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ORIGINAL ARTICLE

Epidemiological aspects of patients underwent appendectomy in Birjand, Iran, from May 2017 to 2019

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Abstract

Introduction: Appendectomy is one of the most performed surgeries worldwide. There are lots of factors involved in the incidence of appendicitis, and most of them vary among populations. Therefore, the present study aimed to evaluate the epidemiological aspects of appendicitis in Birjand, Iran, for the first time.

Methods: This prospective study included 666 cases out of 673 acute appendicitis patients treated surgically in Imam Reza Hospital in Birjand, Iran, from May 2017 to 2019. The data were analyzed regarding gender, age groups, and season in SPSS software (version. 22) using a t-test and the Chi-square test. A p-value less than 0.05 was considered statistically significant.

Results: The annual incidence of acute appendicitis in Birjand was 12.74 per 10.000 population with the mean age of 25.43±14.97 years. The highest frequency of appendectomy was observed in 11-20-year-old groups (32.1%) and then in 21-30-year-old groups (27.3%). The frequency of the appendectomy was higher in male than female (P=0.005), and the peak of the surgeries was in the summer. Moreover, the majority of the admitted patients in the summer were male (n=123), whereas the frequency of female patients in the autumn was higher than that of male (n=81). The most frequent pathological diagnosis in both genders was acute gangrenous appendicitis (i.e., 44% in female and 40% in male). Furthermore, the incidence rates of advanced stages of appendicitis, such as "acute supportive appendicitis and periappendicitis" and "acute supportive appendicitis and priappendicitis with perforation" were significantly higher in male than female (P<0.05).

Conclusions: The findings of this study provide basic epidemiological information for the first time regarding appendicitis status in Birjand, Iran. Since the appendicitis was more frequent among youth and was more complicated in male, it is essential to inform these target groups about the signs and symptoms of this medical emergency.

Key words: Age, Appendicitis, Epidemiology, Incidence, Seasons

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Introduction

Appendicitis is one of the most common clinical conditions accounts for referral of patients to the hospital (1). Despite advances in therapeutic and diagnostic techniques, acute appendicitis remains a clinical emergency and is one of the most common causes of acute abdominal pain (2). The early diagnosis of this disease is very important and challenging. In case of latency in diagnosis, serious complications, such as perforation, peritonitis, and sepsis may occur, which even might lead to death (3-5).

Since the first description of appendectomy by Fitz in 1886 as a lifesaving treatment for acute appendicitis, this surgical technique has remained the gold standard for the treatment of this disease (6). Nowadays, the surgical treatment of this condition is well developed and widely performed worldwide; however, the etiology of this medical emergency is yet little developed (7). Appendectomy is one of the most common surgical procedures in the world. More than 300000 appendectomy procedures are performed in the United States (US) each year (8).

In England, approximately, one in seven people may expect to undergo appendectomy at some time in his/her life (1). Some studies have shown that the lifetime risk of appendectomy procedure is 11 per 10,000 population in the US and the most affected group is between the ages of 10 and 19 years (9). Therefore, appendicitis as a costly problem imposes huge budgeting directly or indirectly on the health care systems (7). The incidence rate of acute appendicitis has been reported to vary based on several factors, such as country, racial/ethnic differences, geographic regions, age, gender, season, diet, occupation, and socioeconomic levels; however, the reasons for this variation are still unknown (10).

Appendicitis has shown different incidence rates over the past decades in different countries. In the late 19th century, the incidence rate of this condition was high in Western countries which decreased in the mid part of the 20th century. On the other hand, the incidence rate of appendicitis was very low in developing countries in the 20th century; however, it increased dramatically at the beginning of the 21st century (11). Information from epidemiological studies is used to plan new health services and evaluate the overall health status of the population.

With this background in mind, it is necessary to understand the epidemiological feature of appendicitis in each part of the world to develop plans for healthcare resource utilization. In spite of numerous studies that have been carried out regarding different aspects of appendicitis in the world, to the best of our knowledge, few studies have been conducted on the status of appendicitis in different parts of Iran. Moreover, there is a dearth of research regarding appendicitis and appendectomy in Birjand, Iran. One of the most striking epidemiologic features of appendicitis is the marked variation in incidence rates by geographic area. Currently, our knowledge about acute appendicitis is largely based on studies which carried out in other countries. Therefore, this study aimed to investigate the epidemiological aspects of acute appendicitis in patients who underwent appendectomy in Imam Reza hospital in Birjand, Iran, from May 2017 to 2019.

Methods

This cross-sectional, prospective study was carried out in the surgical ward of Imam Reza Hospital affiliated to Birjand University of Medical Sciences, Birjand, Iran, from May 2017 to 2019. The study protocol was approved by the Ethical Committee of Birjand University of Medical Sciences, Birjand, Iran (IR.BUMS.REC.1398.090).

The inclusion criteria were 1) pathologically approved cases, 2) residency in Birjand, and 3) participants' or parents' (for the cases lower than the legal age of 18 years) willingness to participate in the study. On the other hand, the participants from other cities, those who were unwilling to participate in the study, and the patients with pathologically unapproved appendicitis were excluded from the study.

During the research procedure, a total of 673 appendectomy surgery were performed out of which 666 cases met the inclusion criteria.

The routine process for hospitalization and surgery is as follows

Firstly, each patient receives a hospital code and his/her demographic characteristics, including age, gender, occupation, educational status, and living area are asked and recorded in special forms. Subsequently, the cases are examined by an emergency medicine specialist or an on-call surgeon. The cases whose acute appendicitis is confirmed based on the clinical symptoms using Alvarado Scoring System are selected for an emergency appendectomy. Alvarado constructed a scoring system in which the scores 1-4, 5-6, 7-8, and 9-10 represent unlikely appendicitis, possible appendicitis, acute appendicitis, and definitive appendicitis, respectively (Table 1). Eventually, the participants are surgically treated. After surgery,

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the removed tissue is histologically examined to confirm acute appendicitis and determine an exact pathological diagnosis.

The data obtained from the participants who met the inclusion criteria were noted and used in the present study. All patients were grouped according to age, gender, and season of operation. The frequency of acute appendicitis was tested in each category. Moreover, continuous variables were expressed as mean±SD, and their association was tested using a t-test and the Chi-square test. The data were analyzed in SPSS software (version 22). A P-value less than 0.05 was considered statistically significant.

Results

During the research procedure, (i.e., from 2017 to 2019) 673 patients underwent appendectomy operation; however, seven patients were excluded from the study due to not meeting the inclusion criteria. The incidence rate of appendicitis in urban and rural areas of Birjand, Iran, was 12.74, per 10000 population per year. The mean age of the patients was 25.43±14.97 year (age range: 4-87 years). In total, 79% of the patients lived in the urban area, whereas 21% of them lived in rural and suburban areas. Regarding the occupational status, the majority of the patients were students (54.8%) and self-employed (22%). Moreover, most patients had educational degrees less than high-school diploma (38.9%) and 26.8% of them had a high-school diploma or its equivalent.

With respect to the mean age, there was no statistically significant difference between males (25.52±14.87 years) and females (25.30±15.09 years) (P=0.29, Table 2). In addition, the mean age of urban living patients (24.43±14.22 years) was significantly lower than those living in rural and suburban areas (29.45±17.98 years; P<0.001). The results obtained from the present study showed that out of 666 patients who underwent appendectomy, 350 cases (52.66%) were male (Table 3). Moreover, the age group of 11-20-year-olds obtained the highest frequency of appendectomy (i.e., 32.1%-32.3% in female and 32% in male) followed by the age group of 21-30

Table 1: Alvarado scoring system as an aid for diagnosing acute appendicitis

	Variables	Score
Symptoms	Migratory right iliac fossa pain	1
	Nausea / Vomiting	1
	Anorexia	1
Signs	Tenderness in right iliac fossa	2
	Rebound tenderness in right iliac fossa	1
	Elevated temperature	1
Laboratory findings	Leucocytosis	2
	Shift to left of Neutrophils	1
Total	-	10

Table 2: Comparison of the mean age of patients regarding gender and living area

	Categories	Age mean±SD	P-value
Gender	Male	25.52±14.87	0.29
	Female	25.30±15.09	
Living area	Urban	24.43±14.22	<0.001*
	Rural and suburban	29.45± 17.98	

* Independent t-test showing differences at significant level of 0.05

Table 3: Frequency of appendicitis regarding age and gender

Age groups	Female N (%)	Male N (%)	Total N (%)	P-value
0-10	42 (13.3)	40 (11.4)	82 (12.3)	
11-20	102 (32.3)	112 (32.0)	214 (32.1)	
21-30	78 (24.7)	104 (29.7)	182 (27.3)	
31-40	47 (14.19)	47 (13.4)	94 (14.1)	0.77
41-50	24 (7.6)	23 (6.6)	47 (7.1)	
≥51	23 (7.3)	24 (6.9)	47 (7.1)	
Total	316 (47.44)	350 (52.55)	666 (100)	

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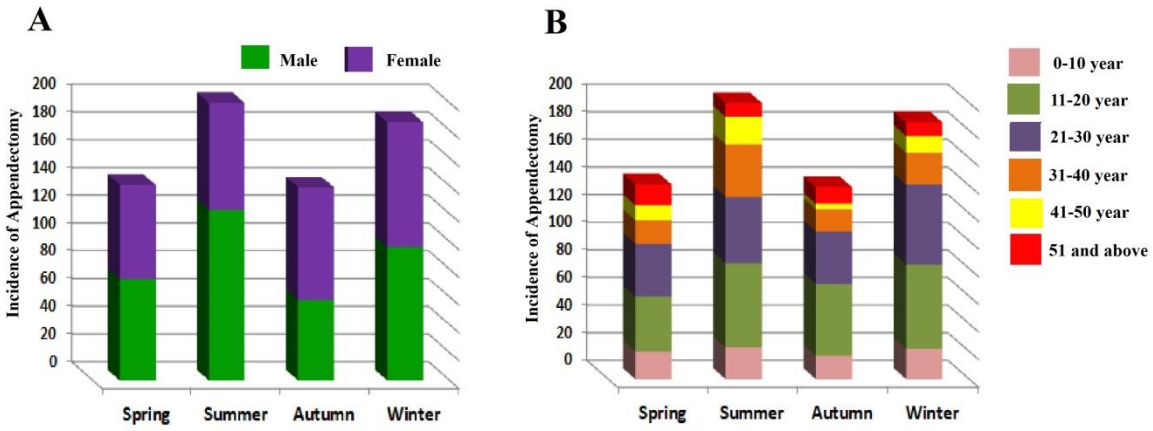

Figure 1: Seasonal variation of appendicitis regarding gender (A) and age groups (B)

Table 4: The frequency (%) of pathological diagnosis regarding gender and age groups

		Diagnosis						P-value
		1 N (%)	2 N (%)	3 N (%)	4 N (%)	5 N (%)	6 N (%)	
Gender	Male	39 (12%)	96 (29.5%)	35 (10.7%)	123 (37.7%)	27 (8.3%)	6 (1.8%)	0.019*
	Female	26 (8.7%)	73 (24.3%)	14 (4.7%)	131 (43.7%)	46 (15.3%)	10 (3.3%)	
Age	0-10	12 (15%)	19 (23.8%)	4 (5%)	32 (40%)	10 (12.5%)	3 (3.7%)	0.014*
	11-20	21 (10.5%)	51 (25.5%)	4 (2%)	84 (42%)	34 (17%)	6 (3%)	
	21-30	15 (8.7%)	54 (31.2%)	12 (6.9%)	75 (43.3%)	15 (8.7%)	2 (1.2%)	
	31-40	5 (5.7%)	24 (27.6%)	10 (11.5%)	37 (42.5%)	10 (11.5%)	1 (1.2%)	
	41-50	9 (20.9%)	7 (16.3%)	12 (27.9%)	11 (25.6%)	1 (2.3%)	3 (7%)	
	≥51	3 (7%)	14 (32.5%)	7 (16.3%)	15 (34.9%)	3 (7%)	1 (2.3%)	
Total		65 (10.4%)	169 (27%)	49 (7.8%)	254 (40.6%)	73 (11.7%)	16 (2.5%)	626 (100)

* Chi-square is significant at 0.05 significant level.
Diagnosis; 1:Reactive follicular hyperplasia, 2:Acute supportive appendicitis and priappendicitis, 3:Acute supportive appendicitis and priappendicitis with perforation, 4: Acute gangrenous appendicitis and priappendicitis, 5: Early acute appendicitis, and 6: Other (including fibrotic appendix with serosal congestion, fecal impaction and serosal congestion, necrotic tissue with chronic inflammation, appendiceal neuroma and oxyuriasis

years (i.e., 24.7%-27.3% in female and 29.7% in male). However, no significant difference was observed between males and females regarding the proportion of patients in age categories (P=0.77).

The results of seasonal variation based on gender or age groups are illustrated in Figure 1. Generally, most of the surgeries were performed in the summer (i.e., August or Mordad and Shahrivar). Moreover, a statistically significant difference was observed between genders in terms of the frequency of the seasonal appendectomy (P=0.005, Figure1A). The majority of the admitted patients in the summer were male (n=123), whereas the frequency of female patients in the autumn was higher than that of male (n=81). However, there was no statistically significant association between the age groups and season regarding the frequency of appendectomy (P=0.15, Figure1 B).

Table 4 tabulates the frequency of pathological diagnosis. Accordingly, the most frequent diagnoses were acute gangrenous appendicitis and periappendicitis (40.6%). There was a statistically significant association between gender and diagnosis types (P=0.019). In both genders, the most frequent diagnosis was acute gangrenous appendicitis (37.7% in female and 43.7% in the male). However, the frequency of "acute supportive appendicitis and priappendicitis" (29.5% in male, 24.3% in female) and "acute supportive appendicitis and priappendicitis with perforation" (10.7% in male, 4.7% in female) were higher in males; nonetheless the incidence of "early acute appendicitis" (8.3% in male, 15.3% in female) was lower in male than that in female.

Furthermore, a statistical relationship was observed between age groups and the types of pathological diagnosis (P=0.014). In all age groups, the most abundant pathological diagnosis was "acute gangrenous appendicitis and priappendicitis"

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(25.6-43.3%). The highest frequency of both "reactive follicular hyperplasia" and "early acute appendicitis" categories was observed in the 11-20-year-old participants. Moreover, "acute supportive appendicitis and priappendicitis with perforation" were mostly reported among patients in the 21-50 age group.

Discussion

To the best of our knowledge, this study is the first attempt to investigate the incidence rate of appendectomy in Birjand, Iran. According to the report of the statistical center of Iran, the total urban and rural population of Birjand was 261,324 in 2016 (12). Since the appendicitis patients who underwent appendectomy were 666 cases in two consecutive studied years, the annual incidence of this disease was 12.74 per 10,000 population.

Unfortunately, no study was conducted to report the annual incidence rate of appendicitis in Iran. The majority of the studies performed in Iran has not estimated the incidence rate of appendicitis. The annual incidence of appendicitis in the rural population of Maharashtra state, India, was 30.18, 40.17 and 30.85 per 10,000 population in three consecutive studied years, respectively, which was significantly higher than that in this study (13).

Lin et al. (2015) analyzed epidemiological features of appendicitis in Taiwan from 2003 to 2011. They reported that the overall incidence rate of appendicitis was 13.95 per 10,000 population per year in this country which was also higher than that in the present study (14). Based on a meta-analysis carried out by Ferris et al. (2017) throughout the 21st century, the incidence rate of appendicitis in North America stabilized and was estimated 10 per 10000 people/year (11). The incidence rate of this condition varies in Europe with the highest (15.1 per 10000 population/year) and lowest (10.5 per 10000 population/year) rates in Western and Eastern Europe, respectively. On the other hand, the incidence rate of this clinical emergency is increasing in many industrialized countries of Asia, Middle East, Southern America, and Africa (11).

The incidence rate of appendicitis in Birjand, Iran, was slightly higher than that in some European countries and US which might be due to the young age of half of Birjand's population who are under 35 years of age.

The highest incidence rate of acute appendicitis in this study occurred in the age range of 11-20 years (32.1%) followed by a 21-30-year-old group which included 27.3% of the population. These two age groups totally constituted 71.7% of the cases who were under 30 years of age. In line with the results of this study, Nabipour (2003) reported that the majority of appendicitis cases (76.6%) were under 30 years in Kerman, Iran (15). In a study conducted by Lohar et al. on a rural population in India (2014), the incidence rate of appendicitis was the highest in an 11-20-year-old group which was consistent with findings in this study (13).

The results obtained from a study performed by Rashid Azar et al. (2017) in Babol, Iran, showed that the age range of 21-30 years was the most common age group affected with appendicitis (16). However, Lin et al. (2015) determined the age range of 0-14 years as the most frequent age group (14). The age-specific incidence rate had a different pattern of male to female ratio in this study. Regarding the age group of 21-30 year, the males obtained a higher incidence rate of appendicitis, compared to females (29.7% versus 24.7%), whereas the incidence rate of this condition was higher in females within the age range of 0-10 years (13.3% versus 11.4%). In the other age groups, the male and female were affected equally. Similar to our findings, male to female ratio was highest in the age group of 21-30 years in a study conducted by Lohar et al. (2014) (13).

The most important reason that justifies the higher incidence rate of appendicitis in children and young people is its functional role. The appendix works as a part of the immune system in the early years of life; however, it loses its function with age, especially in the middle ages (17). Therefore, it seems that appendicitis occurs mostly during the period in which the appendix plays a functional role.

Seasonal variation is another important factor in an epidemiological study of acute appendicitis, and numerous studies have been conducted in this regard in different countries (18-22). In this investigation, the most frequent acute appendicitis was observed in the summer and its peak was in August (Mordad and Shahrivar in Solar Hijri calendar). There were differences between genders regarding the frequency of this parameter; accordingly, it was significantly higher in males than females.

In line with the findings in this study, the highest and lowest acute appendicitis rates occurred in the summer (i.e., July, August, and September) and winter (i.e., December), respectively, according to a study performed in California (10). In other studies carried out by Ahmed et al. in Pakistan (2018), Lee

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et al. in South Korea (2010), and Oguntola et al. in South-Western Nigeria (2010), the peak incidence rate of an appendectomy was reported in the summer (18-20).

In contrast to the results in this study, Nabipour (15), and Sulu et al. (2010) (21) reported the highest incidence rate in the winter, and the most frequent appendectomy rate was reported to occur in November and December in Iraq (22). The reasons for the increased incidence rate of appendicitis in the summer are not yet understood. However, several assumptions have been proposed, including the impact of dehydration, bowel movements decreasing, infections or allergens on the reactivity of the lymphoid tissue in the appendix, the effects of diet and humidity, as well as changes in atmospheric pressure (23).

The present study revealed that the most frequent pathological diagnosis was acute gangrenous (42.3%), whereas, in contrast to our finding, this type of diagnosis was 6.1% in a study carried out in India (13). In the aforementioned investigation, the most frequent diagnosis of appendicitis was inflammation (13). In the same line, in a study conducted by Rashid-Azar et al. (2017), suppurative appendicitis was the most common type that was observed on pathological examination (16). In a study performed by Nabipour in Kerman, Iran, and another research in Modarres Hospital, Tehran, Iran, 33.76% and 79.6% of cases were suffering from suppurative appendicitis, respectively, which were different from our findings in this study (5, 15).

Abu ful et al. (2019) designed and conducted a study based on a scale suggested by Ditillo et al. (2006) about appendicitis (24). They classified the patients with acute appendicitis from the onset of symptoms to surgery (25). In their study, the patients were categorized into 4 groups (G), namely G1= simple, G2= phlegmonous, G3= gangrenous, and G4= perforated appendicitis. They concluded that the time elapsed from the onset of the symptoms to appendectomy correlated with increased pathology grade and complication rate (25). Vejdan et al., who also reported previously that around 21% of appendicitis patients underwent appendectomy in Birjand, presented the complicated form of this emergency which highlighted the need to raise the physicians' and patients' awareness about the signs and symptoms of this condition (26). Based on the results of the aforementioned study and due to the gangrenous type of appendicitis in the most cases in this study, the long delays between onset of symptoms and patients' referral to the hospital need to be reduced and prevented.

Conclusions

The findings of this study provide basic epidemiological information regarding appendicitis status in Birjand, Iran, for the first time. There are similarities and differences between this study and other previous research; however, the dissimilarities can be considered in further analytical studies. The findings can also be useful for surgeons and health care managers. Based on the findings of the present study, the most affected age group was in 11-20 years age group most of whom were students; accordingly, it is of utmost importance to raise the students' awareness in this area which might be useful in early detection of acute appendicitis. This study is the first step towards enhancing our understanding of acute appendicitis status in Birjand, Iran. Further studies are required to explain the risk factors of this condition in this area.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of the study.

References

1. Ashley DJ. Observations on the epidemiology of appendicitis. Gut. 1967; 8(6):533-8. PMID: 6079804 DOI: 10.1136/gut.8.6.533
2. Yazar AS, Erdoğan S, Şahin C, Güven Ş. Reliability of ultrasonography and the Alvarado scoring system in acute appendicitis. Turk J Pediatr. 2018; 60(2):173-9. PMID: 30325124 DOI: 10.24953/turkjped.2018.02.009
3. Hall NJ, Kapadia MZ, Eaton S, Chan WW, Nickel C, Pierro A, et al. Outcome reporting in randomised controlled trials and meta-analyses of appendicitis treatments in children: a systematic review. Trials. 2015; 16(1):275. PMID: 26081254 DOI: 10.1186/s13063-015-0783-1

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4. Ross MJ, Liu H, Netherton SJ, Eccles R, Chen PW, Boag G, et al. Outcomes of children with suspected appendicitis and incompletely visualized appendix on ultrasound. Acad Emerg Med. 2014; 21(5):538-42. PMID: 24842505 DOI: 10.1111/acem.12377
5. Malekpour N, Basharat S, Bakhshi T. Negative appendectomy rate during 5 years in Modarres Hospital of Tehran, Iran, and correlation with imaging. J Analyt Res Clin Med. 2018; 6(2):98-101. doi: 10.15171/jarcm.2018.015
6. Fitz RH. Perforating inflammation of the vermiform appendix. Am J Med Sci. 1886; 92:321-46.
7. Addiss DG, Nathan S, Fowler BS, Tauxe RV. The epidemiology of appendicitis and appendectomy in the United States. Am J Epidemiol. 1990; 132(5):910-25. PMID: 2239906 DOI: 10.1093/oxfordjournals.aje.a115734
8. Mason RJ. Surgery for appendicitis: is it necessary? Surg Infect. 2008; 9(4):481-8. PMID: 18687030 DOI: 10.1089/sur.2007.079
9. Buckius MT, McGrath B, Monk J, Grim R, Bell T, Ahuja V. Changing epidemiology of acute appendicitis in the United States: study period 1993–2008. J Surg Res. 2012; 175(2):185-90. PMID: 22099604 DOI: 10.1016/j.jss.2011.07.017
10. Luckmann R, Davis P. The epidemiology of acute appendicitis in California: racial, gender, and seasonal variation. Epidemiology. 1991; 2(5):323-30. PMID: 1742380 DOI: 10.1097/00001648-199109000-00003
11. Ferris M, Quan S, Kaplan BS, Molodecky N, Ball CG, Chernoff GW, et al. The global incidence of appendicitis: a systematic review of population-based studies. Ann Surg. 2017; 266(2):237-41. PMID: 28288060 DOI: 10.1097/SLA.0000000000002188
12. Population and housing census of Iran in 2016. The Statistical Center of Iran. Available at: URL: https://www.amar.org.ir/english/Population-and-Housing-Censuses/Census-2016-Detailed-Results; 2019.
13. Lohar HP, Calcuttawala MA, Nirhale DS, Athavale VS, Malhotra M, Priyadarshi N. Epidemiological aspects of appendicitis in a rural setup. Med J Dr DY Patil Univ. 2014; 7(6):753. DOI: 10.4103/0975-2870.144867
14. Lin KB, Chan CL, Yang NP, Lai RK, Liu YH, Zhu SZ, et al. Epidemiology of appendicitis and appendectomy for the low-income population in Taiwan, 2003–2011. BMC Gastroenterol. 2015; 15:18. PMID: 25888516 DOI: 10.1186/s12876-015-0242-1
15. Nabipour F, Mohammad BD. Histopathological feature of acute appendicitis in Kerman-Iran from 1997 to 2003. Am J Environ Sci. 2005; 1(2):130-2.
16. Rashidi-Azar K, Darzi AA, Kamali-Ahangar S, Siadati S, Gholizadehpasha A. Clinical presentation of acute appendicitis in Babol; northern Iran. Caspian J Intern Med. 2017; 8(2):129-30. PMID: 28702156 DOI: 10.22088/cjim.8.2.129
17. Sarkar A, Saha A, Roy S, Pathak S, Mandal S. A glimpse towards the vestigiality and fate of human vermiform appendix-a histomorphometric study. J Clin Diagn Res. 2015; 9(2):AC11-15. PMID: 25859439 DOI: 10.7860/JCDR/2015/11178.5581
18. Ahmed W, Akhtar MS, Khan S. Seasonal variation of acute appendicitis. Pak J Med Sci. 2018; 34(3):564-7. PMID: 30034416 DOI: 10.12669/pjms.343.14793
19. Lee JH, Park YS, Choi JS. The epidemiology of appendicitis and appendectomy in south Korea: national registry data. J Epidemiol. 2010; 20(2):97-105. PMID: 20023368 DOI: 10.2188/jea.je20090011
20. Oguntola AS, Adeoti ML, Oyemolade TA. Appendicitis: Trends in incidence, age, gender, and seasonal variations in South-Western Nigeria. Ann Afr Med. 2010; 9(4):213-7. PMID: 20935419 DOI: 10.4103/1596-3519.70956
21. Sulu B, Gunerhan Y, Palanci Y, Isler B, Caglayan K. Epidemiological and demographic features of appendicitis and influences of several environmental factors. Ulus Travma Acil Cerrahi Derg. 2010; 16(1):38-42. PMID: 20209394
22. Albahadili MA. Study of the effect of age, gender and seasonal variation on appendicitis in Azizyah-Iraq. Al-Kufa Univ J Biol. 2016; 8(2):334-41.
23. Ilves I, Fagerström A, Herzig KH, Juvonen P, Miettinen P, Paajanen H. Seasonal variations of acute appendicitis and nonspecific abdominal pain in Finland. World J Gastroenterol. 2014; 20(14):4037-42. PMID: 24833844 DOI: 10.3748/wjg.v20.i14.4037
24. Ditillo MF, Dziura JD, Rabinovici R. Is it safe to delay appendectomy in adults with acute appendicitis? Ann Surg. 2006; 244(5):656-60. PMID: 17060754 DOI: 10.1097/01.sla.0000231726.53487.dd
25. Abu Foul S, Egozi E, Assalia A, Kluger Y, Mahajna A. Is early appendectomy in adults diagnosed with acute appendicitis mandatory? A prospective study. World J Emerg Surg. 2019; 14:2. PMID: 30651750 DOI: 10.1186/s13017-018-0221-2
26. Vejdan A, Naseh G, Masoodi N, Khosravi M. Evaluation of the accuracy of physicians' diagnostic performances in patients with suspected acute appendicitis. J Surg Trauma. 2016; 4(1):11-6.

[DOI: 10.32592/Jsurgery.2019.7.3.103]