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PHYSICAL ACTIVITY, DIETARY HABITS AND FAMILY HISTORY AS RISK FACTORS FOR ACUTE APPENDICITIS IN ADOLESCENTS. A CASE-CONTROL STUDY

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Abstract

Background: *Acute appendicitis is the most common surgical emergency worldwide. Its incidence is higher in the second and third decades of life. The exact cause of acute appendicitis is unknown, although luminal obstruction, genetic factors, infections, and environmental factors may contribute to its development.*

Objectives: *To investigate the physical activity, dietary habits and family history as risk factors for acute appendicitis in adolescents.*

Methods and materials: *This case-control study was conducted from March 2024 to March 2025 in three tertiary care hospitals in Peshawar (Khyber Teaching Hospital, Lady Reading Hospital, and Hayatabad Medical Complex). The cases and controls were selected based on predefined inclusion and exclusion criteria. The data collection tool was a structured questionnaire. After obtaining consent and briefly explaining the questionnaire, it was distributed among the participants. Any missing responses were addressed on the spot. The data was analysed by using SPSS version 20. The chi-square and independent t tests were applied, and a p-value <0.05 was considered statistically significant.*

Results: *120 participants were taken, including 60 cases and 60 controls. In both the appendicitis and control groups, males and females were 41 (68.3%) and 19 (31.7%), respectively. The mean age of the appendicitis group was 15.0±3.14 years, compared to the control group (15.5±3.49). The study revealed a significant association between family history and the development of acute appendicitis (p=0.001, OR=3.35, 95% CI:1.12- 10.0), with a higher proportion of the appendicitis group reporting positive family history 14 (23.33%) as compared to a control group 5 (8.33%). Low fibre intake was more prevalent in the appendicitis group, 38 (63%), than in the control group, 27 (45%), showing a significant link with acute appendicitis risk (p= 0.044, OR=2.11, CI 95%: 1.06-4.21). This study showed that those with acute appendicitis were considerably less physically active than the controls (p <0.001).*

Conclusion: *Family history and a low-fibre diet may contribute to the development of acute appendicitis, while engaging in physical activity may reduce the risk. Further studies are needed to strengthen these findings.*

INTRODUCTION

The word appendicitis is derived from the Latin words appendix and –itis. Itis refers to inflammation [1]. Appendicitis is an appendix inflammation that is present in the right lower abdomen and attached to the large intestine [2]. Acute appendicitis(AA) is the most common reason for abdominal surgery in children [3]. Geographical differences are reported, with a lifetime risk for AA of 9% in the USA, 8% in Europe, and 2% in Africa [4]. South Asian countries such as India showed the largest increase in the age-standardised prevalence rate between 1990 and 2019 [5].

Classic symptoms of appendicitis include periumbilical pain, which is radiated to the right lower quadrant, vomiting, and low-grade fever [6]. Acute appendicitis most commonly occurs between the ages of 10 and 20 years, with a lifetime risk of 8.6% and 6.7% for males and females, respectively [1]. The current study suggested that nausea, C-reactive protein, dizziness, vomiting, muscular symptoms, irritable bowel syndrome, guarding, and loss of appetite were considered higher risk factors for appendicitis [7]. The most common cause of acute appendicitis (AA) is luminal obstruction of the appendix vermiform, which is caused by an appendicolith, lymphoid hyperplasia, stool impaction and an appendicular or caecal tumour [8]. Sedentary behaviour is spreading worldwide because of the lack of available space for exercise, increased occupational sedentary behaviours such as office work, and the increased use of television and video devices. The duration of sedentary behaviour is 8.3 hours daily among the Korean population and 7.7 hours among the American adult population [9]. A sedentary lifestyle is associated with a high incidence of chronic diseases such as cardiovascular disease and diabetes [10].

Studies have shown that the incidence of appendicitis is highest in communities that consume more potatoes and sugar [11] and in those that consume a low-fibre diet [12]. The chance of acute appendicitis increases in individuals with a positive family history of AA compared to those with no family history of AA [13].

The gut microbiota is a major contributor to human health and is affected by physical activity and diet [14]. Therefore, sedentary behaviour, diet and a positive family history of AA could contribute to an increased risk of appendicitis. Despite advancements in technology, the exact causes of AA are still unclear; hence, various possible causes of AA are estimated to include mechanical obstruction, inadequate dietary fibre, smoking, air pollution and familial susceptibility [15]. Exploring the associations between these three variables and appendicitis can help to fill this knowledge gap and provide a more comprehensive understanding of the aetiology of this condition.

Acute appendicitis is one of the most common abdominal surgical emergencies [16], with a considerable economic burden due to hospitalisations and surgical procedures [17]. Understanding risk factors such as sedentary behaviour, diet and family susceptibility could lead to preventive strategies, reducing the incidence and associated costs.

Objectives:

To investigate the physical activity, dietary habits and family history as risk factors for acute appendicitis in adolescents.

Materials and methods:

Ethical approval:

Approval was given by the IREB department of Khyber Medical College, Peshawar, on 26 April 2024. Reference no. 333/DME/KMC. Informed written consent was obtained from participants before distributing the questionnaire.

Study design and setting:

This case-control study was conducted from March 2024 to March 2025 in the tertiary care hospitals of Peshawar, the city of Khyber Pakhtunkhwa, Pakistan. The tertiary care hospitals were KTH (Khyber Teaching Hospital), LRH (Lady Reading Hospital), and HMC (Hayatabad Medical Complex).

Sample size and Sampling technique:
The sample size was calculated using the OpenEpi software, considering the odds ratio(3.24) from the previous study examining the relationship between dietary fibre and appendicitis [12]. The calculated sample size was 98, but after discussing it with the experts, it was increased to 120, containing 60 cases and 60 controls. The hospitals were selected through a convenience sampling technique, whereas the case and control groups were chosen through a non-probability purposive technique.

Inclusion and Exclusion criteria:
Adolescents aged 10 to 19 years diagnosed with acute appendicitis and admitted for appendectomy were included as cases, while those of the same age group admitted for non-appendicitis surgical conditions served as controls. Exclusion criteria for cases included the presence of other serious abdominal conditions such as tumours or burns, whereas controls with a previous history of appendicitis were excluded.

Data collection methods:
Data collection utilised a structured questionnaire consisting of four sections: demographics, physical activity, dietary habits, and family history. The questionnaire, originally developed in English, was paper-based and self-administered. It had content validity by being presented to three experts in the field. Following expert refinement, pilot testing with 12 participants confirmed the clarity of terminology, practical completion time (mean: 8 minutes), and technical feasibility in clinical settings. Physical activity (PA) was assessed by the International Physical Activity Questionnaire (IPAQ), which evaluates vigorous PA, moderate PA, walking PA, and sedentary time. The setting time was assessed by measuring the minutes per day on a typical weekday. Dietary habits were assessed by asking: How many times did you consume fruits, vegetables, legumes, and rice in the last week? Family history was assessed by question: Has anyone in your first-degree family (parents, siblings, children, grandparents) been diagnosed with acute appendicitis? Questionnaires were explained to participants, and informed written consent was obtained before administration. Any missing responses were interpreted and completed during the fieldwork to have a complete data set.

Data analysis and presentation:
Categorical variables were represented using numbers and percentages, whereas numerical variables were defined using mean ±SD. The odds ratio was used to measure the association between the occurrence of appendicitis and low fibre intake, as well as family history and physical activity. Answers to the frequency (previous week from appendectomy) of food intake were allocated arithmetical codes for statistical analysis (**Table 1**). The total score was calculated for each participant, and then the median of **7** was obtained. Participants with a total score lower than or equal to the median score were considered to have low dietary intake. This method of analysis was used in a previous study [18].
Physical activity was measured through the International Physical Activity Questionnaire (IPAQ). Weekly MET-minutes were derived by applying the IPAQ scoring instructions, which instruct using MET values of 3.3 for walking, 4.0 for moderate physical activity, and 8.0 for vigorous physical activity and multiplying by the frequency and duration of each activity type (walking, moderate, vigorous). Participants were classified as having low, moderate, or high levels of physical activity based on total MET-minutes per week (**Table 2**).
Sitting time was examined as a continuous variable based on self-reported average number of minutes sitting per day on a typical weekday. Means and standard deviations were obtained, and an independent t-test was used to compare groups. Family history responses were reported as frequency and percentage. SPSS software version 20 was used for data analysis. The chi-square and student-t-test were applied, and a p-value < 0.05 was considered statistically significant.

Table 1

Response	Code
Never	0
1-2 times/week	1
3-4 times/week	2
5-6 times/week	3
Daily	4

Table 2

Physical activity level	Criteria (MET-min/week)
Low	<600
Moderate	≥600 to <3000
High	≥3000

Bias:

To avoid selection bias, cases and controls were drawn from the same population and based on pre-defined inclusion and exclusion criteria. Recall bias was minimized by asking structured and specific questions. Interviewer bias was minimized by training all data collectors and asking each participant the same questionnaire format.

Results:

Table 3 compares the different variables in the appendicitis and control groups. The mean age of the appendicitis group was 15.0±3.14 years, and the control group was 15.5±3.49 years. The groups had no statistically significant association (p-value 0.086).

The frequency of appendicitis was more prevalent in males, 41 (68.3%), than in females, 19 (31.7%). There was no statistically significant difference between the genders (p=1.00, OR=1, CI 95%: 0.47-2.12). 14 (23.33%) of the appendicitis group and 5 (8.33%) of the control group had a positive family history of acute appendicitis. P-value (0.0011) was calculated, which showed that the family history may be a potential risk factor for acute appendicitis. The people having a positive family history of acute appendicitis have 3.35 times more odds of developing appendicitis as compared to those without a family history (OR=3.35, 95%CI:(1.12-10.0)

38 (63%) of the appendicitis group and 27 (45%) of the control group reported low fibre intake. The p-value was statistically significant (0.044), suggesting that a lower fibre intake may be a potential risk factor for acute appendicitis. Those with a low fibre intake have 2.1 times more odds of developing appendicitis as compared to those with higher fibre intake (OR=2.11, CI 95%: 1.06-4.21). The chi-square test was applied to find the p-value for categorical variables like gender, family history, fibre intake, and physical activity, while the student-t-test was used to find the p-value for age and duration of physical activity.

Table 4

Table 4 demonstrates that the appendicitis group were significantly less active than controls in all categories of physical activity. For low activity levels, cases reported an average of 440 ± 30 MET-min/week while controls reported 560 ± 40(p<.000). For the moderate range, means were 850 ± 20 in cases and 1100 ± 30 in controls (p <.0001). For high activity cases were the average of 3150±10 MET-min/week, controls 3200±15 (p <0.0001). These results show that those with acute appendicitis were considerably less physically active than the controls, therefore suggesting a protective role of physical activity against the risk of acute appendicitis. The Student t test assessed the statistically significant association between different physical activity levels.

Table 5

Table 5 shows the setting time between the appendicitis and control groups. The appendicitis group reported a higher setting time (240±30 minutes) than the control group (210±15 minutes) with a statistically significant difference (<0.001). The Student t test assessed the statistically significant

association between the setting time of theappendicitis group and the control group.

Table 3: Comparison of different variables between the appendicitis and control groups

Variable	Appendicitis group	Control group	Total	OR(95%CI)	P valve
Age (Mean ± SD in years)	15.0 ± 3.14	15.5 ± 3.49	–		0.086
Gender				1.0(0.47-2.12)	1.00
Male	41 (68.3%)	41	82		
Female	19 (31.7%)	19	38		
Family History				3.35(1.12-10.01)	**0.0011**
Positive	14 (23.33%)	5 (8.33%)			
Negative	46 (76.66%)	55 (91.66%)	–		
Fibre Intake				2.11(1.06-4.21)	**0.044**
Low-Fibre Intake	38 (63%)	27 (45%)	–		
Higher-fibre Intake	22 (36%)	33 (55%)	–		

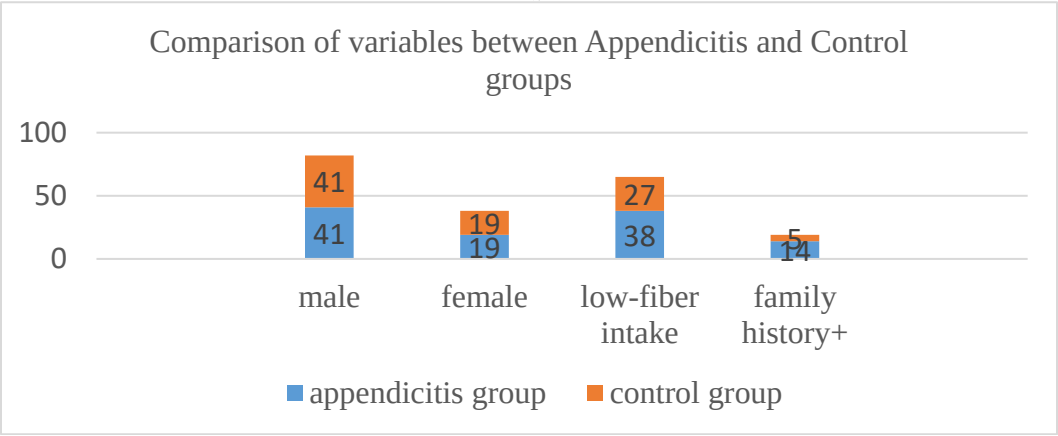
Table 4: Comparison of physical activity levels(MET-min/week) between the appendicitis and control groups

Physical activity	Appendicitis group (n%)	Control group (n% %)	Appendicitis (MET-minutes ±SD)	Control (MET-minutes ± SD)	P-valve
Low	41 (68.3%)	15 (25%)	440 ±30	560 ±40	< 0.0001
Moderate	15 (25%)	36 (60%)	850 ±20	1100 ±30	< 0.0001
high	4 (6.6%)	9 (15%)	3150 ±10	3200 ±15	< 0.0001

Table 5: Comparison of setting time/day in appendicitis and the control group

Groups	Setting time (minutes)/day (mean ±SD)	p-valve
Appendicitis	240±30	<0.001
Control	210±15	

Graph:



Discussion:

Acute appendicitis is one of the most common abdominal surgical emergencies [16], with a considerable economic burden due to hospitalizations and surgical procedures [17]. The severity and duration of inflammation are closely tied to the infection's intensity and the disease's progression. As the condition worsens, the inflammation expands to the surrounding fatty tissue and nearby organs [19]. This study included 60 patients with appendicitis and 60 control patients without appendicitis. The mean age of the appendicitis group was 15.0±3.14 years as compared to the control group (15.5±3.49). In this study, frequency of male patients 41 (68.3%), were higher than female 19 (31.7%), which agrees with other studies which showed that acute appendicitis is more common in males [19] [20] [21], while another study done in Indonesia revealed a higher frequency in females [22]. There was no significant distribution of appendicitis between the genders (p=1.00). A study suggests that the difference between genders may be due to hormonal differences. Testosterone may suppress the immune system, making males susceptible to infection [23]. Males may have a narrow appendix lumen, which makes them susceptible to obstruction and infection [24] [25]. Some studies suggest that there is a behavioural difference between males and females; males delay seeking clinical care, which leads to complications like perforated appendicitis. In females, clinicians may confuse the pain of appendicitis with other gynaecological conditions, which is why males have a higher frequency of appendicitis than females [26] [27].

This study found the family history as an important risk factor for the development of appendicitis (p=0.0011). This study revealed that 14 (23.33%) of the appendicitis group and 5 (8.33%) of the control group had a positive family history of acute appendicitis, which is similar to the other studies done in Belgium, and Iraq which showed that 129 (55.8%) and 34% in the appendicitis group and 13 (6.7%) and 15% in the control group had a positive history of acute appendicitis respectively [28] [19]. This finding suggests that genetic or environmental factors may play a role in the development of appendicitis [29] [30]. More studies are needed to prove the genetics of appendicitis, which could help clinicians in early diagnosis [31].

Our study found that weekly physical activity may reduce the risk of developing appendicitis, which is aligned with another study, which showed that no physical activity may increase this risk for developing appendicitis [32]. Physical activity has a positive effect on gut microbiota, which then improves digestion, prevents constipation and improves the overall health of the gastrointestinal system, which may indirectly reduce the risk of appendicitis [33][34].

A low-fibre diet may cause fecalith formation in the appendix lumen or obstruct lumen [35][36], and this study found that low fibre intake is more common in the appendicitis group 38 (63%) than in the control group 27 (45%). This agrees with another study done in Rawalpindi, Pakistan, which confirmed that 61.5% of appendicitis patients had low fibre intake compared to controls (45.5%) [18]. Another study also concluded that low fibre intake may be a potential risk factor for appendicitis [12].

Conclusions:

Low-fibre intake and family history may be associated with acute appendicitis (AA), while physical activity may reduce the chance of AA.

Limitations:

We did not measure the exact amount of fibre the participants took, but only the frequency of consumption of food per week. Dietary fibre only derived from the consumption of fruits, legumes, vegetables, and rice was the focus of this study, while other food items high in fibre, such as whole grains, nuts and seeds, were not accounted for and may limit the assessment of dietary fibre overall. Therefore, further studies are needed to strengthen these findings.

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