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Seasonal variation of acute appendicitis in Erbil province

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Saman Taher Barzinjy [1*] Balen Salah Koyee [2]

Abstract

Background and objective: Acute appendicitis is the commonest surgical emergencies present throughout all months of the year, but some particular months are associated with higher rates of its incidence. A seasonal pattern of appendicitis with a mostly predominant peak is seen during the summer months in most countries. The aim of this study is to analyze the current knowledge and controversies related to seasonal variability of acute appendicitis in Erbil city.

Methods: A search was conducted using Microsoft Access version 2010, which includes all of the case data from East Erbil Emergency Hospital from March 2, 2010, to November 17, 2021. Some of the patients were eliminated from the study in order to control the incidence of acute appendicitis by season and year.

Results: In this retrospective study, the ages of the patients included were between 1 – 92 years, with a mean age and SD of 24.74 ± 12.29 years, the gender distribution was (56.9%) male and (43.1%) female, in extreme age groups only 316 cases recorded, the most common age group affected by acute appendicitis was teenagers (36.23%), Maximum number of cases presented during summer period (1713 cases, 28.08%) particularly June. while autumn season has least incidence (1293 cases, 21.2%) especially November.

Conclusion: The exact cause of seasonal variation of the incidence of acute appendicitis is still unclear, further studies are necessary to determine the association between seasonal occurrence of acute appendicitis and these factors.

Keywords: Appendicitis periodicity; Seasonal appendicitis; Variation of seasonal appendicitis.

Introduction

Acute appendicitis (AA) is the most common surgical emergency presenting to the emergency department and emergency hospitals.[1,2] Making appendectomy to be one of the most common operations done in the emergency departments and hospitals worldwide.[3] The lifetime risk for AA is defined as 7%.[4] Other researchers estimated that the prevalence of this disease is 28.6%.[5] According to global research, approximately 7% of people will have an appendectomy because they have acute appendicitis at some point in their lives. On the other hand, over 250,000 appendectomy procedures are carried out each year in the US alone.[6]

The incidence of acute appendicitis is variable according to sex, race, food culture, geographical region, country, age, and seasons.[7] It is found that the second, third and fourth decades of life are the most common ages of patients affected by acute appendicitis during their life reporting that a mean age is 31.3 years and 22 years as a median age.[8] Consistently, other report has estimated that in infancy lives, acute appendicitis is relatively rare disease, and it becomes increasingly more common in childhood period and early

[1] Department of Surgery, Faculty of General Medicine, Koya University, KOY45, Kurdistan Region, Iraq.
[2] Department of General Surgery, College of Medicine, Hawler Medical University, Erbil, Kurdistan Region, Iraq
Correspondence: saman.taher@koyauniversity.org

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adult life, reaching a peak incidence in the adolescence period and early third decade of life. Showing that there is approximately equal incidence of acute appendicitis among males and females before the age of puberty.[9] equal rate of incidence between male and female has been reported in another study.[10]

The exact cause of acute appendicitis is not well understood. Environmental factors have been implicated in the causation, including months of summer season, allergens, dust and air pollution.[11] Different studies have been done to determine the seasonal variation and periodicity of acute appendicitis but with variable results.[12] The exact cause determining that why acute appendicitis cases increase in summer season more than other seasons is still not clear, many extrinsic factors such as Relative humidity, travel,[4] air pollution,[13] Smoking,[14] gastrointestinal infection,[15] mechanical obstruction, familial susceptibility And low fiber diet,[11] are thought to play roles in the etiology. However a lot of epidemiological studies on appendicitis have been conducted, but most of these studies have concentrated on Western worlds,[16] in contrast, few epidemiological studies have concentrated on acute appendicitis among Asian populations. The epidemiological features and lifetime risk of acute appendicitis and appendectomy in South Korea reported by Researchers.[17] These studies were mainly concerned about the monthly variation in the incidence of acute appendicitis.

The incidence of acute appendicitis is raised in some ethnic groups and complications are increased in minorities of them, this mostly related to lack of access to healthcare. The severity of acute appendicitis cases are divided into non-perforated (simple) and complex (perforated, gangrenous, and pelvic or intra -abdominal abscess).[18]

In a study performed in two cities with variation in their altitudes and climatic characteristics in Turkey, acute appendicitis was more commonly recorded in the summer months in that city having lower altitude and more commonly seen in the winter months in that city having higher altitude.[19]

Another study has been performed in Manama-Bahrain which is situated in archipelago area in the Arab Gulf with an arid climate, assumed that the year in that region is divided only into two main seasons: summer (June-September) and winter (December-March). These two seasons separated by two transitional periods: the first started at April and ends in May and the second transitional period started at October and ends at November.[20] Meanwhile the climate in our region to some degree is differing from the mentioned cities and regions in one side and with another climate of Europe and northern part of the world in another side as well.

To our search and knowledge there is no research data about seasonal variation of the incidence of acute appendicitis in Kurdistan and particularly in Erbil city. The aim of the present study is for confirming the possible existence of seasonal variability in the increase the incidence of acute appendicitis in Erbil city-Iraq and compare it with different parts of the world, by describing intensively the data available on the higher incidence of appendicitis throughout specific months and seasons of the year and by summarizing the critical sequences that need to be expressed for clinical presentations of acute appendicitis at the variable times of the year. The diagnosis of the reasons for seasonal variation of the disease may help us to search for the possible preventive measures to prevent or at least to decrease incidence of this disease which is regarded as a commonest surgical emergency and it will cost of billions of dollars yearly all over the world.

Methods

To examine our locality trends in the seasonality of appendicitis, by this retrospective study we reviewed the data

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recorded in Rojhalat Emergency Hospital, located inside Erbil City, Capital of Kurdistan Region- Iraq, from the period of 2nd March 2010 (day of the opening and receiving first case) to 17th November 2021, the file contained the necessary relevant information about all cases including, file number, triple name of the patients, age, sex, occupation, presentation features, responsible physician and surgeon, diagnosis, date of admission and date of discharge, we focused on the cases confirmed for the diagnosis of acute appendicitis throughout full history taking, clinical examinations and investigations such as urine analysis, CBC, and ultrasound scan, the study included those patients underwent operations for acute appendicitis and those treated conservatively for catarrhal appendicitis especially for unfit patients or because of the development of appendicular mass as well, those cases of initial suspicion of acute appendicitis and the final diagnoses of other pathologies and other differential diagnose such as complicated ovarian cysts, ureteric colicks, meckle's diverticulitis, rupture ectopic pregnancies, pelvic inflammatory diseases, colonic mass, urinary tract infections ….etc. excluded from the study, the file used in our study reported case data in days as well (day, month, year). We divided the patients to different age groups (0-9, 10-19, 20-29, 30-39, 40-49, 50-59 and more than 60) and to seasonal group (winter, center and its town and rural areas) and some surrounding cities, seasons were center and its town and rural areas) and some surrounding cities, seasons were defined based on their occurrence in the Kurdistan region – Iraq: Winter (21st December- 20th March), Spring (21st March - 20th June), Summer (21st June-20th September) and Autumn (21st September-20th December), for better and more accurate results the cases before 21st march 2010 (7 cases) and cases after 20th March 2021(77 cases) were excluded from the study .

The file contained 7294 cases, 7 and 77 cases admitted before 21st March 2010 and after 20th March 2021 respectively and they excluded from the study, the remaining cases were 7210 cases included for gender and age groups with month variations of affection by acute appendicitis, for the purpose of season regulation and organization only 6101 cases who diagnosed as acute appendicitis between the period of 1st January 2011 and 31st December 2020 included in the study (for seasonal variation and annual incidence). Microsoft excel version 2010 used for data entry and statistical analysis.

Results

In this retrospective study, the ages of the patients included were between 1 – 92 years, with a mean age and SD of 24.74 ± 12.29, the gender distribution were 4102 (56.9%) cases male and 3108 (43.1%) female (Figure 1)

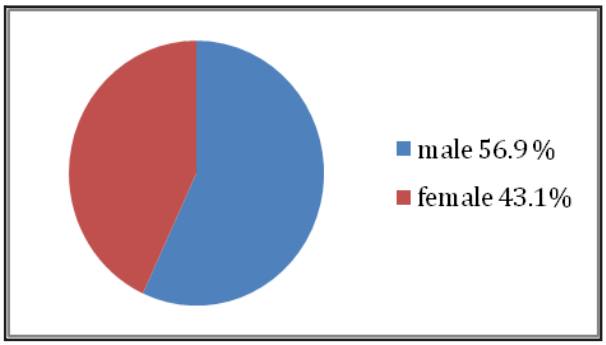

Figure 1 (A) Bar chart of the monthly diagnosed cholera cases in Erbil. (B) The pie chart represents gender distribution of the diagnosed cholera case.

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Age group classification and sex among in each age group was as follows (Table 1).
In extreme age groups (less than 10 years and more than 60 years) only 135 (1.87%) and 181 (2.51%) cases recorded respectively, the most common age group affected by acute appendicitis was teenagers (36.23%) followed by the age of third decade of life with slight difference (35.55%), the remaining (8.38%) were distributed between the age of 40 – 59 years age groups, only among extreme age groups (less than 10 and more than 60 years) there is slight female predominance (52.6% Vs. 47.4% and 50.83% Vs. 49.17% respectively), meanwhile significant male predomination observed in all other age groups particularly for third decade age and teenagers (60.43% Vs. 39.57% and 56.81% Vs. 43.19% respectively), (Figure 2).

Table 1 Gender distribution by age

Age group	Male No (%)	Female No (%)
less than 10 y	64 (47.4)	71 (52.6)
10-19 y	1484 (56.81)	1128 (43.19)
20-29 y	1549 (60.43)	1014 (39.53)
30-39 y	583 (52.28)	532 (47.72)
40-49 y	227 (53.28)	199 (46.72)
50-59 y	106 (59.55)	72 (40.45)
more than 60 y	89 (49.17)	92 (50.83)
Total	4102 (54.14)	3108 (45.86)

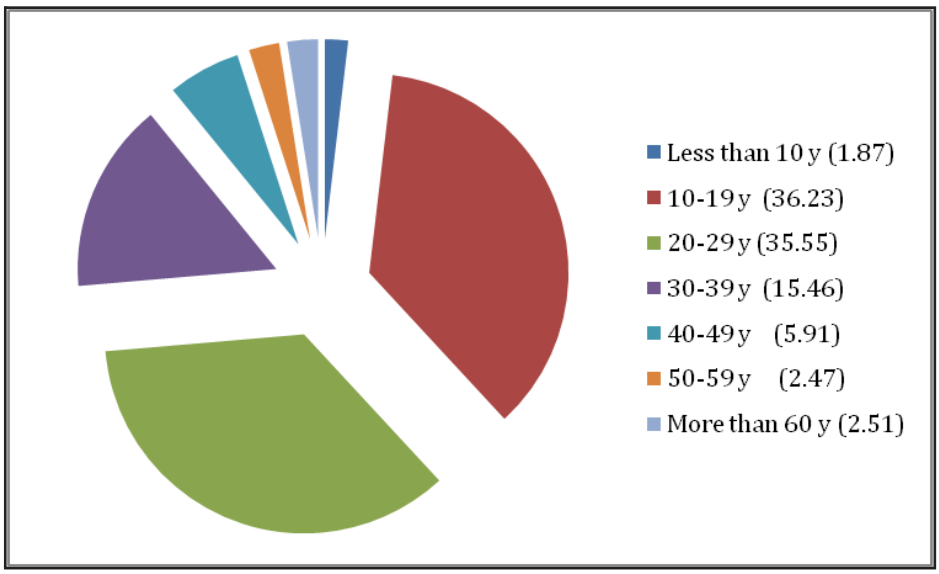

Figure 2 Distribution and percentage of the patients according to age groups

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Maximum incidence of acute appendicitis observed during June, followed by May and July with very slight difference between the two latter, meanwhile two of autumn months (November and October) recorded the minimum incidence (Figure 3).

Maximum number of case record observed in 2012 (991 cases), followed by 2013 (830 cases), with minimum case admission observed for acute appendicitis in 2015 and 2019 (305 and 406 cases respectively) (Table 2).

Table 2 Patients distribution among years

Year	No	%
2010	467	6.48
2011	751	10.42
2012	991	13.74
2013	830	11.51
2014	647	8.97
2015	305	4.23
2016	474	6.57
2017	632	8.77
2018	460	6.38
2019	406	5.63
2020	605	8.39
2021	642	8.90
Total	7210	100.00

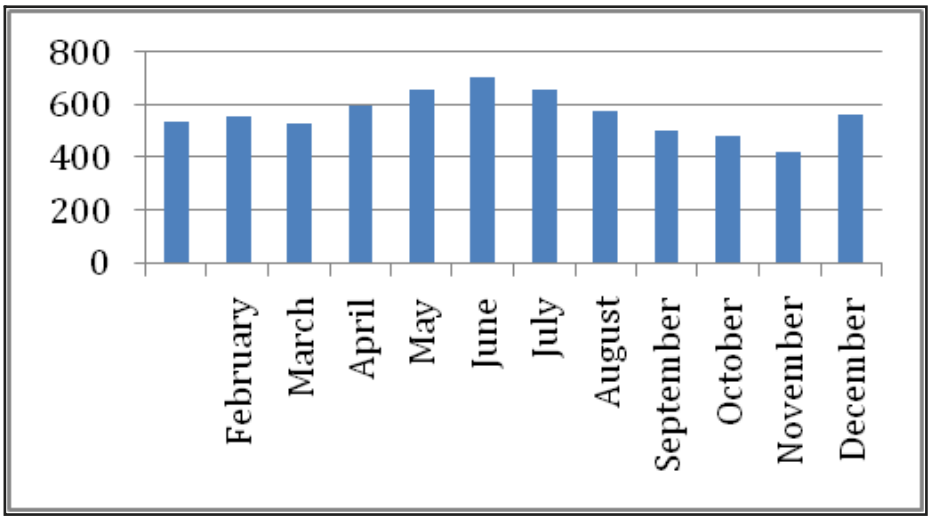

Figure 3 Variation of acute appendicitis according to months of year

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Maximum number of cases of acute appendicitis presented to the hospital during summer period (Table 3) (1713 cases, 28.08%) particularly June, followed by spring (1609, 26.37%), while autumn season has least incidence (1293 cases, 21.2%) especially November (Figure 3).

Discussion

The peak incidence of acute appendicitis was found in summer months and the lowest incidence rate in winter months, this is observed again in our study by finding of low incidence rate in November and highest in May and July (Figure 3).

The exact explanation for raising the incidence of acute appendicitis during the warmer times are unclear but various speculations have been made such as, the effects of diet, humidity, infections, changes in atmospheric pressure or dehydration. Imre et al.[21] conducted a study at Finland in different centers they found clear relation between seasonality of acute appendicitis and increased incidence in Summer season same risk factors are present in our region for the development of acute appendicitis. Babita et Al.[22] conducted a study in India for about 10 years (between January 2003 and July 2012). A total of 395 cases were involved. The cases recorded with maximum number in the August, this is nearly in concordance with our results that showed data for about 11 years (2010-2021)with highest incidence during July, in our region July and August are very hot and human are more liable for dehydration, late Spring season (May) also has more incidence of acute appendicitis because of the allergens and warm periods of the year. Lin et al.[23] conducted another study in 2015 in Taiwan estimating that highest incidence of acute appendicitis occurs among young populations between the ages of 15 and 29 years; higher rates of acute appendicitis found in male than female patients at all age groups except for the age group of more than 70 years, our study results confirmed these results, since the teenagers and third decade age group contribute about 72% among all age groups (Table 1 and Figure 4), other concordance result of our study is male predomination among all age groups except for the extreme ages (less than 10 and more than 60) showing very slight female predominance (52.6% Vs. 47.4% and 50.83% Vs. 49.17% respectively), (Figure 1 and 2, Table 1), Acute appendicitis incidence rates were 11.76 % more in the summer than in the winter months,[23] this percentage in our study found to be about 15.3% between Summer and Winter and 32.4% between Summer and Autumn (Figure 3 and Table 3) .

This review reveals the facts that the seasonal variation of acute appendicitis in most the subject countries is prevailing throughout the summer season,[24]nearly the same results estimated in our study with the presence of the same risk factors as increased the fast-food restaurants, sweet shops, and low fiber diets during trip periods of spring and Summer in Kurdistan

Table 3 distribution of the number and percentage of the patients among seasons

Season	No.	%
Winter	1486	(24.35)
Spring	1609	(26.37)
Summer	1713	(28.08)
Autumn	1293	(21.2)
Total	6101	(100%)

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region. We can hypothesize that consuming large number of sweets and sugar content diets in combination of a low fiber diet can cause infrequent bowel motion and increase exposure of the bowel to infection, which in turn leads to acute appendicitis. However, more studies are necessary to answer the trends in the incidence of acute appendicitis among populations who are on traditional diet eating with both low and high fiber content as well as sugary and sweets diets.

Lowest incidence rate of acute appendicitis in the spring months has been observed in contrast to the highest incidence during summer season, this will confirm significant seasonal variation. This is consistent with the findings of other studies, in contrast to our study of the high incidence of the disease in spring which is next in highest incidence after summer season.[25]

There is wide range of difference in sex incidence in our study (Male 56.9% Vs. Female 43.1%)(Figure 1) in compare to a study in which strong male predominance has been observed and accounting for 77.4% of the study.[26]In our region however there is no well-known sandstorm time but sometimes it may happen during summer and late spring that may be contributed to the higher incidence of acute appendicitis during the mentioned seasons in our study. In other areas like Turkey, Nigeria, certain parts of the United Kingdom and United States the various findings were observed. For example, appendicitis was more common in Nigeria throughout the rainy season, which is well known period for allergens, humidity, and higher rates of viral, bacterial and intestinal parasitic infestations,[27] apart from rain and humidity, viral and bacterial agents with allergens may be linked to the causation of acute appendicitis in our study.

Another study has been conducted in Taiwan on pediatric age group, it was observed that the percentage of cases affected by acute appendicitis with the presence of fecoliths in summer was less than other seasons and this was because of lymphoid hyperplasia which may be related to the outbreak of enterovirus throughout this season of the year.[28] Zhang et al. suggested that acute appendicitis among pediatric age groups were associated with less sunshine, lower humidity and higher temperatures.[29] Studies have suggested Dietary habits, role for dehydration and less bowel movement might be related to the increased incidence of acute appendicitis during summer.[30] however in our study only 1.87% of the cases were below age of 10 years (Table1), this little recorded number and percentage of acute appendicitis in our study is due to the presence of a special hospital for pediatric age group in our city where they will receive and manage most of the pediatric surgical cases, this little number of the acute appendicitis cases recorded in our study will needs further evaluation and study among this age group by pediatric surgeons and pediatric hospitals.

Another key factor suggested by Fares is the role of infectious agents in the causation of acute appendicitis that leads to lymphoid hyperplasia and in turn luminal obstruction. Peak of infection in Summer found in some countries is due to microbial agents such as Salmonella, Campylobacter, Entamoeba histolytica, Escherichia coli, Trichuris trichiura, Ascaris lumbricoides, Strongyloides stercoralis Enterobius vermicularis, and Taenia saginata,[15] higher acute appendicitis incidence in our study in summer almost related to the mentioned pathogens.

It is estimated that the incidence of acute appendicitis is high through spring months between February and May, and found that this seasonal density may be related to some seasonal environmental causes, such as allergic reaction to pollen release or non-specific viral infections, because of the same reasons availability in our region and study spring season also has high incidence rate. A Japanese study in the literature found a statistically significant increase in atmospheric pressure in the

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two weeks before the diagnosis of female patients in their third decades of lives. High atmospheric pressure leads to clear air and patients are more likely to go out from their homes to spend time outside when the weather is clear and nice. Hence, the effects of high atmospheric pressure may lead to higher diagnostic rates because of more medical consultations for the presentation of the features of acute appendicitis.[31]

In Nigeria as a tropical region, a study was conducted, in tropical and subtropical regions; it is more common to speak of the dry season versus the rainy, wet or monsoon season. The winter (rainy season) started from March and ends in October, while summer (dry season) starts in November and ends in March,[32] meanwhile year in our region is divided to four seasons, each season includes three months, however some months of spring and autumn are hot like summer months, we can say that May and first three weeks of June are part of spring and last 10 days of September with October are within autumn season but most of the times they are hot period as same as summer season. As same as the other studies done, the exact cause behind the reason why acute appendicitis cases is more reported in summer months than other seasons in this study is still not clear, but several extrinsic factors such as, gastrointestinal infection, low fiber diet and air pollution, during summer months could have roles of the higher incidence of acute appendicitis.

Conclusion

Seasonal variability of acute appendicitis is quite clearly demonstrated by the epidemiological data; showing mostly a peak during the summer months. The exact cause behind the reason why acute appendicitis cases are more reported in summer months than other seasons is still not clear, several extrinsic factors such as, gastrointestinal infection, low fiber diet and air pollution, during summer months could have roles of the higher incidence of acute appendicitis. Further prospective and retrospective studies are necessary so as to more accurately determine the possible association between seasonal occurrence of acute appendicitis and these factors. Trial should be done to minimize the modifiable risk factors of acute appendicitis so as to decrease its incidence, and in turn decrease the surgical intervention, complications, morbidities, mortalities and the costs of the intervention as well.

Competing interests

The authors declare that they have no competing interests.

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