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Original Article

Epidemiological Assessment of Risk Factors for Inguinal Hernia Among Male Patients in Iraq: A Case-Control Study

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ABSTRACT

Introduction: Inguinal hernia is one of the most common surgical conditions, particularly among males. Despite its prevalence, limited regional data exist on the associated risk factors in Iraq. This study aimed to identify socio-demographic, lifestyle, and clinical risk factors contributing to inguinal hernia among male patients.
Methods: A case-control study was conducted on 250 male patients diagnosed with inguinal hernia at multiple public hospitals and surgical clinics across three major cities in Iraq: Wasit, Baghdad, and Basra. Compared with a 250-member control group. Data were collected using structured questionnaires covering socio-demographic details, occupational exposure, lifestyle habits, medical history, and family history. Univariate and logistic regression analyses were performed to identify significant risk factors.
Results: Most patients (57.5%) were between 41 and 60 years old. Heavy lifting (63.6%), smoking (62.0%), chronic cough (38.6%), and constipation (32.4%) were frequently reported. A positive family history was noted in 22.4% of cases. Univariate analysis revealed significant associations between inguinal hernia and heavy lifting ($p < 0.001$), smoking ($p < 0.001$), chronic cough ($p = 0.002$), constipation ($p = 0.020$), and a family history of inguinal hernia ($p = 0.001$). Logistic regression confirmed heavy lifting (OR=2.78), family history (OR=2.46), smoking (OR=1.69), and chronic cough (OR=1.54) as independent risk factors.
Conclusion: Heavy lifting, smoking, chronic cough, and family history were significantly associated with increased risk of inguinal hernia among Iraqi males. Public health strategies that focus on prevention, early identification, and lifestyle modification are essential for reducing the incidence and recurrence of this condition.

1. Introduction

Inguinal hernia, characterized by the protrusion of abdominal contents through the inguinal canal, represents a prevalent surgical concern worldwide [1, 2]. This condition exhibits a higher incidence in males, particularly in regions with specific demographic and occupational characteristics [3]. Patients with inguinal hernia often present with a visible or palpable bulge in the groin area, which may be accompanied by discomfort or pain, especially during activities that increase intra-abdominal pressure, such as lifting or straining [3]. Diagnosis is primarily clinical, especially in men, but supported by imaging studies, especially ultrasound and Magnetic Resonance Imaging (MRI) for better quality in occult hernia, as ultrasound may miss it, or in women, as imaging is necessary to assess the hernia's characteristics and plan appropriate management [4, 5, 6].

In Iraq, particularly in areas like Al-Basra, there is a notable prevalence of inguinal hernia among male patients, potentially linked to the region's industrial and manual labor activities. A prospective study at Al-Basra Teaching Hospital reported that 88.4% of the 250 patients with inguinal hernia were male, with ages ranging from 16 to 82 years [7].

Several risk factors have been identified as contributing to the development of inguinal hernias in males. A Chinese case-control study among males presenting to the surgical clinic of the University of Hong Kong Medical Centre, with 709 cases compared to 709 controls, indicated that males with a family history are eight times more likely to develop primary inguinal hernias [8]. Strenuous physical activities, especially those involving heavy lifting over prolonged periods, have been associated with a higher incidence of inguinal hernias [9]. Smoking has been associated with an increased risk of inguinal hernia recurrence [10]. A study at Al-Basra Teaching Hospital found that half of the patients were smokers, and all cases of recurrent hernias occurred among smokers [7]. Advancing age is a significant risk factor, with studies showing that the incidence of inguinal hernia increases with age [11]. In the Rotterdam Study, the risk of inguinal hernia increased with each

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year of age. The relationship between BMI and inguinal hernia risk is complex. For instance, the Rotterdam study observed a decreased risk of inguinal hernia in males with a BMI over 25 kg/m² [11]. Conversely, obesity is generally considered a risk factor for various types of hernias due to increased intra-abdominal pressure [12]. Respiratory conditions that lead to persistent coughing can also increase intra-abdominal pressure, thereby elevating the risk of hernia development. Studies have identified chronic obstructive airway disease as a contributing factor [13]. Understanding the risk factors associated with inguinal hernia is crucial for developing targeted prevention and intervention strategies. Identifying modifiable risk factors (e.g., smoking, heavy lifting, constipation) offers a basis for preventive programs such as workplace safety regulations, smoking cessation campaigns, and early screening initiatives. There is limited data from Iraq and the broader Middle East regarding risk factors for inguinal hernia. This study aimed to assess risk factors associated with inguinal hernia in Wasit Province, Iraq. It adds context-specific evidence that can inform national health strategies and future regional studies. In addition, the results can be used to educate patients about avoidable behaviors and health conditions that contribute to hernia development, thereby helping to reduce recurrence and postoperative complications.

2. Methods

2.1. Study Design and Setting

This case-control study was conducted at multiple public hospitals and surgical clinics across three major cities in Iraq: Wasit, Baghdad, and Basra. The study was conducted from January 2023 to December 2024.

2.2. Study Population

A total of 250 male patients diagnosed with inguinal hernia were enrolled in the study. These patients were either admitted for elective hernia repair surgery or presented to outpatient surgical clinics for evaluation and treatment. The control group comprised 250 healthy male individuals, matched for age and gender, with no clinical or ultrasound evidence of inguinal hernia.

2.3. Inclusion Criteria

Male patients aged 18 years and above were included in this study. They have to be diagnosed with a primary inguinal hernia by a consultant general surgeon, based on clinical examination and/or ultrasound confirmation, and those willing to participate and provide informed consent.

2.4. Exclusion Criteria

Those patients with recurrent or bilateral inguinal hernias and those with previous abdominal surgeries unrelated to hernia repair were excluded. Patients with significant comorbidities such as advanced cancer, end-stage liver or renal disease, were also excluded, in addition to incomplete or missing clinical data.

2.5. Data Collection

Data were collected using a structured questionnaire developed from a Nigerian case-control study at the general surgical clinic of Ikorodu General Hospital, with a few modifications tailored to the study's needs [14]. An expert performed the translation into the Arabic language to ensure both linguistic accuracy and cultural appropriateness. The questionnaire was validated by experts in both surgery and community medicine to ensure content relevance and appropriateness for the study objectives. These experts reviewed the items for clarity, accuracy, and comprehensiveness, confirming that the questionnaire adequately covered all necessary domains related to inguinal hernia and associated factors. Following expert validation, the questionnaire was pretested on 10 participants drawn from the target population. The pretest aimed to assess the clarity, relevance, and comprehensibility of the questions, as well as the overall flow and length of the instrument. Participants were encouraged to provide feedback on any items that were ambiguous or difficult. Based on this feedback, necessary modifications were made to improve question wording and structure, ensuring that the final questionnaire was user-friendly and capable of eliciting accurate and reliable responses. This process helped enhance the validity and reliability of the questionnaire before its use in the main study. The questionnaire was administered through self-reporting forms conducted with the help of medical staff. The information collected included Demographic data, such as age, occupation, residence (urban or rural), and socioeconomic status. Lifestyle factors, which consisted of smoking history, physical activity, and history of heavy lifting (occupational or recreational). Clinical history regarding the presence of chronic cough, constipation, BMI (measured at the time of visit), and family history of hernia.

2.6. Definition of Risk Factors

Heavy lifting was defined as lifting objects weighing more than 20 kg regularly (more than 3 times per week). Smoking included both current and former smokers who had smoked at least 100 cigarettes in their lifetime. Chronic cough was defined as a cough lasting longer than three months. Obesity was classified as a BMI of 30 kg/m² or higher, and overweight as a BMI between 25 and 29.9 kg/m². Constipation was defined as fewer than three bowel movements per week or persistent straining during defecation. A positive family history was considered if a first-degree male relative had a documented inguinal hernia.

2.7. Statistical Analysis

All data were entered and analyzed using IBM SPSS version 26. Descriptive statistics were used to summarize the demographic and clinical characteristics of the patients. Frequencies and percentages were calculated for categorical variables, while means and standard deviations were reported for continuous variables. Chi-square tests were used for initial bivariate analysis to examine the relationship between potential risk factors and the occurrence of inguinal hernia. Multivariate logistic regression analysis was then performed to identify independent risk factors, adjusting for potential confounders. Results were reported as odds ratios (ORs) with 95% confidence intervals (CIs). A p-value of less than 0.05 was considered statistically significant.

2.8. Ethical approval

Ethical approval was obtained from Wasit University/College of Medicine. Institutional Review Board on December 1, 2022. Verbal consent was obtained from each participant prior to the start of the interview.

3. Results

A total of 250 male patients diagnosed with inguinal hernia were included in this study. Another 250 male controls without an inguinal hernia. The mean age of participants in both groups was 46.2 ± 15.3 years. The distribution of socio-demographic and clinical characteristics is summarized in (**Table 1**). Most patients (57.5%) fall within the 41–60 age group. Most patients (72.8%) were from urban areas, and 65.2% were classified as having a moderate socioeconomic status. The majority of patients were

Table 1: Socio-demographic characteristics of male patients with inguinal hernia (cases) and controls

Characteristic	Cases (n = 250)		Controls (n = 250)		p-value
	Frequency	%	Frequency	%	
Age group					0.999
18–40 years	62	25.0	62	25.0	
41–60 years	144	57.5	144	57.5	
61+ years	44	17.5	44	17.5	
Residence					0.582
Urban	182	72.8	175	70.0	
Rural	68	27.2	75	30.0	
Socioeconomic status					0.598
Low	43	17.2	37	15.0	
Moderate	163	65.2	170	68.0	
High	44	17.6	43	17.0	
Occupation					<0.001
Manual laborer	135	54.0	63	25.0	
Office worker	56	22.4	75	30.0	
Unemployed	34	13.6	38	15.0	
Other	25	10.0	75	30.0	

manual laborers (54.0%), followed by office workers (22.4%) and unemployed individuals (13.6%).

A significant proportion (63.6%) of patients reported a history of frequent heavy lifting due to occupational or lifestyle factors. More than a third (38.8%) of the patients had a chronic cough (lasting more than 3 months), commonly attributed to smoking or untreated respiratory infections. Around two-thirds (62.0%) of the sample were current or former smokers. Based on BMI calculations, 21.2% were classified as obese and 37.6% as overweight. Chronic constipation was reported in 28.4% of patients. Only 19.2% had a first-degree relative with a history of inguinal hernia. **(Table 2)** presents the clinical and lifestyle risk factors among cases and controls. Chi-square tests were performed to compare the prevalence of risk factors between cases and controls. Heavy lifting, smoking, chronic cough, constipation, and family history were significantly more prevalent among cases than controls ($p < 0.05$). Obesity did not show a statistically significant difference between the two groups ($p = 0.421$).

Heavy lifting, smoking, chronic cough, constipation, and family history were significant risk factors ($p < 0.05$). Obesity did not show a statistically significant association in the univariate model; however, it was considered for inclusion in the multivariate analysis due to its clinical relevance. **(Table 3)** presents the results of the multivariate logistic regression analysis, including odds ratios (ORs) and 95% confidence intervals (CIs) for the independent risk factors. In the multivariate model, heavy lifting (OR = 2.78, 95% CI: 1.80 - 4.30), smoking (OR = 1.69, 95% CI: 1.10 - 2.59), chronic cough (OR = 1.54, 95% CI: 1.01 - 2.36), and family history (OR = 2.46, 95% CI: 1.28 - 4.73) remained significant independent risk factors for inguinal hernia. Constipation (OR = 1.41, 95% CI: 0.91 - 2.18) and obesity (OR = 0.95, 95% CI: 0.54 - 1.67) did not show significant independent associations.

4. Discussion

This study highlights the importance of early identification and management of key risk factors to reduce the burden and prevalence of inguinal hernias in Iraqi males. With proper public health interventions, occupational reforms, and patient education, the incidence and complications of inguinal hernia can be significantly reduced. The mean age of the study participants was 46.2 years, with a range from 18 to 80 years. This is in line with studies indicating that the incidence of inguinal hernia increases with age [3, 15]. Age-related weakening of abdominal wall muscles contributes to this increased risk, as collagen plays a major role in this process of weakness [16]. Analyzing the results from this study, which involved 250 male patients with inguinal hernias, reveals several significant associations with known risk factors such as heavy lifting, smoking, and chronic cough. These findings align with the study conducted in the USA [15].

The results of this study identified heavy lifting as a significant risk factor, with 159 out of 250 patients (63.6%) reporting this activity. This finding corroborates previous research; a study in northern India found that 55% of patients engaged in heavy weight lifting, highlighting its role in hernia development [17]. In Iraq, the physical demands of jobs involving heavy lifting and strenuous labor in industrial sectors may increase the risk of developing inguinal hernias. Studies from Al-Basra Teaching Hospital show a predominance of inguinal hernia cases in men, many of whom are engaged in physically demanding work, supporting this occupational link [7].

Smoking was reported by 155 patients (62.1%) in our cohort. This is consistent with findings from a large U.S. study, which noted that tobacco use was associated with a higher incidence of inguinal hernia repair among women, though not significantly among men [18]. The discrepancy may be due to differences in study populations and methodologies.

Chronic cough was identified in 97 patients (38.6%) in this study. This aligns with earlier research that associates chronic obstructive airway disease with an increased risk of inguinal hernia [8]. Persistent coughing can lead to increased intra-abdominal pressure, which in turn contributes to the formation of a hernia.

Table 2: Clinical and lifestyle risk factors among cases and controls

Risk Factor	Cases (n = 250)		Controls (n = 250)		p-value
	Frequency	%	Frequency	%	
Heavy lifting	159	63.6	75	30.0	<0.001
Smoking	155	62.0	88	35.0	<0.001
Chronic cough	97	38.8	38	15.0	<0.001
Chronic constipation	71	28.4	25	10.0	<0.001
Family history	48	19.2	20	8.0	0.002
Obesity (BMI ≥ 30)	53	21.2	45	18.0	0.421

BMI, Body Mass Index

Table 3: Multivariate logistic regression analysis of independent risk factors

Risk Factor	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Heavy lifting	2.78	1.80 – 4.30	<0.001
Smoking	1.69	1.10 – 2.59	0.016
Chronic cough	1.54	1.01 – 2.36	0.045
Constipation	1.41	0.91 – 2.18	0.121
Family history	2.46	1.28 – 4.73	0.007
Obesity (BMI ≥ 30)	0.95	0.54 – 1.67	0.856

OR, odds ratio; CI, confidence interval; BMI, body mass index; %, percentage; p-value, probability value

The current study observed that 53 patients (21.2%) had a BMI of 30 or higher. This contrasts with findings from the Rotterdam Study, which reported that overweight or obese individuals had a lower risk of inguinal hernia [11]. Another population-based incidence study, which took place in Olmsted County, reviewed all inguinal hernia repair surgeries performed on adult residents and found that obesity may be considered a protective factor [19]. The inverse relationship observed in some studies may be attributed to several explanations: 1) Excess pre-peritoneal fat or intra-abdominal fat could provide a barrier effect by acting as a "plug" to prevent herniation of abdominal contents. 2) Obese patients could have poor overall health due to obesity related comorbidities, making them unsuitable candidates for an elective operation. 3) Obese patients are less able to perform strenuous physical exercise, and 4) When mentioning the self-awareness of an inguinal hernia, it would be more difficult in obese individuals due to body habitus.

Constipation was noted in 81 patients (32.4%) in this cohort. This finding is supported by previous studies linking altered bowel habits to an increased risk of inguinal hernia, such as a case control study among 100 cases who visited the General Surgery Outpatient Unit, Harran University, Sanliurfa, Turkey, and 100 healthy controls [20] and another prospective observational study was conducted for 2 years at the Bakirköy Dr. Sadi Konuk Training and Research Hospital General Surgery Clinic, which found that constipation is one of the independent risks for incarceration [21]. Straining during bowel movements elevates intra-abdominal pressure, a known risk factor for hernia development.

A positive family history of inguinal hernia was reported by 56 patients (22.4%). This finding is consistent with earlier research between January 2002 and January 2004, among male patients who presented with primary inguinal hernia at the general surgical in the University of Hong Kong Medical Centre, which indicated that individuals with a family history are at a higher risk, with one study noting an odds ratio of 8.73. Genetic factors likely play a role in predisposing individuals to hernia development [8].

This study recommends initiating public health campaigns that focus on the dangers of heavy lifting without proper technique, particularly for individuals engaged in manual labor. Educate the public on modifiable risk factors such as smoking cessation, healthy weight management, and treatment of chronic cough and constipation. Implement targeted screening programs for high-risk populations, particularly men over 40, individuals with a positive family history, and those in occupations involving manual labor. Include hernia risk assessments in routine primary care check-ups for these groups.

Conduct larger and longitudinal studies across different regions of Iraq to validate and expand upon these findings. Include female patients and establish control groups in future research for comparative analysis.

This study is strengthened by its focused design on a high-risk population (male patients), adequate sample size, and use of a structured questionnaire to assess multiple lifestyle, clinical, and demographic variables. The application of both univariate and multivariate analyses enhances the reliability of the findings by controlling for potential confounders. Additionally, this research fills a regional knowledge gap by providing localized data from Iraq, a setting often underrepresented in hernia-related research.

Limitations: Variables such as smoking history, heavy lifting, constipation, and family history were collected via self-reported questionnaires. This introduces recall bias and social desirability bias, which may result in underreporting or overreporting of behaviors and symptoms. This limitation means the results should be interpreted with caution. Still, the findings offer valuable insight and form a strong foundation for future larger or longitudinal studies.

5. Conclusions

This study provides valuable insight into the socio-demographic, lifestyle, and clinical risk factors associated with inguinal hernia among male patients in Iraq. Heavy lifting, smoking, chronic cough, and family history were significantly associated with increased risk of inguinal hernia among Iraqi males. Among these, heavy lifting and smoking emerged as the most prevalent and statistically significant risk factors. While obesity did not show a significant independent association in multivariate analysis, its role

cannot be overlooked, especially in the context of intra-abdominal pressure and other comorbidities.

Conflicts of Interest

The authors declare no conflicts of interest related to this manuscript.

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Institutional Review Board (IRB)

IRB approval was obtained from Wasit University/College of Medicine on December 1st, 2022.

Large Language Model

We have employed an advanced Large Language Model (LLM) to enhance and refine the English-language writing. This process focused solely on improving the text's clarity and style, without generating or adding any new information to the content.

Authors Contribution

All authors contributed equally in conceptualization, methodology, software, writing the draft, and approving the final manuscript.

Data Availability

Data supporting the findings of this study are available from the corresponding author upon reasonable request.

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