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Who accesses surgery at district level in sub-Saharan Africa? Evidence from Malawi and Zambia

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Abstract

OBJECTIVES To examine age and gender distribution for the most common types of surgery in Malawi and Zambia.

METHODS Data were collected from major operating theatres in eight district hospitals in Malawi and nine in Zambia. Raw data on surgical procedures were coded by specialist surgeons for frequency analyses.

RESULTS In Malawi female surgical patients had a mean age of 25 years, with 91% aged 16–40 years. Females accounted for 85%, and obstetric cases for 75%, of all surgical patients. In Zambia, female surgical patients had a mean age of 26, with 75% aged 16–40 years. They accounted for 55% of all cases, 34% being obstetric. Male surgical patients in Malawi were on average older (33 years) than in Zambia (23 years). General surgical cases in men and women, respectively, had a median age of 42 and 32 in Malawi and 26 and 30 in Zambia. The median age of trauma patients was 12 in males and 10 in females in both countries. Children aged 0–15 years accounted for 64–65% of all trauma cases in Malawi and 57–58% in Zambia, with peak incidences in 6- to 10-year-olds.

CONCLUSIONS Women of reproductive (16–45 years) mainly undergoing Caesarean sections and children aged 0–15 years who accounted for two-thirds of trauma cases are the main patient populations undergoing surgery at district hospitals in Zambia and Malawi. Verification and analysis of routine hospital data, across 10–30% of districts countrywide, demonstrated the need to prioritise quality assurance in surgery and anaesthesia, and preventive interventions in children.

keywords surgery, Africa, district level, task-shifting, demography

Introduction

Surgery and surgical patients have for long been invisible in the global health policy arena [1], despite evidence of the inability of rural populations in most sub-Saharan African (SSA) countries to access surgical services [1–4]. However, over the last decade, treatable surgical conditions have gained recognition, as they contribute to 11% of the global burden of disease (BoD) [5–7] and are central to achieving global health goals [8]; much of the burden of surgically avoidable morbidity and mortality in low- and middle-income countries (LMICs) can be tackled [9]. SSA's 25 million surgical disability-adjusted life years (DALYs) represent the highest population burden of surgically avertable DALYs worldwide, at 38/1000 population [1, 7]; however, much is hidden underneath these highline figures. In the absence of population data, surgical BoD estimates rely on hospital admission data [10] and modelling [11]. While evidence is emerging on the types of surgical procedures performed in rural SSA [12], there is a lack of data on the demography of those who undergo surgical procedures in such settings [13], in part due to the lack of reliable data collection systems at district hospitals, where much of the basic emergency and common elective surgery takes place [14].

Routine data on the sex and age distributions of patients undergoing common surgical procedures at district hospitals, which are the usual first point of contact for rural populations [15], are needed to identify target groups who access surgical care. Such data can: identify where investments in staff deployment, training and resources are needed at district hospitals; help evaluate surgical responses; and can identify the need for, inform and help to target prevention strategies [9]. This study aimed to demonstrate the feasibility and potential value from analysing routine district hospital surgical data in two SSA countries. Data for the paper were collected during the evaluation of the Clinical Officer Surgical Training in Africa (COST-Africa) research project [16], 2011–16, funded by the European Union. The project aimed to strengthen the provision of surgery through in-service training and supervision of surgical non-physician clinicians (NPCs) based at district-level hospitals in Malawi and Zambia.

Study setting

Malawi has a population of 18 million, with the highest proportion in SSA, at 84%, of people living in rural areas [17]. A network of 27 government-owned district hospitals and 23 faith-based district-level hospitals provides surgical services to rural areas, where almost all surgery is undertaken by non-physician clinicians (NPCs) termed clinical officers [18, 19]. Four central hospitals in urban areas [20, 21] are staffed by specialist surgeons who manage referred cases and patients who bypass lower-level facilities [22]. Zambia, where 60.5% of its population of 16 million live in rural areas [23], has a network of 103 district-level hospitals, comprising 84 government-owned and 19 faith-based district hospitals [24] that provide first-level surgical care [4]. Because of the greater dispersal of the population, some people travel up to 100 km to reach a surgical facility [25]. Zambia also faces health workforce shortages [26] and uses surgically trained NPCs to deliver much of the district-level surgery [27].

In Malawi, COST-Africa supported the delivery of an in-service BSc in surgery programme to 16 NPC surgical trainees, who were posted in pairs to eight government district hospitals in the southern and central regions, trained by surgical specialists who visited the facilities fortnightly. In Zambia, 10 surgically trained NPCs were deployed to nine district hospitals across nine provinces, where they received 3-monthly in-person supervisory visits from provincial surgical specialists who also provided remote supervision by mobile phone.

Methods

COST-Africa NPCs, who were the lead surgical clinicians at these hospitals, were trained by project researchers to enter data on surgical procedures, collected in each hospital's hard copy major operating theatre register, into a MS Excel template and to transmit the data set monthly to the research team. A surgical procedure was defined as any procedure requiring general, regional or local anaesthesia performed in a major operating theatre [28]. Data were monitored and cleaned, and feedback on data errors was provided to each NPC by local researchers. Training reinforcement was delivered midway through the data collection period in Malawi, but was deemed not necessary in Zambia.

The periods of prospective data collection, 2014–2015, are shown in Table 1. All participating hospitals were visited before the period of data collection ended to ensure that all data on cases undertaken in major operating theatres were captured and to verify the data by comparing hard copy registers with electronic data sets. Raw data were coded by specialist surgeons, using a master list and codebook for all common surgical conditions and procedures presenting to district hospitals in these settings. Analysis was performed using SPSS v 23. The study was approved by the College of Medicine Malawi, University of Zambia and Royal College of Surgeons in Ireland Research Ethics Committees.

Table 1 Hospitals involved in the study and periods of data collection

Malawi January 2014–December 2015 (24 months in all hospitals)		Zambia	
Southern region	Mangochi	North-Western Province	Mwinilunga DH August 14–December 15 (17 months)
	Mwanza		Kalene MH April 15–December 15 (9 months)
	Mulanje	Southern Province	Maamba* DH November 13–August 15 (22 months)
	Nsanje		Choma DH* August 14–December 15 (17 months)
Central region	Dedza	Lusaka Province	Mtendere MH January 14–Aug 1520 months)
	Dowa		Siavonga DH May 15–December 15 (8 months)
	Nkhotakota	Luapula Province	Kasaba MH November 13–October 15 (24 months)
	Mchinji	Central Province	Serenje DH January 15–December 15 (12 months)
		Muchinga Province	Isoka DH June 15–December 15 (7 months)

Results

Overall age and gender distribution

The age distribution in 5-year categories by gender is presented in Figure 1. Females accounted for 84.7% of surgical patients in Malawi and for 55.1% in Zambia; with 91.2% of female cases in Malawi and 74.5% in Zambia in the age categories 16 through to 40 years. This reflects the high volume of obstetric surgery carried out at the district level, with Caesarean sections accounting for a higher proportion of cases in Malawi (43.3%) than in Zambia (27.2%) – see Figure 2. Zambia had a higher percentage of paediatric cases in males aged 0–15 years (48.2%) than Malawi (31.9%), whereas the proportion of surgery in males aged 26–70 years was higher in Malawi (51.0%) than in Zambia (31.1%). Zambia also had a higher proportion of surgery in females in the 0- to 15-year category (30.8%) than Malawi (15.6%).

Categories of surgery

Figure 2 shows the distribution across the three main categories of surgical procedures commonly conducted at the district level in Malawi and Zambia. Obstetric cases accounted for almost three-quarters of surgical procedures in Malawi versus one-third in Zambia, with trauma cases accounting for a threefold higher percentage of cases managed in the major operating theatre in Zambia: 13.2% *vs.* 4.4%. The category 'other' accounted for 43.8% of major surgical cases in Zambia and for 14.5% in Malawi. The most frequent 'other' procedures were foreign body removal (39.2%), debridement/sloughectomy (12.9%) and circumcision (9.2%). Less common (1–6%) were as follows: other major and minor obstetric procedures (unclassified), suturing, cataract removal, other major disability preventive procedures and other major injury-related procedures.

Table 2 shows the percentage breakdown for the most common procedures among the three bellwether categories [29] – obstetric, general and trauma-related surgery in Malawi and Zambia. Among the five types of hernias, inguinal and femoral hernia repairs, together, were the most common, accounting for 87.7% of hernia repairs in Malawi and 79.4% in Zambia.

Age and gender distribution for the three major categories of surgery

Obstetric patients were on average in their mid-twenties, with those in Malawi marginally younger than in Zambia. General surgery cases were on average younger in Zambia, especially among men: mean 29.7 years vs. 41.9 years in Malawi. The mean age of trauma patients was young in both countries, averaging 19–21 years, with a median age of 10 (females) and 12 (males) in both countries (Table 3).

Figure 3 illustrates the breakdown for general surgery and trauma cases in 5-year age categories for males, Figure 4 for females. In Malawi, close to two-thirds of trauma cases managed in the major operating theatre were in children aged 0–15 years, for females (63.6%) and males (65.5%); with 6- to 10-year-olds alone accounting for 37.8% of trauma cases among females and 34.1% among males. A similar pattern of trauma procedures in the paediatric population was found in

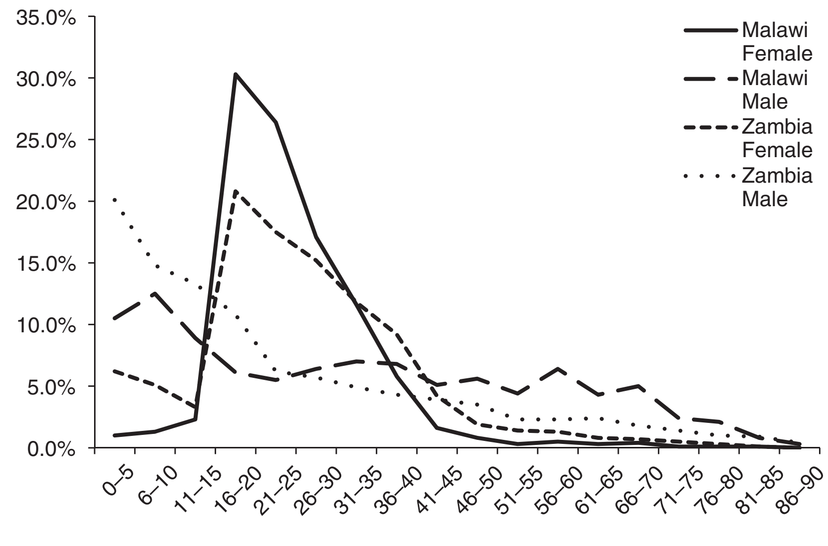

Figure 1 Age and gender distribution of surgical patients in Malawi and Zambia.

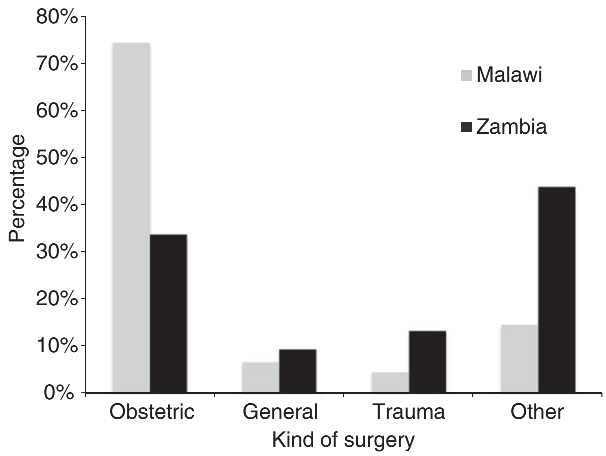

Figure 2 Frequencies of the three main categories of surgical procedures in Malawi and Zambia.

Zambia: females aged 0–15 years accounting for 57.7%, and girls aged 6–10 years for 31.7%; males aged 0–15 years comprising 57.1%, and boys aged 6–10 years 28.9%. Adults aged 21–55 years accounted for 17.0% of trauma cases undergoing procedures in the major theatre among females in Malawi and 20.0% among males, whereas in Zambia, 21- to 55-year-old patients accounted for a somewhat higher percentage of such procedures among females (29.2%) and males (29.1%).

The demographic patterns for general surgery were not so marked. In Malawi, 62.6% of general surgery cases in women were in the age range 16–40 years, *vs.* 52.0% in Zambia. Among men, general surgery in Malawi was most common among older men (60.9%, 35–60 years); while in Zambia, there was no noticeable concentration of general surgery cases across the different age categories of male adults. In Zambia, there was an early peak in general surgery, especially in males: 26.0%, in 0- to 5-year-olds and 10.7% in 6- to 10-year-old males; and a peak of 15.5% in females aged 0–5 years. In Malawi, there was a more modest peak in males aged 0–5 years (7.8%) but not in females (Figures 5 and 6).

Age and gender distribution for two index surgical procedures

In Malawi, hernia repairs in males and females were widely distributed across the age categories, with a peak of 13.4% in women aged 31–35 years and another in those aged 56–60 years. In Zambia, 27.3% of hernia repairs in females and 29.5% in males were in children aged 0–5 years, with over 40% of hernias in Zambia in 0- to 15-year-olds. Most manipulations under anaesthesia of fractures were in children, with little difference in distribution by gender: 68.1% girls and 67.3% boys in Malawi; 57.2% girls and 62.0% boys in Zambia.

Table 2 Percentage distribution of the most common surgical procedures in Malawi and Zambia

Obstetric Surgery Malawi *n* = 21 089 Zambia *n* = 2123	General Surgery Malawi *n* = 1861 Zambia *n* = 589	Trauma-related surgery Malawi *n* = 1244 Zambia *n* = 837
Caesarean section	Emergency and elective Inguinal/femoral hernia	Manipulation under anaesthesia (MuA) for open fracture
Malawi *n* = 63.2%	Malawi *n* = 56.6%	Malawi *n* = 15.1%
Zambia *n* = 81.8%	Zambia *n* = 49.1%	Zambia *n* = 6.9%
Hysterectomy	Umbilical/incisional/epigastric hernia	MuA (closed fracture)
Malawi *n* = 2.6%	Malawi *n* = 8.0%	Malawi *n* = 71.4%
Zambia *n* = 3.8%	Zambia *n* = 12.7%	Zambia *n* = 85.1%
Repair of ruptured uterus	Exploratory laparotomy	Other major trauma-related procedures:
Malawi *n* = 0.7%	Malawi *n* = 11.9%	Malawi *n* = 13.5%
Zambia *n* = 0.5%	Zambia *n* = 22.1%	Zambia *n* = 8.0%
Salpingectomy	Hydrocoele repair	
Malawi *n* = 0.8%	Malawi *n* = 23.6%	
Zambia *n* = 2.2%	Zambia *n* = 16.1%	
Tubal ligation		
Malawi *n* = 5.3%		
Zambia *n* = 10.5%		
Evacuation of uterus		
Malawi *n* = 27.5%		
Zambia *n* = 1.2%		

Table 3 Mean age in three main categories of surgical procedures in Malawi and Zambia by gender

Age in years			Obstetric surgical patients	General surgical patients	Trauma surgical patients
Malawi	Female	Mean	24.7	33.9	19.2
		Median	23	32	10
		SD	6.8	17	19.3
	Male	Mean		41.9	17.7
		Median		44	12
		SD		21.3	15.8
Zambia	Female	Mean	26.1	29.7	21.4
		Median	24.0	30	10
		SD	7.9	18.7	19.7
	Male	Mean		29.7	18.3
		Median		26	12
		SD		25.3	15.6

Discussion

This article contributes to the growing body of evidence about surgery in SSA, which is needed to establish country-specific priorities and inform strategies for countries who are not yet tackling their surgical burden of disease [8, 30]. It adds to the published literature [9] by reporting data from district hospitals, which are the cornerstone of essential surgical services in SSA, yet are rarely reported in the literature. This paper goes beyond providing frequency distributions of types and volume of surgery, which has characterised descriptive studies in LMICs [9], to analyse the age and gender patterns of patients who underwent surgical procedures in the major operating theatres in district hospitals. Such information can enable national managers to target, quality-assure and evaluate the impact of surgical services [9] and provide pointers to where research is needed on modifiable risk factors for the design of preventive interventions [31]. These data could also be useful to monitor and compare the numbers of patients accessing surgical services with incidence rates, where these are available, so as to target demand-stimulation activities. This points to need for research on incidence rates to strengthen the evidence base for policy and practice. While facility-based data have inherent limitations, the results are based on verified routine operating theatre data collected in 30% of Malawi's district hospitals over 2 years and for 6–26 months in 10% of Zambia's district-level hospitals that have the capacity to serve large proportions of these countries' populations.

Two-thirds of all major surgical cases undertaken at the district level in Malawi and one-third in Zambia were females in their mid-twenties obtaining emergency obstetric care; neither country has met the WHO-recommended 10–15% of deliveries by Caesarean section [22, 32]. Building surgical capacity to manage rising obstetric demand requires investments in infrastructure [4, 20], training and supervision of district hospital staff [33]. In Zambia, the higher proportion of general surgical procedures and the more diverse set of surgical procedures, categorised as 'other', suggest a greater capacity to

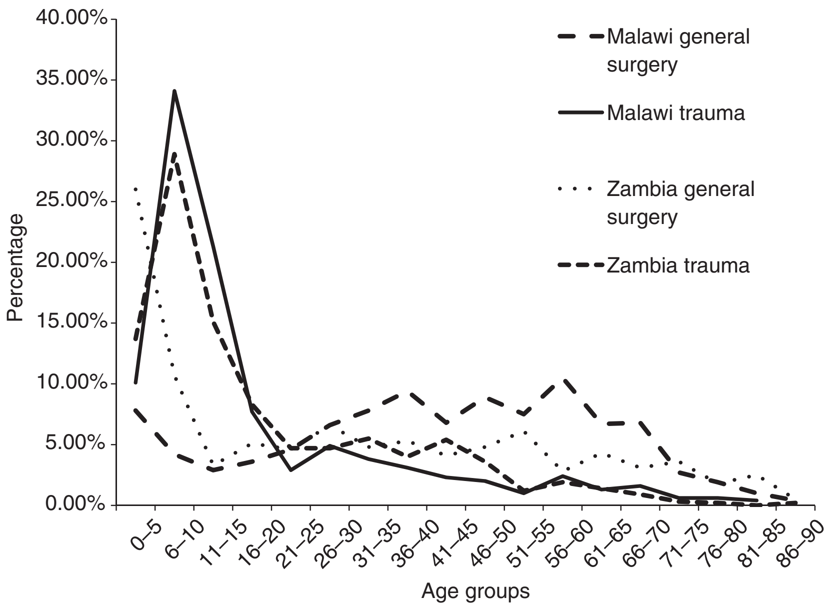

Figure 3 Age distribution for general and trauma surgery in Malawi and Zambia in males.

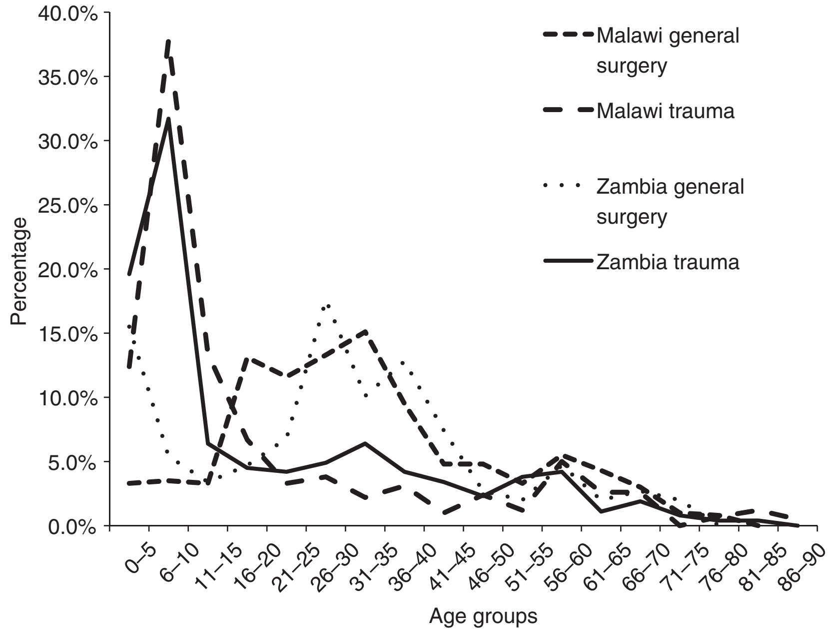

Figure 4 Age distribution for general and trauma surgery in Malawi and Zambia in females.

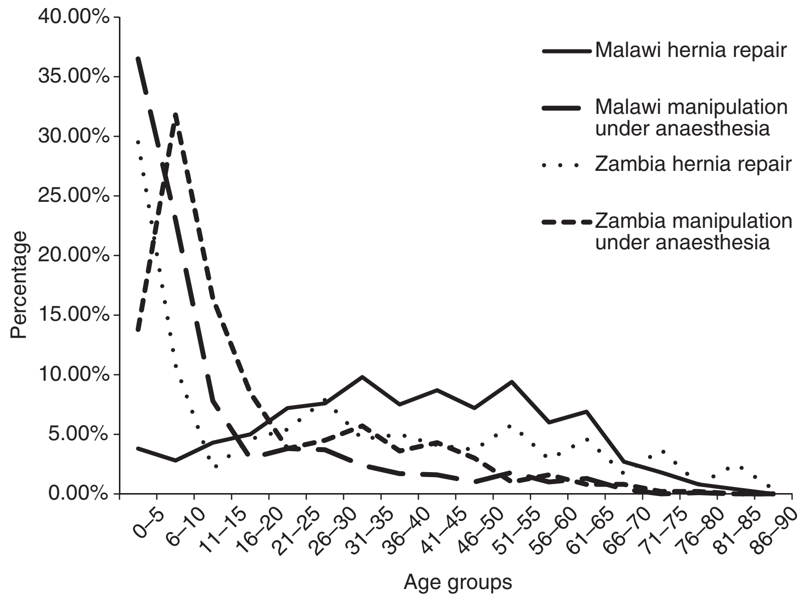

Figure 5 Age distribution for inguinal/femoral hernia repairs and manipulation under anaesthesia in Malawi and Zambia in males. Majority of hernias were inguinal 92%, with 8% of femoral (emergency and elective cases combined).

deliver a broader range of surgical procedures at Zambia's district-level hospitals. These are often far from referral hospitals and staffed by surgically active NPCs who have more surgical training and experience than NPCs in Malawi [26, 34, 35]. Zambia's NPCs work alongside Medical Officers who could support decisions to undertake surgery at the district level [35]. In Malawi, district hospital surgical care relies mainly on clinical officers [36], only some of whom have received formal surgical training [37].

The age profile of surgical patients in both countries indicates that trauma and general surgical procedures are most commonly undertaken on the youngest sections of the population that have not yet entered the labour market [38], and also in the economically productive age groups. This corresponds with research from Malawi and

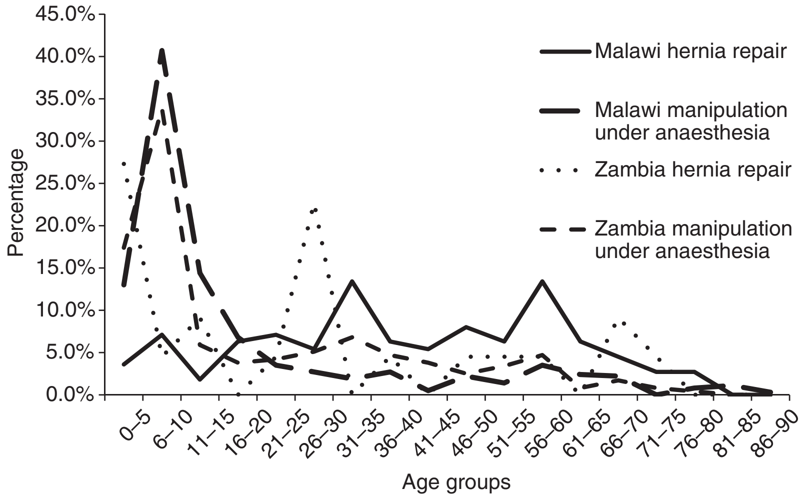

Figure 6 Age distribution for inguinal/femoral hernia repairs and manipulation under anaesthesia in Malawi and Zambia in females. Majority of hernias were inguinal 92%, with 8% of femoral (emergency and elective cases combined).

Sierra Leone [13] and the global burden of disease [39]. However, almost overshadowed by the high burden of emergency obstetric surgery was the remarkably high proportion of trauma procedures in 0- to 15-year-old girls and boys, accounting for 65% of all selected trauma cases in Malawi and 57% in Zambia. The 17% of trauma procedures in females aged 21–55 years in Malawi, and 20% in males, was little more than half of the 38% trauma procedures in 6- to 10-year-old girls and 34% in boys. Manipulation of fractures under anaesthesia accounted for most such procedures, where children aged 0–15 years accounted for over two-thirds of all such procedures in Malawi and between half and two-thirds in Zambia. This high burden of trauma in young children is consistent with empirical studies from the region [40–43], although equally high burdens in girls as boys are not usually reported [44–46]. The somewhat higher level of trauma surgery in adults in Zambia may reflect a more mobile population at greater risk of road traffic accidents [47].

It is among young children that more detailed investigation and interventions are particularly needed to manage and prevent injuries that account for a higher population BoD than is caused by HIV, tuberculosis and malaria combined [48]. Ministries of Health and specialist surgeons and anaesthetists at referral hospitals need to ensure that there is adequate capacity at district hospitals, to safely deliver paediatric surgery. While routine data in our study identified the basic demography (age and sex) of patients and the procedures carried out at district hospitals, population and community studies are required to collect accurate data on incidence rates and risk factors, respectively, so as to design of preventive interventions.

Our study demonstrated that routine district hospital operating theatre registers in two SSA countries contain demographic data (age and sex) of the population groups undergoing common major surgical procedures. Such routine data are currently underused. Given the limitations of household data pertaining to this burden, routine district hospital data should be used, both to monitor epidemiological patterns and to evaluate the functionality of operating theatres, as a key performance indicator (KPI) for the district hospital. Translating such data into surgical intelligence could assist in channelling resources and training for safe surgery and anaesthesia to meet the needs of the target groups that these hospitals serve. In this study, a research project (COST-Africa – see www.costafrica.eu) was providing training and supervision to ensure quality surgery, which was likely to have affected the types of cases undertaken. In other settings where in-service training and supervision are not available – which is the norm [9] – the high need and reliance of this paediatric population on district-level surgery should be a cause of concern.

Particular steps were taken in this study to ensure high-quality data. These included training and supervision of district hospital NPCs in data collection, data cleaning with feedback on data errors to data collectors and hospital visits to ensure that all sources of data were being captured and to validate data. By attempting little more than to ensure the validity and reliability of the operating theatre register data currently collected in typical African district hospitals, and translating the data into useful information, this study showed the potential for large-scale monitoring of surgical care by rural populations in Africa with the aim of improving quality of care and to make inroads towards reducing avoidable morbidity and mortality.

The definition of a surgical procedure in this study was one that took place in a district hospital major operating theatre (OT) and was therefore captured in the major OT register. The study did not include the surgical procedures that took place in minor theatres, in accident and emergency and in outpatient departments. This is an important limitation because for a number of common procedures – for example manipulations of fractures, suturing, debridement and (in the case of Zambia) evacuations of the uterus – the study did not capture the unknown numbers and proportions of these procedures that took place outside of the major OTs.

The decision about what would be considered major surgical cases for this study was based on the pragmatism of data collection in low-resource, rural settings. In the attempt to ensure completeness of data collection across hospitals and to maximise data quality (reliability), we limited data collection to surgical cases undertaken in the main operating theatre, tasking trained data collectors to prospectively enter data in the hard copy of a tool designed for this purpose. While the recording, transfer, entry and transmission of such data was an additional activity for surgical staff, consequent limitations are – in our view – outweighed by the importance of reporting on surgical cases collected from routine OT registers. Such data signal the types and volume of cases deemed by district staff as of sufficient seriousness as to require anaesthesia and intervention in a major OT, and provide a useful insight into who gets access to surgical services in rural Africa.

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