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Epidemiological Profile and Seasonal Variation of Acute Appendicitis

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Abstract

Introduction: Acute appendicitis is a common surgical condition, typically treated by appendectomy, though conservative management is possible. Understanding its epidemiology and seasonal variation aids in recognizing disease patterns and improving management. This study aims to assess the disease burden and seasonal trends of acute appendicitis.

Methods: This retrospective, observational, cross-sectional study was conducted from September to December, 2024, at Rapti Academy of Health Sciences (RAHS), based on the hospital records of patients registered from April 2023 to March 2024. The study included 472 patients diagnosed with acute appendicitis, appendicular lump, or abscess, who underwent appendectomy. Data were collected through record review using a preformed proforma.

Results: The study found a nearly equal gender distribution, with males comprising 55.1% and females 44.9%. Most participants were aged 20-40 years (41.5%, mean age: 32.48 years). Acute appendicitis was the most common diagnosis (79.2%), and open appendectomy was the most frequently used treatment (72.5%). The highest number of cases occurred in June (10%), with a mean temperature of 33.17°C. No statistically significant correlation was found between environmental factors (temperature, humidity, sunshine) and appendicitis incidence.

Conclusion: While none of the environmental factors showed a statistically significant association with the frequency of acute appendicitis, the condition was more common during the rainy season.

Keywords: appendectomy; appendicitis; seasonal variation

Introduction

Appendicitis, an inflammation of the vermiform appendix, is the most common acute abdominal surgical emergency in children and a leading cause of abdominal surgery globally.[1] According to a 2019 study by Guan et al., the age-standardized prevalence and incidence of appendicitis were 8.7 and 229.9 per 100,000 population, respectively, with increases of 20.8% and 20.5% from 1990 to 2019.[2] The annual incidence is approximately 233 cases per 100,000 people, with a lifetime risk of 6.7% to 8.6%.[2] In Nepal, 220 deaths from appendicitis and its complications occurred in 2020, accounting for 0.14% of total deaths, with an age-adjusted death rate of 1.00 per 100,000, ranking Nepal 16th globally for appendicitis-related mortality.[3]

Appendicitis typically results from a blockage of the appendix lumen, often caused by an appendicolith.[4,5] Other factors, including intestinal parasites, fibrosis, hypertrophied lymphatic tissue, and appendiceal tumors, may contribute. However, many cases remain unexplained. While appendicitis can occur year-round, some studies suggest a higher incidence during the rainy season due to factors like high humidity, increased infections, and intestinal parasites, while others disagree.[6-8]

Diagnosis primarily relies on clinical signs, confirmed through radiological investigations. Important parameters like CBC, WBC count, and prothrombin time should also be evaluated. Treatment typically involves resuscitation,

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patient stabilization, and prompt appendectomy.[9] Delays in diagnosis and treatment can lead to complications like perforation and peritonitis. Surgical options include open appendectomy, conventional laparoscopic appendectomy, and NOTES.[10] This study aims to assess the disease burden and seasonal variation of acute appendicitis.

Methods

The study is a retrospective, observational, cross-sectional study conducted from September to December, 2024, at the Rapti Academy of Health Sciences (RAHS), Department of General Surgery, under the supervision of the Institutional Review Committee (IRC-RAHS) (Ref No: 428). RAHS is a tertiary care center where acute appendicitis cases are managed frequently. The study included patients diagnosed with acute appendicitis, appendicular lump, or appendicular abscess from April 2023 to March 2024. The required number of patients was calculated using the following standard equation.[11]

$n=(Z^2)P(1-P)/d^2$

Where n is the sample size

z = z statistic for the level of confidence (1.96)

P = expected prevalence (6.7%)[11]

d = allowable error (2.26%).

The recommended sample size for the study was 472.

A total of 472 participants who underwent acute appendectomy were included, while those lost to follow-up were excluded. Data were collected through a review of records from the general surgery ward and the operating theater, using a preformed proforma.

Statistical Analysis

Descriptive information of patients was collected with the aid of Epi-data 3.1. After data collection, the information was analyzed using IBM SPSS version 16.0. Quantitative data were summarized using mean and standard deviation, while categorical data were summarized by frequency and percentage.

Results

Table 1 shows that the gender distribution of participants was nearly equal, with males constituting 55.1% and females 44.9%. In terms of age, the majority of participants were between 20 and 40 years old, making up 41.5% of the sample (mean age: 32.48 years). Regarding diagnoses, most participants were diagnosed with acute appendicitis (79.2%), while appendicular perforation, mucocele appendix, and resolving appendicitis were the least common diagnoses, each accounting for 0.2%. For treatment modalities, open appendectomy was the most frequently used method, comprising 72.5% of cases.

Table 1: Socio-demographic variables, diagnosis, and treatment of acute appendicitis

SN	Variable	Frequency	Percentage
1	**Gender**		
	Female	260	55.1%
	Male	212	44.9%
	Total	472	100%
2	**Age Groups**		
	< 20 Years	125	26.5%
	20 – 40 Years	196	41.5%
	40 – 60 Years	111	23.5%
	>= 60 Years	40	8.5%
	Total	472	100%
3	**Diagnosis**		
	Acute Appendicitis	374	79.2%
	Appendicular Abscess	14	3.0%
	Appendicular Lump	78	16.5%
	Appendicular Perforation	1	0.2%
	Mucocele Appendix	1	0.2%
	Recurrent Appendicitis	3	0.6%
	Resolving Appendicitis	1	0.2%
	Total	472	100%
4	**Treatment Modalities**		
	Conservative Management	90	19.1%
	Lap Appendectomy	34	7.2%
	Lump Dissection and Drainage	1	0.2%
	Open Appendectomy	342	72.5%
	Referred	5	1.1%
	Total	472	100%

Table 2 illustrates the association between gender and age, showing that females (55.1%) were slightly more common than males (44.9%). In the 20-40 years age group, there were more female participants (57.7%) compared to males (42.3%). Regarding the association between gender and diagnosis, acute appendicitis was the most prevalent diagnosis, with 54.0% of females and 46.0% of males being diagnosed. In terms of treatment modalities, open appendectomy was the most common method, with 55.0% of females and 45.0% of males undergoing this procedure for the treatment of acute appendicitis.

Table 2: Association of gender with age groups, diagnosis and treatment of acute appendicitis

SN	Variables	Gender		Total
		Female	Male	
1	**Age Groups (Years)**			
	< 20 Years	57 (45.6%)	68 (54.4%)	125 (100%)
	20 – 40 Years	113 (57.7%)	83 (42.3%)	196 (100%)
	40 – 60 Years	68 (61.3%)	43 (38.7%)	111 (100%)
	>= 60 Years	22 (55.0%)	18 (45.0%)	40 (100%)
	Total	260 (55.1%)	212 (44.9%)	472 (100%)
2	**Diagnosis**			
	Acute Appendicitis	202 (54.0%)	172 (46.0%)	374 (100%)
	Appendicular Abscess	10 (71.4%)	4 (28.6%)	14 (100%)
	Appendicular Lump	44 (56.4%)	34 (43.6%)	78 (100%)
	Appendicular Perforation	0 (0.0%)	1 (100%)	1 (100%)
	Mucocele Appendix	1 (100%)	0 (0.0%)	1 (100%)
	Recurrent Appendicitis	2 (66.7%)	1 (33.3%)	3 (100%)
	Resolving Appendicitis	1 (100%)	0 (0.0%)	1 (100%)
	Total	260 (55.1%)	212 (44.9%)	472 (100%)
3	**Treatment Modalities**			
	Conservative Management	53 (58.9%)	37 (41.1%)	90 (100%)
	Lap Appendectomy	15 (44.1%)	19 (55.9%)	34 (100%)
	Lump Dissection and Drainage	1 (100%)	0 (0.0%)	1 (100%)
	Open Appendectomy	188 (55.0%)	154 (45.0%)	342 (100%)
	Referred	3 (60.0%)	2 (40.0%)	5 (100%)
	Total	260 (55.1%)	212 (44.9%)	472 (100%)

Table 3: Association of age groups with diagnosis and treatment of acute appendicitis

SN	Variables	Age Groups (Years)				Total
		< 20	20–40	40–60	>= 60	
1	**Diagnosis**					
	Acute Appendicitis	106 (28.3%)	164 (43.9%)	80 (21.4%)	24 (6.4%)	374 (100%)
	Appendicular Abscess	1 (7.1%)	9 (64.3%)	3 (21.4%)	1 (7.1%)	14 (100%)
	Appendicular Lump	16 (20.5%)	20 (25.6%)	27 (34.6%)	15 (19.2%)	78 (100%)
	Appendicular Perforation	1 (100%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100%)
	Mucocele Appendix	0 (0.0%)	1 (100%)	0 (0.0%)	0 (0.0%)	1 (100%)
	Recurrent Appendicitis	0 (0.0%)	2 (66.6%)	1 (33.3%)	0 (0.0%)	3 (100%)
	Resolving Appendicitis	1 (100%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100%)
	Total	125 (26.5%)	196 (41.5%)	111 (23.5%)	40 (8.5%)	472 (100%)
2	**Treatment Modalities**					
	Conservative Management	18 (20.0%)	29 (32.2%)	27 (30.0%)	16 (17.3%)	90 (100%)
	Lap Appendectomy	8 (23.5%)	16 (47.1%)	8 (23.5%)	2 (5.9%)	34 (100%)
	Lump Dissection and Drainage	0 (0.0%)	0 (0.0%)	1 (100%)	0 (0.0%)	1 (100%)
	Open Appendectomy	98 (28.7%)	148 (43.3%)	75 (21.9%)	21 (6.1%)	342 (100%)
	Referred	1 (20.0%)	3 (60.0%)	0 (0.0%)	1 (20.0%)	5 (100%)
	Total	125 (26.5%)	196 41.5%	111 (23.5%)	40 (8.5%)	472 (100%)

Table 3 shows the association between age groups and diagnosis, with the 20-40 years age group having the highest

percentage of acute appendicitis diagnoses at 43.9%. Similarly, in the association between age groups and treatment modalities, open appendectomy was the most common treatment, with 43.3% of participants in the 20-40 years age group undergoing this procedure.

Table 4: Month-wise distribution of acute appendicitis

Months	Mean Temperature (°C)	Relative Humidity (%)	Mean Sunshine Hours	Frequency (%)
January	14.53	55.83	8.94	40(8.5%
February	18.56	51.47	11.27	42(8.9%)
March	24.64	37.63	12.01	43(9.1%)
April	30.48	31.84	13.36	37(7.8%)
May	33.58	35.89	14.28	34(7.2%)
June	33.17	54.32	14.46	47(10.0%)
July	28.86	84.41	13.58	44(9.3%)
August	28.28	86.71	13.36	32(6.8%)
September	27.03	84.06	12.27	32(6.8%)
October	24.2	70.55	9.44	38(8.1%)
November	20.52	62.03	9.22	43(9.1%)
December	16.48	56.59	9.13	40(8.5%)
Total				472 (100%)

Weather data is taken from climate data.[12]

Table 4 shows that the majority of cases occurred in June, accounting for 10% of the total cases, with a mean temperature of 33.17°C, a relative humidity of 54.32%, and an average of 14.46 sunshine hours. The least common months were August and September, each representing 6.8% of the cases.

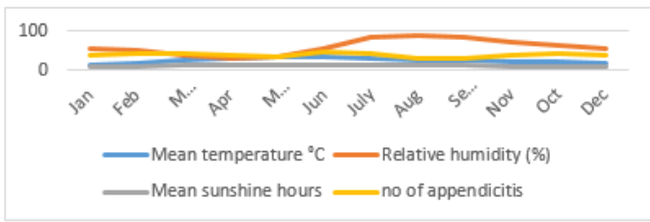

Figure 1: Correlation of acute appendicitis with mean temperature, humidity, and average sunshine hours

Figure 1 shows that the correlation between the incidence of acute appendicitis and average temperature in Celsius is moderately negative (correlation coefficient: -0.41, p-value: 0.189), but not statistically significant. The correlation between appendicitis incidence and relative humidity (correlation coefficient: -0.295, p-value: 0.35) and with daily sunshine hours (correlation coefficient: -0.272, p-value: 0.392) are weak negative correlations, also not statistically significant. None of the environmental factors were found to have a statistically significant relationship with the incidence of acute appendicitis.

Discussion

The demographic profile of acute appendicitis in this study includes 472 cases, accounting for 38.19% (472 out of 1236 patients) of total admissions to the surgical ward. The gender distribution of acute appendicitis shows a female predominance, with females comprising 55.1% and males 44.9%. This finding is consistent with previous studies.[13,14] However, it contrasts with most studies that report a male predominance.[15,16] This discrepancy in the incidence of the disease may be attributed to a higher number of males seeking employment abroad in this region.

The most common age group for acute appendicitis is 20-40 years, which is consistent with findings from other studies.[17] Complications related to acute appendicitis, such as appendicular perforation, are more prevalent in males, whereas appendicular abscesses and lump formation occur more frequently in females. In terms of management, the majority of cases are treated with surgical appendectomy, with only 19.07% of cases being managed conservatively. Most of these conservatively managed cases involve appendicular lumps and abscesses diagnosed upon admission. This rate of conservative management is lower compared to a study conducted in a central hospital in Nepal.[18]

Seasonal variation in acute appendicitis shows that the majority of cases occurred in June, accounting for 10% of cases, with a mean temperature of 33.17°C, relative humidity of 54.32%, and an average of 14.46 sunshine hours. The least number of cases were observed in August and September, each accounting for 6.8%. These findings are consistent with those of other studies.[19] While appendicitis can occur year-round, a relatively higher number of cases are observed during the rainy season.[20,21] However, some studies have reported a higher incidence during the summer months.[22] In this study, it appears that acute appendicitis is more common during the rainy season, likely due to factors such as high humidity, an increased incidence of infections, and intestinal parasites. Additional contributing factors may include air pollution, low-fiber diets, and gastrointestinal infections. As this was a retrospective study, data were collected from the admission records of the respective ward. Patients who were not admitted or who refused admission were not included in the study. Additionally, patients admitted to nearby hospitals were also excluded, which may have influenced the results of this study.

Conclusion

Acute appendicitis predominantly affected individuals in the 20-30 years age group. The incidence of appendicitis was higher during the months of June and July, which coincided with the rainy season, while fewer cases were observed in August and September. However, no significant correlation was found between environmental factors such as relative humidity, average temperature, or sunshine hours and the incidence of acute appendicitis.

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