BMJ Open

Prevalence and associated factors of external hernia among adult patients visiting the surgical outpatient department at the University of Gondar Comprehensive Specialised Hospital, Northwest Ethiopia: a cross-sectional study

Anteneh Ayelign Kibret [1], Solomon Yirdaw Tekle,[2] Miklol Mengistu H/Mariam,[2] Amanuel Girma Worede,[1] M A Dessie [1]

To cite: Kibret AA, Tekle SY, H/Mariam MM, *et al*. Prevalence and associated factors of external hernia among adult patients visiting the surgical outpatient department at the University of Gondar Comprehensive Specialised Hospital, Northwest Ethiopia: a cross-sectional study. *BMJ Open* 2022;**12**:e056488. doi:10.1136/bmjopen-2021-056488

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2021-056488).

Received 16 August 2021
Accepted 11 March 2022

[1]Human Anatomy, University of Gondar, Gondar, Ethiopia
[2]Department of Surgery, University of Gondar, Gondar, Ethiopia

Correspondence to
Anteneh Ayelign Kibret;
antesha04@gmail.com

ABSTRACT

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

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

Study setting UOGCSH.

Participants All adult patients above 18 years of age who visited the surgical 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% to 15.1%). The epigastric hernia had the highest prevalence 16 (34%), followed by inguinal hernia 14 (29.8%). Old age (adjusted OR (AOR) =2.47, 95% CI 1.06 to 5.78), constipation (AOR 3.67, 95% CI 1.68 to 8.11), chronic cough (AOR 5.18, 95% CI 2.17 to 12.3) and lifting of heavy objects (AOR 7.39, 95% CI 3.36 to 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.

Strengths and limitations of this study

- 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 generalised 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%and 30%,[10 11] incisional hernia ranged between 3% and 15%, femoral hernia between 2.5% and 7.4%, and epigastric hernia between 3.4% and 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, a history of surgery, sex, age, chronic cough, constipation, smoking, strenuous work activities and family history of hernia were identified to have a strong association with external hernia.[1 16–22] Hernias are among the most common surgical conditions causing a significant number of morbidity and mortality in various parts of Africa.[23 24] Untreated hernia can lead to life-threatening complications, such as strangulation, incarceration and intestinal obstruction. Of these, strangulation is an acute surgical emergency with significant fatal consequences.[25] In Nigeria and Sudan, strangulated external hernia was the most common cause of intestinal obstruction, accounting for 56.9% and 27.7% of cases, respectively.[24] Lack of adequate surgical care for inguinal hernia is causing higher rate of mortality in remote rural communities.[26]

Despite the common occurrence and clinical significance of external hernia, until this study was done, very limited epidemiological studies were done to indicate the magnitude and risk factors for external hernia in the world. Therefore, this study was aimed to assess the prevalence and associated factors of external hernia among adult patients visiting the surgical outpatient department (OPD) at the University of Gondar Comprehensive Specialised Hospital (UOGCSH). Finally, the output of this study will hopefully help clinicians and policy-makers to design a reliable strategy.

METHODS

Study design and setting

An institution-based cross-sectional study was conducted from 5 April 2020 to 22 June 2020 among adult surgical patients who visited the surgical OPD at the UOGCSH. The hospital was found in 1954 and it is in the North Gondar administrative zone, Amhara National Regional State, which is about 750 km Northwest of Addis Ababa (the capital city of Ethiopia). According to the 2015 population projection of major cities in Ethiopia, the total population size of Gondar town was estimated to be 323 900. Currently, Gondar town has one Referral Hospital and eight government Health Centres. UOGCSH is a teaching hospital, which serves more than 5 million people of the North Gondar zone and people from the neighbouring zones. It is estimated that around 21 000 patients visit the surgical OPD per year.

Population, sample size determination and sampling procedure

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

Variables and data collection procedures

The dependent variable for this study was having any of the external hernias such as: inguinal, epigastric, umbilical, paraumbilical, femoral and incisional hernias. External hernia was diagnosed by general surgeons based on history and physical examination. Data were collected on the sociodemographic characteristics (age, sex, residence, educational status, occupation and average monthly income), clinical factors (family history of hernia, heavy weightlifting, constipation, straining during urination, body mass index, a history of abdominal surgery, history of abdominal trauma, chronic cough and history of Ascites), behavioural and obstetric factors (smoking, alcohol intake and parity). Chronic cough was defined as current or previous history of cough for more than a month. Besides, straining during urination means difficulty of urination that lasted for three or more months. Constipation was defined as unsatisfactory defecation which is characterised by infrequent stool, difficulty in defecation or both for more than 3 months.[27] Interviewer-administered questionnaire which was adapted from different literatures was used to collect data. Five nurses with a bachelorette degree were trained and employed as data collectors. The questionnaire was prepared in English and translated into Amharic and back to English for consistency of the tool. The tool was pre-tested in 10% of a sample size at Debark primary hospital 2 weeks before the main data collection. Necessary adjustments were made based on the pretest result (online supplemental file 1).

Data processing and analysis

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

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

Patient and public involvement

Patients were not involved in this study.

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

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

*Others: unemployed, solider, driver, retire and artist.
OPD, outpatient department; UOGCSH, University of Gondar Comprehensive Specialised Hospital.

RESULTS

Sociodemographic characteristics

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

Clinical, behavioural 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% to 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% to 17.09%) and 11.59% (95% CI 7.57% to 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 with age between 19 and 45 (AOR 2.47, 95% CI 1.06 to 5.78). The odds of having an external hernia was 3.67 times higher among participants who had constipation compared with their counterparts (AOR 3.67, 95% CI 1.68 to 8.11). Patients who had chronic cough had 5.18 times higher odds of having external hernia compared with their counterparts (AOR 5.18, 95% CI 2.17 to 12.3). The odds of having an external hernia was 7.39 times higher among participants lifting heavy objects compared with participants who did not (AOR 7.39, 95% CI 3.36 to 16.2) (table 3).

DISCUSSION

This study assessed the prevalence of external hernia and its associated factors among adult patients visiting the surgical OPD at the UOGCSH, Northwest Ethiopia and found the prevalence of external hernia to be 11.7%. The result is consistent with a study conducted in Arar City, Northern Saudi Arabia 11.5%.[1] In this study, epigastric hernias accounted 34% of the total hernia cases which

Table 2 Clinical, behavioural and obstetric characteristics of adult patients visiting surgical OPD at the UOGCH, Ethiopia, 2020 (n=403)

Variable	Frequency	%
Family history of hernia		
Yes	19	4.8
No	384	95.2
Smoking		
No smoking	385	98.0
Previously smoking	6	1.5
Currently smoking	2	0.5
Alcohol intake		
No alcohol	301	74.7
Previous alcohol intake	32	8.0
Current alcohol intake	70	17.3
Parity		
Nulliparous	54	26.0
Primiparous	22	10.7
Multi parous	68	32.9
Grand multipara	63	30.4
Straining during urination		
Yes	64	15.9
No	339	84.1
Constipation		
Yes	96	23.9
No	307	76.1
Prolonged cough		
Yes	42	10.4
No	361	89.6
Lifting of heavy objects		
Yes	84	20.9
No	319	79.1
Previous abdominal surgery		
Yes	40	10.0
No	363	90.0
History of abdominal trauma		
Yes	13	3.2
No	390	96.8
History of Ascites		
Yes	5	1.24
No	398	98.76
BMI		
14–17.9	58	14.39
18–24.9	311	77.17
25–29.9	27	6.70
30–34.9	7	1.74

BMI, body mass index; OPD, outpatient department; UOGCSH, University of Gondar Comprehensive Specialised Hospital.

puts it at the top of all the cases. Nonetheless, proportion of epigastric hernia reported by other studies worldwide is much lower and ranged between 3.4% and 8.1%.[12 13 28]

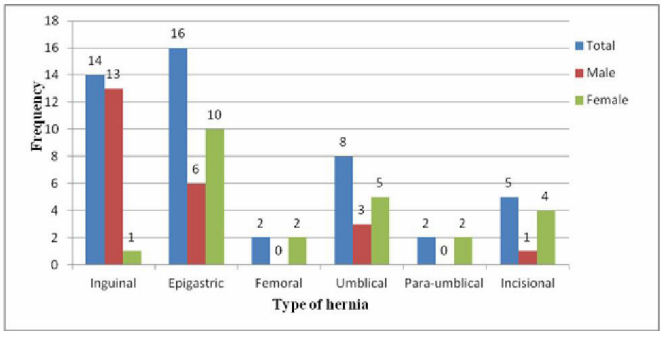

Figure 1 Bar graph that shows the frequency distribution of types of hernia with the sex of adult patients visiting surgical OPD at the UOGCH, Ethiopia, 2020. OPD, outpatient department; UOGCH, University of Gondar Comprehensive Specialised Hospital.

According to studies conducted in Nigeria, Egypt and India the proportion of inguinal hernia was found to be 70.2%, 56% and 21.8%, respectively.[12 28 29] However, the proportion of inguinal hernia in this study was found to be 29.8%.

This study indicates that older age participants were more likely to be diagnosed with external hernia compared with younger age groups. This finding is supported by different studies elsewhere.[6 16 17] The reason could be attributed to the degenerative weakness of abdominal muscles and fibrous tissue in the elderly age group. Loss of abdominal muscle strength and resistance to high intra-abdominal pressure can lead to herniation.[30 31] Another potential reason could be associated with the age-related decline in blood testosterone level and enhancement of oestrogen via the action of aromatase enzyme. Lower abdominal muscles (LAMs) are sensitive to our body's oestrogen hormone and tends to express very high levels of oestrogen receptor-α. As a result, the increase in oestrogen level can lead to atrophy and fibrosis of LAM which may result in the occurrence of hernia in males.[32] On the other hand, when women reach postmenopausal age, they start to accumulate intra-abdominal adipose tissue which will cause separation of muscle bundle and layers, weakening of aponeurosis and then predisposing to hernia.[33]

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

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

Variable	External hernia		Crude OR (95% CI)	Adjusted OR (95% CI)	P value
	Yes	No			
Age					
19–45	18	249	1	1	
46–84	29	107	3.74 (1.99 to 7.04)	2.47 (1.06 to 5.78)	0.036
Residence					
Urban	16	204	1	1	
Rural	31	152	2.6 (1.37 to 4.92)	0.73 (0.30 to1.85)	0.55
Educational status					
No formal education	38	172	4.63 (1.60 to 13.4)	2.90 (0.89 to 9.4)	0.07
Primary and Secondary education	5	100	1.05 (0.27 to 4.03)	1.64 (0.37 to 7.08)	0.50
College or above	4	84	1	1	
Staining during urination					
Yes	16	48	3.31 (1.68 to 6.50)	0.83 (0.33 to 2.25)	0.712
No	31	308	1	1	
Constipation					
Yes	26	70	5.05 (2.68 to 9.51)	3.67 (1.68 to 8.11)	0.001
No	21	286	1	1	
Prolonged cough					
Yes	17	25	7.50 (3.64 to 15.4)	5.18 (2.17 to12.3)	<0.001
No	30	331	1	1	
Lifting heavy objects					
Yes	29	55	8.81 (4.58 to 16.9)	7.39 (3.36 to 16.2)	<0.001
No	18	301	1	1	
BMI					
14–17.9	7	51	1.15 (0.48 to 2.7)	1.35 (0.4 to 3.8)	0.56
18–24.9	33	278	1	1	
25–34.9	7	27	2.1 (0.82 to 0.17)	3.01 (0.95 to 9.54)	0.06

BMI, body mass index; OPD, outpatient department; UOGCSH, University of Gondar Comprehensive Specialised Hospital.

increased odds of having external hernia. The notion of our study is supported by different studies.[22 37 39] This could be attributed to increasing intra-abdominal pressure causing breakage in the fibres of transversals fascia, which leads to muscle weakness and results in the occurrence of hernia.[40]

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

CONCLUSION

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

Acknowledgements We are grateful to thank the study participant for their valuable contribution and provide appropriate information and Dr. Abebe Muche, Mr. Haileab Fekadu, and Mr. Adhanom G/Egzabher for their close, friendly, comments, assistance, intellectual and guidance to our work. The authors like to express their gratitude to all the members of the Department of Human Anatomy as well as the surgery department of the University of Gondar comprehensive specialised hospital as their contributions were vital in the completion of this research work.

Contributors AAK, SYT, MMH, AGW and MAD conceived and designed the study, acquired, analysed and interpreted data, prepared the manuscript and approved the final manuscript. AAK is the guarantor.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Consent obtained directly from patient(s).

Ethics approval Ethical approval was obtained from the ethical review committee of the College of Medicine and Health Sciences, University of Gondar (Reference No 1856/12 dated 18 March 2020). Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available on reasonable request.

ORCID iDs
Anteneh Ayelign Kibret http://orcid.org/0000-0002-4487-5015
M A Dessie http://orcid.org/0000-0002-9186-8029

REFERENCES

1 AhmedAlenazi A, Alsharif MM, Hussain MA, *et al*. Prevalence, risk factors and character of abdominal hernia in Arar City, Northern Saudi Arabia in 2017. *Electron Physician* 2017;9:4806–11.
2 Kingsnorth A, LeBlanc K. Hernias: inguinal and incisional. *Lancet* 2003;362:1561–71.
3 Sangwan M, Sangwan V, Garg M. Abdominal wall hernia in a rural population in India—Is spectrum changing? *Open J Epidemiol* 2013;2013.
4 Primatesta P, Goldacre MJ. Inguinal hernia repair: incidence of elective and emergency surgery, readmission and mortality. *Int J Epidemiol* 1996;25:835–9.
5 Kingsnorth A, LeBlanc K. Hernias: inguinal and incisional. *The Lancet* 2003;362:1561–71.
6 Sazhin A, Zolotukhin I, Seliverstov E, *et al*. Prevalence and risk factors for abdominal wall hernia in the general Russian population. *Hernia* 2019;23:1237–42.
7 Patel HD, Groen RS, Kamara TB, *et al*. An estimate of hernia prevalence in Sierra Leone from a nationwide community survey. *Hernia* 2014;18:297–303.
8 Garba ES. The pattern of adult external abdominal hernias in Zaria. *Niger J Surg Res* 2000;2.
9 Nordberg EM. Incidence and estimated need of caesarean section, inguinal hernia repair, and operation for strangulated hernia in rural Africa. *Br Med J* 1984;289:92–3.
10 Belcher DW, Nyame PK, Wurapa FK. The prevalence of inguinal hernia in adult Ghanaian males. *Trop Geogr Med* 1978;30:39–43.
11 Yordanov YS, Stoyanov SK. The incidence of hernia on the island of Pemba. *East Afr Med J* 1969;46:687–91.
12 Ammar A, Ismail T. Abdominal wall hernias in upper Egypt: a different spectrum. *East Cent Afr J Surg* 2008;13:109–14.
13 Ohene-Yeboah M, Abantanga F, Oppong J, *et al*. Some aspects of the epidemiology of external hernias in Kumasi, Ghana. *Hernia* 2009;13:529–32.
14 Odula PO, Kakande I. Groin hernia in Mulago Hospital, Kampala. *East Cent Afr J Surg* 2004;9.
15 Gelan EA. Experience of open mesh hernia repair at a teaching hospital in Addis Ababa, Ethiopia-A three year retrospective study. *Ethiop Med J* 2018;56.
16 Iqbal MN, Akhter S, Irfan M. Prevalence of hernia in relation to various risk factors in Narowal, Pakistan. *Sci Lett* 2015;3:29–32.
17 Ruhl CE, Everhart JE. Risk factors for inguinal hernia among adults in the US population. *Am J Epidemiol* 2007;165:1154–61.
18 Liem MS, van der Graaf Y, Zwart RC, *et al*. Risk factors for inguinal hernia in women: a case-control study. The Coala trial group. *Am J Epidemiol* 1997;146:721–6.
19 Jansen PL, Klinge U, Jansen M, *et al*. Risk factors for early recurrence after inguinal hernia repair. *BMC Surg* 2009;9:1–5.
20 Sorensen LT, Friis E, Jorgensen T, *et al*. Smoking is a risk factor for recurrence of groin hernia. *World J Surg* 2002;26:397.
21 Flich J, Alfonso JL, Delgado F, *et al*. Inguinal hernia and certain risk factors. *Eur J Epidemiol* 1992;8:277–82.
22 Ashindoitiang JA, Ibrahim NA, Akinlolu OO. Risk factors for inguinal hernia in adult male Nigerians: a case control study. *Int J Surg* 2012;10:364–7.
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 Res Notes* 2012;5:1–8.
24 ElRashied M, Widatalla AH, Ahmed ME. External strangulated hernia in Khartoum, Sudan. *East Afr Med J* 2007;84:379.
25 Ohene-Yeboah M. Strangulated external hernias in Kumasi. *West Afr J Med* 2003;22:310–3.
26 Ohene-Yeboah M, Abantanga FA. Inguinal hernia disease in Africa: a common but neglected surgical condition. *West Afr J Med* 2011;30:77–83.
27 Gray JR. What is chronic constipation? definition and diagnosis. *Can J Gastroenterol* 2011;25 Suppl B:7b–10.
28 Rao G, Rao A, Pujara N. Prevalence of hernia among fishermen population in Kutch district. India. *National J Integrated Res Med* 2015;6:44–51.
29 Igwe PO, Dodiyi-manuel A, Nwankwo N. Hernia in South Southern Nigeria: five year retrospective study. *IOSR J Dent Med Sci* 2016;15:96–111.
30 Lauscher JC, Loh JC, Rieck S, *et al*. Long-term follow-up after incisional hernia repair: are there only benefits for symptomatic patients? *Hernia* 2013;17:203–9.
31 van der Rest M, Garrone R. Collagen family of proteins. *Faseb J* 1991;5:2814–23.
32 Zhao H, Zhou L, Li L, *et al*. Shift from androgen to estrogen action causes abdominal muscle fibrosis, atrophy, and inguinal hernia in a transgenic male mouse model. *Proc Natl Acad Sci U S A* 2018;115:E10427–36.
33 Kark AE, Kurzer M. Groin hernias in women. *Hernia* 2008;12:267–70.
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. *Int J Curr Res* 2014;6:9.
35 Kartal A, Yalcın M, Citgez B, *et al*. The effect of chronic constipation on the development of inguinal herniation. *Hernia* 2017;21:531–5.
36 Lau H, Fang C, Yuen WK, *et al*. Risk factors for inguinal hernia in adult males: a case-control study. *Surgery* 2007;141:262–6.
37 Carbonell JF, Sanchez JL, Peris RT, *et al*. Risk factors associated with inguinal hernias: a case control study. *Eur J Surg* 1993;159:481–6.
38 Billiar T, Andersen D, Hunter J. *Schwartz's principles of surgery: McGraw-Hill Professional*, 2004.
39 Balamaddaiah G, Reddy S. Prevalence and risk factors of inguinal hernia: a study in a semi-urban area in Rayalaseema, Andhra Pradesh, India. *Int Surg J* 2016;3:1310–3.
40 Coste AH, Jaafar S, Parmely JD. *Umbilical hernia*, 2017.