain and increasing their awareness about acute appendicitis will improve the operation outcome.

Keywords: acute appendicitis, associated factors, treatment outcome

Introduction

Appendicitis is defined as an inflammation of the vermiform appendix disease entities that require immediate surgical intervention.^{1–3}

Globally, appendicitis is the commonest abdomen surgical emergency with more than 250, 000 cases on an annual basis.^{4–7}

Though the incidence is declining, it is high among people living in the developed world.^{8–11} In the last few decades, in African countries, appendicitis frequency is increasingly noted.^{12–14} In Ethiopia, the incidence is increasing

Correspondence: Wolde Melese Ayele
Email wolde400@gmail.com

Received: 18 February 2021
Accepted: 16 April 2021
Published: 6 May 2021

through time such as in Debre Markos Referral Hospital (26.6%),¹⁵ as stated by Mohammed S et al a studies in 2014 by Nebyou S et al (28%), in 2019 by Wosen MT (55.4%),¹⁶ and 36 deaths in Gondar University Hospital.¹⁷

According to the previous studies, the very salient factors of postoperative unfavorable outcome are socio-demographic characteristics such as age,^{11,18–26} sex (being male),^{3,11,19,20,22} being female,¹⁸ season,^{3,10,27,28} length of diagnosis,²⁹ prompt surgical intervention,³⁰ and behavioral factors.^{31,32}

Unfavorable outcomes include peritonitis and septic shock,²² hospital-acquired pneumonia,³³ wound infection,^{34,35} abdominal obstruction, and deaths.^{17,35}

In Ethiopia, perforated 45 (17.4%), gangrenous appendices 25 (9.5%), and post-operative death with a mortality rate of 1.2% were the common complications reported by previous studies.^{36,37} Despite these studies, it is still controversial as to whether acute appendicitis is due to late presentation or long hospital stay. Thus, this study aimed to assess whether personal factors, behavioral factors, in-hospital factors are associated with unfavorable outcomes of appendectomy. This study hypothesizes that the unfavorable outcome is due to the late presentation of cases and operation-related factors. Also, this study will investigate appendicular symptoms that will be a factor of an unfavorable outcome of appendicitis surgery. The finding will have a vital impact on the policymakers, health care providers, especially for nurses and surgeons, and clients to give a personal decision on the arrival as early as possible for the prompt intervention of appendicitis.

Patients and Methods

Study Setting and Period

This study was conducted in Dessie Comprehensive Specialized Hospital from 1 September 2019 to 30 August 2020. Dessie is found 401 km north of Addis Ababa, the capital city of Ethiopia, and 480 km southeast of Bahir Dar, the main city of the regional state, Amhara. Dessie Comprehensive Specialized Hospital is serving more than eight million people. Currently, Dessie Comprehensive Specialized Hospital is a teaching hospital for Wollo University. Only open appendectomy procedure is found in the hospital.

Study Design and Participants

A retrospective institution-based cross-sectional study was conducted among all patients who undergo appendicitis operation. The whole appendicitis patients who undergo appendix operation were included. However, those appendicitis patients

who were treated without surgical procedures were excluded from the study. No sampling method was used due to the fact that all clients who undergo appendicitis operation were included in the study.

Data Collection Instrument and Procedures

Data were collected using a pre-tested questionnaire developed by reviewing the previous works of literature.^{23,38–40} Data were collected from the surgical ward and the patient registries.

One day of training about the purpose of the study and the data collection procedure was given to the data collectors. The data collection tool was pre-tested for its validity and reliability at Dessie Specialized Comprehensive Hospital. The pre-test was conducted among appendicitis patients who operated before 30 August 2019. Regular monitoring and follow-up of the data collection procedures were concerned by the principal investigator.

Data Processing and Analysis

Epi-data and SPSS version 25 were used for data entry and advanced analysis, respectively. Mean, range and standard deviation (SD) were used to present the descriptive statistics of continuous variables. Similarly, the proportion was used to describe the discrete characteristics of participants. A binary logistic regression model was computed to obtain the odds ratio with a 95% confidence interval of statistical associations between the outcome and predictor variables. The multivariable regression model was assessed for the goodness of fit using the Hosmer–Lemeshow test statistics. The dependent variable was unfavorable outcomes such as post-operation infection, intra or post-operative death, and intestinal obstructions of the appendicitis operation. A patient was considered to have an unfavorable outcome if one or more of those mentioned outcomes were recorded as yes (coded as =1), whereas a person did not have an unfavorable outcome if none of the outcomes were observed (code= 0). The independent variables were socio-demographic characteristics, behavioral factors, clinical signs, and surgical procedure factors. A p-value of less than 0.05 was used to declare the statistically significant variables.

Ethical Clearance

The ethical approval was obtained from the ethical committee of College of Medicine and Health Sciences, Wollo University. Similarly, a permission letter was obtained from Dessie Comprehensive Specialized Hospital. The data were collected

anonymously, and the information obtained is kept confidential.

Operational Definitions

Favorable Outcome

Patients who undergo appendectomy for acute appendicitis, then improved and discharged from the hospital irrespective of hospital stay.

Unfavorable Outcome

Clients with acute appendicitis, who developed one or more postoperative complication, eg wound infection, intestinal obstruction, or died during- or post-operation period, were considered as having unfavorable outcome.

Results

Participant Socio-Demographic Characteristics

A total of 300 patients have performed an appendicitis operation in Dessie Specialized Comprehensive Hospital during the study period. Among the participants, the majority were below the age of 20, 168 (56%). The study subjects' age was ranging from 4 to 78 years with a mean age of 20.5 ± 9.67 (SD) years old. From the patients who undergo acute appendicitis, 206 (68.7%) were males and 162 (54%) were urban residents (Table 1).

Table 1 Socio-Demographic Characteristics of Appendicitis Operated Patients (n=300)

Characteristics	Frequency	Percent
Age category (in year)		
≤5	81	27
16–24	132	44
25–35	71	23.7
>35	16	5.3
≤5	81	27
Mean ± SD, range	25±9.67, 4–78	
Sex		
Male	205	68.3
Female	95	31.7
Residency		
Urban	162	54
Rural	138	46

Pattern of Clinical Features and Management Profile

Two hundred fifteen (71.7%) of the participants were presented with fever. Two hundred eighty-seven (85.7%) and 215 (71.7%) of the study participants were presented with vomiting and loss of appetite, respectively. During the physical examination, abdominal tenderness 270 (90%) was the main sign, of whom 30 (10%) of the patients had generalized abdominal tenderness. Surprisingly, the white blood cell count was raised ($>10,000$ cells/mm³) amongst 253 (84.3%) of the clients. Among the abdominal incisions performed during the operation, the right lower quadrant incision 189 (63%) was the predominant incision. Lower abdominal mid-line incision 79 (26.3%) was the second. The intra-operative findings include an inflamed appendix 147 (49%) patients followed by gangrenous appendix 68 (22.7%) patients (Table 2).

Management Outcome of Acute Appendicitis

Among the appendix patients who operated, 88% (95% CI: 83.7–91.2%) had favorable management outcomes, whereas 36 (12%) experienced one or more unfavorable management outcomes such as postoperative wound infection and paralytic ileus (abdominal obstruction). Among the appendicitis patients who undergo appendix operation, three were developed fecal fistula. One death was recorded because of sepsis during the surgery procedure. Two hundred-two (67.3%) of the patients were discharged within three days, while four stayed more than seven days of admission. Regarding the position of the appendix, retro-cecal 214 (71.3%) and pelvic 66 (22%) were the commonest positions (Table 3).

Factors Associated with Management Outcome of Acute Appendicitis

Factors associated with the management outcome of acute appendicitis operation were computed by binary logistic regression analysis.

This study confirmed that female appendicitis patients were less likely to be at risk of postoperative unfavorable outcomes.

The residency of patients had a statistically significant association with the management outcome of appendicitis-operated patients. Those appendicitis patients living outside Dessie were 3.83 times more at risk to experience a negative appendicitis postoperative outcome.

Table 2 Clinical Features and Management Findings of Patients Operated for Acute Appendicitis (n=300)

Variables	Frequency	Percent
Symptoms		
Abdominal pain	300	100.0
Vomiting	257	85.7
Fever	215	71.7
Nausea	203	67.7
Loss of appetite	215	71.7
Swelling on abdomen	10	3.3
Clinical signs		
Generalized abdominal tenderness	30	10.0
RLQ tenderness	270	90.0
Febrile	194	64.7
Roving's sign	118	39.3
Obturator sign	132	44.0
Psoas sign	125	41.7
Right lower quadrant mass	12	4.0
White blood cell count		
>10,000	253	84.3
≤10,000	47	15.8
Types of incision		
Gridiron	19	6.3
Lantz incision (Rocky Davis)	189	63.0
Lower midline	79	26.3
Gridiron and lower midline	13	4.3
Operative finding		
Normal appendix	4	1.33
Inflamed appendix	147	49.0
Perforated	55	18.3
Gangrenous	68	22.7
Appendicular abscess	20	6.7
Appendicular mass	4	1.33
Inflammatory peritoneal fluid	2	0.74

Similarly, those clients who were admitted after one day of onset of the disease were more likely to have one or more bad outcomes when compared with those who were accessible within a day.

The duration of the hospital stay had also an association with the management outcome of appendix cases. Those appendicitis cases that stayed in the hospital more than three days were more likely affected by unfavorable outcomes compared to those patients who left the hospital before three days.

Moreover, the study subjects who had a mass in the right lower quadrant before operative management were

Table 3 Characteristics of Patients' Appendix Operation Outcomes

Characteristics	Frequency	Percent
Post operation complication		
No complication	264	88.0
Wound infection	23	7.7
Ileus	6	2.0
Incisional hernia	3	1.0
Fecal fistula	3	1.0
Death	1	0.3
Operative procedure		
Appendectomy	250	83.30
Abscess drainage	22	7.33
Peritoneal lavage	26	8.70
Negative and treated with prophylactic	2	0.67
Position of appendix		
Retrocecal	214	71.3
Pelvic	66	22.0
Others	20	6.7
Length of hospital stay		
<3days	202	67.3
3–7 days	94	31.3
>7days	4	1.3

roughly six times more likely to have post-operative complications relative to those appendicitis patients who have no mass on the RLQ (Table 4).

Discussion

Acute appendicitis is a public health problem in the developed world. Though the incidence is lower in Africa, appendicitis is a shared problem.^{7–11}

The overall postoperative unfavorable outcome was 12% (95% CI: 8.3–15.6%). This result is similar to the finding from a study in Lagos, Nigeria (13.5%).²⁵ However, this outcome is lower when compared with the previous studies done in Ghana (43.1%).^{34,35} This discrepancy might be due to socioeconomic, the study period, and population variation. From the overall postoperative complications, 7.7% was wound infection which is lower compared with the previous studies (32%, 8%, 41.5%).^{34–36} According to this study, one death was noted. The cause of the death was reported as sepsis. This cause of death is supported by the study.³⁸ A ruptured appendix can actually lead to death in some

Table 4 Logistic Regression Analysis of Factors Associated with Appendix Outcome

Variables	Outcome		COR (95% CI)	AOR (95% CI)
	Unfavorable	Favorable		
Sex				
Male	31	175	1	
Female	5	89	0.31(0.11–0.82)	0.49(0.13–0.07)
Residency				
Dessie	11	151	1	
Out of Dessie	25	113	3.03(1.43–6.42)	3.83(1.33–11.02)
Duration of illness before arrival at the hospital				
<24hours	16	196	1	
1–3days	6	38	1.93(0.71–5.26)	1.67(1.34–8.37)
≥4 days	14	30	5.71(2.53–12.89)	5.38(1.63–7.69)
Length of hospital stay				
≤3days	16	186	1	
>3days	20	78	2.98(1.46–6.05)	3.21(2.06–8.10)
Mass in the RLQ				
Yes	5	5	8.35(2.29–30.48)	6.01(2.11–14.50)
No	31	259	1	

cases. If it is left untreated, peritonitis can quickly spread, resulting in septicemia.⁴¹

This study also revealed a similar pattern of clinical symptoms with previous studies. All of the patients showed abdominal pain (100%), followed by vomiting (85.7%). This result is congruent with the finding of the previous studies.^{34,35,37} Regarding physical examination, tenderness over the right lower quadrant (RLQ) was the foremost finding, which is similar to the findings from Zewiditu memorial hospital and Ghana.^{35,37}

Of those patients who have post-operative unfavorable outcomes, 7.7% were with wound infection. This peak postoperative wound infection proportion might be due to the majority of the cases arriving just after they experienced more complication phase of the disease. Among those patients who have postoperative wound infection, 30.56% had perforated appendix during the surgery procedure. In this study, those patients who have post-operation wound infection, 61% stay in the hospital for more than 3 days, and 95.6% of patients had a fever before operative management. Among patients who had post-operation wound infection, 52.1% were lower midline types of incision and 74% of patients found retrocecal position of the appendix. This study also showed that, of

those cases who developed post-operative wound infection, 60.8% tried to find medical aid after 24 hours of the onset of the disease.

After adjusting the confounding variables, this study identified that sex, residency, duration of illness before arrival at the hospital, length of hospital stay, and RLQ mass were the factors associated with management outcomes of appendicitis operation.

This investigation confirmed that sex was the associated factor of the unfavorable outcome of the appendicitis operation. Females were 51% less likely to develop post-operative hostile consequence (AOR= 0.49; 95% CI: 0.13–0.074). This effect is similar to the finding from the scholars in Gondar University Hospital,¹⁷ Tikur Anbesa Teaching Hospital,⁴⁰ and in Mekelle.³⁹

The residency was another novel finding of this study. Those appendicitis patients who lived in rural areas were roughly four times more at risk to experience post-operative unfavorable outcomes compared with the urban residents (AOR= 3.83; 95% CI: 1.33–11.02). This might be because of the far setting of hospitals from the rural area. In the Ethiopia context, the specialized and referral hospitals are settled in the urban area. Therefore, rural patients are obligated to travel a long journey to access

those hospitals. Also, this study identified that long duration of illness without intervention was the risk factor for unfavorable outcomes. These two factors could be intermingled to yield those unfavorable outcomes. The latter is similar to the finding from a study in Tikur Anbesa hospital in which delay in intervention due to late presentation to hospital is an important preventable factor.²³

Moreover, this study identified that the length of hospital stay was a statistically associated factor of post-operation unfavorable outcomes. Accordingly, those patients who stayed at the hospital more than three days after the operation were three times more likely to develop unfavorable outcomes (AOR= 3.21; 95% CI: 2.06–8.10). This result is congruent with finding,⁴² which might be due to hospital-acquired infection.

Mass in the lower right quadrant was another novel independent predictor of post-operation unfavorable outcomes. This might be due to the scientific fact that the more tenderness of body parts is the most difficult surgical procedure. This might result in nosocomial infections.

Lastly, the investigators confirmed that age was not an independent predictor of post-operation unfavorable outcomes of appendectomy. This result has disagreements with the previous studies^{15,17,42} in which elderly patients are more at risk to develop post-operation negative outcomes. This disagreement may be due to the study period and socio-demographic variations of the studies. Therefore, increased awareness of the risks by both the community and physicians is essential to reduce the number of post-operation unfavorable outcomes.⁴³

This study included all the appendicitis patients who undergo appendix operation during the study period, which might be its strength. However, it has the following limitations. First, since a cross-sectional design was employed, it was unable to ascertain the temporality of variables. Likewise, the study did not include the independent predictors such as professional related, knowledge of the participants about the outcome variable, and other factors that might be the risk factors for post-operative unfavorable outcomes. Second, because the study was institution-based, it is difficult to generalize the findings to the overall population of the community. Finally, since the wealth of the participants and the numbers of operators during surgical procedures were not investigated, the investigator noted future researchers to address.

Conclusions

This study explored that the proportion of unfavorable outcomes of appendicitis operation was higher. Males were

more affected than females. Residents who were out of the city at which the hospital setting was, arrival after 24 hours at the hospital, length of hospital stay more than three days, and RLQ mass were the positive predictors of unfavorable outcomes of appendicitis operation. While female gender was the negative independent predictor of the unfavorable outcome of the appendicitis operation. Hence, health education for rural residents for early referral and prompt management for early discharging will reduce unfavorable outcomes of appendicitis operation. Moreover, the healthcare providers, especially the surgeons, are recommended to give special attention to those appendicitis cases presented with lower right quadrant tenderness. The policymakers and the hospital administrators also recommended giving a due emphasis to fulfill and use of laparoscopic procedure over that of open.

Data Sharing Statement

Except the raw data, all essential information are included in the manuscript.

Ethical Approval and Consent to Participate

Wollo University, College of Medicine and Health Sciences ethical review committee (ERC) approved the ethical issue. A permission letter was obtained from the Dessie Comprehensive Specialized Hospital. The ERC approved that consenting of the study participants could be waived due to the retrospective nature of the study. The personal medical registration numbers (MRN) and names of the participants were not used during the data collection procedure. Hence, I confirmed that the data were anonymized and maintained with confidentiality. All the data collection process was in harmony with the Helsinki Declaration.

Acknowledgments

I am happy to thank Wollo University, College of Medicine ethical review committee, and Dessie Comprehensive Specialized Hospital. I am also grateful to acknowledge the data collectors and clerks.

Funding

This study received no specific funding grant from external agency.

Disclosure

The author reported no conflicts of interest for this work.

References

- Hobler K. Acute and suppurative appendicitis: disease duration and its implications for quality improvement. *Perm Med J*. 1998;2(2):5–8.
- Fitz R. Perforating inflammation of the vermiform appendix; with special reference to its early diagnosis and treatment. 1. *Am J Med Sci*. 1886;184:321.
- Luckmann R. Incidence and case fatality rates for acute appendicitis in California. A population-based study of the effects of age. *Am J Epidemiol*. 1989;129(5):905–918. doi:10.1093/oxfordjournals.aje.a115224
- Andersson RE. The natural history and traditional management of appendicitis revisited: spontaneous resolution and predominance of prehospital perforations imply that a correct diagnosis is more important than an early diagnosis. *World J Surg*. 2007;31(1):86–92. doi:10.1007/s00268-006-0056-y
- Shogilev DJ, Duus N, Odom SR, Shapiro NI. Diagnosing appendicitis: evidence-based review of the diagnostic approach in 2014. *West J Emerg Med*. 2014;15(7):859–871. doi:10.5811/westjem.2014.9.21568
- Morino M, Pellegrino L, Castagna E, Farinella E, Mao P. Acute nonspecific abdominal pain: a randomized, controlled trial comparing early laparoscopy versus clinical observation. *Ann Surg*. 2006;244(6):881–886. discussion 886–888. doi:10.1097/01.sla.0000246886.80424.ad
- Ajao OG. Appendicitis in a tropical African population. *J Natl Med Assoc*. 1979;71(10):997–999.
- Al-Omran M, Mamdani M, McLeod RS. Epidemiologic features of acute appendicitis in Ontario, Canada. *Can J Surg*. 2003;46(4):263–268.
- Blomqvist P, Ljung H, Nyrén O, Ekblom AJ. Appendectomy in Sweden 1989–1993 assessed by the inpatient registry. *J Clin Epidemiol*. 1998;51(10):859–865. doi:10.1016/s0895-4356(98)00065-1
- Mungadi IA, Jabo BA, Agwu NP. A review of appendectomy in Sokoto, North-Western Nigeria. *Niger J Med*. 2004;13(3):240–243.
- Walker AR, Segal I. Appendicitis: an African perspective. *J R Soc Med*. 1995;88(11):616–619.
- Addiss DG, Shaffer N, Fowler BS, Tauxe RV. The epidemiology of appendicitis and appendectomy in the United States. *Am J Epidemiol*. 1990;132(5):910–925. doi:10.1093/oxfordjournals.aje.a115734
- Osman AA. Epidemiological study of appendicitis in Khartoum. *Int Surg*. 1974;59(4):218–221.
- Ofili OP. Implications of the rising incidence of appendicitis in Africans. *Cent Afr J Med*. 1987;33(10):243–246.
- Afenigus AD, Bayieh AM, Kassahun B. Treatment outcomes of acute appendicitis and associated factors among admitted patients with a diagnosis of acute abdomen in Debre Markos referral hospital, Amhara region, North West Ethiopia. *J Perioper Pract*. 2019;1750458920928473.
- Obsa MS, Adema BG, Shanka GM, Lake EA, Azeze GA, Fite RO. Prevalence of acute appendicitis among patient admitted for acute abdomen in Ethiopia: systematic review and meta-analysis. *Int J Surg Open*. 2020;26:154–160. doi:10.1016/j.ijso.2020.09.003
- Tsegaye S, Osman M, Bekele A. Surgically treated acute abdomen at Gondar University Hospital, Ethiopia. *East Cent Afr J Surg*. 2007;12(1):53–57.
- Willmore WS, Hill AG. Acute appendicitis in a Kenyan rural hospital. *East Afr Med J*. 2001;78(7):355–357. doi:10.4314/eamj.v78i7.9007
- Burkitt DP, Walker AR, Painter NS. Effect of dietary fibre on stools and the transit-times, and its role in the causation of disease. *Lancet*. 1972;2(7792):1408–1412. doi:10.1016/S0140-6736(72)92974-1
- Freud E, Pilpel D, Mares AJ. Acute appendicitis in childhood in the Negev region: some epidemiological observations over an 11-year period (1973–1983). *J Pediatr Gastroenterol Nutr*. 1988;7(5):680–684. doi:10.1097/00005176-198809000-00010
- Luckmann R, Davis P. The epidemiology of acute appendicitis in California: racial, gender, and seasonal variation. *Epidemiology*. 1991;2(5):323–330. doi:10.1097/00001648-199109000-00003
- Jahangiri Y, Sadigh N, Ahmadnia A. Epidemiologic features, seasonal variations and false positive rate of acute appendicitis in Shahr-e-Rey, Tehran. *Int J Surg*. 2007;5(2):95–98. doi:10.1016/j.ijso.2006.03.009
- Asefa Z. Acute appendicitis in Yirgalem Hospital, Southern Ethiopia. *Ethiop Med J*. 2002;40(2):155–162.
- Ricci MA, Trevisani MF, Beck WC. Acute appendicitis. A 5-year review. *Am Surg*. 1991;57(5):301–305.
- Mallick MS. Appendicitis in pre-school children: a continuing clinical challenge. A Retrospective Study. *Int J Surg*. 2008;6(5):371–373. doi:10.1016/j.ijso.2008.06.003
- Gürleyik G, Gürleyik E. Age-related clinical features in older patients with acute appendicitis. *Eur J Emerg Med*. 2003;10(3):200–203. doi:10.1097/00063110-200309000-00008
- Ayoade A, Olawoye O, Salami B, Banjo A. Acute appendicitis in Olabisi Onabajo University teaching Hospital Sagamu, A three year review. *Niger J Clin Pract*. 2006;9(1):52–56.
- Gallerani M, Boari B, Anania G, Cavallero G, Manfredini R. Seasonal variation in onset of acute appendicitis. *Clin Ter*. 2006;157(2):123–127.
- Simpson J, Samaraweera AP, Sara RK, Lobo DN. Acute appendicitis—a benign disease? *Ann R Coll Surg Engl*. 2008;90(4):313–316. doi:10.1308/003588408X285973
- Gerst PH, Mukherjee A, Kumar A, Albu E. Acute appendicitis in minority communities: an Epidemiologic Study. *J Natl Med Assoc*. 1997;89(3):168–172.
- Ingraham AM, Cohen ME, Bilimoria KY, Pritts TA, Ko CY, Esposito TJ. Comparison of outcomes after laparoscopic versus open appendectomy for acute appendicitis at 222 ACS NSQIP hospitals. *Surgery*. 2010;148(4):625–637. doi:10.1016/j.surg.2010.07.025
- Hanson AL, Crosby RD, Basson MD. Patient preferences for surgery or antibiotics for the treatment of acute appendicitis. *JAMA Surg*. 2018;153(5):471–478. doi:10.1001/jamasurg.2017.5310
- Zoguereh DD, Lemaître X, Ikoli JF, et al. [Acute appendicitis at the National University Hospital in Bangui, Central African Republic: epidemiologic, clinical, paraclinical and therapeutic aspects]. *Sante (Montrouge, France)*. 2001;11(2):117–125.
- Chamisa I. A clinicopathological review of 324 appendices removed for acute appendicitis in Durban, South Africa: a retrospective analysis. *Ann R Coll Surg Engl*. 2009;91(8):688–692. doi:10.1308/003588409X12486167521677
- Fashina IB, Adesanya AA, Atoyebi OA, Osinowo OO, Atimomo CJ. Acute appendicitis in Lagos: a review of 250 cases. *Niger Postgrad Med J*. 2009;16(4):268–273.
- Kotisso B, Messele G. Acute appendicitis in Ethiopia. *East Afr Med J*. 1996;73(4):251–252.
- Bekele A, Mekasha A. Clinical profile and risk factors for perforation of acute appendicitis in children. *East Afr Med J*. 2006;83(8):434–439. doi:10.4314/eamj.v83i8.9457
- Andersson MN, Andersson RE. Causes of short-term mortality after appendectomy: a Population-Based Case-Controlled Study. *Ann Surg*. 2011;254(1):103–107. doi:10.1097/SLA.0b013e31821ad9c4
- Hagos M. Pattern of acute appendicitis in Mekelle, Ethiopia. *Ethiop Med J*. 2014;52(3):113–118.
- Kotiso B, Abdurahman Z. Pattern of acute abdomen in adult patients in Tikur Anbessa Teaching Hospital, Addis Ababa, Ethiopia. *East Cent Afr J Surg*. 2007;12(1):47–52.
- Humes D, Simpson J. Acute appendicitis. *BMJ*. 2006;333(7567):530–534. doi:10.1136/bmj.38940.664363.AE
- Pham X-BD, Sullins VF, Kim DY, et al. Factors predictive of complicated appendicitis in children. *J Surg Res*. 2016;206(1):62–66. doi:10.1016/j.jss.2016.07.023
- Lee S, Ho H. Acute appendicitis: is there a difference between children and adults? *Am Surg*. 2006;72(5):409–413. doi:10.1177/000313480607200509

Open Access Emergency Medicine**Dovepress****Publish your work in this journal**

The Open Access Emergency Medicine is an international, peer-reviewed, open access journal publishing original research, reports, editorials, reviews and commentaries on all aspects of emergency medicine. The manuscript management system is completely online

and includes a very quick and fair peer-review system, which is all easy to use. Visit <http://www.dovepress.com/testimonials.php> to read real quotes from published authors.

Submit your manuscript here: <https://www.dovepress.com/open-access-emergency-medicine-journal>