



Population-based rates of hernia surgery in Ghana

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Abstract

Purpose To estimate the population-based annual rate of hernia surgery in Ghana, so as to better define the met and unmet need and to identify opportunities to decrease the unmet need.

Methods Data on operations performed from June 2014 to May 2015 were obtained from representative samples of 48 of 124 district (first-level) hospitals, 9 of 11 regional (referral) hospitals, and 3 of 5 tertiary hospitals, and scaled-up to nationwide estimates. Rates of hernia surgery were compared to previously published annual incidence of symptomatic hernia in Ghana (210/100,000 population) and to published annual rates of hernia surgery in high-income countries (120–275/100,000).

Results Estimated 17,418 [95% uncertainty interval (UI) 8154–26,683] hernia operations were performed nationally. The annual rate of hernia operations was 65 operations/100,000 population (95% UI 30.2–99.0). The rate was considerably less than the annual incidence of new symptomatic hernia or rates of hernia surgery in high-income countries. Hernia operations represented 7.5% of all operations. Most hernia operations (74%) were performed at district hospitals. Most district hospitals (54%) did not have fully trained surgeons, but nonetheless performed 38% of district-level hernia operations.

Conclusions The rate of hernia operations fell short of estimated need. Most hernia repairs were performed at district hospitals, many without fully trained surgeons. Future global surgery benchmarking needs to address both overall surgical rates as well as rates for specific highly important operations. Countries can strengthen their planning for surgical care by defining their total, met, and unmet need for hernia surgery.

Keywords Hernia · Population-based rates · Ghana · Low- and middle-income country · Global surgery

Introduction

The Lancet Commission on Global Surgery recommended a benchmark of 5000 operations/100,000 population/year as a rate at which low- and middle-income countries (LMICs) could achieve most of the population wide benefits of surgery [1]. Planning for surgical care would be further aided by identifying benchmarks for specific surgical conditions.

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This is especially the case for conditions that cause a high burden of death and disability and for which there are cost-effective operations that would be feasible to deliver to all people in a given country, even in settings with very limited resources [2, 3].

Inguinal, femoral, and other abdominal wall hernias fit the above description perfectly. They cause a significant health burden, leading to 44,000 deaths and 3,481,000 disability adjusted life years (DALYs) lost globally [4]. Moreover, hernia repair is one of the most cost-effective of all operations and it would be eminently feasible to assure its availability to all people in any country [2]. To assist with planning for hernia surgery and to be able to gauge how close a country is coming to the goal of assuring the availability of hernia repair to all who need it, it would be useful to know both the overall need and how much of that need is being met.

In Ghana, the annual incidence rate of new asymptomatic inguinal hernias was estimated at 210/100,000 [5]. How much of that need is being met can be measured by current operative productivity of hernia repairs. Several studies have looked at such output on a hospital level in other countries, using the catchment area of the hospitals as the denominator. Grimes et al. estimated an average annual rate of inguinal hernia surgery at district hospitals from nine African countries at 30/100,000, which is considerably smaller than the above need [6].

Estimates on a national basis would be especially useful for nationwide planning for surgical services. Such rates are well known in high-income countries. Annual rates of 120–275 operations for inguinal hernia per 100,000 have been estimated for Australia, the United Kingdom, and the United States [7–10]. Such nationwide estimates of hernia surgery have been scarce for LMICs. In one of the few such studies, a nationwide enumeration of all surgeries in Sierra Leone reported an annual rate of surgery for all hernia of 86/100,000 [11].

We sought to address the dearth of information on rates of hernia surgery in LMICs. The goal of the current study was to estimate the rate of hernia surgery in Ghana, examining rates by age and gender, by elective vs. emergent, and by level of the health care system. By so doing, we hoped to provide data that would be useful for nationwide planning to meet the needs of the population for hernia surgery in Ghana and in other LMICs.

Methods

Setting

Ghana is a lower middle-income country with a population of 26 million people [12]. Provision of hospital-based surgical care usually begins with district (first-level) hospitals

[13, 14], which include both government-run hospitals and faith-based hospitals. These have 50–100 beds and offer some surgical services, but are often not staffed by fully trained surgeons [15]. Regional hospitals have 100–500 beds and are typically staffed by specialist surgical providers (such as general surgeons, obstetricians, and orthopedic surgeons). Tertiary hospitals have 500–2000 beds and offer a broader range of surgical services. At the time of data collection, Ghana had 124 district, 11 regional, and 5 tertiary hospitals. Approximately half (54%) of district hospitals did not have fully trained surgeons available [3].

Study design

The number and types of operations performed in Ghana over a 1-year period from June 2014 to May 2015 were determined by a retrospective review of surgical logbook data at a representative sample of all hospitals. Details of power estimation, hospital sampling, and study methodology have been previously described [3]. Briefly, all regional and tertiary hospitals and 48 of 124 district hospitals, selected by simple random sampling, were invited to participate in the study. Private hospitals were excluded, since they do not significantly contribute to the national surgical volume [16]. Details of all operations done for a diagnosis of any type of abdominal wall hernia are reported herein.

Data collection and analysis

All operations logged in operating theater and procedure area registers at sampled hospitals were transcribed into Excel (Microsoft Corp., USA). An operation was defined as a procedure performed in an operating theater or procedure area regardless of type of surgical provider or type of anesthesia. Data gathered included the date of procedure, patient demographics, operation(s) performed, and anesthesia type. For hernia operations, additional data gathered included the type of hernia and whether the operation was elective or emergent (i.e., whether it was incarcerated, obstructed, or strangulated).

Data were described with numbers and percentages. Utilization of hospital-level probability weights to arrive at national estimates for each operation has been previously described [3]. Briefly, district- and regional-level weights were determined as the inverse of the proportion of hospitals surveyed (48/124 and 9/11, respectively). Tertiary-level weights were determined as the inverse of the proportion of surveyed hospital bed capacity (2000/4400). Bootstrap standard errors were calculated to provide 95% uncertainty intervals (UI) for the total annual national estimate of operations. Surgical rates were expressed as operations per 100,000 population using 2014 population estimates [12]. Data were analyzed with Stata v14 (StataCorp, USA).

Ethics

No identifying information on the patients was recorded. The study was approved by the Committee on Human Research Publications and Ethics of Kwame Nkrumah University of Science and Technology and deemed exempt by the University of Washington Institutional Review Board.

Results

National Estimates

All of the 48 district hospitals, 9 of 11 regional hospitals, and 3 of 5 tertiary hospitals participated in the study. At sampled hospitals, a total of 103,505 operations were performed over the 1-year period. This translates to an estimated 232,776 (95% UI 178,004–287,549) operations performed nationwide over the 1-year period. Based on the 2014 population of Ghana (26,962,563), the annual rate of operations was 869 per 100,000 population (95% UI 664–1073 operations) [3]. A total of 17,418 (95% UI 8154–26,683) of these were operations for hernia, for an annual rate of hernia operations of 65 operations/100,000 (95% UI 30–99). Hernia operations represented 7.5% of

all operations. Most (96%) hernia operations were elective (Table 1). Most (97%) of the elective hernia operations were for inguinal hernias with smaller numbers of femoral, incisional, and ventral non-incisional hernias. Seven-hundred and one (701, 4.0%) of the hernia operations were emergencies. The emergency operations included: laparotomy for bowel obstruction or perforated bowel (77%), reduction and repair of incarcerated groin hernia (23%).

Demographics

The numbers of hernia operations varied by age group (Table 2). The corresponding annual rates of hernia surgery were: 26/100,000 (95% UI 10–43) for persons aged 0–14 years; 72 (95% UI 27–115) for persons aged 15–64 years; and 238 (95% UI 97–378) for persons 65 years and older. In all age groups inguinal hernias predominated.

There were over three times as many hernia operations for males as for females (Table 3). The corresponding annual rates were: 98/100,000 (95% UI 42–153) for males and 30 (95% UI 12–49) for females. For both sexes groin hernias predominated. Females had higher proportion of incisional hernias and ventral non-incisional hernias than

Table 1 Hernia repairs performed in Ghana (2014–2015)

	District hospitals		Regional hospitals		Tertiary hospitals		All hospitals	
	<i>N</i>	(%)	<i>N</i>	(%)	<i>N</i>	(%)	<i>N</i>	(%)
Elective hernia repair	12,511	(98)	1629	(93)	2576	(90)	16,717	(96)
Inguinal hernia	12,160	(95)	1575	(90)	2521	(88)	16,256	(93)
Femoral hernia	77	(0.6)	13	(0.7)	13	(0.5)	104	(0.6)
Ventral non-incisional hernia	209	(1.6)	21	(1.2)	26	(0.9)	256	(1.5)
Incisional hernia	46	(0.4)	18	(1.0)	13	(0.5)	78	(0.4)
Diagnosis not stated	18	(0.1)	2	(0.1)	2	(0.1)	23	(0.1)
Emergency hernia repair	294	(2.3)	121	(6.9)	286	(10)	701	(4.0)
Total	12,805	(100)	1750	(100)	2862	(100)	17,418	(100)

Table 2 Hernia repairs performed in Ghana by age group (2014–2015)

	Age groups (years)									
	0–14		15–64		≥ 65		Missing age		Total	
	<i>N</i>	(%)	<i>N</i>	(%)	<i>N</i>	(%)	<i>N</i>	(%)	<i>N</i>	(%)
Elective hernia repair	2549	(92)	10,640	(96)	2122	(97)	1406	(98)	16,717	(96)
Inguinal hernia	2492	(90)	10,332	(94)	2041	(93)	1390	(97)	16,256	(93)
Femoral hernia	0	(0)	54	(0.5)	46	(2.1)	4	(0.3)	104	(0.6)
Ventral non-incisional hernia	52	(1.9)	178	(1.6)	25	(1.1)	3	(0.2)	256	(1.5)
Incisional hernia	3	(0.1)	57	(0.5)	9	(0.4)	10	(0.7)	78	(0.4)
Diagnosis not stated	3	(0.1)	19	(0.2)	1	(0.1)	0	(0)	23	(0.1)
Emergency hernia repair	208	(7.5)	401	(3.6)	67	(3.1)	25	(1.7)	701	(4.0)
Total	2757	(100)	11,041	(100)	2189	(100)	1431	(100)	17,418	(100)

Table 3 Hernia repairs performed in Ghana by gender (2014–2015)

	Male		Female		Missing gender		Total	
	<i>N</i>	(%)	<i>N</i>	(%)	<i>N</i>	(%)	<i>N</i>	(%)
Elective hernia repair	12,676	(97)	3849	(93)	192	(93)	16,717	(96)
Inguinal hernia	12,562	(96)	3508	(85)	186	(90)	16,256	(93)
Femoral hernia	30	(0.2)	74	(1.8)	0	(0)	104	(0.6)
Ventral non-incisional hernia	67	(0.5)	184	(4.5)	5	(2.5)	256	(1.5)
Incisional hernia	3	(0.0)	74	(1.8)	1	(0.6)	78	(0.4)
Diagnosis not stated	14	(0.1)	9	(0.2)	0	(0)	23	(0.1)
Emergency hernia repair	411	(3.1)	276	(6.7)	14	(6.8)	701	(4.0)
Total	13,087	(100)	4125	(100)	206	(100)	17,418	(100)

males, but these were still a very small proportion of all hernia operations.

Procedure-type estimates by hospital level

The vast majority (74%) were performed at district hospitals (Table 1). The overall pattern of types of hernia was similar for all hospital levels. The percent of emergency surgery, however, rose with increasing hospital level: 2.3% of hernia repairs were emergent at the district level, 6.9% at regional hospital, and 10% at tertiary.

At the district level, most (62%) hernia repairs were done at hospitals that had at least one fully trained surgeon available. Nonetheless, a significant number (38%) were done at district hospitals that did not have a fully trained surgeon available (Table 4).

Discussion

We sought to estimate the rate of hernia surgery in Ghana, examining rates by age and gender, by elective vs. emergent, and by level of the health care system. We estimated a nationwide annual rate of hernia surgery of 65/100,000. Rates were higher in the elderly and in males. The majority of operations were performed at district (first-level)

hospitals, many of which did not have fully trained surgeons available.

The population-based rate of hernia surgery has been evaluated for several high-income countries, with fairly consistent findings. In the United States, the nationwide annual inguinal hernia repair rate was estimated at 275/100,000 in 2003 [7]; in Australia, the nationwide rate varied between 120 and 130 over 2002–2015 [8]; in the Oxford area in the United Kingdom (UK), the rate was estimated at 130/100,000 in 1996 [9], and nationwide in the UK the rate was estimated at 217/100,000 in 2011 [10].

Similar estimates for LMICs have been sparse. In a systematic review of met and unmet need of surgical disease in rural-sub-Saharan Africa, Grimes et al. used several previously published estimates of inguinal hernia surgery from district hospitals in nine primarily eastern African countries, along with the estimates of those hospitals' catchment areas, to derive an average annual population-based rate of 30/100,000 [6].

A nationwide enumeration of all surgery in Sierra Leone reported an annual rate for all surgery of 400 operations/100,000 and of surgery for all hernia of 86/100,000. Hernias accounted for 22% of the national surgical volume [11]. The current nationwide estimate in Ghana of 65/100,000 is similar to the estimate from Sierra Leone. Both of these are higher than the above-noted multinational

Table 4 Hernia repairs performed in district-level hospitals in Ghana according to surgeon availability (2014–2015)

	Fully trained surgeon availability					
	Available		Not available		All district hospitals	
	<i>N</i>	(%)	<i>N</i>	(%)	<i>N</i>	(%)
Elective hernia repair	7641	(97)	4869	(99)	12,510	(98)
Inguinal hernia	7445	(94)	4714	(96)	12,159	(95)
Femoral hernia	44	(0.6)	34	(0.7)	77	(0.6)
Ventral non-incisional hernia	98	(1.2)	111	(2.3)	209	(1.6)
Incisional hernia	41	(0.5)	5	(0.1)	46	(0.4)
Diagnosis not stated	13	(0.2)	5	(0.1)	18	(0.1)
Emergency hernia repair	248	(3.1)	46	(0.9)	294	(2.3)
Total	7889	(100)	4916	(100)	12,805	(100)

district hospital estimate of 30/100,000, possibly because the nationwide estimates include better-served urban areas, in addition to the rural areas which comprised the district hospital estimates. In addition, the district hospital estimate was of only inguinal hernia. However, in the Ghanaian estimate, only a small percent of all hernia operations were other than inguinal. Compared to Sierra Leone, the Ghanaian rate for all operations is higher (869/100,000, compared to 400 in Sierra Leone) and the percent of all operations that are hernia repairs is lower (7.6%, compared to 22% in Sierra Leone).

The emergency hernia operation rate for Ghana was estimated at 2.6/100,000. This is higher than that for the Oxford area in the UK (1.2/100,000), Grimes et al., in their report on hernia operation rates from East Africa, did not provide estimates for emergency hernia operation rates. However, 54% of operated groin hernias in Northwestern Tanzania were for emergencies (i.e., incarceration, obstruction, or strangulation) [17]. Application of this percent to the estimated 30/100,000 rate of hernia operations for eastern African countries provides an emergency hernia operation estimate of 16.2/100,000 for this region, higher than our estimate for Ghana. These estimates suggest that although less hernias are operated upon as emergencies in Ghana compared to East Africa, more needs to be done to reduce the hernia burden among sufferers in Ghana by striving for the lower emergency surgery rates of higher income countries.

The higher rates of hernia surgery for males and the elderly fits with the known epidemiology of hernia and with prior reports [5, 9, 10, 18]. The current study estimated that 4% of hernia operations were emergencies, which is similar to the 5% in the nationwide UK study [10], but less than the Oxford area study (9%) [9].

All of the above LMIC estimates are well below the high-income country levels. They are inadequate to address the current burden of hernia. For example, in Nepal, the prevalence of inguinal hernia was estimated at 1144/100,000 for people aged 5–49 years and at 2941/100,000 for people aged over 50 years [19]. In Ghana, the annual incidence rate of new inguinal hernias was estimated at 210/100,000 along with a backlog of 530,000 existing inguinal hernias (equating to 1966/100,000 general population). To keep up with the new cases and to address the existing backlog would require a rate of 420 operations/100,000 per year over the next 10 years [5].

Several measures have been promoted to increase the availability of essential surgical services, such as hernia repair, in LMICs. These include increased emphasis on district hospitals, to which the less well-served rural people have greater access. Another measure, especially for the more straightforward procedures such as hernia repair, is task sharing [1, 2]. It is notable that in the current study in Ghana, these measures are already underway. The majority of hernia repairs are being performed at district hospitals, with a

significant number at hospitals that do not have surgeons, where general doctors are performing the hernia repairs.

In addition to the above measures, better understanding of the national-level met and unmet needs for hernia surgery would assist in planning. The Lancet Commission on Global Surgery recommended a benchmark of 5000 operations of all types/100,000 population/year [1]. Planning for surgical care would be further aided by identifying benchmarks for specific surgical conditions [3]. The above-noted estimate of 210 new symptomatic hernias/100,000 population per year in Ghana was based on data from the US, making the assumption that the rate would not be that different between countries [5]. Pending data to contrary, it would be reasonable to use a similar benchmark goal in all countries as the minimum total need. Most LMICs also have a backlog of untreated cases, which would put the benchmark goal somewhat higher. It would be a reasonable next step for most countries to understand their own met needs through tabulation of existing data from hospital records for all hospitals, or through a representative sample of hospitals as was done in this study.

Before drawing conclusions, the limitations of the study methods must be addressed. First, data came from logbooks and not operative records. This may have led to underassessment of hernia operations done for emergency indications. Second, our study did not include private hospitals. There is little information regarding quantity of care provided by private hospitals [20]. However, the vast majority of surgical care in Ghana is provided by government and faith-based hospitals, which were included in the study. The private sector's role is estimated to be less than 10% [16]. Therefore, considering their potential contribution would adjust our estimated hernia repair rate by no more than 10%. Third, the study did not assess outcomes. We do not know differences in quality of care or outcomes for the different hospital levels or for hospitals with and without fully trained surgeons. Finally, humanitarian missions such as ApriDec Medical Outreach Group [21] and others [22] occasionally conduct hernia repairs at Ghanaian hospitals. These operations are recorded in theater log books of these hospitals, which served as the source of data for this study. As such, numbers reported in the study include cases performed by humanitarian missions. However, as the study did not collect data on whether the operations were performed by mission groups or otherwise, we are unable to quantify the contribution of humanitarian missions to the estimated rate of hernia operations in Ghana.

Despite these limitations, this study provides useful estimates of the annual hernia repair rate in Ghana, as well as the distribution of operations by demographics, hernia type, and hospital level. These data are useful for future benchmarking and for efforts to strengthen the health system to better address the current burden of hernia in Ghana and in other similar LMICs.

Conclusions

The Lancet Commission on Global Surgery recommended a benchmark of 5000 operations/100,000 population/year. Future benchmarking efforts should address different types of operations as well as different levels of the health care system [3]. This study showed Ghana's nationwide annual hernia repair rate to be higher than several prior estimates from other African countries, but lower than high-income country rates and lower than that needed to adequately address the current health burden being caused by hernia. Efforts to improve on this scenario could include several measures that are already underway, but which need to be achieved to a greater extent: increasing the number of district hospitals with fully trained surgeons; increasing hernia training for the general doctors who do hernia surgery at district hospitals that do not have fully trained surgeons; and increasing the use of relatively under-utilized regional hospitals. Moreover, this study has shown the potential utility for any country to define its total, met, and unmet need for hernia surgery.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no competing interest in any form related directly or indirectly to the subject of this article.

Ethical approval The study was approved by the Committee on Human Research Publications and Ethics of Kwame Nkrumah University of Science and Technology and deemed exempt by the University of Washington Institutional Review Board.

Statement of human and animal rights This article does not contain any studies with human or animal participants performed by any of the authors.

Informed consent Formal consent was not required for this study.

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