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Prevalence and associated factors of external hernia among adult patients visiting the Surgical Outpatient Department in the University of Gondar Comprehensive Specialized Hospital, Northwest Ethiopia: A cross-sectional study

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Abstract

Objectives: The aim this study was to assess the prevalence and associated factors of external hernia among adult patients visiting surgical outpatient department at the University of Gondar Comprehensive Specialized Hospital, Northwest Ethiopia.

Study design: An institution-based cross-sectional study was conducted from April to june 2020

Study setting: University of Gondar Comprehensive Specialized Hospital

Participants: All adult patients above 18 years old who visited the surgical OPD at the UOG Comprehensive Specialized Hospital

Outcome: Prevalence of external hernia

Result: A total of 403 study participants were involved in this study with a response rate of 100%. The prevalence of external hernia was 11.7% (95%CI; 8.8, 15.1). Epigastric hernia had the highest prevalence 16 (34%) followed by inguinal hernia 14(29.8%). Old age (AOR=2.47, 95% CI; 1.06, 5.78), constipation (AOR=3.67, 95% CI; 1.68, 8.11), chronic cough (AOR=5.18, 95% CI; 2.17, 12.3) and lifting of heavy objects (AOR=7.39, 95% CI; 3.36, 16.2) had a statistically significant association with external hernia.

Conclusion: Regardless of hardly any significant gender difference, the overall prevalence of external hernia was high**.** Old age, constipation, chronic cough, and lifting of heavy objects were found to be significantly associated with external hernia. Patients who have constipation and cough should get appropriate treatment in time and those who are engaged in an occupation that requires strenuous activities and older age groups better to reduce workload.

Strength and limitation

- ✓ The study is the first of its kind in Ethiopia.
- ✓ The study is also comprehensive which includes most of the external hernia types.

- ✓ It could not establish a cause-effect relationship because of the cross-sectional nature of the study design.
- ✓ In addition, this study was an institution based and the findings may not fully reflect the entire population and also possible that recall bias may have been introduced.

Introduction

Hernia is defined as a protrusion of part of the contents of the abdominal cavity through a weakness in the abdominal wall (1). Abdominal wall hernias are the most frequently encountered surgical condition that affects all age groups regardless of sex (2). Globally the prevalence of abdominal wall hernia was 1.7% for all ages (3). Abdominal wall hernias are accounting for 15% - 18% of all surgical procedures (4, 5), and annually more than 20 million hernias are operated on worldwide (6). There are country-specific studies demonstrating the prevalence of external hernia. For instance, in the general Russian population, the prevalence of external hernia was 20.9% (7). In Arar City, Northern Saudi Arabia the prevalence of abdominal hernia was 11.5% (2). Out of the external hernias, an inguinal hernia is the most commonly observed type which accounts for about 75% of all abdominal wall hernias (8, 9). A study conducted in Sierra Leone revealed that the prevalence of hernia was 7.10% (10). The overall incidence of inguinal hernia in Africa has been estimated and ranged between 60 and 175 inguinal hernias per 100,000 (11). In sub-Saharan Africa countries, there are some reports demonstrating the prevalence of inguinal hernia between 7.7 and 30 % (12, 13) and incisional hernia ranged between 3 to 15% (8, 14, 15), femoral hernia 2.5 to 7.4% (8, 15, 16), and epigastric hernia 3.4 to 3.9% (8, 14, 15).

In a study conducted in Addis Ababa, Ethiopia, groin hernia was found to be the most common form and accounting for 66.3% followed by recurrent hernias 28.5% and incisional hernias 21.4%

(17). Different factors that are associated with external hernias have been identified by previous studies. This include, muscular weakness (18), repeated pregnancies, previous history of surgery and sex (2), age (2, 7, 19), chronic cough (20, 21), constipation (22), smoking (23-25), lifting of heavy objects and strenuous work activities (21, 26-28), and family history of hernia (2, 7, 19). Hernias are among the commonest surgical conditions resulting in consequential morbidity and mortality in various parts of Africa (17, 29, 30). Untreated hernia can lead to life-threatening complications; such as strangulation, incarceration, and intestinal obstruction (31). Of these, strangulation is an acute and most serious surgical emergency and is probably with fatal consequences (32). In Nigeria and Sudan, the strangulated external hernia was the most common cause of intestinal obstruction, accounting for 56.9% and 27.7% of cases respectively (29). Following hernia surgery, post-surgical complications, hernia recurrence, infected and non-infected fluid collections, and complications related to prosthetic material are also common (31). A great many deaths could also occur due to a lack of adequate surgical care for inguinal hernia disease almost daily in remote rural communities (33).

Even if documentation concerning the magnitude and risk factors of external hernia have the greatest importance to the clinical practitioners and the society at large. But, until this study was done, there were very limited epidemiological studies in the world. And also, in Ethiopia information with respect to the prevalence and risk factors of external hernia has not been documented. Therefore, the aim of the present study is to assess the prevalence and associated factors of external hernia among adult patients visiting the surgical outpatient department (OPD) at the University of Gondar Compressive Specialized Hospital. Finally, the output of the present study will hopefully help clinicians and policymakers to design a reliable strategy.

Methods

Study design and setting

An institution-based cross-sectional study was conducted from April to June 2020 G.C among adult surgical patients who visited the surgical outpatient department (OPD) at the UOG Comprehensive Specialized Hospital. The hospital was founded in1954 and it is located in the North Gondar administrative zone, Amhara National Regional State, which is about 750 km Northwest of Addis Ababa (the capital city of Ethiopia). According to the 2015 population projection of major cities in Ethiopia, the total population size of Gondar town was estimated to be 323,900. Currently, Gondar town has one Referral Hospital and eight government Health Centers. University of Gondar Comprehensive Specialized Hospital is a teaching hospital, which serves more than five million people of the North Gondar zone and peoples of the neighboring zones. It is estimated that around 21,000 patients visit the surgical OPD per year.

Population, sample size determination and sampling procedure

All adult patients above 18 years old who visited the surgical OPD at the UOG Comprehensive Specialized Hospital were the source population. The study population was all adult patients above 18 years old who visited the surgical OPD during the time of data collection in the UOG Comprehensive Specialized Hospital. Patients who were unable to communicate, mentally, and severely ill were excluded from the study. Sample size and sampling procedure have been published elsewhere (34).

Variables and Data collection procedures

The dependent variable for this study was external herma. Participants who had at least one of the external hernia types either inguinal, epigastric, umbilical, para-umbilical, femoral or incisional hernias were considered as positive external hernia cases. The external hernia was diagnosed based

on history and physical examination. Data was collected on the socio demographic characteristics (age, sex, residence, educational status, occupation, marital status, and average monthly income), clinical factors (family history of hernia, heavy weight lifting, constipation, straining during urination, body mass index (BMI), previous history of abdominal surgery, history of abdominal trauma, chronic cough, and history of Ascites), behavioral and obstetric factors (smoking, alcohol intake, and parity). Chronic cough means a current or previous history of cough for more than one month, straining during urination means difficulty with urination for three months and above. Constipation means unsatisfactory defecation characterized by infrequent stool, difficulty in defecation, or both for more than three months (35). BMI was calculated by dividing weight in kg by height in meters square. BMI <18.5 kg/m2 was considered as underweight 18.5-24.9 kg/m2 as normal, 25-29.9 kg/m2 overweight and ≥30 kg/m2as obese (36). The interviewer-administered structured questionnaire which was adapted from different works of literature was used to collect data from study participants. Five nurses with a bachelor's degree were trained and employed to collect the overall data collection. The questionnaire was prepared in English and translated into Amharic and back to English for consistency of the tool. The tool was pre-tested 10% of a sample size at Debark primary hospital. Necessary adjustments were made based on the pre-test result.

Data processing and analysis

The survey data was entered and cleaned using EPI DATA version 3.1 and analyzed by STATA 14 software. Descriptive statistics were used and the findings were presented using texts, graphs, and tables. A logistic regression model was used to identify factors affecting external hernia. Variables with p-values 0.2 or less in the bi-variable logistic regression analysis were fitted in the multivariable analysis. Adjusted Odds Ratio (AOR) with a 95% Confidence Interval (CI) and p-

value <0.05 in the multivariable analysis were used to declare significant association with the outcome variable. Goodness of fitness of the model was checked by Hosmer and Lemeshow test.

Patient and public involvement

Patients and public were not involved in this study

Results

Socio-demographic characteristics

A total of 403 study participants were involved in this study with a response rate of 100%. The median age of the participants was 38 years old (IQR: 28, 52). Both sexes had nearly equal frequency, 207 (51.3%) were female subjects. With regard to the educational status more than half of the study participants, 210 (52.15%) had no formal education. Of the participants, 135 (33.5%) were farmers and 290 (72%) were married. Almost half of the study participants 200(49.6%) had an average monthly income of less than 1210 ETB (Table 1).

Clinical, behavioral, and obstetric characteristics

Of the total participants, 19(4.8%) of the study participants had a family history of external hernia, and one-fourth (102) of the study participants had a history of alcohol intake. Among female study participants, the majority of the female 153(74%) gave at least one birth. Out of the total study participants, 96 (24%) had constipation, and one-fifth (84) had a history of lifting heavy objects 84 (20.9%) (Table 2).

Prevalence of external hernia

The result of this study revealed that among 403 study participants 47 had external hernia with an overall prevalence of 11.7 % (95%CI; 8.8, 15.1). The frequency of external hernia was most common in ages above 45 years 29(61.8%). The prevalence of external hernia among male and female participants was 11.73% (95% CI: 7.59, 17.09) and 11.59% (95%CI: 7.57, 16.76)

respectively. Out of the total of hernia cases that occurred among females, 23(96%) of them were diagnosed from those who gave one and above birth, and 14 (58.4%) of them had a history of more than four deliveries (grand multipara). Of the total cases of external hernia, epigastric hernia had the highest prevalence 16 (34%) followed by inguinal hernia 14(29.8%) (Figure 1). About 41(10.1%) of the participants had a history of abdominal surgery, subsequently, 5(12.2%) of them develop an incisional hernia. The proportions of direct and indirect inguinal hernia were 4 (28.6%) and 10(71.4%), respectively. The inguinal hernia was identified on the right sides in 12 (85.7%) and on the left sides in 2 (14.3%) of the cases. Except for one case of external hernia which causes complications (incarceration), the rest were reducible with hardly any complications. All external hernia cases were newly diagnosed.

Factors associated with an external hernia

Bivariable and multivariable logistic regression models have been run. The multivariable logistic regression analysis revealed that old age, constipation, chronic cough, and lifting of heavy objects had a significant association with the occurrence of external hernia. The odds of having external hernia were 2.47 times higher among participants with age groups between 46 and 84 as compared to age between 19 and 45 (AOR=2.47, 95%CI; 1.06, 5.78). The odds of having an external hernia were 3.67 times higher among participants who had constipation as compared to their counterparts (AOR=3.67, 95%CI; 1.68, 8.11). The patients who had chronic cough had 5.18 times higher odds of having external hernia as compared to their counterparts (AOR=5.18, 95%CI; 2.17, 12.3). The odds of having an external hernia were 7.39 times higher among participants lifting heavy objects as compared to participants who didn't (AOR=7.39, 95%CI; 3.36, 16.2) (Table 3).

Discussion

This study assessed the prevalence of external hernia and its associated factors among adult patients visiting the surgical OPD at the University of Gondar Comprehensive Specialized Hospital Northwest Ethiopia.

The prevalence of external hernia was found to be 11.7%. The result is consistent with a study conducted in Arar City, Northern Saudi Arabia 11.5% (2). However, it is lower than the study from Russia which reported the prevalence to be 20.9% (7). This could be due to the difference in study settings. In Russia community-based studies was conducted to indicate the prevalence of external hernia. But the current study was conducted in the hospital, and the majority of hernia cases are asymptomatic because of this patient might not frequently visit the hospital which may reduce the prevalence of external hernia (37). Another possible reason could be the difference in the study population and the outcome of a measurement. The study in Russia, participants above the age of 10 years were included and also participants who had a previous history of hernia repair were considered as positive hernia cases. Furthermore, in addition to history and physical examination, ultrasonography was used as an outcome of measurement which might increase the prevalence rate. On the other hand, the prevalence found in this study is higher than a study done in Sierra Leone (7.01%) (10). This might be due to the difference in the study population and the nature of the outcome. The study from Sierra Leone, participants were only male, and also only groin hernias were considered as overall external hernia cases, therefore, this might decrease the prevalence. According to the present study, of the total hernia cases, epigastric hernias had a slightly higher proportion (34%), but the proportion of epigastric hernia in other studies done worldwide is much lower and ranged between 3.4 and 8.1% (14, 15, 38). According to studies conducted in Nigeria, Egypt and India the proportion of inguinal hernia was found to be 70.2%

(39), 56% (14), and 21.8% (38), respectively. However, the proportion of inguinal hernia in the present study was found to be 29.8%. A study conducted in Saudi Arabia showed that para-umbilical hernia had the highest prevalence 33.9% (2), whereas in other studies it ranged from 2.9 to 22.7% (14, 15, 19). In the present study, on the other hand, it was the less frequent type of hernia (4.26%) relative to other types. In the current study, the proportion of umbilical hernia was 17% and possibly ranged between 4.9 and 20.8% in different studies (2, 7, 15). Studies conducted elsewhere reported that the incisional hernia ranged between 2.4 and 5.7 (7, 19, 38), which is lower than the finding of this study 10.64%. The prevalence of femoral hernia in our study was found to be 4.26% which is in line with the finding of studies conducted across the world that lie between 2.5 and 7.4% (8, 15, 16).

In this study, higher odds of external hernia were observed among participants who were older age compared to younger age groups. This finding is supported by different studies (7, 19, 20). The reason could be attributed to the degenerative weakness of abdominal muscles and fibrous tissue in the elderly age group leads to loss of abdominal muscle strength and resistance to high intra-abdominal pressure which may cause herniation (40). Another reason could be, as age increases the blood testosterone level decrease, and estrogen level will be enhanced via the aromatase enzyme. Lower abdominal muscles (LAM) are sensitive to the estrogen hormone and express very high levels of estrogen receptor-α, in turn, leads to atrophy and fibrosis of LAM which may result in the occurrence of hernia in males (41). On the other hand, when women reach postmenopausal age, they start to accumulate intra-abdominal adipose tissue which will cause separation of muscle bundle and layers, weakening of aponeurosis, and then predispose to hernia (42).

In the current study, the study participants with constipation were more likely to have an external hernia as compared to their counterparts. The same result is obtained by the studies done in

America and India (43, 44). This could be due to prolonged straining during defecation which generates high intra-abdominal pressure and results in weakness of abdominal muscle, which in turn, leads to a hernia (45).

In the present study, the study participants with a chronic cough had higher odds of having external hernia as compared to the corresponding groups. Our finding is strongly supported by the studies done elsewhere (20, 21, 46, 47). This may be due to the repeated occurrence of an increase in the intra-abdominal pressure during coughing which results in weakness of abdominal muscle which precedes herniation (48).

Our finding clearly presented that lifting heavy objects had higher odds of having external hernia than their counterparts which was found to be the commonly encountered scenario. The notion of our study is supported by different studies (28, 46, 49), This could be attributed to increasing intra-abdominal pressure causing breakage in the fibers of transversals fascia, which leads to muscle weakness and results in the occurrence of hernia (58).

Generally speaking, herniation has been attributed to high intra-abdominal pressures from constipation, chronic cough, and lifting heavy objects. The study is the first of its kind in the study area and Ethiopia as well. The study is also comprehensive which includes most of the external hernia types data were recorded by well-trained data collectors under the close supervision of the investigators. However, there are some limitations of this study such as it could not establish a cause-effect relationship because of the cross-sectional nature of the study design. In addition, this study was institution-based and the findings may not fully reflect the entire population and also possible that recall bias may have been introduced.

Conclusion

Regardless of hardly any significant gender difference, the external hernia was one of the commonest surgical procedures**.** Old age, constipation, chronic cough, and lifting of heavy objects were found to increase the odds of having an external hernia. Health professionals better to identify and intervene external hernias early, especially for risk groups. Patients who have constipation and cough should get appropriate treatment in time and those who are engaged in an occupation that requires strenuous activities and older age groups should reduce their workload. To show the real burden of the disease community-based studies should be conducted and there is a need for further studies regarding the burden and risk factors of external hernia in a different area of the country using ultrasonography as an outcome measurement.

Abbreviations

AOR: Adjusted Odds Ratio

BMI: Body Mass Index

BP: Blood Pressure

CI: Confidence Interval

COR: Crude Odds Ratio

IAP: Intra-abdominal pressure

LAM: Lower abdominal muscle

OPD: Outpatient department

UOG: University of Gondar

USA: United State of America

Declarations

Ethics Approval and Consent to Participate

Ethical approval was obtained from the ethical review committee of the College of Medicine and Health Sciences, University of Gondar (Reference No 1856/12 dated March 18, 2020). A support letter was obtained from the University of Gondar Research and Community Service and surgery department. Participants were informed about the purpose, objectives, and their right to and not to participate in the study. Written informed consent was obtained from the study participants. To keep confidentiality, respondent's names and other personal identifiers were not included. The collected data were password protected.

Consent for publication

"Not applicable".

Availability of data and material

Data will be available from the corresponding author upon request

Competing Interests

There is no competing of interests related to this work

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Table 1: Socio-demographic characteristics of adult patients visiting surgical OPD at the UOG Comprehensive Hospital, Ethiopia, 2020 (n=403)

Variable	Frequency	Percentage
Sex		
Male	196	48.7
Female	207	51.3
Age		
19-33	161	40.0
34-48	120	30.0
49-63	81	20.1
64-78	35	8.5
79-84	6	1.5
Residence		
Urban	220	54.6
Rural	183	45.4

Occupation		
Farmer	135	33.5
Merchant	31	7.7
Civil servant	58	14.4
Housewife	98	24.3
Student	38	9.4
Daily laborer	18	4.6
Others *	25	6.2
Religion		
Orthodox	388	96.2
Muslim	11	2.8
Protestant	4	1.0
Educational status		
No formal education	210	52.1
Primary education	42	10.4
Secondary education	63	15.7
College or above	88	21.8
Marital status		
Married	290	72
Divorced	28	7
Widowed	9	2.2
Single	76	18.6
Average monthly income		
<1210	200	49.6
1211-8970	194	48.1
>8971	9	2.3

Others*: -unemployed, solider, driver, retire and artist

Table2: Clinical, behavioral and obstetric characteristics of adult patients visiting surgical OPD at the UOG Comprehensive Hospital, Ethiopia, 2020 (n=403)

Variable	Frequency	Percentage (%)
Family history of hernia		
Yes	19	4.8
No	384	95.2
Smoking		
No smoking	385	98.0
Previously smoking	6	1.5
Currently smoking	2	0.5

Alcohol intake		
No alcohol	301	74.7
Previous alcohol intake	32	8.0
Current alcohol intake	70	17.3
Parity		
Nulliparous	54	26.0
Primiparous	22	10.7
Multi parous	68	32.9
Grand multipara	63	30.4
Straining during urination		
Yes	64	15.9
No	339	84.1
Constipation		
Yes	96	23.9
No	307	76.1
Prolonged cough		
Yes	42	10.4
No	361	89.6
Lifting of heavy objects		
Yes	84	20.9
No	319	79.1
Previous abdominal surgery		
Yes	40	10.0
No	363	90.0
History of abdominal trauma		
Yes	13	3.2
No	390	96.8
History of Ascites		
Yes	5	1.24
No	398	98.76
BMI		
14-17.9	58	14.39
18-24.9	311	77.17
25-29.9	27	6.70
30-34.9	7	1.74

Table 3: Multiple logistic regression output for the factors associated with external hernia among adult patients visiting surgical OPD at the UOG Comprehensive Hospital, Ethiopia, 2020 (n=403)

Variable	External hernia		Crude OR (95%CI)	Adjusted OR (95%CI)	P-value
	Yes	No			
Age					
19-45	18	249	1	1	
46-84	29	107	3.74(1.99, 7.04)	2.47(1.06, 5.78)	0.036
Residence					
Urban	16	204	1	1	
Rural	31	152	2.6 (1.37, 4.92)	0.73(0.30,1.85)	0.55
Educational status					
No formal education	38	172	4.63(1.60, 13.4)	2.90(0.89, 9.4)	0.07
Primary and Secondary education	5	100	1.05(0.27, 4.03)	1.64(0.37, 7.08)	0.50
College or above	4	84	1	1	
Staining during urination					
Yes	16	48	3.31(1.68, 6.50)	0.83(0.33, 2.25)	0.712
No	31	308	1	1	
Constipation					
Yes	26	70	5.05(2.68, 9.51)	3.67(1.68, 8.11)	0.001
No	21	286	1	1	
Prolonged cough					
Yes	17	25	7.50(3.64, 15.4)	5.18(2.17,12.3)	0.000
No	30	331	1	1	
Lifting heavy objects					
Yes	29	55	8.81(4.58, 16.9)	7.39(3.36, 16.2)	0.000
No	18	301	1	1	
BMI					
14-17.9	7	51	1.15(0.48, 2.7)	1.35(0.4, 3.8)	0.56
18-24.9	33	278	1	1	
25-34.9	7	27	2.1(0.82,0.17)	3.01(0.95, 9.54)	0.06

AOR: Adjusted Odds Ratio; COR: Crude Odds Ratio; CI: Confidence-interval

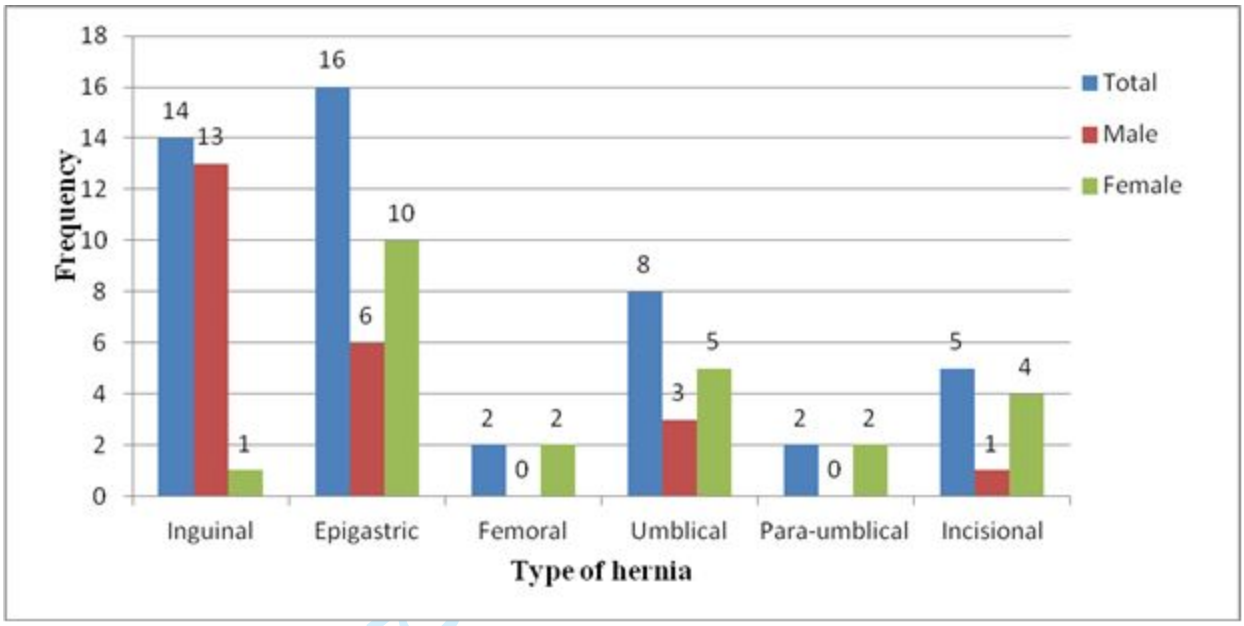

Figure 1: Bar graph that shows the frequency distribution of types of hernia with sex of adult patients visiting surgical OPD at the UOG Comprehensive Hospital, Ethiopia, 2020

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page Number
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-7
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6-7
		(*b*) Describe any methods used to examine subgroups and interactions	6-7
		(*c*) Explain how missing data were addressed	6-7
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	6-7
		(*e*) Describe any sensitivity analyses	6-7
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—e.g., numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7-8
		(b) Give reasons for non-participation at each stage	7-8
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7-8
		(b) Indicate number of participants with missing data for each variable of interest	7-8
Outcome data	15*	Report numbers of outcome events or summary measures	8
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8
		(*b*) Report category boundaries when continuous variables were categorized	8

		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	9
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9-11
Generalisability	21	Discuss the generalisability (external validity) of the study results	10-11
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Prevalence and associated factors of external hernia among adult patients visiting the Surgical Outpatient Department in the University of Gondar Comprehensive Specialized Hospital, Northwest Ethiopia: A cross-sectional study

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Abstract

Objectives: This study aimed to assess the prevalence and associated factors of external hernia among adult patients visiting the surgical outpatient department at the University of Gondar Comprehensive Specialized Hospital, Northwest Ethiopia.

Study design: An institution-based cross-sectional study was conducted from April 5to June 22, 2020

Study setting: University of Gondar Comprehensive Specialized Hospital (UOGCSH).

Participants: All adult patients above 18 years old who visited the surgical outpatient department (OPD) at the UOGCSH

Outcome: Prevalence of external hernia

Result: A total of 403 study participants were involved in this study with a response rate of 100%. The prevalence of external hernia was 11.7% (95%CI; 8.8, 15.1). The epigastric hernia had the highest prevalence 16 (34%) followed by inguinal hernia 14(29.8%). Old age (Adjusted odds ratio (OR)=2.47, 95% CI; 1.06, 5.78), constipation (AOR=3.67, 95% CI; 1.68, 8.11), chronic cough (AOR=5.18, 95% CI; 2.17, 12.3) and lifting of heavy objects (AOR=7.39, 95% CI; 3.36, 16.2) had a statistically significant association with external hernia.

Conclusion: Regardless of hardly any significant gender difference, the overall prevalence of external hernia was high**.** Old age, constipation, chronic cough, and lifting of heavy objects were found to be significantly associated with external hernia. Patients who have constipation and cough should get appropriate treatment in time and those who are engaged in an occupation that requires strenuous activities and older age groups better avoid lifting heavy objects.

Strength and limitation

- ✓ The study is the first of its kind in Ethiopia.
- ✓ The study is also comprehensive which includes most of the external hernia types.
- ✓ It could not establish a cause-effect relationship because of the cross-sectional nature of the study design.

- ✓ In addition, this study was institution-based and the findings may not fully reflect the entire population, we used only history and physical examination as a means of diagnosis for abdominal hernia, however, ultrasound was not used, and also possible that recall bias may have been introduced.

Introduction

Abdominal wall hernias are the most frequently encountered surgical condition that affects all age groups regardless of sex (1). Globally the prevalence of abdominal wall hernia was 1.7% for all ages (2). Abdominal wall hernias are accounting for 15% - 18% of all surgical procedures, and annually more than 20 million hernias are operated on worldwide (3-5). Country-specific studies are demonstrating the prevalence of external hernia. For instance, in the general Russian population, the prevalence of external hernia was 20.9% (6). In Arar City, Northern Saudi Arabia the prevalence of abdominal hernia was 11.5% (1). A study conducted in Sierra Leone revealed that the prevalence of groin hernia was 7.10% (7). Out of the external hernias, an inguinal hernia is the most commonly observed type which accounts for about 75% of all abdominal wall hernias (8). The overall incidence of inguinal hernia in Africa has been estimated and ranged between 60 and 175 inguinal hernias per 100,000 (9).In sub-Saharan Africa countries, some reports are demonstrating the prevalence of inguinal hernia between 7.7 to 30 % (10, 11), incisional hernia ranged between 3 to 15%, femoral hernia 2.5 to 7.4%, and epigastric hernia 3.4 to 3.9% (12-14). A study conducted in Addis Ababa, Ethiopia, indicated that groin hernia was found to be the most common form external hernia and accounted for 66.3% followed by recurrent hernias 28.5% and incisional hernias 21.4% (15). From the previous studies different factors have been identified which has an association with external hernias. This include, muscular weakness, repeated

pregnancies, previous history of surgery and sex, age, chronic cough, constipation , smoking, lifting of heavy objects and strenuous work activities, and family history of hernia (1, 16-22). Hernias are among the commonest surgical conditions resulting in consequential morbidity and mortality in various parts of Africa (23, 24). Untreated hernia can lead to life-threatening complications; such as strangulation, incarceration, and intestinal obstruction. Of these, strangulation is an acute and most serious surgical emergency and is probably with fatal consequences (25) . In Nigeria and Sudan, the strangulated external hernia was the most common cause of intestinal obstruction, accounting for 56.9% and 27.7% of cases respectively (24). A great many deaths could also occur due to a lack of adequate surgical care for inguinal hernia disease almost daily in remote rural communities (26).

Despite the common occurrence and clinical significance of external hernia, until this study was done, very limited epidemiological studies investigated magnitude and risk factors for external hernia in the world. Therefore, the present study aims to assess the prevalence and associated factors of external hernia among adult patients visiting the surgical OPD at the UOGCSH. Finally, the output of the present study will hopefully help clinicians and policymakers to design a reliable strategy.

Methods

Study design and setting

An institution-based cross-sectional study was conducted from April 5 to June 22, 2020 G.C among adult surgical patients who visited the surgical OPD at the UOGCSH. The hospital was founded in1954 and it is located in the North Gondar administrative zone, Amhara National Regional State, which is about 750 km Northwest of Addis Ababa (the capital city of Ethiopia). According to the 2015 population projection of major cities in Ethiopia, the total population size

of Gondar town was estimated to be 323,900. Currently, Gondar town has one Referral Hospital and eight government Health Centers. UOGCSH.is a teaching hospital, which serves more than five million people of the North Gondar zone and peoples of the neighboring zones. It is estimated that around 21,000 patients visit the surgical OPD per year.

Population, sample size determination, and sampling procedure

The source and study population of this study were all adult patients above 18 years old who visited the surgical OPD and those who were during the time of data collection in the UOGCSH respectively. Patients who were unable to communicate, mentally, and severely ill were excluded from the study. The sample size was determined using a single population proportion formula, by using a 95% confidence interval, 0.05 margin of error, 5% non-response rate. As far as our search is concerned, there was no previous study conducted in the area and the expected proportion of hemorrhoids was considered to be 50%. Therefore, the final sample size was 403 and participants were selected using a systematic random sampling technique with skipping intervals of three.

Variables and Data collection procedures

The dependent variable for this study was external herma and the diagnosis performed by general surgeons based on history and physical examination. Participants who had at least one of the external hernia types either inguinal, epigastric, umbilical, para-umbilical, femoral or incisional hernias were considered as positive external hernia cases. Data was collected on the socio-demographic characteristics (age, sex, residence, educational status, occupation, marital status, and average monthly income), clinical factors (family history of hernia, heavy weight lifting, constipation, straining during urination, body mass index (BMI), previous history of abdominal surgery, history of abdominal trauma, chronic cough, and history of Ascites), behavioral and obstetric factors (smoking, alcohol intake, and parity). A chronic cough means a current or

previous history of cough for more than one month, straining during urination means difficulty with urination for three months and above. Constipation means unsatisfactory defecation characterized by infrequent stool, difficulty in defecation, or both for more than three months (27). The interviewer-administered structured questionnaire which was adapted from different works of literature was used to collect data from study participants. Five nurses with a bachelor's degree were trained and employed to collect the overall data collection.

The questionnaire was prepared in English and translated into Amharic and back to English for consistency of the tool. The tool was pre-tested in 10% of a sample size at Debark primary hospital two weeks before the main data collection. Necessary adjustments were made based on the pre-test result.

Data processing and analysis

The survey data were entered and cleaned using EPI DATA version 3.1 and analyzed by STATA 14 software. Descriptive statistics were used and the findings were presented using texts, graphs, and tables. A logistic regression model was used to identify factors affecting external hernia. Variables with p-values 0.2 or less in the bi-variable logistic regression analysis were fitted in the multivariable analysis. AOR with a 95% Confidence Interval (CI) and p-value <0.05 in the multivariable analysis were used to declare significant association with the outcome variable. The goodness of fitness of the model was checked by Hosmer and Lemeshow test.

Patient and public involvement

Patients were involved in this study

Results

Socio-demographic characteristics

A total of 403 study participants were involved in this study with a response rate of 100%. The median age of the participants was 38 years old (IQR: 28, 52). Both sexes had nearly equal frequency, 207 (51.3%) were female subjects and of the total participants 135 (33.5%) were farmers and 290 (72%) were married. Almost half of the study participants 200(49.6%) had an average monthly income of less than 25 US$ (Table 1).

Clinical, behavioral, and obstetric characteristics

Of the total participants, 19(4.8%) of the study participants had a family history of external hernia, and one-fourth (102) of the study participants had a history of alcohol intake. Among female study participants, the majority of the female 153(74%) gave at least one birth. From the total study participants, 96 (24%) had constipation, and one-fifth (84) had a history of lifting heavy objects 84 (20.9%) (Table 2).

Prevalence of external hernia

Of the total participants, 47 had external hernia and gives an overall prevalence of 11.7 % (95%CI; 8.8, 15.1). The frequency of external hernia was most common in ages above 45 years 29 (61.8%). The prevalence of external hernia among male and female participants was 11.73% (95% CI: 7.59, 17.09) and 11.59% (95%CI: 7.57, 16.76) respectively. Out of the total of hernia cases that occurred among females, 23(96%) of them were diagnosed from primiparas and multiparous, and 14 (58.4%) of them had a history of more than four deliveries (grand multipara). Of the total cases of external hernia, epigastric hernia had the highest prevalence 16 (34%) followed by inguinal hernia 14(29.8%) (Figure 1). About 41(10.1%) of the participants had a history of abdominal surgery, subsequently, 5(12.2%) of them develop an incisional hernia. Only one case of external hernia

was present with complications (incarceration), the rest were reducible with hardly any complications. All external hernia cases were newly diagnosed.

Factors associated with an external hernia

Bivariable and multivariable logistic regression models have been run. The multivariable logistic regression analysis revealed that old age, constipation, chronic cough, and lifting of heavy objects had a significant association with the occurrence of external hernia. The odds of having external hernia were 2.47 times higher among participants with age groups between 46 and 84 as compared to age between 19 and 45 (AOR=2.47, 95%CI; 1.06, 5.78). The odds of having an external hernia were 3.67 times higher among participants who had constipation as compared to their counterparts (AOR=3.67, 95%CI; 1.68, 8.11). The patients who had chronic cough had 5.18 times higher odds of having external hernia as compared to their counterparts (AOR=5.18, 95%CI; 2.17, 12.3). The odds of having an external hernia were 7.39 times higher among participants lifting heavy objects as compared to participants who didn't (AOR=7.39, 95%CI; 3.36, 16.2) (Table 3).

Discussion

This study assessed the prevalence of external hernia and its associated factors among adult patients visiting the surgical OPD at the UOGCSH, Northwest Ethiopia.

The prevalence of external hernia was found to be 11.7%. The result is consistent with a study conducted in Arar City, Northern Saudi Arabia 11.5% (1). However, it is lower than the study from Russia which reported the prevalence to be 20.9% (6). This could be due to the difference in study settings. In Russia, community-based studies were conducted to indicate the prevalence of external hernia. But the current study was conducted in the hospital, and the majority of hernia cases are asymptomatic so, asymptomatic patients might not frequently visit the hospital which may reduce the prevalence of external hernia (28). Another possible reason could be the difference

in the study population and the outcome of a measurement. In a study in Russia, participants above the age of 10 years were included, and also participants who had a previous history of hernia repair were considered positive hernia cases. Furthermore, in addition to history and physical examination, ultrasonography was used as an outcome of measurement which might increase the prevalence rate. According to the present study, of the total hernia cases, epigastric hernias had a slightly higher proportion (34%), but the proportion of epigastric hernia in other studies done worldwide is much lower and ranged between 3.4 and 8.1% (12, 13, 29). According to studies conducted in Nigeria, Egypt and India the proportion of inguinal hernia was found to be 70.2%, 56%, and 21.8% respectively (12, 29, 30). However, the proportion of inguinal hernia in the present study was found to be 29.8%.

In this study, higher odds of external hernia were observed among participants who were older age compared to younger age groups. This finding is supported by different studies elsewhere (6, 16, 17). The reason could be attributed to the degenerative weakness of abdominal muscles and fibrous tissue in the elderly age group leads to loss of abdominal muscle strength and resistance to high intra-abdominal pressure which may cause herniation (31, 32). Another reason could be, as age increases the blood testosterone level decrease, and estrogen level will be enhanced via the aromatase enzyme. Lower abdominal muscles (LAM) are sensitive to the estrogen hormone and express very high levels of estrogen receptor-α, in turn, leads to atrophy and fibrosis of LAM which may result in the occurrence of hernia in males (33). On the other hand, when women reach postmenopausal age, they start to accumulate intra-abdominal adipose tissue which will cause separation of muscle bundle and layers, weakening of aponeurosis, and then predisposing to hernia (34).

In the current study, the study participants with constipation were more likely to have an external hernia as compared to their counterparts. The same result is obtained by the studies done in America and India (18, 35). This could be due to prolonged straining during defecation which generates high intra-abdominal pressure and results in weakness of abdominal muscle, which in turn, leads to a hernia (36).

In the present study, the study participants with a chronic cough had higher odds of having external hernia as compared to the corresponding groups. Our finding is strongly supported by the studies done elsewhere (17, 37, 38). This may be due to the repeated occurrence of an increase in the intra-abdominal pressure during coughing which results in weakness of abdominal muscle which precedes herniation (39).

Our finding presented that lifting heavy objects had higher odds of having external hernia than their counterparts which was found to be the commonly encountered scenario. The notion of our study is supported by different studies (22, 38, 40), This could be attributed to increasing intra-abdominal pressure causing breakage in the fibers of transversals fascia, which leads to muscle weakness and results in the occurrence of hernia (41).

The study is the first of its kind in the study area and Ethiopia as well. The study is also comprehensive which includes most of the external hernia types data were recorded by well-trained data collectors under the close supervision of the investigators. However, there are some limitations of this study such as it could not establish a cause-effect relationship because of the cross-sectional nature of the study design. In addition, this study was institution-based, the findings may not fully reflect the entire population, we used only history and physical examination as a means of diagnosis for abdominal hernia but ultrasound was not used and also possible that recall bias may have been introduced.

Conclusion

Regardless of hardly any significant gender difference, the external hernia was one of the commonest surgical procedures**.** Old age, constipation, chronic cough, and lifting of heavy objects were found to increase the odds of having an external hernia. Health professionals better identify and intervene in external hernias early, especially for risk groups. Patients who have constipation and cough should get appropriate treatment in time and those who are engaged in an occupation that requires strenuous activities and older age groups should reduce lifting of heavy objects. To show the real burden of the disease community-based studies should be conducted and there is a need for further studies regarding the burden and risk factors of external hernia in a different area of the country using ultrasonography as an outcome measurement.

Abbreviations

AOR: Adjusted Odds Ratio

BMI: Body Mass Index

BP: Blood Pressure

CI: Confidence Interval

COR: Crude Odds Ratio

IAP: Intra-abdominal pressure

LAM: Lower abdominal muscle

OPD: Outpatient department

UOG: University of Gondar

USA: United State of America

Declarations

Authors contribution

AAK, SYT, MMH, AGW, and MAD conceived and designed the study, acquired, analyzed and interpreted data, prepared the manuscript and approved the final manuscript.

Consent for publication

"Not applicable".

Availability of data and material

Data will be available from the corresponding author upon request

Competing Interests

There is no competing of interests related to this work

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Ethics statement

Ethical approval was obtained from the ethical review committee of the College of Medicine and Health Sciences, University of Gondar (Reference No 1856/12 dated March 18, 2020). A support

letter was obtained from the University of Gondar Research and Community Service and surgery department. Participants were informed about the purpose, objectives, and their right to and not to participate in the study. Written informed consent was obtained from the study participants. To keep confidentiality, respondents' names and other personal identifiers were not included. The collected data were password protected.

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Table 1: Socio-demographic characteristics of adult patients visiting surgical OPD at the UOGCH, Ethiopia, 2020 (n=403)

Variable	Frequency	Percentage
Sex		
Male	196	48.7
Female	207	51.3
Age		
19-33	161	40.0
34-48	120	30.0
49-63	81	20.1
64-78	35	8.5
79-84	6	1.5
Residence Urban	220	54.6
Rural	183	45.4
Occupation		
Farmer	135	33.5
Merchant	31	7.7
Civil servant	58	14.4
Housewife	98	24.3
Student	38	9.4
Daily laborer	18	4.6
Others *	25	6.2
Religion		
Orthodox	388	96.2
Muslim	11	2.8
Protestant	4	1.0
Educational status		
No formal education	210	52.1
Primary education	42	10.4
Secondary education	63	15.7
College or above	88	21.8
Marital status		
Married	290	72
Divorced	28	7
Widowed	9	2.2

Single	76	18.6
Average monthly income in US$		
<25	200	49.6
26-185	194	48.1
>186(1)	9	2.3

Others*: -unemployed, solider, driver, retire and artist

Table2: Clinical, behavioral and obstetric characteristics of adult patients visiting surgical OPD at the UOGCH, Ethiopia, 2020 (n=403)

Variable	Frequency	Percentage (%)
Family history of hernia		
Yes	19	4.8
No	384	95.2
Smoking		
No smoking	385	98.0
Previously smoking	6	1.5
Currently smoking	2	0.5
Alcohol intake		
No alcohol	301	74.7
Previous alcohol intake	32	8.0
Current alcohol intake	70	17.3
Parity		
Nulliparous	54	26.0
Primiparous	22	10.7
Multi parous	68	32.9
Grand multipara	63	30.4
Straining during urination		
Yes	64	15.9
No	339	84.1
Constipation		
Yes	96	23.9
No	307	76.1
Prolonged cough		
Yes	42	10.4
No	361	89.6
Lifting of heavy objects		
Yes	84	20.9
No	319	79.1
Previous abdominal surgery		

Yes	40	10.0
No	363	90.0
History of abdominal trauma		
Yes	13	3.2
No	390	96.8
History of Ascites		
Yes	5	1.24
No	398	98.76
BMI		
14-17.9	58	14.39
18-24.9	311	77.17
25-29.9	27	6.70
30-34.9	7	1.74

Table 3: Multiple logistic regression output for the factors associated with external hernia among adult patients visiting surgical OPD at the UOGCH, Ethiopia, 2020 (n=403)

Variable	External hernia		Crude OR (95%CI)	Adjusted OR (95%CI)	P-value
	Yes	No			
Age					
19-45	18	249	1	1	
46-84	29	107	3.74(1.99, 7.04)	2.47(1.06, 5.78)	0.036
Residence					
Urban	16	204	1	1	
Rural	31	152	2.6 (1.37, 4.92)	0.73(0.30,1.85)	0.55
Educational status					
No formal education	38	172	4.63(1.60, 13.4)	2.90(0.89, 9.4)	0.07
Primary and Secondary education	5	100	1.05(0.27, 4.03)	1.64(0.37, 7.08)	0.50
College or above	4	84	1	1	
Staining during urination					
Yes	16	48	3.31(1.68, 6.50)	0.83(0.33, 2.25)	0.712
No	31	308	1	1	
Constipation					
Yes	26	70	5.05(2.68, 9.51)	3.67(1.68, 8.11)	0.001
No	21	286	1	1	
Prolonged cough					
Yes	17	25	7.50(3.64, 15.4)	5.18(2.17,12.3)	0.000
No	30	331	1	1	

Lifting heavy objects					
Yes	29	55	8.81(4.58, 16.9)	7.39(3.36, 16.2)	0.000
No	18	301	1	1	
BMI					
14-17.9	7	51	1.15(0.48, 2.7)	1.35(0.4, 3.8)	0.56
18-24.9	33	278	1	1	
25-34.9	7	27	2.1(0.82,0.17)	3.01(0.95, 9.54)	0.06

AOR: Adjusted Odds Ratio; COR: Crude Odds Ratio; CI: Confidence-interval

Figure 1: Bar graph that shows the frequency distribution of types of hernia with the sex of adult patients visiting surgical OPD at the UOGCH, Ethiopia, 2020

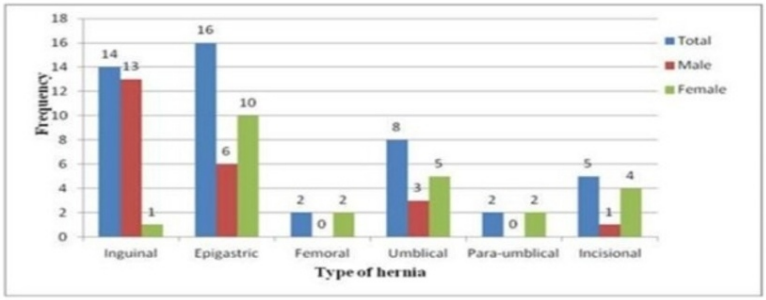

Figure 1: Bar graph that shows the frequency distribution of types of hernia with sex of adult patients visiting surgical OPD at the UOG Comprehensive Hospital, Ethiopia, 2020

89x89mm (300 x 300 DPI)

Annexes 1: Questionnaire (English version)

Questionnaire for research on the prevalence and associated factors of external hernia among adult surgical patients at university of Gondar comprehensive specialized hospital, North West Ethiopia in 2020.

Interviewer's Name_____ Date of interview_____

Supervisor's Name_____ Questionnaire No_____

Socio-demographic characteristics			
No	**Question**	**Response**	**Remark**
101	Sex	1) Male 2) Female	
102	Age	_____ years	
103	Place of residence	1) Urban 2) Rural	
104	Occupation of the study participant?	1) Civil servant 2) Merchant 3) Farmer 4) Housewife 5) Self employed 6) Daily laborer 7) Student 8) Others	Others specify _____
105	Religion of the study participant?	1) Orthodox 2) Muslim 3) Protestant 4) Catholic 5) Others	Others specify _____

106	Education status of the study participant?	1) Unable to read &write 2) Able to read & write 3) Primary education (grade 1–8) 4) Secondary education (grade 9–10) 5) Preparatory (grade 11–12) 6) College or above	
107	Marital Status of the study participant?	1) Single 2) Married 3) Divorced 4) Widowed 5) separated	
108	Average monthly income	_____ETB	
Clinical, obstetric and behavioral factors			
201	Anyone with hernias in your family?	1) Yes 2) No	
202	Do you smoke cigarettes?	1) Never 2) I used to smoke 3) I currently smoke	
203	How would you describe your alcoholic habit?	1) Never drank alcohol 2) Previous alcoholic 3) Current alcoholic	
204	How many children do you have? for women only	_____	
205	Do you have difficulty during	1) Yes	

	urination, hesitancy and dribbling? For male only	2) No	
206	If yes for question number 206, for how long do you have had this problem?	_____month	
207	Have you ever had difficulty during defecation?	1) Yes 2) No If yes for how long _____weeks	
208	Do you have a prolonged cough?	1) Yes 2) No If yes for how long weeks_____	
209	Have you ever had a history of abdominal surgery?	1) Yes 2) No	
210	Do you have a history of abdominal trauma?	1) Yes 2) No	
211	Do you have a history of lifting heavy objects?	1) Yes 2) No	
212	Have you ever had a history of ascites?	1) Yes 2) No	
214	BMI	_____kg/m^2	
215	Hernia	1) Yes 2) No	
216	If yes for question 215, what type of hernia?	1) Inguinal 2) Epigastric 3) Umbilical 4) Femoral 5) Incisional 6) Para umbilical	

		7) Others	
217	Reducibility of hernia during the presentation	1) Reducible 2) Non-reducible	
218	Complication of hernia	1) Present 2) Absent	

Annex- 2: Amharic version questionnaire

ቃለ-መጠይቅ

በጎንደር ዩኒቨርሲቲ ጤና ሳይንስ ኮሌጅ ከሚመጡ የቀዶ ህክምና ታካሚወች ላይ በሄርንያ ስርጭት ና ተያያዥ ምክንያቶች በተመለከተ ለማጥናት የዘጋጀ ቃለ-መጠይቅ፡

ቃል መጠይቅ የሚያደርግው ስም ----------

የተቆጣጣሪው ስም ----------

ቃል መጠይቅ የተደረገበት ቀን----------

የጥናቱ ተሳታፊ የሚስጥር ቁጥር----------

ሀ. ማህበራዊ መስተጋብር ጥያቄወች			
ተ.ቁ	**ጥያቄ**	**መልስ**	
101	ጾታ	1. ወ 2. ሴ	
102	እድሜ /በአመት/	_____	
103	የመኖርያ ቦታ	1.ከተማ 2.ገጠር	
104	ስራ	1. አርሶ አደር 2.ነጋደ 3.የመንግስት ተቀጣሪ 4.የቤት እመቤት	

		5.ተማሪ 6.የቀን ሰራተኛ 7.ስራ አጥ 8.ሌላ(ይጥቀሱ)	
105	ሃይማኖት	1.ኦርቶዶክስ 2.ሙስሊም 3.ፕሮቴስታንት 4.ካቶሊክ 5.ሌላ (ይጥቀሱ)	
106	የትምህርት ደረጃ	1.ማንበብናመጻፍ የማይችል 2.ማንበብናመጻፍ የሚችል 3. የመጀመሪያ ደረጃ /1-8/ 4. ሁለተኛ ደረጃ /9-12/ክፍል 5.ኮሌጅና ከዚያ በላይ	
107	የጋብቻ ሁኔታ	1.ያገባ 2. ያላገባ 3.የሞተባት 4.የተፋታ	
108	አማካ የወር ገቢ		
ከሄርንያ ጋር የተያያዙ ጥያቄወች			

201	ከቤተሰብወት ሄርንያ ያለበት አለ ?	1. አለ 2. የለም	
202	ሲጋራ ያጨሳሉ?	1. አጭሼ አላውቅም 2. አጨስ ነበር 3. አጨሳለው	
203	አልኮል መጠጥ ይጠጣሉ?	1. አልኮል ጠጥቸ አላውቅም 2. አልኮል እጠጣ ነበር 3. አልኮል እጠጣለው	
204	ስንት ልጆች አለወት? ለሴቶች ብቻ	_____ _____	
205	ሽንት በሚሸኑበት ጊዜ ሲሸኑ ማማጥ ፡ ሽንት የመጣ መስሎ መቅረት ና ሲሸኑ መንጠባጠብ አለወት ? ለወንዶች ብቻ	1. አለ 2. የለም	
206	ለጥያቄ ቁጥር 205 አለ ከሆነ መልስወት ችግሩ ለምንያህል ጊዜ ቆየ?	_____	
207	ሽንት ቤት በሚወጡበት ወቅት ሰገራ ለመውጣት ያስቸግርወታል?	1. አወ 2. አያስቸግርም	
208	ለብዙ ጊዜ የቆየ ሳል አለወት?	1. አለ 2. የለም ካለ ለምን ያክል ጊዜ_____	
209	የሆድ ቀዶ ህክምና ተደርጎልወት ያውቃል?	1. አወ 2. አዋያውቅም	
210	ሆድወት ላይ አደጋ ደርሶብወት ያውቃል?	1. አወ 2. አያውቅም	
211	በተደጋጋሚ ከባድ ዕቃ ያነሳሉ?	1. አወ 2. አያውቅም	

212	ሆድቃወት ዉሃ አለው ተብሎ በሀኪም ተነግሮወት ያውቃል?	1. አወ 2. አያውቅም	
213	የስውነት ብዛት ማውጫ	_____kg/m^2	
214	ሄርንያ	1. አለ 2. የለም	
215	ሄርንያ ካለ ምን አይንት ሄርንያ ነው ?	1. ኢንጉይናል 2. ኢፒጋስትሪክ 3. ፊሞራል 4. አምብላይካል 5. ፓራአምብላይካል 6. ኢንሲሽናል 7. ሌሎች	
216	ሄርንያው ወደ ሆድ እቃ ወስጥ ይመለሳል ወይስ አይመለስም?	1. ይመለሳል 2. አይመለስም	

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page Number
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-7
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6-7
		(*b*) Describe any methods used to examine subgroups and interactions	6-7
		(*c*) Explain how missing data were addressed	6-7
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	6-7
		(*e*) Describe any sensitivity analyses	6-7
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—e.g., numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7-8
		(b) Give reasons for non-participation at each stage	7-8
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7-8
		(b) Indicate number of participants with missing data for each variable of interest	7-8
Outcome data	15*	Report numbers of outcome events or summary measures	8
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8
		(*b*) Report category boundaries when continuous variables were categorized	8

		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	9
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9-11
Generalisability	21	Discuss the generalisability (external validity) of the study results	10-11
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Prevalence and associated factors of external hernia among adult patients visiting the Surgical Outpatient Department at the University of Gondar Comprehensive Specialized Hospital, Northwest Ethiopia: A cross-sectional study

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Abstract

Objectives: This study aimed to assess the prevalence and associated factors of external hernia among adult patients visiting the surgical outpatient department at the University of Gondar Comprehensive Specialized Hospital, Northwest Ethiopia.

Study design: Institution-based cross-sectional study was conducted from April 5to June 22, 2020

Study setting: University of Gondar Comprehensive Specialized Hospital (UOGCSH).

Participants: All adult patients above 18 years of age who visited the surgical outpatient department (OPD) at the UOGCSH

Outcome: Prevalence of external hernia

Result: A total of 403 study participants were involved in this study with a response rate of 100%. The prevalence of external hernia was 11.7% (95%CI; 8.8, 15.1). The epigastric hernia had the highest prevalence 16 (34%) followed by inguinal hernia 14(29.8%). Old age (Adjusted odds ratio (OR)=2.47, 95% CI; 1.06, 5.78), constipation (AOR=3.67, 95% CI; 1.68, 8.11), chronic cough (AOR=5.18, 95% CI; 2.17, 12.3) and lifting of heavy objects (AOR=7.39, 95% CI; 3.36, 16.2) had a statistically significant association with external hernia.

Conclusion: Regardless of hardly any significant gender difference, the overall prevalence of external hernia was high**.** Old age, constipation, chronic cough, and lifting of heavy objects were found to have a significant association with an external hernia. Patients who have constipation and cough should get appropriate treatment early.

Strength and limitation

- ✓ The study is comprehensive since it includes most of the external hernia types.
- ✓ It could not establish a cause-effect relationship because of the cross-sectional nature of the study design.
- ✓ Since the study is institution-based, the findings may not be generalized for the entire population.

- ✓ The study used only history and physical examination as a means of diagnosis for external hernia.
- ✓ Recall bias may have been introduced.

Introduction

Abdominal wall hernias are the most frequently encountered surgical condition that affects all age groups regardless of sex (1). Globally, the prevalence of abdominal wall hernia was 1.7% for all ages (2). Abdominal wall hernias, are accounting for 15% - 18% of all surgical procedures, and annually more than 20 million hernias are operated worldwide (3-5). Country-specific studies are demonstrating the prevalence of external hernia. For instance, in the general Russian population, the prevalence of external hernia was 20.9% (6). In Arar City, Northern Saudi Arabia, the prevalence of abdominal hernia was 11.5% (1). A study conducted in Sierra Leone revealed that the prevalence of groin hernia was 7.10% (7). Out of the external hernias, an inguinal hernia is a most commonly observed type accounts for about 75% of all abdominal wall hernias (8). The overall incidence of inguinal hernia in Africa has been estimated and ranged between 60 and 175 inguinal hernias per 100,000 (9). In sub-Saharan Africa countries, some studies reported the prevalence of inguinal hernia between 7.7 to 30 % 7.7 to 30 % (10, 11), incisional hernia ranged between 3 to 15%, femoral hernia 2.5 to 7.4%, and epigastric hernia 3.4 to 3.9% (12-14).

A study conducted in Addis Ababa, Ethiopia, indicated that groin hernia was found to be the most common form of external hernias which accounted for 66.3% of all the cases and it is followed by recurrent 28.5% and incisional hernias 21.4 % % (15). Previous studies different factors have been identified which have an association with external hernias. This includes,

muscular weakness, repeated pregnancies, previous history of surgery, sex, age, chronic cough, constipation, smoking, strenuous work activities, and family history of hernia (1, 16-22). Hernias are among the commonest surgical conditions causing significant number of morbidity and mortality in various parts of Africa (23, 24). Untreated hernia can lead to life-threatening complications; such as strangulation, incarceration, and intestinal obstruction. Of these, strangulation is an acute and most serious surgical emergency and is probably with fatal consequences (25) . In Nigeria and Sudan, the strangulated external hernia was the most common cause of intestinal obstruction, accounting for 56.9% and 27.7% of cases, respectively (24). A great many deaths could also occur due to a lack of adequate surgical care for inguinal hernia disease almost daily in remote rural communities (26).

Despite the common occurrence and clinical significance of external hernia, until this study was done, there are very limited epidemiological studies investigated to indicate the magnitude and risk factors for external hernia in the world. Therefore, the present study aims to assess the prevalence and associated factors of external hernia among adult patients visiting the surgical OPD at the UOGCSH. Finally, the output of the present study will hopefully help clinicians and policymakers to design a reliable strategy.

Methods

Study design and setting

An institution-based cross-sectional study was conducted from April 5 to June 22, 2020 G.C among adult surgical patients who visited the surgical OPD at the UOGCSH. The hospital was found in 1954 and it is located in the North Gondar administrative zone, Amhara National Regional State, which is about 750 km Northwest of Addis Ababa (the capital city of Ethiopia). According to the 2015 population projection of major cities in Ethiopia, the total population size

of Gondar town was estimated to be 323,900. Currently, Gondar town has one Referral Hospital and eight government Health Centers. UOGCSH is a teaching hospital, which serves more than five million people of the North Gondar zone and peoples of the neighboring zones. It is estimated that around 21,000 patients visit the surgical OPD per year.

Population, sample size determination, and sampling procedure

The source and study population of this study were all adult patients above 18 years who visited the surgical OPD and those who were available during the time of data collection in the UOGCSH respectively. Patients who were unable to communicate, mentally, and severely ill were excluded from the study. The sample size was determined using a single population proportion formula, by using a 95% confidence interval, 0.05 margin of error, 5% non-response rate. Since there was no previous study conducted in the area, we considered expected proportion of external hernia to be 50%. Hence, the final sample size was 403 and participants were selected using a systematic random sampling technique with skipping intervals of three.

Variables and Data collection procedures

The dependent variable for this study was having any of the external hernias such as: inguinal, epigastric, umbilical, para-umbilical, femoral and incisional hernias. The outcome was diagnosed by general surgeons based on history and physical examination. Data was collected on the socio-demographic characteristics (age, sex, residence, educational status, occupation, and average monthly income), clinical factors (family history of hernia, heavy weight lifting, constipation, straining during urination, body mass index (BMI), previous history of abdominal surgery, history of abdominal trauma, chronic cough, and history of Ascites), behavioral and obstetric factors (smoking, alcohol intake, and parity). Chronic cough was defined as current or previous history of cough for more than a month. Besides, straining during urination means difficulty of

urination that lasts for three or more months. Constipation was defined as unsatisfactory defecation which is characterized by infrequent stool, difficulty in defecation, or both for more than three month (27). Interviewer-administered structured questionnaire adapted from different literature was used to collect data. Five nurses with a bachelor's degree were trained and employed as data collector. The questionnaire was prepared in English and translated into Amharic and back to English for consistency of the tool. The tool was pre-tested in 10% of a sample size at Debark primary hospital two weeks before the main data collection. Necessary adjustments were made based on the pre-test result.

Patient and public involvement

Patients were involved in this study

Results

Socio-demographic characteristics

A total of 403 study participants were included in this study with a response rate of 100%. The median age of the participants was 38 years old (IQR: 28, 52). Both sexes had nearly equal frequency, 207 (51.3%) were female subjects. Of the total participants, 135 (33.5%) were farmers and almost half of the study participants 200(49.6%) had an average monthly income less than 25 US$ (Table 1).

Clinical, behavioral, and obstetric characteristics

Of the total participants, 19(4.8%) had a family history of external hernia, and one-fourth (102) had a history of alcohol intake. Among female study participants, the majority 153(74%) gave at least one birth. about quarter, 96 (24%) of the participants had constipation, and one-fifth had a history of lifting heavy objects 84 (20.9%) (Table 2).

Prevalence of external hernia

Of the total participants, 47 had external hernia and gives an overall prevalence of 11.7 % (95%CI; 8.8, 15.1). More than half of external hernia cases, 29 (61.8%), occurred at the age of above 45. The prevalence of external hernia among male and female participants was 11.73% (95% CI: 7.59, 17.09) and 11.59% (95%CI: 7.57, 16.76), respectively. Out of the total of hernia cases that occurred among females, 23(96%) of them were diagnosed from primiparas and multiparous, and 14 (58.4%) of them had a history of more than four deliveries (grand multipara). Of the total cases of external hernia epigastric and inguinal hernia had nearly equal prevalence 16 (34%) and 14(29.8%) respectively (Figure 1). About 41(10.1%) of the participants had a history of abdominal surgery and only 5(12.2%) of them had an incisional hernia. Only one case of external hernia was present with complications (incarceration) and all external hernia cases were newly diagnosed.

Factors associated with an external hernia

The multivariable logistic regression analysis revealed that old age, constipation, chronic cough, and lifting of heavy objects had a significant association with the occurrence of external hernia. The odds of having external hernia was 2.47 times higher among participants with age groups between 46 and 84 compared to age between 19 and 45 (AOR=2.47, 95%CI; 1.06, 5.78). The odds of having an external hernia was 3.67 times higher among participants who had constipation compared to their counterparts (AOR=3.67, 95%CI; 1.68, 8.11). Patients who had chronic cough had 5.18 times higher odds of having external hernia compared to their counterparts (AOR=5.18, 95%CI; 2.17, 12.3). The odds of having an external hernia was 7.39 times higher among participants lifting heavy objects compared to participants who didn't (AOR=7.39, 95%CI; 3.36, 16.2) (Table 3).

Discussion

This study assessed the prevalence of external hernia and its associated factors among adult patients visiting the surgical OPD at the UOGCSH, Northwest Ethiopia and found the prevalence of external hernia to be 11.7%. The result is consistent with a study conducted in Arar City, Northern Saudi Arabia 11.5% (1). In this study, epigastric hernias accounted 34% of the total hernia cases which puts it at the top of all the cases. Nonetheless, proportion of epigastric hernia reported by other studies worldwide is much lower and ranged between 3.4 and 8.1% (12, 13, 29). According to studies conducted in Nigeria, Egypt and India the proportion of inguinal hernia was found to be 70.2%, 56%, and 21.8%, respectively (12, 29, 30). However, the proportion of inguinal hernia in the present study was found to be 29.8%.

In this study, higher odds of external hernia was observed among participants who were older age compared to younger age groups. This finding is supported by different studies elsewhere (6, 16, 17). The reason could be attributed to the degenerative weakness of abdominal muscles and fibrous tissue in the elderly age group leads to loss of abdominal muscle strength and resistance to high intra-abdominal pressure which may cause herniation (31, 32). Another reason could be, as age increases the blood testosterone level decrease, and estrogen level will be enhanced via the aromatase enzyme. Lower abdominal muscles (LAM) are sensitive to the estrogen hormone and express very high levels of estrogen receptor-α, in turn, leads to atrophy and fibrosis of LAM which may result in the occurrence of hernia in males (33). On the other hand, when women reach postmenopausal age, they start to accumulate intra-abdominal adipose tissue which will cause separation of muscle bundle and layers, weakening of aponeurosis, and then predisposing to hernia (34).

In the current study, the study participants with constipation were more likely to have an external hernia as compared to their counterparts. The same result is obtained by the studies done in America and India (18, 35). This could be due to prolonged straining during defecation which generates high intra-abdominal pressure and results in weakness of abdominal muscle, which in turn, leads to a hernia (36).

In the present study, the study participants with a chronic cough had higher odds of having external hernia as compared to the corresponding groups. Our finding is strongly supported by the studies done elsewhere (17, 37, 38). This may be due to the repeated occurrence of increased intra-abdominal pressure during coughing which results in weakness of abdominal muscle and followed herniation (39).

Our finding showed that lifting heavy objects increased odds of having external hernia. The notion of our study is supported by different studies (22, 38, 40), This could be attributed to increasing intra-abdominal pressure causing breakage in the fibers of transversals fascia, which leads to muscle weakness and results in the occurrence of hernia (41).

The study is the first of its kind in the study area and Ethiopia as well. The study is also comprehensive which includes most of the external hernia types data were recorded by well-trained data collectors under the close supervision of the investigators. However, there are some limitations of this study such as it could not establish a cause-effect relationship because of the cross-sectional nature of the study design. In addition, this study was institution-based, the findings may not fully reflect the entire population, we used only history and physical examination as a means of diagnosis for abdominal hernia but ultrasound was not used and also possible that recall bias may have been introduced.

Conclusion

Regardless of hardly any significant gender difference, the overall prevalence of external hernia was high**.** Old age, constipation, chronic cough, and lifting of heavy objects were found to increase the odds of having an external hernia. Health professionals better identify and intervene in external hernias early, especially for risk groups. Patients who have constipation and cough should get appropriate treatment in time To show the real burden of the disease community-based studies should be conducted and there is a need for further studies regarding the burden and risk factors of external hernia in a different area of the country using ultrasonography as an outcome measurement.

Abbreviations

AOR: Adjusted Odds Ratio

BMI: Body Mass Index

BP: Blood Pressure

CI: Confidence Interval

COR: Crude Odds Ratio

IAP: Intra-abdominal pressure

LAM: Lower abdominal muscle

OPD: Outpatient department

UOG: University of Gondar

USA: United State of America

Declarations

Authors contribution

AAK, SYT, MMH, AGW, and MAD conceived and designed the study, acquired, analyzed and interpreted data, prepared the manuscript and approved the final manuscript.

Consent for publication

"Not applicable".

Availability of data and material

Data will be available from the corresponding author upon request

Competing Interests

There is no competing of interests related to this work

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Ethics statement

Ethical approval was obtained from the ethical review committee of the College of Medicine and Health Sciences, University of Gondar (Reference No 1856/12 dated March 18, 2020). A support letter was obtained from the University of Gondar Research and Community Service and surgery

department. Participants were informed about the purpose, objectives, and their right to and not to participate in the study. Written informed consent was obtained from the study participants. To keep confidentiality, respondents' names and other personal identifiers were not included. The collected data were password protected.

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Table 1: Socio-demographic characteristics of adult patients visiting surgical OPD at the UOGCH, Ethiopia, 2020 (n=403)

Variable	Frequency	Percentage
Sex		
Male	196	48.7
Female	207	51.3
Age		
19-33	161	40.0
34-48	120	30.0
49-63	81	20.1
64-78	35	8.5
79-84	6	1.5
Residence		
Urban	220	54.6
Rural	183	45.4
Occupation		
Farmer	135	33.5
Merchant	31	7.7
Civil servant	58	14.4
Housewife	98	24.3
Student	38	9.4
Daily laborer	18	4.6
Others *	25	6.2
Religion		
Orthodox	388	96.2
Muslim	11	2.8
Protestant	4	1.0
Educational status		
No formal education	210	52.1
Primary education	42	10.4
Secondary education	63	15.7
College or above	88	21.8
Average monthly income in US$		
<25	200	49.6
26-185	194	48.1
>186(1)	9	2.3

Others*: -unemployed, solider, driver, retire and artist

Table2: Clinical, behavioral and obstetric characteristics of adult patients visiting surgical OPD at the UOGCH, Ethiopia, 2020 (n=403)

Variable	Frequency	Percentage (%)
Family history of hernia		
Yes	19	4.8
No	384	95.2
Smoking		
No smoking	385	98.0
Previously smoking	6	1.5
Currently smoking	2	0.5
Alcohol intake		
No alcohol	301	74.7
Previous alcohol intake	32	8.0
Current alcohol intake	70	17.3
Parity		
Nulliparous	54	26.0
Primiparous	22	10.7
Multi parous	68	32.9
Grand multipara	63	30.4
Straining during urination		
Yes	64	15.9
No	339	84.1
Constipation		
Yes	96	23.9
No	307	76.1
Prolonged cough		
Yes	42	10.4
No	361	89.6
Lifting of heavy objects		
Yes	84	20.9
No	319	79.1
Previous abdominal surgery		
Yes	40	10.0
No	363	90.0
History of abdominal trauma		
Yes	13	3.2
No	390	96.8
History of Ascites		
Yes	5	1.24
No	398	98.76
BMI		
14-17.9	58	14.39

18-24.9	311	77.17
25-29.9 30-34.9	27 7	6.70 1.74

Table 3: Multiple logistic regression output for the factors associated with external hernia among adult patients visiting surgical OPD at the UOGCH, Ethiopia, 2020 (n=403)

Variable	External hernia		Crude OR (95%CI)	Adjusted OR (95%CI)	P-value
	Yes	No			
Age					
19-45	18	249	1	1	
46-84	29 107		3.74(1.99, 7.04)	2.47(1.06, 5.78)	0.036
Residence					
Urban	16 204		1	1	
Rural	31 152		2.6 (1.37, 4.92)	0.73(0.30,1.85)	0.55
Educational status					
No formal education Primary and Secondary education	38 172 5 100		4.63(1.60, 13.4) 1.05(0.27, 4.03)	2.90(0.89, 9.4) 1.64(0.37, 7.08)	0.07 0.50
College or above	4 84		1	1	
Staining during urination					
Yes	16 48		3.31(1.68, 6.50)	0.83(0.33, 2.25)	0.712
No	31 308		1	1	
Constipation					
Yes No	26 70 21 286		5.05(2.68, 9.51) 1	3.67(1.68, 8.11) 1	0.001
Prolonged cough Yes No	17 30 331	25	7.50(3.64, 15.4) 1	5.18(2.17,12.3) 1	<0.001

Lifting heavy objects				
Yes	29		8.81(4.58, 16.9)	7.39(3.36, 16.2)	
No	55		1	1	<0.001
	18				
	301				
BMI					
14-17.9	7	51	1.15(0.48, 2.7)	1.35(0.4, 3.8)	0.56
18-24.9	33		1	1	
25-34.9	278		2.1(0.82,0.17)	3.01(0.95, 9.54)	0.06
	7	27			

AOR: Adjusted Odds Ratio; COR: Crude Odds Ratio; CI: Confidence-interval

Figure 1: Bar graph that shows the frequency distribution of types of hernia with the sex of adult patients visiting surgical OPD at the UOGCH, Ethiopia, 2020

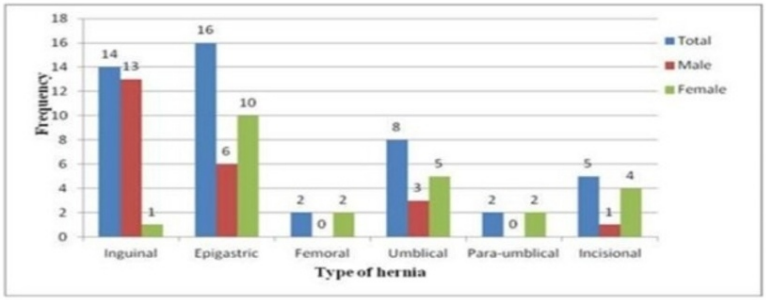

Figure 1: Bar graph that shows the frequency distribution of types of hernia with sex of adult patients visiting surgical OPD at the UOG Comprehensive Hospital, Ethiopia, 2020

89x89mm (300 x 300 DPI)

Annexes 1: Questionnaire (English version)

Questionnaire for research on the prevalence and associated factors of external hernia among adult surgical patients at the University of Gondar comprehensive specialized hospital, North West Ethiopia in 2020.

Interviewer's Name_____ Date of interview_____
Supervisor's Name_____ Questionnaire No_____

Socio-demographic characteristics			
No	**Question**	**Response**	**Remark**
101	Sex	1) Male 2) Female	
102	Age	_____ years	
103	Place of residence	1) Urban 2) Rural	
104	Occupation of the study participant?	1) Civil servant 2) Merchant 3) Farmer 4) Housewife 5) Self-employed 6) Daily laborer 7) Student 8) Others	Others specify _____
105	Religion of the study participant?	1) Orthodox 2) Muslim 3) Protestant 4) Catholic 5) Others	Others specify _____
106	Educational status of the study participant?	1) Unable to read &write 2) Able to read & write 3) Primary education (grade 1–8) 4) Secondary education (grade 9–10) 5) Preparatory (grade 11–12) 6) College or above	
107	Marital Status of the study participant?	1) Single 2) Married 3) Divorced 4) Widowed 5) separated	
108	Average monthly income	_____ETB	

Clinical, obstetric, and behavioral factors			
201	Anyone with hernias in your family?	1) Yes 2) No	
202	Do you smoke cigarettes?	1) Never 2) I used to smoke 3) I currently smoke	
203	How would you describe your alcoholic habit?	1) Never drank alcohol 2) Previous alcoholic 3) Current alcoholic	
204	How many children do you have? for women only	_____	
205	Do you have difficulty during urination, hesitancy and dribbling? For male only	1) Yes 2) No	
206	If yes for question number 206, for how long do you have had this problem?	_____month	
207	Have you ever had difficulty during defecation?	1) Yes 2) No If yes for how long _____weeks	
208	Do you have a prolonged cough?	1) Yes 2) No If yes for how long weeks_____	
209	Have you ever had a history of abdominal surgery?	1) Yes 2) No	
210	Do you have a history of abdominal trauma?	1) Yes 2) No	
211	Do you have a history of lifting heavy objects?	1) Yes 2) No	
212	Have you ever had a history of ascites?	1) Yes 2) No	
214	BMI	_____kg/m^2	
215	Hernia	1) Yes 2) No	
216	If yes for question 215, what type of hernia?	1) Inguinal 2) Epigastric 3) Umbilical 4) Femoral 5) Incisional 6) Para umbilical 7) Others	
217	Reducibility of hernia during the	1) Reducible	

	presentation	2) Non-reducible	
218	Complication of hernia	1) Present 2) Absent	

Annex- 2: Amharic version questionnaire

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page Number
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-7
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6-7
		(*b*) Describe any methods used to examine subgroups and interactions	6-7
		(*c*) Explain how missing data were addressed	6-7
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	6-7
		(*e*) Describe any sensitivity analyses	6-7
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—e.g., numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7-8
		(b) Give reasons for non-participation at each stage	7-8
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7-8
		(b) Indicate number of participants with missing data for each variable of interest	7-8
Outcome data	15*	Report numbers of outcome events or summary measures	8
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8
		(*b*) Report category boundaries when continuous variables were categorized	8

		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	9
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9-11
Generalisability	21	Discuss the generalisability (external validity) of the study results	10-11
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Prevalence and associated factors of external hernia among adult patients visiting the Surgical Outpatient Department at the University of Gondar Comprehensive Specialized Hospital, Northwest Ethiopia: A cross-sectional study

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Abstract

Objectives: This study was aimed to assess the prevalence and associated factors of external hernia among adult patients visiting the surgical outpatient department at the University of Gondar Comprehensive Specialized Hospital, Northwest Ethiopia.

Study design: Institution-based cross-sectional study was conducted from April 5to June 22, 2020

Study setting: University of Gondar Comprehensive Specialized Hospital (UOGCSH).

Participants: All adult patients above 18 years of age who visited the surgical outpatient department (OPD) at the UOGCSH

Outcome: Prevalence of external hernia

Result: A total of 403 study participants were involved in this study with a response rate of 100%. The prevalence of external hernia was 11.7% (95%CI; 8.8, 15.1). The epigastric hernia had the highest prevalence 16 (34%) followed by inguinal hernia 14(29.8%). Old age (Adjusted odds ratio (OR)=2.47, 95% CI; 1.06, 5.78), constipation (AOR=3.67, 95% CI; 1.68, 8.11), chronic cough (AOR=5.18, 95% CI; 2.17, 12.3) and lifting of heavy objects (AOR=7.39, 95% CI; 3.36, 16.2) had a statistically significant association with external hernia.

Conclusion: Regardless of hardly any significant gender difference, the overall prevalence of external hernia was high**.** Old age, constipation, chronic cough, and lifting of heavy objects were found to have a significant association with an external hernia. Patients who have constipation and cough should get appropriate treatment early.

Strength and limitation

- ✓ The study is comprehensive since it includes most of the external hernia types.
- ✓ It could not establish a cause-effect relationship because of the cross-sectional nature of the study design.

- ✓ Since the study is institution-based, the findings may not be generalized for the entire population.
- ✓ The study used only history and physical examination as a means of diagnosis for external hernia.
- ✓ Recall bias may have been introduced.

Introduction

Abdominal wall hernia is the most frequently encountered surgical condition that affects all age groups regardless of sex (1). Globally, the prevalence of abdominal wall hernia was 1.7% for all ages (2). Abdominal wall hernias are accounting for 15% - 18% of all surgical procedures, and annually more than 20 million hernias are operated worldwide (3-5). Country-specific studies are demonstrating the prevalence of external hernia. For instance, in the general Russian population, the prevalence of external hernia is 20.9% (6). In Arar City, Northern Saudi Arabia, the prevalence of abdominal hernia is 11.5% (1). A study conducted in Sierra Leone revealed that the prevalence of groin hernia is 7.10% (7). Among the external hernias, an inguinal hernia is the most observed type accounting for about 75% of all abdominal wall hernias (8). The overall incidence of inguinal hernia in Africa has been estimated to range between 60 and 175 per 100,000 (9). In sub-Saharan Africa countries, some studies reported the prevalence of inguinal hernia between 7.7 to 30 % (10, 11), incisional hernia ranged between 3 to 15%, femoral hernia 2.5 to 7.4%, and epigastric hernia 3.4 to 3.9% (12-14). A study conducted in Addis Ababa, Ethiopia, indicated that inguinal hernia was found to be the most common form of external hernias which accounted for 66.3% of all the cases, and it is followed by recurrent 28.5% and incisional hernias 21.4 % (15). In previous studies, different factors including muscular weakness, repeated pregnancies, previous history of surgery, sex, age, chronic cough, constipation, smoking, strenuous work activities, and family history of

hernia were identified to have a strong association with external hernia (1, 16-22). Hernias are among the commonest surgical conditions causing a significant number of morbidity and mortality in various parts of Africa (23, 24). Untreated hernia can lead to life-threatening complications, such as strangulation, incarceration, and intestinal obstruction. Of these, strangulation is an acute surgical emergency with significant fatal consequences (25). In Nigeria and Sudan, strangulated external hernia was the most common cause of intestinal obstruction, accounting for 56.9% and 27.7% of cases, respectively (24). Lack of adequate surgical care for inguinal hernia is causing higher rate of mortality in remote rural communities (26).

Despite the common occurrence and clinical significance of external hernia, until this study was done, very limited epidemiological studies were done to indicate the magnitude and risk factors for external hernia in the world. Therefore, the present study was aimed to assess the prevalence and associated factors of external hernia among adult patients visiting the surgical OPD at the UOGCSH. Finally, the output of the present study will hopefully help clinicians and policymakers to design a reliable strategy.

Methods

Study design and setting

An institution-based cross-sectional study was conducted from 04/05/2020 to 06/22/2020 among adult surgical patients who visited the surgical OPD at the UOGCSH. The hospital was found in 1954 and it is in the North Gondar administrative zone, Amhara National Regional State, which is about 750 km Northwest of Addis Ababa (the capital city of Ethiopia). According to the 2015 population projection of major cities in Ethiopia, the total population size of Gondar town was estimated to be 323,900. Currently, Gondar town has one Referral Hospital and eight government Health Centers. UOGCSH is a teaching hospital, which serves more than five million people of

the North Gondar zone and people from the neighboring zones. It is estimated that around 21,000 patients visit the surgical OPD per year.

Population, sample size determination, and sampling procedure

The source and study population of this study were all adult patients above the age of 18 years who visited the surgical OPD and those who were available during the time of data collection in the UOGCSH respectively. Patients who were not responsive due to severe illness or mental health problems were excluded from the study. The sample size was determined using a single population proportion formula, by using a 95% confidence interval, 0.05 margin of error, 5% non-response rate. Since there was no previous study conducted in the area, we considered expected proportion of external hernia to be 50%. Hence, the final sample size was 403. Participants were selected using a systematic random sampling technique with skipping intervals of three.

Variables and Data collection procedures

The dependent variable for this study was having any of the external hernias such as: inguinal, epigastric, umbilical, para-umbilical, femoral and incisional hernias. External hernia was diagnosed by general surgeons based on history and physical examination. Data was collected on the sociodemographic characteristics (age, sex, residence, educational status, occupation, and average monthly income), clinical factors (family history of hernia, heavy weightlifting, constipation, straining during urination, body mass index (BMI), previous history of abdominal surgery, history of abdominal trauma, chronic cough, and history of Ascites), behavioral and obstetric factors (smoking, alcohol intake, and parity). Chronic cough was defined as current or previous history of cough for more than a month. Besides, straining during urination means difficulty of urination that lasted for three or more months. Constipation was defined as unsatisfactory defecation which is characterized by infrequent stool, difficulty in defecation, or

both for more than three months (27). Interviewer-administered questionnaire which was adapted from different literatures was used to collect data. Five nurses with a bachelorette degree were trained and employed as data collectors. The questionnaire was prepared in English and translated into Amharic and back to English for consistency of the tool. The tool was pre-tested in 10% of a sample size at Debark primary hospital two weeks before the main data collection. Necessary adjustments were made based on the pre-test result.

Data processing and analysis

The survey data were entered and cleaned using EPI DATA version 3.1 and analyzed by STATA 14 software. Descriptive statistics were used, and the findings were presented using texts, graphs, and tables. A logistic regression model was used to identify factors affecting external hernia. Variables with p-values 0.2 or less in the bi-variable logistic regression analysis were fitted in the multivariable analysis. AOR with a 95% Confidence Interval (CI) and p-value <0.05 in the multivariable analysis were used to declare significant association with the outcome variable.

The goodness of fitness of the model was checked by Hosmer and Lemeshow test.

Patient and public involvement

Patients were not involved in this study

Results

Socio-demographic characteristics

A total of 403 study participants were included in this study with a response rate of 100%. The median age of the participants was 38 years old and the interquartile range was 24. Both sexes had nearly equal frequency, 207 (51.3%) were female subjects. Of the total participants, 135 (33.5%) were farmers, and almost half of the study participants 200(49.6%) had an average monthly income of less than 25 US$ (Table 1).

Clinical, behavioral, and obstetric characteristics

Of the total participants, 19(4.8%) had a family history of external hernia, and one-fourth (102) had a history of alcohol intake. Among female study participants, the majority 153(74%) gave at least one birth. About quarter, 96 (24%) of the participants had constipation, and one-fifth had a history of lifting heavy objects 84 (20.9%) (Table 2).

Prevalence of external hernia

Of the total participants, 47 of them had external hernia which makes the overall prevalence of 11.7 % (95%CI; 8.8, 15.1). More than half of external hernia cases, 29 (61.8%), occurred at the age of above 45. The prevalence of external hernia among male and female participants was 11.73% (95% CI: 7.59, 17.09) and 11.59% (95%CI: 7.57, 16.76), respectively. Among the total number of hernia cases that were observed in females, 23(96%) of them were diagnosed from primiparas and multiparous, and 14 (58.4%) of them had a history of more than four deliveries (grand multipara). Of the total cases of external hernia, epigastric and inguinal hernias had nearly equal prevalence of 16 (34%) and 14(29.8%) respectively (Figure 1). About 41(10.1%) of the participants had a history of abdominal surgery and only 5(12.2%) of them had an incisional hernia. Only one case of external hernia was present with complications (incarceration) and all external hernia cases were newly diagnosed.

Factors associated with an external hernia

The multivariable logistic regression analysis revealed that old age, constipation, chronic cough, and lifting of heavy objects had a significant association with the occurrence of external hernia. The odds of being diagnosed with external hernia was 2.47 times higher among participants with age groups between 46 and 84 compared to age between 19 and 45 (AOR=2.47, 95%CI; 1.06, 5.78). The odds of having an external hernia was 3.67 times higher among participants who had

constipation compared to their counterparts (AOR=3.67, 95%CI; 1.68, 8.11). Patients who had chronic cough had 5.18 times higher odds of having external hernia compared to their counterparts (AOR=5.18, 95%CI; 2.17, 12.3). The odds of having an external hernia was 7.39 times higher among participants lifting heavy objects compared to participants who didn't (AOR=7.39, 95%CI; 3.36, 16.2) (Table 3).

Discussion

This study assessed the prevalence of external hernia and its associated factors among adult patients visiting the surgical OPD at the UOGCSH, Northwest Ethiopia and found the prevalence of external hernia to be 11.7%. The result is consistent with a study conducted in Arar City, Northern Saudi Arabia 11.5% (1). In this study, epigastric hernias accounted 34% of the total hernia cases which puts it at the top of all the cases. Nonetheless, proportion of epigastric hernia reported by other studies worldwide is much lower and ranged between 3.4 and 8.1% (12, 13, 28). According to studies conducted in Nigeria, Egypt, and India the proportion of inguinal hernia was found to be 70.2%, 56%, and 21.8%, respectively (12, 28, 29). However, the proportion of inguinal hernia in the present study was found to be 29.8%.

This study indicates that older age participants were more likely to be diagnosed with external hernia compared to younger age groups. This finding is supported by different studies elsewhere (6, 16, 17). The reason could be attributed to the degenerative weakness of abdominal muscles and fibrous tissue in the elderly age group. Loss of abdominal muscle strength and resistance to high intra-abdominal pressure can lead to herniation (30, 31). Another potential reason could be associated with the age-related decline in blood testosterone level and enhancement of estrogen via the action of aromatase enzyme. Lower abdominal muscles (LAM) are sensitive to our body's estrogen hormone and tends to express very high levels of estrogen receptor-α. As a result, the

increase in estrogen level can lead to atrophy and fibrosis of LAM which may result in the occurrence of hernia in males (32). On the other hand, when women reach postmenopausal age, they start to accumulate intra-abdominal adipose tissue which will cause separation of muscle bundle and layers, weakening of aponeurosis, and then predisposing to hernia (33).

In the current study, the study participants with constipation were more likely to have an external hernia as compared to their counterparts. The same result is obtained by the studies done in America and India (18, 34). This could be due to prolonged straining during defecation which generates high intra-abdominal pressure and results in weakness of abdominal muscle, which in turn, leads to hernia (35). In the present study, the study participants with a chronic cough had higher odds of having external hernia as compared to the corresponding groups. Our finding is strongly supported by the studies done elsewhere (17, 36, 37). This may be due to the repeated occurrence of increased intra-abdominal pressure during coughing which results in weakness of abdominal muscle and followed herniation (38). Our finding showed that lifting heavy objects increased odds of having external hernia. The notion of our study is supported by different studies (22, 37, 39). This could be attributed to increasing intra-abdominal pressure causing breakage in the fibers of transversals fascia, which leads to muscle weakness and results in the occurrence of hernia (40).

The study is the first of its kind in the study area and in Ethiopia as well. The study is also comprehensive which includes most of the external hernia types. Data were recorded by well-trained data collectors under the close supervision of the investigators. However, there are some limitations of this study such as it could not establish a cause-effect relationship because of the cross-sectional nature of the study design. In addition, this study was institution-based, the findings may not fully reflect the entire population. We used only history and physical examination as a

means of diagnosis for abdominal hernia, and ultrasound was not used for diagnosis. It is possible that recall bias may have been introduced.

Conclusion

Regardless of hardly any significant gender difference, the overall prevalence of external hernia was high**.** Old age, constipation, chronic cough, and lifting of heavy objects were found to increase the odds of having an external hernia. Health professionals better identify and intervene in external hernias early, especially for high-risk groups. Patients who have constipation and cough should get appropriate treatment in time. Community-based studies should be conducted to reveal the burden of the disease. There is also a need for further studies regarding the burden and risk factors of external hernia in different areas of the country.

Abbreviations

AOR: Adjusted Odds Ratio

BMI: Body Mass Index

BP: Blood Pressure

CI: Confidence Interval

COR: Crude Odds Ratio

IAP: Intra-abdominal pressure

LAM: Lower abdominal muscle

OPD: Outpatient department

UOG: University of Gondar

USA: United States of America

Declarations

Authors contribution

AAK, SYT, MMH, AGW, and MAD conceived and designed the study, acquired, analyzed and interpreted data, prepared the manuscript, and approved the final manuscript.

Consent for publication

"Not applicable".

Availability of data and material

Data will be available from the corresponding author upon request

Competing Interests

There is no competing of interests related to this work

Funding

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Ethics statement

Ethical approval was obtained from the ethical review committee of the College of Medicine and Health Sciences, University of Gondar (Reference No 1856/12 dated March 18, 2020). A support letter was obtained from the University of Gondar Research and Community Service and surgery department. Participants were informed about the purpose, objectives, and their right to and not to participate in the study. Written informed consent was obtained from the study participants.

To keep confidentiality, respondents' names and other personal identifiers were not included.

The collected data were password protected.

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Table 1: Socio-demographic characteristics of adult patients visiting surgical OPD at the UOGCH, Ethiopia, 2020 (n=403)

Variable	Frequency	Percentage
Sex		
Male	196	48.7
Female	207	51.3
Age		
19-33	161	40.0
34-48	120	30.0
49-63	81	20.1
64-78	35	8.5
79-84	6	1.5
Residence Urban	220	54.6
Rural	183	45.4
Occupation		
Farmer	135	33.5
Merchant	31	7.7
Civil servant	58	14.4
Housewife	98	24.3
Student	38	9.4
Daily laborer	18	4.6
Others *	25	6.2
Religion		
Orthodox	388	96.2
Muslim	11	2.8
Protestant	4	1.0
Educational status		

No formal education	210	52.1
Primary education	42	10.4
Secondary education	63	15.7
College or above	88	21.8
Average monthly income in US$		
<25	200	49.6
26-185	194	48.1
>186(1)	9	2.3

Others*: -unemployed, solider, driver, retire and artist

Table2: Clinical, behavioral and obstetric characteristics of adult patients visiting surgical OPD at the UOGCH, Ethiopia, 2020 (n=403)

Variable	**Frequency**	**Percentage (%)**
Family history of hernia		
Yes	19	4.8
No	384	95.2
Smoking		
No smoking	385	98.0
Previously smoking	6	1.5
Currently smoking	2	0.5
Alcohol intake		
No alcohol	301	74.7
Previous alcohol intake	32	8.0
Current alcohol intake	70	17.3
Parity		
Nulliparous	54	26.0
Primiparous	22	10.7
Multi parous	68	32.9
Grand multipara	63	30.4

Straining during urination		
Yes	64	15.9
No	339	84.1
Constipation		
Yes	96	23.9
No	307	76.1
Prolonged cough		
Yes	42	10.4
No	361	89.6
Lifting of heavy objects		
Yes	84	20.9
No	319	79.1
Previous abdominal surgery		
Yes	40	10.0
No	363	90.0
History of abdominal trauma		
Yes	13	3.2
No	390	96.8
History of Ascites		
Yes	5	1.24
No	398	98.76
BMI		
14-17.9	58	14.39
18-24.9	311	77.17
25-29.9 30-34.9	27 7	6.70 1.74

Table 3: Multiple logistic regression output for the factors associated with external hernia among adult patients visiting surgical OPD at the UOGCH, Ethiopia, 2020 (n=403)

Variable	External hernia		Crude OR (95%CI)	Adjusted OR (95%CI)	P-value
	Yes	No			
Age					
19-45	18	249	1	1	
46-84	29	107	3.74(1.99, 7.04)	2.47(1.06, 5.78)	0.036
Residence					
Urban	16	204	1	1	
Rural	31	152	2.6 (1.37, 4.92)	0.73(0.30,1.85)	0.55
Educational status					
No formal education	38	172	4.63(1.60, 13.4)	2.90(0.89, 9.4)	0.07
Primary and Secondary education	5	100	1.05(0.27, 4.03)	1.64(0.37, 7.08)	0.50
College or above	4	84	1	1	
Staining during urination					
Yes	16	48	3.31(1.68, 6.50)	0.83(0.33, 2.25)	0.712
No	31	308	1	1	
Constipation					
Yes	26	70	5.05(2.68, 9.51)	3.67(1.68, 8.11)	0.001
No	21	286	1	1	
Prolonged cough					
Yes	17	25	7.50(3.64, 15.4)	5.18(2.17,12.3)	<0.001
No	30	331	1	1	
Lifting heavy objects					
Yes	29	55	8.81(4.58, 16.9)	7.39(3.36, 16.2)	<0.001

No	18	301	1	1	
BMI					
14-17.9	7	51	1.15(0.48, 2.7)	1.35(0.4, 3.8)	0.56
18-24.9	33	278	1	1	
25-34.9	7	27	2.1(0.82,0.17)	3.01(0.95, 9.54)	0.06

AOR: Adjusted Odds Ratio; COR: Crude Odds Ratio; CI: Confidence-interval

Figure 1: Bar graph that shows the frequency distribution of types of hernia with the sex of adult patients visiting surgical OPD at the UOGCH, Ethiopia, 2020

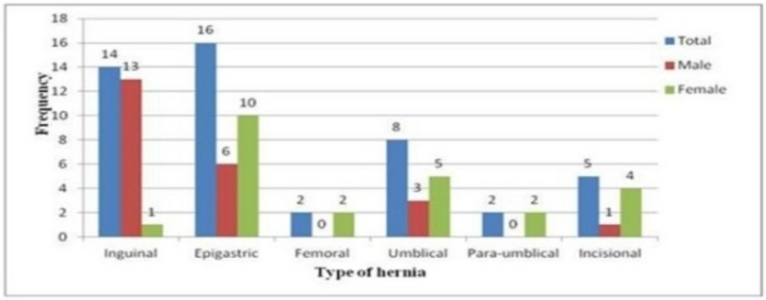

Figure 1: Bar graph that shows the frequency distribution of types of hernia with sex of adult patients visiting surgical OPD at the UOG Comprehensive Hospital, Ethiopia, 2020

89x89mm (300 x 300 DPI)

Annexes 1: Questionnaire (English version)

Questionnaire for research on the prevalence and associated factors of external hernia among adult surgical patients at the University of Gondar comprehensive specialized hospital, North West Ethiopia in 2020.

Interviewer's Name_____ Date of interview_____
Supervisor's Name_____ Questionnaire No_____

Socio-demographic characteristics			
No	**Question**	**Response**	**Remark**
101	Sex	1) Male 2) Female	
102	Age	_____ years	
103	Place of residence	1) Urban 2) Rural	
104	Occupation of the study participant?	1) Civil servant 2) Merchant 3) Farmer 4) Housewife 5) Self-employed 6) Daily laborer 7) Student 8) Others	Others specify _____
105	Religion of the study participant?	1) Orthodox 2) Muslim 3) Protestant 4) Catholic 5) Others	Others specify _____
106	Educational status of the study participant?	1) Unable to read &write 2) Able to read & write 3) Primary education (grade 1–8) 4) Secondary education (grade 9–10) 5) Preparatory (grade 11–12) 6) College or above	
107	Marital Status of the study participant?	1) Single 2) Married 3) Divorced 4) Widowed 5) separated	
108	Average monthly income	_____ETB	

Clinical, obstetric, and behavioral factors			
201	Anyone with hernias in your family?	1) Yes 2) No	
202	Do you smoke cigarettes?	1) Never 2) I used to smoke 3) I currently smoke	
203	How would you describe your alcoholic habit?	1) Never drank alcohol 2) Previous alcoholic 3) Current alcoholic	
204	How many children do you have? for women only	_____	
205	Do you have difficulty during urination, hesitancy and dribbling? For male only	1) Yes 2) No	
206	If yes for question number 206, for how long do you have had this problem?	_____month	
207	Have you ever had difficulty during defecation?	1) Yes 2) No If yes for how long _____weeks	
208	Do you have a prolonged cough?	1) Yes 2) No If yes for how long weeks_____	
209	Have you ever had a history of abdominal surgery?	1) Yes 2) No	
210	Do you have a history of abdominal trauma?	1) Yes 2) No	
211	Do you have a history of lifting heavy objects?	1) Yes 2) No	
212	Have you ever had a history of ascites?	1) Yes 2) No	
214	BMI	_____kg/m^2	
215	Hernia	1) Yes 2) No	
216	If yes for question 215, what type of hernia?	1) Inguinal 2) Epigastric 3) Umbilical 4) Femoral 5) Incisional 6) Para umbilical 7) Others	
217	Reducibility of hernia during the	1) Reducible	

	presentation	2) Non-reducible	
218	Complication of hernia	1) Present 2) Absent	

Annex- 2: Amharic version questionnaire

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page Number
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-7
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6-7
		(*b*) Describe any methods used to examine subgroups and interactions	6-7
		(*c*) Explain how missing data were addressed	6-7
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	6-7
		(*e*) Describe any sensitivity analyses	6-7
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—e.g., numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7-8
		(b) Give reasons for non-participation at each stage	7-8
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7-8
		(b) Indicate number of participants with missing data for each variable of interest	7-8
Outcome data	15*	Report numbers of outcome events or summary measures	8
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8
		(*b*) Report category boundaries when continuous variables were categorized	8

		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	9
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9-11
Generalisability	21	Discuss the generalisability (external validity) of the study results	10-11
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.