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RISK FACTORS OF ACUTE APPENDICITIS AMONG PATIENTS ATTENDING SURGICAL HOSPITALS IN MOSUL CITY

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ABSTRACT

Background: Acute appendicitis is classically a surgical emergency, but it can also present as a chronic condition. It typically presents with generalized abdominal pain or periumbilical pain that may later radiate to the right lower quadrant. Nausea and vomiting may be present. Diagnosis is based on history, physical examination, general laboratory and radiological investigations. The cause of acute appendicitis is unknown, but it is likely multifactorial. The lifetime risk of developing acute appendicitis is six to seventeen percent globally. **Objective:** To evaluate risk factors of acute appendicitis among patients attending surgical hospitals in Mosul city. **Patients & Methods:** A descriptive, observational case-control study. The study was conducted at the level of three major surgical hospitals in Mosul city (Al-Jomhuri Hospital, Al-Salam Teaching Hospital, and Mosul General Hospital) with a sample size of 410, 205 for acute appendicitis cases and 205 for controls without acute appendicitis. Data was collected from 2nd January to 30th of June 2024. **Result:** The total number of cases was 205, of which 109 were males (53%) and 96 were females (47%), with a statistically significant difference between cases and controls (p-value = 0.045). First-degree family history of acute appendicitis was found among 160 (78%) cases compared to 92 (45%) controls with significant differences between them (p-value < 0.001). Acute appendicitis was found to be high among age groups < 35 years in 111 (54%), with statistically significant difference between cases and controls (p-value = 0.018). primary education level, overweight, smoking, and low fiber intake were found to be risk factors for acute appendicitis (p-value = 0.035, 0.045, 0.022, 0.003), respectively. **Conclusions:** The study showed that acute appendicitis is more common among male (53%) in comparism to female (47%) with statistically significant difference (p value =0.045), age of 35 years old and younger (54 %) with a first-degree family history of appendicitis(78%) is a risk factor for acute appendicitis; other risk factors such as being overweight, smoking, and low fiber intake(50%,54% and 20%) respectively are risk factors with significant differences between cases and controls in variable degrees. In this study there were 64% had gradual onset abdominal pain, 61% had right iliac fossa pain, 76% anorexia and 68% had constipation.

KEYWORDS: Acute appendicitis, risk factors, Mosul, Iraq.

1-INTRODUCTION AND REVIEW OF LITERATURE

1-1 Background

The appendix is like a little pouch connected to the intestine. It is situated in the lower-right abdomen. The inflamed appendix (appendicitis) presented with pain in the right lower abdomen, vomiting, nausea, and decreased appetite, which are typical symptoms of appendicitis. However, about 40% of people do not exhibit these common symptoms.[1]

An obstruction in the appendix's ilium is the major cause of appendicitis. A fecaloma, or calcified "stone" formed from feces, is usually the cause of this obstruction. Other possible causes of this obstruction include intestinal parasites, tumors, gallstones, and inflamed lymphoid tissue from a viral infection.[2] The obstructed appendix leads to bacterial growth, reduced blood flow, and elevated pressure, all of which cause inflammation. Several things combine to cause tissue damage and, eventually, tissue death. The appendix may rupture if this procedure is not managed soon, releasing bacteria into the abdominal cavity and possibly causing serious and fatal consequences.[3] Acute appendicitis is considered a surgical emergency. The lifetime risk estimates range from six to seventeen %, based on different geographic locations. Appendicitis is classified as uncomplicated or complicated based on these complications. Depending on the necrosis in the appendix tissue, as or non-gangrenous classification can also be made.[4]

Acute appendicitis most likely has a complex etiology. Appendicitis has been linked to specific environmental exposures, which are frequently connected to a lifestyle like that of the West. Hygiene improvement seems to be linked to a larger prevalence of the disease. Additionally, smokers have more risk for appendicitis, and it seems to occur more frequently in the summer. However, summertime is when gastrointestinal tract infections generally occur more frequently.[5]

Around the world, appendicitis incidence varies; it is highest in industrialized countries and lowest in low-income countries. Additionally, the incidence changed over time, rising in Western countries at the beginning of the 20th century, peaking in the middle, and falling at the end. The incidence has not changed since then.[6]

The signs and symptoms of the patient play a major role in the diagnosis of appendicitis. Close monitoring, useful imaging, and blood testing might be useful when the diagnosis is uncertain. Computed tomography (CT scan) and ultrasound are the two imaging techniques most frequently used to diagnose appendicitis. CT scan is more accurate than an ultrasound. However, due to the dangers of radiation exposure, ultrasonography might be the first imaging test that is recommended for children and pregnant women. Ultrasonography is mostly used to identify crucial differentials, such as mesenteric adenitis in children or ovarian pathology in females, even though it may also help with diagnosis.[7]

The inflamed appendix should be surgically removed as part of the usual therapy for acute appendicitis. Either an open abdominal incision (laparotomy) or a minimally invasive approach involving tiny incisions and cameras (laparoscopy). Sometimes, in the case of non-ruptured appendicitis, antibiotics might be beneficial.[8]

1.2 Etiology

Although the main causes of appendicitis have remained unknown, the following factors are known to affect the disease's development; Inadequate dietary intake, the development of coprolite in the intestines, the length of the appendix, the wedging of a foreign body within it, parasite infections, external scar suppression, and an imbalance in the gut flora (particularly when antibiotics are used more frequently).[9]

Acute appendicitis appears to be caused by obstruction. The obstruction leads to the enlargement and mucus-filling. This constant generation of mucus increases in the lumen and the appendix walls. The rising pressure causes the tiny veins to obstruct and thrombose, and the lymphatic flow stagnates. Currently, spontaneous recovery is uncommon. The appendix becomes ischemic and then necrotic as the blood artery blockage worsens.[10] As germs penetrate through the walls of the appendix, pus develops inside and around it (suppuration). Appendiceal rupture, also referred to as a "burst appendix," is the final result and can result in sepsis, peritonitis, and, in severe cases, even death.[11]

1.3 Pathological finding

Acute appendicitis can cause a variety of inflammatory conditions.
1- Appendix catarrhalis.
2- Perforated appendicitis.
3- Appendicitis gangrenosa.
4- Appendicitis ulcerosa.
5- Appendicitis phlegmonosa.[12]

Diffuse peritonitis and periapendicular infiltration can result from progressing inflammation.[13]

1.4 Risk Factors of having an acute appendicitis

1.4.1. Age and Gender

Acute appendicitis commonly affects individuals between the ages of 10 and 30. However, it can occur at any age.
Gender: Males tend to have a slightly higher incidence of acute appendicitis compared to females, especially during adolescence and young adulthood.

1.4. 2. Family History

A family history of appendicitis increases the risk of developing the condition. This suggests a genetic predisposition.

1.4. 3. Dietary Factors Low fiber intake

Diets low in fiber may contribute to the development of appendicitis due to increased constipation and harder stool, which can obstruct the appendix.

1.4. 4. Infections

Bacterial and viral infections such as Yersinia enterocolitica, adenovirus, and certain gastrointestinal infections may trigger inflammation in the appendix. Parasitic infections, in some cases, parasites like

Entamoeba histolytica, have been implicated in causing appendicitis, particularly in developing countries.

1.4. 5. Obstruction
The most common cause of acute appendicitis is obstruction of the lumen (the opening inside the appendix). Obstruction can be caused by Fecoliths (hardened stool), Enlarged lymphoid tissue (often associated with infections), Tumors, and Foreign bodies.

1.4. 6. Seasonal Variations
Some research suggests that appendicitis may be more common during certain times of the year, particularly in summer and autumn, possibly linked to seasonal infections.

1.4. 7. Smoking
Smoking has been associated with an increased risk of appendicitis, possibly due to the impact of smoking on the immune system and blood circulation.

1.4. 8. Geographical and Socioeconomic Factors
Appendicitis tends to occur more frequently in developed countries, possibly due to dietary differences. It is less common in rural areas of developing nations. Some studies suggest that lower socioeconomic status might be linked to a higher incidence of appendicitis due to variations in diet, healthcare access, and hygiene.

1.4. 9. Other Medical Conditions
People with certain gastrointestinal conditions, like Crohn's disease, or those with previous abdominal infections may be at increased risk.

1.4. 10. Stress and Immunosuppression
Chronic stress and conditions that weaken the immune system (like HIV or immunosuppressive medications) may contribute to a higher susceptibility to infections and inflammation, including appendicitis.[14-18]

1.5 Signs and Symptoms
Fever, nausea, vomiting, and intense abdominal pain are some of the symptoms that indicate acute appendicitis. The inflamed appendix irritates the adjacent abdominal wall as it gets bigger and more inflammatory. As a result, the discomfort concentrates in the right lower abdominal area. Children under three may not exhibit this traditional migration of pain.[19]

Around the umbilicus, appendicitis pain may initially seem dull. The discomfort typically gets localized after a few hours and moves towards the lower right quadrant. The right iliac fossa may exhibit localized findings as one of the symptoms. Pressure, even light pressure, makes the abdominal wall extremely sensitive. The lower abdomen hurts when deep tension is suddenly released (Blumberg's sign).[20]

When an appendix is retrocecal, located behind the cecum, it can be silent and not cause tenderness when deeply compressed on the right abdominal quadrant. The gas-filled cecum shields the inflamed appendix from pressure, which explains this. Likewise, the abdomen usually has no rigidity when the appendix is fully located within the pelvis. A digital rectal examination in these situations reveals rectovesical pouch pain. Dunphy's sign or point discomfort in the area, known as (McBurney's point), is brought on by coughing.[21]

1.6 Diagnosis
Anorexia, which can happen with or without vomiting, migrating right iliac fossa pain together, generalized guarding, and localized muscular stiffness, are the hallmarks of a typical case of appendicitis. People with situs inversus totalis may experience pain that just affects the left abdomen quadrant.[22]

A thorough history and a clinical examination will aid in the diagnosis. The following signs can help in the diagnosis.

- **Plenes' sign**: percussive pain.
- **Blumberg's sign is** discomfort in the abdomen that persists after pressure is released; this pain is usually felt at the location of the continuous inflammation, which in appendicitis is the lower right abdomen.
- **Rovsings sign:** the patient experiences pain in the right lower abdomen when pressure is applied to the left lower abdomen.
- **Psoas sign:** indicates specifically the retrocecal localization of the inflamed appendix; the patient experiences pain at the appendix site when the patient does passive hip extension or active hip flexion while supine. Inflammation of the psoas muscles, as well as the peritoneum covering the iliopsoas muscles, is what causes the pain.
- **Obturator sign:** abdominal pain caused by internal rotation, flexion, and abduction of the right thigh, more obvious in pelvic form.
- **Hamburger sign:** decreased appetite and anorexia, which is eighty % sensitive for appendicitis.
- **Kocher's sign,** sometimes known as **Kosher's, is characterized by the initial paraumbilical discomfort and then shifting** to the right iliac region.[23-27]

➢ **Laboratory tests:** A complete blood count (CBC) is conducted to check for signs of inflammation or infection, even though there is no specific lab test for appendicitis. White blood cell (WBC) counts can be raised in 70–90% of cases of appendicitis; however, elevated WBC counts can also result from various other abdominal and pelvic diseases. WBC counts may not be a reliable indicator of appendicitis alone; instead, they may point to inflammation. The neutrophil ratio, however, was more sensitive and specific for acute appendicitis.[28-29]

Pregnancy tests should be requested for all women of reproductive age.

➢ **Imaging: Ultrasonography** is the recommended initial option due to the health hazards associated with radiation exposure in children, with a CT scan serving as a valid follow-up if the results of the ultrasound are unclear. When diagnosing appendicitis in adults and teenagers, a CT scan is more reliable than an ultrasound. The sensitivity and specificity of a CT scan are 94% and 95%, respectively. The overall sensitivity and specificity of ultrasonography were 86% and 81%, respectively.[30]

The right iliac fossa's free fluid accumulation can be seen on ultrasound, along with the appendix's apparent appearance, increased blood flow when utilizing color Doppler, and non-compressibility due to the appendix's walled-off abscess. Additional secondary sonographic indicators of acute appendicitis include the acoustic shadowing of an appendicolith and the presence of echogenic mesenteric fat encircling the appendix. In a small percentage of cases (around 5%), iliac fossa ultrasonography is normal, even in the presence of appendicitis. This false-negative result is particularly relevant to cases of appendicitis that occur before the appendix has developed a noticeable dilation.

Additionally, people with bigger volumes of fat and gas in their bowels that make it technically harder to visualize the appendix are more likely to have false-negative results. Despite these limitations, skilled sonographers can frequently differentiate between appendicitis and other conditions with comparable symptoms. A few of these problems include pain originating from the Fallopian tubes or ovaries or inflammation of the lymph nodes close to the appendix.[31-32]

Computed tomography (CT) has become widely used when accessible, particularly in patients whose diagnosis is unclear from their history and physical examination. Radiation safety concerns typically prevent pregnant women and children from receiving CT scans, especially with the widespread use of MRI. The appendix size has the highest positive predictive value for the accurate diagnosis of appendicitis; indirect indicators can either boost or decrease sensitivity and specificity. A size greater than 6 mm is specific and 95% sensitive for appendicitis.[33]

Magnetic resonance imaging (MRI) usage has grown in popularity for the diagnosis of appendicitis in infants and pregnant patients because of the radiation dosage, which can harm developing infants or children even though it poses almost no danger to healthy adults. It is more helpful in the second and third trimesters of pregnancy, especially when the appendix is moving due to the enlarging uterus and becomes harder to locate with ultrasound. Since the fetus is still undergoing organogenesis and there have not been any long-term studies done on the possible hazards or side effects, MRIs are often not recommended for first-trimester pregnancies.[34-35]

X-ray Plain abdominal radiography (PAR) should not be routinely taken from a patient undergoing evaluation for appendicitis since it is generally not helpful in diagnosing the condition. While small intestinal obstruction, perforated ulcers, and ureteral calculi can all be identified with plain abdomen images, appendicitis is rarely mistaken for any of these disorders. Less than 5% of patients undergoing an appendicitis evaluation have an opaque fecalith in the right lower quadrant. It has been shown that a barium enema is an inadequate diagnostic method for appendicitis. Although appendicitis has been linked to the inability of the appendix to fill during a barium enema, up to 20% of normal appendices do not fill.[36-38]

1.7 Scoring

In an attempt to detect individuals who may have appendicitis, several grading systems have been devised. However, there are differences in the performance of scores, such as the Pediatric Appendicitis Score and the Alvarado Score.[39-40] The most well-known scoring system is the Alvarado score. While a score of seven or higher is suggestive of acute appendicitis, a score of less than five recommends against an appendicitis diagnosis. table 1.1.

Table 1.1: Alvarado Score).[40]

Migratory right iliac fossa pain	1 point
Anorexia	1 point
Nausea and vomiting	1 point
Right iliac fossa tenderness	2 points
Rebound abdominal tenderness	1 point
Fever	1 point
High white blood cell count (leukocytosis)	2 points
Shift to the left (segmented neutrophils)	1 point
Total score	**10 points**

1.8 Differential diagnosis

- **Women:** Since ectopic pregnancies can mimic the signs and symptoms of appendicitis, all women of reproductive age must be screened for pregnancy. Similar pain in the abdomen may also be indicative of endometriosis, menarche, ovarian torsion, pelvic inflammatory disease, dysmenorrhea, or Mittelschmerz (the release of an egg in the ovaries approximately two weeks before menstruation).[41]
- **Adults:** U.T.I, Renal colic, pancreatitis, rectus sheath hematoma, epiploic appendagitis, testicular torsion, pancreatitis, regional enteritis, cholecystitis, Adult-onset Crohn's disease and ulcerative colitis mesenteric ischemia, diverticulitis, intestinal blockage, colonic cancer, and leaking aortic aneurysms.[42]

1.9 Management

Surgery is usually used to treat acute appendicitis. Antibiotics are safe and efficient in treating simple appendicitis; nevertheless, in 26% of cases, recurrences occurred within a year, necessitating an appendectomy.

In the event of an appendicolith, antibiotic efficacy is reduced.[43]

Antibiotics are useful when administered to patients before, during, or after surgery to minimize possible post-operative problems in emergency appendectomy procedures.[44-45]

- **Pain**

Early in the patient's care, painkillers (such as morphine) should be administered since they do not seem to have an impact on the clinical diagnosis of appendicitis. In the past, several pediatric surgeons expressed concern that analgesics would influence a child's clinical exam, and some advised against giving them until the surgeon could perform an examination.[46-48]

- **Surgery**

An appendectomy is the surgical technique used to remove the appendix. An appendectomy can be done laparoscopically or openly. When treating acute appendicitis, laparoscopic appendectomy offers some advantages over open appendectomy, including a reduced incidence of superficial surgical site infections, less pain following surgery, and a quicker recovery period. On the other hand, laparoscopic appendectomy has an almost three times higher incidence of intra-abdominal abscess than open appendectomy.[49]

- **After surgery**

Hospital stays usually last a few hours to a few days, but if problems arise, they may extend to a few weeks. Depending on the disease's severity and whether the appendix ruptured before surgery, the recovery period may differ. If there is no appendix rupture, healing from appendix surgery is usually much faster.[50] Patients must follow their surgeon's advice and avoid strenuous activities while recovering from surgery to allow their tissues to heal.

1.10 Prognosis

After surgery, most patients with appendicitis recover rapidly; however, problems may arise if treatment is postponed or if peritonitis develops. The length of recovery varies depending on factors such as age, condition, problems, and alcohol intake, but it typically lasts between 10 and 28 days. It takes three weeks for young children (around ten years old) to recover.

There is ongoing debate on the necessity of performing an elective interval appendectomy to avoid repeated episodes of appendicitis in cases where the condition cures without surgery.[51]

The appendicular mass is another entity. It occurs when the appendix is left in place during an infection, allowing the intestine and omentum to stick to it and create a palpable mass. Surgery is dangerous during this time unless pus formation is detected by ultrasonography or the patient is toxic and feverish. The problem should be treated medically.[52]

An unusual appendectomy complication known as "Stump appendicitis" appears as inflammation in the remaining appendiceal stump after an incomplete appendectomy. Stump appendicitis is detectable by ultrasound imaging techniques, and it might appear months or years after the initial appendectomy.[53]

AIM OF THE STUDY

The study aims to evaluate the risk factors of acute appendicitis among patients attending surgical hospitals in Mosul city.

Specific Objectives

1- To identify the relationship between socio-demographic characteristics of the study sample with acute appendicitis.
2- To evaluate the relationship between the history of low fiber diet and acute appendicitis.
3- To describe the relationship between the history of smoking among the study sample and acute appendicitis.
4- To identify the relationship between increased BMI and the development of acute appendicitis.
5- To evaluate the relationship between family history and acute appendicitis among the study sample.
6- To evaluate the relationship between Inflammatory bowel disease and other comorbidity with acute appendicitis

2. PATIENTS AND METHODS

2.1 Administrative setting

The Directorate of health obtained the letter of permission to conduct this study. This study was also approved by the Local Scientific Council of the Arab Board of Health Specializations of Family and Community Medicine in Iraq; the concept and aims of the study were explained to all participants, and verbal consent was obtained. The administration of Al Jamhori Teaching hospital, Al Salam Teaching Hospital, and Mosul General Hospital has been informed about the nature and range of the study. Data collection will be kept confidential and will not be divulged except for the purpose of the study.

A specifically designed questionnaire on paper collected the information and then transferred it to an electronic application called Google Form to be ready for the SPSS analytic computer application.

2.2 Study Setting

The research was conducted at three main surgical departments in Nineveh governorate; one was located on the left bank of Mosul (Al Salam teaching hospital), the second and third ones were located on the Right bank of Mosul (Al Jamhori Teaching Hospital, and Mosul general hospitals).

Emergency units of these hospitals were open 24 hours a day, all days of the week, with an average of patients between 250 and 300 daily. The investigator connects with the residents' general surgery doctors to collect data from patients with acute appendicitis presentation to these hospitals at different times of the week. After the case has been operated on and histopathological results or the surgeons' cross-finding in the operation notes of patients' files confirm the diagnosis of acute appendicitis.

Al Jamhori teaching hospital is considered the most important surgical hospital in Mosul; in addition to that, it is the only hospital in Mosul in which there are pure surgical units. It is approved as a teaching hospital where undergraduate and postgraduate medical students from different surgical branches are trained.

Al Salam Teaching Hospital has many advantages. It is the only hospital on Mosul's left bank with medical and gyne-obstetric departments. In addition to that, its buildings are not made of caravans like the Al Jamhori hospital.

Al Mosul General Hospital is located on the right bank of the Tigris River, and it has multiple specialties serving hospitals. It provides services for many patients from the south of Mosul.

The investigator is a senior house office/ Arabic board student who collects the information by directly meeting the patients, explaining the study's purpose, and providing full confidentiality.

2.3 Study design

An observational, descriptive, case-control study was adopted to achieve the present study's objectives. Data was collected from the participants retrospectively using the non-randomized convenience technique. Verbal informed consent was obtained, and a modified questionnaire was used to assess the risk factors of acute appendicitis in Mosul.

2.4 The study Period

Data was collected over six months, from the 2nd of January 2024 to the 30th of June 2024.

2.5 Study sample

Four hundred ten participants. 205 for each case and control.

2.6 Case definition

All available patients attending Al Salam, Al Jamhory teaching hospitals, and Mosul general hospital suffering from acute abdominal pain and diagnosed with appendicitis by the specialist surgeon and underwent appendicectomy by cross-apparent findings documented by surgeons at operation note of patients' files which is confirmed by histopathological results.

2.7 Control definition

The patients who are presented to the hospital without acute appendicitis.

2.8 Inclusion Criteria

All patients with acute appendicitis from equal to or above 14 years, both genders, regardless of their race, religion, and beliefs, were included in the study.

2.9 Exclusion Criteria

- Patients with insufficient data.
- The patients who disagreed were included in the study.
- Patients less than 14 years old.

2.10 The Steps of the Study

1- The seniors of general surgery clinically evaluated patients with Acute appendicitis. Then, the senior, after the operation, shifts the patients to the investigator after confirming the diagnosis.

2-The investigator then filled out the questionnaire by privately interviewing the patients.

3- The investigator measured weight and height. Body mass index was measured by dividing each patient's weight in kilograms by the square of the height in meters (kg/m^2).[54]

Classification of BMI as show in the table 2.1

BMI	Class
<18.5	underweight
18.5-24.9	normal
25-29.9	overweight
30 and more	Obesy

4- The data collected by the questionnaire will finally be analyzed to estimate the risk factors of acute appendicitis and to fulfill other parts of the objectives.

2.11 Pretest (Pilot study)

The pilot study included a survey of 20 patients. The aims of this pilot study were.

1. To examine the questionnaire's completeness and suggest any modifications required.
2. To assess the cooperation of the patients and to detect the difficulties that may be faced during the study.

The feedback from the pilot study was

- The response rate was 85 %. (15% did not respond to the investigator, i.e., 3 out of 20 cases participated in the pilot study).

2.12 The questionnaire form

A specifically designed questionnaire form was used for data collection, which includes patient code, age, gender, residency, marital state, dietary history if it contains high fiber or not, weight, height calculates BMI, educational level, presence of co- morbidities, family history of acute appendicitis, drug history of taking NSAIDs, Steroid, Antipsychotic. Presenting symptoms, site, radiation, onset of pain, associated symptoms, smoking history, no.

of cigarette, alcohol history, physical activity level. **(Index 1).**

2.13 Statistical analysis

The data collected during the study were summarized in Microsoft Excel version 2016 sheets. The statistical analysis was performed by using IBM-SPSS version 26. The Chi-square test was used to find the difference between the categorical variables. The odds ratio was used to estimate possible association, calculated using a two-by-two table.

A two-by-two table was designed as follows.

Table 2.2: Two by two table.

Risk factors	Cases	Controls	Total
Present	A (cases exposed)	B (controls exposed)	a+b
Absent	C (cases not exposed)	D (controls not exposed)	c+d
Total	a+c	b+d	a+b+c+d

- The odds ratio was calculated to measure the association between risk factors and the disease.
- The odds ratio is the ratio of the odds that the cases were exposed to the odds that the controls were exposed.

Odd ratio was calculated by using the following equation.

$$OR = \frac{a \times d}{b \times c}$$

The interpretation of the value of OR will be as follows:

OR =1 (The exposure is not related to the disease)

OR>1 (The exposure is positively related to the disease).

OR<1 (The exposure is negatively related to the disease)

- A95 % confidence interval (CI) of the results will be calculated, quantifying the uncertainty of value within which we can be 95% sure that the true value for the whole population lies.

CI is calculated by using the following equation.

Cl for the upper value = OR $^{1+1.96}\sqrt{x^2}$

CI for the lower value = OR $^{1+1.96}\sqrt{x^2}$

The Chi-square (x^2) test was used to find the statistical association.

P value is the probability that the observed difference between study groups resulted from chance alone, and a p-value <0.05 is used as a significant association.

3. RESULTS

The study included 410 subjects. Subjects with appendicitis (cases) were 205 (50%), and those without appendicitis (controls) were 205 (50%) too.

Table 3.1 compares socio-demographic parameters between subjects with appendicitis (cases) and those without appendicitis (controls). Regarding gender factors, no significant association or statistically significant differences were found for those with appendicitis compared to those without appendicitis. Additionally, a Family history of appendicitis is shown to have a risky association and statistically significant difference. Moreover, individuals with appendicitis were shown to be more smokers compared to those without appendicitis, with risky association and statistically significant differences.

Table 3.1: Comparison of socio-demographic between subjects with appendicitis and those with no appendicitis.

Demographic and personal characteristics	Cases *(n = 205)*	Controls *(n=205)*	Odds ratio (95% confidence interval)	P value
Male gender Female gender	109 (53%) 96 (47%)	138 (67%) 67 (33%)	0.572 (0.124-1.976)	0.045
Family history	160 (78%)	92 (45%)	**4.333 (1.227-7.334)**	**<0.001**
Married	127 (62%)	164 (80%)	0.407 (0.026-1.255)	0.233

Table 3.2 compares age groups between subjects with appendicitis and those without appendicitis. Younger individuals than 35 years old are shown to be risky and statistically significant for having appendicitis.

Table 3.2: Comparison of age groups between subjects with appendicitis and those without appendicitis.

Age	Cases *(n = 205)*	Controls *(n=205)*	Odds ratio (95% confidence interval)	P value
-14-less than 25 years	44 (22%)	17 (8 %)	**3.243 (1.499-6.453)**	**0.022**
-25-less than 35 years	111 (54%)	52 (25%)	**3.521 (3.162-8.066)**	**0.018**
-35-less than 45 yrs	39 (19%)	81 (40%)	0.351 (0.135-0.905)	0.038
-45 and above	11 (5%)	55 (27%)	0.142 (0.080-0.462)	0.009

Table 3.3 illustrates a higher percentage of individuals with appendicitis who lived in rural areas, but the association and the difference were not statistically significant.

Table 3.3: Comparison of residence state between subjects with appendicitis and those without appendicitis.

Residency	Cases *(n = 205)*	Controls *(n=205)*	Odds ratio (95% confidence interval)	P value
- Rural - Urban	45 (22%) 160 (78%)	28 (14%) 177 (86%)	1.732 (0.481-4.014)	0.326

Table 3.4 shows a risky association and statistically significant difference in education levels between the two groups, with a higher proportion of secondary and university education levels in the appendicitis group compared to the no appendicitis group with the risky association and statistically significant.

Table 3.4: Comparison of educational levels between subjects with appendicitis and those without appendicitis.

Education:	Cases *(n = 205)*	Controls *(n=205)*	Odds ratio (95% confidence interval)	P value
-Primary	109 (53%)	130 (63%)	0.662 (0.024-0.966)	**0.035**
-Secondary or university	96 (47%)	75 (36%)	**1.576 (1.028-2.266)**	**0.036**

Table 3.5 shows a comparison of the study groups regarding BMI categories; underweight and overweight were shown to have a risky association with appendicitis and are statistically significant for underweight. In contrast, the normal weight and obese BMI category showed no significant association or statistically significant difference.

Table 3.5: Comparison of BMI categories between subjects with appendicitis and those without appendicitis.

BMI	Cases *(n = 205)*	Controls *(n=205)*	Odds ratio (95% confidence interval)	P value
-Normal	75 (37%)	130 (63%)	0.344 (0.014-1.794)	0.518
-Underweight	17 (8%)	2 (1%)	**8.608 (1.057-14.359)**	**0.005**
-Overweight	103 (50%)	60 (29%)	**2.488 (1.122-3.400)**	**0.045**
-Obese	10 (5%)	13 (6%)	0.824 (0.324-1.769)	0.521

Table 3.6 shows a comparison of cases and controls regarding chronic medical diseases. The presence of COPD, Crohn's or Ulcerative colitis, history of gastroenteritis within 7-10 days, and diabetes were risky and statistically significantly different among the appendicitis group compared to the non-appendicitis group. Moreover, the use of NSAIDs and steroids was shown to be risky and statistically significantly more in the appendicitis group, too.

Table 3.6: Comparison of cases and controls regarding chronic medical diseases and previous drug history.

Variables	Cases *(n = 205)*	Controls *(n=205)*	Odds ratio (95% confidence interval)	P value
Comorbidity: -COPD -Inflammatory bowel disease -Diabetes -History of gastroenteritis within 7-10 days	 19 (9%) 5 (2%) 10 (5%) 16(8%)	 8 (4%) 2 (1%) 4 (2%) 6(3%)	 **2.373(1.019-3.224)** **2.020(1.006-2.737)** **4.599(1.006-8.789)** **2.811(1.168-3.129)**	 **<0.001** **<0.001** **<0.001** **<0.001**
Drug history -NSAIDs -Steroids	 33 (16%) 31 (15%)	 14 (7%) 12 (6%)	 **2.535(1.003-3.747)** **2.764(1.124-4.789)**	 **<0.001** **<0.001**

Table 3.7 explores the risky association and significant difference between smoking and low fiber diet, with no significant association or statistical difference regarding other variables.

Table 3.7: Comparison of social, physical, and dietary characteristics between socioeconomic appendicitis and those with no appendicitis.

Variable	Cases *(n = 205)*	Controls *(n=205)*	Odds ratio (95% confidence interval)	P value
Smoking	40 (20%)	21 (10%)	**2.25 (1.162-3.793)**	**0.022**
Alcohol	5 (2%)	6 (3%)	0.659 (0.337-1.172)	0.240
Low physical activity	99 (48%)	92 (45%)	1.128 (0.457-1.701)	0.334
Dietary history: - High fiber - Low fiber - Mixed	 112 (55%) 111 (54%) 86 (42%)	 152 (74%) 72 (35%) 51 (25%)	 0.429 (0.022-0.861) **2.180 (1.838-2.499)** 2.172 (0.334-4.729)	 0.003 **0.003** 0.493

Table 3.8. Sign & Symptom of Acute Appendicitis.

Signs and symptoms	Cases *(n = 205)*
Pain: - Gradual - Sudden	 131 (64%) 74 (36%)
Site of pain: - Right iliac fossa - Lower abdomen - central	 125 (61%) 17 (8%) 93 (45%)
Shifting pain	165 (80%)
Associated features: - Anorexia - Nausea - Constipation - Fever - Vomiting - Diarrhea	 156 (76%) 153 (75%) 139 (68%) 73 (36%) 62 (30%) 13 (6%)
Dysuria	45 (22%)

The study revealed that 64% of patients have gradual pain, 61% of patients have right iliac fossa pain, 80% had shifting pain, 76 % of patients have anorexia, 75 % have nausea and 68 % have constipation.

4-DISCUSSION

Appendicitis is the world's most common general surgical emergency, causing significant morbidity and mortality, particularly in developing countries. There may be occasions when the presentation and handling of it are difficult. The lack of specificity and resemblance to other diseases regarding signs and symptoms may contribute to inaccurate diagnosis, which is challenging and complicated. Modern approaches to appendicitis care aim to achieve higher complexity and precision through imaging techniques, grading systems, and a more extensive range of therapeutic options. It is still difficult to diagnose acute appendicitis based only on physical examination and clinical presentation. Many clinical grading systems have been created to aid in the early detection of acute appendicitis. The Alvarado score was the most widely used for adults and children.

For the general public, acute appendicitis and the subsequent appendectomy are the most common surgical events and are regarded as routine surgical procedures. The most frequent acute abdominal condition needing surgery and the most prevalent cause of non-traumatic acute abdominal discomfort is appendicitis. Due to the high lifetime frequency of acute appendicitis, complicated appendicitis, which includes abscess, phlegmon, and generalized peritonitis, continues to cause significant morbidity and mortality rates around the globe.

4.1 Discussion of risk factors for acute appendicitis

4.1.1 Gender

The study revealed that male with appendicitis were more than females, males with appendicitis were statistically significant with p value(0.045). Sex difference analysis of conditions has been widely researched over the last two decades, and sex can influence and impact conditions from initial presentation to the outcome of treatment.[54] Theofanis F Kollias et al. published a recent systemic review that found no official risk factors to differ between the sexes. However, males were more likely to complain of symptoms like right lower quadrant cramps/tenderness/pain and loss of appetite.[55] Zainab Khairalla Aouda et al. showed that male with 1.3-1.4.more likely inflamed appendix.

4.1.2 Family history

The study showed that the presence of a positive first-degree family history of acute appendicitis is risky for developing acute appendicitis ($P < 0.001$). A statistically significant, similar finding was obtained by Drescher et

al.; his findings revealed that adults with a known family history of appendicitis presenting to the emergency department (ED) were more likely to have appendicitis than those without.[56] Abbas Heydari et al. considered in their study that the knowledge of a family history of appendicitis, in combination with other clinical and laboratory findings, can assist an emergency physician in determining the likelihood of the diagnosis in patients with suspected acute appendicitis at the ED.[57]

4.1.3 Marital Status

Regarding marital status, the study revealed that being married was not risky and not statistically different between patients with appendicitis and those without appendicitis. Jian Li et al. explore in their study that living alone was more likely to develop complicated appendicitis, with no significant difference mentioned regarding marital state and appendicitis risk.[58]

4.1.4 Age

Comparing the ages of patients with appendicitis and those without appendicitis, the study illustrates that appendicitis was found to have a risky association and statistically significant differences among less than 35 years age groups from those older than 35 years. Close findings were obtained by an epidemiological study conducted in Iran. And Ethiopia.[59]

4.1.5 Residency

Regarding residence factors, the study shows acute appendicitis was more prevalent among urban regions, but the association was not risky, and there was not statistically significant difference. This fact was explained by the difficulty transporting patients from rural areas and delayed hospital attendance. As a result, acute appendicitis among rural patients appeared to be more complicated or ruptured. Enver Özkurt et al. explained that factors significantly associated with complicated cases (abscess/perforation) were referral regions such as remote towns, pre-operative hospital delay, and duration of referral. In their study, Toon Peeters et al. conclude that fifteen factors affect acute appendicitis development, among them having grown up in a rural environment.[60]

4.1.6 Educational level

This study revealed that 53% of cases were at the primary level of education, and there is a significance difference between case and control ($P < 0.035$); this result was similar to Toon Peeters, who again found that patients with a secondary level of education were significantly differed for having acute appendicitis, anyhow, she found no significant difference among the population of the secondary educational level group regarding rates of appendicitis related complication.[61]

4.1.7 BMI category

Regarding patients' body mass index, the study revealed that being overweight (50%) was risky and statistically significant difference for having appendicitis, while normal weight was not significant for acute appendicitis. A similar study done by M. Ryoo et al. explores that BMI categories $\geq 30–40$ kg/m^2 and BMI $\geq 60–70$ kg/m^2 demonstrated a respective increased acute appendicitis risk of 12% and 287%.[62-65]

4.1.8 Comorbid condition

The study found that chronic inflammatory bowel disease, chronic obstructive pulmonary disease, diabetes mellitus, and gastroenteritis within 7-10 days; in addition to that, using NSAIDs and steroid drugs was risky and statistically different among patients with acute appendicitis. Infection dissemination might appear as these comorbid conditions may decrease the immune system. Den-Ko Wu et al. did a population-based matched cohort study; they found that non-*Typhoidal Salmonella* Infection was risky for acute appendicitis development, diabetes, and immunosuppressive disease or drugs can predispose to the dissemination of *Typhoidal Salmonella* Infection.[66] On the reverse side, appendectomy found by Wei-Sheng Chung et al. increases ulcerative colitis and Crohn's disease risks irrespective of appendicitis.[67] In contrast, Salah Alghamdi et al. found in their meta-analysis that appendectomy was protective against ulcerative colitis. However, the impact was negative on Crohn's disease. He adds that further studies assessing the effects of appendectomy on the prognosis of ulcerative colitis are recommended.[68] Furthermore, Siripong Sirikurnpiboon et al. found no difference between patients with acute appendicitis and controls concerning having COPD or diabetes mellitus.[69]

4.1.9 Smoking

Smoking was found to be risky and statistically significant among patients with appendicitis ($P < 0.022$). Toon Peeters and M. Ryoo showed that smoking was significantly associated with acute appendicitis.[70, 72]

4.1.10 Low physical activity level

The study shows no statistically significant difference regarding physical activity between patients with and without appendicitis ($P < 0.334$). Most cases explain this from those less than 35 physically active years. In contrast to the study conducted by Jie Chen et al., who did an interesting mendelian control-analysis, he found that a sedentary lifestyle was associated with sixteen gastrointestinal problems, including acute appendicitis. In comparison, moderate-to-vigorous intensity physical activity was associated with eight gastrointestinal problems, not including acute appendicitis.[73]

4.1.11 Low fiber intake

Patients with appendicitis were significantly found to eat fibers and mixed food, and those with no appendicitis ($P < 0.003$) were found to eat high-fiber food. Low fiber consumption can cause constipation. Constipation is a risk factor for blockage in the appendix canal, which ultimately causes appendicitis. Ali Akbar et al. had a study that revealed that there are 6 parts of the literature

sampled, namely Arifuddin et al. (2017), Hidayat et al. (2022), Peeters et al. (2023), Siraj et al. (2020), Ahmedet al (2017), and Alchemist et al. (2022) state that are eating patterns, namely low fiber consumption, diet sugar, drinking water, and fast food play a role in the incidence of appendicitis and have a significant relationship. He adds that Sirajet et al. (2022) research states that a high-fiber diet is a protective factor against acute appendicitis.[74-77]

4.1.12 sign and symptoms

This study showed that most of the patients gradually (64%), right iliac fossa abdominal pain (61%) with anorexia (76%); this result of our study shows similar results to the study of Andresson et al., Ohle et al., and Bhangu et al.[78-81]

5.1 CONCLUSIONS

From our study, we conclude that.

1- Males are at greater risk than females for developing appendicitis and there is a significant difference between them.
2- People who are less than 35 years old are at increased risk of acute appendicitis.
3- Having a family of acute appendicitis is risky for getting appendicitis.
4- Being overweight is a risk factor for developing acute appendicitis.
5- There is a significant association between smoking and acute appendicitis.
6- Low fiber intake is risky for appendicitis.
7- Comorbidity conditions and medication with immune suppression can increase acute appendicitis.

5.2 Recommendations

1- people who are young and less than (35 years) of age and those with first-degree relatives who had acute appendicitis in the past should take caution about any pain in the abdomen and right lower quadrant as it may indicate acute appendicitis to be carefully followed and investigated.
2- controlling modifiable risk factors for acute appendicitis, such as smoking, low fiber diet, and body weight, is particularly important in a sedentary life.
3- Further studies are needed to explored more possible risk factors couldnot been studied such as seasonalvariation

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