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Original Research Article

Exploring the seasonal impact on appendectomy: incidence, patterns, predictors, and healthcare implication of appendectomy at Prince Ali military hospital

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ABSTRACT

Background: This study at Prince Ali military hospital in Al Karak, Jordan, investigates seasonal variations in appendicitis incidence and outcomes, assessing diagnostic and treatment strategies across different seasons. The aim is to understand how seasonal changes influence appendicitis rates and to evaluate the effectiveness of diagnostic methods and treatment approaches.
Methods: A retrospective observational study was conducted on 321 confirmed cases of inflamed or perforated appendicitis from March 2021 to February 2024. Patient demographics, dates of surgery, surgical interventions, and postoperative complications were analyzed, with a focus on seasonal trends.
Results: Out of 394 reviewed cases, 321 (81.47%) met the inclusion criteria, showing significant seasonal variations in appendicitis incidence. Autumn saw the highest rate of appendicitis cases at 32.09% while the lowest was in Winter (22.12%). Regarding normal appendix, the highest rate was in winter (21.98%), and the lowest was in summer (13.09%). The mean patient age was 25.20 years, with a majority being male (66.36%). Open surgeries were the most common, comprising 91.9% of cases, compared to 8.1% for laparoscopic procedures. Diagnostic analysis revealed a very strong correlation between CT findings and histopathological outcomes ($p=3.23\times10^{-11}$) and a significant but less strong correlation for ultrasound findings ($p=0.000446$). These results suggest that both diagnostic methods are effective, with CT scans showing a stronger correlation. The distribution of cases across seasons was 32.087% in autumn, 23.05% in spring, 22.741% in summer, and 22.118% in winter.
Conclusions: Significant seasonal peaks in appendicitis are evident, particularly in autumn, driven by changes in diet and viral infections. The superior effectiveness of CT scans during winter highlights the need for adaptive diagnostic strategies across seasons. These findings advocate for healthcare systems to seasonally adjust resources and diagnostics to optimize appendicitis management, with further research needed to expand these insights globally.

Keywords: Appendicitis, Seasonal variation, Diagnostic accuracy, Surgical outcomes, Mediterranean climate, Normal appendix

INTRODUCTION

Appendectomy, surgical removal of appendix, is primarily indicated for appendicitis, which ranks among the most common acute surgical emergencies globally.[1] Lifetime risk of developing acute appendicitis is significant, 8.6% in males and 6.7% in females.[2] In recent years, no. of cases in patients aged 30-69 has increased to 6.3%.[3]

There is a growing evidence base to suggest that the incidence of acute appendicitis displays seasonal variation.[4,5] Which can significantly influence both its incidence and the outcomes of treatment. These variations are thought to be driven by environmental factors such as changes in diet, infectious disease rates, and even temperature fluctuations, which collectively impact gastrointestinal function and overall health.[6]

In diverse climates, particularly those that experience extreme seasonal changes like the Mediterranean climate of Al Karak, Jordan, which is characterized by cold, rainy winters and hot, dry summers.[7] Appendicitis rates show marked seasonal peaks. These peaks correlate with dietary changes during cold months when higher caloric and harder-to-digest foods are more prevalent, potentially leading to increased appendiceal luminal obstruction.[8,9] Furthermore, the incidence of viral gastroenteritis, which spikes in colder months, may contribute to lymphoid hyperplasia in appendix, heightening risk of appendicitis.[10]

Modern diagnostic modalities, including ultrasound and computed tomography (CT), are pivotal in diagnosing appendicitis, though their use and effectiveness can vary with seasonal factors. For instance, ultrasound may be less effective in winter due to increased abdominal fat layers in patients, which can obscure sonographic windows.[11] Similarly, the presentation of appendicitis symptoms may be more pronounced or altered during colder months due to changes in physical activity and overall behavior patterns of individuals, which can delay diagnosis and treatment.[12,13]

Surgical intervention for appendicitis primarily involves appendectomy, which can be performed via traditional open surgery or through less invasive laparoscopic methods.[14] Although laparoscopic appendectomy is associated with shorter recovery times and fewer complications, its feasibility might be influenced by the stage of appendicitis, which is again impacted by seasonal diagnosis delays.[9]

Despite advancements in surgical techniques and postoperative care, appendicitis still presents significant challenges in terms of timely diagnosis and effective management particularly during peak seasons.[6] These challenges necessitate a robust understanding of appendicitis epidemiology, emphasizing the need for healthcare systems to adapt their approaches based on seasonal trends. This could involve adjusting staffing and equipment availability to cope with seasonal surges and refining diagnostic protocols to accommodate variations in symptom presentation and complication rates across different times of the year.[10]

In summary, understanding the seasonal dynamics of appendicitis within the specific context of Mediterranean climates can lead to more effective and tailored healthcare strategies, optimizing patient outcomes and resource allocation in hospitals like Prince Ali military hospital in Al Karak, Jordan

METHODS

A retrospective analysis was conducted on 321 cases of confirmed inflamed or perforated appendicitis out of 394 initial cases at Prince Ali military hospital over three years from 2021 to 2024. The study excluded patients with a normal appendix confirmed by histopathology. This was crucial to ensure that only genuine cases of appendicitis were analyzed, excluding misdiagnoses. This approach allowed for a more accurate assessment of appendicitis incidence and diagnostic effectiveness throughout the seasons (Figure 1).

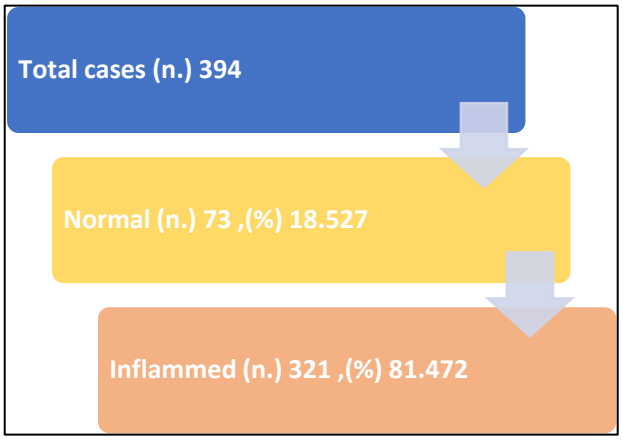

Figure 1: Exclusion criteria.

Ethical approval was approved by institutional ethics committee.

Data collection using Google forms included patient demographics, surgical dates, types of surgical intervention, histopathology findings, and postoperative complications. Gender distribution was analyzed to identify any disparities in appendicitis incidence between males and females. Surgery was performed by a general surgery specialist or resident, histopathology reports were reviewed and approved by a consultant histopathology doctor. Chi-square tests were employed to assess the seasonal impact on surgical techniques and complication rates, providing statistical validation for observed trends.

RESULTS

Out of the 394 initial cases reviewed, 321 cases (81.47%) met the predefined inclusion criteria for analysis,

and seasonal variations were observed in the incidence of normal appendix findings. The highest was in winter, with 20 out of 91 cases (21.98%), and the lowest in summer, with 11 out of 84 cases (13.09%). The mean age was 25.214 years. Male patients were 213 (66.36%) mean age of 24.61 years and female patients were 108 (33.64%) mean age of 26.5 years (Figure 2). Open surgeries were the predominant approach for appendectomy, comprising 295 (91.9%) of cases, while laparoscopic procedures accounted for the remaining 26 cases (8.1%) (Figure 4). For CT findings vs. histopathological findings, the p is extremely low (3.23×10-11), indicating a very strong association between CT findings and histopathological results. For ultrasound findings vs. histopathological findings, the p is also very low (0.000446), indicating a significant association, though less strong than the CT findings. This suggests that ultrasound findings also have a statistically significant relationship with histopathological outcomes, but the association is not as pronounced as with CT.

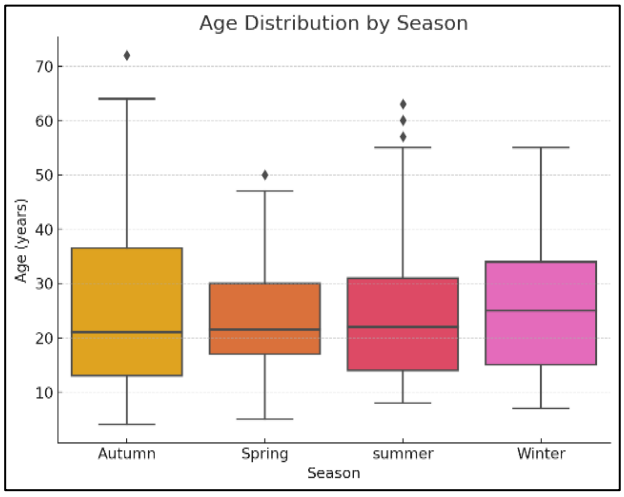

Figure 2: Age distribution of appendicitis cases at Prince Ali military hospital.

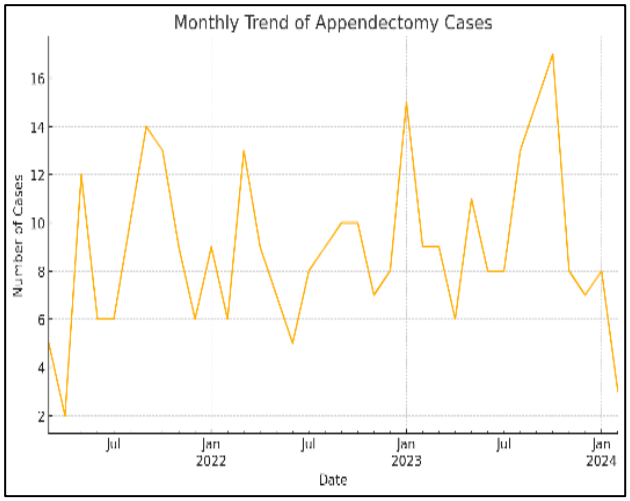

Figure 3: Monthly trend of appendectomy cases.

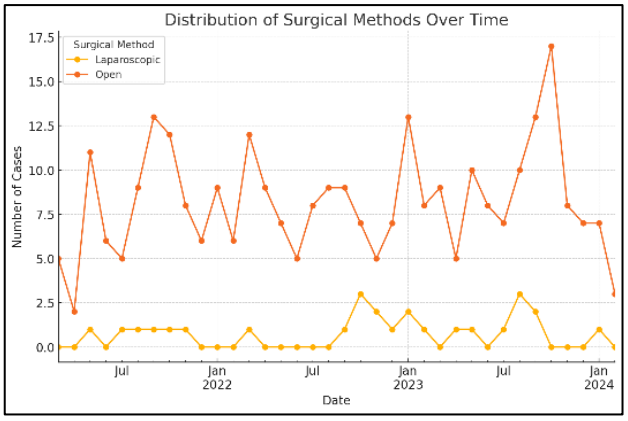

Figure 4: Distribution of surgical methods over time.

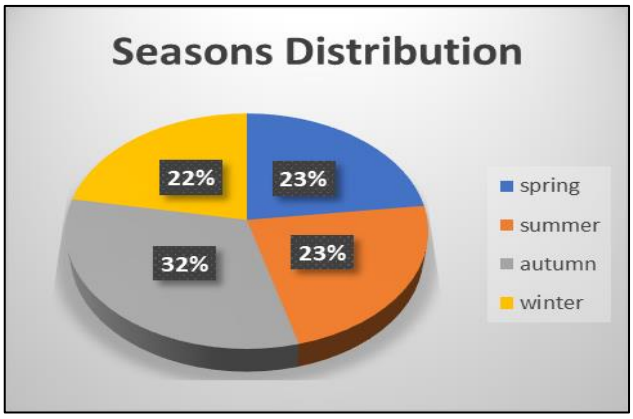

Figure 5: Seasonal distribution of appendicitis.

These results suggest that both diagnostic methods are useful in predicting different histopathological outcomes, with CT findings showing a stronger correlation. This could influence how these diagnostic tools are utilized in clinical settings, particularly in the diagnosis and management of appendicitis.

Table 1: Seasonal and annual distribution of appendicitis cases at Prince Ali military hospital (2021-2024).

Year	Season	N	Percentages (%)
2021/2022	Spring	19	5.919
	Summer	22	6.853
	Autumn	36	11.214
	Winter	21	6.542
2022/2023	Spring	29	9.03
	Summer	22	6.853
	Autumn	27	8.411
	Winter	32	9.968
2023/2024	Spring	26	8.099
	Summer	29	9.03
	Autumn	40	12.461
	Winter	18	5.607

Cases distribution was: autumn:103 cases (32.087%) spring: 74 cases (23.05%) summer: 73 cases (22.741%) winter: 71 cases (22.118%) (Figure 3 and 5).

DISCUSSION

In our study, the rate of normal appendix findings varied notably with the seasons: 21.98% in winter, 18.681% in spring, 19.531% in autumn, and 13.09% in summer. This variation contrasts with the global average, where the negative appendectomy rate typically ranges between 10% and 20%. Notably, our findings in winter exceeded this range, suggesting a possible over-diagnosis or a more conservative approach to surgical intervention during colder months. On the other hand, the lower rate observed in summer aligns closely with the global average, potentially indicating greater diagnostic accuracy or different patient presentations during warmer weather.

The variation in appendicitis rates across seasons may reflect environmental influences on symptom presentation and the variable use of diagnostic tools like CT scans and ultrasounds throughout the year. Our study's findings underscore the importance of considering seasonal factors in the clinical evaluation of suspected appendicitis. This approach could lead to more targeted diagnostic protocols and potentially reduce unnecessary surgeries, particularly during periods with higher rates of normal findings.

The seasonal variation in the rate of inflamed appendix findings was notable: 23.05% in spring, 22.74% in summer, 32.09% in autumn, and 22.12% in winter. This suggests that autumn sees a higher incidence of appendicitis compared to other seasons (Table 1 and Figure 5).

Our study's findings, which reveal a significant seasonal variation in the incidence of appendicitis at Prince Ali military hospital, align with several previous studies conducted in different geographic regions. For instance, a seven-year study (2011-2017) by Yamani demonstrated a seasonal variation in appendicitis, with a peak during winter and autumn, and a decrease during spring and summer.[15] Similarly, Gok's study in Anatolia showed an increase in acute appendicitis cases during the winter months.[16] Another study conducted in Kars also indicated a higher incidence of appendicitis in winter.[17] In Kirman, Iran, research determined that appendicitis was more prevalent during the winter season.[18] These studies collectively support our findings, suggesting that environmental factors, such as temperature and possibly related viral infections, might play a crucial role in the seasonal variation of appendicitis. While our study indicates a significant seasonal variation in the incidence of appendicitis, with higher rates in autumn, it is important to acknowledge that not all studies support this finding. For instance, Luckmann's study in California highlighted minimal seasonal variation in appendicitis rates.[1] Conversely, a study conducted by Imre et al in various centers across Finland showed a clear correlation between seasonality and acute appendicitis, with increased incidence during the summer season.[19] Additionally, a study published in 2014 by Lohar et al reported that the occurrence of appendicitis peaked in the spring and was at its lowest in the summer.[20]

These variations underscore the necessity of tailoring appendicitis management strategies to accommodate local and seasonal factors, thereby enhancing the effectiveness of healthcare systems in different climates. These findings highlight the importance of considering seasonal influences when diagnosing and managing appendicitis. This insight could be pivotal for healthcare planning and resource allocation, ensuring preparedness during peak seasons. Further studies are needed to explore the underlying causes of these seasonal trends in appendicitis rates.

Limitations

This study is limited by its observational design, small sample size, and single-center scope, which may affect the generalizability of the findings. Additionally, the absence of a comprehensive computerized data system in previous years could have led to inconsistencies in data collection, impacting the robustness of our results. Despite these limitations, the study offers valuable insights into the seasonal variability of appendicitis rates.

CONCLUSION

This study shows significant seasonal fluctuations in appendicitis, peaking in autumn due to dietary and viral changes. CT scans were the most effective diagnostic tool, especially during winter when ultrasound effectiveness was reduced by increased abdominal fat. The findings emphasize the need for healthcare systems to adapt diagnostics and resources seasonally to improve outcomes. Increasing CT availability in colder months is advised. Further research should expand geographically to enhance global appendicitis management strategies.

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