The scope of operative general paediatric surgical diseases in South Africa

- The Chris Hani Baragwanath Experience

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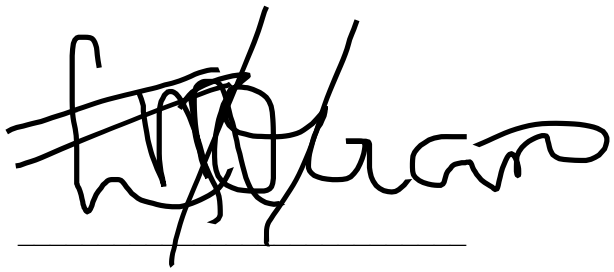
DECLARATION

I, Maame Tekyiwa Botchway, student number 1596010 declare that this research report is my original work and is being submitted for the degree of Master of Medicine within the Department of Paediatric Surgery at the University of the Witwatersrand, Johannesburg.



Maame Tekyiwa Botchway

March 2021

DEDICATION

I dedicate this work to my dearest husband, Rev Nii Laryea Botchway, whose encouragement; support and unconditional love are comparable to none. I am truly blessed to have you in my life.

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I would like to acknowledge the following persons for helping make this work a reality:

1. My supervisors: Associate Prof Deirdre Kruger and Dr Andrew Grieve for guiding me through the process.

2. Mr Charles Adjei Manful for helping with the statistical work.

3. Colleague paediatric surgical registrars for giving me their logbooks to cross reference my data.

PUBLICATIONS AND PRESENTATIONS ARISING FROM THIS STUDY

Manuscript has been published in the Annals of Paediatric Surgery. (attached in appendix).

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Background: Infectious diseases have always been the limelight of global health with very little focus on childhood surgical conditions even though children constitute about half of the population in Low- and Middle-Income Countries (LMICs). A significant proportion of the burden of global disease can be reduced by surgical intervention.

Methods: A retrospective cross-sectional descriptive study analysing theatre logbook data as at the Chris Hani Baragwanath Academic Hospital (CHBAH) over a one-year period (2017).

Results: There were 1699 operative general paediatric surgical procedures of which 61.7% were elective and 38.3% emergencies. Of these, surgeries for congenital anomalies were performed in almost all the subspecialties.

Conclusion: There is a high operative paediatric surgical burden at the Chris Hani Baragwanath Academic Hospital. Congenital anomalies are ranked one of the five leading causes of under-five mortality thus operative interventions will significantly reduce under-five mortality. Therefore, the role of Paediatric Surgical care as an essential component of global health cannot be under rated.

Keywords: Paediatric Surgical Diseases, congenital anomalies, operative burden, South Africa, Global Surgery

INTRODUCTION

Africa constitutes less than one-fifth of the world's population yet contributes 25% of the global burden of disease.[1] While children under the age of 15 years make up 26% of the world's population, they make up 43% of the population in sub-Saharan Africa. Furthermore, it is estimated that the population of many African countries will at least double by 2050, with Africa's youth rising to 35% of the world youth total by then.[1] Surgical conditions account for 6-12% of all paediatric visits and contribute to up a third of all childhood mortalities.[2] According to Bickler's group about 90% of children living in low- and middle-income countries (LMIC) will have a surgically treatable condition by the age of 15 years,[2] and, if not treated, it can cause severe morbidity and mortality.[3] Surgical conditions thus play a significant role in the overall burden of paediatric disease in LMICs. Recently, Butler's group used population data from four LMICs and concluded that there is a high burden of unmet surgical need, with almost 20% of children requiring surgery and 62% of those children having at least one unmet surgical need.[4]

Despite its importance, little attention is given to paediatric surgical care in LMICs. Until recently, paediatric surgical care was '*the neglected stepchild of global health*' and, as it was not considered an essential service, excluded in many funded programs both nationally and internationally.[3] Paediatric surgical care is generally seen as an expensive specialty due to the peculiar surgical conditions, distinct anaesthetic challenges and unique perioperative needs. Moreover, the care of these children could be lifelong and require frequent follow up until adulthood.

There is a significant volume of operative procedures globally with an estimation of 312.9 million operations in 2012.[6] Due to the socioeconomic conditions in resource constrained LMICs, differences exist between LMICs and high-income countries in the patterns of disease and the practice of paediatric surgical care.[3] Despite the perceived burden of paediatric surgical diseases in LMICs countries, there is scarce epidemiological data making it difficult to assess the actual surgical burden of the paediatric population.[7]

In a review of the paediatric surgical workforce in South Africa in 2017, Dell found that there were only 5.55 paediatric surgeons per one million population under 14 years of age, with an average age of 39.5 years and 55% male.[8] These figures fell far below developed countries such as the United States of America (USA) of one paediatric surgeon to approximately one hundred and eight thousand children as at 2006.[8.]

South Africa is one of the pioneers of the practice of paediatric surgery in Africa. Nevertheless, a dearth of specialist paediatric surgeons in South Africa is a major obstacle in the effective delivery of paediatric surgical care. In 2018, Dell reported 0.80 paediatric surgeons per million total populations in South Africa, with four provinces in the country not having one, compared to 8.20 paediatric surgeons per million total populations in the USA.[8] This falls short of the one paediatric surgeon per 500 000 population recommended internationally.[9]

The Chris Hani Baragwanath Academic Hospital (CHBAH) in Soweto, Johannesburg, is making giant strides in the provision of paediatric surgical services in the State public sector. It is the biggest hospital in the southern hemisphere and fourth largest in the world. Its main catchment area is in Soweto serving a local population of over three million people.[10] CHBAH also acts as a major referral centre for the Gauteng Province and neighbouring provinces.

The Paediatric Surgical Unit of CHBAH is a highly specialised, managing complex cases. There are two theatres dedicated to the paediatric surgical unit at the CHBAH (a neonatal theatre and a general paediatric theatre).

Elective operative procedures are performed four times a week at the neonatal theatre and three times a week at the general paediatric theatre. Emergency surgery is performed anytime of the day and week, pending availability of an anaesthetist. The large population CHBAH serves coupled with multiple referrals and limited resources makes theatre days very busy with many cold (elective) cases waiting.

Few studies, if any, have investigated the burden of operative paediatric surgical procedures in South Africa. Therefore, this study aimed to look at the scope of operative paediatric surgical procedures at CHBAH, and reports on the number and nature of elective and emergency procedures over a 12-month study period.

METHODS

Operative data over a 12-month study period from January 2017 to December 2017 were retrospectively collected from theatre logbooks at the Paediatric Surgical Unit of the CHBAH. Demographic details (name, age, sex) and clinical data (name of operation, nature of operation) are recorded into the logbook by the theatre nurse. These books are subsequently kept in theatre and audited at the end of the year.

To ensure accuracy and avoid missing data points, data was cross referenced with the monthly statistics of the Unit as well as operative logbooks of colleague paediatric surgical registrars. Since all registrars are supposed to log every operative procedure they are involved in, cross referencing will help in filling in any missing data from the logbooks.

As per the admission age cut-off of the CHBAH Paediatric Surgical Unit, all patients 10 years old and younger were included in our study. Burn operative procedures were excluded from the study cohort because burns are managed by plastic surgeons in other hospitals in South Africa such as the Red Cross Memorial Children's Hospital.

Demographic and clinical data (such as date of procedure, age, gender, nature of procedure and nature of procedure) were extracted unto a data collection sheet. Data collected was captured into a Microsoft Excel (2016) spreadsheet and subsequently imported into, and analysed using, STATA version 15.0 (StataCorp) Descriptive data was generated from the analysis.

Ethical approval was obtained for this retrospective, cross-sectional, descriptive study from the Human Research Ethics Committee (Medical) of the University of the Witwatersrand (Certificate number M180406).

RESULTS

The demographic and clinical characteristics of the study cohort are shown in Table 1. A total of 1699 procedures were performed over the one-year study period. The median age for the study cohort was 1 year with an interquartile range (IQR) of 0-4 years and a male: female ratio of 1.5:1. Most of the procedures were performed in children under 5 years (76.6%).

Table 1 Demographic and clinical characteristics of paediatric surgical patients, CHBAH, 2017 (n=1699)

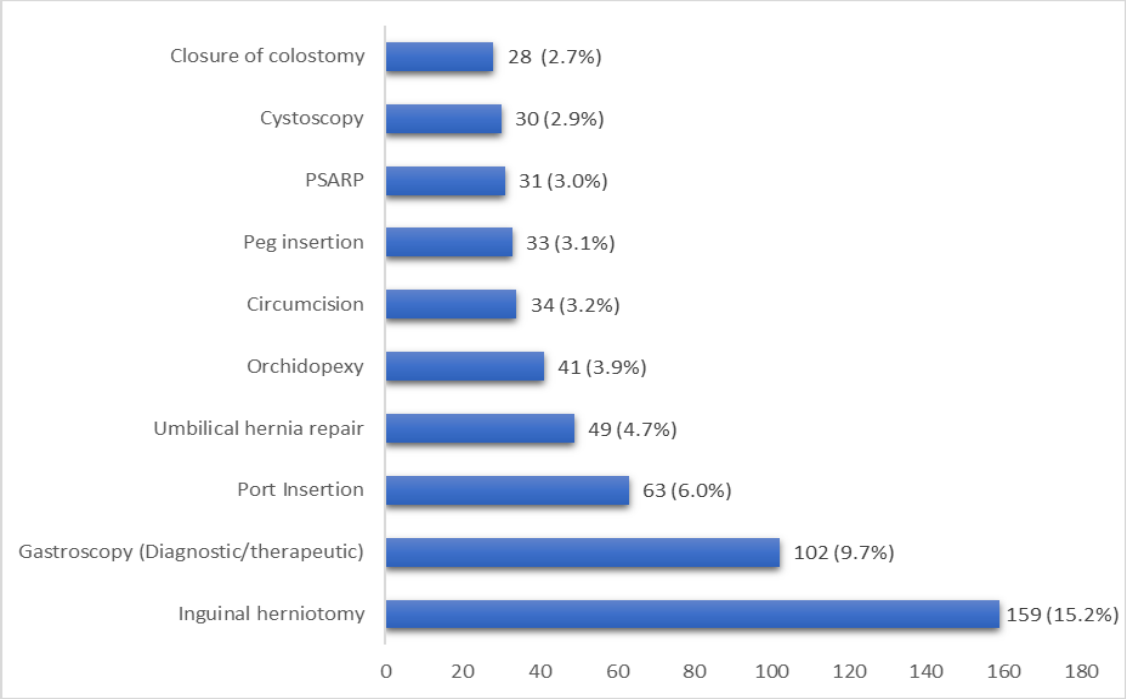
Parameters	All procedures	Paediatric Surgical Procedures	
		Elective	Emergency
Surgery type, n (%)	1699 (100)	1049 (61.7)	650 (38.3)
Age, years (IQR)	1.0 (0.0 – 4.0)	2.0 (0.0 – 4.0)	1.0 (0.0 – 4.0)
Age groups, n (%)			
<28 days	246 (14.5)	48 (4.6)	198 (30.5)
28 days – 12 months	446 (26.3)	322 (30.7)	125 (19.2)
1 year – 5 years	609 (35.8)	434 (41.4)	174 (26.8)
5 – 10 years	398 (23.4)	245 (23.4)	153 (23.5)
Male sex, n (%)	1029 (60.6)	676 (64.4)	353 (54.3)

Abbreviation: IQR, interquartile range;

Procedures performed

Out of the 1699 procedures performed, 1049 (61.7%) were elective procedures and 650 (38.3%) were emergencies procedures. Of the elective procedures, inguinal herniotomy was the most frequent procedure performed (27.8%), followed by diagnostic or therapeutic gastroscopy at 17.9% (Figure 1).

Incision and drainage of abscesses (22.4%) was the most frequent emergency procedure performed, followed by rigid oesophagoscopy (15.9%) (Figure 2).



Abbreviations: PSARP, Posterior Sagittal Anorectoplasty

Figure 1. Ten most common elective paediatric surgical procedures

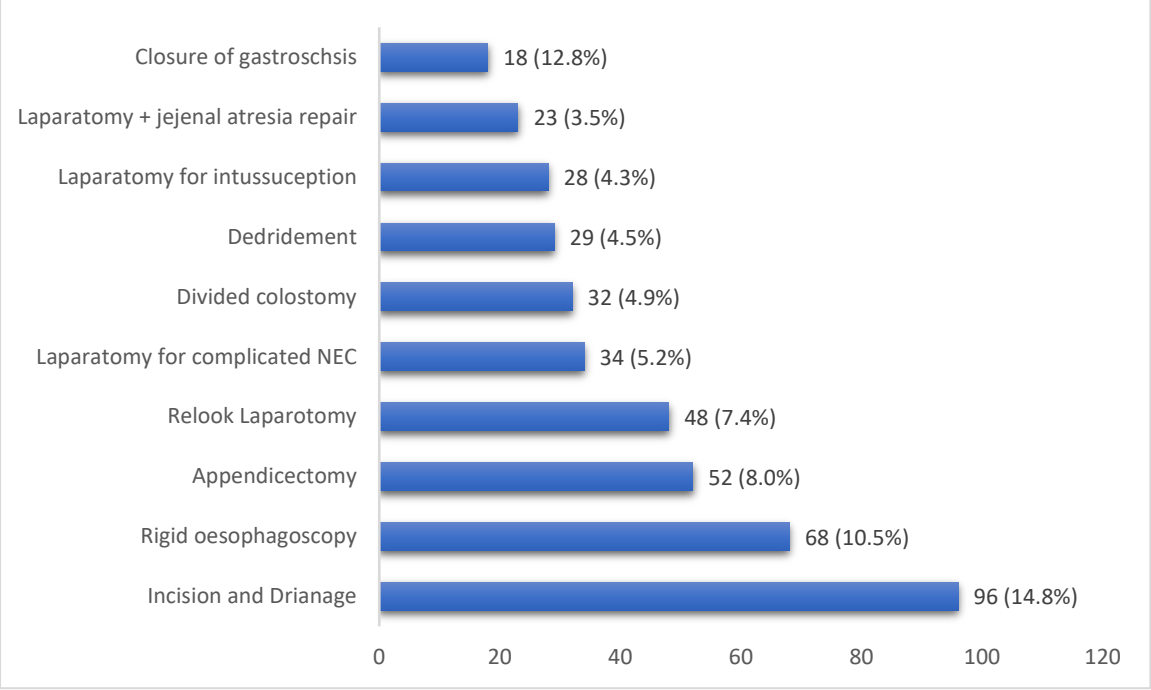


Figure 2. Ten most common emergency paediatric surgical procedures

Paediatric surgical procedures by gender

Inguinal herniotomy was the most common procedure performed in males (14.1%), (Figure 3), whereas gastroscopy was the most common procedure performed in females (30.2%), (Figure 4).

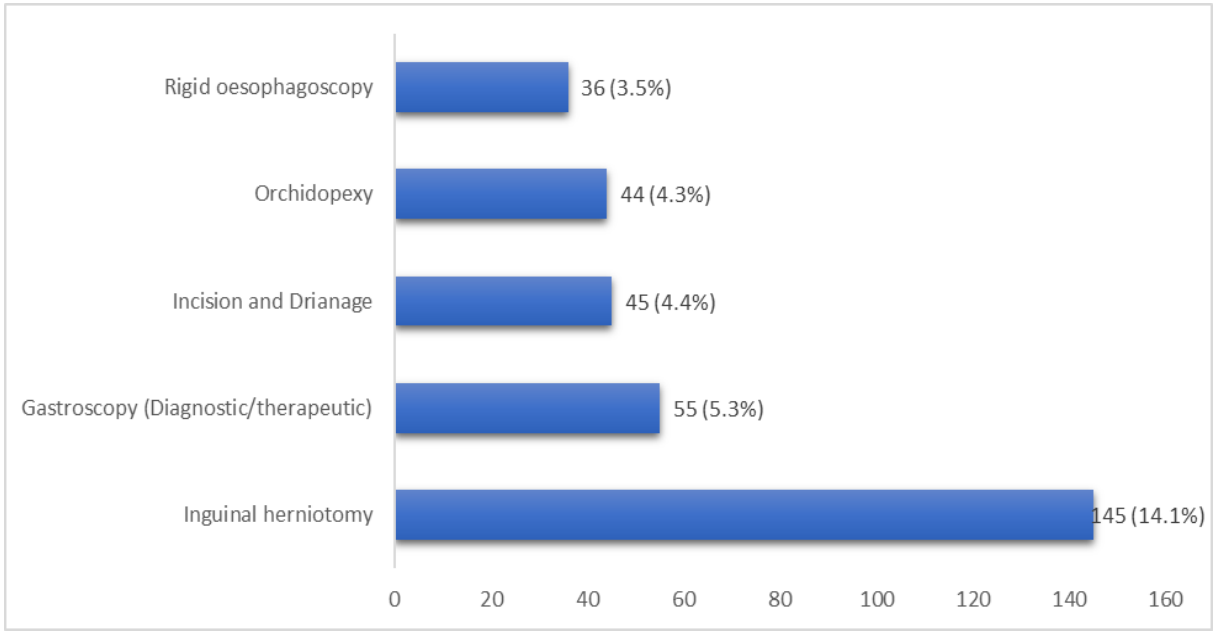


Figure 3: Five commonest procedures in males

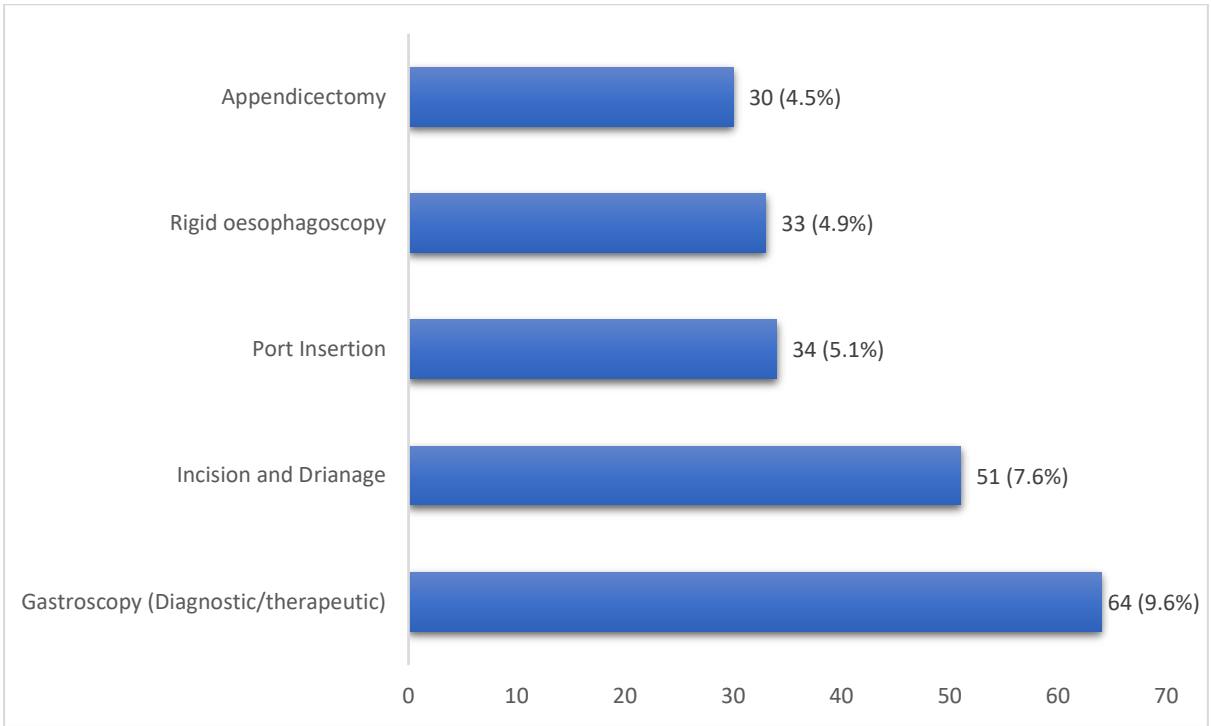


Figure 4: Five commonest procedures in females

Paediatric surgical procedures by age

A laparotomy for complicated necrotising enterocolitis (25.2%) and divided colostomy (25.2%) were the most common procedures performed in neonates. Inguinal herniotomy was frequently performed in children under one year old. Appendicectomy was the most common procedure performed in the older age group (5years – 10years).

Table 2. Most common paediatric surgical procedures by age group

Age group	Commonest procedure	n (%)
< 28 days	Laparotomy for complicated NEC and divided colostomy	60 (3.5)
28 days - 12 months	Inguinal herniotomy	77 (4.5)
1 year - 5 years	Gastroscopy (diagnostic/therapeutic)	51 (3)
5 years - 10 years	Appendicectomy	46 (2.7)

Abbreviation: NEC, necrotising enterocolitis.

Procedure by Subspecialty

Gastrointestinal tract (GIT) surgery was the most common procedure performed in this study (49.5%), followed by general paediatric surgical cases (26.0%) (figure 5). Procedures less frequently performed were for oncological and hepatobiliary conditions.

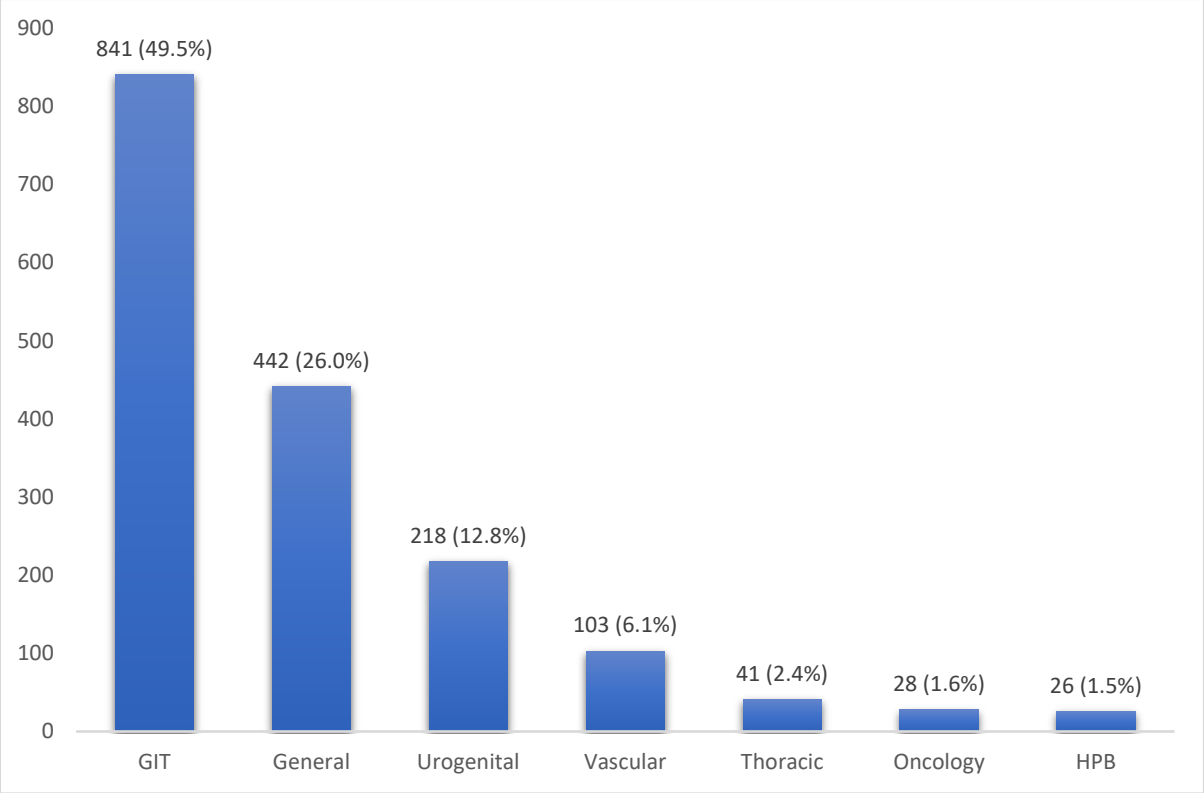


Figure 5 Most common paediatric surgical procedures per subspecialty

Table 3 shows the paediatric surgical procedures per subspecialty. Most (14.1%) of GIT cases were gastroscopy (diagnostic/therapeutic). Inguinal herniotomy was the most prevalent (35.7%) general cases. About two-thirds (61.2%) of vascular procedures were port insertion. More than half of HBP procedures were Kasai portoenterostomy.

Table 3. Most common paediatric surgical procedures per subspecialty category

Category Key procedure	n (%) of all procedures	% of category
GIT	**841 (49.5)**	
Gastroscopy (diagnostic/therapeutic)	119 (7.0)	14.1
Rigid oesophagoscopy	69(4.1)	8.0
Appendicectomy	53(3.1)	6.3
Relook laparotomy	48(2.8)	5.7
Divided colostomy	39(2.3)	4.6
General	**442 (26.0)**	
Inguinal herniotomy	158 (9.3)	35.7
Incision and drainage.	96 (5.7)	21.7
Umbilical hernia repair	49(28.9)	11.1
Debridement	29(1.7)	6.6
Excision biopsy	26(1.5)	5.9
Urogenital	**218 (12.8)**	
Orchidopexy	44 (2.6)	20.2
Circumcision	36 (2.1)	16.5
Cystoscopy	30(1.8)	13.8
Hypospadias repair	20(1.2)	9.2
Cauterisation of genital warts	18(1.1)	8.3
Vascular	**103 (6.1)**	
Port insertion	63 (3.7)	61.2
Port removal	32 (1.9)	31.1
Above knee amputation	4(0.2)	3.9
Quinton line insertion	2(0.1)	1.9
Thoracic	**41 (2.4)**	
OA/TOF repair	17 (1.0)	41.5
Rigid bronchoscopy	10 (0.6)	24.4
Repair of CDH	3(0.2)	7.3
Aortopexy	2(0.1)	4.9
Laryngoscopy+ removal of coin	2(0.1)	4.9
Oncology	**28 (1.7)**	
Nephrectomy	7 (0.4)	25

Excision of sacrococcygeal teratoma	4 (0.2)	14.3
Excision of adrenal mass	2(0.1)	7.1
Right orchidectomy	2(0.1)	7.1
HPB	**26 (1.5)**	
Kasai portoenterostomy	15 (0.9)	57.7
Open liver biopsy	5 (0.3)	19.2
OTC + liver biopsy	5 (0.3)	19.2

Abbreviations: CDH, congenital diaphragmatic hernia; GIT, gastrointestinal tract; HPB, hepatopancreatobiliary; OA/TOF, oesophageal Atresia with tracheooesophageal fistula; OTC, on table cholangiography

DISCUSSION AND CONCLUSION

There is scarcity in the literature on paediatric surgical conditions in sub-Saharan Africa with even more scanty data on operative paediatric surgical conditions[4]. South Africa is no exception even though it houses the largest hospital in the southern hemisphere. This study gives a good insight to the scope of operative paediatric surgical conditions at the CHBAH. of

Our cohort of 1699 surgeries performed during our 12-month study period confirms the high demand of paediatric surgical care.[12] The male preponderance in the study is in keeping with other literature. [5,13]

Children living in Africa are affected by a broad spectrum of surgical conditions categorized under injuries, congenital anomalies, surgical infections and tumour.[5] In sub-Saharan Africa, the bulk of paediatric surgical admissions needing surgical intervention were due to injuries, congenital anomalies and infections.[14] In our audit, the common diagnostic categories needing intervention were mainly congenital anomalies, surgical infections and tumours. Trauma was not that common because most of them are usually managed conservatively without needing operative intervention.[15, 16] In this study, congenital anomalies ranked top in almost all the sub-specialties of paediatric surgical procedures. This finding is in keeping with available data and our study therefore supports the view that congenital anomalies make up most paediatric surgical procedures in sub-Saharan Africa.[3,5] This is not surprising since globally, congenital anomalies took 14th position in the overall burden of diseases with DALYs of 52 billion.[17] Common congenital anomalies operated on as elective cases were inguinal hernias, umbilical hernias and undescended testes. The latter is in keeping with a study by Abantanga and Amaning in 2002 that reported on elective paediatric surgical admissions at a referral center in Kumasi, Ghana.[18]

In a study on the scope of emergency paediatric surgical cases seen at a teaching hospital in Tanzania over a one-year period,[19] the authors reported that of the 414 paediatric operative procedures performed, 74% were elective and 26% were emergency procedures, and the two most common emergency procedures were for bowel obstruction and peritonitis. From our study, emergency operative procedures accounted for 38.3% of the total procedures performed and, in contrast to the above-mentioned study, our two most common procedures were incision & drainage for abscesses and rigid oesophagoscopy for ingested foreign body material.

Neonatal surgery has the likelihood of being a cost effective health intervention considering the fact that these conditions have no alternative form of management but surgical.[20] During

the era of the Millennium Development Goals, there was a significant global reduction in mortality for children under five years old with neonatal mortality however lagging behind [21, 22]The third Sustainable Development Goal (SDG) aims to "*end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1000 live births and under-5 mortality to at least as low as 25 per 1000 live births by 2030*."[23] The actual burden of neonatal surgical diseases in Africa is not known. A survey in Africa however revealed that neonatal surgical diseases contribute to about 10 to 20% of the workload of paediatric surgeons in this region.[20] This is confirmed in our study where 14% of the surgeries performed in the cohort were due to neonatal conditions. The little literature available shows that the workload of neonatal surgery in major referral centers in sub–Saharan Africa has very little variation.[24] In a study by Ameh looking at Neonatal Surgery in Africa, fifty percent of the 626 neonatal procedures performed at the Jos University Teaching hospital in Nigeria over a 10-year period (January 2001-December 2010) were emergency procedures.[25] In the same study, 40% of the 516 neonatal surgeries performed over a 10-year period at the Ahmadu Bellow University Teaching Hospital also in Nigeria were emergency procedures.[25] The difference in proportions is quite wide in our study with 80.5% of the 246 procedures performed during the study year. There are so many reasons for this increased number. The spectrum of cases in their study was similar to the common neonatal conditions operated on in our study. Congenital anomalies still ranked top in these conditions. A major limitation of our study is its retrospective nature. Some of the information may not have been reported and even if recorded there is the issue of reporting bias.

Our study gives a good perspective on the scope of operative paediatric surgical conditions in Johannesburg. Most of the procedures performed were for congenital anomalies. This is not surprising because congenital anomalies are one of the leading causes of under 5 mortality globally thus contributing significantly to the burden of paediatric surgical diseases. Children with congenital anomalies such as jejunal atresia and anorectal malformations are still alive due to the procedures they had. It is therefore imperative to strengthen paediatric surgical services especially in LMICs to achieve the third Sustainable Development Goal.

In conclusion, even though the practice of Paediatric Surgery is advancing globally, there is still a deficiency in paediatric surgical care in LMICs carrying a significant burden of disease,

especially in children. Even though the disease burden may be similar across sub-Saharan Africa, the scope of paediatric surgery may be different between institutions, as well as from one country to the next country.

Further research needs to be done in other teaching hospitals in Johannesburg and South Africa to better determine the operative paediatric surgical burden nationally. This will form a basis of good evidence to policy makers and Non-Governmental Organizations (NGOs) on the need to include paediatric surgery in funded programs.

There is also the need for other researchers and clinicians in LMICs to look at the scope of paediatric surgical conditions in each region and explore the barriers to providing effective and efficient paediatric surgical care.

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None

Conflicts of interest

None

Presentations

None

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APPENDIX A: APPROVED PROTOCOL

Operative logbook data as a proxy for the scope of operative general paediatric surgical diseases in South Africa - The Johannesburg Experience.

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INTRODUCTION/BACKGROUND

Africa makes up less than one-fifth of the world's population but carries 25% of the global burden of disease (Population Reference Bureau, 2018). The latter may be attributed to poverty, illiteracy, civil conflicts and poor leadership. Moreover, the life expectancy at birth in South Africa is 62.9 years, compared to 71.4 years globally (WHO, 2015). Where children under the age of 15 years make up 26% of the world's population, they make up 43% of the population in sub-Saharan Africa. Furthermore, it is estimated that the population of many African countries will at least double by 2050, with Africa's youth rising to 35% of the world youth total by then (Population Reference Bureau, 2018). Findings from the 2013 Global Burden of Disease Study (Kyu, Pinho et al. 2016), showed that among children and adolescents the leading causes of death for countries in sub-Saharan Africa were diarrheal diseases, HIV/AIDS and malaria.

It has long been suggested that surgical conditions play a crucial role in the overall burden of disease in children in developing countries (Loeffler, 1988), but only recently has the global burden of paediatric surgical disease received growing awareness (Poenaru 2016). Generally, paediatric surgery is poorly defined in many developing countries with vast differences in the practices of paediatric surgery between developing and developed countries (Bickler & Rhode, 2002). There has been a reduction in morbidity and mortality through great advances in operative techniques, anesthetic skills, and medical advancement over time. (Raval et al, 2011, Bruny et al, 2013).

Nevertheless, the global burden of disease in children is striking with close to 90% of children residing in low-income and middle-income countries (LMIC) having a surgically treatable condition by 15 years of age (Weiser et al, 2008). Bickler's group (Bickler et al., 2001) noted that only 50% of children who suffered a surgically treatable condition benefited from surgical care, thus resulting in a massive unoperated population experiencing persistent morbidity and often mortality due to inadequate access to surgical health care. Recently, Butler's group used population data from four LMIC countries to estimate the paediatric surgical needs and concluded that there is a high burden of unmet surgical need, where almost 20% of children required surgery yet 62% of those children had at least one unmet surgical need (Butler, Tran et al. 2017). Furthermore, the authors reiterated the large deficiency in trained paediatric surgeons with many countries lacking any.

In an earlier study from Sierra Leone, the lack of infrastructure and other resources for paediatric surgery contributed to the gap in provision of surgical care (Kushner, Groen et al. 2012). Similarly, upon assessment of the capacity of paediatric surgery in 10 countries in West

Africa, Okoye's group reported that half of the teaching hospitals they looked at couldn't boast of having at least two qualified paediatric surgeons. They therefore concluded that most hospitals in West Africa could not effectively provide paediatric surgical care services (Okoye et al., 2015).

Chirdan et al. (2010) investigated how delivery and training challenges affected Paediatric Surgical Units in Africa. According to them, Africa lacks paediatric surgeons in comparison to other parts of the globe. Likewise, in a study by El Hallaby (2012), the authors reported that even South Africa, which is more developed and advanced than other LMICs, was severely short of paediatric surgical specialists with only 37 qualified paediatric surgeons at the time, 3 of which were not in active service and 4 of which were out of the country practicing elsewhere. In review of the paediatric surgical work force in low and middle-income countries, Krishnaswami's group published results showing that as at 2015, there were 0.65 paediatric surgeons per million total population in South Africa as compared to 3.92 paediatric surgeons per million total population in the USA. This deluge of paediatric surgeons results in general adult surgeons operating on children based on adult treatment concepts not suited to children.

South Africa is one of the pioneers of the practice of Paediatric Surgery in Africa. In the 1920's the first paediatric surgeons in South Africa from the Hospital for Sick Children in London landed in South Africa (Cywes et al, 2003). The premier unit for paediatric surgery was seen in Cape Town at the Groote Schuur Hospital during the late 1940's. This later led to the establishment of the Red Cross Children's hospital which continues to be the only functional children's hospital in Southern Africa. Many organizations both national and regional have promoted the practice of paediatric surgery. An example of such an organization is the Pan African Paediatric Surgical Association (PAPSA) which was formed in 1994. Many African surgeons have championed the development of the practice of Paediatric Surgery locally. The last few decades have also seen many Africans training in paediatric surgery.

The Chris Hani Baragwanath Academic Hospital (CHBAH) is one of the hospitals in South Africa that has seen significant growth and advancement in the practice of Paediatric Surgery over the years. It is the largest hospital in Africa and third largest in the world. It serves a local population of over three million people with its main catchment population being in Soweto (Gauteng Province, n.d) and is a referral center for Gauteng and other neighbouring provinces for Paediatric surgery. As an academic hospital, it is focused on patient care, research and training.

Despite all this, paediatric surgery as a discipline in Africa is relatively new and still challenged with infrastructure and other resources. Most of the scarce research available looks mainly at the challenges and barriers to effective paediatric surgical care. The Paediatric Surgical Unit of the Chris Hani Baragwanath Hospital is one of the highly specialized units in the country and manages various types of cases. Complex surgeries ranging from colorectal to hepatobiliary are performed. Due to its large coverage area and multiple referrals coupled with the limited resources, theatres days are always busy and overbooked with many cold cases on the waiting list. Limited data, if any, have looked at the paediatric surgical work load that South Africa is burdened with and therefore this project aims to look at the demographics of the paediatric population receiving surgery and the scope of operative paediatric surgical procedures in South African, despite the limited resources.

RESEARCH QUESTION

- What is the scope of general paediatric surgical diseases in a high-volume center in Johannesburg, South Africa?

AIM

- To analyze the theatre logbook data as a proxy for the scope of general paediatric surgical diseases at the Chris Hani Baragwanath Academic Hospital (CHBAH).

OBJECTIVES

From the theatre logbook at CHBAH, the objectives of this study are:

- To determine the total numbers of general paediatric surgical procedures performed over a 12-month period and specify the number of emergency and elective procedures.
- To report the most common paediatric surgical procedures performed and determine the frequency of all procedures.
- To determine whether any specific surgical procedures are more common depending on age and gender.

METHODOLOGY

Study Design

A retrospective study will be undertaken by reviewing theatre logbooks of general paediatric surgical cases performed from 1st January 2017 to 31st December 2017. Theatre logbooks will give a good account of all procedures performed since it is mandatory for all procedures performed to be recorded. I will however cross reference with the monthly morbidity and

mortality presentations as theatre log books may not always give the exact surgeries performed and their indication.

Setting

The study site will be at the Paediatric Surgical Department of the Chris Hani Baragwanath Academic Hospital (CHBAH).

Study Population

- Children (birth to 10 years)
- Operated on by general paediatric surgeons at CHBAH.

Inclusion criteria: All paediatric cases (birth to 10 years) performed in 2017 by paediatric surgeons will be included in the study.

Exclusion criteria: Burn operative procedures will be excluded. This is because burns are generally operated on by plastic surgeons in other provinces and countries.

Measuring Instrument

Data collected from theatre logbooks will be compiled unto a data sheet as attached.

Data Collection

For each procedure, data will be collected on a datasheet (attached) and captured in MS Excel. Data will then be grouped according to age (e.g. < 30 days old, 1 to 6 months, 6 months to 1 year, and system involved. Frequency of procedures will be classified as rare (less than 20), less common (20 to 50) and very common (more than 50).

Data Analysis

The data spreadsheet will be imported into the STATISTICA suite of analytic software. Descriptive statistics will be used to report on the type and number of procedures performed and an ANOVA or non-parametric Kruskal-Wallis test will be used, as appropriate, to determine changes in procedure type by seasons.

ETHICS

A copy of the research proposal will be submitted to the management team of the CHBAH seeking permission to use hospital data. An ethics application will be submitted to the Human Research Ethics Committee (Medical) of the University of Witwatersrand for approval and the study will only commence once ethical clearance has been obtained.

TIMING

	2017			2018					
	May-June	July-Aug	Sept-Nov	Mar	April 2018	May-June	July-Aug	Sept-Oct	Nov-Dec
Project idea	x								
Literature Review		x							
Preparing Protocol			x						
Protocol Deadline				x					
Protocol Assessment					x				
Ethics Application				x					
Collecting data					x	x			
Data Analysis							x		
Writing up-thesis								x	
Writing up-paper									x

FUNDING

Research will be funded by the researcher and will be mainly for stationary, photocopying and printing.

PROBLEMS

Some cases booked on the list may have been cancelled for various reasons. Also, because of the limited amount of theatre space, there is a long waiting list. All these add up to the operative burden and will be discussed during the write up.

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APPENDIX B: DATA COLLECTION SHEET

UNIQUE CASE NUMBER	AGE	SEX	DATE OF PROCEDURE	TYPE OF PROCEDURE	NAME OF PROCEDURE

APPENDIX C: ETHICS CLEARANCE

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

R14/49 Dr M Botchway

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
CLEARANCE CERTIFICATE NO. M180406

NAME: (Principal Investigator)	Dr M Botchway
DEPARTMENT:	School of Clinical Medicine Department of Surgery Chris Hani Baragwanath Academic Hospital
PROJECT TITLE:	Operative logbook data as a proxy for the operative burden of paediatric surgical diseases in South Africa - the Johannesburg experience
DATE CONSIDERED:	04/05/2018
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Drs A Grieve and D Kruger
APPROVED BY:	Professor CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	01/06/2018

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary on 3rd floor, Phillip V Tobias Building, Parktown, University of the Witwatersrand, Johannesburg.
I/We fully understand the conditions under which I am/we are authorised to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated from the research protocol as approved, I/we undertake to resubmit to the Committee. **I agree to submit a yearly progress report.** The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in **April** and will therefore be due in the month of **April** each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature _____ Date _____

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX D: PUBLISHED ARTICLE

Botchway et al. Annals of Pediatric Surgery (2020) 16:44
https://doi.org/10.1186/s43159-020-00052-w

Annals of Pediatric Surgery

ORIGINAL RESEARCH Open Access

The scope of operative general paediatric surgical diseases in South Africa—the Chris Hani Baragwanath experience

Maame Tekyiwa Botchway[1*], Deirdre Kruger[2], Charles Adjei Manful[3] and Andrew Grieve[1]

Abstract

Background: Infectious diseases have always been the lime light of global health with very little focus on childhood surgical conditions despite the fact that children constitute about half of the population in LMICs. A significant proportion of the burden of global disease can be reduced by surgical intervention. South Africa is one of the pioneers of the practice of paediatric surgery in Africa with a great burden of paediatric surgical conditions.
Few studies, if any, have investigated the burden of operative paediatric surgical procedures in South Africa. Therefore, this retrospective study aimed to look at the scope of operative paediatric surgical procedures at the Chris Hani Baragwanath Academic Hospital (CHBAH) based in Johannesburg, South Africa, and reports on the numbers of elective and emergency procedures over a 12-month study period.

Results: There were 1699 operative general paediatric surgical procedures of which 61.7% were electives and 38.3% were emergencies. The scope of general paediatric surgical conditions operated on fell under the categories of congenital anomalies, infections and tumours. Of these, surgeries for congenital anomalies were performed in almost all the subspecialties.

Conclusion: There is a high operative paediatric surgical burden at the CHBAH. The role of paediatric surgical care as an essential component of global health cannot be underrated.

Keywords: Paediatric surgical diseases, Congenital anomalies, Operative burden, South Africa, Global surgery

Background

Africa constitutes less than one fifth of the world's population yet contributes 25% of the global burden of disease [1]. Where children under the age of 15 years make up 26% of the world's population, they make up 43% of the population in sub-Saharan Africa. Furthermore, it is estimated that the population of many African countries will at least double by 2050, with Africa's youth rising to 35% of the world youth total by then [1]. Surgical conditions account for 6–12% of all paediatric visits and contribute to up a third of all childhood mortalities [2]. According to Bickler's group, about 90% of children living in low- and middle-income countries (LMICs) will have a surgical treatable condition by the age of 15 years [2] and, if not treated, can cause severe morbidity and mortality [3]. Surgical conditions thus play a significant role in the overall burden of paediatric disease in LMICs. Recently, Butler's group used population data from four LMICs and concluded that there is a high burden of unmet surgical need, with almost 20% of children requiring surgery and 62% of those children having at least one unmet surgical need [4].

Irrespective of its importance, little attention is given to paediatric surgical care in LMICs. Until recently, paediatric surgical care was seen as 'the neglected step child of global health' and, as it was not considered an essential service, excluded in many funded programmes both nationally and internationally [3]. Paediatric surgical care is generally seen

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as an expensive specialty due to the peculiar surgical conditions, distinct anaesthetic challenges and unique perioperative needs. Moreover, the care of these children could be lifelong and require frequent follow-ups until adulthood.

There is a significant volume of operative procedures globally with an estimation of 312.9 million operations in 2012 [5]. Due to the socioeconomic conditions in resource-constrained LMICs, differences exist between developing and developed countries in the patterns of disease and practice of paediatric surgical care [3]. Despite the perceived burden of paediatric surgical diseases in developing countries, there is scarce epidemiological data, making it difficult to assess the actual surgical burden of the paediatric population [6].

In a review of the surgical workforce in South Africa in 2017, Dell published results showing that there were only 5.55 paediatric surgeons per one million population under 14 years of age, with an average age of 39.5 years and 55% male (Dell, 2017). This only left a workforce of only thirty giving a ratio of one specialist to every two million population. These figures fell far below developed countries such as the United States of America (USA) of one paediatric surgeon to approximately one hundred and eight thousand children as at 2006 (Polley et al. 2009).

South Africa is one of the pioneers of the practice of paediatric surgery in Africa. Nevertheless, a dearth of specialist paediatric surgeons in South Africa is a major obstacle in the effective delivery of paediatric surgical care. In 2015, Dell reported 0.80 paediatric surgeons per million total population in South Africa, with four provinces in the country not having one, compared to 8.20 paediatric surgeons per million total population in the USA [7]. This falls short of the one paediatric surgeon per 500,000 population recommended internationally [8].

The Chris Hani Baragwanath Academic Hospital (CHBAH) in Soweto, Johannesburg, is one of the institutions in sub-Saharan Africa making giant strides in the provision of paediatric surgical services in the State sector. It is the biggest hospital in the Southern Hemisphere and the fourth largest in the world. Its main catchment area is in Soweto serving a local population of over three million people [9]. CHBAH also acts as a major referral centre for the Gauteng Province and neighbouring provinces. The Paediatric Surgical Unit of the CHBAH is a highly specialized one managing complex cases from hepatobiliary to colorectal pathologies. There are two theatres dedicated to the paediatric surgical unit at the CHBAH (a neonatal theatre and a general paediatric theatre). Elective operative procedures are performed four times a week at the neonatal theatre and three times a week at the general paediatric theatre. Emergency surgeries are performed any time of the day and week on availability of an anaesthetist. The large population it serves coupled with multiple referrals and limited resources makes theatre days very busy with many cold cases waiting.

Few studies, if any, have investigated the burden of operative paediatric surgical procedures in South Africa. Therefore, this study aimed to look at the scope of operative paediatric surgical procedures at the CHBAH based in Johannesburg, South Africa, and reports on:

- The numbers of elective and emergency procedures over the 12-month study period
- The most common procedures performed with respect to age, gender and subspecialty

Methods

Ethical approval was obtained for this cross-sectional, descriptive study from the Human Research Ethics Committee (Ethics Certificate number M180406). Operative data over a 12-month study period from 1st January 2017 to 31st December 2017 were retrospectively collected from theatre logbooks at the Paediatric Surgical Unit of the CHBAH.

In order to ensure accuracy and avoid missing data points, data was cross-referenced with the monthly statistics of the Unit as well as operative logbooks of other paediatric surgical registrars. As per the admission age cut-off of the CHBAH Paediatric Surgical Unit, all patients 10 years old and younger were included in our study. Burn operative procedures were excluded from the study cohort because burns are managed by plastic surgeons in other hospitals and countries.

Demographic and clinical data were recorded and included the date of the procedure, age, gender, nature and type of the procedure performed. Data collected was captured unto an excel sheet and subsequently imported and analysed using STATA version 15.0. Data was

Table 1 Demographic and clinical characteristics in paediatric surgical patients

Parameters	All procedures	Paediatric surgical procedures	
		Elective	Emergency
n, number (%)	1699 (100%)	1049 (61.7%)	650 (38.3%)
Age, years (IQR)	1.0 (0.0–4.0)	2.0 (0.0–4.0)	1.0 (0.0–4.0)
Age groups, n (%)			
< 28 days	246 (14.5%)	48 (4.6%)	198 (30.5%)
28 days–12 months	446 (26.3%)	322 (30.7%)	125 (19.2%)
1–5 years	609 (35.8%)	434 (41.4%)	174 (26.8%)
5–10 years	398 (23.4%)	245 (23.4%)	153 (23.5%)
Male gender, *n* (%)	1029 (60.6%)	676 (64.4%)	353 (54.3%)

Abbreviation: IQR Interquartile range

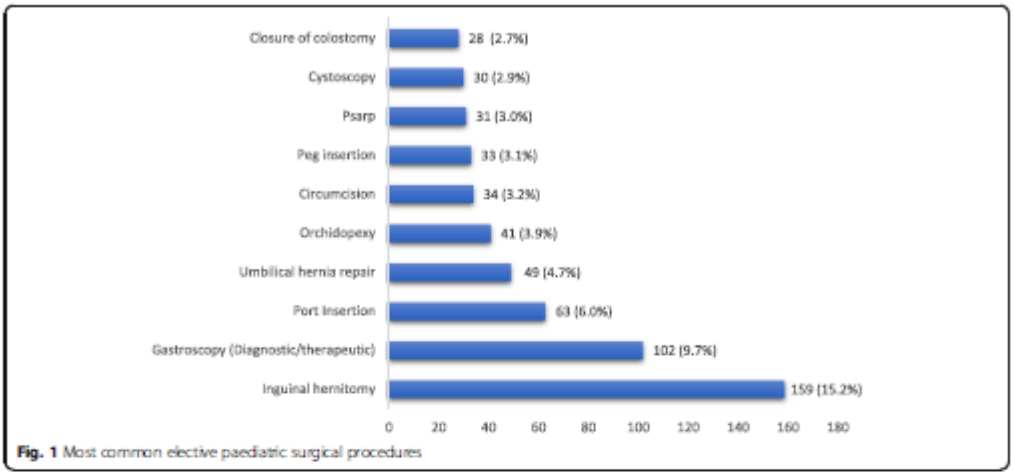

Fig. 1 Most common elective paediatric surgical procedures

subsequently grouped according to age (e.g. < 30 days old, 1 to 6 months, 6 months to 1 year) and system involved. Descriptive data was generated from the analysis.

Results

The demographic and clinical characteristics of the study cohort are shown in Table 1. A total of 1699 procedures were performed over the 1-year study period. The median age for the study cohort was 1 year with an interquartile range (IQR) of 0–4 years and a male to female ratio of 1.5:1. The majority of the procedures were performed in children under 5 years (76.6%).

Out of the 1699 procedures performed, 1049 (61.7%) were elective procedures and 650 (38.3%) were emergency procedures. Of the elective procedures, inguinal herniotomy was the most frequent procedure performed at 27.8%, followed by diagnostic or therapeutic gastroscopy at 17.9% (Fig. 1). From Fig. 2, incision and drainage

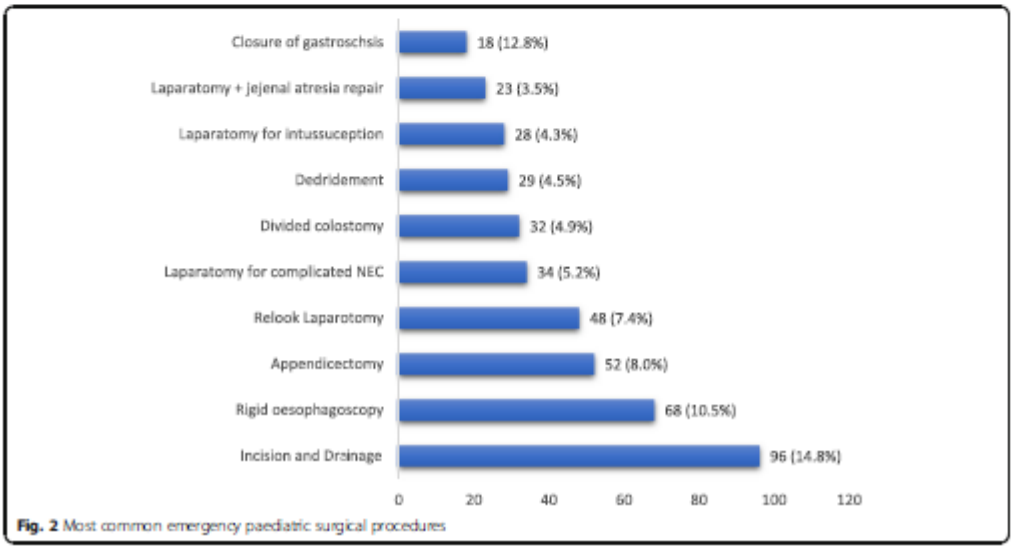

Fig. 2 Most common emergency paediatric surgical procedures

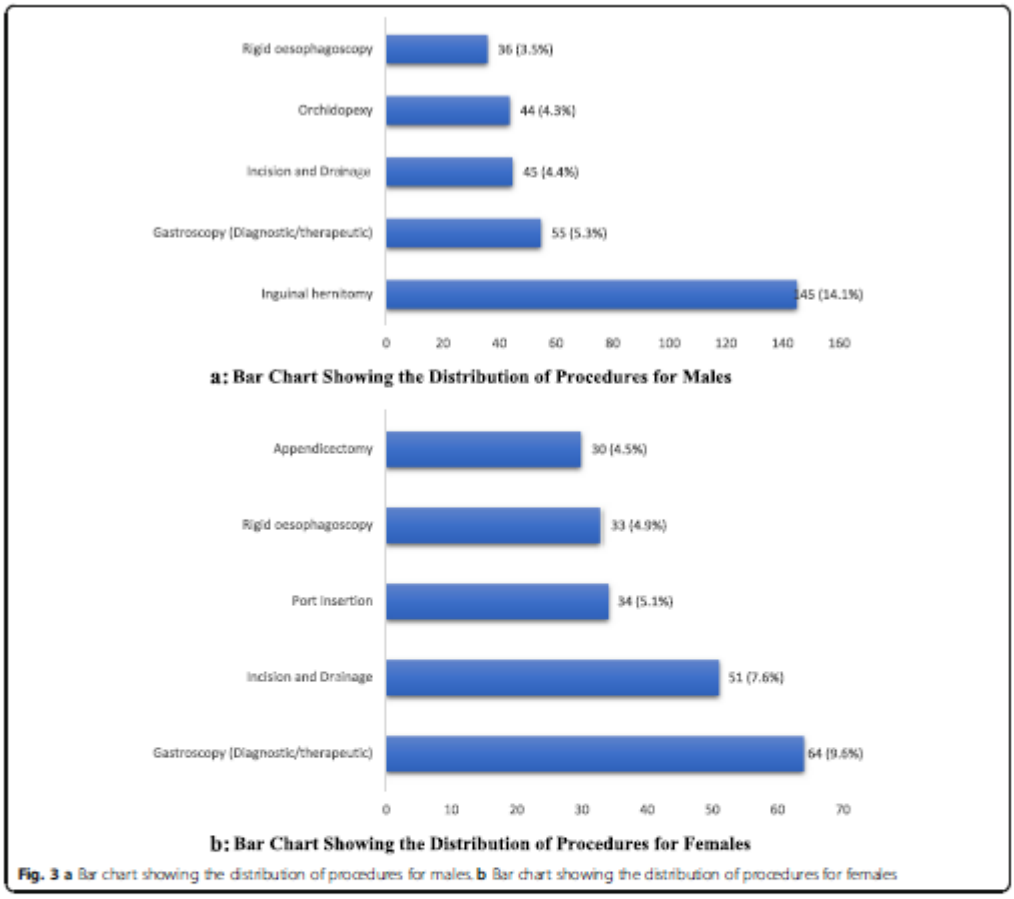

Fig. 3 **a** Bar chart showing the distribution of procedures for males. **b** Bar chart showing the distribution of procedures for females

of abscesses (22.4%) was the most frequent emergency procedure performed, followed by rigid oesophagoscopy (15.9%).

Paediatric surgical procedures by gender

From Fig. 3, inguinal hemiotomy was the most common procedure performed in males (14.1%, Fig. 3a), whereas gastroscopy was the most common procedure performed in females (30.2%, Fig. 3b).

Paediatric surgical procedures by age

As evidenced in Table 2, both laparotomy for complicated necrotizing enterocolitis (25.2%) and divided colostomy (25.2%) were the most common procedures performed in neonates. Inguinal herniotomy was frequently performed in children under 1 year old. Appendicectomy was the most common procedure performed in the older age group.

Procedure by subspecialty

As shown in Fig. 4, gastrointestinal tract (GIT) surgeries were the most common procedures performed in this study (49.5%), followed by general paediatric surgical

Table 2 Most common paediatric surgical procedures by age group

Age group	Commonest procedure	*n* (%)
< 28 days	Laparotomy for complicated NEC and divided colostomy	60 (3.5%)
28 days–12 months	Inguinal hemiotomy	77 (4.5%)
1–5 years	Gastroscopy (diagnostic/therapeutic)	51 (3%)
5–10 years	Appendicectomy	46 (2.7%)

Abbreviation: *NEC* necrotizing enterocolitis

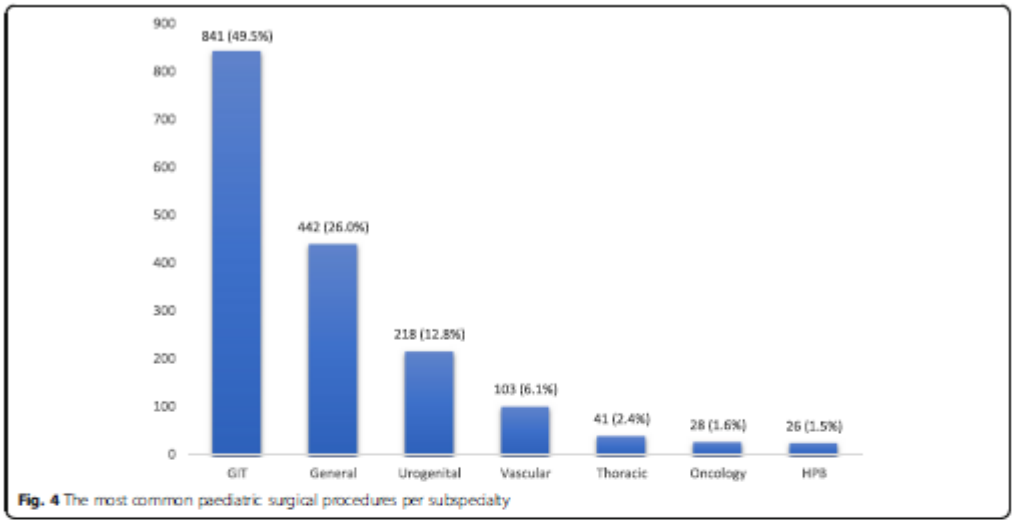

Fig. 4 The most common paediatric surgical procedures per subspecialty

cases (26.0%). The least performed surgeries were oncological and hepatobiliary procedures.

Table 3 shows the paediatric surgical procedures per subspecialty. The majority (14.1%) of GIT cases were gastroscopy (diagnostic/therapeutic). Inguinal herniotomy was the most prevalent (35.7%) general cases. About two thirds (61.2%) of vascular procedures were port insertion. More than half of HBP procedures were Kasai portoenterostomy.

Discussion

There is scarcity in the literature on paediatric surgical conditions in sub-Saharan Africa with even more scanty data on operative paediatric surgical conditions [4]. South Africa is no exception despite the fact that it houses the largest hospital in the Southern Hemisphere. This study gives a good insight to the scope of operative paediatric surgical conditions at the CHBAH. The Paediatric Surgical Unit of the CHBAH is a busy unit providing paediatric surgical services round the clock. It extends its coverage not only to the Gauteng Province but also to other neighbouring provinces and other nations in Africa. The unit manages general paediatric surgical conditions, paediatric trauma and complex and highly specialized paediatric surgical conditions. Even though the age cut-off for the Unit is 10 years, there are some children above this number who are managed in the Unit, most of which are colorectal, urology and oncology cases.

The mid-year population of South Africa as at 2018 was 57.7 million with 15.8 million of the population being 0–4 years [10]. The population of Soweto, a major drainage area of CHBAH, is 1.2 million [10]. As per the department's statistics, a total of 8516 children visited the outpatient department of the Paediatric Surgical Unit of the CHBAH in 2018. This together with our cohort of 1699 surgeries performed during our 12–month study period confirms the high demand of paediatric surgical care in LMICs [11]. The male preponderance in the study is in keeping with other literature [12, 13].

Children living in Africa are affected by a broad spectrum of surgical conditions categorized under injuries, congenital anomalies, surgical infections and tumours [12]. In sub-Saharan Africa, the bulk of paediatric surgical admissions needing surgical intervention were due to injuries, congenital anomalies and infections [14]. In our audit, the common diagnostic categories needing intervention were mainly congenital anomalies, surgical infections and tumours. Trauma was not that common because most of them are usually managed conservatively without needing operative intervention [15, 16]. In this study, congenital anomalies ranked top in almost all the subspecialties of paediatric surgical procedures. This finding is in keeping with available data [3, 12], and our study therefore supports the view that congenital anomalies make up the majority of paediatric surgical procedures in sub-Saharan Africa [12]. This is not surprising considering the fact that globally, congenital anomalies took 14th position in the overall burden of diseases with DALYs of 52 billion [17]. Common congenital anomalies operated on as elective cases were inguinal hernias, umbilical hernias and undescended testes. The latter is in keeping with a study by Abantanga and Amaning in 2002 that reported on elective paediatric surgical admissions at a referral centre in Kumasi, Ghana [18].

Table 3 Most common paediatric surgical procedures per subspecialty category

Category Key procedure	*n* (%) of all procedures	Percentage of category
GIT	**841 (49.5%)**	
Gastroscopy (diagnostic/therapeutic)	119 (7.0%)	14.1
Rigid oesophagoscopy	69 (4.1%)	8.0
Appendicectomy	53 (3.1%)	6.3
Relook laparotomy	48 (2.8%)	5.7
Divided colostomy	39 (2.3%)	4.6
General	**442 (26.0%)**	
Inguinal hemiotomy	158 (9.3%)	35.7
Incision and drainage	96 (5.7%)	21.7
Umbilical hernia repair	49 (28.9%)	11.1
Debridement	29 (1.7%)	6.6
Excision biopsy	26 (1.5%)	5.9
Urogenital	**218 (12.8%)**	
Orchidopexy	44 (2.6%)	20.2
Circumcision	36 (2.1%)	16.5
Cystoscopy	30 (1.8%)	13.8
Hypospadias repair	20 (1.2%)	9.2
Cauterisation of genital warts	18 (1.1%)	8.3
Vascular	**103 (6.1%)**	
Port insertion	63 (3.7%)	61.2
Port removal	32 (1.9%)	31.1
Above knee amputation	4 (0.2%)	3.9
Quinton line insertion	2 (0.1%)	1.9
Thoracic	**41 (2.4%)**	
OA/TOF repair	17 (1.0%)	41.5
Rigid bronchoscopy	10 (0.6%)	24.4
Repair of CDH	3 (0.2%)	7.3
Aortopexy	2 (0.1%)	4.9
Laryngoscopy + removal of coin	2 (0.1%)	4.9
Oncology	**28 (1.7%)**	
Nephrectomy	7 (0.4%)	25
Excision of sacrococcygeal teratoma	4 (0.2%)	14.3
Excision of adrenal mass	2 (0.1%)	7.1
Right orchidectomy	2 (0.1%)	7.1
HPB	**26 (1.5%)**	
Kasai portoenterostomy	15 (0.9%)	57.7
Open liver biopsy	5 (0.3%)	19.2
OTC + liver biopsy	5 (0.3%)	19.2

Abbreviations: *CDH* congenital diaphragmatic hernia, *GIT* gastrointestinal tract, *HPB* hepatopancreatobiliary, *OA/TOF* oesophageal atresia with tracheooesophageal fistula, *OTC* on-table cholangiography

In a study on the scope of emergency paediatric surgical cases seen at a teaching hospital in Tanzania over a 1-year period [19], the authors reported that of the 414 paediatric operative procedures performed, 74% were elective and 26% were emergency procedures, and the two most common emergency procedures were for bowel obstruction and peritonitis. From our study, emergency operative procedures accounted for 38.3% of the total procedures performed and, in contrast to the abovementioned study, our two most common procedures were incision and drainage for abscesses and rigid oesophagoscopy for ingested foreign body material.

During the era of the Millennium Development Goals, there was a significant global reduction in mortality for children under 5 years old with neonatal mortality however lagging behind [20, 21]. The third sustainable development goal aims to 'end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1000 live births and under-5 mortality to at least as low as 25 per 1000 live births by 2030' [22]. Neonatal surgery has the likelihood of being a cost-effective health intervention considering the fact that these conditions have no alternative form of management but surgical. The actual burden of neonatal surgical diseases in Africa is not known. A survey in Africa however revealed that neonatal surgical diseases contribute to about 10 to 20% of the workload of paediatric surgeons in this region [23]. This is confirmed in our study where 14% of the surgeries performed in the cohort were due to neonatal conditions. The little literature available shows that the workload of neonatal surgery in major referral centres in sub-Saharan Africa has very little variation [24]. In a study by Ameh looking at Neonatal Surgery in Africa, 50% of the 626 neonatal procedures performed at the Jos University Teaching hospital in Nigeria over a 10-year period (January 2001–December 2010) were emergency procedures [25]. In the same study, 40% of the 516 neonatal surgeries performed over a 10-year period at the Ahmadu Bellow University Teaching Hospital also in Nigeria were emergency procedures [25]. The difference in proportions is quite wide in our study with 80.5% of the 246 procedures performed during the study year. There are so many reasons for this increased number. The variation of cases in their study was however similar to the common neonatal conditions operated on in our study. Congenital anomalies still ranked top in these conditions.

A limitation of our study is the retrospective study design, and as a result, some information may not have been recorded.

Conclusion

Our study gives a good perspective on the scope of operative paediatric surgical conditions in Johannesburg. Most of the procedures performed were for congenital anomalies. This is not surprising considering the fact that congenital anomalies are one of the leading causes of under 5 mortality globally, thus contributing significantly to the burden of paediatric surgical diseases. It is therefore imperative to strengthen paediatric surgical services especially in LMICs in order to achieve the third Sustainable Development Goal.

In conclusion, despite the fact that the practice of Paediatric Surgery is advancing globally, there is still a deficiency in paediatric surgical care in LMICs carrying a significant burden of disease, especially in children. Even though the disease burden may be similar across sub-Saharan Africa, the scope of paediatric surgery may be different between institutions, as well as from one country to the next country.

Further research needs to be done in other teaching hospitals in Johannesburg and South Africa as a whole to better determine the operative paediatric surgical burden nationally. This will form a basis of good evidence to policy makers and non-governmental organizations (NGOs) on the need to include paediatric surgery in funded programmes.

There is also the need for other researchers and clinicians in LMICs to look at the scope of paediatric surgical conditions in each region and explore the barriers to providing effective and efficient paediatric surgical care.

Abbreviations

CDH: Congenital diaphragmatic hernia; CHBAH: Chris Hani Baragwanath Academic Hospital; DALYs: Disability-adjusted life years; GIT: Gastrointestinal tract; HPB: Hepatopancreatobiliary; IQR: Interquartile range; LMICs: Low- and middle-income countries; NEC: Necrotizing enterocolitis; NGOs: Non-governmental organizations; OA/TOF: Oesophageal atresia with tracheooesophageal fistula; OTC: On-table cholangiography

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Authors' contributions

MTB: concept, data collection, analysis and write up. DK: literature review and supervised manuscript write up. CAM: statistical work and analysis. AG: literature review and supervised manuscript write up. All authors have read and approved the manuscript.

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Availability of data and materials

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This article does not contain any studies with human participants or animals performed by any of the authors. Ethical approval with certificate number M180406 (available on request) was received from the Human Research Ethics Committee.

Consent for publication

Consent to publish was received from the Department of Paediatric Surgery.

Competing interests

Dr Maame Tekyiwa Botchway declares that she has no competing interest.
Dr Deirdre Kruger declares that she has no competing interest.
Dr Adjei declares that he has no competing interest.
Dr Grieve declares that he has no competing interest.

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