Published in final edited form as:

Int J Gynaecol Obstet. 2020 February ; 148(2): 205–209. doi:10.1002/ijgo.13019.

Estimating Obstetric and Gynecologic Surgical Rate: A Benchmark of Surgical Capacity building in Ghana

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Abstract

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Drafting of the manuscript: All authors.

Critical revision of the manuscript for important intellectual content: All authors.

Administrative, technical, or material support: All authors.

Conflicts of interest: The authors declare no competing interest in any form related directly or indirectly to the subject of this article.

Objectives: To estimate the annual rate of obstetric and gynecologic (ObGyn) operations performed in Ghana and establish a baseline for tracking expansion of Ghana's surgical capacity.

Methods: Data were obtained for ObGyn operations performed in Ghana between 2014 and 2015 from a nationally representative sample of hospitals and scaled-up for national estimates. Operations were classified as "essential" or "other" according to The World Bank's Disease Control Priorities Project. Data were used to calculate Cesarean section (C-section)-to-total-operation-ratio (CTR) and estimate the C-section rate based on the number of live births in 2014.

Results: 90,044 (95% UI: 69,461–110,628) ObGyn operations were performed nationally over the one-year period, yielding an annual national ObGyn operation rate of 881/100,000 females aged 12 years (95% UI: 679–1,082). 87% were essential procedures, 80% of which were C-sections. District hospitals performed 71% of ObGyn operations. The national C-section rate was 7.2% and the CTR was 0.27.

Conclusions: The C-section rate of 7.2% suggests inadequate access to obstetric care. The CTR of 0.27 suggests inadequate overall surgical capacity. These measures, along with estimates of distribution of procedures by hospital level, provide useful baseline data to support surgical capacity building efforts in Ghana and similar countries.

Keywords

Obstetrics and gynecology; Surgical rate; Ghana; enumeration; Cesarean section; Global surgery

Introduction

The rate of development of surgical care has lagged behind the massive gains made in global health over the past 3 decades [1]. For example globally, maternal disorders has been reported as contributing 234 disease-adjusted life years (DALY) per 100,000 total population [2]. More recently, conditions that might benefit from timely obstetric and gynecologic (ObGyn) surgery comprise 6% of the global disease burden of females, accounting for 1,785 disease-adjusted life years (DALY) per 100,000 females [3]. Low- and middle-income countries (LMICs) contribute disproportionately to this burden while demonstrating the least capacity to adequately address the burden [4, 5]. To address this situation, The Lancet Commission on Global Surgery proposed a surgery rate of 5,000 operations/100,000 people at which LMICs might achieve the maximum population-wide benefits of surgery [6]. The Commission, however, did not indicate benchmarks for specific surgical operations such as for ObGyn conditions. Ghana currently performs 869 operations/100,000 total population, which falls far below the Lancet Commission benchmark [7]. In Ghana particularly, ObGyn surgical operations have the ability to target about 11% of the disease burden among females [3].

Serial assessments of surgical capacity have been deemed impractical, especially in LMICs, because of time and other resource constraints [8]. Many LMICs, however, have high birth rates resulting in a large number of cesarean sections (C-sections) [9]. With hospitals having limited capacities in these countries reporting high proportions of C-sections from their case volumes, the ratio of C-sections to total operations has been identified as representing a simple and feasible metric for assessing and tracking surgical capacity in LMICs [8, 10, 11].

Countries with a C-section to total operation ratio (CTR) greater than 0.2 have been linked to critical surgical capacity deficiencies. High income countries, with reported adequate surgical capacity, are associated with CTRs less than 0.03 [8, 12]. Additionally, C-sections are effective in saving maternal and newborn lives and in populations with C-section rates below 10%, maternal and neonatal mortality has been known to decrease when C-section rates increase [13].

We aimed to estimate the annual rate of ObGyn surgical operations in Ghana and differentiate it by type of operation and hospital level as well as establish the CTR and C-section rate for Ghana. By so doing, we hoped to provide a baseline for tracking improvements in surgical capacity over time.

Methods

This study was conducted as part of a larger study on enumeration of all surgical operations in Ghana [7]. In Ghana, surgical service provision begins at district (first-level) hospitals, which have up to 100 beds, are staffed mostly by medical officers and nurse anesthetists and offer some surgical services. Regional hospitals receive referrals from district hospitals, have more surgical providers including fully-trained surgeons (e.g. general and ObGyn surgeons), and have 100–500 beds. Tertiary hospitals typically contain 500–2,000 beds and provide a wider range of surgical services. Details of the study methodology have previously been published [7]. Briefly, the number and types of surgical operations performed in operating theatres from May 2014 to June 2015 were obtained from theatre log books of 48/124 district hospitals, 9/11 regional hospitals and 3/5 tertiary hospitals in the country. A “surgical operation” was defined as any procedure performed in a theatre irrespective of surgical provider or anesthesia type. For the present study, all recorded ObGyn surgical operations were included. C-sections were recorded as elective or emergency as noted in the log books. Operations were classified into “essential procedures” as described by The World Bank’s Disease Control Priorities Project (DCP-3) versus “other” [14]. The former is regarded as those surgical operations that have the highest population impact and are most cost-effective to provide.

National estimates for each ObGyn surgical operation were calculated using hospital-level appropriate probability weights, which have previously been described [7]. District- and regional-level weights were determined by dividing the total number of hospitals by the number of hospitals surveyed (124/48 and 11/9, respectively). Tertiary-level weights were determined by dividing the total tertiary hospital bed capacity by that from the hospitals surveyed (4,400/2,000). Bootstrap analysis was performed to provide 95% uncertainty intervals (UIs) of the total one-year national estimate of all ObGyn surgical operations. This was divided by the 2014 Ghanaian population of females 12 years to estimate the annual ObGyn surgical operation rate.

To calculate the C-section to total operation ratio, the total number of C-sections performed in Ghana over the one-year period was divided by the estimated total number of all surgical operations performed in Ghana over the same time period. Ghana’s 2014 crude birth rate (32.029/1000 people) was multiplied by the country’s mid-year population to estimate

number of live births for 2014 [15, 16]. The total number of C-sections performed over the one-year period was divided by the number of live births in 2014 to estimate the C-section rate. Data analysis was performed with Stata v14 (StataCorp, College Station, TX, USA).

Ethics

The Committee on Human Research Publications and Ethics of Kwame Nkrumah University of Science and Technology provided ethical approval while the study was deemed exempt by the University of Washington IRB.

Results

Over the one-year period, an estimated 90,044 (95% UI 69,461–110,628) ObGyn surgical operations were performed nationwide. The 2014 population of Ghanaian females 12 years was 10,226,085 [17]. The annual national rate of ObGyn surgical operations was 881/100,000 females 12 years (95% UI 679–1,082). 77,900 (87%) of all ObGyn surgical operations were categorized as essential procedures. Majority of these were C-sections, comprising 62,219 (80%) of essential procedures and 62,219 (69%) of all ObGyn operations (Table 1). At each hospital level, essential ObGyn procedures comprised 73%–91% of all ObGyn operations. Among the ObGyn operations not classified within the essential category, uterine fibroid operations were the most common (5,374; 44%).

District hospitals performed 64,177 (71%) of all ObGyn operations in Ghana (Table 1). ObGyn operations not classified within the essential category performed at district hospitals comprised less than 10% (5,846; 9.1%) of ObGyn operations performed at district hospitals. However, they made up nearly half of ObGyn operations not classified within the essential category performed at all hospital levels. Majority (3,557; 61%) of these operations were for uterine fibroids. Twenty-six of the forty-eight district hospitals did not have a fully-trained surgeon. These hospitals, however performed 24,479 (38%) of all district-level ObGyn operations (Table 2). C-sections, laparotomy for ectopic pregnancy, manual vacuum aspiration and dilatation and curettage were the most commonly performed operations. Obstetric fistula repair was the one essential procedure only performed in district hospitals staffed by a fully-trained surgeon.

Regional hospitals performed the least number of ObGyn operations, contributing only 6,450 (7%) of the annual national ObGyn surgical output. As in district and tertiary hospitals, regional hospitals performed mostly essential procedures (Table 1). They also performed a relatively higher proportion of obstetric fistula repair than the other hospital levels.

Tertiary hospitals performed fewer essential ObGyn procedures compared to district and regional hospitals, but performed more procedures outside of the essential category (Table 1). Most (3,137; 61%) operations not classified within the essential category performed in tertiary hospitals were for other benign conditions including procedures for uterovaginal prolapse, hydrotubation for infertility, insertion or removal of contraceptive devices and cervical cerclage placements.

The estimated total number of surgical operations performed in Ghana over the period was 232,776, including 62,219 C-sections [7]. 31,021 (50%) of C-sections were performed as emergencies. The national C-section to total operation ratio across all hospital levels was thus 0.27. There were an estimated 863,584 live births in Ghana in 2014, based on Ghana's 2014 crude birth rate of 32.029/1000 mid-year population [15, 16]. The C-section rate was estimated at 7.2% and the ratio of emergency to total C-sections was 0.47 (95% CI: 0.44 – 0.49)

Discussion

Surgically correctable ObGyn conditions represent 11% of the disease burden among females in Ghana [3]. However like many LMICs, Ghana lacks capacity to adequately address this burden [4, 5]. Additionally, Ghanaian women face increased barriers to surgical care compared to men [18]. While the Lancet Commission proposed a benchmark for overall surgical care in LMICs to address the surgical disease burden, it did not propose a specific benchmark for ObGyn conditions. Thus, we sought to estimate the annual rate of ObGyn surgical operations nationally, characterized by hospital-level and procedure type and also estimate the C-section to total operation ratio (CTR) and C-section rate in order to compare Ghana's surgical capacity with proposed standards. The national rate of ObGyn surgical operations was estimated at 881/100,000 females 12 years. Given that the overall surgical rate for Ghana is less than 20% of the 5,000/100,000 population proposed by the Lancet Commission, the ObGyn surgical rate most likely represents deficiencies as well. Additionally, the national CTR of 0.27 and the C-section rate of 7.2% both point to inadequate surgical capacity in the country.

Before discussing the study findings, the limitations of the study must be addressed. Firstly, the study was performed retrospectively and we could not ascertain whether there were sporadic instances of case omission. However, we did not encounter any unexplained periods of non-surgical activity. Secondly, contributions from hospitals in the private sector to the national annual ObGyn surgical rate were not included as these hospitals are estimated to account for less than 10% of the total national surgical output [19]. Hence, excluding private hospitals is not expected to significantly affect our estimates. Thirdly, 33% of C-sections were not clearly designated as being emergencies or elective in the theatre log books. These were considered as elective C-sections leading to the arrival of emergency to total C-sections ratio of 0.47 (95% CI: 0.44 – 0.49). Finally, two tertiary and two regional hospitals did not contribute to the study. This necessitated our application of weights to estimate the national ObGyn surgical rate. It is however, possible that the case mix at these hospitals might vary from that obtained from participating hospitals.

In order to make the largest impact on the global burden of surgery-related disease, DCP-3 proposed a focus on essential surgery [14]. Six of the ObGyn surgical operations recorded from Ghanaian operating theatres fell into this category, together comprising 87% of all ObGyn operations performed in the country. This suggests that, across hospital levels, current resources are being directed toward those procedures which are most cost-effective, feasible and likely to have a large population impact. The observed decrease in percent of essential procedures, and accompanying increase in percent of the more complex other

procedures performed, with increase in hospital level is consistent with the expected role of each hospital level. With the exception of obstetric fistula repairs, the DCP-3 recommends that district hospitals be equipped to carry out all essential obstetric procedures [14]. In fact, the data revealed that while regional and tertiary hospital performed most of these repairs as expected, district hospitals could conduct obstetric fistula repairs when a fully-trained surgeon was available.

The high ObGyn surgical volume of district hospitals suggests that they are a vital source for improving surgical access. By presenting first to more prevalent and widely-dispersed district hospitals, women may ameliorate some barriers to surgical care such as the distance to a health facility [18]. Though regional hospitals are equipped with more beds, staff and other resources than district hospitals, our data suggest that they are being underutilized in the current three-tier system of surgical service provision in Ghana. Like district hospitals, regional hospitals are dispersed across the country and therefore represent valuable assets in expanding access to care. Prior reports have focused on targeting district hospitals to reduce unmet surgical need [2]. However, there is the need to also expand the role of regional hospitals, in Ghana, to ease the burden on tertiary hospitals that are currently receiving a disproportionate number of referrals [20].

Given that C-section represents a large proportion of the ObGyn surgical case load, special consideration has been given to its utility as a metric of surgical capacity. In addition to being an essential procedure, C-section has also been classified as a Bellwether procedure, since a nation's ability to perform C-sections is correlated with the ability to perform other essential obstetric procedures [1]. Unlike rates of ObGyn surgical operations as a whole, C-section rates have been discussed as a benchmark in the context of global health. Between 10%–15% has been recommended as the population C-section rate at which the operations are frequent enough to address obstetric need and still show a positive effect on maternal or neonatal mortality [13]. Ghana's estimated C-section rate of 7.2% indicates that improving access to cesarean delivery for all women in the country who need it would be beneficial to maternal and neonatal mortality rates. However, only one-half of the total C-sections performed in Ghana over the one-year period were for emergency indications. This might limit the utility of using the C-section rate to adequately represent the met surgical need as the metric was more meant to capture emergency cases [21]. The estimated CTR of 0.27 for Ghana is more consistent with the known low surgical rate (869 operations/100,000 people) and may serve as a more appropriate proxy for continued evaluation of national surgical rate and monitoring relative improvements in surgical capacity.

Task shifting in surgery has been successfully implemented in LMICs and has the potential to improve surgical capacity in these settings, where adequate surgical capacity has been lacking [22, 23]. The high rates of ObGyn surgical operations done by district hospitals which lacked fully-trained surgeons are evidence of effective task shifting. These hospitals performed 40% of all C-sections performed at district hospitals. In Ghana, continuous training after graduation from medical school begins with a two-year internship at the end of which house officers (interns) are most likely to have met a minimum threshold of observation of commonly performed surgical procedures such as laparotomy, appendectomy and herniorrhaphy [24]. The house officer (intern) is, however, expected to be competent at

performing a C-section without supervision at the end of the training. This suggests that implementation of early task shifting measures, especially through formal education, is more advanced in the ObGyn field than in other surgical disciplines in Ghana and provides a useful template to advance task shifting initiatives across other surgical fields [25].

Conclusion

Ghana had an estimated national annual ObGyn surgical operation rate of 881 operations/100,000 females 12 years and critical deficiencies in surgical capacity as indicated by its high C-section to total operation ratio. Our study provides useful baseline data that will support the much needed surgical capacity building efforts in Ghana and other LMICs.

Acknowledgements:

The authors thank all participating institutions and the dedicated volunteers for obtaining data needed for the study.

Funding: This study was funded by grants D43-TW007267 and R25-TW009345 from the Fogarty International Center, US National Institutes of Health. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

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Synopsis:

Ghana's C-section rate of 7.2% suggests inadequate access to obstetric care while its C-section to total operation ratio of 0.27 suggests inadequate overall surgical capacity.

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Table 1.

National annual estimates of obstetric and gynecologic surgical operations performed in Ghana 2014-2015. Other Essential ObGyn Procedures Include: manual vacuum aspiration, laparotomy for ectopic pregnancy, tubal ligation and hysterectomy for uterine rupture or intractable PPH.

	<u>District hospitals</u>		<u>Regional hospitals</u>		<u>Tertiary hospitals</u>		<u>All hospitals</u>	
	N	(%)	N	(%)	N	(%)	N	(%)
Essential ObGyn Procedures	58,331	(91)	5,313	(82)	14,256	(73)	77,900	(87)
<i>Cesarean section</i>	45,683	(71)	4,693	(73)	11,843	(61)	62,219	(69)
<i>Manual vacuum aspiration and D&C</i>	9,457	(15)	173	(2.7)	1,434	(7.4)	11,065	(12)
<i>Laparotomy for ectopic pregnancy</i>	2,242	(3.5)	343	(5.3)	759	(3.9)	3,344	(3.7)
<i>Tubal ligation</i>	703	(1.1)	16	(0.2)	42	(0.2)	760	(0.8)
<i>Hysterectomy for uterine rupture or intractable PPH</i>	230	(0.4)	26	(0.4)	42	(0.2)	297	(0.3)
<i>Obstetric fistula repair</i>	15	(0.02)	62	(1.0)	136	(0.7)	214	(0.2)
Other ObGyn Procedures	5,846	(9.1)	1,137	(18)	5,161	(27)	12,144	(13)
<i>Procedures for uterine fibroids</i>	3,557	(5.5)	578	(9.0)	1,239	(6.4)	5,374	(6.0)
<i>Procedures for other benign ObGyn conditions</i>	1,491	(2.3)	307	(4.8)	3,137	(16)	4,935	(5.5)
<i>Diagnostic procedures for gynecologic cancers</i>	333	(0.5)	92	(1.4)	464	(2.4)	889	(1.0)
<i>Therapeutic procedures for gynecologic cancers</i>	465	(0.7)	160	(2.5)	321	(1.7)	946	(1.1)
Total ObGyn Procedures	64,177	(100)	6,450	(100)	19,417	(100)	90,044	(100)
Total Annual Surgical Procedures	143,750	(100)	20,247	(100)	68,779	(100)	232,776	(100)
C-section to Total operation ratio	0.32		0.23		0.17		0.27	

Table 2.

National annual estimates of obstetric and gynecologic surgical operations performed by district hospitals staffed with or without fully-trained surgeons.

	Fully-trained surgeon				All district hospitals	
	Staffed		Not Staffed			
	N	(%)	N	(%)	N	(%)
Essential ObGyn procedures	35,185	(89)	23,146	(95)	58,331	(91)
<i>Cesarean section</i>	27,339	(69)	18,344	(75)	45,683	(71)
<i>Obstetric fistula repair</i>	15	(0.04)	0	(0)	15	(0.02)
<i>Other essential ObGyn procedures</i> *	7,830	(20)	4,802	(20)	12,632	(20)
Other ObGyn Procedures	4,513	(11)	1,333	(5)	5,846	(9)
<i>Procedures for uterine fibroids</i>	2,764	(7.0)	793	(3.2)	3557	(5.5)
<i>Procedures for other benign ObGyn conditions</i>	1,121	(2.8)	369	(1.5)	1,491	(2.3)
<i>Diagnostic procedures for gynecologic cancers</i>	287	(0.7)	46	(0.2)	333	(0.5)
<i>Therapeutic procedures for gynecologic cancers</i>	341	(0.9)	124	(0.5)	465	(0.7)
Total ObGyn Procedures	39,698	(100)	24,479	(100)	64,177	(100)

* Other Essential ObGyn Procedures Include: manual vacuum aspiration, laparotomy for ectopic pregnancy, tubal ligation and hysterectomy for uterine rupture or intractable PPH