

**CLINICAL PRESENTATION AND SURGICAL TREATMENT OUTCOMES
IN CHILDREN WITH UMBILICAL HERNIA AT MOI TEACHING AND
REFERRAL HOSPITAL- ELDORET KENYA**

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MEDICINE**

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DECLARATION

CANDIDATE'S DECLARATION

This dissertation is personal original work and has not been presented for the award of a degree in any other university or institution.

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DEDICATION

This work is dedicated to Mr. Hussein Ali Ahmed and Mrs. Habiba Ali Saman, whose love and support have given me strength all through life. To my amazing wife, Deka Adan, for her unconditional support.

I am truly grateful.

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ABBREVIATIONS

AMPATH	Academic Model Providing Access to Health care
IH	Inguinal Hernia
IQR	Inter- Quartile Range
KMTC	Kenya Medical Training College
MTRH	Moi Teaching and Referral Hospital
PEM	Protein Energy Malnutrition
SOPC	Surgical Outpatient Clinic
SSO	Surgical Site Occurrences
STD	Standard Deviation
UC	Umbilical Cord
UH	Umbilical Hernia

DEFINITIONS OF TERMS

Asymptomatic umbilical hernia: the contents of the hernia can be returned into the peritoneal cavity completely.

Child: defined as a person younger than 18 years as per World Health Organization.

Clinical presentation: refers to signs and symptoms present in a child with an umbilical hernia.

Evisceration: contents of the umbilical hernia break through the skin overlying the sac.

Hematoma: a collection of blood in the post-surgical site after surgical repair.

Incarcerated umbilical hernia: there is entrapment of hernial sac and its contents such that the hernia cannot be returned into the peritoneal cavity.

Length of hospital stay: duration of stay from time of operation to discharge or death.

Mortality: death that is directly linked to the UH or its complications.

Obstructed umbilical hernia: incarcerated umbilical hernia where a section of the bowel becomes trapped inside the hernial sac, causing an obstruction.

Outcomes: results or occurrences following a specific process or event.

Seroma: a collection of serous fluid in the post-surgical site after surgical repair.

Strangulated umbilical hernia: contents of the hernia cannot be returned into the peritoneal cavity, and blood supply of the hernia contents is compromised.

Treatment: refers to any surgical intervention done on a patient with an umbilical hernia.

Treatment Outcomes: occurrences following umbilical hernia surgery from intraoperative up to two weeks post-operative and includes both morbidity and mortality.

Umbilical hernia: refers to a hernia limited to the umbilical ring.

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ABSTRACT.

Background: Umbilical hernia is common among Afro-Caribbean children with a prevalence of between 15-23%. Although largely harmless, it can cause serious complications like strangulation and evisceration. The majority of the surgical repairs are done as an emergency rather than electives due to strong cultural influence, which delays early surgical intervention. There is a paucity of data on the treatment outcomes following surgical repair.

Objective: To describe the clinical presentations and surgical treatment outcomes in children with umbilical hernia at Moi Teaching and Referral Hospital.

Methods: This was a descriptive prospective study conducted between March 2019 to March 2020. A total of 39 participants aged below 18 years were recruited. Data on socio-demographics, clinical evaluation, indication for surgery and post-operative outcomes were collected using an interviewer-based questionnaire. Descriptive statistics including frequencies and proportions were used for categorical variables while measures of central tendency and spread were used for continuous variables. Treatment outcomes were assessed in terms of complications, mortality and length of hospital stay at 24 hours and day 14 post-operatively. Students' T-test and Analysis of Variance were used to assess the association between categorical variables at 0.05 α level of significance.

Results: Patients' age ranged between 5 to 147 months with a median of 25 (IQR: 14,50) months. Females constituted 51.3% (n=20). Majority of participants (92.3%) had normal nutritional status. Few participants (18%) had a positive family history of umbilical or inguinal hernia. Umbilical swelling with pain (n=32) was the commonest symptom while irreducible tender swelling (n=29) was the main clinical finding. A greater proportion (64.1%) had a moderate-sized defect. Incarcerated umbilical hernia was the commonest pre-operative diagnosis (66.7%). Seventy-four per cent (n=29) underwent emergency hernia repair, with incarceration accounting for 89.7%. One participant developed a hematoma post-operatively. The mean length of hospital stay was 2.40 (std=0.89) days. Overall mortality rate was 2.6%. Defect size had a statistically significant influence on the length of hospital stay (p-value=0.002).

Conclusion: Median age for UH repair at MTRH is 25 months. Most of the UH repairs are done as an emergency, with incarceration being the leading cause of complicated UH. Operative repair remains a low-risk procedure. The size of the defect is a predictor of the length of hospital stay.

Recommendation: Since most of the children in our set-up present at a young age with complicated UH, early surgical intervention should be considered.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Umbilical hernia refers to the protrusion of abdominal contents through the weak umbilicus, which may result partly from failure of the round ligament (obliterated umbilical vein) to close the umbilical ring and partly from the absence of the Richet fascia (Burcharth et al., 2015). It is also defined, according to the European Hernia Society's classification, as a hernia in the region 3 cm above to 3 cm below the umbilicus, situated in the midline with rectus muscle forming the lateral margins (Winsnes et al., 2016). Umbilical hernias are common among Afro-Caribbean and premature children. No wide-scale epidemiologic studies have been done, and most literature is from single institutions.

In Kenya, umbilical hernia occurrence is second to inguinal hernia (Waweru et al., 2014).

Three forms of umbilical hernia are recognized in clinical practice: congenital, infantile, and adult type. An umbilical hernia can also be classified as small (< 2cm), median (2-4cm), and large (>4cm) depending on the size of the fascial defect (Eker et al., 2009). Abdominal wall defects such as Gastroschisis and Omphalocele are thought to be developmental in origin. In contrast, an umbilical hernia results from severe stress and strain against the fresh umbilical wound or weak cicatrix.

The absence of umbilical fascia and family history of hernia in one or both parents are some of the suggested reasons why umbilical hernia is common among Black-African children. No variation in the incidence of umbilical hernia has been observed concerning socioeconomic factors as might dietary adequacy. Other risk factors for

umbilical hernias include obesity, physical strain, Down's syndrome, black ethnicity, and hypothyroidism (Burcharth et al., 2015).

Umbilical hernia is more common in females than males. It is not clear why the incidence of UH is higher in females, but it is possibly related to the less well-developed musculature in the females (Machekano & Katzenstein, 1994).

Most of the defects close gradually after birth, and up to 90% close before the 4th birthday (Zendejas et al., 2011). In most institutions, hernia repair is indicated only if the child is symptomatic. However, some Africa cultures regard it as a hallmark of beauty (Ireland et al., 2014). Umbilical hernia is common in their families and serves as proof of the true paternity of the child. Treatment, according to them, removes this family identity; because it is purely a familial and not sporadic lesion (David & Mike, 2009).

Management of umbilical hernia involves surgical repair using various methods. However, conservative management using wide strip adhesive plaster extending across the abdomen has yielded good results in children less than one year (Evans, 2000).

Complications like strangulation and incarceration, which are surgical emergencies, can result from an umbilical hernia. Despite predisposition to these complications, umbilical hernia is commonly ignored, and its presence is rarely described during physical examinations by health workers. More so, there is a paucity of data regarding the outcome of the surgical treatment done at Moi Teaching and Referral Hospital.

In this respect, the study will seek to elucidate the clinical presentation and treatment outcomes following surgical treatment of these patients.

1.2 Statement of the Problem

Umbilical hernia is a common condition in this region and contributes to a sizable proportion of all children admitted to the surgical wards at MTRH, Eldoret.

Elective surgical repair of UH is recommended at the age of 4 years and above. However, experience in the MTRH hospital suggests that many of these children present with complicated UH that requires emergency surgery at an age younger than 4 years. This could be due to the strong cultural influence regarding umbilical hernia in our community; it is considered a hallmark of beauty. In fact, some parents get concerned when their child has no umbilical hernia. This greatly hinders early reporting to the hospital for diagnosis and treatment.

Although some parents may think it is magnificent and outstanding in attractiveness, its complications are enormous. When these unwanted and undesirable difficulties occur, it has a colossal psychological and financial impact on them.

Some cultures and beliefs associate umbilical hernia with some charm and mystic activities; thus, making the parents not seek early health care service and hence bring the child to the hospital with a hernia that has complicated.

No studies have been conducted in Kenya to directly assess the surgical management of UH, its treatment outcomes, and associated post-operative complications.

1.3 Justification

The general subject of umbilical hernia has been widely published in the developed world but Kenya has contributed little to this body of knowledge. Despite the treatment for many years, the outcome is unknown in our hospital.

Much published work dwells more on long-term complications like recurrence while underrating short-term outcomes such as wound infection, hematoma, and seroma. All

the treatment guidelines available are from the western world, yet the condition is common in the African population.

This study will address clinical presentations and early surgical treatment outcomes of umbilical hernia among children attending MTRH, Eldoret, western part of Kenya.

The findings of this study will help identify the gaps in our practice as well as guiding the health care workers, patients and policy makers regarding clinical presentation and surgical treatment outcomes of umbilical hernia.

1.4 Research Question

What is the clinical presentation and surgical treatment outcomes of UH in children treated at MTRH?

1.5 Objectives

1.5.1 Broad Objective

To describe the clinical presentation and treatment outcomes in children with UH at MTRH.

1.5.2 Specific Objectives

1. To describe the socio-demographic characteristics of children who were surgically treated for umbilical hernia at Moi Teaching and Referral Hospital.
2. To describe the clinical presentation of umbilical hernia as operated at MTRH.
3. To determine the indications for surgery in children undergoing repair for UH.
4. To determine surgical treatment outcomes and factors associated with the outcome.

CHAPTER TWO

2.0 LITERATURE REVIEW

UH refers to the protrusion of abdominal contents through the weak umbilicus, which may result partly from failure of the round ligament (obliterated umbilical vein) to close the umbilical ring and partly from the absence of the Richet fascia.

Anatomically, the umbilical ring consists of the umbilical scar, round ligament, and umbilical fascia ((Thomson et al., 2012). Usually, the round ligament passes over the umbilical ring's superior margin and attaches to the inferior margin. However, if it only attaches to the superior margin of the ring, so that the floor of the umbilical ring is formed by the umbilical fascia and peritoneum, this will create a weakness and hence predispose to an umbilical hernia.

Embryologically, it is attributed to the recti's failure to approximate in the midline following the return of the midgut into the peritoneal cavity, leaving a midline defect in the linea alba (Thomson et al., 2012).

UH develops when the umbilical ring fails to close after cord separation(Odonnell et al., 1998). It presents as a protrusion at the umbilicus, especially when the infant cries or strains. The defect is covered anteriorly by the skin and posteriorly by the peritoneum. The fault varies in size ranging from 0.5 cm to >1.5 cm. Rarely, the defect diameter exceeds more than 2 cm (Odonnell et al., 1998).

UH is a common condition and has a racial predilection, with African-Caribbean children developing 6 to 10 times more than white counterparts (Odonnell et al., 1998).

The natural history of UH is that majority close spontaneously before the 4th birthday. Spontaneous closure is unlikely after the age of 4-5 years (Zendejas et al., 2011). Surgical repair is recommended in all children whose defect has not closed by the 4th or 5th year since complications increase with advancing age (Odonnell et al., 1998).

Certain predictors of closure are measured, including the diameter and the sharpness of the fascial edge. A diameter >1.5 cm is less likely to close spontaneously; the thicker and more rounded the fascial edge, the more likely the hernia will close (Thomson et al., 2012).

2.1 Embryological Development of the Umbilicus

Development of the embryo begins with establishing the posterior abdominal wall (Gray SW, 1972). The yolk sac is ventral while the amniotic cavity is posterior (fig.1A). As growth continues, the ventral abdominal wall develops by simultaneously forming cranial, caudal, and lateral in-folding. This in-folding attenuates the yolk sac.

Part of the yolk sac becomes intra-coelomic and later develops into the mid and hindgut (fig.1B). The omphalomesenteric or vitelline duct is the attenuated connection between the extra-coelomic yolk sac and the midgut. It is supplied by the vitelline artery and vein. As the embryo continues to develop, the vitelline duct in the yolk sac fuses with the chorion (body stalk).

Closure of the abdominal wall occurs around the 10th gestational week with the return of the midgut to the abdominal cavity. Both somatopleures fold medially, and the narrowing vitello-intestinal isthmus forms the vitelline duct (Papagrigoriadis & Browse, 1998).

The chorion contains the umbilical vein, umbilical arteries, and the allantois. The allantois, a projection of the hindgut portion of the intra-coelomic yolk sac, forms the bladder wall (Gray SW, 1972).

The vitelline veins develop into the hepatic and the portal veins while the vitelline artery contributes to the formation of the superior mesenteric artery (In Rowe MI, ONeill, Grosfeld JL, 1985). The fusion of the body stalk containing the paired umbilical arteries, the umbilical vein, and the allantois, and the yolk stalk containing the vitelline duct represents the UC (fig.1C).

The UC is covered by an outer layer of amnion and contains the primitive mesenchymal tissue (Wharton's Jelly). The vitelline duct usually obliterates between the 5th and 9th week of intra-uterine life.

Shortly after birth, the umbilical vessels close and are transformed into lateral umbilical ligaments and ligamentum teres. The obliterated portion of the allantois forms the urachus or the median umbilical ligament. This ligament connects the dome of the bladder to the umbilicus.

Closure of the umbilicus after birth is aided by obstruction of the umbilical arteries. The aetiology of UHs is unknown, but most occur through the umbilical-vein part of the umbilical ring (Papagrigoriadis & Browse, 1998).

The urachus forms between the 8th and 16th week of gestation. Five to eight days after birth, the umbilical cord separates from the abdominal wall, and its area of insertion condenses to a fibromuscular ring that closes the defect. There are cases of delayed separation of the cord later than three weeks (Harvey, n.d. 1979). Granuloma is the most common abnormality in children with delayed separation of the cord. There is a

30% or greater incidence of having omphalomesenteric or vitelline duct remnant (Kutin ND, Allen JE, 1979).

The separation of the umbilical cord depends on the infiltration of neutrophils and subsequent necrosis. Factors linked to delayed stump separation include deficiency of complement receptor (CR3)(Ross et al., 2016), x-linked familial occurrence, neutrophil defect, and malfunction of monocytes and natural killer cells(Bowen et al., 1982).

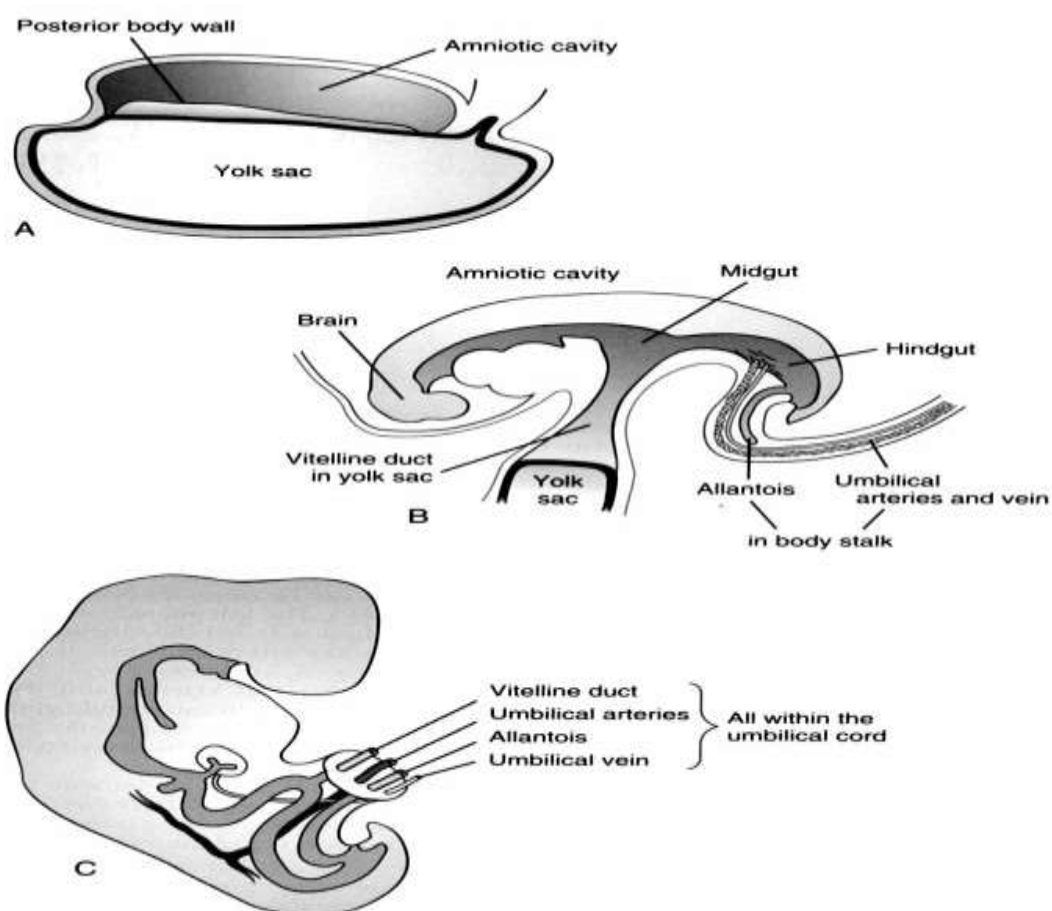


Figure1. Development of umbilical cord. (A)A posterior body wall is established. (B)Vitelline duct forms with craniocaudal and lateral in folding. (C)The UC forms with the fusion of the yolk stalk and body stalk (Odonnell et al., 1998).

2.2 Epidemiology

The prevalence of UH differs from one region to the other (Burcharth et al., 2015). It is common in Afro-Caribbean and premature children (Ireland et al., 2014). There is evidence of UH in more than 80% of infants weighing less than 1200 grams compared to 21% of infants weighing over 2500 grams (Odonnell et al., 1998). Twenty per cent of full-term neonates and 80% of premature babies weighing < 1500grams have UH (Keshtgar & Griffiths, 2003).

It is more common in females than males with a sex ratio of 2:1 (Waweru et al., 2014). It is common among children of African descent with low birth weight compared to their white counterparts (Zendejas et al., 2011), (Evans, 2000). In Australia, the prevalence resembles that of mixed-race South Africa with 15% (Ireland et al., 2014).

In Africa, the prevalence can be as high as 50% in some regions (Komlatsè et al., 2014). In Nigeria, congenital umbilical hernia is up to 23%, while it is 15% in South Africa (Ireland et al., 2014). UH constitutes 8.7% of all pediatric external abdominal hernias in Zaria, Nigeria (Ameh et al., 2003). The high proportion of umbilical hernia among school children in rural Nigeria is due not only to PEM but also to inherited physiological characteristics, inadequate medical care, and living in an unhygienic environment (Ebomoyi, 1991).

The incidence in Tanzania is high during the first year of life, gradually decreasing by the 15th year (Machekano & Katzenstein, 1994).

In Kenya, umbilical hernia is the second commonest type after inguinal hernia (Waweru et al., 2014).

The level of education influences the attitudes toward umbilical hernia among the African populations. Educated elites residing in urban cities consider UH as a lesion requiring treatment compared to their rural counterparts (David & Mike, 2009).

2.3 Classification of Umbilical Hernia

Three forms of UH are recognized in clinical practice: congenital, infantile, and adult types.

The Congenital type occurs as a result of a faulty union of the visceral plates in the midline. The infantile type occurs soon after birth due to the umbilical cicatrix's yielding after separation of the cord. The adult variety develops later in life, especially in multiparous women (Crump, 1952).

It can also be classified depending on the fascial defect's size using the length, width, or surface area. Primary abdominal wall hernias are more or less round or oval-shaped, and their size can be described with one measurement, i.e. width and length will be more or less comparable most of the time. Using a cut-off of 2 and 4 cm, the defect has been classified into small (<2cm), median (2-4cm), and large (>4cm) by the European Hernia Society (Eker et al., 2009).

However, there are no standardized recommendations on measuring the size of the defect in ventral hernias. Five methods have been described to obtain the width and length to calculate the defect size (Cherla et al., 2017). These methods are radiologic computerized tomography scan, intra-operative measurements of length and width with or without insufflation, and clinical physical examinations. Sizes are weakly to moderately correlated among the five methods (Cherla et al., 2017).

Table1: European Hernia Society classification for primary abdominal wall hernias.

E H S		Diameter cm	Small <2cm	Medium ≥ 2-4cm	Large ≥ 4cm
Primary Abdominal Wall Hernia Classification					
Midline	Epigastric				
	Umbilical				
Lateral	Spigelian				
	Lumbar				

Proboscoid umbilical hernia represents approximately 17% of all umbilical hernias. The size of the fascial defect is similar to other umbilical hernias. They have a large redundant overlying skin, hence a characteristic protuberant or proboscoid appearance. Proboscoid type requires early surgical intervention for cosmesis, social and surgical reasons (Odonnell et al., 1998).

2.4 Risk Factors

Several risk factors for UH have been described. These include obesity, physical strain, Down's syndrome, black ethnicity and hypothyroidism, Broncho-asthma, right inguinal hernia, cryptorchidism, and Beckwith-Wiedemann Syndrome (Machekano & Katzenstein, 1994) (Burcharth et al., 2015). Some of these conditions cause increased intra-abdominal pressure hence predispose to hernia.

Many causes describe the high prevalence of UH among black children. These include; absence of umbilical fascia (Machekano & Katzenstein, 1994), hereditary or family history of hernia in one or both parents (Crump, 1952), and seasonal variations,

especially during windy and cold weather. These are considered a risk factor in the occurrence of complications (African & Journal, 2016).

There is no variation in umbilical hernia incidence concerning socioeconomic factors (Machekano & Katzenstein, 1994).

2.5 Clinical Presentation and Indications for Surgery

UH is noticed as a painless protrusion at the umbilicus. It is more visible when the infant strains or cries and reduces when an infant is at rest. Some children may feel some discomfort and peri-umbilical pain. However, cases with acute complications can present with various signs and symptoms. Much of the hernia repairs in Africa are carried out as an emergency, while elective procedures are few (Waweru et al., 2014). Most African parents are not aware of any complications associated with an umbilical hernia and hence object to any surgical intervention irrespective of the size and shape (David & Mike, 2009).

Possible predisposing factors for complications include pica, where sand may accumulate intra-luminally and form an enterolith which cannot be reduced through the neck of the hernia because of its size, and ascarids, which may become entrapped and produce a similar clinical effect on the hernia (R.A. Brown et al., 2006).

An incarcerated hernia is characterized by a painful episode, vomiting, and irreducibility.

In obstructed hernia, the patient may present with features of intestinal obstruction.

Generally, the natural history of UH is spontaneous closure within the first five years of life (Chirdan et al., 2006), but closure can occur as late as 14 years (Tarpley, 2001).

Defect sizes of less than 0.5 cm close spontaneously by the 2nd year (Zendejas et al., 2011), while defects more than 1.5cm are unlikely to close (Gera, 2016).

There are no clear recommendations available in the literature regarding the rule or time of surgical repair for asymptomatic umbilical hernias in the pediatric age group. In contrast, immediate repair is frankly recommended in complicated or symptomatic ones.

Operative intervention is recommended if the child is above five years, the hernia sac is large or in cases where the patient is symptomatic (Chirdan et al., 2006). Extremely thin skin overlying the umbilical protrusion is another indication for surgery (Machekano & Katzenstein, 1994).

Other reasons for repair include excessive manipulation of the hernia by the child and psychological and cosmetic reasons, especially in the western world (Tarpley, 2001). In Africa, presentation for cosmetic repair is rare (Chirdan et al., 2006).

Usually, different countries have different recommendations for the repair of umbilical hernias. In India, the repair is advocated for all hernias persisting beyond two years of age (Gera, 2016). The repair is recommended in defects more than 1.5cm diameter in girls more than 2 years and boys more than 4 years of age in the USA. In South Africa, defects more than 2 cm in children more than five years of age and observed incarceration are the only indications for repair (Gera, 2016).

In Zimbabwe, prophylactic repair is done in girls over two years of age and in all children over four years of age (Machekano & Katzenstein, 1994). Recent studies suggest an increase in complication rates (Keshtgar & Griffiths, 2003). Strangulation and incarceration are the most common complications reported (Ameh et al., 2003). Incarceration can occur at any age and can lead to strangulation and bowel gangrene. The incidence of acute complications is high in India (24%) and less in developed countries (Western Australia 1%, and the USA at 7.4%).

In Africa, acute complications range from 15% in Senegal to 44% in Nigeria (Ireland et al., 2014). High levels of poverty could explain this; hence, patients cannot pay for the cost of surgery, and many health facilities lack adequate responses (Kuubiere et al., 2015).

Incarceration is more common in girls than boys, and the median age for incarceration is four years (3 weeks to 12 years) and defect size of > 1.5 cm diameter (Chirdan et al., 2006).

Incarceration and strangulation are more common in medium-sized defects (diameter of 2-4 cm) compared to the small (<2 cm) or large (>4cm) defects. It is thought that small defects are too small to contain bowel while large defects have a wide neck making incarceration unlikely. Impaction of foreign bodies that precipitate incarceration may be a reason why some umbilical hernias get incarcerated (Chirdan et al., 2006).

Obstruction is a recognized emergency in Africa but rare among the whites. In Zimbabwe, it is the commonest indication for admission and occurred more in females (60%) than males (Machekano & Katzenstein, 1994). It is thought that a high fiber diet consumed by African children could predispose to obstruction since a loop of the small intestine with a food bolus may be incarcerated in the hernial sac.

Other complications that require emergency operative reduction include spontaneous evisceration, sac abscess, and traumatic rupture (Ameh et al., 2003).

Spontaneous rupture is an exceptionally rare but potentially fatal complication. Several factors are thought to precipitate rupture including the age of the infant or child, the defect size, umbilical sepsis or ulceration and any condition which raises intra-abdominal pressure, i.e., crying, coughing, pneumonia, positive pressure ventilation, ascites, or intra-abdominal pathology (Thomson et al., 2012).

Trauma to the umbilicus from a nappy pin is now only a risk in developing countries where Velcro nappies are not widely used.



Figure 2: Pre-operative appearance of a ruptured umbilical hernia (courtesy of Thomson et al, 2012).

The average age for hernia repair differs from one region to another. It ranges from 3.9 years in the USA (Zendejas et al., 2011) to 6 years in South Africa (Ireland et al., 2014). Age has a bearing on the outcome of UH repair. T.J. Zens et al., 2019 noted a significant increase in the rate of complications in children < 4 years old. Similarly, Halleran et al., 2020 observed that unplanned post-operative hospital revisits and hernia recurrences were higher in children younger than 4 years of age in the USA.

2.6 Diagnosis of Umbilical Hernia

An umbilical hernia is majorly diagnosed through clinical evaluation. Abdominal examination is done in a relaxed patient lying in a supine position and abdomen exposed from the xiphisternum up to the mid-thigh. The size of the defect can be estimated using a standard ruler or tape measure. Features like ulcerations, reducibility, and tenderness are assessed. Radiological imaging is not usually required

to assist in diagnosing umbilical hernias; clinical examination allows an accurate diagnosis (Toms et al 1999).

UH should be distinguished from epigastric hernia and supra-umbilical hernia which are caused by defects along the linea alba between the xiphoid process and umbilicus. An epigastric hernia is defined as a midline hernia 3 cm below the xiphoid process to 3 cm above the umbilicus (Burcharth et al., 2015). The size of supra-umbilical hernia defects is usually small but are mostly symptomatic with pain because of the incarcerated fat from falciform ligament or omentum. They do not close spontaneously, and surgical repair is indicated (Keshtgar & Griffiths, 2003).

Ultrasonography, computed tomography, and magnetic resonance imaging are appropriate investigations for demonstrating an acutely strangulated hernia in the obese and cases of diagnostic uncertainties following physical examination (Toms et al. 1999).

A computed tomography scan provides for the identification of abdominal wall hernia and their contents as well as differentiating hernias from other abdominal masses like abscesses or tumours (Diego et al., 2005).

2.7 Outcomes of Surgical Treatment

UH repair is comparatively a low-risk procedure. Although it is the most common elective general surgery performed in children between 1 and 17 years, there are no formal management guidelines from major pediatric medicine organization (T. J. Zens et al., 2019). However, it is a common practice to wait until four years of age before repairing UH (Keshtgar & Griffiths, 2003).

Treatment of UH involves surgical repair of the umbilical ring and the reconstruction of the umbilicus close to normal using various methods (Komlatsè et al., 2014).

The patient's race remains a significant factor of early hernia repair. White children were more likely to have early repair than those in other racial and ethnic groups (T. J. Zens et al., 2018).

Conservative management using wide strip adhesive plaster extending across the abdomen has yielded good results in children less than one year (Evans, 2000). Adequate adhesive strapping resulted in early spontaneous hernia closure independent of the diameter of the hernia orifice and the timing of treatment. Furthermore, adequate adhesive strapping reduced the rate of infants requiring surgical repair from 10 to 20% in spontaneous closure to 7.86% (Yanagisawa et al., 2016).

Surgical procedures commonly used in the repair of umbilical hernias include suture repair (Mayo's method) and prosthetic repair (mesh repair) methods (Arroyo, A., Garcia P. et al., 2001). Laparoscopic repair has also been tried (Synder, C.L, 2007). Either a para-umbilical or trans-umbilical incision is made, and the sac is dissected, avoiding resection of the contents of the sac. Both sac and contents are restored into the abdominal cavity. Hernioplasty is done by placing a polypropylene prosthesis in the extra-peritoneal plane and fixed with individual sutures (Arroyo, A., Garcia P., et al., 2001). The type of surgical procedure affects the long-term outcome. Suture repair (Mayo's repair) has a high recurrence rate compared to mesh repair. However, there is no difference in the early outcome between the two procedures (Arroyo, A., Garcia P., et al, 2001).

Surgical Site Occurrence (SSO) was coined by Ventral Hernia Working Group and is used to encompass all peri-operative wound events (Petro & Novitsky, 2016). They consist of infections, sterile fluid collection (seroma or hematoma), wound

dehiscence, and enterocutaneous fistulae. According to the Centre for Disease Control, surgical site infection is further classified as superficial, deep, or organ space. Umbilical hernia repair has an overall early post-operative morbidity rate of 2%. These are superficial wound infection (1%), hematoma (1%), and seroma (<1%). The post-operative recurrence rate is 2% (Zendejas et al., 2011). This is similar in Japan where the early post-operative complications consist of wound infection (2.3%) and hematoma (0.8%) (Zenitani et al., 2017).

Factors such as patient's age (< 4years), race /ethnicity, and initial presentation at the emergency department are some of the factors associated with hernia recurrence (Halleran et al., 2020). Wide defects and less developed umbilical fascia with lower tensile strength are possible reasons why recurrence is common in children operated on at a young age (<4 years).

Children admitted for elective surgery have a shorter hospital stay than those admitted for emergency (Machekano & Katzenstein, 1994). The average length of stay is three days (Waweru et al., 2014), and the mortality rate is unknown.

CHAPTER THREE

3.0 Methodology and Procedures

3.1 Study Design

A prospective descriptive study design was conducted for 12 months, starting from 14th March 2019 to 13th March 2020.

3.2 Study Site

The study was carried out at MTRH, Eldoret, Uasin Gishu County. Specifically, the surgical wards, emergency units and surgical outpatient clinic where initial recruitment and follow-up were done.

Eldoret town serves as the headquarters of Uasin Gishu County. It is located 311 km northwest of Nairobi, the capital city. It lies on the geographical latitude of 0° 31'N and longitudinal 35° 17'E. Agriculture is the main economic activity due to its favourable climate and hence, one of Kenya's breadbaskets. It is one of the fastest-growing towns in the country and hosts several universities and middle-level training colleges.

MTRH is the second national referral hospital and serves western Kenya, North Rift, parts of Eastern Uganda, and South Sudan, with an estimated population of 20 million in the catchment area. It has a bed capacity of 1000. MTRH was upgraded from the former Uasin Gishu County Hospital in the late 1990s. According to the hospital's central statistics, MTRH has an average outpatient of 210,000 and cumulative inpatients of 35,000 per year. The hospital hosts students from many training institutions, i.e. KMTC, University of East Africa, Baraton, Moi University, and international students on an exchange program. It has several operating suites, i.e. Majaliwa theatre with six operating suites, Shoe for Africa with two operating suites,

Relay Mother and Baby with two operating suites, Neuro-theatre with two operating suites, and Memorial wing with one operating suite. Both adults and pediatric surgical patients are operated on in these theatres.

It offers specialized services provided by highly trained and specialized medical staff from the hospital and college of health sciences, Moi University. The department of surgery at MTRH has bed occupancy of between 100% and 150%.

The hospital collaborates with some foreign institutions; this led to establishment of AMPATH Research Centre, a collaboration involving Indiana and Moi universities.

The pediatric surgical ward is housed in the children's hospital- Shoe for Africa. The department is run by two pediatric surgeons, one general surgeon, and a team of nurses supplemented by masters of medicine in general and pediatric surgery resident doctors, visiting doctors from Indiana University, training medical and nursing students. The ward has a capacity of 100 beds. The pediatrics surgical outpatient clinic is located in Shoe 4 Africa's outpatient department. It operates weekly for follow up of post-operative patients and booking for elective surgery.

The adult surgical wards have a bed capacity of 100 beds. It is run by a team of general surgeons and residents in their different levels of training. Children between the ages of 15 and 17 years are usually admitted in the surgical wards. The adult surgical outpatient clinic operates four times in a week and older children are booked from this clinic for their elective surgery as well as followed up post-operatively.

3.3 Target Population

All children aged below 18 years admitted to MTRH surgical pediatric ward with umbilical hernia were recruited into the study.

3.3 Study Population

All those in the target population who met eligibility criteria.

3.4 Eligibility Criteria

3.4.1 Inclusion Criteria

All children aged below 18 years with a confirmed diagnosis of Umbilical hernia from 14th March 2019 to 13th March 2020.

Children whose definitive management was surgical treatment.

3.4.2 Exclusion Criteria

Recurrent umbilical hernia

Children with other congenital anomalies

Para-umbilical hernia

3.5 Determination of Sample Size

The main aim of the study was to estimate the treatment outcome as the proportion of those who developed complications within two weeks of follow up. Therefore, the sample size was calculated as described by Lemeshow, et al., (1990) for estimating a single proportion.

$$n \geq \frac{Z_{1-\alpha/2}^2 p(1-p)}{d^2}$$

Where:

n = desired sample size.

$Z_{\alpha/2}$ = Critical value for standard normal distribution at α -level of significance

($\alpha=0.05$, $Z_{\alpha/2}=1.96$)

p = estimated prevalence rate of early complication after surgery =2.0% (from a study done in USA by Zendejas et al., 2011).

d= Margin of error (d=0.05).

q = 1-p

$$n_1 \geq \frac{1.96^2 \times 0.02 (1 - 0.02)}{0.05^2} = 30.12 \text{ rounded of to 31 respondents}$$

Considering the worst-case scenario of a 20% attrition rate, we inflate the sample size by 20% to take care of lost to follow up.

$$n \geq \frac{31}{1 - 0.20} = 38.75 \text{ rounded of to 39 respondents}$$

3.6 Sampling Technique and Data Collection Methods

Consecutive sampling method was employed.

The participants were recruited from the SOPC, surgical wards, and emergency units once a diagnosis of umbilical hernia was made.

The study was conducted by the principal investigator and one research assistant.

The first study subject was identified as the first participant with UH who appeared in the paediatric surgical outpatient clinic on the first day of the study. He was identified by the principal investigator who explained the procedure and purpose of the study to the parents/guardian in a simple and straightforward language which they comprehended.

The explanations were done in a relaxed and comfortable environment. Informed consent was sought from the child's parents/ guardian and assent in children above seven years. Participants' confidentiality was upheld at all times. Eligible participants were enrolled in the study by recording their parent's/guardian's contacts in a register and unique code number allocated to them by the research assistant.

The participant's demographics and the findings of the operation done were obtained from the patient's hospital chart. A face-to-face interview with the parents/ guardians was carried out to obtain the family history and the presenting symptoms; this

information was recorded in a pre-tested questionnaire. The principal investigator/ research assistant did the anthropometric measurements after undergoing two weeks of training at the maternal child health and clinic. Mid-Upper Arm Circumference (MUAC) measurements were taken for all children to determine the nutritional status using arm circumference "insertion" tape which is 25 cm long. The tips of the shoulder and elbow were located. Then, the tape was placed from the tip of the shoulder to the tip of the elbow, and the midpoint was determined and marked. The arm circumference was measured at this midpoint by wrapping the tape around the arm. The weight and the height/length were taken for all children using a standard height board, digital baby scale/ salter scale for children under one year, and digital bathroom scale for children above one year. The Z-score was determined using a standardized World Health Organization Z- score chart.

Physical examination was done and findings were entered into a data collection sheet by the research assistant. The participant was examined in a comfortable examination room, with adequate privacy, by the principal investigator who is a registered medical doctor and a resident in the department of general surgery.

The abdomen was exposed from the xiphisternum up to the mid-thigh. The umbilical fascial defect diameter was measured using a tape measure with the subject in a supine position and abdomen relaxed as much as possible. The width or length measurement represented the diameter of the defect. The width measurement is defined as the greatest horizontal distance in centimetres between the hernial defect's lateral margins on both sides. The length refers to the greatest vertical distance between the most cranial and caudal margin of the hernia defect.

In a standing position, the hernia's protrusion length was measured from the tip of the hernial sac up to the peri-umbilical skin using a standard ruler. The pre-operative diagnosis was made and recorded in the questionnaire.

The operation was performed in the main operating theatre by pediatric surgeons or residents in either general or pediatric surgery. Both the intra-operative findings and final post-operative diagnosis were obtained from the patient's chart and recorded in the questionnaire. A trans-umbilical incision was the standard incision done for all the patients who underwent UH repair at MTRH. The sac was dissected off, and the contents reduced into the abdominal cavity. Herniorrhaphy and umbilicoplasty were done using a simple interrupted suturing technique of the defect with an absorbable suture. The patients were examined on the first post-operative day for any complications and findings recorded. A second examination was conducted on the 14th post-operative day for any complications such as infections, fistula formation, seroma, and wound gaping.

There were two points of follow-up; the first follow-up on day one post-operative in the ward and 2nd follow up at the end of two weeks at the surgical outpatient clinics, and any complications noted were recorded in the data collection sheet.

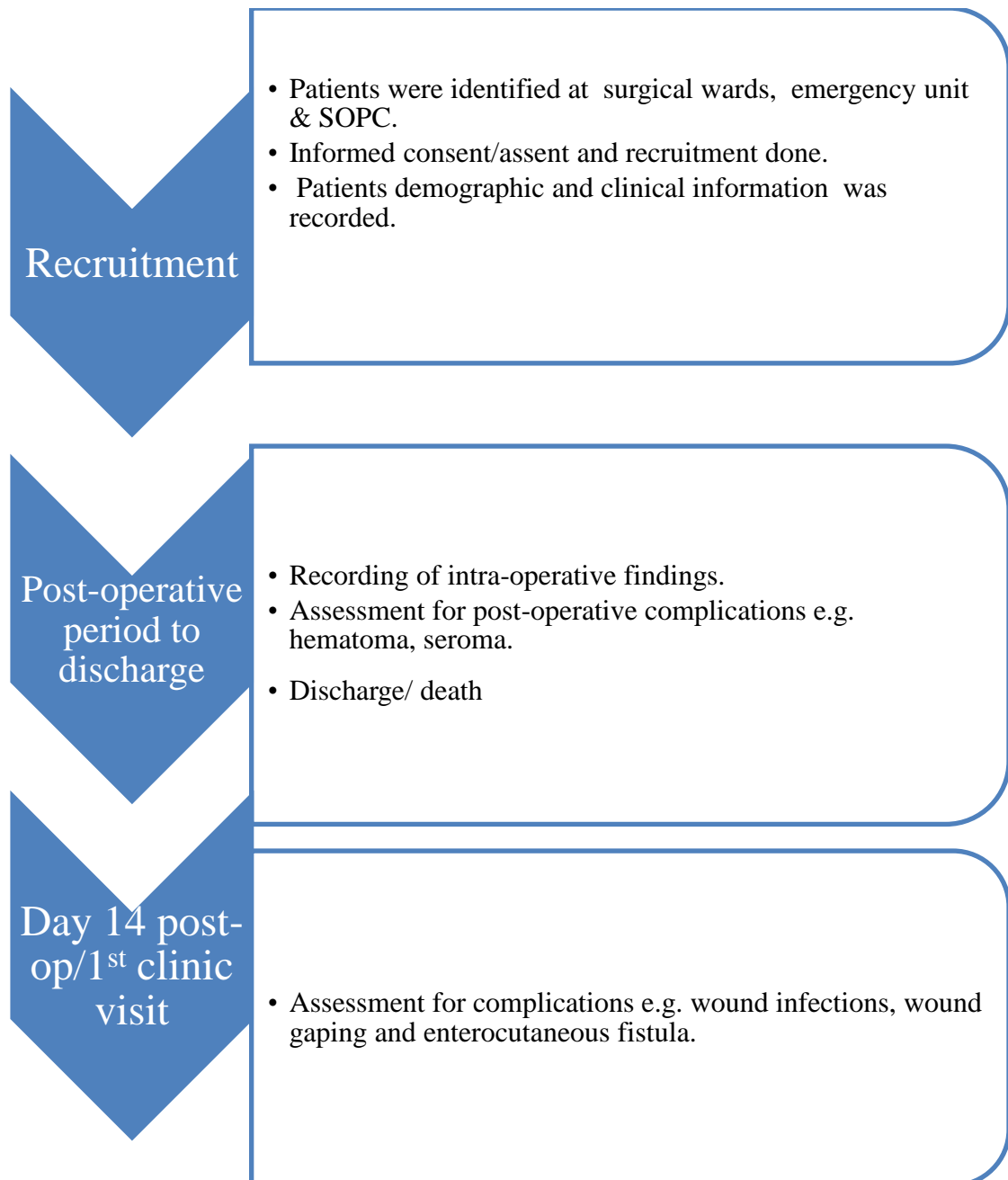


Figure 3: Flow diagram showing study procedure

3.7 Measures of Outcomes

The outcomes of the participants were measured or assessed using morbidity rates, mortality rates, and duration of post-operative hospital stay. Early complications like infections, hematoma, and seroma were assessed. For this study, short-term complications referred to any complications developed within the first two weeks of the post-operative period. The duration of post-operative hospital stay was the interval between the time of operation and the time a decision to discharge the patient was reached. Further stay in the ward for other reasons were not considered.

3.8 Data Management and Analysis

The data collected using questionnaires were checked for completeness by the researcher daily before being keyed into a Microsoft access database. At the end of data collection, data was imported into STATA/MP version 15, where coding, cleaning, and analysis were done.

Descriptive statistics was used to summarize the data. Categorical variables were summarized as frequencies and proportions, while bar graphs were plotted to show the distribution. Numerical variables were summarized through measures of central tendency and dispersion.

Students' T-test and Analysis of Variance (ANOVA) was performed to determine the association between categorical variables at 0.05 α level of significance. The test statistics and corresponding p-values were reported.

3.9 Ethical Consideration

Ethical approval to conduct the study was obtained from the Institutional Research Ethics Committee (IREC) via approval number FAN: IREC 3247 (Appendix 5). The parents/guardian of the patients were informed of the benefits and risks of the study in a language that they fully understood, and informed consent (Appendix 2) was obtained from each participant's parent. Assent from the eligible minors (> 7years) was also obtained after explaining the benefits and risk of the study in a language they fully understood. Permission to conduct the research was sought from the hospital administration before the commencement of the study.

The participants were informed that they were free to withdraw from the study at any stage, and this will not affect their treatment negatively. Patient confidentiality was maintained at all times.

The collected data was stored in a locked cabinet that was only accessible to the principal investigator. Electronic data was stored in a password-protected computer. The disposal of the patient particulars after the completion of the Masters of Medicine program will be as per the IREC guidelines. A copy of this thesis will be available at Moi University Library.

3.10: Dissemination of findings

The thesis report was bound in the university library. It will be published in medical journals and also presented in local/international conferences.

3.11: Study limitation

Measurement of the hernial defect size was a challenge in younger children as they were uncooperative pre-operatively. This was mitigated by measuring the defect size when the child was under general anaesthesia in the operating theatre.

A paucity of literature as most of the available pieces of literature are few and old.

Recall bias by some parents/ guardian as they could not exactly remember the chronology of symptomatology as requested by the principal investigator.

CHAPTER FOUR: RESULTS

4.0 Introduction

A total of 39 children presenting with umbilical hernias and operated at MTRH between March 2019 and March 2020 were recruited in the study.

4.1 Socio-Demographic Characteristics

The 39 participants had a median age of 25 (IQR: 14, 50) months with a range of 5 to 147 months. There was an equal distribution in terms of gender, with females constituting 51.3%.

Table 2: Socio-demographic characteristics

Variable	Freq\	Median	%\IQR
Parent Occupation			
Business	14		35.89
Casual worker	8		20.5
Employed	1		2.56
None	3		7.69
Peasant farmer	13		33.33
Age in months	25	14, 50	
Gender			
Female	20		51.28
Male	19		48.72
Weight in kg	12	9.2, 16.6	
Height in cm	86.5	77, 102	
MUAC	15	13, 15.8	
Z score			
-1SD	29		74.35
-2SD	7		17.95
-3SD	3		7.69

The majority of the participants (61.5%) are from low socioeconomic status, while 38.5% have a stable income source, as shown in the above table.

The median weight was 12 kilograms (IQR: 9.2, 16.6). The median height was 86.5cm (IQR: 77, 102). The median MUAC was 15cm (IQR: 13,15.8). Based on the weight and height, the anthropometric z- score was derived from anthropometric tables. Most of the participants (74.4%) had a Z score of -1SD. Few participants (18%) had a Z score of -2SD, while 7.7% have a Z score of -3SD. This means that 92.3% (n=36) of the participants had an anthropometric Z- score of -2.0 SD or greater and hence have a normal nutrition status. Only 7.7% (n=3) with an anthropometric Z- score of -3SD were moderately malnourished.

4.2 Clinical Presentation

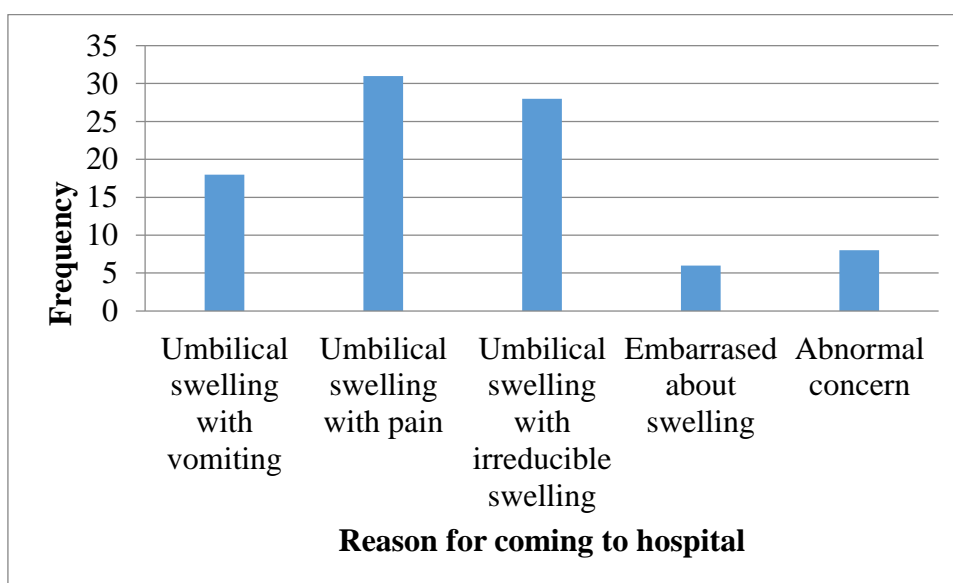
4.2.1 Medical, Family and Social History

Table 4.2.1 below shows the medical and family history of the participants. It was observed that 37 (94.9%) of the participants completed the intrauterine life. Very few (5.1%) had a low birth weight. Seven of the participants (18%) had a family history of an umbilical/ inguinal hernia. Only one participant (2.6%) had a history of chronic cough as a likely predisposing factor.

Table 3: Showing risk factors

Variable	Frequency	%
Completed Intrauterine life		
No	2	5.13
Yes	37	94.87
Birth weight		
Less than 2.5 Kg	2	5.13
More than 2.5 Kg	37	94.87
Parent ever had umbilical/inguinal hernia		
Don't know	3	7.69
No	29	74.36
Yes	7	17.95
Symptom last one month		
Cough	1	2.56
Constipation	0	0
Chronic abdominal distension	0	0
Difficulty in passing urine	0	0

4.2.2: Reasons for Coming to Hospital

**Figure 4: Showing the presenting symptoms**

Umbilical swelling with pain (n=32) was the main reason that brought the participants to the hospital, as shown in figure 4.2.2 above. This was followed by irreducible umbilical swelling (n=28) and umbilical swelling with vomiting (n=18). Only 6 participants felt embarrassed about the umbilical swelling.

4.3: Physical Examination Findings

Table 4.3 below shows the physical examination findings. The mean length of the umbilical hernia was 2.27cm (std=0.85).

On physical examination, 66.7% (n=26) of participants presented with irreducible umbilical swelling. The majority of the participants, 74.4% (n=29), were noted to have had a tender umbilical swelling at the time of the abdominal examination. Only one patient (2.6%) had an ulcerated umbilical swelling.

Most of the participants, 64.1% (n=25), had medium sized umbilical defects (between 2-4cm) while 28.2 % (n=11) had smaller defect sizes (less than 2cm). Only 7.7% (n=3) had a larger umbilical defect (greater than 4cm).

Incarcerated umbilical hernia accounted for the bulk of the pre-operative diagnosis representing 66.7% (n=26). This was followed by reducible umbilical hernia at 25.6% (n=10) and obstructed umbilical hernia at 5.1% (n=2). One patient (2.6%) had evisceration as a pre-operative diagnosis.

Table 4: Shows physical examination findings

Variable	Freq	%
Umbilical swelling reducible	12	30.77
Umbilical swelling irreducible	26	66.67
Umbilical swelling tender	29	74.36
Umbilical swelling ulceration/ wounds	1	2.56
Size of the defect		
<2cm	11	28.21
2-4cm	25	64.1
>4cm	3	7.69
Pre-operative diagnosis		
Evisceration Umbilical hernia	1	2.56
Incarcerated umbilical hernia	26	66.67
Obstructed umbilical hernia	2	5.13
Reducible umbilical hernia	10	25.64

4.4: Indications for surgery and intra-Operative Findings

Table 5: Showing indications for surgery and intra-operative findings

Variable	Freq	%
Reason for surgery		
Elective surgery	10	25.64
Emergency surgery	29	74.36
Cause of the emergency n=29		
Evisceration	1	3.45
Incarceration	26	89.66
Obstruction	2	6.9
Anaesthesia		
Local	0	0
General	39	100
		97.44
Viable contents	38	
Unviable contents	1	2.56

Seventy-four per cent (n=29) of the participants had undergone emergency surgery for their umbilical hernia, while 25.6 % (n=10) had their surgery done electively as shown in the above table 4.4. Among the patients who underwent emergency surgery, 89.7 % (n=26) were due to incarceration, while 6.9 % (n=2) and 3.5 % (n=1) were due to obstruction and evisceration respectively. All the 39 cases were done under general anaesthesia.

Most of the hernial sac contents (n=38) were assessed intra-operatively and found to be viable. One (2.6%) patient had an eviscerated gangrenous small bowel.

4.5: Post-Operative Outcomes

4.5.1: Post-operative complications (24 hours)

Table 6: Post-operative complications (24 hours)

Post-operative complications	Freq	%
Hematoma	1	2.56
Infections	0	0
Wound gaping	0	0
Seroma	0	0
Entero-cutaneous fistula	0	0
Death	1	2.56

There was one complication (2.6%) during the first 24 hours post-operatively due to hematoma, as shown in table 5.5.1 above. One patient died during the first 24 hours post-operatively due to gangrenous small gut and septicemia following evisceration of UH. The remaining 37 participants had no complications during this period.

4.5.2: Post-operative complications (14th day)

Table 7: Post-operative complications (14th day)

Post-operative complications	Freq	%
Infections	0	0
Hematoma	0	0
Wound gaping	0	0
Entero-cutaneous fistula	0	0

All the remaining 38 participants had no complications during the follow-up period (14th-day post-operation).

4.5.3: Length of Post-Operative Hospital Stay

The mean duration of stay in the hospital in days was 2.40 (std=0.89).

4.5.4: Mortality

There was one (2.6%) mortality that occurred due to eviscerated UH and septicemia.

The remaining 38 participants were discharged home.

4.6: Factors Associated with the Post-Operative Outcome

We assessed factors associated with length of post-operative stay in the hospital, and the results are shown in Table 4.6 below. We observed that size of the defect was the only variable that was statistically significantly associated with length of post-operative stay in the hospital (p-value=0.002). As the size of the defect increases, the post-operative length of stay in the hospital increased. Gender was not significant though the mean duration for males was higher than that of females (p-value=0.609). In terms of age, older children had a longer hospital stay though not a statistically significant difference (p-value=0.191). Those who underwent elective surgery had a longer period of stay than those who went for an emergency though the difference was not statistically significant (p-value=0.217).

Table 8: Factors associated with the length of stay in the hospital

Variable	Mean (std)	P-value
Sex		0.609 ¹
Male	2.47 (0.86)	
Female	2.32 (0.94)	
Age		0.191 ¹
<=24 months	2.19 (0.82)	
>24 month	2.57 (0.92)	
Size of defect		0.002 ²
<2 cm	1.82 (0.84)	
2-4 cm	2.5 (0.76)	
>4cm	3.7 (0.58)	
Indication for surgery		0.217 ¹
Elective	2.7 (1.13)	
Emergency	2.2 (0.78)	

¹T-test ² ANOVA

CHAPTER FIVE: DISCUSSION

5.0 DISCUSSION

Chapter five covers the discussion of the research findings as per the stated objectives.

5.1: Socio-demographics characteristics

Thirty-nine participants were successfully recruited for the study. The median age of umbilical hernia repair was 25 (IQR: 14, 50) months with a range of 5 to 147 months as opposed to findings by other studies which reported higher mean age (Hills-Dunlap et al., 2019, Chirdan et al; 2016, Zendejas et al., 2011). The difference may be explained by the fact that children in our region present with UH complications at a younger age as opposed to findings from these other studies where most of the surgeries are done electively. Opinion has been varied concerning the timing of surgical repair of UH. However, further analysis of the data revealed that 74.4% (n=29) of the participants came for repair earlier than the recommended age of four years. Those children who underwent emergency repair had a median age of 22 (IQR: 13, 42) months as opposed to findings by other studies (Ameh et al., 2003(60 months), Chirdan et al., 2006 (48 months) and R.A.Brown et al., 2006(36 months). The elective cases had a median age of 41.5 (IQR: 18, 105) months as opposed to findings of R.A.Brown et al., 2006 where the average age for uncomplicated UH repair was six years. Therefore, this study's findings do not agree with the natural history of UH, which suggests that surgical intervention for asymptomatic UH should be delayed until four years of age. Children in this study present much earlier both for emergency and elective repair. Hence, delaying surgical intervention until four years of age may lead to more pre-operative complications. The near equal sex incidence among the participants, with females constituting 51.3% (n=20), has also been shown by other studies (Zendejas et al.,2011). It is at variance with David & Mike, 2009,

who showed high male preponderance (M: F =3:1) and a mean age of 5.3+/- 2.7 years. This Nigerian study focused on the prevalence of children with UH presenting with other surgical pathology; hence, more males were recruited, accounting for the disparity between the male and female participants.

The majority of the participants, 61.5% (n=24), are of a lower socioeconomic status similar to findings shown by other studies (Kuubiere et al., 2015, Ireland et al, 2014 and Ebomoyi, 1991). Lower socioeconomic status is associated with delayed or reduced access to surgical care leading to increased complications. This is due to the inability to pay for the cost of surgery and the inaccessibility/unavailability of health care facilities, especially in rural areas. It varies with Hills-Dunlap et al., 2019 who demonstrated that lower-income quintiles were associated with increased odds of early repair due to access to public insurance and the surgeon's concerns that these children may not have routine primary care and follow-up. This is quite different in our set-up where the percentage of people covered by public insurance is low and regular medical visits are unlikely.

The majority of the patients, 92.3% (n=36), had an anthropometric Z- score of -2.0 SD or greater and hence had normal nutritional status. However, malnutrition causes weakness of the abdominal muscles hence predisposing to umbilical hernia. It varies with Ebomoyi, 1991, who noted less than 2% of well-nourished children had UH. His study focused on assessing the relationship between nutritional status and UH in a sizeable Nigerian population, hence the variation.

5.2: Clinical presentation

Most of the patients (97.4%) had no identifiable risk factor for their UH. Other studies have shown the existence of other pathologies in these children (T. Zens et al.,2017, David & Mike, 2009 and Thomson et al.,2012). The known risk factors include Genito-urinary pathologies, conditions causing chronic coughs like Broncho-Asthma and pertussis, constipation, and ascites.

Heredity and familial predisposition have been implicated in the development of umbilical hernia in the African population. However, only 18% of the participants in this study had a family history of umbilical or inguinal hernias as opposed to findings in the USA, where most Afro-Caribbean children have a positive family history (CRUMP, 1952). However, some patients' files were missing this information due to incomplete history taking and this may account for the disparity between the studies.

Despite the association of UH with low birth weight and prematurity (Thomson et al., 2012, Zendejas et al., 2011), many of the participants (94.9%, n=37) in this study were born at term with a birth weight > 2.5kilograms. Probably, the differences between the sample sizes and the duration of the study could explain these variations. The study findings are similar to Keshtgar and Griffiths, 2003 who noted UH incidence as 18-21% in term babies weighing 2500grams in the United Kingdom.

Although UH is primarily described as asymptomatic by most literature, the findings in this study are contrary. Umbilical swelling with pain (n=32) and irreducibility (n=28) was the main presenting symptom among participants, similar to findings by R. A. Brown et al., 2006 in South Africa. The most typical examination findings were tenderness (74.4%) and irreducibility (66.7%, n=26). Most of the participants, 74.4% (n=29), similar to findings of Ireland et al., 2014, Papagrigoriadis & Browse, 1998

and Keshtgar & Griffiths, 2003 were patients with acute complications where the common signs and symptoms reported were abdominal pain, vomiting, erythema, and tender irreducible umbilical swelling. It varies with Waweru et al., 2014, who noted that painless abdominal/ groin swelling was the most typical clinical presentation (81.6%) in Nyeri Provincial Hospital. However, his study focused on all forms of hernias, the majority of the patients were adults, and was not specific to UH.

The majority of the participants, 64.1% (n=25), had a medium-sized umbilical defect (2-4cm), and the mean length of the hernia was 2.27cm (std=0.85), as also reported by other studies (Ameh et al., 2003 and Chirdan et al., 2006). This agrees with the fact that complications are more common in medium-sized defects. It contrasts findings by Tarpley, 2001, who demonstrated an average hernia diameter of 4.2 cm with only 11 complications in Nigeria. Most of the literature available does not give the measurement of the hernia defect in their studies as corroborated by T. J. Zens et al., 2019, who noted that in children under two years old, the indication for surgery was described by the operating surgeon as a large defect in 92% of cases. For the few who measured the defect sizes, there was no standardized description in classifying them, unlike this study that adopted the European Hernia Society Classification. This poses a challenge in comparing these findings with the existing literature.

Although UH complications are believed to be rare, 66.7% (n=26) of the participants had incarcerated UH as their pre-operative diagnosis, which is similar to findings of Chirdan et al., 2006, Machezano & Katzenstein, 1994 and T. Zens et al., 2017. This could be attributed to the fact that, being a hospital-based study, children with complications are more likely to come to the hospital. At the same time, many asymptomatic cases remain at home as the condition is perceived as "normal" in our

society. Incarceration rate differs based on geographical location, being lower in the USA (0.19%) and higher in Africa and India (32-45%) since children in African countries and India rarely present to a hospital unless there is an acute complication related to the hernia (T. Zens et al., 2017). This seems to agree with this study. It differs with findings by T. J. Zens et al., 2019, who, while evaluating age-dependent outcomes in asymptomatic UH in a large retrospective study over seven years in the USA, noted an incarceration rate of 2.6% in 31 symptomatic cases.

Fewer participants, 25.6%, had an asymptomatic reducible UH and underwent elective UH surgical repair similar to findings shown by David & Mike, 2009. Some of these were older children who presented for cosmetic reasons.

The spontaneous evisceration of UH is potentially fatal but occurs rarely. This study has documented a single case of a spontaneous evisceration of the small bowel through the umbilicus, similar to findings by T. Zens et al., 2017; Thomson et al., 2012 and Ameh et al., 2003. Globally, only 20 cases of spontaneous evisceration from UH have been reported (T. Zens et al., 2017). The patient, a 6-month-old female, was brought to the hospital several hours after her bowel's evisceration. Before this, she has been crying for several hours. The whole length of the small intestine was gangrenous, and resection could not be done. She succumbed four hours later as opposed to findings of Thomson et al., 2012, who reported on a similar case with healthy and non-ischemic bowels, and after a repair, the child survived post-operatively. However, the evisceration occurred in a hospital setting, and timely intervention was undertaken, unlike our case which presented late to the facility. Other precipitating events for evisceration include coughing, pneumonia, ascites, positive pressure ventilation, or abdominal pathology (Thomson et al., 2012).

5.3 Indications for surgery

The natural history of UH is spontaneous closure, usually in the first three years of life. However, much of the repairs in Africa are carried out as an emergency, while elective procedures are few (Waweru et al., 2014). In this study, 74% (n=29) of the patients had undergone an emergency repair for their UH, with incarceration accounting for 90% (n=26). This agrees with the findings of Ameh et al., 2003(64%) in Nigeria. This similarity explains the fact that, in our environment, majority of patients with complications present for repair. In all the patients with incarceration, hernia reduction was done in the emergency department under sedation and analgesia, and repair was undertaken 24 hours later. However, Zendejas et al., 2011) and R.A Brown et al., 2006 have reported a low incarceration rate in the USA and South Africa of 7% and 7.2% respectively as opposed to the findings by this study. Probably, the populations in the developed world perceive UH as an abnormality while a deep-rooted cultural practice in Africa delays early surgical intervention. Hence, this may account for the regional variation in incidences of incarceration of UH. There were few cases of obstructed UH (n=2) reported in this study as opposed to findings in Zimbabwe, where obstruction was the most typical cause of emergency UH repair comprising 37.5% (Machekano & Katzenstein, 1994). The high fibre diet consumed by African children could predispose to obstruction by allowing a small bowel loop with food bolus to be trapped in the hernial sac (Machekano & Katzenstein, 1994).

Although elective repair of UH is not common in Africa (Tarpley, 2001), this study has shown that 26% (n=10) of the participants underwent an elective repair similar to findings by other authors (Zenitani et al., 2017, Machekano & Katzenstein, 1994). Six of these patients were older children and had proboscoïd UH and hence felt ashamed

about the swelling. In the other four children, the persistence of the hernia was the reason for the elective repair.

Most of the hernial sac contents (n=38) were assessed intra-operatively and found to be viable. One (2.6%) patient with bowel evisceration through the umbilicus had an unviable whole small gut. General anaesthesia remains the primary mode of anaesthesia for UH surgery (Waweru et al., 2014). This is reflected in the study, where all the operations were done under general anaesthesia.

5.4: Post-operative outcomes and associated factors

Operative repair of UH is a low-risk procedure. However, just like any other surgical procedure, complications do arise. This study has recorded a single complication (2.6%) which occurred 24 hours post-operatively and concurs with findings of Zendejas et al., 2011 and Ameh et al., 2003 in the USA and Nigeria respectively. The complication was due to hematoma formation in a patient who had a huge umbilical hernia. Other studies did not report post-operative complications in their findings (Machekano & Katzenstein, 1994 and Waweru et al., 2014).

The mean duration of post-operative hospital stay was 2.40 days (std=0.89) and concurred with the findings of Waweru et al., 2014. This contrasts findings in Zimbabwe, where children who underwent UH surgery have an average hospital stay of 5.3 days (range 2-14 days) (Machekano & Katzenstein, 1994). The Zimbabwean study assessed the duration the patient was admitted to the hospital up to the time of discharge. However, this study evaluated from the day of operation up to discharge; hence this accounts for the difference between the length of hospital stay in both studies. Elective patients had a longer duration (2.7 days vs 2.2 days) of stay than those who underwent emergency repair. The patients for elective repair were older

children with large defects and hence stayed longer in the ward, possibly due to post-operative pain, though this study did not assess pain. In some centres in the USA, the vast majority (95.8%) of patients who undergo UH repair are discharged the same day (Halleran et al., 2020) due to established daycare surgery as opposed to MTRH, where daycare surgery is yet to take effect.

The defect's size was the only variable that was statistically significantly associated with the post-operative length of stay in the hospital (p-value = 0.002) after being subjected to Analysis of Variance (ANOVA). As the size of defect increases, the length of stay in the hospital increased as opposed to R.A Brown et al., 2006 who proposed defect size as a predictive factor for pre-operative complications.

The participants' age has no association with the post-operative length of hospital stay as a predictor of post-operative outcome (p-value=0.191) as opposed to findings by Halleran et al.; 2020, who noted that post-operative complications following a pediatric UH repair are higher in children younger than four years of age. Hence, this study's findings do not support delaying asymptomatic UH repair in children until four years of age.

One mortality (2.6%) resulted from a child with eviscerated UH and gangrenous small bowel with severe sepsis and anaemia. This concurs with Thomson et al., 2012 who described evisceration of UH as rare but potentially fatal with a mortality rate of 10%. This is contrary to findings in Western Australia where there was no mortality recorded in a 12-year retrospective study (Ireland et al., 2014).

CHAPTER SIX: CONCLUSION AND RECOMMENDATION

6.1: Conclusion.

The median age for UH repair at MTRH is low (25 months) with near equal sex distribution. Abdominal pain and irreducible hernia were present in almost all children with complicated UH. Emergency repair is the most common surgery done for UH at MTRH with incarceration being the main indication of surgery. Operative repair of UH remains a low-risk procedure. The size of the defect is a predictor of the length of hospital stay.

6.2: Recommendations

Since majority of the children in our set up present at younger age with complicated UH, early surgical intervention should be considered.

Children with umbilical hernia should be actively observed/followed up to prevent morbidity from incarceration.

Parents of children with umbilical hernias should be alerted about the signs and symptoms of the hernia's potential complications.

Multi-center study is needed to determine an earlier cut-off age for repair of UH in our set-up.

REFERENCES

- African, S., & Journal, M. (2016). Umbilical hernia in children in a developing country: Does the season have an effect on the occurrence of strangulation? (August).
- Aguirre, D. A., Santosa, A. C., Casola, G., & Sirlin, C. B. (2005). Abdominal wall hernias: imaging features, complications, and diagnostic pitfalls at multi-detector row CT. *Radiographics*, 25(6), 1501-1520.
- Ameh, E. A., Chirdan, L. B., Nmadu, P. T., & Yusufu, L. M. D. (2003). Complicated umbilical hernias in children. *Pediatric Surgery International*, 19(4), 280-282.
- Arroyo, A., Garcia, P., Perez, F., Andreu, J., Candela, F., & Calpena, R. (2001). Randomized clinical trial comparing suture and mesh repair of umbilical hernia in adults. *British journal of surgery*, 88(10), 1321-1323.
- Bandré, E., Kaboré, R. A., Sanou, A., Ouédraogo, I., Soré, O., Tapsoba, T., ... & Bachy, B. (2010). Strangulated umbilical hernia in children (Burkina Faso): differences with developed countries. *Bulletin de la Societe de pathologie exotique (1990)*, 103(2), 100-103.
- Bowen, T. J., Ochs, H. D., Altman, L. C., Price, T. H., Van Epps, D. E., Brautigan, D. L., ... Wedgwood, R. J. (1982). Severe recurrent bacterial infections associated with defective adherence and chemotaxis in two patients with neutrophils deficient in a cell-associated glycoprotein. *The Journal of Pediatrics*, 101(6), 932-940.
- Brown, R. A., Numanoglu, A., & Rode, H. (2006). Complicated umbilical hernia in childhood. *South African Journal of Surgery*, 44(4), 136-137.
- Burcharth, J., Pedersen, M. S., Pommergaard, H. C., Bisgaard, T., Pedersen, C. B., & Rosenberg, J. (2015). The prevalence of umbilical and epigastric hernia repair: a nationwide epidemiologic study. *Hernia*, 19(5), 815-819.
- Cherla, D. V., Lew, D. F., Escamilla, R. J., Holihan, J. L., Cherla, A. S., Flores-Gonzalez, J., ... & Liang, M. K. (2018). Differences of alternative methods of measuring abdominal wall hernia defect size: a prospective observational study. *Surgical endoscopy*, 32(3), 1228-1233.
- Chirdan, L. B., Uba, A. F., & Kidmas, A. T. (2006). Incarcerated Umbilical Hernia in Children. *European Journal of Pediatric Surgery*, 16(1), 45-48.
- Crump, E. P. (1952). Umbilical hernia. *The Journal of Pediatrics*, 40(2), 214-223.
- David, O., & David, M. (2009). The prevalence, spontaneous resolution, and parent's attitudes towards umbilical hernia coexisting in Nigerian children presenting with other surgical pathology. *Annals of Pediatric Surgery*, 5, 16-20.

- Ebomoyi, E., Parakoyi, D. B., & Omonisi, M. K. (1991). Nutritional status and umbilical hernia in Nigerian school children of different ethnic groups. *Journal of the National Medical Association*, 83(10), 905.
- Evans, A. G. (1941). The comparative incidence of umbilical hernias in colored and white infants. *Journal of the National Medical Association*, 33(4), 158.
- Gera, P. (2016). Umbilical Hernia in Childhood : Indications and Mode of Repair, 4, 4–6.
- Gray SW, skandalakis J. (1972). *embryology for surgeons, anterior abdominal wall*.
- Halleran, D. R., Minneci, P. C., & Cooper, J. N. (2020). Association between age and umbilical hernia repair outcomes in children: A multistate population-based cohort study. *The Journal of pediatrics*, 217, 125-130.
- Harvey, B. A. M. (n.d.). Saturday 26. *Lancet*, 1100–1102.
- Hills-Dunlap, J. L., Melvin, P., Graham, D. A., Kashtan, M. A., Anandalwar, S. P., & Rangel, S. J. (2019). Association of sociodemographic factors with adherence to age-specific guidelines for asymptomatic umbilical hernia repair in children. *JAMA pediatrics*, 173(7), 640-647.
- In Rowe MI, O'Neill, Grosfeld JL, et al(eds). (1985). Sadler Tw: Digestive System. In *Langman's Medical Embryology, Baltimore, Williams and Wilkins*.
- Ireland, A., Gollow, I., & Gera, P. (2014). Low risk, but not no risk, of umbilical hernia complications requiring acute surgery in childhood. *Journal of Paediatrics and Child Health*, 50(4), 291–293.
- Keshtgar, A. S., & Griffiths, M. (2003). Incarceration of umbilical hernia in children: is the trend increasing? *European Journal of pediatric surgery*, 13(01), 40-43.
- Komlatsè, A. N. G., Anani, M. A. K., Azanledji, B. M., Komlan, A., Komla, G., & Hubert, T. (2014). Umbilicoplasty in children with huge umbilical hernia. *African Journal of Paediatric Surgery*, 11(3), 256.
- Kutin ND, Allen JE, J. T. (1979). The Umbilical Polyp. *Journal of Pediatric Surgery*, (14), 741–744.
- Kuubiere, C. B., Alhassan, A., Mogre, V., & Majeed, S. F. (2015). The Epidemiology of Hernias in Tamale, Northern Ghana, 3(3), 269–274.
- Lemeshow, S., Jr, D. W. H., Klar, J., & Lwanga, S. K. (1990). *Adequacy of Sample Size in Health Studies*. Chichester: John Wiley and Sons
- Machekano, R., & Katzenstein, D. (1994). Umbilical hernia in Bulawayo : some observations from a hospital based study, 40(11).
- Meier, D. E., OlaOlorun, D. A., Omodele, R. A., Nkor, S. K., & Tarpley, J. L. (2001). Incidence of umbilical hernia in African children: redefinition of “normal” and reevaluation of indications for repair. *World journal of surgery*, 25(5), 645-648.

- Muysoms, F., Miserez, M., Berrevoet, F., Campanelli, G., Champault, G. G., Chelala, E., ...&Pascual, M. H. (2009). Classification of primary and incisional abdominal wall hernias. *Hernia*, *13*(4), 407-414.
- Odonnell, K. A., Glick, P. L., & Caty, M. G. (1998). PEDIATRIC UMBILICAL PROBLEMS, *45*(4), 791–800.
- Papagrigoriadis, S., & Howard, E. R. (1998). Incarceration of umbilical hernias in children: a rare but important complication. *Pediatric surgery international*, *14*(3), 231-232.
- Petro, C. C., & Novitsky, Y. W. (2016). Classification of hernias. In *Hernia Surgery* (pp. 15-21). Springer, Cham.
- Ross, D., Walport, J., Springer, A., Newman, L., & Harrison, A. (2016). By Gordon Rebecca, *66*(4), 882–890.
- Snyder, C. L. (2007, February). Current management of umbilical abnormalities and related anomalies. In *Seminars in pediatric surgery*, *16*(1), 41-49 WB Saunders.
- Thomson, W. L., Wood, R. J., & Millar, A. J. (2012). A literature review of spontaneous evisceration in paediatric umbilical hernias. *Pediatric surgery international*, *28*(5), 467-470.
- Toms, A. P., Dixon, A. K., Murphy, J. M. P., & Jamieson, N. V. (1999). Illustrated review of new imaging techniques in the diagnosis of abdominal wall hernias. *British journal of surgery*, *86*(10), 1243-1249
- Waweru, J., Barasa, M., Mwenda, A. S., & Mwago, J. (2014). Hernia surgery in Nyeri Provincial General Hospital, Kenya: Our 6 year experience. *Annals of African Surgery*, *11*(2), 3–5.
- Winsnes, A., Haapamäki, M. M., Gunnarsson, U., & Strigård, K. (2016). Surgical outcome of mesh and suture repair in primary umbilical hernia: postoperative complications and recurrence. *Hernia*, *20*(4), 509-516.
- Yanagisawa, S., Kato, M., Oshio, T., & Morikawa, Y. (2016). Reappraisal of adhesive strapping as treatment for infantile umbilical hernia. *Pediatrics International*, *58*(5), 363-368.
- Zendejas, B., Kuchena, A., Onkendi, E. O., Lohse, C. M., Moir, C. R., Ishitani, M. B., ...Zarroug, A. E. (2011). Fifty-three – year experience with pediatric umbilical hernia repairs ☆, ☆☆☆. *Journal of Pediatric Surgery*, *46*(11), 2151–2156.
- Zenitani, M., Sasaki, T., Tanaka, N., & Oue, T. (2018). Umbilical appearance and patient/parent satisfaction over 5 years of follow-up after umbilical hernia repair in children. *Journal of pediatric surgery*, *53*(7), 1288-1294.
- Zens, T. J., Cartmill, R., Muldowney, B. L., Fernandes-Taylor, S., Nichol, P., & Kohler, J. E. (2019). Practice variation in umbilical hernia repair demonstrates a need for best practice guidelines. *The Journal of pediatrics*, *206*, 172-177.

Zens, T. J., Rogers, A., Cartmill, R., Ostlie, D., Muldowney, B. L., Nichol, P., & Kohler, J. E. (2019). Age-dependent outcomes in asymptomatic umbilical hernia repair. *Pediatric surgery international*, 35(4), 463-468.

Zens, T., Nichol, P. F., Cartmill, R., & Kohler, J. E. (2017). Management of asymptomatic pediatric umbilical hernias: a systematic review. *Journal of pediatric surgery*, 52(11), 1723-1731.

APPENDICES

Appendix I: Questionnaire

QUESTIONNAIRE

SECTION A: SOCIO-DEMOGRAPHIC DATA

Date.....Study No.....

What is the occupation of the parent/guardian of the child?

Government/County employee

Peasant farmer

Casual worker

Business

None

Others specify.....

Age of the child: Years Months

Gender of the child Male Female

Weight of the child.....kg

Height /length (in cm)

MUAC

Z- Score -3SD -2SD -1SD

SECTION B: MEDICAL HISTORY AND FAMILY SOCIAL HISTORY

Did this child complete 9 months of intrauterine life? YES NO

What was the child's weight at birth?

Less than 2.5 kg

More than 2.5 kg

Has the child had any one or more of the following symptoms in the last month?

Chronic cough YES NO

Constipation YES NO

Chronic abdominal distension YES NO

Difficulty in passing urine YES NO

Others(specify).....

Has any of the parents ever had inguinal or umbilical swelling (hernia)?

YES NO DON'T KNOW

Reasons for coming to the hospital

Umbilical swelling with:

Vomiting YES NO

Pain YES NO

Irreducible swelling YES NO

Feeling embarrassed about the swelling YES NO

Unable to wear clothes YES NO

For cosmesis/concern that is abnormal YES NO

SECTION C: PHYSICAL EXAMINATION FINDING

Umbilical swelling - Reducible YES NO

Irreducible YES NO

Tender YES NO

Ulceration/ wounds YES NO

Length of the umbilical herniacm

Size of the defect (width in cm) < 2cm..... 2-4cm..... > 4cm.....

Pre-operative diagnosis.....

SECTION D: INTRAOPERATIVE FINDING

Reason for surgery Emergency surgery.....

Elective surgery.....

If an emergency, what is the likely cause of the emergency?

Incarceration.....

Strangulation.....

Obstruction.....

Evisceration.....

Others.....

Type of anaesthesia used in the surgery

Local anaesthesia YES NO

General anaesthesia YES NO

During the operation, were the contents viable? YES NO

SECTION E: POST-OPERATIVE OUTCOME AND COMPLICATION

What is/are the complication(s) observed in the first 24 hours of post-operation?

No complications Yes No

Infections Yes No Hematoma Yes No

Wound gaping Yes No

Seroma Yes No Entero-cutaneous fistula Yes No

Others

What is/are the complication(s) observed on the 14th day of post-operation (follow up)?

No complication Yes No

Infections Yes No Hematoma Yes No

Wound gaping Yes No

Entero-cutaneous fistula Yes No

Others

Date of admission of the child.....

Date of discharge of the child.....

Length of post-operative hospital stay.....

Number of patients discharged.....

Number of patients who died.....

Appendix II: Consent Form

STUDY TITLE: clinical presentation and surgical treatment outcomes among children with an umbilical hernia at MTRH

Serial Number: -----

Study Number: -----

Dear Parent/ Guardian,

My name is Dr Yussuf. I am pursuing masters of medicine degree in the department of general surgery at Moi University.

I am conducting a research study to determine the clinical presentation and early surgical treatment outcomes among children with umbilical hernias at Moi Teaching and Referral Hospital-Eldoret Kenya.

I would like to include your child as a participant to use his/her data and findings to improve the management of patients with similar problems. No name is required, and your information/ findings shall be utilized only for the research.

This will require that I administer to you a questionnaire and examine your infant/ child.

The physical examination will involve undressing the abdomen while the participant is lying on a comfortable and secure examination bed. The examiner will then examine the umbilicus. The examination is in no way harmful to your child. Participation in this study is voluntary, and your decision on whether to participate or not will not prejudice you/ your child's care in any way. Strict confidentiality will be observed at all times. There will be no added costs.

I hope that you accept for your child to participate in this study.

Parent/ Guardian:

I, Mr/Mrs/Miss..... being a person aged 18 years and over, having read/ been explained to the above, and in the knowledge that it is voluntary, do hereby give consent for my child to participate in this study. I understand that my child has the right to withdraw from the research at any time, for any reason, without penalty or harm.

Relation to the child if not the parent-----

SignatureDate:.....

Child's signature if above 7 years (Assent)

Signature.....Date:.....

Name of the person taking the consent:

Signature-----Name-----Date-----

TAFSIRI: IDHINI YA KUSHIRIKI KWA UTAFITI**IDHINI FOMU**

Nakuomba Mzazi / Mlezi,

Jina langu ni Daktari Yussuf.

Ninasoma shahada ya uzamili katika idara ya upasuaji. Ninafanya utafiti juu ya matokeo ya upasuaji wa kurekebisha henia ya kitovu kwa Watoto wanaotembelea Hospitali kuu ya Moi Teaching and Referral, Eldoret.

Ningependelea mtoto wako akuwe mshiriki.

Utahitajika kujibu maswali kadha. Na pia mtoto kufanyiwa uchunguzi wa kimwili.

Uchunguzi wa kimwili utahusisha ukaguzi wa eneo la kitovu kama mgonjwa amelazwa katika kitanda mzuri na salama. Uchunguzi huu hauna madhara yoyote kwa mtoto wako. Usiri utatunzwa wakati wowote.

Ushiriki wako kwa utafiti huu ni kwa hiari na uamuzi wako. Una ruhusa kukataa kujibu maswali ama kutojihusisha na utafiti huu wakati wowote. Uamuzi wako kushiriki au kutoshiriki utafiti huu hauta athiri huduma kwa mtoto wako kwa njia yoyote. Kushiriki kwa mtoto wako kwa utafiti huu hauna ongezeko wa gharama. Utafiti huu utafafanua maarifa juu ya kupima na kutibu ugonjwa huu na itatusaidia kuyarekebisha na kuboresha huduma yetu kwa watoto wanaoathirika.

Nina omba idhini ya mtoto wako kushiriki.

Ahsante.

Ruhusa ya mzazi/mlezi

Mimi ----- nimeelewa maelezo juu ya huu utafiti
na ninakubali mtoto wangu kushiriki.

Sahihi-----Tarehe-----

Walio juu ya miaka 7

Mimi ----- nimeelewa maelezo juu ya huu utafiti
na ninakubali kushiriki.

Sahihi-----Tarehe-----

Jina la anayechukua idhini

Sahihi -----Jina-----

Tarehe-----

Appendix III: Work plan

ACTIVITY	TIMELINES	PERSON RESPONSIBLE	LOCATION
Proposal writing	3 months (Jan – March 2018)	Principal investigator	Moi University, MTRH
Critique of the proposal by department/supervisors	3 months (July– Sep2018)	Principal investigator/colleagues / Supervisors	Moi University, MTRH
Presentation to IREC / IREC approval	Oct 2018	Principal investigator	Moi University, MTRH
Study participants recruitment and data collection	12 months	Principal investigator, Research assistant	Pediatric Surgical ward and POPC
Data analysis and interpretation	3 months (March-May 2020)	Principal investigator	Moi University
Completion of thesis writing	July 2020	Principal investigator	Moi University
Critique of the thesis by supervisors	3 months (July – Sept 2020)	Supervisors	Moi University
Thesis defense	Nov 2020	Principal investigator	Moi University

Appendix IV: Budget

Foolscaps and photocopy paper 10 reams @ 600	6000
Printing proposal booklets 6 copies	4800
Printing & binding thesis booklets 6 copies	6000
Questionnaire printing 100 copies	3600
Pens 2 dozen	480
Notebooks 4	400
Pocket files 2	400
Internet services	10000
Research assistant's wage @ 5000/month	45000
Biostatistician	30000
IREC fee	2000
Miscellaneous	25000
TOTAL	KSh. 120,080

Appendix V: IREC Approval



MU/MTRH-INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC)
 MOI TEACHING AND REFERRAL HOSPITAL
 P.O. BOX 3
 ELDORET
 Tel: 334711/2/3
 Reference: IREC/2018/303
Approval Number: 0003247



MOI UNIVERSITY
 COLLEGE OF HEALTH SCIENCES
 P.O. BOX 4606
 ELDORET
 14th March, 2019

Dr. Yussuf Salat Jelle,
 Moi University,
 School of Medicine,
 P.O. Box 4606-30100,
ELDORET-KENYA



Dear Dr. Salat,

RE: FORMAL APPROVAL

The MU/MTRH- Institutional Research and Ethics Committee has reviewed your research proposal titled: -

"Clinical Presentation and Treatment Outcomes among Children with Umbilical Hernia at Moi Teaching and Referral Hospital, Eldoret, Kenya".

Your proposal has been granted a Formal Approval Number: **FAN: IREC 3247** on 14th March, 2019. You are therefore permitted to begin your investigations.

Note that this approval is for 1 year; hence will expire on 13th March, 2020. If it is necessary to continue with this research beyond the expiry date, a request for continuation should be made in writing to IREC Secretariat two months prior to the expiry date. You will be required to submit progress report(s) on application for continuation, at the end of the study and any other times as may be recommended by the Committee.

Furthermore, you must notify the Committee of any proposal change (s) or amendment (s), serious or unexpected outcomes related to the conduct of the study, or study termination for any reason. You will also be required to seek further clearance from any other regulatory body/authority that may be appropriate and applicable to the conduct of this study.

Sincerely,

DR. S. NYABERA
DEPUTY-CHAIRMAN
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE

cc CEO - MTRH Dean - SOP Dean - SOM
 Principal - CHS Dean - SON Dean - SOD

Appendix VI: Hospital Approval



An ISO 9001:2015 Certified Hospital



MOI TEACHING AND REFERRAL HOSPITAL

Telephone : (+254)053-2033471/2/3/4
 Mobile: 722-201277/0722-209795/0734-600461/0734-683361
 Fax: 053-2061749
 Email: ceo@mtrh.go.ke/directorsoffice@mtrh@gmail.com

Nandi Road
 P.O. Box 3 – 30100
 ELDORET, KENYA

Ref: ELD/MTRH/R&P/10/2/V.2/2010

19th March, 2019

Dr. Yussuf Salat Jelle,
 Moi University,
 School of Medicine,
 P.O. Box 4606-30100,
ELDORET-KENYA.

APPROVAL TO CONDUCT RESEARCH AT MTRH

Upon obtaining approval from the Institutional Research and Ethics Committee (IREC) to conduct your research proposal titled:-

“Clinical Presentation and Treatment Outcomes among Children with Umbilical Hernia at Moi Teaching and Referral Hospital, Eldoret, Kenya”.

You are hereby permitted to commence your investigation at Moi Teaching and Referral Hospital.

Wilson 19/03/2019
DR. WILSON K. ARUASA, MBS MOI TEACHING AND REFERRAL HOSPITAL
CHIEF EXECUTIVE OFFICER
MOI TEACHING AND REFERRAL HOSPITAL
 cc - Senior Director, (CS)
 - Director of Nursing Services (DNS)
 - HOD, HRISM
APPROVED
19 MAR 2019
 SIGN.....
 P. O. Box 3 - 30100, ELDORET

All correspondence should be addressed to the Chief Executive Officer

Visit our Website: www.mtrh.go.ke

TO BE THE LEADING MULTI-SPECIALTY HOSPITAL FOR HEALTHCARE, TRAINING AND RESEARCH IN AFRICA