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PREVALENCE OF HALLUX VALGUS: AN OBSERVATIONAL POST-MORTEM BASED STUDY AT THE UNIVERSITY TEACHING HOSPITAL, LUSAKA.

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This dissertation of MBAWE ZULU on THE PREVALENCE OF HALLUX VALGUS: AN OBSERVATIONAL POST-MORTEM BASED STUDY AT THE UNIVERSITY TEACHING HOSPITAL, LUSAKA has been approved in partial fulfillment of the requirements for the award of Master of Science in Human Anatomy by the University of Zambia.

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ABSTRACT

PREVALENCE OF HALLUX VALGUS: AN OBSERVATIONAL POST-MORTEM BASED STUDY AT THE UNIVERSITY TEACHING HOSPITAL, LUSAKA.

Background. Hallux valgus is the lateral deviation of the big toe towards the other toes of the same foot. It is one of the commonest orthopaedic conditions of the forefoot. There are many risk factors including heredity, sex, age and footwear. The condition can progress to a painful stage where surgery, which may be expensive, is indicated. Numerous studies have been conducted to investigate its aetiology and demographics. However, the prevalence of hallux valgus in Zambia is not known. The gold standard for studying hallux valgus is radiology. However, because of lack of such a modality, the clinical Manchester Scale was used instead as it gives the necessary information on angulation deformity which is the main objective of the study.

Objectives. To determine the prevalence of hallux valgus, and its distribution with gender, age and foot length among dead bodies brought in for autopsy at the UTH mortuary

Method and equipment. Three hundred and forty five dead bodies qualified for the study. Each foot was set in a standard position, on a glass jig, at 90 degrees dorsiflexion. Then, hallux vulgas was measured using the Manchester scale. Foot-length of the left was measured, on a line joining the most distal point of the ball of the longest toe to the most proximal part of the calcaneal pad, using a metric ruler.

Results. The prevalence of HV was found to be at 2.6 per cent (9 cases) by clinical definition and 34.6 (118 cases) per cent radiographically, by extrapolation. There was 1.45 percent (5 cases) prevalence among females and 1.15 per cent (4 cases) male even though there was no statistical association between HV and gender (p-value>0.05). The prevalence of HV increased with age, and was highest (41 cases, 21.7 per cent) in the 30 to 49 year age group (p-value<0.05). The prevalence of HV increased with foot length with the 20 cm to 30 cm foot length category having a peak frequency of 75 cases (p-value<0.05).

Conclusion Prevalence of HV is 2.6 per cent. The frequency of HV among females is 1.45 per cent and 1.15 per cent among males. The age group with most moderate and severe HV (1.7 per cent) is 30 to 49 years. Furthermore, within each age group there was an increasing trend with ageing. HV is greatly prevalent among feet in the 25 to 30 cm range (1.4 per cent). Furthermore, an increasing trend of HV was evident with increasing foot length in the other groups.

Key words: Hallux Valgus; Manchester scale; Post-mortem; Lusaka.

DEDICATION

For my Mother and remembering my Father.

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I appreciate my family for the support and for understanding my absence from their enduring love. A zillion thanks to my elder Brother David Makadani Zulu for guiding me into the scholastic pathway. I am indebted to my employer, Lusaka Apex Medical University, particularly Professor Lupando Munkonge, for the support. Also, I thank the Medical Education Partnership Initiative for awarding me the scholarship without which little would have been realised. Special thanks go to my supervisor Professor Krikor Erzingatsian under whose tutelage this paper was developed as well as for being a living example of enthusiasm. I give my gratitude to Dr Elliot B. Kafumukache and the Department of Anatomy of the University of Zambia, School of Medicine for accommodating the programme. Dr Selestine Nzala the Assistant Dean-Postgraduate is appreciated for his prompt assistance in numerous ways towards facilitating my scholarly welfare. Professor Sekelani Banda is acknowledged for giving some useful information on research development. I thank my classmates for the worth-while company. I thank Dr Victor Mudenda, Head of Pathology and Microbiology department of the University Teaching Hospital for granting me the permission to conduct data collection from the mortuary. Lastly but not the least, I would like to thank the staff at the UTH mortuary particularly the forensic unit for the co-operation and assistance rendered during data collection. Above all, I give thanks and praises to GOD.

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ABBREVIATIONS and ACRONYMS

CSO: Central Statistical Office of the Government of the Republic of Zambia

ERES CONVERGE: Excellence in Research and Ethics Science (I.R.B.No 00005948)

HV: ***Hallux Valgus*** means deviation of the big toe towards other toes of the same foot.

HVA: ***Hallux Valgus Angle*** means the angle between long axes of the first metatarsal and proximal phalange in the horizontal plane.

IMA: Inter-metatarsal Angle mean the one between the first and the second metatarsal

UNZA: the University of Zambia, Lusaka, Zambia.

UTH: University Teaching Hospital, Lusaka, Zambia.

TECHNICAL TERMINOLOGY

AGE: For the purposes of this study, age is defined as ten years and older. As it is about ten years of age that a growth spurt commences and there is increased confinement in the shoe thereon.

HALLUX VALGUS: means a condition of the foot in which there is a deviation of the big toe towards other toes of the same foot. For the purposes of this study, it means a condition of the foot with HV angle greater than 20 degrees.

HALLUX VALGUS ANGLE: means the angle between long axes of the first metatarsal and proximal phalange in the horizontal plane.

INTER-METATARSAL ANGLE: means the angle between the long axis of the first metatarsal bone and the long axis of the second metatarsal bone.

MANCHESTER SCALE: A reference scale made up of four standardized photographs of the foot used to measure/grade severity of Hallux Valgus. (*See figure 3*)
Clinical interpretation of Manchester scale grades with respect to HV angles is a follows:

1. **Grade 0 <15 degrees** **no deformity**
2. **Grade 1 15-20 degree** **mild**
3. **Grade 2 21 to 39 degree** **moderate**
4. **Grade 3 ≥ 40 degree** **severe**

POST-MORTEM: *After death*. For this study, that includes all dead bodies undergoing autopsy and embalming under the auspices of the University of Zambia Department of Microbiology and Pathology at UTH.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Hallux Valgus (HV) is a condition of the foot in which the tip of the big toe deviates towards the other toes. It may become so painful that surgery may be required to correct the deformity and control the symptoms (Coughlin *et al*, 2007). Footwear has been associated with this condition as an aetiologic factor, as well as intrinsic factors such as heredity (Pique-Vidal *et al*, 2007). HV is more associated with females. The cause of HV is multifactorial some of which are still controversial as to cause and effect (Mann, 1984). Studies on HV have been conducted on living subjects (Enwemeka, 1984) and at autopsy (Coughlin, 2004).The methods used for the studies have included radiography and specialized-weight bearing equipment to determine changes in position of the deformity on erect posture (Coughlin, 2004).

Such a study has not been performed in a Zambian population. By undertaking this study we aim to obtain baseline information on the nature and extent of HV in a selected group. The group so selected was of dead people presented to the University Teaching Hospital (UTH) mortuary for autopsy.

1.2. Rationale of the study

HV is one of the commonest orthopedic conditions worldwide (Mann, 1984). We however do not have information on the prevalence of the condition in Zambia. A study of this nature can offer information which can subsequently be used as a basis for further studies on the causes, presentation, frequency, severity and management of HV. Clinicians thereafter may wish to investigate the presence of co-morbidities and associated sequelae in the presence of HV, such as falls and fractures in the elderly as a result of HV which had remained undetected (D'Arcangelo *et al*, 2011). Preventive measures could be introduced in due course.

Misdiagnosis and mismanagement of HV may be the result of inadequate attention being paid at the time of clinical examination to the foot because of perceived rarity of the condition (Coughlin, 2007). Such shortcomings could be addressed by increasing the awareness of clinicians to the diagnosis of HV.

It is possible that with the advent of globalization the adoption of Western life styles, fashion and consumerism, the use of unsuitable shoe-ware could lead to an increase in the prevalence of HV

in the country (Milone, 2002). These are considerations which a study of this nature could have the potential to help redress. Furthermore, by analysing the results it may be possible to offer concrete guidelines for the prevention of HV within the country.

This study was undertaken because of the necessity to establish baseline information on HV in Zambia. Even though studies such as by Coughlin et al indicate that HV affects 2 to 4 per cent of the global population, the picture is not clear in Zambia. (Coughlin *et al*, 2014). Even though the anatomical knowledge gained from this study is primarily of academic interest, it has the potential to benefit patients suffering from this disabling condition. Preventive measures can also be advocated and cost effective early treatments can be offered to patients.

The justification for carrying out the study during an autopsy session was the avoidance of the need for consent other than that which had already been given to the pathologist performing the autopsy, it was cost effective as there was not travel expenditure or the giving of a stipend to the participants. The study was carried out in one locality. However, our study on autopsy subjects was not significantly different from fresh-frozen or embalmed subjects as they all maintain the skeletal angulation, as in the living, irrespective of the method used at preservation (Pearshall *et.al*, 2003; Bitar *et al*, 2010). Non-radiographic, non-invasive modalities of estimating HV angles have proven to be reliable and valid compared to radiography (Garrow *et al*, 2001; Nix *et al*, 2012). This study used the Manchester scale and measurements were limited to angulation and length of the foot. As the study was based on dead bodies, the role of weight bearing on the degree of HV was not considered. Apart from pain, HV has an aspect of cosmesis which may cause lack of participation due to embarrassment in some living patient (LaPorta *et al*, 1994). Therefore among the dead that aspect does not arise.

Being a baseline study, the information obtained provided useful facts on prevalence, extent, type, and degree of the deformity on people who have died in Lusaka and the surrounding catchment area, thus indirectly reflecting the prevalence of the deformity in the general population of Zambia.

Such a study can be utilised by the various departments in a teaching hospital to plan curriculums, to train, and offer preventive measures for the future. Furthemore, anthropometric studies such as this can be useful among anthropologists and medico-legally as height of a person can be estimated from foot length (Patel *et al*, 2007).

1.3. Research Question

What is the prevalence of HV at the UTH in Lusaka in a population of dead bodies brought to the UTH mortuary.

1.4. General Objective

To determine the prevalence of HV in a population of dead bodies brought to the UTH Mortuary.

1.5. Specific Objectives

To establish the prevalence of HV by:

1. **Gender.**
2. **Age**
3. **Foot length**.

1.6. Scope of the study

The scope of the study is limited to the measurement of the angulation of the deformity as measured using the Manchester scale and the length of the foot using a metric ruler.

CHAPTER TWO

2.0. LITERATURE REVIEW

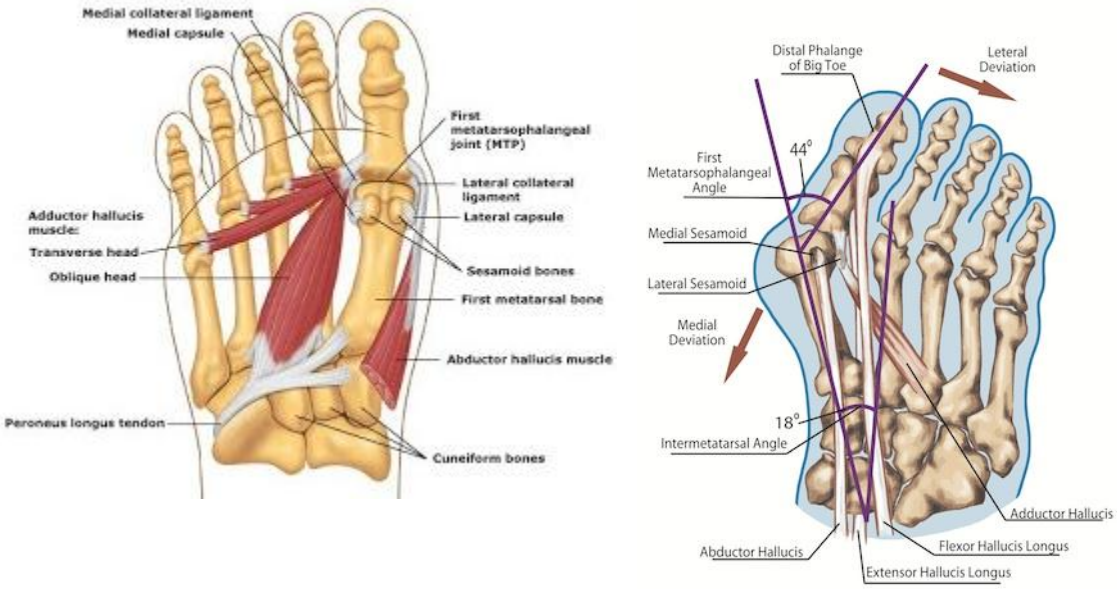
2.1. Definition of HV

Hallux Valgus is one of the commonest conditions of the foot worldwide. It is characterised by the first metatarsophalangeal joint progressively becoming subluxed leading to lateral deviation of the hallux, medial displacement of the distal end of the first metatarsal bone and bony enlargement of the first metatarsal head often referred to as a bunion. (Mann, 1981).Lateral deviation or adduction of the Hallux is not necessarily associated with clinical symptoms in all cases but some pre-existing deviations tend to become exaggerated with age. However, only a long term study on individuals could determine how far a lateral deviation present from an early age could increase liability to symptoms (Barnicot and Hardy, 1955).Clinical hallux valgus has a metatarso-phalangeal angle greater than + 20 degrees (Brenner, 2002) whereas radiographic definition of HV is greater than 15 degrees (Becker and Saragas1995). Therefore, there exists differing schools of thought on the historical, clinical and radiological parameters which define deformities **(**Coughlin *et al*, 2007**).** In this study the clinical definition was adopted.

2.2 Aetiology

Aetiology of HV is likely to be multifactorial and co-morbidities could have a bearing on its aetiology (Menz, 2005). Paleopathogenesis and the role of footwear on HV has been studied (May, 2005**;** Barnett, 1962) including a case-control study regarding angulation among a subpopulation of predominantly shoe wearing and a habitually barefoot cohort (Barnicot and Hardy, 1955). In another study, the cause of HV in part was found to be footwear (Kato and Watanabe, 1981) which could also be the reason why females have a higher prevalence of HV than males (Nashimura *et al*, 2014 and Golightly *et al*, 2014) even though the former have generally a shorter foot length (Patel *et al*, 2007).The aetiology of HV has also been reviewed by Noakes in 1981 and Coughlin *et al* in 2007.

Figure I: Intrinsic gross anatomical factors of hallux valgus ***(courtesy of https://alliancephysicaltherapy.wordpress.com/2013/page2/ and www.shutterstock.com.13530350)***



The role of insertion site of the tibialis anterior muscle in affecting mobility at the first metatarso-phalangeal joint thus determining the position of the toe was considered (Brenner, 2007).The same applies to other muscles such as the adductor hallucis which adducts the first toe towards the second. The role if any of sesemoid bones, pes planus, the relative length of the first metatarsal and its articulation with the cuneiform bone and degenerative changes in adjoining joints have all been studied (Becker and Saragas, 1995; D`Arcangelo *et al*, 2011**).** HV is also directly associated with hypermobility in extension of the first tarso-metatarsal joint (Klaue *et al*, 1994). HV is often noted as a result of a prominent bunion which accompanies the deformity often with metatarsalgia and surgery is often necessary to correct both the bunion and HV deformity (Nix *et al*, 2010). In order to determine the role of surgery and cost effectiveness of surgery we need to know how prevalent the condition is.

2.3 Prevalence

The literature suggests there is under-reporting of the condition thus it becomes difficult to predict the extent of surgical services necessary to deal with the problem. Metatarsalgia is also under-reported in the management of HV (Coughlin *et al*, 2004).

Although HV is generally regarded as being one of the most common orthopaedic foot conditions its true prevalence is difficult to determine due to differences in case definitions used across different studies (Menz and Munteanu, 2005). Furthermore, the incidence and demographics of HV is largely ill defined or unknown (Coughlin *et al*, 2007). It is estimated at 2 to 4 percent in the global population (Coughlin *et al*, 2014) whereas other investigators found that it was the commonest forefoot deformity with an estimated prevalence of 23 to 35 per cent (Wulker and Mittag, 2012). In the United States of America (USA) it affects 1 per cent of the population of adults. The prevalence of absolute radiographic HV was at 28.9 % among Japanese community dwellers (Nashimura *et. al*, 2014). While a report from Lagos, Nigeria (Owoeye *et al*, 2011) gave a prevalence of 15.4 per cent. Among notable reports we have been able to search on the findings on the roles of gender, age and foot length in HV are:

Gender

Findings have indicated that the prevalence of HV is greater among females: 56.7 per cent and 43.6 per cent female and male respectively (Owoeye *et al*, 2011) Nix *et al* found in 2010 that the prevalence was 30 per cent among females and 13 per cent amongst males.

Age

HV could increase with age: 3 % among those between 15 years to 30 years of age inclusive; 9 %, 31 to 60 years; and 16 % among those over 60 years (Bandar and Qassem, 2014), and in the Republic of South Africa a study concluded that HVA increased with age (Gottschalk et al, 1984).

Foot length

Apart from inconclusive findings about the association between foot length and HV (Barnicot and Hardy, 1951; Barnett, 1962), Patel *et al* in 2007, measured foot length in relation to total body height. Several other investigators found that increased first metatarsal length was related to HV (Coughlin *et al* 2007; LaPorta *et al*, 1994; Hardy and Clapham, 1951; Munuera *et al*, 2008). However, we have been unable to trace other reports on correlation of foot length and HV.

Above all, we do not know the prevalence in Zambia.

2.4 Clinical evaluation of HV and foot length.

Visual inspection of the foot has been described as a screening method for HV in children (Pique-Vidal and Vila 2009**)** whereas in order to obtain data on finer details such as sesamoid

position, level of osteoarthritic changes of the first metatarsal bone and adjacent joints, radiography is required (Mann, 1981). As an alternative, Auto-CAD® of digital photographs of x-rays has been used to measure HV angle only (Nix, 2012; Garrow *et al*, 2001).The non-radiographic grading scale such as the Manchester scale is an option which gives information only on angulation deformity (Menz *et al* 2010 and Munteanu *et al*, 2005).The Manchester scale is non-invasive method and has been shown to provide a valid representation of the degree of HV deformity when compared to the radiographic measurement of Hallux Valgus Angle – HVA and Intermetatarsal Angle – IMA (Pique-Vidal *et al*, 2009).There are several other ways of measuring HV including clinical history, observation, physical examination and a non-weight bearing radiographic assessment among others. However, the minimum standard set by the research committee of the American Orthopaedic Society is weight-bearing roentgenography with assessment of HVA and IMA (Smith *et al*, 1984). Further, the Manchester scale is reliable as a tool for measuring the angulation as weight bearing only accentuates the deformity (Tanaka *et al*, 1995) and that HVA is the most commonly used in literature (Smith et al, 1984) especially that this study is a survey. For measuring the length of the foot various methods are used among those is the metric ruler (Barnett, 1964).

The left foot was selected for measurement in conformity with the international agreement for paired measurements made in Geneva in 1912 (Patel *et al*, 2007). Patel *et al* in 2007 concluded that the mean foot lengths in the sample population of Gujarat were 24.4 cm (21.2 to 27.4 cm) and 22.34 cm (19.5-24.8 cm) in the male and the female respectively.

CHAPTER THREE

3.0 METHODS AND MATERIALS

3.1. Study design

It was a prevalence study based on the general objective. Data was collected at one point in time, between September 2014 and March 2015.

3.2. Study setting:

It was a hospital based study, done at the UTH mortuary.

3.3. Target population

Bodies brought to the UTH mortuary.

3.4. Inclusion Criteria

- Native Zambians
- Male and female
- Ages: ten year and older

3.5. *Exclusion Criteria*

- Rigor mortis as it was difficult to dorsi-flex the foot to a standard 90 degree posture.
- Any gross anatomical deformity or disease of the foot such as pes cavus, wounds and scars including osteotomy incisional scars.

3.6. Sampling method

Convenient sampling was used to enroll the participants, who were dead bodies brought to U.T.H. mortuary, within the period of data collection of the study.

3.7. Study limitations

Radiography is an option which could give more objective evaluation of the angulation as it is a direct measure of the bony deformity without soft tissues confounding the accuracy of the measurement. However, even simple visual recording of the deformity has been reported. Radiography was not available for the purposes of this study neither were fresh frozen nor embalmed bodies which other studies have used.

Evaluation of HV during weight bearing – which would only accentuate the deformity in the erect posture was not included as cadavers were examined in the supine position. Thus, the results of this study are based on the static position of the cadaver without considering functional effects of weight-bearing.

3.8. Sample size calculation

To calculate a conservative sample size the formula below was used:

$$\underline{\mathbf{N = \frac{Z^2 \times P(1-P)}{(E)^2}}}$$ where;

N= Sample required

Z=Z statistic at confidence=1.96, using 95 per cent Confidence Interval

P=0.5, since expected prevalence is not known.

E= Confidence Interval=0.05, accuracy range (+/- 5 per cent)

Therefore, the calculated sample size= 422 **dead bodies. However, only 345 dead bodies qualified for the study within the time frame of the study.**

3.9. Variables

Dependent variables

- *Hallux Valgus Angle/Severity*

Independent variables:

1. ***Gender***
2. ***Age***
3. ***Foot length***

3.10. Data Collection

Data collected from comparing standardized photograph of the foot of the participant to the Manchester scale (HVA Score) as well as measurements of the length of the foot was entered appropriately on the Data Capture sheet (see annex).

3.11. Physical Examination Procedure

All information available about the participants for the particular day was obtained from the UTH Mortuary authority. Then, the qualifying participant was drawn from the refrigerator and put on the autopsy table in dorsal recumbency. Then, the left foot was dorsi-flexed at 90 degree on a jig with the plantar surface applied to the glass foot-pad/screen. This was to standardize the posture of the foot. Thereafter, a photograph was taken to capture the dorsal view of the mid- and distal foot. The angulation of the hallux was compared to the Manchester scale (After Garrow *et al*, 2001).The foot length was measured on the plantar surface. The foot length measured on an imaginary straight line connecting the middle of the distal tip of ball of the longest toe to a point in the middle of the proximal arc of the calcaneal pad using a 5 cm interval metric ruler. (After Barnicott and Hardy, 1955). See annex

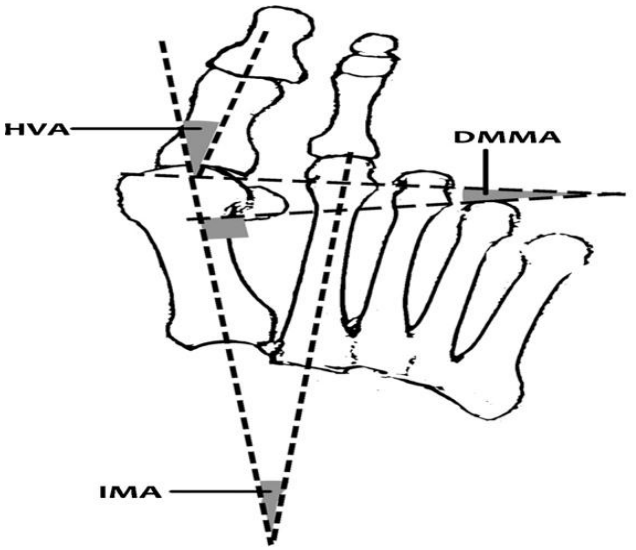


Figure 2: Schema of a radiograph of the fore-foot highlighting the hallux valgus angle (HVA) angle=HVA and Inter-metatarsal angle (IMA). The Manchester scale as a non-radiographic tool can be used to grade hallux valgus (*vide infra*).

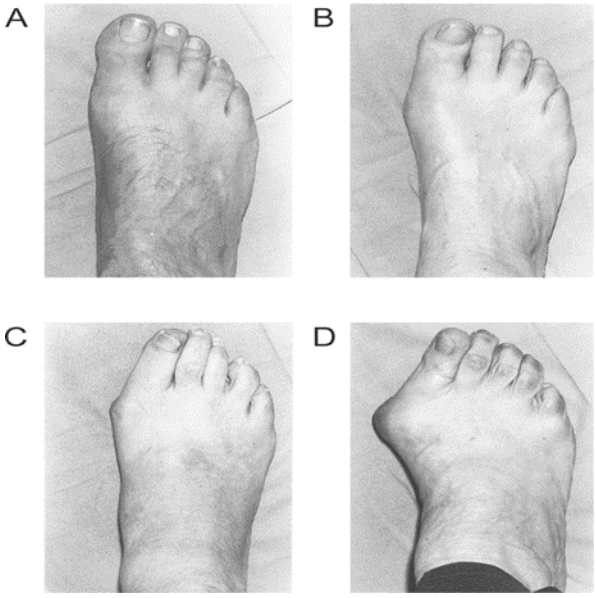


Figure 3: **Manchester scale (right foot shown)** A: no deformity (score = 0), B: mild deformity (score = 1), C: moderate deformity (score = 2),D: severe deformity (score = 3). Severity grades correlates to angle ranges reliable (after Pique-Vidal *et al*, 2009): HVA is categorized as normal (<15°), mild (15–20°), moderate (21–39°), and severe (≥ 40°); the IMA as normal (<9°), mild (9–11°), moderate (12–17°), and severe (≥ 18°). (Courtesy of Menz *et al*, 2011)

3.12. Ethical Considerations

Prior to the commencement of this study, ERES CONVERGE reviewed and approved the protocol. And a consent waiver was granted. Permission was also granted from the UTH Office of the Managing Director as well as the UNZA, School of Medicine, Department of Pathology and Microbiology. The participant's identity was kept in confidence and the project was confined to the study of the foot only. A consent waiver was granted by ERES as no invasive procedure(s) was done on the participant.

3.13. Data Analysis

Data from the collection sheet was then entered in IBM® SPSS version 20 for analysis. Data was described using percentages, bar charts and a pie chart. To test for goodness of fit of the distribution of HV (categorical) with gender, age and foot length (which are all categorical), Chi-squared and Fishers exacts tests were used.

CHAPTER FOUR

4. RESULTS

4.1 Descriptive statistics for recruited post-mortem participants

The study recruited a total of post-mortem recruits, of which 154 (44.6 %) were female and 191(55.4 %) were male. And the majority age range was 20-29 years representing 37.4 per cent.

Table I: Distribution of gender by age of the recruited participants

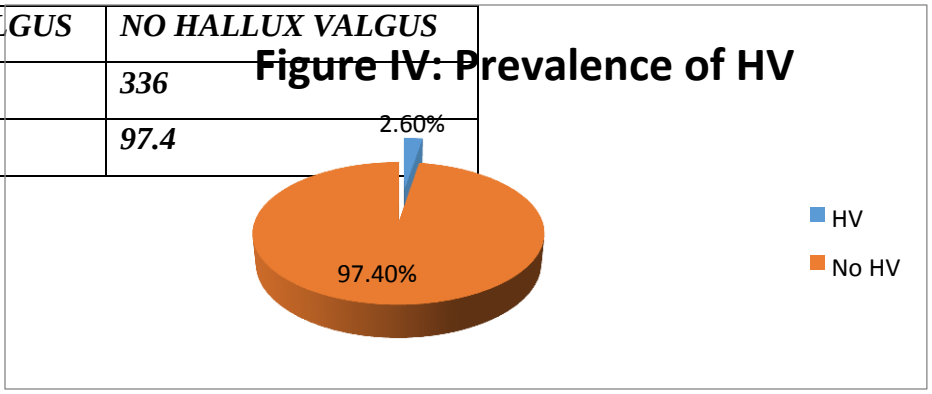
AGE/ YEARS	10-19	20-29	30-39	40-49	50-59	60-69	70-79
Female	10	65	31	20	25	3	0
Male	21	64	61	14	27	1	3
Total	31	129	92	34	52	4	3
Percentage/%	**9**	**37.4**	**26.4**	**9.8**	**15.1**	**1.2**	**0.8**

4.2 Descriptive statistics for cases of hallux valgus versus those without hallux valgus

Nine cases (2.6 per cent) had moderate and severe hallux valgus. One hundred and one (31.6 per cent) had mild hallux valgus. There were five cases (1.45 per cent) among females and 4 cases among males of moderate and severe hallux valgus (p-value< 0.05).

Table II: Frequency of hallux valgus

	HALLUX VALGUS	*NO HALLUX VALGUS*
Count	***9***	***336***
Percentage/%	***2.6***	***97.4***



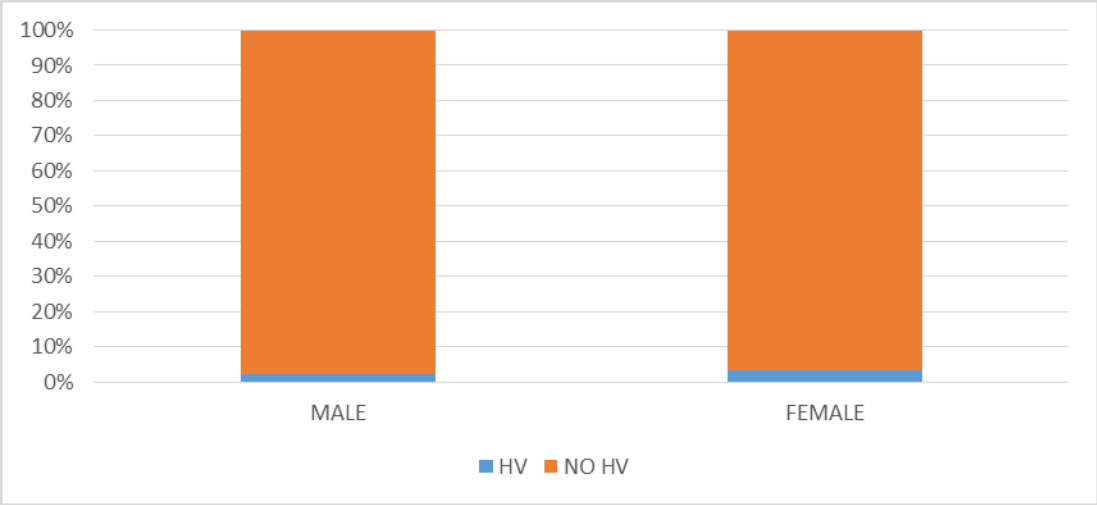
4.3 Distribution of HV by gender

Among the female five cases (1.45 %) of HV were recorded and 4 cases were noticed among males representing a marginal HV prevalence of 1.15 per cent

Table III: Frequency of HV by gender (p-value>0.05)

	HV	NO HV	TOTAL
MALE	4	187	154
FEMALE	5	149	191
TOTAL	**9**	**336**	

Figure 5: Graph depicting distribution of HV <u>by gender</u> (p-value>0.05)



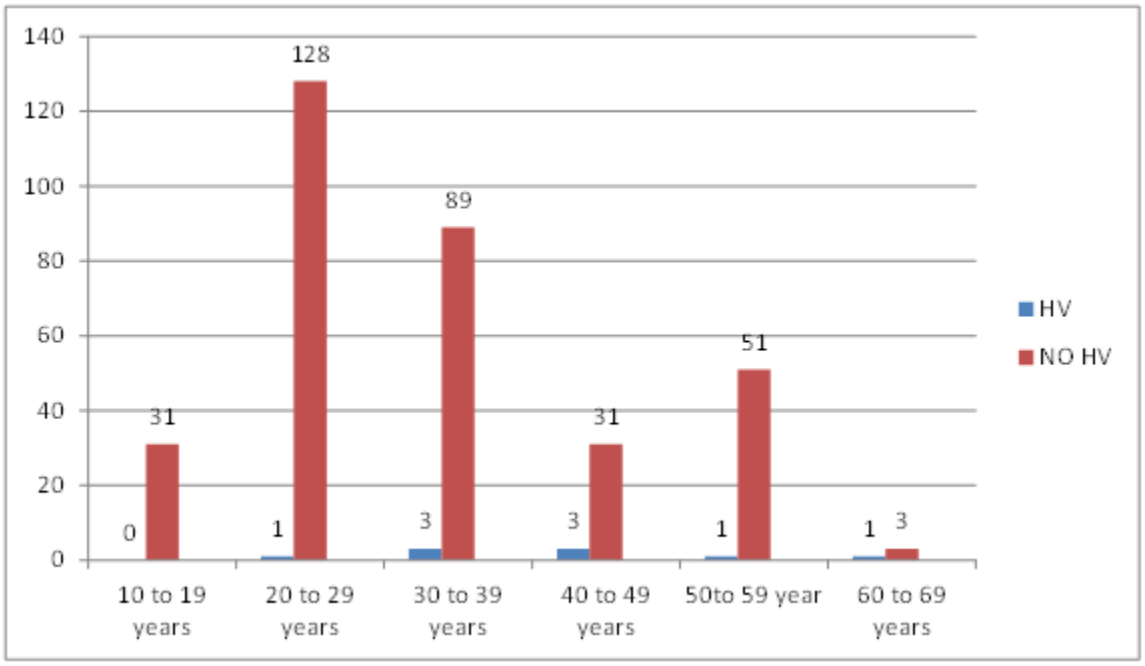
4.4 Distribution of HV <u>by age</u>

There was one case (0.8%) of hallux valgus among those in the 20-29 year range; 3.2% among 30-39 years; 8.8% among 40-49 years; 1.9% for those in the 50 -59 year range, and 25 per cent for those older than 60 years. However, among the recruits there was no one older than seventy nine.

Table IV: Distribution of HV <u>by age (p-value<0.05)</u>

Age (Years)	10-19	20-29	30-39	40-49	50-59	60-69	70-79	Total	/100
Grade 0	23	109	43	19	30	3	0	227	65.8
Grade 1	8	19	46	12	21	0	3	109	31.6
Grade 2	0	1	2	2	1	1	0	7	2.0
Grade 3	0	0	1	1	0	0	0	2	0.6
Total	31	129	92	34	52	4	3	345	100
%	**0**	**0.8**	**3.2**	**8.8**	**1.9**	**2.5**	**0**		

Figure VI: Graphic presentation of distribution of HV by age (p-value<0.05)



4.5 Distribution of HV by foot length

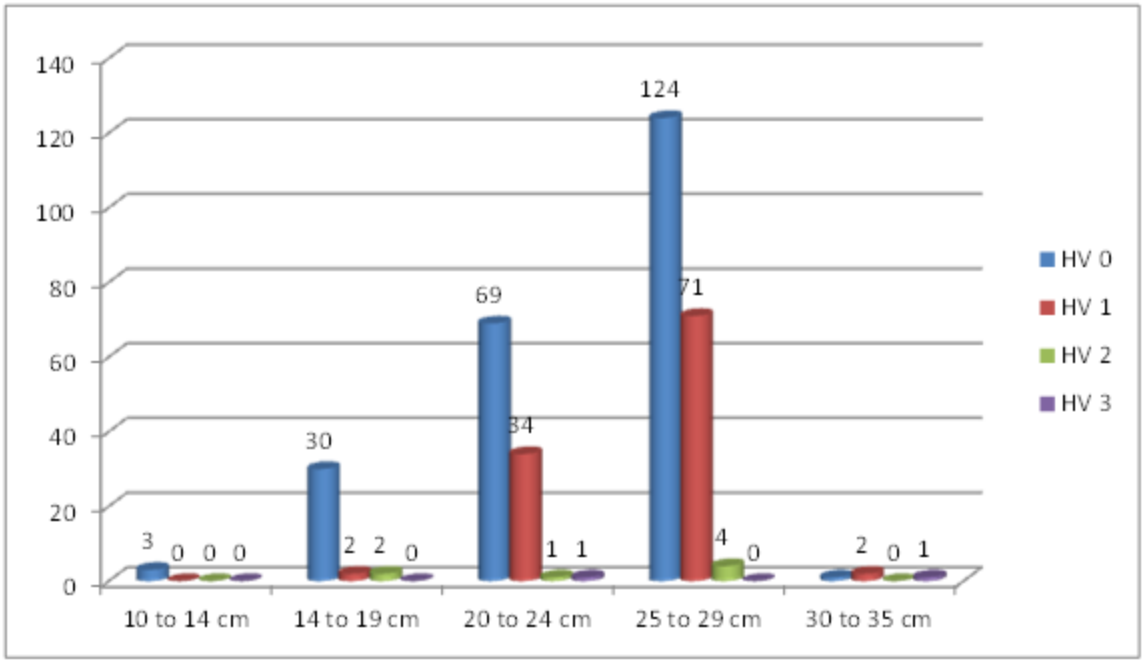
There was no hallux valgus case among those with foot–length shorter than 15 cm; 5.8 per cent (2 cases) in the range 15-19 cm; 2 cases(1.9 %), 20-29 cm; 4 cases (2.0 %), 25-29 cm; 1 case (25 %) among feet longer than 30 cm.(p-value 0.05). There was no subject with a foot length longer than 35 cm. Foot- length in the range 25 to 29 centimeters (57.7 per cent) was the mode range followed by 20 -24 cm range (30.4%).

Table V: Distribution of HV by foot length (p-value<0.05)

HV GRADE Foot length	**0**	**1**	**2**	**3**	**Total**	**%**	**Row Percentage HV/ %**
10-14	3	0	0	0	**3**	**0.8**	**0**
15-19 cm	30	2	2	0	**34**	**9.9**	**5.5**
20-24 cm	69	34	1	1	**105**	**30.4**	**1.9**
25-29 cm	124	71	4	0	**199**	**57.7**	**2.0**
30-35 cm	1	2	0	1	**4**	**1.2**	**25**

Total	**227**	**109**	**7**	**2**	**345**	**100**	

Figure VI: Graph of distribution of hallux vulgas with foot length (p-value<0.05)



4.6 Qualitative analysis on the distribution of HV with gender, age and foot length

HV has many risk factors and causes including footwear, heredity, sex, age and intrinsic factors of the foot.

Even though a specialized study is required to investigate causation, associations between HV with age, sex and foot length are discussed here using Chi-squared test and Fisher's exact tests on the normality of the distributions.

The female had a slightly higher frequency of 1.45 % (4) than the male, at 1.15%, even though, the difference was not statistically significant (p-value, 0.52) as shown in figure IV.

The trend as qualitatively shown in figure V seems to be bell shaped with the peak prevalence among the age range 30 year to 39 years (14.2 per cent). Therefore, the differences in the frequencies of HV with age are statistically significant. This finding is further augmented by the statistically significant differences between HV severity and age at p-value of 0.0001, as shown in figure V.

Foot length had a statistically significant association to HV of p-value of 0.0001 at 0.95 confidence level. HV was most prevalent, 21.7% (75), in participants with foot size ranging from

25 cm to 30 cm and the least 0.9% (3), with 0% prevalence for participant within the foot size range of 10 cm to 14 cm. Furthermore, a parallel increase (27.2 percentage points) in the frequency of grades severe and moderate HV with foot size was seen from 14 cm to 29 cm. As well, a steady increase (35 percentage points) in frequencies of grade 0 HV was also noticed in the same foot size range as can be seen in figure VI.

CHAPTER FIVE
5. DISCUSSION

This study considered the general prevalence of HV in relation to gender and foot length in a selected population of dead bodies that were brought to the UTH mortuary. This section seeks to explore the findings of this study in light of study objectives.

5.1 Prevalence of HV

The general prevalence of 2.6 % was determined from cumulative frequencies of HV grades 2 and 3 as is clinically defined whereas it was determined at 34.2 per cent radiographically which further includes Grade 1 scores, by extrapolation from literature (Brenner, 2007 and Pique-Vidal *et al*, 2009).The difference is 31.6 per cent which is the prevalence grade 1 HV. Furthermore, both prevalences differ from findings of other studies such as was determined in Lagos, 15.4 per cent (Owoeye *et al*, 2011), and that among the adult population in the USA, 1 per cent (Bandar and Qassem, 2014). However, the 34.2 per cent prevalence compares with that which was determined among Japanese community dwellers, 29.8 per cent (Nashimura *et al* 2014), and the 2.6 per cent prevalence is within the estimated prevalence in the general population of between 2 and 4 per cent (Coughlin, 2014) and it may also be comparable to the upper limit of the estimated prevalence among the adults in the USA. The difference with both scenarios in the USA and Lagos likely owes to differences in either one or a combination of factors such as case description, foot wear trends, geographical location, ethnicity, etc. (Coughlin, 2007). Further study needs to be done to establish the exact factor(s). Another explanation about the differences in the outcome is that the study in Lagos was confined to the youth whereas in the USA it was confined to the adults only. Each study had a different case definition and spread in the study population which explains different prevalences. The other difference could be because this study was performed on dead bodies whereas others were performed on living people. However, this difference in the study populations should be studied further in order to be validated as studies have shown that it was insignificant (Pearshall *et al*, 2003 and Bitar *et al*, 2010).

5.2 Distribution of HV by gender

In this study, of the 345 subjects, 154 (44.6 per cent) were female; and 191(55.4 per cent) male. And of the 9 cases of clinical HV, 5 were female (1.45 per cent) and 4 (1.15 per cent) were male. This is in line with many other findings which showed that HV was more common among females, among other findings: 56.7 per cent and 43.6 per cent female and male respectively (Owoeye et. al, 2011) and 30 per cent among females and 13 per cent amongst males (Nix et.al, 2010). Thus, it is not unusual that percentages differ even significantly from one study to the other. Statistically there was no association between HV severity and gender, in this study, as shown by a significant p-value of 0.51. That meant the difference between the prevalence of HV in male and female was not so significant. That could have been in part due to disproportionate sampling in that more males were recruited as opposed to the distribution of gender in the Zambian population. However, at least the female population had one more case of HV indicating there is a possibility of even more cases than male if proportionately represented. Therefore, a purposeful sampling for the specific study of distribution of HV with gender is more representative as there are 50.7 per cent female and 49.3 per cent males in Lusaka (CSO, 2010). Thus, it may be biologically plausible that the greater prevalence of HV was due to constricting footwear (Mann, 1984; Kato and Watanabe, 1981; Coughlin *et al*, 2007) and that the percentage variance may be due to ethno-geographic, socio-economic differences and methodological differences (Nix *et al*, 2010). Apart from that, distribution of age with the gender may have had an effect on the HV frequencies by gender which could be a subject for another project.

5.3 Distribution of HV by age

In this study, it was found that there was a significant association (p-value 0.03) between age and HV as has been found by other investigators (Gottschalk *et al*, 1984, Nix *et al*, 2014). There was noticeable increase in cases of mild HV with age from adolescence, peaking at 41 cases in the 30-39 year age range. This is unlike an expected increase in prevalence of HV in the teen years due to growth spurts associated with puberty as primary and secondary centers of ossification of phalanges, metatarsals and tarsals fuse by adolescence (Gottschalk *et al*, 1984; Golightly *et al*, 2014). Therefore, increased growth foot dimensions at adolescence and subsequent increased confinement in the shoe could be a plausible explanation of that observation. That could partly explain why most moderate and severe cases of HV (4 cases) were in age band 30 to 49 years of

age. Then a significant reduction (15 cases of mild HV) was seen among subjects over 39 year but younger than 50 year with an increase in cases among subject older than 50 years. This lack of a systematic trend in incidence of HV is most likely due to under-representation in the sample population or an increased tendency to be unshod or both. However, the former explanation is more plausible as degenerative changes such as osteoarthritis mostly begin to occur over 30 years of age are more likely associated with HV (D'Arcangelo *et al*, 2011). Therefore, there was likely an increase in HV with age. We hypothesize that the association between aging and the incidence of HV is related to extraneous factors such as constricted footwear which could be a subject for further study.

5.4 Distribution of HV by foot-length.

The role of footwear and the structural characteristics of the foot in aetiology of HV have been controversial (Nix, 2010; Noakes, 1981). Most studies showed that constricting shoes and occupation were implicated as causes of HV (Coughlin and Jones, 2007; May, 2005; Kato and Watanabe, 1981). Other studies dealing with sidedness concluded that there was little difference between the left and right foot which could have affected the prevalence and severity of HV (Roddy *et al*, 2008; Owoeye *et al*, 2011). Most biomechanical risk factors such as increased metatarsal length, roundness of the head of the first metatarsal and increased IMA and HVA are associated with HV as well as certain clinical risk factors such as pain which can increase the likelihood of HV (Kernozek *et al*, 2003). Other clinical risk factors such as pes planus and pes cavus are inconsistent (Roddy *et al*, 2008). However, despite so many studies on foot dimensions, very few studies (Barnicott and Hardy, 1955) have looked at the association of foot length with HV. In this study, there was a noticeable trend of HV in parallel to an increase in foot length, peaking in the 25 to 30 cm range at 21.7 per cent (75 cases) and of the four cases where foot length was longer than 30 cm, all had HV including one severe case. It can be speculated, from this study, that the frequency and severity of HV increased with foot length. However, a more focused study on this association is necessary to ascertain the speculation.

5.5 Limitations of the study

The study did not look at the effect of weight bearing on the severity HV.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

Using the clinically based Manchester scale, the prevalence of HV at the UTH among dead bodies brought to the mortuary is 2.6 per cent.

1. ***Gender.***

   The prevalence of HV among females is 1.45 per cent and among males 1.15 per cent.

2. ***Age.***

   The group with the most moderate and severe HV (1.7 per cent) is in the age range of 30 to 49 years. Furthermore, within each age group there was an increasing trend with ageing.

3. ***Foot-length.***

   HV appears to be more prevalent among feet in the 25 to 29 cm range (1.4 per cent). Furthermore, an increasing trend of HV was evident with increasing foot length in the other groups.

5.3 RECOMMENDATIONS

Examination of feet should be standard practice in health centers.

5.4 FUTURE RESEARCH

1. A larger country wide or wider cross-sectional study is advised in order to establish a true prevalence of HV.
2. Further studies to be done with the use of radiographs.
3. A study among a school-going cohort needs to be performed in order to clearly establish risk factors such as the role of footwear and role if any of the growth of the foot.
4. A clinical study which includes weight bearing should be conducted.

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ANNEX

TABLE I: DATA CAPTURE SHEET

No	GENDER	AGE/YR	HV GRADE

TABLE II: DISTRIBUTION OF HV BY AGE

VARIABLE									
NORMAL									
HV*									

TABLE III: DISTRIBUTION OF HV BY FOOT LENGTH

	HV	NO HV
10-14 CM		
15-19 CM		
20-24 CM		
25-29 CM		
30-35 CM		

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16th May, 2014

Ref. No. 2014-Feb-008

The Principal Investigator
Dr. Mbawe Zulu
The University of Zambia - SoM
Anatomy Department
P.O. Box 50110,
LUSAKA.

Dear Dr. Zulu,

RE: PREVALENCE OF HALLUX VALGUS: AN OBSERVATIONAL AUTOPSY BASED STUDY AT THE UNIVERSITY TEACHING HOSPITAL IN LUSAKA.

Reference is made to your corrections dated 13th May, 2014. The IRB resolved to approve this study and your participation as principal investigator for a period of one year.

Review Type	Ordinary	Approval No. **2014-Feb-008**
Approval and Expiry Date	Approval Date: 21st May, 2014	Expiry Date: 20th May, 2015
Protocol Version and Date	10/04/14	20th May, 2015
Information Sheet, Consent Forms and Dates	• N/A	20th May, 2015
Consent form ID and Date	Version-Nil	20th May, 2015
Recruitment Materials	Nil	20th May, 2015
Other Study Documents	Data Capture Sheet.	20th May, 2015
Number of participants approved for study	422	20th May, 2015

7.0.APPENDICES

7.1 DATA CAPTURE SHEETS

TABLE I: INDIVIDUAL DATA CAPTURE SET

FOOT LENGTH LEFT	FOOT WIDTH LEFT	HVA LEFT	FOOT LENGTH RIGHT	FOOT WIDTH RIGHT	HVA RIGHT	MEAN HA

TABLE II: DISTRIBUTION OF AGE BY GENDER

YEARS	0-19	20-29	30-39	40-49	50-59	60-69	70-79	≥80	TOTAL
FEMALE									
MALE									

TABLEIII: AGE DISTRIBUTION OF SPECIMEN WITH OR WITHOUT HV

YEARS	0-19	20-29	30-39	40-49	50-59	60-69	70-79	≥80	TOTAL
NORMAL									
HV									

APPROVED
21 MAY 2014
ERES CONVERGE
P/BAG 125, LUSAKA.

REPUBLIC OF ZAMBIA

MINISTRY OF HEALTH
University Teaching Hospital

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OFFICE OF THE SENIOR MEDICAL SUPERINTENDENT

Our Ref:

Your Ref:

27th May, 2014

Dr. Zulu
School of Medicine
Department of Anatomy
LUSAKA.

RE: LETTER OF APPROVAL

This letter serves to inform you that you have been given permission to proceed with your research entitled: " PREVALENCE OF HALLUX VALGUS" at University Teaching hospital.

Your assistance in this matter will be appreciated

Yours faithfully

REPUBLIC OF ZAMBIA
MINISTRY OF HEALTH
UNIVERSITY TEACHING HOSPITAL
27 MAY 2014
& MICROBIOLOGY DEPT
P/BAG RW 35, LUSAKA

Dr. Victor Chilumbi Mudenda,
Head of Department
PATHOLOGY AND MICROBIOLOGY

cc. file

Dr. Mbawe Zulu,
Anatomy Dept.,
University of Zambia.

10th October, 2013.

The Managing Director
/Senior Medical Superintendant,
University Teaching Hospital,
LUSAKA.
u.f.s. Head, Department of Pathology and Microbiology

Dear Sir/Madam,

RE: REQUEST TO CONDUCT A STUDY AT THE UNIVERSITY TEACHING HOSPITAL

With reference to the above, I wish to ask for permission to carry out a study titled: ***Prevalence of Hallux Valgus—An Observational Autopsy Based Study at the UTH in Lusaka.***

I am a 28-year old male, MSc Human Anatomy student at the University of Zambia, School of Medicine. I wish to enroll subjects undergoing postmortem. Therefore, it is prudent that permission is sought from your office before any study of this nature is carried out. The brief description of the study is as reflected in the copy that is attached to this letter.

Your consideration of this letter will highly be appreciated.

Yours faithfully,

ZULU Mbawe, BVM.

Plantar view of feet on the hinged glass jig. Foot length was measured from the plantar surface.

Dorsal view of the feet. The Manchester scale was used to measure angulation of the hallux. An example of a grade 1 HV case.

TIME FRAME OF THE STUDY

	MAY 2014	SEPT 2014	DEC 2014	JAN 2015	FEB 2015	MAR 2015	APR 2015	MAY 2015	
ERES APPROVES STUDY	**DONE**								
DATA COLLECTION		**YES**	**YES**	**YES**	**YES**	**DONE**			
DATA ANALYSIS			**YES**	**YES**	**YES**	**YES**	**DONE**		
WRITE UP OF THE THESIS				**YES**	**YES**	**YES**	**YES**	**DONE**	
VIVA VOCE							**DONE**		
SUBMISSION FOR THESIS EXAMINATION								**DONE**	

BUDGET

ITEM	UNIT PRICE/ ZMW
DIGITAL CAMERA	5,000
GLASS JIG	250
CONSUMABLES e.g gloves, sanitizers	250
ALLOWANCES FOR ASSISTANT	5,500
SUNDRY	500
GRAND TOTAL	**11,500**