

# BMJ Open

BMJ Open is committed to open peer review. As part of this commitment we make the peer review history of every article we publish publicly available.

When an article is published we post the peer reviewers' comments and the authors' responses online. We also post the versions of the paper that were used during peer review. These are the versions that the peer review comments apply to.

The versions of the paper that follow are the versions that were submitted during the peer review process. They are not the versions of record or the final published versions. They should not be cited or distributed as the published version of this manuscript.

BMJ Open is an open access journal and the full, final, typeset and author-corrected version of record of the manuscript is available on our site with no access controls, subscription charges or pay-per-view fees (<http://bmjopen.bmj.com>).

If you have any questions on BMJ Open's open peer review process please email [info.bmjopen@bmj.com](mailto:info.bmjopen@bmj.com)

# BMJ Open

## 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

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2021-056488
Article Type:	Original research
Date Submitted by the Author:	16-Aug-2021
Complete List of Authors:	Kibret, Anteneh; University of Gondar, Department of Human Anatomy Tekle, Solomon ; University of Gondar, Department of Surgery H/Maryam , Miklol; University of Gondar, Surgery Worede, Amanuel ; University of Gondar, Department of Human Anatomy Dessie, M; University of Gondar, Department of Human Anatomy
Keywords:	SURGERY, Adult surgery < SURGERY, PUBLIC HEALTH, Anatomy < NATURAL SCIENCE DISCIPLINES, Adult gastroenterology < GASTROENTEROLOGY

SCHOLARONE™  
Manuscripts



I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

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

4 Anteneh Ayelign Kibret<sup>1\*</sup>, Solomon Yirdaw Tekle<sup>2</sup>, Miklol Mengistu H/maryam <sup>2</sup>, Amanuel  
5 Girma Worede<sup>1</sup> and Meseleh Ambaw Desse<sup>1</sup>

6  
7 <sup>1</sup>Department of Human Anatomy, University of Gondar, college of medicine and health science,  
8 School of Medicine, Gondar, Ethiopia

9 <sup>2</sup>Department of Surgery, University of Gondar, college of medicine and health science, School of  
10 Medicine, Gondar, Ethiopia

11 Email

12 Anteneh Ayelign Kibret (AAK): [antesha04@gmail.com](mailto:antesha04@gmail.com)

13 Solomon Yirdaw Tekle (SYT): [Solomonyirdaw15@gmail.com](mailto:Solomonyirdaw15@gmail.com)

14 Miklol Mengistu H/Maryam (MMH): [miklol.mengistu@yahoo.com](mailto:miklol.mengistu@yahoo.com)

15 Amanuel Girma Worede (AGW): [amanuelgirma.w@gmail.com](mailto:amanuelgirma.w@gmail.com)

16 Meseleh Ambaw Desse (MAD): [mituababi@gmail.com](mailto:mituababi@gmail.com)

17  
18 \*Corresponding author (AAK): [antesha04@gmail.com](mailto:antesha04@gmail.com)

## 19 Abstract

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

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

24 **Study setting:** University of Gondar Comprehensive Specialized Hospital

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

27 **Outcome:** Prevalence of external hernia

28 **Result:** A total of 403 study participants were involved in this study with a response rate of 100%.  
29 The prevalence of external hernia was 11.7% (95%CI; 8.8, 15.1). Epigastric hernia had the highest  
30 prevalence 16 (34%) followed by inguinal hernia 14(29.8%). Old age (AOR=2.47, 95% CI; 1.06,  
31 5.78), constipation (AOR=3.67, 95% CI; 1.68, 8.11), chronic cough (AOR=5.18, 95% CI; 2.17,  
32 12.3) and lifting of heavy objects (AOR=7.39, 95% CI; 3.36, 16.2) had a statistically significant  
33 association with external hernia.

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

## 39 Strength and limitation

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

- 1  
2  
3 42 ✓ It could not establish a cause-effect relationship because of the cross-sectional nature of  
4  
5 43 the study design.  
6  
7  
8 44 ✓ In addition, this study was an institution based and the findings may not fully reflect the  
9  
10 45 entire population and also possible that recall bias may have been introduced.  
11  
12 46

## 47 Introduction

16  
17 48 Hernia is defined as a protrusion of part of the contents of the abdominal cavity through a weakness  
18  
19 49 in the abdominal wall (1). Abdominal wall hernias are the most frequently encountered surgical  
20  
21 50 condition that affects all age groups regardless of sex (2). Globally the prevalence of abdominal  
22  
23 51 wall hernia was 1.7% for all ages (3). Abdominal wall hernias are accounting for 15% - 18% of all  
24  
25 52 surgical procedures (4, 5), and annually more than 20 million hernias are operated on worldwide  
26  
27 53 (6). There are country-specific studies demonstrating the prevalence of external hernia. For  
28  
29 54 instance, in the general Russian population, the prevalence of external hernia was 20.9% (7). In  
30  
31 55 Arar City, Northern Saudi Arabia the prevalence of abdominal hernia was 11.5% (2). Out of the  
32  
33 56 external hernias, an inguinal hernia is the most commonly observed type which accounts for about  
34  
35 57 75% of all abdominal wall hernias (8, 9). A study conducted in Sierra Leone revealed that the  
36  
37 58 prevalence of hernia was 7.10% (10). The overall incidence of inguinal hernia in Africa has been  
38  
39 59 estimated and ranged between 60 and 175 inguinal hernias per 100,000 (11). In sub-Saharan Africa  
40  
41 60 countries, there are some reports demonstrating the prevalence of inguinal hernia between 7.7 and  
42  
43 61 30 % (12, 13) and incisional hernia ranged between 3 to 15% (8, 14, 15), femoral hernia 2.5 to  
44  
45 62 7.4% (8, 15, 16), and epigastric hernia 3.4 to 3.9% (8, 14, 15).

50  
51 63 In a study conducted in Addis Ababa, Ethiopia, groin hernia was found to be the most common  
52  
53 64 form and accounting for 66.3% followed by recurrent hernias 28.5% and incisional hernias 21.4%

1  
2  
3 65 (17). Different factors that are associated with external hernias have been identified by previous  
4  
5 66 studies. This include, muscular weakness (18), repeated pregnancies, previous history of surgery  
6  
7  
8 67 and sex (2), age (2, 7, 19), chronic cough (20, 21), constipation (22), smoking (23-25), lifting of  
9  
10 68 heavy objects and strenuous work activities (21, 26-28), and family history of hernia (2, 7, 19).  
11  
12 69 Hernias are among the commonest surgical conditions resulting in consequential morbidity and  
13  
14 70 mortality in various parts of Africa (17, 29, 30). Untreated hernia can lead to life-threatening  
15  
16 71 complications; such as strangulation, incarceration, and intestinal obstruction (31). Of these,  
17  
18 72 strangulation is an acute and most serious surgical emergency and is probably with fatal  
19  
20 73 consequences (32). In Nigeria and Sudan, the strangulated external hernia was the most common  
21  
22 74 cause of intestinal obstruction, accounting for 56.9% and 27.7% of cases respectively (29).  
23  
24 75 Following hernia surgery, post-surgical complications, hernia recurrence, infected and non-  
25  
26 76 infected fluid collections, and complications related to prosthetic material are also common (31).  
27  
28  
29 77 A great many deaths could also occur due to a lack of adequate surgical care for inguinal hernia  
30  
31 78 disease almost daily in remote rural communities (33).  
32  
33  
34 79 Even if documentation concerning the magnitude and risk factors of external hernia have the  
35  
36 80 greatest importance to the clinical practitioners and the society at large. But, until this study was  
37  
38 81 done, there were very limited epidemiological studies in the world. And also, in Ethiopia  
39  
40 82 information with respect to the prevalence and risk factors of external hernia has not been  
41  
42 83 documented. Therefore, the aim of the present study is to assess the prevalence and associated  
43  
44 84 factors of external hernia among adult patients visiting the surgical outpatient department (OPD)  
45  
46 85 at the University of Gondar Compressive Specialized Hospital. Finally, the output of the present  
47  
48 86 study will hopefully help clinicians and policymakers to design a reliable strategy.  
49  
50  
51  
52  
53  
54  
55  
56  
57

## 87 **Methods**

### 88 **Study design and setting**

89 An institution-based cross-sectional study was conducted from April to June 2020 G.C among  
90 adult surgical patients who visited the surgical outpatient department (OPD) at the UOG  
91 Comprehensive Specialized Hospital. The hospital was founded in 1954 and it is located in the  
92 North Gondar administrative zone, Amhara National Regional State, which is about 750 km  
93 Northwest of Addis Ababa (the capital city of Ethiopia). According to the 2015 population  
94 projection of major cities in Ethiopia, the total population size of Gondar town was estimated to  
95 be 323,900. Currently, Gondar town has one Referral Hospital and eight government Health  
96 Centers. University of Gondar Comprehensive Specialized Hospital is a teaching hospital, which  
97 serves more than five million people of the North Gondar zone and peoples of the neighboring  
98 zones. It is estimated that around 21,000 patients visit the surgical OPD per year.

### 99 **Population, sample size determination and sampling procedure**

100 All adult patients above 18 years old who visited the surgical OPD at the UOG Comprehensive  
101 Specialized Hospital were the source population. The study population was all adult patients above  
102 18 years old who visited the surgical OPD during the time of data collection in the UOG  
103 Comprehensive Specialized Hospital. Patients who were unable to communicate, mentally, and  
104 severely ill were excluded from the study. Sample size and sampling procedure have been  
105 published elsewhere (34).

### 106 **Variables and Data collection procedures**

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



1  
2  
3 110 on history and physical examination. Data was collected on the socio demographic characteristics  
4  
5 111 (age, sex, residence, educational status, occupation, marital status, and average monthly income),  
6  
7  
8 112 clinical factors (family history of hernia, heavy weight lifting, constipation, straining during  
9  
10 113 urination, body mass index (BMI), previous history of abdominal surgery, history of abdominal  
11  
12 114 trauma, chronic cough, and history of Ascites), behavioral and obstetric factors (smoking, alcohol  
13  
14  
15 115 intake, and parity). Chronic cough means a current or previous history of cough for more than one  
16  
17 116 month, straining during urination means difficulty with urination for three months and above.  
18  
19 117 Constipation means unsatisfactory defecation characterized by infrequent stool, difficulty in  
20  
21 118 defecation, or both for more than three months (35). BMI was calculated by dividing weight in kg  
22  
23 119 by height in meters square. BMI <18.5 kg/m<sup>2</sup> was considered as underweight 18.5-24.9 kg/m<sup>2</sup> as  
24  
25 120 normal, 25-29.9 kg/m<sup>2</sup> overweight and ≥30 kg/m<sup>2</sup> as obese (36). The interviewer-administered  
26  
27 121 structured questionnaire which was adapted from different works of literature was used to collect  
28  
29 122 data from study participants. Five nurses with a bachelor's degree were trained and employed to  
30  
31 123 collect the overall data collection. The questionnaire was prepared in English and translated into  
32  
33 124 Amharic and back to English for consistency of the tool. The tool was pre-tested 10% of a sample  
34  
35  
36  
37 125 size at Debarq primary hospital. Necessary adjustments were made based on the pre-test result.

### 126 **Data processing and analysis**

127 The survey data was entered and cleaned using EPI DATA version 3.1 and analyzed by STATA  
128 14 software. Descriptive statistics were used and the findings were presented using texts, graphs,  
129 and tables. A logistic regression model was used to identify factors affecting external hernia.  
130 Variables with p-values 0.2 or less in the bi-variable logistic regression analysis were fitted in the  
131 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 fit 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)

1  
2  
3 155 respectively. Out of the total of hernia cases that occurred among females, 23(96%) of them were  
4  
5 156 diagnosed from those who gave one and above birth, and 14 (58.4%) of them had a history of more  
6  
7  
8 157 than four deliveries (grand multipara). Of the total cases of external hernia, epigastric hernia had  
9  
10 158 the highest prevalence 16 (34%) followed by inguinal hernia 14(29.8%) (Figure 1). About  
11  
12 159 41(10.1%) of the participants had a history of abdominal surgery, subsequently, 5(12.2%) of them  
13  
14 160 develop an incisional hernia. The proportions of direct and indirect inguinal hernia were 4 (28.6%)  
15  
16 161 and 10(71.4%), respectively. The inguinal hernia was identified on the right sides in 12 (85.7%)  
17  
18 162 and on the left sides in 2 (14.3%) of the cases. Except for one case of external hernia which causes  
19  
20 163 complications (incarceration), the rest were reducible with hardly any complications. All external  
21  
22 164 hernia cases were newly diagnosed.

#### 26 165 **Factors associated with an external hernia**

28 166 Bivariable and multivariable logistic regression models have been run. The multivariable logistic  
29  
30 167 regression analysis revealed that old age, constipation, chronic cough, and lifting of heavy objects  
31  
32 168 had a significant association with the occurrence of external hernia. The odds of having external  
33  
34 169 hernia were 2.47 times higher among participants with age groups between 46 and 84 as compared  
35  
36 170 to age between 19 and 45 (AOR=2.47, 95%CI; 1.06, 5.78). The odds of having an external hernia  
37  
38 171 were 3.67 times higher among participants who had constipation as compared to their counterparts  
39  
40 172 (AOR=3.67, 95%CI; 1.68, 8.11). The patients who had chronic cough had 5.18 times higher odds  
41  
42 173 of having external hernia as compared to their counterparts (AOR=5.18, 95%CI; 2.17, 12.3). The  
43  
44 174 odds of having an external hernia were 7.39 times higher among participants lifting heavy objects  
45  
46 175 as compared to participants who didn't (AOR=7.39, 95%CI; 3.36, 16.2) (Table 3).

## 176 Discussion

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

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

199 (39), 56% (14), and 21.8% (38), respectively. However, the proportion of inguinal hernia in the  
200 present study was found to be 29.8%. A study conducted in Saudi Arabia showed that para-  
201 umbilical hernia had the highest prevalence 33.9% (2), whereas in other studies it ranged from 2.9  
202 to 22.7% (14, 15, 19). In the present study, on the other hand, it was the less frequent type of hernia  
203 (4.26%) relative to other types. In the current study, the proportion of umbilical hernia was 17%  
204 and possibly ranged between 4.9 and 20.8% in different studies (2, 7, 15). Studies conducted  
205 elsewhere reported that the incisional hernia ranged between 2.4 and 5.7 (7, 19, 38), which is lower  
206 than the finding of this study 10.64%. The prevalence of femoral hernia in our study was found to  
207 be 4.26% which is in line with the finding of studies conducted across the world that lie between  
208 2.5 and 7.4% (8, 15, 16).

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

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

1  
2  
3 222 America and India (43, 44). This could be due to prolonged straining during defecation which  
4  
5 223 generates high intra-abdominal pressure and results in weakness of abdominal muscle, which in  
6  
7  
8 224 turn, leads to a hernia (45).

9  
10 225 In the present study, the study participants with a chronic cough had higher odds of having external  
11  
12 226 hernia as compared to the corresponding groups. Our finding is strongly supported by the studies  
13  
14  
15 227 done elsewhere (20, 21, 46, 47). This may be due to the repeated occurrence of an increase in the  
16  
17 228 intra-abdominal pressure during coughing which results in weakness of abdominal muscle which  
18  
19 229 precedes herniation (48).

20  
21 230 Our finding clearly presented that lifting heavy objects had higher odds of having external hernia  
22  
23  
24 231 than their counterparts which was found to be the commonly encountered scenario. The notion of  
25  
26 232 our study is supported by different studies (28, 46, 49), This could be attributed to increasing intra-  
27  
28 233 abdominal pressure causing breakage in the fibers of transversals fascia, which leads to muscle  
29  
30 234 weakness and results in the occurrence of hernia (58).

31  
32  
33 235 Generally speaking, herniation has been attributed to high intra-abdominal pressures from  
34  
35 236 constipation, chronic cough, and lifting heavy objects. The study is the first of its kind in the study  
36  
37  
38 237 area and Ethiopia as well. The study is also comprehensive which includes most of the external  
39  
40 238 hernia types data were recorded by well-trained data collectors under the close supervision of the  
41  
42 239 investigators. However, there are some limitations of this study such as it could not establish a  
43  
44 240 cause-effect relationship because of the cross-sectional nature of the study design. In addition, this  
45  
46  
47 241 study was institution-based and the findings may not fully reflect the entire population and also  
48  
49 242 possible that recall bias may have been introduced.

50  
51  
52 243

1  
2  
3 244 **Conclusion**  
4

5 245 Regardless of hardly any significant gender difference, the external hernia was one of the  
6  
7 246 commonest surgical procedures. Old age, constipation, chronic cough, and lifting of heavy objects  
8  
9  
10 247 were found to increase the odds of having an external hernia. Health professionals better to identify  
11  
12 248 and intervene external hernias early, especially for risk groups. Patients who have constipation and  
13  
14 249 cough should get appropriate treatment in time and those who are engaged in an occupation that  
15  
16 250 requires strenuous activities and older age groups should reduce their workload. To show the real  
17  
18 251 burden of the disease community-based studies should be conducted and there is a need for further  
19  
20 252 studies regarding the burden and risk factors of external hernia in a different area of the country  
21  
22 253 using ultrasonography as an outcome measurement.  
23  
24

25  
26 254 **Abbreviations**  
27

28 255 AOR: Adjusted Odds Ratio  
29

30 256 BMI: Body Mass Index  
31

32 257 BP: Blood Pressure  
33

34 258 CI: Confidence Interval  
35

36 259 COR: Crude Odds Ratio  
37

38 260 IAP: Intra-abdominal pressure  
39

40 261 LAM: Lower abdominal muscle  
41

42 262 OPD: Outpatient department  
43

44 263 UOG: University of Gondar  
45

46 264 USA: United State of America  
47  
48

49  
50  
51 265  
52

53  
54 266  
55  
56  
57



**267 Declarations****268 Ethics Approval and Consent to Participate**

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

**276 Consent for publication**

277 "Not applicable".

**278 Availability of data and material**

279 Data will be available from the corresponding author upon request

**280 Competing Interests**

281 There is no competing of interests related to this work

**282 Funding**

283 The authors received no specific funding for this work.

284

**285 Acknowledgments**

286 We are grateful to thank the study participant for their valuable contribution and provide  
287 appropriate information and Dr. Abebe Muche, Mr. Haileab Fekadu, and Mr. Adhanom  
288 G/Egzabher for their close, friendly, comments, assistance, intellectual and guidance to our work.  
289 The authors like to express their gratitude to all the members of the Department of Human



1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

290 Anatomy as well as the surgery department of the University of Gondar comprehensive specialized  
291 hospital as their contributions were vital in the completion of this research work.

For peer review only

**References**

1. Sultan B, Quresh Z, Malik MA. Frequency of external hernias in Ayub teaching hospital Abbottabad. *Journal of Ayub Medical College Abbottabad*. 2009;21(3):57-8.
2. AhmedAlenazi A, Alsharif MM, Hussain MA, Alenezi NG, Alenazi AA, Almadani SA, et al. Prevalence, risk factors and character of abdominal hernia in Arar City, Northern Saudi Arabia in 2017. *Electronic physician*. 2017;9(7):4806.
3. Aljubairy AM. Prevalence of Inguinal Hernia in Relation to Various Risk Factors. *EC Microbiology*. 2017;9:182-92.
4. Sangwan M, Sangwan V, Garg M, Mahendirutta P, Garg U. Abdominal wall hernia in a rural population in India—Is spectrum changing? *Open journal of epidemiology*. 2013;3(03):135.
5. Primitesta P, Goldacre M. Inguinal hernia repair: incidence of elective and emergency surgery, readmission and mortality. *Int J Epidemiol*. 1996;25:835-9.
6. LeBlanc K. Hernias: inguinal and incisional/K. LeBlanc, A. Kingsnorth. *Lancet*. 2003;362(9395):1561-71.
7. Sazhin A, Zolotukhin I, Seliverstov E, Nikishkov A, Shevtsov Y, Andriyashkin A, et al. Prevalence and risk factors for abdominal wall hernia in the general Russian population. *Hernia*. 2019:1-6.
8. Garba E. The pattern of adult external abdominal hernias in Zaria. *Nigerian Journal of Surgical Research*. 2000;2(1):12-5.
9. Williams N, O'Connell PR. *Bailey & Love's short practice of surgery*: Crc Press; 2008.
10. Patel HD, Groen RS, Kamara TB, Samai M, Farahzad MM, Cassidy LD, et al. An estimate of hernia prevalence in Sierra Leone from a nationwide community survey. *Hernia*. 2014;18(2):297-303.
11. Nordberg EM. Incidence and estimated need of caesarean section, inguinal hernia repair, and operation for strangulated hernia in rural Africa. *Br Med J (Clin Res Ed)*. 1984;289(6437):92-3.
12. Belcher D, Nyame P, Wurapa F. The prevalence of inguinal hernia in adult Ghanaian males. *Tropical and geographical medicine*. 1978;30(1):39-43.
13. Yordanov Y, Stoyanov S. The incidence of hernia on the island of Pemba. *East African medical journal*. 1969;46(12):687-91.
14. Ammar A, Ismail T. Abdominal wall hernias in upper Egypt: a different spectrum. *East and Central African Journal of Surgery*. 2008;13(2):109-14.
15. Ohene-Yeboah M, Abantanga F, Oppong J, Togbe B, Nimako B, Amoah M, et al. Some aspects of the epidemiology of external hernias in Kumasi, Ghana. *Hernia*. 2009;13(5):529.
16. Odula PO, Kakande I. Groin hernia in Mulago hospital, Kampala. *East and Central African journal of surgery*. 2004;9(1).
17. Gelan EA. Experience of Open Mesh Hernia Repair at a Teaching Hospital in Addis Ababa, Ethiopia-A Three Year Retrospective Study. *Ethiopian Medical Journal*. 2018;56(4).
18. Kanth S, Kumar P. Prevalence and Surgical Outcome of Inguinal Hernia in Children at Tertiary Care Hospital in India.
19. Iqbal MN, Akhter S, Irfan M. Prevalence of hernia in relation to various risk factors in Narowal, Pakistan. *Sci Lett*. 2015;3(1):29-32.
20. Ruhl CE, Everhart JE. Risk factors for inguinal hernia among adults in the US population. *American journal of epidemiology*. 2007;165(10):1154-61.

- 1  
2  
3 337 21. Lau H, Fang C, Yuen WK, Patil NG. Risk factors for inguinal hernia in adult males: a case-  
4 338 control study. *Surgery*. 2007;141(2):262-6.
- 5 339 22. Liem MS, van der Graaf Y, Zwart RC, Geurts I, van Vroonhoven TJ, Group botCT. Risk  
6 340 factors for inguinal hernia in women: a case-control study. *American journal of epidemiology*.  
7 341 1997;146(9):721-6.
- 8 342 23. Jansen PL, Klinge U, Jansen M, Junge K. Risk factors for early recurrence after inguinal  
9 343 hernia repair. *BMC surgery*. 2009;9(1):18.
- 10 344 24. Cannon DJ, Read RC. Metastatic emphysema: a mechanism for acquiring inguinal  
11 345 herniation. *Annals of surgery*. 1981;194(3):270.
- 12 346 25. Sorensen LT, Friis E, Jorgensen T, Vennits B, Andersen BR, Rasmussen GI, et al. Smoking  
13 347 is a risk factor for recurrence of groin hernia. *World journal of surgery*. 2002;26(4):397-400.
- 14 348 26. Flich J, Alfonso J, Delgado F, Prado M, Cortina P. Inguinal hernia and certain risk factors.  
15 349 *European journal of epidemiology*. 1992;8(2):277-82.
- 16 350 27. PERVAIZ A, MASHHADI NM, SIPRA FS. Prevalence and Associated Risk Factors for  
17 351 Inguinal Hernia among Prisoners Confined in Prisons of Punjab. *Journal of Fatima Jinnah Medical*  
18 352 *University*. 2017;11(1).
- 19 353 28. Ashindoitiang J, Ibrahim N, Akinlolu O. Risk factors for inguinal hernia in adult male  
20 354 Nigerians: a case control study. *International Journal of Surgery*. 2012;10(7):364-7.
- 21 355 29. ElRashied M, Widatalla A, Ahmed M. External strangulated hernia in Khartoum, Sudan.  
22 356 *East African medical journal*. 2007;84(8):379.
- 23 357 30. Mabula JB, Chalya PL. Surgical management of inguinal hernias at Bugando Medical  
24 358 Centre in northwestern Tanzania: our experiences in a resource-limited setting. *BMC research*  
25 359 *notes*. 2012;5(1):585.
- 26 360 31. Aguirre DA, Santosa AC, Casola G, Sirlin CB. Abdominal wall hernias: imaging features,  
27 361 complications, and diagnostic pitfalls at multi-detector row CT. *Radiographics*. 2005;25(6):1501-  
28 362 20.
- 29 363 32. Ohene-Yeboah M. Strangulated external hernias in Kumasi. *West African journal of*  
30 364 *medicine*. 2003;22(4):310-3.
- 31 365 33. Ohene-Yeboah M, Abantanga F. Inguinal hernia disease in Africa: a common but neglected  
32 366 surgical condition. *West African journal of medicine*. 2011;30(2):77-83.
- 33 367 34. Kibret AA, Oumer M, Moges AM. Prevalence and associated factors of hemorrhoids  
34 368 among adult patients visiting the surgical outpatient department in the University of Gondar  
35 369 Comprehensive Specialized Hospital, Northwest Ethiopia. *PloS one*. 2021;16(4):e0249736.
- 36 370 35. Gray JR. What is chronic constipation? Definition and diagnosis. *Canadian Journal of*  
37 371 *Gastroenterology*. 2011;25.
- 38 372 36. Organization WH. Obesity: preventing and managing the global epidemic: World Health  
39 373 *Organization*; 2000.
- 40 374 37. Kingsnorth A, Leblanc K. Choice of anesthesia: general, regional or local anesthetic.  
41 375 Kingsnorth AN, Leblanc KA *Management of abdominal hernias 3rd ed* London, New York:  
42 376 Edward Arnold publishers. 2003:105-14.
- 43 377 38. Rao G, Rao A, Pujara N, Pujara P, Patel S. Prevalence Of Hernia Among Fishermen  
44 378 Population In Kutch District, India. *National Journal of Integrated Research in Medicine*.  
45 379 2015;6(4).
- 46 380 39. Igwe P, Dodiyyi-Manuel A, Nwankwo N. Hernia In South Southern Nigeria: Five Year  
47 381 *Retrospective Study*.

- 382 40. Truskett P. Bailey and Love's Short Practice of Surgery; Edited by NS Williams, CJK  
 383 Bulstrode and PRO'Connell. Boca Raton, FL: CRC Press, 2013. 1517 pages. ISBN  
 384 978-1-4441-2128-5. Price: \$199.95. ANZ Journal of Surgery. 2014;3(84):193-.
- 385 41. Zhao H, Zhou L, Li L, Coon V J, Chatterton RT, Brooks DC, et al. Shift from androgen to  
 386 estrogen action causes abdominal muscle fibrosis, atrophy, and inguinal hernia in a transgenic  
 387 male mouse model. Proc Natl Acad Sci U S A. 2018;115(44):E10427-E36.
- 388 42. Russell RCG, Williams NS, Bulstrode CJ. Bailey & Love's short practice of surgery:  
 389 Arnold London; 2000.
- 390 43. Liem MS, van der Graaf Y, Zwart RC, Geurts I, van Vroonhoven TJ. Risk factors for  
 391 inguinal hernia in women: a case-control study. The Coala Trial Group. Am J Epidemiol.  
 392 1997;146(9):721-6.
- 393 44. Fatima A, Mohiuddin MR. Study of incidence of inguinal hernias and the risk factors  
 394 associated with the inguinal hernias in the regional population of a South Indian City. International  
 395 Journal of Current Research and Review. 2014;6(23):9.
- 396 45. Kartal A, Yalcın M, Citgez B, Uzunkoy A. The effect of chronic constipation on the  
 397 development of inguinal herniation. Hernia. 2017;21.
- 398 46. Carbonell JF, Sanchez JL, Peris RT, Ivorra JC, Del Baño MJ, Sanchez CS, et al. Risk  
 399 factors associated with inguinal hernias: a case control study. Eur J Surg. 1993;159(9):481-6.
- 400 47. Banafa NS, Aram FO. Risk factors of hernia in hadramout-yemen-a case control study.  
 401 2009.
- 402 48. Billiar T, Andersen D, Hunter J, Brunicardi F, Dunn D, Pollock RE. Schwartz's principles  
 403 of surgery: McGraw-Hill Professional; 2004.
- 404 49. Balamaddaiah G, Reddy SRM. Prevalence and risk factors of inguinal hernia: a study in a  
 405 semi-urban area in Rayalaseema, Andhra Pradesh, India. International Surgery Journal.  
 406 2016;3(3):1310-3.

407

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

Variable	Frequency	Percentage
<b>Sex</b>		
Male	196	48.7
Female	207	51.3
<b>Age</b>		
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
<b>Residence</b>		
Urban	220	54.6
Rural	183	45.4

<b>Occupation</b>		
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
<b>Religion</b>		
Orthodox	388	96.2
Muslim	11	2.8
Protestant	4	1.0
<b>Educational status</b>		
No formal education	210	52.1
Primary education	42	10.4
Secondary education	63	15.7
College or above	88	21.8
<b>Marital status</b>		
Married	290	72
Divorced	28	7
Widowed	9	2.2
Single	76	18.6
<b>Average monthly income</b>		
<1210	200	49.6
1211-8970	194	48.1
>8971	9	2.3

410

411 *Others\*: -unemployed, soldier, driver, retire and artist*

412

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

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

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

415

416

417 **Table 3: Multiple logistic regression output for the factors associated with external hernia**  
 418 **among adult patients visiting surgical OPD at the UOG Comprehensive Hospital, Ethiopia,**  
 419 **2020 (n=403)**

Variable	External hernia		Crude OR (95%CI)	Adjusted OR (95%CI)	P-value
	Yes	No			
<b>Age</b>					
19-45	18	249	1	1	
46-84	29	107	3.74(1.99, 7.04)	2.47(1.06, 5.78)	0.036
<b>Residence</b>					
Urban	16	204	1	1	
Rural	31	152	2.6 (1.37, 4.92)	0.73(0.30,1.85)	0.55
<b>Educational status</b>					
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	
<b>Staining during urination</b>					
Yes	16	48	3.31(1.68, 6.50)	0.83(0.33, 2.25)	0.712
No	31	308	1	1	
<b>Constipation</b>					
Yes	26	70	5.05(2.68, 9.51)	3.67(1.68, 8.11)	0.001
No	21	286	1	1	
<b>Prolonged cough</b>					
Yes	17	25	7.50(3.64, 15.4)	5.18(2.17,12.3)	0.000
No	30	331	1	1	
<b>Lifting heavy objects</b>					
Yes	29	55	8.81(4.58, 16.9)	7.39(3.36, 16.2)	0.000
No	18	301	1	1	
<b>BMI</b>					
<b>14-17.9</b>	7	51	1.15(0.48, 2.7)	1.35(0.4, 3.8)	0.56
<b>18-24.9</b>	33	278	1	1	
<b>25-34.9</b>	7	27	2.1(0.82,0.17)	3.01(0.95, 9.54)	0.06

420

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

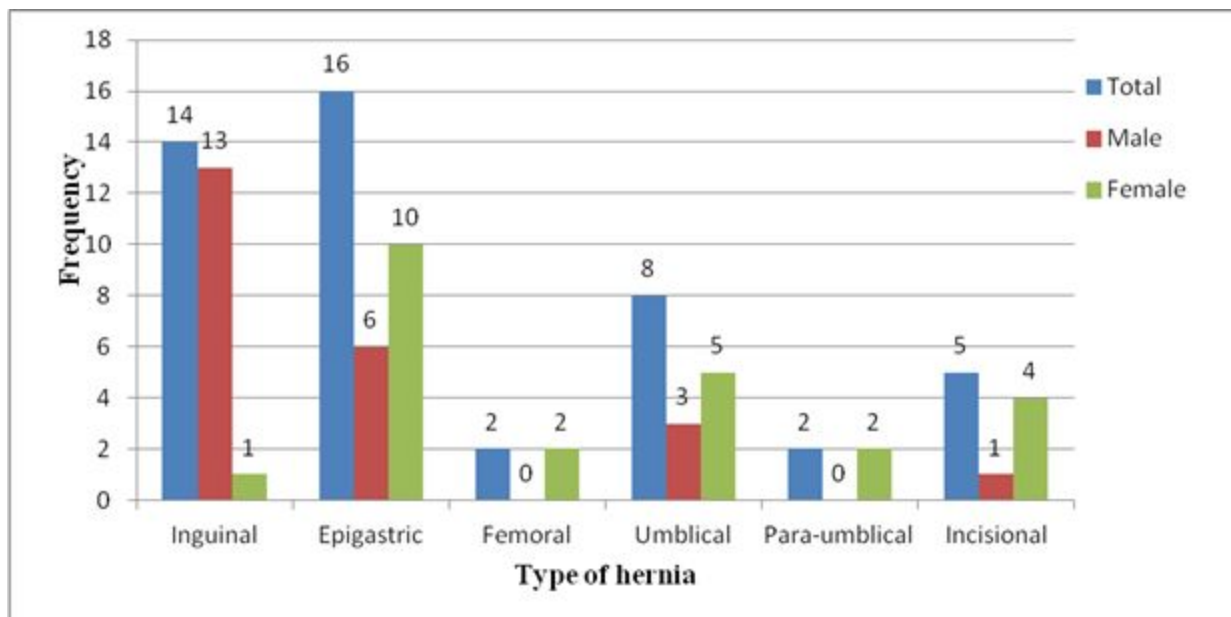
422

423

424

425





**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
<b>Title and abstract</b>	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
<b>Introduction</b>			
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
<b>Methods</b>			
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
<b>Results</b>			
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	
<b>Discussion</b>			
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
<b>Other information</b>			
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](http://www.strobe-statement.org).

# BMJ Open

## 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

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2021-056488.R1
Article Type:	Original research
Date Submitted by the Author:	21-Dec-2021
Complete List of Authors:	Kibret, Anteneh; University of Gondar, Human anatomy Tekle, Solomon ; University of Gondar, Department of Surgery H/Maryam , Miklol; University of Gondar, Surgery Worede, Amanuel ; University of Gondar, Department of Human Anatomy Dessie, M; University of Gondar, Human Anatomy
<b>Primary Subject Heading</b>:	Surgery
Secondary Subject Heading:	Public health, Gastroenterology and hepatology
Keywords:	SURGERY, Adult surgery < SURGERY, PUBLIC HEALTH, Anatomy < NATURAL SCIENCE DISCIPLINES, Adult gastroenterology < GASTROENTEROLOGY, Functional bowel disorders < GASTROENTEROLOGY

SCHOLARONE™  
Manuscripts



I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

1  
2  
3 1 **Prevalence and associated factors of external hernia among adult patients visiting the**  
4  
5 2 **Surgical Outpatient Department in the University of Gondar Comprehensive Specialized**  
6  
7 3 **Hospital, Northwest Ethiopia: A cross-sectional study**

8  
9  
10 4 Anteneh Ayelign Kibret<sup>1\*</sup>, Solomon Yirdaw Tekle<sup>2</sup>, Miklol Mengistu H/maryam <sup>2</sup>, Amanuel  
11  
12 5 Girma Worede<sup>1</sup> and M A Dessie<sup>1</sup>

13  
14  
15 6 <sup>1</sup>Department of Human Anatomy, University of Gondar, college of medicine and health science,  
16  
17 7 School of Medicine, Gondar, Ethiopia

18  
19 8 <sup>2</sup>Department of Surgery, University of Gondar, college of medicine and health science, School of  
20  
21 9 Medicine, Gondar, Ethiopia

22  
23  
24 10 Email

25  
26  
27 11 Anteneh Ayelign Kibret (AAK): [antesha04@gmail.com](mailto:antesha04@gmail.com)

28  
29  
30 12 Solomon Yirdaw Tekle (SYT): [Solomonyirdaw15@gmail.com](mailto:Solomonyirdaw15@gmail.com)

31  
32  
33 13 Miklol Mengistu H/Maryam (MMH): [miklol.mengistu@yahoo.com](mailto:miklol.mengistu@yahoo.com)

34  
35  
36 14 Amanuel Girma Worede (AGW): [amanuelgirma.w@gmail.com](mailto:amanuelgirma.w@gmail.com)

37  
38  
39 15 M A Dessie (MAD): [mituababi@gmail.com](mailto:mituababi@gmail.com)

40  
41  
42  
43 16  
44  
45  
46 17 \*Corresponding author (AAK): [antesha04@gmail.com](mailto:antesha04@gmail.com)

47  
48  
49 18 **Abstract**

50  
51 19 **Objectives:** This study aimed to assess the prevalence and associated factors of external hernia  
52  
53 20 among adult patients visiting the surgical outpatient department at the University of Gondar  
54  
55 21 Comprehensive Specialized Hospital, Northwest Ethiopia.

22 **Study design:** An institution-based cross-sectional study was conducted from April 5 to June 22,  
23 2020

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

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

27 **Outcome:** Prevalence of external hernia

28 **Result:** A total of 403 study participants were involved in this study with a response rate of 100%.

29 The prevalence of external hernia was 11.7% (95%CI; 8.8, 15.1). The epigastric hernia had the  
30 highest prevalence 16 (34%) followed by inguinal hernia 14(29.8%). Old age (Adjusted odds ratio  
31 (OR)=2.47, 95% CI; 1.06, 5.78), constipation (AOR=3.67, 95% CI; 1.68, 8.11), chronic cough  
32 (AOR=5.18, 95% CI; 2.17, 12.3) and lifting of heavy objects (AOR=7.39, 95% CI; 3.36, 16.2) had  
33 a statistically significant association with external hernia.

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

### 39 **Strength and limitation**

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

1  
2  
3 44 ✓ In addition, this study was institution-based and the findings may not fully reflect the entire  
4  
5 45 population, we used only history and physical examination as a means of diagnosis for  
6  
7 46 abdominal hernia, however, ultrasound was not used, and also possible that recall bias may  
8  
9 47 have been introduced.  
10  
11  
12 48

## 14 49 **Introduction**

16  
17 50 Abdominal wall hernias are the most frequently encountered surgical condition that affects all age  
18  
19 51 groups regardless of sex (1). Globally the prevalence of abdominal wall hernia was 1.7% for all  
20  
21 52 ages (2). Abdominal wall hernias are accounting for 15% - 18% of all surgical procedures, and  
22  
23 53 annually more than 20 million hernias are operated on worldwide (3-5). Country-specific studies  
24  
25 54 are demonstrating the prevalence of external hernia. For instance, in the general Russian  
26  
27 55 population, the prevalence of external hernia was 20.9% (6). In Arar City, Northern Saudi Arabia  
28  
29 56 the prevalence of abdominal hernia was 11.5% (1). A study conducted in Sierra Leone revealed  
30  
31 57 that the prevalence of groin hernia was 7.10% (7). Out of the external hernias, an inguinal hernia  
32  
33 58 is the most commonly observed type which accounts for about 75% of all abdominal wall hernias  
34  
35 59 (8). The overall incidence of inguinal hernia in Africa has been estimated and ranged between 60  
36  
37 60 and 175 inguinal hernias per 100,000 (9). In sub-Saharan Africa countries, some reports are  
38  
39 61 demonstrating the prevalence of inguinal hernia between 7.7 to 30 % (10, 11), incisional hernia  
40  
41 62 ranged between 3 to 15%, femoral hernia 2.5 to 7.4%, and epigastric hernia 3.4 to 3.9% (12-14).

42  
43 63 A study conducted in Addis Ababa, Ethiopia, indicated that groin hernia was found to be the most  
44  
45 64 common form external hernia and accounted for 66.3% followed by recurrent hernias 28.5% and  
46  
47 65 incisional hernias 21.4% (15). From the previous studies different factors have been identified  
48  
49 66 which has an association with external hernias. This include, muscular weakness, repeated  
50  
51  
52  
53  
54  
55  
56  
57

1  
2  
3 67 pregnancies, previous history of surgery and sex, age, chronic cough, constipation , smoking,  
4  
5 68 lifting of heavy objects and strenuous work activities, and family history of hernia (1, 16-22).  
6  
7  
8 69 Hernias are among the commonest surgical conditions resulting in consequential morbidity and  
9  
10 70 mortality in various parts of Africa (23, 24). Untreated hernia can lead to life-threatening  
11  
12 71 complications; such as strangulation, incarceration, and intestinal obstruction. Of these,  
13  
14 72 strangulation is an acute and most serious surgical emergency and is probably with fatal  
15  
16 73 consequences (25) . In Nigeria and Sudan, the strangulated external hernia was the most common  
17  
18 74 cause of intestinal obstruction, accounting for 56.9% and 27.7% of cases respectively (24). A great  
19  
20 75 many deaths could also occur due to a lack of adequate surgical care for inguinal hernia disease  
21  
22 76 almost daily in remote rural communities (26).

23  
24  
25  
26 77 Despite the common occurrence and clinical significance of external hernia, until this study was  
27  
28 78 done, very limited epidemiological studies investigated magnitude and risk factors for external  
29  
30 79 hernia in the world. Therefore, the present study aims to assess the prevalence and associated  
31  
32 80 factors of external hernia among adult patients visiting the surgical OPD at the UOGCSH. Finally,  
33  
34 81 the output of the present study will hopefully help clinicians and policymakers to design a reliable  
35  
36 82 strategy.

## 37 38 39 40 83 **Methods**

### 41 42 84 **Study design and setting**

43  
44 85 An institution-based cross-sectional study was conducted from April 5 to June 22, 2020 G.C  
45  
46 86 among adult surgical patients who visited the surgical OPD at the UOGCSH. The hospital was  
47  
48 87 founded in1954 and it is located in the North Gondar administrative zone, Amhara National  
49  
50 88 Regional State, which is about 750 km Northwest of Addis Ababa (the capital city of Ethiopia).  
51  
52  
53 89 According to the 2015 population projection of major cities in Ethiopia, the total population size



1  
2  
3 90 of Gondar town was estimated to be 323,900. Currently, Gondar town has one Referral Hospital  
4  
5 91 and eight government Health Centers. UOGCSH is a teaching hospital, which serves more than  
6  
7 92 five million people of the North Gondar zone and peoples of the neighboring zones. It is estimated  
8  
9 93 that around 21,000 patients visit the surgical OPD per year.  
10  
11

#### 12 94 **Population, sample size determination, and sampling procedure**

13  
14 95 The source and study population of this study were all adult patients above 18 years old who  
15  
16 96 visited the surgical OPD and those who were during the time of data collection in the UOGCSH  
17  
18 97 respectively. Patients who were unable to communicate, mentally, and severely ill were excluded  
19  
20 98 from the study. The sample size was determined using a single population proportion formula, by  
21  
22 99 using a 95% confidence interval, 0.05 margin of error, 5% non-response rate. As far as our search  
23  
24 100 is concerned, there was no previous study conducted in the area and the expected proportion of  
25  
26 101 hemorrhoids was considered to be 50%. Therefore, the final sample size was 403 and participants  
27  
28 102 were selected using a systematic random sampling technique with skipping intervals of three.  
29  
30  
31  
32

#### 33 103 **Variables and Data collection procedures**

34  
35 104 The dependent variable for this study was external herma and the diagnosis performed by general  
36  
37 105 surgeons based on history and physical examination. Participants who had at least one of the  
38  
39 106 external hernia types either inguinal, epigastric, umbilical, para-umbilical, femoral or incisional  
40  
41 107 hernias were considered as positive external hernia cases. Data was collected on the socio-  
42  
43 108 demographic characteristics (age, sex, residence, educational status, occupation, marital status, and  
44  
45 109 average monthly income), clinical factors (family history of hernia, heavy weight lifting,  
46  
47 110 constipation, straining during urination, body mass index (BMI), previous history of abdominal  
48  
49 111 surgery, history of abdominal trauma, chronic cough, and history of Ascites), behavioral and  
50  
51 112 obstetric factors (smoking, alcohol intake, and parity). A chronic cough means a current or  
52  
53  
54  
55  
56  
57

1  
2  
3 113 previous history of cough for more than one month, straining during urination means difficulty  
4  
5 114 with urination for three months and above. Constipation means unsatisfactory defecation  
6  
7  
8 115 characterized by infrequent stool, difficulty in defecation, or both for more than three months (27).  
9

10 116 The interviewer-administered structured questionnaire which was adapted from different works of  
11  
12 117 literature was used to collect data from study participants. Five nurses with a bachelor's degree  
13  
14  
15 118 were trained and employed to collect the overall data collection.  
16

17  
18 119 The questionnaire was prepared in English and translated into Amharic and back to English for  
19  
20 120 consistency of the tool. The tool was pre-tested in 10% of a sample size at Debarq primary hospital  
21  
22 121 two weeks before the main data collection. Necessary adjustments were made based on the pre-  
23  
24  
25 122 test result.  
26

### 27 123 **Data processing and analysis**

28  
29 124 The survey data were entered and cleaned using EPI DATA version 3.1 and analyzed by STATA  
30  
31 125 14 software. Descriptive statistics were used and the findings were presented using texts, graphs,  
32  
33  
34 126 and tables. A logistic regression model was used to identify factors affecting external hernia.  
35  
36 127 Variables with p-values 0.2 or less in the bi-variable logistic regression analysis were fitted in the  
37  
38 128 multivariable analysis. AOR with a 95% Confidence Interval (CI) and p-value <0.05 in the  
39  
40  
41 129 multivariable analysis were used to declare significant association with the outcome variable. The  
42  
43 130 goodness of fitness of the model was checked by Hosmer and Lemeshow test.  
44

45  
46 131

### 47 132 **Patient and public involvement**

48  
49  
50 133 Patients were involved in this study  
51  
52  
53  
54  
55  
56  
57

## 134 **Results**

### 135 **Socio-demographic characteristics**

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

### 141 **Clinical, behavioral, and obstetric characteristics**

142 Of the total participants, 19(4.8%) of the study participants had a family history of external hernia,  
143 and one-fourth (102) of the study participants had a history of alcohol intake. Among female study  
144 participants, the majority of the female 153(74%) gave at least one birth. From the total study  
145 participants, 96 (24%) had constipation, and one-fifth (84) had a history of lifting heavy objects  
146 84 (20.9%) (Table 2).

### 147 **Prevalence of external hernia**

148 Of the total participants, 47 had external hernia and gives an overall prevalence of 11.7 % (95%CI;  
149 8.8, 15.1). The frequency of external hernia was most common in ages above 45 years 29 (61.8%).  
150 The prevalence of external hernia among male and female participants was 11.73% (95% CI: 7.59,  
151 17.09) and 11.59% (95%CI: 7.57, 16.76) respectively. Out of the total of hernia cases that occurred  
152 among females, 23(96%) of them were diagnosed from primiparas and multiparous, and 14  
153 (58.4%) of them had a history of more than four deliveries (grand multipara). Of the total cases of  
154 external hernia, epigastric hernia had the highest prevalence 16 (34%) followed by inguinal hernia  
155 14(29.8%) (Figure 1). About 41(10.1%) of the participants had a history of abdominal surgery,  
156 subsequently, 5(12.2%) of them develop an incisional hernia. Only one case of external hernia

1  
2  
3 157 was present with complications (incarceration), the rest were reducible with hardly any  
4  
5 158 complications. All external hernia cases were newly diagnosed.

### 8 159 **Factors associated with an external hernia**

10 160 Bivariable and multivariable logistic regression models have been run. The multivariable logistic  
11  
12 161 regression analysis revealed that old age, constipation, chronic cough, and lifting of heavy objects  
13  
14 162 had a significant association with the occurrence of external hernia. The odds of having external  
15  
16 163 hernia were 2.47 times higher among participants with age groups between 46 and 84 as compared  
17  
18 164 to age between 19 and 45 (AOR=2.47, 95%CI; 1.06, 5.78). The odds of having an external hernia  
19  
20 165 were 3.67 times higher among participants who had constipation as compared to their counterparts  
21  
22 166 (AOR=3.67, 95%CI; 1.68, 8.11). The patients who had chronic cough had 5.18 times higher odds  
23  
24 167 of having external hernia as compared to their counterparts (AOR=5.18, 95%CI; 2.17, 12.3). The  
25  
26 168 odds of having an external hernia were 7.39 times higher among participants lifting heavy objects  
27  
28 169 as compared to participants who didn't (AOR=7.39, 95%CI; 3.36, 16.2) (Table 3).

### 33 170 **Discussion**

35 171 This study assessed the prevalence of external hernia and its associated factors among adult  
36  
37 172 patients visiting the surgical OPD at the UOGCSH, Northwest Ethiopia.

40 173 The prevalence of external hernia was found to be 11.7%. The result is consistent with a study  
41  
42 174 conducted in Arar City, Northern Saudi Arabia 11.5% (1). However, it is lower than the study  
43  
44 175 from Russia which reported the prevalence to be 20.9% (6). This could be due to the difference in  
45  
46 176 study settings. In Russia, community-based studies were conducted to indicate the prevalence of  
47  
48 177 external hernia. But the current study was conducted in the hospital, and the majority of hernia  
49  
50 178 cases are asymptomatic so, asymptomatic patients might not frequently visit the hospital which  
51  
52 179 may reduce the prevalence of external hernia (28). Another possible reason could be the difference

1  
2  
3 180 in the study population and the outcome of a measurement. In a study in Russia, participants above  
4  
5 181 the age of 10 years were included, and also participants who had a previous history of hernia repair  
6  
7 182 were considered positive hernia cases. Furthermore, in addition to history and physical  
8  
9 183 examination, ultrasonography was used as an outcome of measurement which might increase the  
10  
11 184 prevalence rate. According to the present study, of the total hernia cases, epigastric hernias had a  
12  
13 185 slightly higher proportion (34%), but the proportion of epigastric hernia in other studies done  
14  
15 186 worldwide is much lower and ranged between 3.4 and 8.1% (12, 13, 29). According to studies  
16  
17 187 conducted in Nigeria, Egypt and India the proportion of inguinal hernia was found to be 70.2%,  
18  
19 188 56%, and 21.8% respectively (12, 29, 30). However, the proportion of inguinal hernia in the  
20  
21 189 present study was found to be 29.8%.

22  
23  
24  
25  
26 190 In this study, higher odds of external hernia were observed among participants who were older age  
27  
28 191 compared to younger age groups. This finding is supported by different studies elsewhere (6, 16,  
29  
30 192 17). The reason could be attributed to the degenerative weakness of abdominal muscles and fibrous  
31  
32 193 tissue in the elderly age group leads to loss of abdominal muscle strength and resistance to high  
33  
34 194 intra-abdominal pressure which may cause herniation (31, 32). Another reason could be, as age  
35  
36 195 increases the blood testosterone level decrease, and estrogen level will be enhanced via the  
37  
38 196 aromatase enzyme. Lower abdominal muscles (LAM) are sensitive to the estrogen hormone and  
39  
40 197 express very high levels of estrogen receptor- $\alpha$ , in turn, leads to atrophy and fibrosis of LAM  
41  
42 198 which may result in the occurrence of hernia in males (33). On the other hand, when women reach  
43  
44 199 postmenopausal age, they start to accumulate intra-abdominal adipose tissue which will cause  
45  
46 200 separation of muscle bundle and layers, weakening of aponeurosis, and then predisposing to hernia  
47  
48 201 (34).

1  
2  
3 202 In the current study, the study participants with constipation were more likely to have an external  
4  
5 203 hernia as compared to their counterparts. The same result is obtained by the studies done in  
6  
7 204 America and India (18, 35). This could be due to prolonged straining during defecation which  
8  
9 205 generates high intra-abdominal pressure and results in weakness of abdominal muscle, which in  
10  
11 206 turn, leads to a hernia (36).

12  
13  
14 207 In the present study, the study participants with a chronic cough had higher odds of having external  
15  
16 208 hernia as compared to the corresponding groups. Our finding is strongly supported by the studies  
17  
18 209 done elsewhere (17, 37, 38). This may be due to the repeated occurrence of an increase in the intra-  
19  
20 210 abdominal pressure during coughing which results in weakness of abdominal muscle which  
21  
22 211 precedes herniation (39).

23  
24  
25 212 Our finding presented that lifting heavy objects had higher odds of having external hernia than  
26  
27 213 their counterparts which was found to be the commonly encountered scenario. The notion of our  
28  
29 214 study is supported by different studies (22, 38, 40). This could be attributed to increasing intra-  
30  
31 215 abdominal pressure causing breakage in the fibers of transversals fascia, which leads to muscle  
32  
33 216 weakness and results in the occurrence of hernia (41).

34  
35  
36 217 The study is the first of its kind in the study area and Ethiopia as well. The study is also  
37  
38 218 comprehensive which includes most of the external hernia types data were recorded by well-  
39  
40 219 trained data collectors under the close supervision of the investigators. However, there are some  
41  
42 220 limitations of this study such as it could not establish a cause-effect relationship because of the  
43  
44 221 cross-sectional nature of the study design. In addition, this study was institution-based, the findings  
45  
46 222 may not fully reflect the entire population, we used only history and physical examination as a  
47  
48 223 means of diagnosis for abdominal hernia but ultrasound was not used and also possible that recall  
49  
50 224 bias may have been introduced.

1  
2  
3 225  
4  
5 226 **Conclusion**  
6  
7  
8 227 Regardless of hardly any significant gender difference, the external hernia was one of the  
9  
10 228 commonest surgical procedures. Old age, constipation, chronic cough, and lifting of heavy objects  
11  
12 229 were found to increase the odds of having an external hernia. Health professionals better identify  
13  
14 230 and intervene in external hernias early, especially for risk groups. Patients who have constipation  
15  
16 231 and cough should get appropriate treatment in time and those who are engaged in an occupation  
17  
18 232 that requires strenuous activities and older age groups should reduce lifting of heavy objects. To  
19  
20 233 show the real burden of the disease community-based studies should be conducted and there is a  
21  
22 234 need for further studies regarding the burden and risk factors of external hernia in a different area  
23  
24 235 of the country using ultrasonography as an outcome measurement.  
25  
26  
27

28 236 **Abbreviations**

29  
30  
31 237 AOR: Adjusted Odds Ratio

32  
33 238 BMI: Body Mass Index

34  
35 239 BP: Blood Pressure

36  
37 240 CI: Confidence Interval

38  
39 241 COR: Crude Odds Ratio

40  
41 242 IAP: Intra-abdominal pressure

42  
43 243 LAM: Lower abdominal muscle

44  
45 244 OPD: Outpatient department

46  
47 245 UOG: University of Gondar

48  
49 246 USA: United State of America

50  
51  
52  
53  
54 247  
55  
56  
57

248

**249 Declarations****250 Authors contribution**

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

**253 Consent for publication**

254 “Not applicable”.

**255 Availability of data and material**

256 Data will be available from the corresponding author upon request

**257 Competing Interests**

258 There is no competing of interests related to this work

**259 Funding**

260 The authors received no specific funding for this work.

**261 Acknowledgments**

262 We are grateful to thank the study participant for their valuable contribution and provide  
263 appropriate information and Dr. Abebe Muche, Mr. Haileab Fekadu, and Mr. Adhanom  
264 G/Egzabher for their close, friendly, comments, assistance, intellectual and guidance to our work.

265 The authors like to express their gratitude to all the members of the Department of Human  
266 Anatomy as well as the surgery department of the University of Gondar comprehensive specialized  
267 hospital as their contributions were vital in the completion of this research work.

**268 Ethics statement**

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



1  
2  
3 271 letter was obtained from the University of Gondar Research and Community Service and surgery  
4  
5 272 department. Participants were informed about the purpose, objectives, and their right to and not to  
6  
7  
8 273 participate in the study. Written informed consent was obtained from the study participants. To  
9  
10 274 keep confidentiality, respondents' names and other personal identifiers were not included. The  
11  
12 275 collected data were password protected.  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57

For peer review only

**References**

1. AhmedAlenazi A, Alsharif MM, Hussain MA, Alenezi NG, Alenazi AA, Almadani SA, et al. Prevalence, risk factors and character of abdominal hernia in Arar City, Northern Saudi Arabia in 2017. *Electronic physician*. 2017;9(7):4806-11.
2. Kingsnorth A, LeBlanc K. Hernias: inguinal and incisional. *Lancet (London, England)*. 2003;362(9395):1561-71.
3. Sangwan M, Sangwan V, Garg M, Mahendirutta P, Garg U. Abdominal wall hernia in a rural population in India—Is spectrum changing? *Open journal of epidemiology*. 2013;2013.
4. Primatesta P, Goldacre MJ. Inguinal hernia repair: incidence of elective and emergency surgery, readmission and mortality. *International journal of epidemiology*. 1996;25(4):835-9.
5. Kingsnorth A, LeBlanc K. Hernias: inguinal and incisional. *The Lancet*. 2003;362(9395):1561-71.
6. Sazhin A, Zolotukhin I, Seliverstov E, Nikishkov A, Shevtsov Y, Andriyashkin A, et al. Prevalence and risk factors for abdominal wall hernia in the general Russian population. *Hernia : the journal of hernias and abdominal wall surgery*. 2019;23(6):1237-42.
7. Patel HD, Groen RS, Kamara TB, Samai M, Farahzad MM, Cassidy LD, et al. An estimate of hernia prevalence in Sierra Leone from a nationwide community survey. *Hernia : the journal of hernias and abdominal wall surgery*. 2014;18(2):297-303.
8. Garba ES. The Pattern Of Adult External Abdominal Hernias In Zaria. *Nigerian Journal of Surgical Research*. 2000;2.
9. Nordberg EM. Incidence and estimated need of caesarean section, inguinal hernia repair, and operation for strangulated hernia in rural Africa. *British medical journal (Clinical research ed)*. 1984;289(6437):92-3.
10. Belcher DW, Nyame PK, Wurapa FK. The prevalence of inguinal hernia in adult Ghanaian males. *Tropical and geographical medicine*. 1978;30(1):39-43.
11. Yordanov YS, Stoyanov SK. The incidence of hernia on the island of Pemba. *East African medical journal*. 1969;46(12):687-91.
12. Ammar A, Ismail T. Abdominal wall hernias in upper Egypt: A different spectrum. *East and Central African Journal of Surgery*. 2008;13(2):109-14.
13. Ohene-Yeboah M, Abantanga F, Oppong J, Togbe B, Nimako B, Amoah M, et al. Some aspects of the epidemiology of external hernias in Kumasi, Ghana. *Hernia : the journal of hernias and abdominal wall surgery*. 2009;13(5):529-32.
14. Odula PO, Kakande I. Groin hernia in Mulago hospital, Kampala. *East and Central African journal of surgery*. 2004;9(1).
15. Gelan EA. Experience of Open Mesh Hernia Repair at a Teaching Hospital in Addis Ababa, Ethiopia-A Three Year Retrospective Study. *Ethiopian Medical Journal*. 2018;56(4).
16. Iqbal MN, Akhter S, Irfan M. Prevalence of hernia in relation to various risk factors in Narowal, Pakistan. *Sci Lett*. 2015;3(1):29-32.
17. Ruhl CE, Everhart JE. Risk factors for inguinal hernia among adults in the US population. *American journal of epidemiology*. 2007;165(10):1154-61.
18. Liem MS, van der Graaf Y, Zwart RC, Geurts I, van Vroonhoven TJ. Risk factors for inguinal hernia in women: a case-control study. *The Coala Trial Group. Am J Epidemiol*. 1997;146(9):721-6.
19. Jansen PL, Klinge U, Jansen M, Junge K. Risk factors for early recurrence after inguinal hernia repair. *BMC surgery*. 2009;9(1):1-5.
20. Sorensen LT, Friis E, Jorgensen T, Vennits B, Andersen BR, Rasmussen GI, et al. Smoking is a risk factor for recurrence of groin hernia. *World journal of surgery*. 2002;26(4):397.

- 322 21. Flich J, Alfonso J, Delgado F, Prado M, Cortina P. Inguinal hernia and certain risk factors.  
323 European journal of epidemiology. 1992;8(2):277-82.
- 324 22. Ashindoitiang J, Ibrahim N, Akinlolu O. Risk factors for inguinal hernia in adult male Nigerians: a  
325 case control study. International Journal of Surgery. 2012;10(7):364-7.
- 326 23. Mabula JB, Chalya PL. Surgical management of inguinal hernias at Bugando Medical Centre in  
327 northwestern Tanzania: our experiences in a resource-limited setting. BMC research notes. 2012;5(1):1-  
328 8.
- 329 24. ElRashied M, Widatalla A, Ahmed M. External strangulated hernia in Khartoum, Sudan. East  
330 African medical journal. 2007;84(8):379.
- 331 25. Ohene-Yeboah M. Strangulated external hernias in Kumasi. West African journal of medicine.  
332 2003;22(4):310-3.
- 333 26. Ohene-Yeboah M, Abantanga FA. Inguinal hernia disease in Africa: a common but neglected  
334 surgical condition. West African journal of medicine. 2011;30(2):77-83.
- 335 27. Gray JR. What is chronic constipation? Definition and diagnosis. Canadian journal of  
336 gastroenterology = Journal canadien de gastroenterologie. 2011;25 Suppl B(Suppl B):7b-10b.
- 337 28. Kingsnorth A, Leblanc K. Choice of anesthesia: general, regional or local anesthetic. Kingsnorth  
338 AN, Leblanc KA Management of abdominal hernias 3rd ed London, New York: Edward Arnold publishers.  
339 2003:105-14.
- 340 29. Rao G, Rao A, Pujara N, Pujara P, Patel S. Prevalence of hernia among fishermen population in  
341 Kutch district. India. National J Integrated Res Med. 2015;6(4):44-51.
- 342 30. Igwe PO, Dodiya-manuel A, Nwankwo N. Hernia In South Southern Nigeria: Five Year  
343 Retrospective Study. IOSR Journal of Dental and Medical Sciences. 2016;15:96-111.
- 344 31. Lauscher J, Loh J, Rieck S, Buhr H, Ritz J. Long-term follow-up after incisional hernia repair: are  
345 there only benefits for symptomatic patients? Hernia : the journal of hernias and abdominal wall  
346 surgery. 2013;17(2):203-9.
- 347 32. Garrone R. Collagen family of proteins. FASEB J. 1991;5:2814-23.
- 348 33. Zhao H, Zhou L, Li L, Coon J, Chatterton RT, Brooks DC, et al. Shift from androgen to estrogen  
349 action causes abdominal muscle fibrosis, atrophy, and inguinal hernia in a transgenic male mouse  
350 model. Proceedings of the National Academy of Sciences. 2018;115(44):E10427-E36.
- 351 34. Kark AE, Kurzer M. Groin hernias in women. Hernia : the journal of hernias and abdominal wall  
352 surgery. 2008;12(3):267-70.
- 353 35. Fatima A, Mohiuddin MR. Study of incidence of inguinal hernias and the risk factors associated  
354 with the inguinal hernias in the regional population of a South Indian City. International Journal of  
355 Current Research and Review. 2014;6(23):9.
- 356 36. Kartal A, Yalcin M, Citgez B, Uzunkoy A. The effect of chronic constipation on the development  
357 of inguinal herniation. Hernia : the journal of hernias and abdominal wall surgery. 2017;21(4):531-5.
- 358 37. Lau H, Fang C, Yuen WK, Patil NG. Risk factors for inguinal hernia in adult males: a case-control  
359 study. Surgery. 2007;141(2):262-6.
- 360 38. Carbonell J, Sanchez J, Peris R, Ivorra J, Del Baño M, Sanchez C, et al. Risk factors associated with  
361 inguinal hernias: a case control study. The European journal of surgery= Acta chirurgica.  
362 1993;159(9):481-6.
- 363 39. Billiar T, Andersen D, Hunter J, Brunicardi F, Dunn D, Pollock RE. Schwartz's principles of surgery:  
364 McGraw-Hill Professional; 2004.
- 365 40. Balamaddaiah G, Reddy SRM. Prevalence and risk factors of inguinal hernia: a study in a semi-  
366 urban area in Rayalaseema, Andhra Pradesh, India. International Surgery Journal. 2016;3(3):1310-3.
- 367 41. Coste AH, Jaafar S, Parmely JD. Umbilical hernia. 2017.

368

369

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

Variable	Frequency	Percentage
<b>Sex</b>		
Male	196	48.7
Female	207	51.3
<b>Age</b>		
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
<b>Residence</b>		
Urban	220	54.6
Rural	183	45.4
<b>Occupation</b>		
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
<b>Religion</b>		
Orthodox	388	96.2
Muslim	11	2.8
Protestant	4	1.0
<b>Educational status</b>		
No formal education	210	52.1
Primary education	42	10.4
Secondary education	63	15.7
College or above	88	21.8
<b>Marital status</b>		
Married	290	72
Divorced	28	7
Widowed	9	2.2

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

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

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

377

378

379 **Table 3: Multiple logistic regression output for the factors associated with external hernia**  
 380 **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			
<b>Age</b>					
19-45	18	249	1	1	
46-84	29	107	3.74(1.99, 7.04)	2.47(1.06, 5.78)	0.036
<b>Residence</b>					
Urban	16	204	1	1	
Rural	31	152	2.6 (1.37, 4.92)	0.73(0.30,1.85)	0.55
<b>Educational status</b>					
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	
<b>Staining during urination</b>					
Yes	16	48	3.31(1.68, 6.50)	0.83(0.33, 2.25)	0.712
No	31	308	1	1	
<b>Constipation</b>					
Yes	26	70	5.05(2.68, 9.51)	3.67(1.68, 8.11)	0.001
No	21	286	1	1	
<b>Prolonged cough</b>					
Yes	17	25	7.50(3.64, 15.4)	5.18(2.17,12.3)	0.000
No	30	331	1	1	

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

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

382

383

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

386

387

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

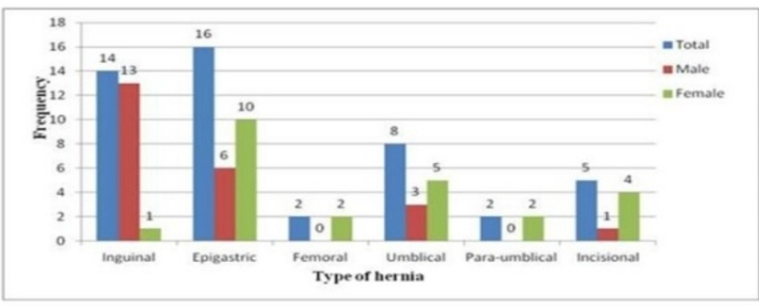


Figure 1: Bar graph that shows the frequency distribution of types of hernia with sex of adult patients visiting surgical OPD at the UOG Comprehensive Hospital, Ethiopia, 2020

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 \_\_\_\_\_

<b>Socio-demographic characteristics</b>			
<b>No</b>	<b>Question</b>	<b>Response</b>	<b>Remark</b>
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 <sup>2</sup>	
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 ታካሚዎች ላይ በሄርንያ ስርጭት ና ተያያዥ ምክንያቶች በተመለከተ ለማጥናት የዘጋጀ ቃለ-መጠይቅ፡

ቃል መጠይቅ የሚያደርግው ስም -----

የተቆጣጣሪው ስም -----

ቃል መጠይቅ የተደረገበት ቀን-----

የጥናቱ ተሳታፊ የሚሰጥር ቁጥር-----

ሀ. ማህበራዊ መስተጋብር ጥያቄዎች			
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	

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

ከሄርንዩ ጋር የተያያዙ ጥያቄዎች

201	ከቤተሰብወት ሄርንያ ያለበት አለ ?	1. አለ 2. የለም	
202	ሲጋራ ያጨሳሉ?	1. አጭሽ አላውቅም 2. አጨስ ነበር 3. አጨሳለው	
203	አልኮል መጠጥ ይጠጣሉ?	1. አልኮል ጠጥቻ አላውቅም 2. አልኮል እጠጣ ነበር 3. አልኮል እጠጣለው	
204	ሰንት 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 ለምን ያህል 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. አሞያውቅም	
210	ሆድወት ላይ አደጋ ደርሶብወት ያውቃል?	1. አወ 2. አሞያውቅም	
211	በተደጋጋሚ ከባድ ዕቃ ያነሳሉ?	1. አወ 2. አሞያውቅም	

212	ሆድቃወት ወሃ አለው ተብሎ በሀኪም ተነግሮወት ያውቃል?	1. አወ 2. አይውቅም	
213	የሰውነት ብዛት ማውጫ	_____ kg/m <sup>2</sup>	
214	ሄርንያ	1. አለ 2. የለም	
215	ሄርንያ ካለ ምን አይነት ሄርንያ ነው ?	1. ኢንፍላሜሽን 2. ኢንፍላሜሽን 3. ፊሎራል 4. አምብላይዳ 5. ፓራአምብላይዳ 6. ኢንሰሽን 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
<b>Introduction</b>			
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
<b>Methods</b>			
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
<b>Results</b>			
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	
<b>Discussion</b>			
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
<b>Other information</b>			
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](http://www.strobe-statement.org).

# BMJ Open

## 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

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2021-056488.R2
Article Type:	Original research
Date Submitted by the Author:	28-Feb-2022
Complete List of Authors:	Kibret, Anteneh; University of Gondar, Human anatomy Tekle, Solomon ; University of Gondar, Department of Surgery H/Maryam , Miklol; University of Gondar, Surgery Worede, Amanuel ; University of Gondar, Department of Human Anatomy Dessie, M; University of Gondar, Human Anatomy
<b>Primary Subject Heading</b>:	Surgery
Secondary Subject Heading:	Public health, Gastroenterology and hepatology
Keywords:	SURGERY, Adult surgery < SURGERY, PUBLIC HEALTH, Anatomy < NATURAL SCIENCE DISCIPLINES, Adult gastroenterology < GASTROENTEROLOGY, Functional bowel disorders < GASTROENTEROLOGY

SCHOLARONE™  
Manuscripts



I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

1  
2  
3 1 **Prevalence and associated factors of external hernia among adult patients visiting the**  
4  
5 2 **Surgical Outpatient Department at the University of Gondar Comprehensive Specialized**  
6  
7 3 **Hospital, Northwest Ethiopia: A cross-sectional study**

8  
9  
10 4 Anteneh Ayelign Kibret<sup>1\*</sup>, Solomon Yirdaw Tekle<sup>2</sup>, Miklol Mengistu H/maryam <sup>2</sup>, Amanuel  
11  
12 5 Girma Worede<sup>1</sup> and M A Dessie<sup>1</sup>

13  
14  
15 6 <sup>1</sup>Department of Human Anatomy, University of Gondar, college of medicine and health science,  
16  
17 7 School of Medicine, Gondar, Ethiopia

18  
19 8 <sup>2</sup>Department of Surgery, University of Gondar, college of medicine and health science, School of  
20  
21 9 Medicine, Gondar, Ethiopia

22  
23  
24 10 Email

25  
26  
27 11 Anteneh Ayelign Kibret (AAK): [antesha04@gmail.com](mailto:antesha04@gmail.com)

28  
29  
30 12 Solomon Yirdaw Tekle (SYT): [Solomonyirdaw15@gmail.com](mailto:Solomonyirdaw15@gmail.com)

31  
32  
33 13 Miklol Mengistu H/Maryam (MMH): [miklol.mengistu@yahoo.com](mailto:miklol.mengistu@yahoo.com)

34  
35  
36 14 Amanuel Girma Worede (AGW): [amanuelgirma.w@gmail.com](mailto:amanuelgirma.w@gmail.com)

37  
38  
39 15 M A Dessie (MAD): [mituababi@gmail.com](mailto:mituababi@gmail.com)

40  
41  
42  
43 16  
44  
45  
46 17 \*Corresponding author (AAK): [antesha04@gmail.com](mailto:antesha04@gmail.com)

47  
48  
49 18 **Abstract**

50  
51 19 **Objectives:** This study aimed to assess the prevalence and associated factors of external hernia  
52  
53 20 among adult patients visiting the surgical outpatient department at the University of Gondar  
54  
55 21 Comprehensive Specialized Hospital, Northwest Ethiopia.

22 **Study design:** Institution-based cross-sectional study was conducted from April 5 to June 22,  
23 2020

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

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

27 **Outcome:** Prevalence of external hernia

28 **Result:** A total of 403 study participants were involved in this study with a response rate of  
29 100%. The prevalence of external hernia was 11.7% (95%CI; 8.8, 15.1). The epigastric hernia  
30 had the highest prevalence 16 (34%) followed by inguinal hernia 14(29.8%). Old age (Adjusted  
31 odds ratio (OR)=2.47, 95% CI; 1.06, 5.78), constipation (AOR=3.67, 95% CI; 1.68, 8.11),  
32 chronic cough (AOR=5.18, 95% CI; 2.17, 12.3) and lifting of heavy objects (AOR=7.39, 95%  
33 CI; 3.36, 16.2) had a statistically significant association with external hernia.

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

#### 38 **Strength and limitation**

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

- 1  
2  
3 44 ✓ The study used only history and physical examination as a means of diagnosis for  
4  
5 45 external hernia.  
6  
7  
8 46 ✓ Recall bias may have been introduced.  
9  
10 47

## 11 48 **Introduction**

14 49 Abdominal wall hernias are the most frequently encountered surgical condition that affects all  
15 50 age groups regardless of sex (1). Globally, the prevalence of abdominal wall hernia was 1.7% for  
16 51 all ages (2). Abdominal wall hernias, are accounting for 15% - 18% of all surgical procedures,  
17 52 and annually more than 20 million hernias are operated worldwide (3-5). Country-specific  
18 53 studies are demonstrating the prevalence of external hernia. For instance, in the general Russian  
19 54 population, the prevalence of external hernia was 20.9% (6). In Arar City, Northern Saudi  
20 55 Arabia, the prevalence of abdominal hernia was 11.5% (1). A study conducted in Sierra Leone  
21 56 revealed that the prevalence of groin hernia was 7.10% (7). Out of the external hernias, an  
22 57 inguinal hernia is a most commonly observed type accounts for about 75% of all abdominal wall  
23 58 hernias (8). The overall incidence of inguinal hernia in Africa has been estimated and ranged  
24 59 between 60 and 175 inguinal hernias per 100,000 (9). In sub-Saharan Africa countries, some  
25 60 studies reported the prevalence of inguinal hernia between 7.7 to 30 % 7.7 to 30 % (10, 11),  
26 61 incisional hernia ranged between 3 to 15%, femoral hernia 2.5 to 7.4%, and epigastric hernia 3.4  
27 62 to 3.9% (12-14).

28 63 A study conducted in Addis Ababa, Ethiopia, indicated that groin hernia was found to be the  
29 64 most common form of external hernias which accounted for 66.3% of all the cases and it is  
30 65 followed by recurrent 28.5% and incisional hernias 21.4 % % (15). Previous studies different  
31 66 factors have been identified which have an association with external hernias. This includes,

1  
2  
3 67 muscular weakness, repeated pregnancies, previous history of surgery, sex, age, chronic cough,  
4  
5 68 constipation, smoking, strenuous work activities, and family history of hernia (1, 16-22).  
6  
7  
8 69 Hernias are among the commonest surgical conditions causing significant number of morbidity  
9  
10 70 and mortality in various parts of Africa (23, 24). Untreated hernia can lead to life-threatening  
11  
12 71 complications; such as strangulation, incarceration, and intestinal obstruction. Of these,  
13  
14 72 strangulation is an acute and most serious surgical emergency and is probably with fatal  
15  
16 73 consequences (25). In Nigeria and Sudan, the strangulated external hernia was the most common  
17  
18 74 cause of intestinal obstruction, accounting for 56.9% and 27.7% of cases, respectively (24). A  
19  
20 75 great many deaths could also occur due to a lack of adequate surgical care for inguinal hernia  
21  
22 76 disease almost daily in remote rural communities (26).

23  
24  
25  
26 77 Despite the common occurrence and clinical significance of external hernia, until this study was  
27  
28 78 done, there are very limited epidemiological studies investigated to indicate the magnitude and  
29  
30 79 risk factors for external hernia in the world. Therefore, the present study aims to assess the  
31  
32 80 prevalence and associated factors of external hernia among adult patients visiting the surgical  
33  
34 81 OPD at the UOGCSH. Finally, the output of the present study will hopefully help clinicians and  
35  
36 82 policymakers to design a reliable strategy.

## 37 38 39 40 83 **Methods**

### 41 42 84 **Study design and setting**

43  
44 85 An institution-based cross-sectional study was conducted from April 5 to June 22, 2020 G.C  
45  
46 86 among adult surgical patients who visited the surgical OPD at the UOGCSH. The hospital was  
47  
48 87 found in 1954 and it is located in the North Gondar administrative zone, Amhara National  
49  
50 88 Regional State, which is about 750 km Northwest of Addis Ababa (the capital city of Ethiopia).  
51  
52  
53 89 According to the 2015 population projection of major cities in Ethiopia, the total population size

1  
2  
3 90 of Gondar town was estimated to be 323,900. Currently, Gondar town has one Referral Hospital  
4  
5 91 and eight government Health Centers. UOGCSH is a teaching hospital, which serves more than  
6  
7 92 five million people of the North Gondar zone and peoples of the neighboring zones. It is  
8  
9  
10 93 estimated that around 21,000 patients visit the surgical OPD per year.

#### 12 94 **Population, sample size determination, and sampling procedure**

14  
15 95 The source and study population of this study were all adult patients above 18 years who visited  
16  
17 96 the surgical OPD and those who were available during the time of data collection in the  
18  
19 97 UOGCSH respectively. Patients who were unable to communicate, mentally, and severely ill  
20  
21 98 were excluded from the study. The sample size was determined using a single population  
22  
23 99 proportion formula, by using a 95% confidence interval, 0.05 margin of error, 5% non-response  
24  
25  
26 100 rate. Since there was no previous study conducted in the area, we considered expected  
27  
28 101 proportion of external hernia to be 50%. Hence, the final sample size was 403 and participants  
29  
30  
31 102 were selected using a systematic random sampling technique with skipping intervals of three.

#### 33 103 **Variables and Data collection procedures**

35 104 The dependent variable for this study was having any of the external hernias such as: inguinal,  
36  
37 105 epigastric, umbilical, para-umbilical, femoral and incisional hernias. The outcome was diagnosed  
38  
39 106 by general surgeons based on history and physical examination. Data was collected on the socio-  
40  
41 107 demographic characteristics (age, sex, residence, educational status, occupation, and average  
42  
43 108 monthly income), clinical factors (family history of hernia, heavy weight lifting, constipation,  
44  
45 109 straining during urination, body mass index (BMI), previous history of abdominal surgery,  
46  
47 110 history of abdominal trauma, chronic cough, and history of Ascites), behavioral and obstetric  
48  
49 111 factors (smoking, alcohol intake, and parity). Chronic cough was defined as current or previous  
50  
51 112 history of cough for more than a month. Besides, straining during urination means difficulty of  
52  
53  
54  
55  
56  
57



1  
2  
3 113 urination that lasts for three or more months. Constipation was defined as unsatisfactory  
4  
5 114 defecation which is characterized by infrequent stool, difficulty in defecation, or both for more  
6  
7  
8 115 than three month (27). Interviewer-administered structured questionnaire adapted from different  
9  
10 116 literature was used to collect data. Five nurses with a bachelor's degree were trained and  
11  
12 117 employed as data collector. The questionnaire was prepared in English and translated into  
13  
14 118 Amharic and back to English for consistency of the tool. The tool was pre-tested in 10% of a  
15  
16 119 sample size at Debarq primary hospital two weeks before the main data collection. Necessary  
17  
18 120 adjustments were made based on the pre-test result.

## 121 **Patient and public involvement**

122 Patients were involved in this study

## 123 **Results**

### 124 **Socio-demographic characteristics**

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

### 130 **Clinical, behavioral, and obstetric characteristics**

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

### 135 **Prevalence of external hernia**

136 Of the total participants, 47 had external hernia and gives an overall prevalence of 11.7 %  
137 (95%CI; 8.8, 15.1). More than half of external hernia cases, 29 (61.8%), occurred at the age of  
138 above 45. The prevalence of external hernia among male and female participants was 11.73%  
139 (95% CI: 7.59, 17.09) and 11.59% (95%CI: 7.57, 16.76), respectively. Out of the total of hernia  
140 cases that occurred among females, 23(96%) of them were diagnosed from primiparas and  
141 multiparous, and 14 (58.4%) of them had a history of more than four deliveries (grand  
142 multipara). Of the total cases of external hernia epigastric and inguinal hernia had nearly equal  
143 prevalence 16 (34%) and 14(29.8%) respectively (Figure 1). About 41(10.1%) of the participants  
144 had a history of abdominal surgery and only 5(12.2%) of them had an incisional hernia. Only one  
145 case of external hernia was present with complications (incarceration) and all external hernia  
146 cases were newly diagnosed.

### 147 **Factors associated with an external hernia**

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

## 158 Discussion

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

168 In this study, higher odds of external hernia was observed among participants who were older  
169 age compared to younger age groups. This finding is supported by different studies elsewhere (6,  
170 16, 17). The reason could be attributed to the degenerative weakness of abdominal muscles and  
171 fibrous tissue in the elderly age group leads to loss of abdominal muscle strength and resistance  
172 to high intra-abdominal pressure which may cause herniation (31, 32). Another reason could be,  
173 as age increases the blood testosterone level decrease, and estrogen level will be enhanced via  
174 the aromatase enzyme. Lower abdominal muscles (LAM) are sensitive to the estrogen hormone  
175 and express very high levels of estrogen receptor- $\alpha$ , in turn, leads to atrophy and fibrosis of LAM  
176 which may result in the occurrence of hernia in males (33). On the other hand, when women  
177 reach postmenopausal age, they start to accumulate intra-abdominal adipose tissue which will  
178 cause separation of muscle bundle and layers, weakening of aponeurosis, and then predisposing  
179 to hernia (34).

1  
2  
3 180 In the current study, the study participants with constipation were more likely to have an external  
4  
5 181 hernia as compared to their counterparts. The same result is obtained by the studies done in  
6  
7 182 America and India (18, 35). This could be due to prolonged straining during defecation which  
8  
9 183 generates high intra-abdominal pressure and results in weakness of abdominal muscle, which in  
10  
11 184 turn, leads to a hernia (36).

14  
15 185 In the present study, the study participants with a chronic cough had higher odds of having  
16  
17 186 external hernia as compared to the corresponding groups. Our finding is strongly supported by  
18  
19 187 the studies done elsewhere (17, 37, 38). This may be due to the repeated occurrence of increased  
20  
21 188 intra-abdominal pressure during coughing which results in weakness of abdominal muscle and  
22  
23 189 followed herniation (39).

26  
27 190 Our finding showed that lifting heavy objects increased odds of having external hernia. The  
28  
29 191 notion of our study is supported by different studies (22, 38, 40), This could be attributed to  
30  
31 192 increasing intra-abdominal pressure causing breakage in the fibers of transversals fascia, which  
32  
33 193 leads to muscle weakness and results in the occurrence of hernia (41).

35  
36 194 The study is the first of its kind in the study area and Ethiopia as well. The study is also  
37  
38 195 comprehensive which includes most of the external hernia types data were recorded by well-  
39  
40 196 trained data collectors under the close supervision of the investigators. However, there are some  
41  
42 197 limitations of this study such as it could not establish a cause-effect relationship because of the  
43  
44 198 cross-sectional nature of the study design. In addition, this study was institution-based, the  
45  
46 199 findings may not fully reflect the entire population, we used only history and physical  
47  
48 200 examination as a means of diagnosis for abdominal hernia but ultrasound was not used and also  
49  
50 201 possible that recall bias may have been introduced.

## 202 **Conclusion**

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

## 211 **Abbreviations**

212 AOR: Adjusted Odds Ratio

213 BMI: Body Mass Index

214 BP: Blood Pressure

215 CI: Confidence Interval

216 COR: Crude Odds Ratio

217 IAP: Intra-abdominal pressure

218 LAM: Lower abdominal muscle

219 OPD: Outpatient department

220 UOG: University of Gondar

221 USA: United State of America

222

223

224

1  
2  
3 **225 Declarations**  
4

5 **226 Authors contribution**  
6

7  
8 **227** AAK, SYT, MMH, AGW, and MAD conceived and designed the study, acquired, analyzed and  
9  
10 **228** interpreted data, prepared the manuscript and approved the final manuscript.  
11  
12

13 **229 Consent for publication**  
14

15 **230** “Not applicable”.  
16

17  
18 **231 Availability of data and material**  
19

20 **232** Data will be available from the corresponding author upon request  
21

22 **233 Competing Interests**  
23

24 **234** There is no competing of interests related to this work  
25  
26

27 **235 Funding**  
28

29 **236** The authors received no specific funding for this work.  
30

31 **237 Acknowledgments**  
32

33  
34 **238** We are grateful to thank the study participant for their valuable contribution and provide  
35  
36 **239** appropriate information and Dr. Abebe Muche, Mr. Haileab Fekadu, and Mr. Adhanom  
37  
38 **240** G/Egzabher for their close, friendly, comments, assistance, intellectual and guidance to our  
39  
40 **241** work. The authors like to express their gratitude to all the members of the Department of Human  
41  
42 **242** Anatomy as well as the surgery department of the University of Gondar comprehensive  
43  
44 **243** specialized hospital as their contributions were vital in the completion of this research work.  
45  
46  
47

48 **244 Ethics statement**  
49

50 **245** Ethical approval was obtained from the ethical review committee of the College of Medicine and  
51  
52 **246** Health Sciences, University of Gondar (Reference No 1856/12 dated March 18, 2020). A support  
53  
54 **247** letter was obtained from the University of Gondar Research and Community Service and surgery  
55  
56  
57

1  
2  
3 248 department. Participants were informed about the purpose, objectives, and their right to and not  
4  
5 249 to participate in the study. Written informed consent was obtained from the study participants.  
6  
7  
8 250 To keep confidentiality, respondents' names and other personal identifiers were not included.  
9  
10 251 The collected data were password protected.  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57

For peer review only

**References**

1. AhmedAlenazi A, Alsharif MM, Hussain MA, Alenezi NG, Alenazi AA, Almadani SA, et al. Prevalence, risk factors and character of abdominal hernia in Arar City, Northern Saudi Arabia in 2017. *Electronic physician*. 2017;9(7):4806-11.
2. Kingsnorth A, LeBlanc K. Hernias: inguinal and incisional. *Lancet (London, England)*. 2003;362(9395):1561-71.
3. Sangwan M, Sangwan V, Garg M, Mahendirutta P, Garg U. Abdominal wall hernia in a rural population in India—Is spectrum changing? *Open journal of epidemiology*. 2013;2013.
4. Primatesta P, Goldacre MJ. Inguinal hernia repair: incidence of elective and emergency surgery, readmission and mortality. *International journal of epidemiology*. 1996;25(4):835-9.
5. Kingsnorth A, LeBlanc K. Hernias: inguinal and incisional. *The Lancet*. 2003;362(9395):1561-71.
6. Sazhin A, Zolotukhin I, Seliverstov E, Nikishkov A, Shevtsov Y, Andriyashkin A, et al. Prevalence and risk factors for abdominal wall hernia in the general Russian population. *Hernia : the journal of hernias and abdominal wall surgery*. 2019;23(6):1237-42.
7. Patel HD, Groen RS, Kamara TB, Samai M, Farahzad MM, Cassidy LD, et al. An estimate of hernia prevalence in Sierra Leone from a nationwide community survey. *Hernia : the journal of hernias and abdominal wall surgery*. 2014;18(2):297-303.
8. Garba ES. The Pattern Of Adult External Abdominal Hernias In Zaria. *Nigerian Journal of Surgical Research*. 2000;2.
9. Nordberg EM. Incidence and estimated need of caesarean section, inguinal hernia repair, and operation for strangulated hernia in rural Africa. *British medical journal (Clinical research ed)*. 1984;289(6437):92-3.
10. Belcher DW, Nyame PK, Wurapa FK. The prevalence of inguinal hernia in adult Ghanaian males. *Tropical and geographical medicine*. 1978;30(1):39-43.
11. Yordanov YS, Stoyanov SK. The incidence of hernia on the island of Pemba. *East African medical journal*. 1969;46(12):687-91.
12. Ammar A, Ismail T. Abdominal wall hernias in upper Egypt: A different spectrum. *East and Central African Journal of Surgery*. 2008;13(2):109-14.
13. Ohene-Yeboah M, Abantanga F, Oppong J, Togbe B, Nimako B, Amoah M, et al. Some aspects of the epidemiology of external hernias in Kumasi, Ghana. *Hernia : the journal of hernias and abdominal wall surgery*. 2009;13(5):529-32.
14. Odula PO, Kakande I. Groin hernia in Mulago hospital, Kampala. *East and Central African journal of surgery*. 2004;9(1).
15. Gelan EA. Experience of Open Mesh Hernia Repair at a Teaching Hospital in Addis Ababa, Ethiopia-A Three Year Retrospective Study. *Ethiopian Medical Journal*. 2018;56(4).
16. Iqbal MN, Akhter S, Irfan M. Prevalence of hernia in relation to various risk factors in Narowal, Pakistan. *Sci Lett*. 2015;3(1):29-32.
17. Ruhl CE, Everhart JE. Risk factors for inguinal hernia among adults in the US population. *American journal of epidemiology*. 2007;165(10):1154-61.
18. Liem MS, van der Graaf Y, Zwart RC, Geurts I, van Vroonhoven TJ. Risk factors for inguinal hernia in women: a case-control study. *The Coala Trial Group. Am J Epidemiol*. 1997;146(9):721-6.
19. Jansen PL, Klinge U, Jansen M, Junge K. Risk factors for early recurrence after inguinal hernia repair. *BMC surgery*. 2009;9(1):1-5.
20. Sorensen LT, Friis E, Jorgensen T, Vennits B, Andersen BR, Rasmussen GI, et al. Smoking is a risk factor for recurrence of groin hernia. *World journal of surgery*. 2002;26(4):397.



- 1  
2  
3 298 21. Flich J, Alfonso J, Delgado F, Prado M, Cortina P. Inguinal hernia and certain risk factors.  
4 299 European journal of epidemiology. 1992;8(2):277-82.  
5 300 22. Ashindoitiang J, Ibrahim N, Akinlolu O. Risk factors for inguinal hernia in adult male Nigerians: a  
6 301 case control study. International Journal of Surgery. 2012;10(7):364-7.  
7 302 23. Mabula JB, Chalya PL. Surgical management of inguinal hernias at Bugando Medical Centre in  
8 303 northwestern Tanzania: our experiences in a resource-limited setting. BMC research notes. 2012;5(1):1-  
9 304 8.  
10 305 24. ElRashied M, Widatalla A, Ahmed M. External strangulated hernia in Khartoum, Sudan. East  
11 306 African medical journal. 2007;84(8):379.  
12 307 25. Ohene-Yeboah M. Strangulated external hernias in Kumasi. West African journal of medicine.  
13 308 2003;22(4):310-3.  
14 309 26. Ohene-Yeboah M, Abantanga FA. Inguinal hernia disease in Africa: a common but neglected  
15 310 surgical condition. West African journal of medicine. 2011;30(2):77-83.  
16 311 27. Gray JR. What is chronic constipation? Definition and diagnosis. Canadian journal of  
17 312 gastroenterology = Journal canadien de gastroenterologie. 2011;25 Suppl B(Suppl B):7b-10b.  
18 313 28. Kingsnorth A, Leblanc K. Choice of anesthesia: general, regional or local anesthetic. Kingsnorth  
19 314 AN, Leblanc KA Management of abdominal hernias 3rd ed London, New York: Edward Arnold publishers.  
20 315 2003:105-14.  
21 316 29. Rao G, Rao A, Pujara N, Pujara P, Patel S. Prevalence of hernia among fishermen population in  
22 317 Kutch district. India. National J Integrated Res Med. 2015;6(4):44-51.  
23 318 30. Igwe PO, Dodiya-manuel A, Nwankwo N. Hernia In South Southern Nigeria: Five Year  
24 319 Retrospective Study. IOSR Journal of Dental and Medical Sciences. 2016;15:96-111.  
25 320 31. Lauscher J, Loh J, Rieck S, Buhr H, Ritz J. Long-term follow-up after incisional hernia repair: are  
26 321 there only benefits for symptomatic patients? Hernia : the journal of hernias and abdominal wall  
27 322 surgery. 2013;17(2):203-9.  
28 323 32. Garrone R. Collagen family of proteins. FASEB J. 1991;5:2814-23.  
29 324 33. Zhao H, Zhou L, Li L, Coon J, Chatterton RT, Brooks DC, et al. Shift from androgen to estrogen  
30 325 action causes abdominal muscle fibrosis, atrophy, and inguinal hernia in a transgenic male mouse  
31 326 model. Proceedings of the National Academy of Sciences. 2018;115(44):E10427-E36.  
32 327 34. Kark AE, Kurzer M. Groin hernias in women. Hernia : the journal of hernias and abdominal wall  
33 328 surgery. 2008;12(3):267-70.  
34 329 35. Fatima A, Mohiuddin MR. Study of incidence of inguinal hernias and the risk factors associated  
35 330 with the inguinal hernias in the regional population of a South Indian City. International Journal of  
36 331 Current Research and Review. 2014;6(23):9.  
37 332 36. Kartal A, Yalcin M, Citgez B, Uzunkoy A. The effect of chronic constipation on the development  
38 333 of inguinal herniation. Hernia : the journal of hernias and abdominal wall surgery. 2017;21(4):531-5.  
39 334 37. Lau H, Fang C, Yuen WK, Patil NG. Risk factors for inguinal hernia in adult males: a case-control  
40 335 study. Surgery. 2007;141(2):262-6.  
41 336 38. Carbonell J, Sanchez J, Peris R, Ivorra J, Del Baño M, Sanchez C, et al. Risk factors associated with  
42 337 inguinal hernias: a case control study. The European journal of surgery= Acta chirurgica.  
43 338 1993;159(9):481-6.  
44 339 39. Billiar T, Andersen D, Hunter J, Brunicardi F, Dunn D, Pollock RE. Schwartz's principles of surgery:  
45 340 McGraw-Hill Professional; 2004.  
46 341 40. Balamaddaiah G, Reddy SRM. Prevalence and risk factors of inguinal hernia: a study in a semi-  
47 342 urban area in Rayalaseema, Andhra Pradesh, India. International Surgery Journal. 2016;3(3):1310-3.  
48 343 41. Coste AH, Jaafar S, Parmely JD. Umbilical hernia. 2017.

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

Variable	Frequency	Percentage
<b>Sex</b>		
Male	196	48.7
Female	207	51.3
<b>Age</b>		
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
<b>Residence</b>		
Urban	220	54.6
Rural	183	45.4
<b>Occupation</b>		
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
<b>Religion</b>		
Orthodox	388	96.2
Muslim	11	2.8
Protestant	4	1.0
<b>Educational status</b>		
No formal education	210	52.1
Primary education	42	10.4
Secondary education	63	15.7
College or above	88	21.8
<b>Average monthly income in US\$</b>		
<25	200	49.6
26-185	194	48.1
>186(1)	9	2.3

346  
 347 **Others\*:** -unemployed, soldier, driver, retire and artist

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

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

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

350

351

352 **Table 3: Multiple logistic regression output for the factors associated with external hernia**  
 353 **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			
<b>Age</b>					
19-45	18	249	1	1	
46-84	29	107	3.74(1.99, 7.04)	2.47(1.06, 5.78)	0.036
<b>Residence</b>					
Urban	16	204	1	1	
Rural	31	152	2.6 (1.37, 4.92)	0.73(0.30,1.85)	0.55
<b>Educational status</b>					
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	
<b>Staining during urination</b>					
Yes	16	48	3.31(1.68, 6.50)	0.83(0.33, 2.25)	0.712
No	31	308	1	1	
<b>Constipation</b>					
Yes	26	70	5.05(2.68, 9.51)	3.67(1.68, 8.11)	0.001
No	21	286	1	1	
<b>Prolonged cough</b>					
Yes	17	25	7.50(3.64, 15.4)	5.18(2.17,12.3)	<0.001
No	30	331	1	1	

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

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

355

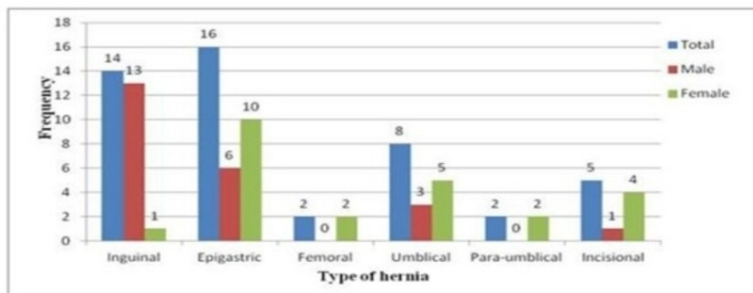
356

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

359

360

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60



**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 <sup>2</sup>	
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**

□□-□□□□  
 □□□□□ □□□□□□ □□ □□□□ □□□ □□□□ □□□ □□□□□ □□  
 □□□□□ □□□□ □ □□□□ □□□□□□ □□□□□□ □□□□□ □□□□ □□-□□□□□□  
 □□ □□□□ □□□□□□□ □□ -----  
 □□□□□□□□ □□ -----  
 □□ □□□□ □□□□□□□□ □□-----  
 □□□□□ □□□□ □□□□□ □□□-----

□. □□□□□ □□□□□□ □□□□□□			
□.□	□□□□	□□□□	
101	□□	1. □ 2. □	
102	□□□□ /□□□□□/	_____	
103	□□□□□□ □□	1.□□□□ 2.□□□□	
104	□□	1. □□□□ □□□□ 2.□□□□ 3.□□□□□□□ □□□□ 4.□□□□ □□□□ 5.□□□□ 6.□□□□ □□□□ 7.□□ □□ 8.□□ ( □□□□□)	
105	□□□□□□	1.□□□□□□□ 2.□□□□□ 3.□□□□□□□□ 4.□□□□□	

		5.□□ (□□□□)	
106	□□□□□□ □□□	1. □□□□□□□□□□ □□□□□□ 2. □□□□□□□□□ □□□□ 3. □□□□□□□ □□□ /1-8/ 4. □□□□□□□□ □□□□ /9-12/□□□□ 5. □□□□□ □□□□ □□□□	
107	□□□□□ □□□□	1.□□□□ 2. □□□□□ 3.□□□□□□ 4.□□□□□	
108	□□□□ □□□□ □□		

□□□□□□ □□ □□□□□□ □□□□□□

201	□□□□□□□□ □□□□ □□□□□□ □□?	1. □□ 2. □□□□	
202	□□□□ □□□□□?	1. □□ñ □□□□□□ 2. □□□□ □□□□ 3. □□□□□□	
203	□□□□□ □□□□ □□□□□?	1. □□□□□ □□□□ □□□□□□ 2. □□□□□ □□□□ □□□□ 3. □□□□□ □□□□□□	
204	□□□□ □□□□ □□□□□? □□□□□□ □□	----- -----	
205	□□□□ □□□□□□□□ □□ □□□□ □□□□ □ □□□□ □□□□ □□□□ □□□□□ □ □□□□ □□□□□□□□ □□□□□ ? □□□□□□ □□	1. □□ 2. □□□□	
206	□□□□□ □□□□ 205 □□ □□□□ □□□□□□ □□□□ □□□□□□□□ □□ □□?	_____	
207	□□□□ □□ □□□□□□□□ □□□□ □□□□ □□□□□□ □□□□□□□□□□?	1. □□ 2. □□□□□□□□	
208	□□□□ □□ □□□□ □□ □□□□□?	1. □□	

		2. □□□ □□ □□□ □□□ □□	
209	□□□ □□ □□□□ □□□□□□□ □□□□?	1. □□ 2. □□□□□□	
210	□□□□ □□ □□□ □□□□□□ □□□□?	1. □□ 2. □□□□□□	
211	□□□□□□ □□□ □□ □□□□?	1. □□ 2. □□□□□□	
212	□□□□□ □□ □□□ □□□ □□□□ □□□□□□ □□□□?	1. □□ 2. □□□□□□	
213	□□□□□ □□□ □□□	_____ kg/m <sup>2</sup>	
214	□□□□	1. □□ 2. □□□	
215	□□□□ □□ □□ □□□□ □□□□ □□ ?	1. □□□□□□ 2. □□□□□□□ 3. □□□□ 4. □□□□□□□□ 5. □□□□□□□□□ 6. □□□□□□ 7. □□□	
216	□□□□□ □□ □□ □□ □□□ □□□□□ □□□ □□□□□□?	1. □□□□□□ 2. □□□□□□□	

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
<b>Introduction</b>			
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
<b>Methods</b>			
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
<b>Results</b>			
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	
<b>Discussion</b>			
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
<b>Other information</b>			
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](http://www.strobe-statement.org).

# BMJ Open

**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**

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2021-056488.R3
Article Type:	Original research
Date Submitted by the Author:	09-Mar-2022
Complete List of Authors:	Kibret, Anteneh; University of Gondar, Human anatomy Tekle, Solomon ; University of Gondar, Department of Surgery H/Maryam , Miklol; University of Gondar, Surgery Worede, Amanuel ; University of Gondar, Department of Human Anatomy Dessie, M; University of Gondar, Human Anatomy
<b>Primary Subject Heading</b>:	Surgery
Secondary Subject Heading:	Public health, Gastroenterology and hepatology
Keywords:	SURGERY, Adult surgery < SURGERY, PUBLIC HEALTH, Anatomy < NATURAL SCIENCE DISCIPLINES, Adult gastroenterology < GASTROENTEROLOGY, Functional bowel disorders < GASTROENTEROLOGY

SCHOLARONE™  
Manuscripts



I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

1  
2  
3 **Prevalence and associated factors of external hernia among adult patients visiting the**  
4 **Surgical Outpatient Department at the University of Gondar Comprehensive Specialized**  
5 **Hospital, Northwest Ethiopia: A cross-sectional study**  
6  
7  
8  
9

10 Anteneh Ayelign Kibret<sup>1\*</sup>, Solomon Yirdaw Tekle<sup>2</sup>, Miklol Mengistu H/maryam <sup>2</sup>, Amanuel  
11  
12 Girma Worede<sup>1</sup> and M A Dessie<sup>1</sup>  
13

14 <sup>1</sup>Department of Human Anatomy, University of Gondar, college of medicine and health science,  
15 School of Medicine, Gondar, Ethiopia  
16  
17

18 <sup>2</sup>Department of Surgery, University of Gondar, college of medicine and health science, School of  
19 Medicine, Gondar, Ethiopia  
20  
21

22 Email  
23

24 Anteneh Ayelign Kibret (AAK): [antesha04@gmail.com](mailto:antesha04@gmail.com)  
25

26 Solomon Yirdaw Tekle (SYT): [Solomonyirdaw15@gmail.com](mailto:Solomonyirdaw15@gmail.com)  
27

28 Miklol Mengistu H/Maryam (MMH): [miklol.mengistu@yahoo.com](mailto:miklol.mengistu@yahoo.com)  
29

30 Amanuel Girma Worede (AGW): [amanuelgirma.w@gmail.com](mailto:amanuelgirma.w@gmail.com)  
31

32 M A Dessie (MAD): [mituababi@gmail.com](mailto:mituababi@gmail.com)  
33  
34  
35  
36  
37  
38  
39  
40  
41

42 \*Corresponding author (AAK): [antesha04@gmail.com](mailto:antesha04@gmail.com)  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60



## 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 5 to 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

1  
2  
3 hernia were identified to have a strong association with external hernia (1, 16-22). Hernias are  
4 among the commonest surgical conditions causing a significant number of morbidity and mortality  
5 in various parts of Africa (23, 24). Untreated hernia can lead to life-threatening complications,  
6 such as strangulation, incarceration, and intestinal obstruction. Of these, strangulation is an acute  
7 surgical emergency with significant fatal consequences (25). In Nigeria and Sudan, strangulated  
8 external hernia was the most common cause of intestinal obstruction, accounting for 56.9% and  
9 27.7% of cases, respectively (24). Lack of adequate surgical care for inguinal hernia is causing  
10 higher rate of mortality in remote rural communities (26).

11  
12 Despite the common occurrence and clinical significance of external hernia, until this study was  
13 done, very limited epidemiological studies were done to indicate the magnitude and risk factors  
14 for external hernia in the world. Therefore, the present study was aimed to assess the prevalence  
15 and associated factors of external hernia among adult patients visiting the surgical OPD at the  
16 UOGCSH. Finally, the output of the present study will hopefully help clinicians and policymakers  
17 to design a reliable strategy.

## 18 **Methods**

### 19 **Study design and setting**

20  
21 An institution-based cross-sectional study was conducted from 04/05/2020 to 06/22/2020 among  
22 adult surgical patients who visited the surgical OPD at the UOGCSH. The hospital was found in  
23 1954 and it is in the North Gondar administrative zone, Amhara National Regional State, which is  
24 about 750 km Northwest of Addis Ababa (the capital city of Ethiopia). According to the 2015  
25 population projection of major cities in Ethiopia, the total population size of Gondar town was  
26 estimated to be 323,900. Currently, Gondar town has one Referral Hospital and eight government  
27 Health Centers. UOGCSH is a teaching hospital, which serves more than five million people of

1  
2  
3 the North Gondar zone and people from the neighboring zones. It is estimated that around 21,000  
4 patients visit the surgical OPD per year.  
5  
6

### 7 **Population, sample size determination, and sampling procedure**

8  
9  
10 The source and study population of this study were all adult patients above the age of 18 years  
11 who visited the surgical OPD and those who were available during the time of data collection in  
12 the UOGCSH respectively. Patients who were not responsive due to severe illness or mental health  
13 problems were excluded from the study. The sample size was determined using a single population  
14 proportion formula, by using a 95% confidence interval, 0.05 margin of error, 5% non-response  
15 rate. Since there was no previous study conducted in the area, we considered expected proportion  
16 of external hernia to be 50%. Hence, the final sample size was 403. Participants were selected  
17 using a systematic random sampling technique with skipping intervals of three.  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27

### 28 **Variables and Data collection procedures**

29  
30 The dependent variable for this study was having any of the external hernias such as: inguinal,  
31 epigastric, umbilical, para-umbilical, femoral and incisional hernias. External hernia was  
32 diagnosed by general surgeons based on history and physical examination. Data was collected on  
33 the sociodemographic characteristics (age, sex, residence, educational status, occupation, and  
34 average monthly income), clinical factors (family history of hernia, heavy weightlifting,  
35 constipation, straining during urination, body mass index (BMI), previous history of abdominal  
36 surgery, history of abdominal trauma, chronic cough, and history of Ascites), behavioral and  
37 obstetric factors (smoking, alcohol intake, and parity). Chronic cough was defined as current or  
38 previous history of cough for more than a month. Besides, straining during urination means  
39 difficulty of urination that lasted for three or more months. Constipation was defined as  
40 unsatisfactory defecation which is characterized by infrequent stool, difficulty in defecation, or  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57

1  
2  
3 both for more than three months (27). Interviewer-administered questionnaire which was adapted  
4  
5 from different literatures was used to collect data. Five nurses with a bachelorette degree were  
6  
7 trained and employed as data collectors. The questionnaire was prepared in English and translated  
8  
9 into Amharic and back to English for consistency of the tool. The tool was pre-tested in 10% of a  
10  
11 sample size at Debarq primary hospital two weeks before the main data collection. Necessary  
12  
13 adjustments were made based on the pre-test result.  
14  
15

### 16 17 **Data processing and analysis**

18  
19 The survey data were entered and cleaned using EPI DATA version 3.1 and analyzed by STATA  
20  
21 14 software. Descriptive statistics were used, and the findings were presented using texts, graphs,  
22  
23 and tables. A logistic regression model was used to identify factors affecting external hernia.  
24  
25 Variables with p-values 0.2 or less in the bi-variable logistic regression analysis were fitted in the  
26  
27 multivariable analysis. AOR with a 95% Confidence Interval (CI) and p-value <0.05 in the  
28  
29 multivariable analysis were used to declare significant association with the outcome variable.  
30  
31

32  
33 The goodness of fitness of the model was checked by Hosmer and Lemeshow test.  
34

### 35 36 **Patient and public involvement**

37  
38 Patients were not involved in this study  
39

## 40 41 **Results**

### 42 43 **Socio-demographic characteristics**

44  
45 A total of 403 study participants were included in this study with a response rate of 100%. The  
46  
47 median age of the participants was 38 years old and the interquartile range was 24. Both sexes had  
48  
49 nearly equal frequency, 207 (51.3%) were female subjects. Of the total participants, 135 (33.5%)  
50  
51 were farmers, and almost half of the study participants 200(49.6%) had an average monthly income  
52  
53 of less than 25 US\$ (Table 1).  
54  
55  
56  
57

### **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

1  
2  
3 constipation compared to their counterparts (AOR=3.67, 95%CI; 1.68, 8.11). Patients who had  
4  
5 chronic cough had 5.18 times higher odds of having external hernia compared to their counterparts  
6  
7 (AOR=5.18, 95%CI; 2.17, 12.3). The odds of having an external hernia was 7.39 times higher  
8  
9 among participants lifting heavy objects compared to participants who didn't (AOR=7.39, 95%CI;  
10  
11 3.36, 16.2) (Table 3).  
12  
13

## 14 **Discussion**

15  
16 This study assessed the prevalence of external hernia and its associated factors among adult  
17  
18 patients visiting the surgical OPD at the UOGCSH, Northwest Ethiopia and found the prevalence  
19  
20 of external hernia to be 11.7%. The result is consistent with a study conducted in Arar City,  
21  
22 Northern Saudi Arabia 11.5% (1). In this study, epigastric hernias accounted 34% of the total  
23  
24 hernia cases which puts it at the top of all the cases. Nonetheless, proportion of epigastric hernia  
25  
26 reported by other studies worldwide is much lower and ranged between 3.4 and 8.1% (12, 13, 28).  
27  
28 According to studies conducted in Nigeria, Egypt, and India the proportion of inguinal hernia was  
29  
30 found to be 70.2%, 56%, and 21.8%, respectively (12, 28, 29). However, the proportion of inguinal  
31  
32 hernia in the present study was found to be 29.8%.  
33  
34  
35  
36

37  
38 This study indicates that older age participants were more likely to be diagnosed with external  
39  
40 hernia compared to younger age groups. This finding is supported by different studies elsewhere  
41  
42 (6, 16, 17). The reason could be attributed to the degenerative weakness of abdominal muscles and  
43  
44 fibrous tissue in the elderly age group. Loss of abdominal muscle strength and resistance to high  
45  
46 intra-abdominal pressure can lead to herniation (30, 31). Another potential reason could be  
47  
48 associated with the age-related decline in blood testosterone level and enhancement of estrogen  
49  
50 via the action of aromatase enzyme. Lower abdominal muscles (LAM) are sensitive to our body's  
51  
52 estrogen hormone and tends to express very high levels of estrogen receptor- $\alpha$ . As a result, the  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 increase in estrogen level can lead to atrophy and fibrosis of LAM which may result in the  
4 occurrence of hernia in males (32). On the other hand, when women reach postmenopausal age,  
5  
6 they start to accumulate intra-abdominal adipose tissue which will cause separation of muscle  
7  
8 bundle and layers, weakening of aponeurosis, and then predisposing to hernia (33).  
9

10  
11 In the current study, the study participants with constipation were more likely to have an external  
12  
13 hernia as compared to their counterparts. The same result is obtained by the studies done in  
14  
15 America and India (18, 34). This could be due to prolonged straining during defecation which  
16  
17 generates high intra-abdominal pressure and results in weakness of abdominal muscle, which in  
18  
19 turn, leads to hernia (35). In the present study, the study participants with a chronic cough had  
20  
21 higher odds of having external hernia as compared to the corresponding groups. Our finding is  
22  
23 strongly supported by the studies done elsewhere (17, 36, 37). This may be due to the repeated  
24  
25 occurrence of increased intra-abdominal pressure during coughing which results in weakness of  
26  
27 abdominal muscle and followed herniation (38). Our finding showed that lifting heavy objects  
28  
29 increased odds of having external hernia. The notion of our study is supported by different studies  
30  
31 (22, 37, 39). This could be attributed to increasing intra-abdominal pressure causing breakage in  
32  
33 the fibers of transversals fascia, which leads to muscle weakness and results in the occurrence of  
34  
35 hernia (40).  
36  
37  
38  
39  
40  
41

42  
43 The study is the first of its kind in the study area and in Ethiopia as well. The study is also  
44  
45 comprehensive which includes most of the external hernia types. Data were recorded by well-  
46  
47 trained data collectors under the close supervision of the investigators. However, there are some  
48  
49 limitations of this study such as it could not establish a cause-effect relationship because of the  
50  
51 cross-sectional nature of the study design. In addition, this study was institution-based, the findings  
52  
53 may not fully reflect the entire population. We used only history and physical examination as a  
54  
55  
56  
57  
58  
59  
60



1  
2  
3 means of diagnosis for abdominal hernia, and ultrasound was not used for diagnosis. It is possible  
4  
5 that recall bias may have been introduced.  
6

## 7 8 **Conclusion**

9  
10 Regardless of hardly any significant gender difference, the overall prevalence of external hernia  
11  
12 was high. Old age, constipation, chronic cough, and lifting of heavy objects were found to increase  
13  
14 the odds of having an external hernia. Health professionals better identify and intervene in external  
15  
16 hernias early, especially for high-risk groups. Patients who have constipation and cough should  
17  
18 get appropriate treatment in time. Community-based studies should be conducted to reveal the  
19  
20 burden of the disease. There is also a need for further studies regarding the burden and risk factors  
21  
22 of external hernia in different areas of the country.  
23  
24  
25

## 26 **Abbreviations**

27  
28 AOR: Adjusted Odds Ratio

29  
30 BMI: Body Mass Index

31  
32 BP: Blood Pressure

33  
34 CI: Confidence Interval

35  
36 COR: Crude Odds Ratio

37  
38 IAP: Intra-abdominal pressure

39  
40 LAM: Lower abdominal muscle

41  
42 OPD: Outpatient department

43  
44 UOG: University of Gondar

45  
46 USA: United States of America

## 47 48 **Declarations**

## 49 50 **Authors contribution**

1  
2  
3 AAK, SYT, MMH, AGW, and MAD conceived and designed the study, acquired, analyzed and  
4 interpreted data, prepared the manuscript, and approved the final manuscript.  
5  
6

### 7 **Consent for publication**

8  
9  
10 “Not applicable”.

### 11 **Availability of data and material**

12  
13  
14 Data will be available from the corresponding author upon request

### 15 **Competing Interests**

16  
17  
18 There is no competing of interests related to this work

### 19 **Funding**

20  
21  
22 The authors received no specific funding for this work.

### 23 **Acknowledgments**

24  
25  
26 We are grateful to thank the study participant for their valuable contribution and provide  
27 appropriate information and Dr. Abebe Muche, Mr. Haileab Fekadu, and Mr. Adhanom  
28 G/Egzabher for their close, friendly, comments, assistance, intellectual and guidance to our work.

29  
30  
31 The authors like to express their gratitude to all the members of the Department of Human  
32 Anatomy as well as the surgery department of the University of Gondar comprehensive  
33 specialized hospital as their contributions were vital in the completion of this research work.

### 34 **Ethics statement**

35  
36  
37 Ethical approval was obtained from the ethical review committee of the College of Medicine and  
38 Health Sciences, University of Gondar (Reference No 1856/12 dated March 18, 2020). A support  
39 letter was obtained from the University of Gondar Research and Community Service and surgery  
40 department. Participants were informed about the purpose, objectives, and their right to and not  
41 to participate in the study. Written informed consent was obtained from the study participants.  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

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

The collected data were password protected.

## References

1. AhmedAlenazi A, Alsharif MM, Hussain MA, Alenezi NG, Alenazi AA, Almadani SA, et al. Prevalence, risk factors and character of abdominal hernia in Arar City, Northern Saudi Arabia in 2017. *Electronic physician*. 2017;9(7):4806-11.
2. Kingsnorth A, LeBlanc K. Hernias: inguinal and incisional. *Lancet (London, England)*. 2003;362(9395):1561-71.
3. Sangwan M, Sangwan V, Garg M, Mahendirutta P, Garg U. Abdominal wall hernia in a rural population in India—Is spectrum changing? *Open journal of epidemiology*. 2013;2013.
4. Primatesta P, Goldacre MJ. Inguinal hernia repair: incidence of elective and emergency surgery, readmission and mortality. *International journal of epidemiology*. 1996;25(4):835-9.
5. Kingsnorth A, LeBlanc K. Hernias: inguinal and incisional. *The Lancet*. 2003;362(9395):1561-71.
6. Sazhin A, Zolotukhin I, Seliverstov E, Nikishkov A, Shevtsov Y, Andriyashkin A, et al. Prevalence and risk factors for abdominal wall hernia in the general Russian population. *Hernia : the journal of hernias and abdominal wall surgery*. 2019;23(6):1237-42.
7. Patel HD, Groen RS, Kamara TB, Samai M, Farahzad MM, Cassidy LD, et al. An estimate of hernia prevalence in Sierra Leone from a nationwide community survey. *Hernia : the journal of hernias and abdominal wall surgery*. 2014;18(2):297-303.
8. Garba ES. The Pattern Of Adult External Abdominal Hernias In Zaria. *Nigerian Journal of Surgical Research*. 2000;2.
9. Nordberg EM. Incidence and estimated need of caesarean section, inguinal hernia repair, and operation for strangulated hernia in rural Africa. *British medical journal (Clinical research ed)*. 1984;289(6437):92-3.
10. Belcher DW, Nyame PK, Wurapa FK. The prevalence of inguinal hernia in adult Ghanaian males. *Tropical and geographical medicine*. 1978;30(1):39-43.
11. Yordanov YS, Stoyanov SK. The incidence of hernia on the island of Pemba. *East African medical journal*. 1969;46(12):687-91.
12. Ammar A, Ismail T. Abdominal wall hernias in upper Egypt: A different spectrum. *East and Central African Journal of Surgery*. 2008;13(2):109-14.
13. Ohene-Yeboah M, Abantanga F, Oppong J, Togbe B, Nimako B, Amoah M, et al. Some aspects of the epidemiology of external hernias in Kumasi, Ghana. *Hernia : the journal of hernias and abdominal wall surgery*. 2009;13(5):529-32.
14. Odula PO, Kakande I. Groin hernia in Mulago hospital, Kampala. *East and Central African journal of surgery*. 2004;9(1).
15. Gelan EA. Experience of Open Mesh Hernia Repair at a Teaching Hospital in Addis Ababa, Ethiopia-A Three Year Retrospective Study. *Ethiopian Medical Journal*. 2018;56(4).
16. Iqbal MN, Akhter S, Irfan M. Prevalence of hernia in relation to various risk factors in Narowal, Pakistan. *Sci Lett*. 2015;3(1):29-32.
17. Ruhl CE, Everhart JE. Risk factors for inguinal hernia among adults in the US population. *American journal of epidemiology*. 2007;165(10):1154-61.
18. Liem MS, van der Graaf Y, Zwart RC, Geurts I, van Vroonhoven TJ. Risk factors for inguinal hernia in women: a case-control study. *The Coala Trial Group. Am J Epidemiol*. 1997;146(9):721-6.

19. Jansen PL, Klinge U, Jansen M, Junge K. Risk factors for early recurrence after inguinal hernia repair. *BMC surgery*. 2009;9(1):1-5.
20. Sorensen LT, Friis E, Jorgensen T, Vennits B, Andersen BR, Rasmussen GI, et al. Smoking is a risk factor for recurrence of groin hernia. *World journal of surgery*. 2002;26(4):397.
21. Flich J, Alfonso J, Delgado F, Prado M, Cortina P. Inguinal hernia and certain risk factors. *European journal of epidemiology*. 1992;8(2):277-82.
22. Ashindoitiang J, Ibrahim N, Akinlolu O. Risk factors for inguinal hernia in adult male Nigerians: a case control study. *International Journal of Surgery*. 2012;10(7):364-7.
23. Mabula JB, Chalya PL. Surgical management of inguinal hernias at Bugando Medical Centre in northwestern Tanzania: our experiences in a resource-limited setting. *BMC research notes*. 2012;5(1):1-8.
24. ElRashied M, Widatalla A, Ahmed M. External strangulated hernia in Khartoum, Sudan. *East African medical journal*. 2007;84(8):379.
25. Ohene-Yeboah M. Strangulated external hernias in Kumasi. *West African journal of medicine*. 2003;22(4):310-3.
26. Ohene-Yeboah M, Abantanga FA. Inguinal hernia disease in Africa: a common but neglected surgical condition. *West African journal of medicine*. 2011;30(2):77-83.
27. Gray JR. What is chronic constipation? Definition and diagnosis. *Canadian journal of gastroenterology = Journal canadien de gastroenterologie*. 2011;25 Suppl B(Suppl B):7b-10b.
28. Rao G, Rao A, Pujara N, Pujara P, Patel S. Prevalence of hernia among fishermen population in Kutch district. India. *National J Integrated Res Med*. 2015;6(4):44-51.
29. Igwe PO, Dodiya-manuel A, Nwankwo N. Hernia In South Southern Nigeria: Five Year Retrospective Study. *IOSR Journal of Dental and Medical Sciences*. 2016;15:96-111.
30. Lauscher J, Loh J, Rieck S, Buhr H, Ritz J. Long-term follow-up after incisional hernia repair: are there only benefits for symptomatic patients? *Hernia : the journal of hernias and abdominal wall surgery*. 2013;17(2):203-9.
31. Garrone R. Collagen family of proteins. *FASEB J*. 1991;5:2814-23.
32. Zhao H, Zhou L, Li L, Coon J, Chatterton RT, Brooks DC, et al. Shift from androgen to estrogen action causes abdominal muscle fibrosis, atrophy, and inguinal hernia in a transgenic male mouse model. *Proceedings of the National Academy of Sciences*. 2018;115(44):E10427-E36.
33. Kark AE, Kurzer M. Groin hernias in women. *Hernia : the journal of hernias and abdominal wall surgery*. 2008;12(3):267-70.
34. Fatima A, Mohiuddin MR. Study of incidence of inguinal hernias and the risk factors associated with the inguinal hernias in the regional population of a South Indian City. *International Journal of Current Research and Review*. 2014;6(23):9.
35. Kartal A, Yalcin M, Citgez B, Uzunkoy A. The effect of chronic constipation on the development of inguinal herniation. *Hernia : the journal of hernias and abdominal wall surgery*. 2017;21(4):531-5.
36. Lau H, Fang C, Yuen WK, Patil NG. Risk factors for inguinal hernia in adult males: a case-control study. *Surgery*. 2007;141(2):262-6.
37. Carbonell J, Sanchez J, Peris R, Ivorra J, Del Baño M, Sanchez C, et al. Risk factors associated with inguinal hernias: a case control study. *The European journal of surgery= Acta chirurgica*. 1993;159(9):481-6.
38. Billiar T, Andersen D, Hunter J, Brunicardi F, Dunn D, Pollock RE. *Schwartz's principles of surgery*: McGraw-Hill Professional; 2004.
39. Balamaddaiah G, Reddy SRM. Prevalence and risk factors of inguinal hernia: a study in a semi-urban area in Rayalaseema, Andhra Pradesh, India. *International Surgery Journal*. 2016;3(3):1310-3.
40. Coste AH, Jaafar S, Parmely JD. Umbilical hernia. 2017.

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

Variable	Frequency	Percentage
<b>Sex</b>		
Male	196	48.7
Female	207	51.3
<b>Age</b>		
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
<b>Residence</b>		
Urban	220	54.6
Rural	183	45.4
<b>Occupation</b>		
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
<b>Religion</b>		
Orthodox	388	96.2
Muslim	11	2.8
Protestant	4	1.0
<b>Educational status</b>		

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

*Others\*:-unemployed, soldier, 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 (%)
<b>Family history of hernia</b>		
Yes	19	4.8
No	384	95.2
<b>Smoking</b>		
No smoking	385	98.0
Previously smoking	6	1.5
Currently smoking	2	0.5
<b>Alcohol intake</b>		
No alcohol	301	74.7
Previous alcohol intake	32	8.0
Current alcohol intake	70	17.3
<b>Parity</b>		
Nulliparous	54	26.0
Primiparous	22	10.7
Multi parous	68	32.9
Grand multipara	63	30.4

<b>Straining during urination</b>		
Yes	64	15.9
No	339	84.1
<b>Constipation</b>		
Yes	96	23.9
No	307	76.1
<b>Prolonged cough</b>		
Yes	42	10.4
No	361	89.6
<b>Lifting of heavy objects</b>		
Yes	84	20.9
No	319	79.1
<b>Previous abdominal surgery</b>		
Yes	40	10.0
No	363	90.0
<b>History of abdominal trauma</b>		
Yes	13	3.2
No	390	96.8
<b>History of Ascites</b>		
Yes	5	1.24
No	398	98.76
<b>BMI</b>		
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			
<b>Age</b>					
19-45	18	249	1	1	
46-84	29	107	3.74(1.99, 7.04)	2.47(1.06, 5.78)	0.036
<b>Residence</b>					
Urban	16	204	1	1	
Rural	31	152	2.6 (1.37, 4.92)	0.73(0.30,1.85)	0.55
<b>Educational status</b>					
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	
<b>Staining during urination</b>					
Yes	16	48	3.31(1.68, 6.50)	0.83(0.33, 2.25)	0.712
No	31	308	1	1	
<b>Constipation</b>					
Yes	26	70	5.05(2.68, 9.51)	3.67(1.68, 8.11)	0.001
No	21	286	1	1	
<b>Prolonged cough</b>					
Yes	17	25	7.50(3.64, 15.4)	5.18(2.17,12.3)	<0.001
No	30	331	1	1	
<b>Lifting heavy objects</b>					
Yes	29	55	8.81(4.58, 16.9)	7.39(3.36, 16.2)	<0.001

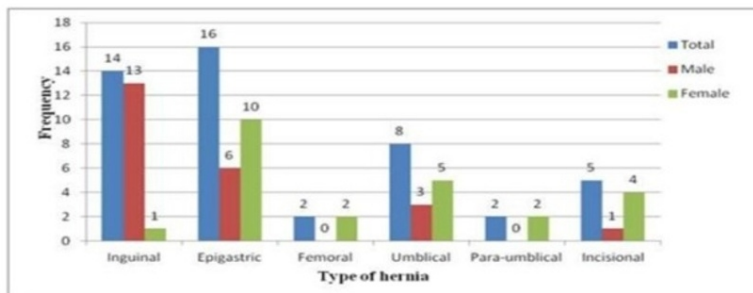


No	18	301	1	1	
<b>BMI</b>					
<b>14-17.9</b>	7	51	1.15(0.48, 2.7)	1.35(0.4, 3.8)	0.56
<b>18-24.9</b>	33	278	1	1	
<b>25-34.9</b>	7	27	2.1(0.82,0.17)	3.01(0.95, 9.54)	0.06

*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**

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60



**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 <sup>2</sup>	
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**

□□-□□□□  
 □□□□□ □□□□□□ □□ □□□□ □□□ □□□□ □□□ □□□□□ □□  
 □□□□□ □□□□ □ □□□□ □□□□□□ □□□□□□ □□□□□ □□□□ □□-□□□□□□  
 □□ □□□□ □□□□□□□ □□ -----  
 □□□□□□□ □□ -----  
 □□ □□□□ □□□□□□□ □□-----  
 □□□□ □□□□ □□□□□ □□□-----

□. □□□□□ □□□□□□ □□□□□□			
□.□	□□□	□□□	
101	□□	1. □ 2. □	
102	□□□ /□□□□/	_____	
103	□□□□□ □□	1.□□□□ 2.□□□□	
104	□□	1. □□□ □□□ 2.□□□□ 3.□□□□□□ □□□□ 4.□□□ □□□□ 5.□□□ 6.□□□ □□□□ 7.□□ □□ 8.□□ ( □□□□)	
105	□□□□□	1.□□□□□□ 2.□□□□ 3.□□□□□□□ 4.□□□□	

		5.□□ (□□□□)	
106	□□□□□□ □□□	1. □□□□□□□□□□ □□□□□□ 2. □□□□□□□□□ □□□□ 3. □□□□□□□ □□□ /1-8/ 4. □□□□□□□□ □□□□ /9-12/□□□□ 5. □□□□□ □□□□ □□□□	
107	□□□□□ □□□□	1.□□□□ 2. □□□□□ 3.□□□□□□ 4.□□□□□	
108	□□□□ □□□□ □□		

□□□□□□ □□ □□□□□□ □□□□□□

201	□□□□□□□□ □□□□ □□□□□□ □□?	1. □□ 2. □□□□	
202	□□□□ □□□□□?	1. □□ñ □□□□□□ 2. □□□□ □□□□ 3. □□□□□□	
203	□□□□□ □□□□ □□□□□?	1. □□□□□ □□□□ □□□□□□ 2. □□□□□ □□□□ □□□□ 3. □□□□□ □□□□□□	
204	□□□□ □□□□ □□□□□? □□□□□□ □□	----- -----	
205	□□□□ □□□□□□□□ □□ □□□□ □□□□ □ □□□□ □□□□ □□□□ □□□□□ □ □□□□ □□□□□□□□ □□□□□ ? □□□□□□□ □□	1. □□ 2. □□□□	
206	□□□□□ □□□□ 205 □□ □□□□ □□□□□□ □□□□ □□□□□□□□ □□ □□?	_____	
207	□□□□ □□ □□□□□□□□ □□□□ □□□□ □□□□□□ □□□□□□□□□□?	1. □□ 2. □□□□□□□□	
208	□□□□ □□ □□□□ □□ □□□□□?	1. □□	

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

		2. □□□ □□ □□□ □□□ □□	
209	□□□ □□ □□□□ □□□□□□□ □□□□?	1. □□ 2. □□□□□□	
210	□□□□ □□ □□□ □□□□□□ □□□□?	1. □□ 2. □□□□□□	
211	□□□□□□ □□□ □□ □□□□?	1. □□ 2. □□□□□□	
212	□□□□□ □□ □□□ □□□ □□□□ □□□□□□ □□□□?	1. □□ 2. □□□□□□	
213	□□□□□ □□□ □□□	_____ kg/m <sup>2</sup>	
214	□□□□	1. □□ 2. □□□	
215	□□□□ □□ □□ □□□□ □□□□ □□ ?	1. □□□□□□□ 2. □□□□□□□□ 3. □□□□□ 4. □□□□□□□□ 5. □□□□□□□□□□ 6. □□□□□□□ 7. □□□	
216	□□□□□ □□ □□ □□ □□□ □□□□□ □□□ □□□□□□?	1. □□□□□□ 2. □□□□□□□	

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
<b>Introduction</b>			
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
<b>Methods</b>			
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
<b>Results</b>			
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	
<b>Discussion</b>			
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
<b>Other information</b>			
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](http://www.strobe-statement.org).