ADDIS ABABA UNIVERSITY

COLLEGE OF HEALTH SCIENCES AND SCHOOL OF MEDICINE

DEPARTMENT OF ANATOMY

The Prevalence and Pattern of Major Limb Amputation and Its Associated Factors Among Patients Admitted to Pediatric and Adult Orthopedic Wards at Three Public Hospitals in Addis Ababa, Ethiopia.

Principal Investigator: Abdi Uka (BSc.)

Research Proposal Submitted to Department of Anatomy, School of Medicine, College of Health Sciences, and Addis Ababa University for Partial Fulfillment of the Requirement for the Degree of Master of Sciences (MSc.) in Anatomy.

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DECLARATION

This is to assure that the thesis prepared by Abdi Uka, entitled: Prevalence and Pattern of major Limb Amputation and its Associated factor among patients admitted to pediatric and adult orthopedic wards at three public hospitals in Addis Ababa, 2022. and submitted in partial fulfillment of the requirements for the Degree of Masters of Science in Human Anatomy complies with the regulations of the university and meets the accepted standards with respect to originality and quality. This thesis has not been presented for a degree in any other university, and that all sources of materials used for the thesis have been duly acknowledged.

ASSURANCE OF PRINCIPAL INVESTIGATORS

I, the undersigned, declare that this postgraduate degree thesis is my original work, has not been presented for a degree in any other university and that all sources of materials used for the thesis have been duly acknowledged.

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APPROVAL OF THE ADVISORS

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LISTS OF ABBREVIATIONS AND ACRONYMS

DM	Diabetes Mellitus
CI	Confidence Interval
CVI	Chronic Venous Insufficiency
FDA	Food and Drug Agency
LA	Limb Amputation
LE	Lower Extremity
MRN	Medical Record Number
OR	Operation Room
PAD	Peripheral Arterial Disease
PVD	Peripheral Vascular Disease
SPSS	Statistical Package for Social Science
USA	United States of America
GBD	Global Burden of Diseases
WHO	World Health Organization
ICD	International Classification of Diseases
TTA	Trans Tibial Amputation
TFA	Transfemoral Amputation
KD	Knee Disarticulation
AKA	Above Knee Amputation
BKA	Below Knee Amputation
LLA	Lower Limb Amputation
ICD	International Classification of Diseases
OSTD	Orthopedic Surgery and Traumatology Department
ODK	Open Data Kit

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ABSTRACT

Introduction: Limb Amputation (LA) is a surgical procedure for the removal of a limb which is indicated when limb recovery is impossible. It is one of the oldest surgical procedures with a history of over 2500 years. It is estimated that 1.2 million individuals are living with an amputation; and that 185,000 are performed each year worldwide. In Ethiopia most prior research concerning limb amputation has focused almost exclusively on lower limb amputation and there is little information regarding the prevalence of limb amputation.

Objectives: To assess the prevalence, and pattern of limb amputation and its associated factors among patients admitted to pediatric and adult orthopedic wards at three public hospitals in Addis Ababa, Ethiopia, 2020

Methods and Materials: Institutional based cross-sectional retrospective study design had been conducted from September 11, 2020, to August 28, 2022. A serial number on patient registration book from adult and pediatric orthopedic wards of selected hospitals was used to select MRN numbers of patient charts randomly. Data was entered into the Open Data Kit (ODK), a data collection tool's latest version, and stored on kobo tool. Then the data was exported to SPSS version 26 for statistical analysis. Bivariable and multivariable binary logistic regression tests were done to analyze Factors associated with major limb amputation by considering a statistical significance level of 5%, and 95% confidence interval (CI)

Results: During the study period, a total of 3,236 patients underwent surgery and among them medical records of 422 cases were selected from which 386 (91.4%) charts were complete and fit for analysis. The Prevalence of amputation was found to be 14.8 percent among all cases and the lower limb was the most predominantly amputated in about 87.1% of cases. Less than half of the limb amputation was done among age groups 61-75 years old, accounting for 42.9% of cases among age groups. Age [AOR=.1.041; 95% CI: (1.021, 1.062)], presence of malignancy [AOR= 20.883; 95% CI: (4.626, 94.265)]**,** diabetic foot ulcer [AOR= 4.973;95% CI: (1.645, 15.038)], and chronic infection [AOR= 4.812; 95% CI: (1.683, 13.760)], showed a significant association with limb amputation

Conclusion: In the current study the common cause of was limb amputation was diabetic foot ulcer contrary to other studies done in our country and it is common among adult age groups. The above knee amputation was the most frequently done amputation level.

Keywords: Retrospective, Prevalence, Pattern, Limb Amputation, Associated Factors.

1. INTRODUCTION

1.1 Background

Limb Amputation is a removal of a limb which is recommended when limb dead is inevitable or when the limb is already dead or not functioning endangering the patient's life. It is one of the earliest surgical intervention with a history of more than 2500 years dating back to the time of Hippocrates (1). It has been used for therapeutic purposes to treat conditions like vascular disease, injuries, infections, malignancy, and congenital defects as well as for ritualistic, and punitive purposes (2-4).

"Amputation" is a general phrase that refers to all kinds of body-part loss. It ranges from the loss of a single toe to the loss of an entire leg or pelvis, and from the loss of a single fingertip to the loss of an entire arm or level of the chest wall. On rare occasions, even above-pelvis, waist-level amputations are required (5).

The pattern of amputation is determined by the severity of the disease, the likelihood that the stump will heal, and the patient's likelihood of rehabilitation potential. Amputations may be performed at different anatomical levels. It could involve the amputation of just one limb (unilateral), both upper and both lower limbs together (bilateral), or both upper and lower limbs involved (multiple amputations) (6).

Lower limb amputation may involve the removal of one or more toes, part of the foot, ankle disarticulation (amputation of a limb through a joint), below the knee amputation, knee disarticulation, above the knee amputation, hip disarticulation and hemipelvectomy (removal of half part of the pelvis).

Upper limb amputation could include the removal of one or more fingers, wrist disarticulation, below-elbow or transradial amputation, elbow disarticulation, arm or above-elbow amputation, shoulder disarticulation, and amputation of the arm, clavicle, and scapula together which refer as for quarter amputation (7).

Amputation procedure is performed after careful consideration of factors that will lead to a successful long-term outcome for patients (8).

Factors such as tissue viability, biomechanical function, micro- and macrovascular circulation, cardiac demand and energy expenditure, and rehabilitation potential play a great role in determining the appropriate level of amputation. According to several studies age, the degree

of the amputation, stump issues, and cognitive ability are clinically significant factors that affects rehabilitation outcomes following lower limb amputation, (9, 10).

1.2. Statement of the problem

Amputation is both a life-saving treatment and a life-altering tragedy (11). Despite the fact that it is done to save a life, amputees face challenges like difficulties in physical activity, stump pain, prosthesis use difficulties, negative alteration in body image, and, alteration in intimate personal relationships, change employment or occupation status, and alteration lifestyle (12).

The Global Burden of Diseases (GBD) study in 2017 produced estimates of the prevalence and rate of traumatic amputation using injury data reported by the WHO in 195 countries from 1990 to 2017. According to this study in 2017, 57.7 million people were living with limb amputation due to traumatic causes worldwide and Regional trends in traumatic limb amputations vary from location to location, with East Asia having the highest number (11.2 million) and South Asia having the second-highest number (9.7 million) of amputations. (13).

According different literature, in traumatic amputation, limb loss typically occurs at time of the accident, but occasionally occurs a few days later as a result of medical problems.The most frequent causes of traumatic amputations includes: traffic collisions (involving cars, motorcycles, bicycles, trains, etc.), labor accidents (involving tools, cylinders, chainsaws, presses, meat, and wood machines, etc.), farming accidents involving machinery and mowers, electric shock hazards, firearms, bladed weapons, explosives, violent rupture of ship rope or industry wire rope, ring traction (ring amputation, de-gloving injuries), building and car doors, animal attacks, and gas cylinder explosions(14).

The leading cause of amputations in the western world is peripheral vascular diseases (15). The study done in Canada from 2006 to 2009 reported that 5342 patients have had LLA for vascular reasons, 81% of those amputations were related to complications associated with diabetes (16). United States of America (USA), accounts for about 82% of all vascular-related lower limb amputations related with diabetes vasculopathy (17) and according to some research, persons with DM have a 30-fold higher lifetime chance of getting an amputation when compared to those patients without the disease (18-20).

According to numerous studies, limb amputation, particularly a major limb amputation, has a significant impact on mobility, particularly in old individuals. Learning to adapt with a lower extremity amputation and to use a walking aid in daily life activities requires a good physical, as well as cognitive, abilities (21).

According to many types of literature, amputation causes substantial alterations in body structures and functions. Along with the actual loss of a body part, there are also repercussions from the underlying illness, comorbid conditions, and concomitant injuries. Amputation survivors may also encounter a variety of activity constraints and participation limitations. Lower extremities amputees face typical activity constraints and limitations related to Selfcare and mobility tasks. These have an impact on a person's capacity to return to and retain employment, maintain social connections, engage in recreational activities, and be an active member of the community (22).

Additionally, it indicated in different literature losing a limb in developing nations is almost like a sentence to poverty and beggary (23). This is due to the fact that rehabilitation facilities are still in their low stage and prosthetic walking aids are still reserved for the wealthy. Hence, there are high financial, social, and psychological impacts for the suffering patient and by extension, for their family and the society at whole (15, 23)

A study done in India among lower limb amputees who were visiting a rehabilitation center for more than 18 years reported that almost more than half of the amputees (52%) had no job at the time of the study and 80% of them reported having a job before amputation and of this groups, 82% of them reported a loss of job as a direct consequence of amputation (24).

Several studies have attempted to explain and identify the magnitudes and causes of limb amputation in Ethiopia. Most prior research concerning limb amputation has done focused almost exclusively on lower limb amputation and its causes, there is little quantitative information in the literature regarding the prevalence and pattern of limb amputation and its associated factor. Hence, this study has been planned to assess the prevalence, pattern of major limb amputations and its associated factors in three public hospitals in Addis Ababa with the view to enlighten the public and make recommendations to prevent the untoward experiences that follow amputations.

1.3 Significance of the study

An amputation not only reduces mobility but can cause significant impairment in quality of life. Understanding the pattern of limb amputation has significant effects on the extent of rehabilitation time and mobility level. The usage of prosthetic devices that optimize the mobility of the amputees also depends on the understanding of the level of amputated limbs.

The current study was conducted within the framework of obtaining reliable information and comparing the result with other data contexts obtained globally and regionally. Accordingly, it provided pertinent and reliable data about the prevalence, and pattern of limb amputation and its associated factors. In addition, the research also provided a significant understanding of the common causes and indications for amputation, and it also provided insights into the extent of the problem and would give hints for further research in this area.

Furthermore, it can be used as baseline data for public and non-public organizations that work in the area of prosthetic provision, for public health policymakers, and for anybody interested in this area.

2. LITERATURE REVIEW

2.1. Prevalence, Cause, and Pattern of major Limb Amputation

In different nations, the number of amputations per 10,000 people ranges from 1.2 to 4.4, and among this up to about 90% are done on the lower limb (23, 25). According predictions by 2050 these numbers might double (1). According to a study done in Canada for 14 years comparing lower limb amputation and upper limb amputation, the course over a year showed that rates of lower extremity amputation were constantly higher (31.86 per 100,000) than UEA (5.84 per 100, 000). In this study the overall prevalence of major limb amputation was reported to be 14.41) (26).

A study that was carried out in England over six years among patients aged 50–84 years who underwent major lower limb amputation and revascularization reported that the prevalence of amputations was 26.3/100,000 among the age groups (27).

The study that was done in the Democratic Republic of Congo which involved all patients who underwent amputation from 1st January 2005 to 31st December 2014, over 10 years, reported that the prevalence of limb amputations to be 14.69% among the patients who undergone surgery over study periods (28).

The study carried out in Rwanda at University Teaching Hospital-Butare between 1st January 2009 and 31st March 2012 in which a total of 3466 participants who were operated in the Surgery department included and among which 107 had undergone limb amputation reported that the prevalence of amputation to be 3.08% among the all patients who had undergone the procedure in surgery department during the study period (29).

The majority of an effective amputation's effort should go into pre-planning the process. A Favorable long-term outcome of amputation for each patient depends on wisely Selecting an acceptable level of amputation (8). Results from studies indicated that determination of amputation level using appropriate physical examination and good clinical judgment alone results in healing of eighty percent of below-knee amputations (BKAs) and ninety percent of above-knee amputations (AKAs) [13]. The availability of a detectable pulse proximal to the location of amputation is associated with a healing probability of nearly 100 % (30).

A study done in Australia showed that among the patients who underwent lower limb amputation around 60 % had below knee amputation and the most of them were male (31).

The study carried out in England reported that above knee amputation was more than below knee amputations (ratio is 1.1:1) (27) and a study done in Southwest Finland reported that 80.1% of cases underwent AKA followed by BKA in 19.9 % of cases (32).

According to another study results from Sweden 89% of lower limb amputees underwent unilateral limb amputations, in which below knee amputation was most common (47%) followed by above knee amputation in 26% ,and minor amputation or partial foot amputation distal to ankle was done in 20%, knee disarticulation was done in 7%, and hip disarticulation, or hemipelvectomy was done in < 1% (33). Also, study done at a tertiary hospital in northwestern Tanzania reported that the ratio of below-knee amputation to above-knee amputation was 1.2:1(4) and a study done in Malawi reported that BKAs was the most frequent surgery, accounting for 271 or 43% of surgeries, followed by AKAs which was done in 213, or 33.8% (34).

Concerning upper limb amputation retrospective Study done in the USA at Seattle hospital shows that trans-humeral amputations were more frequent than any other level of amputation which was done in 38.3%, followed by trans-radial amputations in 30.8% of cases. A study done in Trinidad and Tobago, from January 2010 to December 2016 demonstrated a yearly progressive increase in amputation rate, in which males accounted for 59% of cases, and 60% of amputation surgeries were done at the level of above the of the knee joint (30). Sepsis control was the most common reason for amputation in 71.5% of cases (30).

The study done in the northern part of Ethiopia at Ayder hospital in Mekelle city shows that the commonest type of amputation was major lower limb amputation (58.6 %) which included AKA (35.6%) and BKA (23%) followed by digital amputation (17.2 %). Major upper extremity amputation surgery was done in 11.4%, among which one patient underwent bilateral arm amputation (35).

Several studies reported that most patients with limb amputation in developed countries are older than 60 years of age; However, in the developing world and most parts of Africa, the majority of amputees are younger patients (36, 37). In Ethiopia Studies done at different hospitals shows that Amputation is common in the age group <18 years old, followed by in 19-37 age group (17, 18).

Although there are regional variations in the leading causes of limb amputation, studies have shown that in developed nations peripheral vascular disease ranks as the top reason for amputation while in developing nations trauma, infections, uncontrolled diabetes mellitus, and malignancies are the main reasons (4).

A national level retrospective study done over 8 years in the United State of America reported that amputations due to vascular conditions accounted for the vast majority which results in 82% of limb-loss and trauma related amputations were the 2nd most common cause of limb loss in the united states of America according to this report (17).

Different studies are reporting the rising incidence of diabetes mellitus and vascular disease at worldwide level which reflecting in the greater incidence of type 2 diabetes-related amputations; for example, study done in England reported that the rate of amputation increased between 1996 and 2005 from 2.0 to 2.7 per 100 000 population in England (38). It is estimated that between 40 and 70% of all limb amputations are occurring in people with diabetes mellitus, causing the loss of over a million lower limbs within a year worldwide (39, 40).

Studies done in Lebanon in 2007 shows that Diabetes was the top indication for 59% of the total amputations done for different reasons (41). According to other studies done in Poland from 2010-2019, the percentage of amputations in patients with diabetes disease accounts for about 68.6% of all amputation's cases. This numbers are reported to increase slowly year over year, starting at 61.1% in the year 2010 and increasing to 71.4% in the year 2019 (42).

Other reported causes of major limb amputations include trauma of different causes (16.4%), cancer and malignancies (0.9%), and congenital limb deficiencies (0.8%) (16). Injuries involving machinery (40.1%), powered tools and appliances (27.8%), firearms (8.5%), and motor vehicle crashes (8%) have been reported to be leading causes of trauma-related amputations (16).

Concerning the cause of major limb amputation in Ethiopia, a study done at Tikur Anbessa referral hospital shows that trauma accounted for 44 (40%) of cases of amputation, Gangrene due to various causes for 35 (32%) of cases, Tumors for 19 (17%) of cases, and Chronic infections accounts for 12 (11%) of cases of amputation (43). And another study done at the same hospital on the pediatric age group shows that the most common indication for limb

amputation was gangrene due to complications related to treatment of limb injuries by traditional bone setters, locally called “Wogeshas” which accounts for around 55.5% (44).

2.2. Factors Associated with Limb Amputation

According to a meta-analysis study result reports on risk factors for lower extremity amputation in patients with diabetic foot ulcers, which included the studies published in 2019, risk factors like presence of foot ulcers (P<0.00001), osteomyelitis (P<0.00001), and gangrene (P<0.00001) were reported to be associated with an increased risk of amputation: (45).

Different study results reported also observing a strong association between major amputations and prior intervention for a foot-related problem, as 52% of the sample that had a pre-existing wound or a prior minor amputation underwent re-amputation in 32% of cases (46).

A study done in Lebanon in 2007 shows that there was strong evidence (χ2-test, $P < 0.001$) that patients with different indications for limb amputation surgery had different age distributions. For example, 70% of diabetic patients were aged 70 years or above, when compared with only 4% of trauma patients. According to this study, the mean age was 73 (SD 10) years for limb amputations related to diabetic complication, 63 (SD 12) years for patients presented with the vasculopathy and 30 (SD 18) years for trauma related amputation. This study also indicates males accounts for a higher proportion of trauma-related amputation which accounts for 86% of cases (χ2-test, $P < 0.001$) (41). And also, study done in the United State of America reported that males are at significantly higher risk for trauma-related amputations than females, and the risk of amputation increases with age, regardless of etiology, sex, and race (17).

Another study done in Indonesia at Jakarta General Hospital reported that diabetes mellitus, chronic infections such as skin necrosis, and gangrene were the factors significantly showed amputation risk ($p < 0.005$) (47).

According to a retrospective study done between April 2007 and December 2012 in Brazil regarding the level of amputation, it was observed that individuals who had a higher level of amputation (above the ankle level) were those with associated ischemia diagnosis ($p = 0.002$) and who had already undergone previous amputation ($p = 0.010$). The individuals who had lower levels of amputation (at the foot level) were those who used antibiotics preoperatively ($p = 0.004$) (48).

2.3. Conceptual Frame Work Of pattern of Limb Amputation

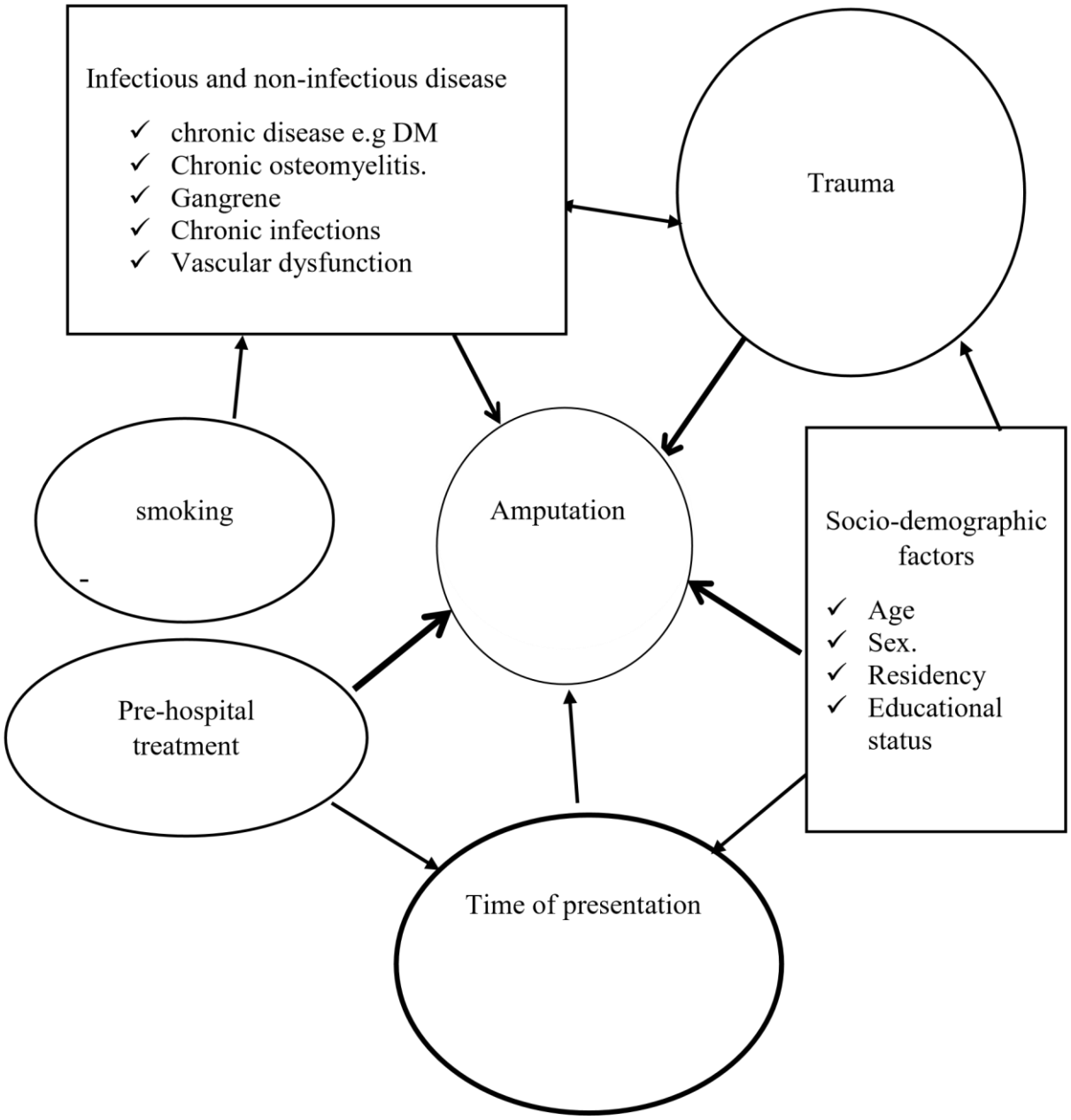

Figure 1: Conceptual framework of risk Factors affecting limb amputation selected from literature (11-20)

3. OBJECTIVES

3.1 General Objective

- To assess the Prevalence and Pattern of major Limb Amputation and its Associated factor among patients admitted to pediatric and adult orthopedic wards at three public hospitals in Addis Ababa, 2022.

3.2 Specific Objectives

- To assess the magnitude of limb amputation among patients who are admitted to pediatric and adult orthopedic wards at selected three public hospitals in Addis Ababa
- To identify the pattern of limb amputation among patients who are admitted to pediatric and adult orthopedic wards at selected three public hospitals in Addis Ababa
- To determine associated factors with limb amputation among patients who are admitted to orthopedic wards at selected three public hospitals in Addis Ababa

4. METHODS AND MATERIALS

4.1. Study Area

The hospital-based two years retrospective study, from September 2020 to August 28, 2022, had been conducted among patients admitted to the Orthopedic and Traumatology department of three selected public hospitals in Addis Ababa, Tikur Anbesa Specialized Hospital, St. Paul's specialized Hospital and Menelik II Hospital which were selected based on the high patient flow.

4.2. Study Period

The study was conducted from April 2022 to August 2022.

4.3. Study Design

An Institutional based cross-sectional retrospective study had been conducted.

4.4. Study Population

4.4.1. Source Population

All patients who had been admitted with orthopedic problems in the Pediatric and adult orthopedic and traumatology departments at selected three public hospitals.

4.4.2. Study Population

All patients who had undergone procedures and whose medical information had been recorded in the registry book of the orthopedic and traumatology department at selected hospitals during the study period.

4.5. Study Units

All patients who had undergone limb amputation during the study period

4.6. Inclusion Criteria and Exclusion Criteria

4.6.1 Inclusion Criteria

All Patients who have undergone a procedure during the study period and had complete information, were included.

All patients with limb problems who had undergone a procedure at the orthopedic and traumatology department and on treatment during the study period were also included.

4.6.2 Exclusion Criteria

Patients with incomplete data and vague information. Patients with the congenital limb amputation and Patient with minor limb amputation.

4.7. Sample size determination

The sample size was determined by using a single population proportion formula and taking an estimated proportion of amputation to be 50 % because there is no previous study conducted regarding the prevalence of amputation in our setup.

Considering the following assumptions, Z = standard normal distribution value at 95%, the confidence level of zα/2 = 1.96, and margin of error (d) = 5%.

$$n = \frac{(Z\alpha/2)^2 \times P \times (1-P)}{d^2} = \frac{1.96^2 \times 0.5(1-0.5)}{0.05^2} = 384.16$$

Where; n = Minimum sample size

P = Estimated prevalence of amputation

Zα/2 = Standard of normal variable

d = Margin of error

Accordingly, n =384, adding 10% as compensation for incomplete recordings, then the final sample size calculated was n =422,

4.8. Sampling techniques and procedures

The total number of patients had undergone procedures at the orthopedic and traumatology department was counted from the Registration book of the operation room of selected hospitals.

The serial numbers on the registration book were used to select study participants using a simple random sampling technique from both adult and pediatric orthopedic wards of selected hospitals. The number of patients selected was allocated based on the proportional number of patients registered in each ward during the study period. Patient information was obtained from the registry books of the orthopedic department and their medical record number (MRN) was taken to retrieve the medical record charts from the MRN archive office. Patient charts recorded with complete information were reviewed. All patients who underwent a procedure and who were taking treatment at orthopedic wards of selected hospitals during the study period was also included.

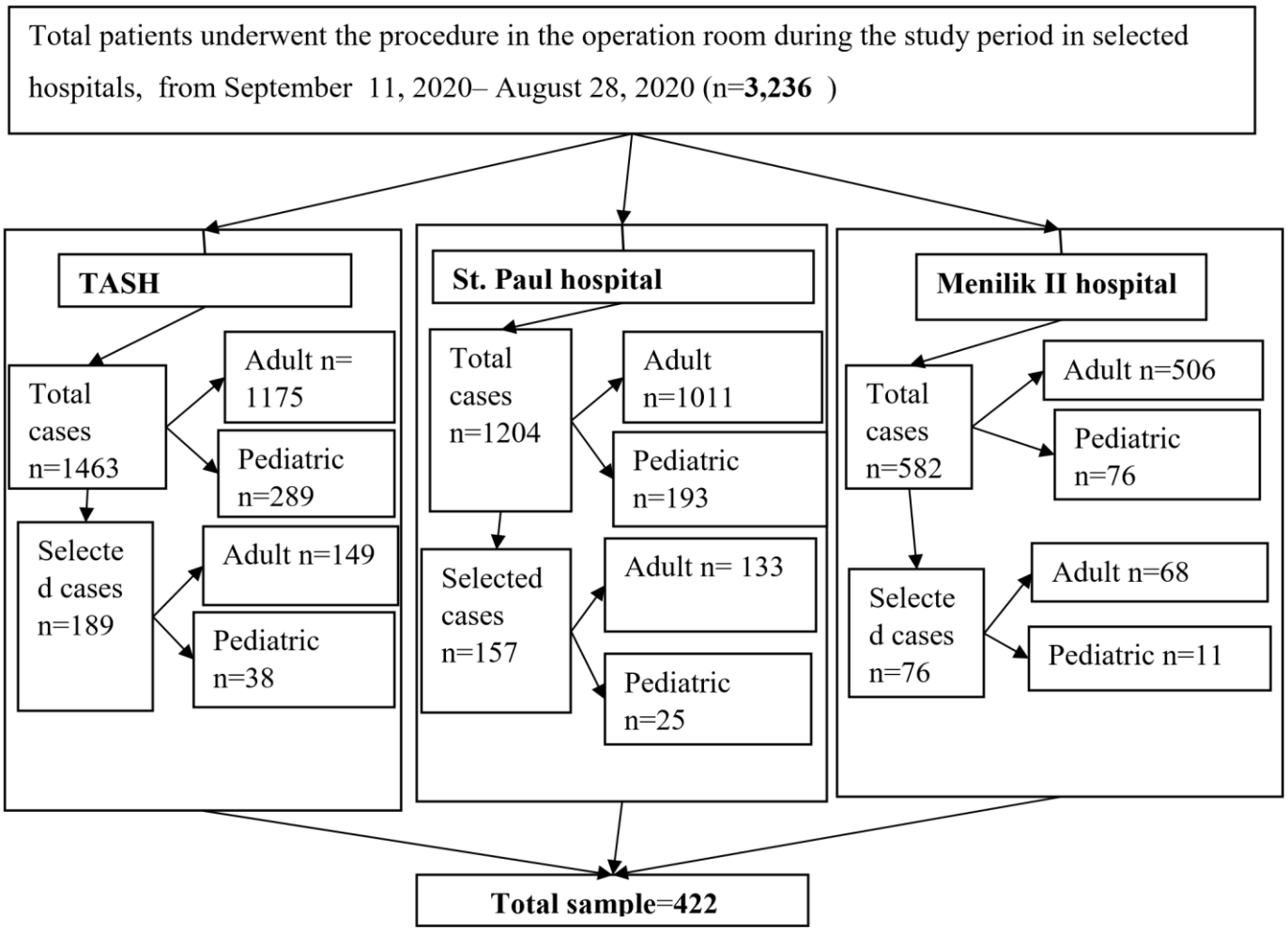

Figure 2. Schematic presentation of sampling procedure in orthopedic and traumatology departments of selected hospitals from September 11, 2020 to August 28, 2022.

4.9. Data Collection Tool and Procedures

The data was collected using a structured checklist that was adopted from different researches and modified to the local situations. The checklists consisted of, socio-demographic characteristics of the study participants and variables that were used to assess the magnitude of the problem and pattern of limb amputation and its associated factors.

4.10. Data Quality Control

Data was collected by assigning three BSc nurses and One BSc health officer as supervisor and the principal investigator also followed the whole procedure closely.

All data collectors first have had a half day training by the principal investigator and had given clear awareness about the objective of the thesis and procedures to follow to avoid any biases. To assure the quality of data, data was cross checked for the consistency & completeness every day after collection, so that missing of information was avoided and incomplete or invalid data was be discarded. Pre-testing of the questionnaire was conducted in 5% of the total sample size at TASH, to check for its validity and effectiveness in measuring intended variables and objectives.

4.11. Study Variables

4.11.1. Dependent Variable

- limb Amputation

4.11.2. Independent Variables

- Age
- Sex
- Educational status
- Residence
- Trauma and Injuries
- Chronic disease
- Congenital limb anomalies
- History of vascular problem
- Pre-Hospital treatment
- Smoking
- Infection
- Alcohol drinking habit
- Previous history of Amputation
-

4.12 Operational definition

Pattern of amputation: - level, gender and age-based, distribution of amputation.

Major limb amputation: refers to any amputation performed at or above the level of the ankle for a lower limb and any amputation at or above the wrist for upper limb

Minor limb amputation: refers to excision of any part of one or more of the toes for lower limb or finger for upper limb

Below Knee Amputation: refers surgical removal of leg through the tibia and fibula

An above-the-knee amputation (AKA): refers to surgical removal of the leg above the knee or transfemoral amputation

Disarticulation: When the amputation is between long bones, which is anatomically through the center of a joint

Incomplete information: Patient's medical charts with incomplete data greater than 20% of the variables of study

4.13. Data Processing and Analysis

Data was entered into Epi-data manager latest version and exported to SPSS 26 for statistical analysis. The results summarized in the form of proportions and frequency tables for categorical variables. Continuous variables summarized using means, median, mode and standard deviation. Bi-variant analysis using binary logistic regression was done to assess the effect of each independent variable. The variable with $P< 0.2$ in Bi-variant analysis was included in multivariable analysis. In the multivariable analysis using multiple logistic regression adjusted OR with 95% CI had been calculated and variable with $P<0.05$ was declared as a significant factor.

4.14. Ethical Considerations

Ethical clearance or approval was obtained from the Department Research Ethics Review Committee (DRERC), Institutional Review Board of CHS, Addis Ababa University and Department of Human Anatomy. A formal letter (Ana/224/2022) from the Human Anatomy Department has been sent to Pediatric and Adult Orthopedic Departments of Tikur Anbessa Specialized Hospital, St. Paul millennium hospital, Minilik II Hospital and City Government of Addis Ababa Health Bureau to get permission and letter of permission was received from each hospitals research office. During data collection, data collectors were trained about the issue of confidentiality and strictly kept confidentiality of the information of patients.

5. RESULTS

5.1 Socio-Demographic Characteristics

During the study period, a total of 3,236 patients were undergone surgery at orthopedic surgery and traumatology department of selected hospitals. Among them medical records of 422 cases were selected from which 386 (91.4%) charts were complete and fit for analysis. Majority of them 288 (74.6%) were male and 98 (25.4 %) were female which makes the male-to-female ratio about 2.9:1.

The median and mean age of patients was 33, and 36.19 years respectively. Above quarter 113 (29.3%) of the participants were between the age group of 16-30 years followed by age group 31-45 years which was about 95 (24.6%). About 166 (43 %) of the patients were residents of Addis Ababa followed by Oromia 111(28 %) and about 41(10.6%) were from Amhara region.

About 72 (19 %) study cases were students, 64(17 %) were private employees, and 44(11 %) a were daily labors. For more detail refer table 1 below.

Table 1: Socio-demographic profile of patients admitted orthopedic surgery and traumatology department of selected public hospitals in Addis Ababa, Ethiopia, from September 11, 2020, to August 28, 2022.

Characteristics		Frequency	Percentage
Age	< 15	64	16.6
	16-30	113	29.3
	31-45	95	24.6
	46-60	63	16.3
	61-75	35	9.1
	> 75	16	4.1
	Total	386	100.0
Gender	Male	288	74.6
	Female	98	25.4
	Total	386	100.0
Address/Region	Addis Ababa	166	43.0
	Oromia	111	28.8

	Amhara	41	10.6
	SNNP	25	6.5
	Afar	14	3.6
	Benshangul-Gumz	9	2.3
	Harari	8	2.1
	Others	12	3.1
	Total	386	100.0
Profession	Private employee	64	17
	Students	72	19
	Daily labor -	44	11
	Government employee	30	8
	Driver	33	9
	Farmers	15	4
	Housewife	7	2
	Sportsmen	6	2
	Retired	6	2
	Soldier	3	1
	Unknown	107	28
	Others	10	3
	Total	386	100

5.2 Behavioral characteristic of the participants

Regarding smoking status of study participants, majority 91.5% of the study participants had no history of smoking, while 8.5% of the respondents had history of smoking.

About 85.5% of the respondents had no history of alcohol drinking and while 14.5% of them reported having history of alcohol drinking. Refer table 2 below.

Table 2: Behavioral characteristics of patients admitted to orthopedic surgery and traumatology department of selected public hospitals in Addis Ababa, Ethiopia, from September 11, 2020, to August 28, 2022.

Behavioral Characteristics of the participants		Frequency	Percentage
Smoking status	Yes	33	8.5
	No	353	91.5
	Total	386	100.0
Alcohol drinking behavior	Yes	56	14.5
	No	330	85.5
	Total	386	100.0

5.3 Reason for hospitalization, Procedure done at Hospitals and prevalence of amputation

5.3.1 Reason for Hospitalization

In this study, among the cases admitted to the orthopedic surgery and traumatology department of selected hospitals during the study period for different reason, the traumatic bone fracture constituted for about more than half 202 (52.3%), dislocation for about 47(12.2%), and chronic infection accounts for about 45(11.7%) of cases. For more detail refer the table 3 below.

Table 3. The reason for hospitalization among patients admitted to orthopedic surgery and traumatology department of selected hospitals Addis Ababa, Ethiopia, September 11, 2020, to August 28, 2022.

Characteristics		Frequency	Percentage
Reason for hospitalization	Traumatic bone fracture	202	52.3
	Dislocation	47	12.2
	Chronic infection	45	11.7
	Diabatic foot ulcer	31	8.0
	Tissue injury	24	6.2
	Malignancy	14	3.6
	Others	23	6.0
	Total	386	100.0

5.3.2 Procedure done at Hospitals and prevalence of amputation

Among the cases admitted to the orthopedic surgery and traumatology department of selected hospitals during the study period and undergone a surgical procedure for different reasons, reduction and fixation constituted for half of procedure, which was done in 194 (50.3%) cases, sign nail 57 (14.8%) cases, and amputation 57(14.8%) cases. For more refer table 4 below.

This survey revealed that the estimated prevalence of the amputation to be 14.8 percent among all cases and among those 57 patients who underwent amputation 42 (73.7 %) of them were underwent emergency surgery and the remaining cases 15 (26.3 %) underwent elective surgery. Three of the patients had a previous history of the amputation on the lower limb, among which one patient had a history of the right lower limb amputation and two had amputated left lower limb.

Table 4: procedure done and kind of operation provided among patients who admitted the orthopedic surgery and traumatology department of selected public hospitals in Addis Ababa, Ethiopia, from September 11, 2020, to August 28, 2022.

Characteristics		Frequency	Percentage
Kind of operation provided	Reduction and fixation	194	50.3
	Tissue repair	14	3.6
	Incision and drainage	23	6.0
	Debridement with tissue repair	14	3.6
	Amputation	57	14.8
	Sign nail	57	14.8
	Others:	27	7
	Total	386	100.0
Type of operation	Elective	15	26.3
	Emergency	42	73.7
	Total	57	100.0

5.4 Indication, and pattern of amputation among patients who underwent major limb amputation.

5.4.1 Indication for major limb amputation

Among the 57 patients who had undergone amputation, about 19 (33.3%) of them had amputation for the diabatic foot gangrene, 16 (28.1 %) for trauma, and 10 (17.5 %) for peripheral arterial insufficiency. Refer to table 5 below for more detail.

Table 5: Causes of amputation among the patients undergone amputation at orthopedic surgery and traumatology department of selected public hospitals in Addis Ababa, Ethiopia, from September 11, 2020, to August 28, 2022.

Characteristics		Frequency	Percentage
Indication for amputation	Diabatic foot gangrene	19	33.3
	Peripheral arterial insufficiency	10	17.5
	Trauma	16	28.1
	Malignancy	6	10.5
	Chronic infection	5	8.8
	Correction amputation for traumatic amputation	1	1.8
	Total	57	100.0

Table 6: type trauma among the patients undergone amputation at orthopedic surgery and traumatology department of selected public hospitals in Addis Ababa, Ethiopia, from September 11, 2020, to August 28, 2022,

Characteristics		Frequency	Percentage
Cause of trauma	Road traffic accident (RTA)	8	50
	Machine injury	3	19
	Fire burn injury	2	13
	electrical burn injury	1	6
	Heavy material injury	1	6
	Traumatic amputation	1	6
	Total	57	100.0

5.4.2 Pattern of major limb amputation

5.4.2.1 Site and level of major limb amputation

In this survey, the most predominant limb amputation was unilateral amputation which had done in 53 (92.5%) of patients and four patients undergone bilateral lower limb amputation. The lower limb was the most predominantly amputated in about 87.1% of cases, in which left lower limb amputation accounts for about 29 (50.9%) of all cases, followed by right lower limb which accounts for about 20(35.1%). Among the patients who had undergone upper limb amputation, right upper limb amputation had done in five cases, and left upper limb amputation had done in three cases. Refer to table 7 below for more detail

Concerning the level of amputation, from patients who had undergone lower limb amputation, about 28(49.1 %) were above-knee amputations followed by below-knee amputations which accounts for 15(26.3%) and one patient underwent Hip disarticulation. From upper limb amputation, 3 (5.3%) were above elbow amputation, and 3(5.3%) were below elbow amputation. Refer to figure 3 below for more detail.

Table 7: amputated limb among the patients who had undergone amputation at orthopedic surgery and traumatology department of selected public hospitals in Addis Ababa, Ethiopia, from September 11, 2020, to August 28, 2022.

Characteristics		Frequency	Percentage
Amputated limb	Left lower limb	29	50.9
	Right lower limb	20	35.1
	Right upper limb	5	8.8
	Left upper limb	3	5.3
	Total	57	100.0

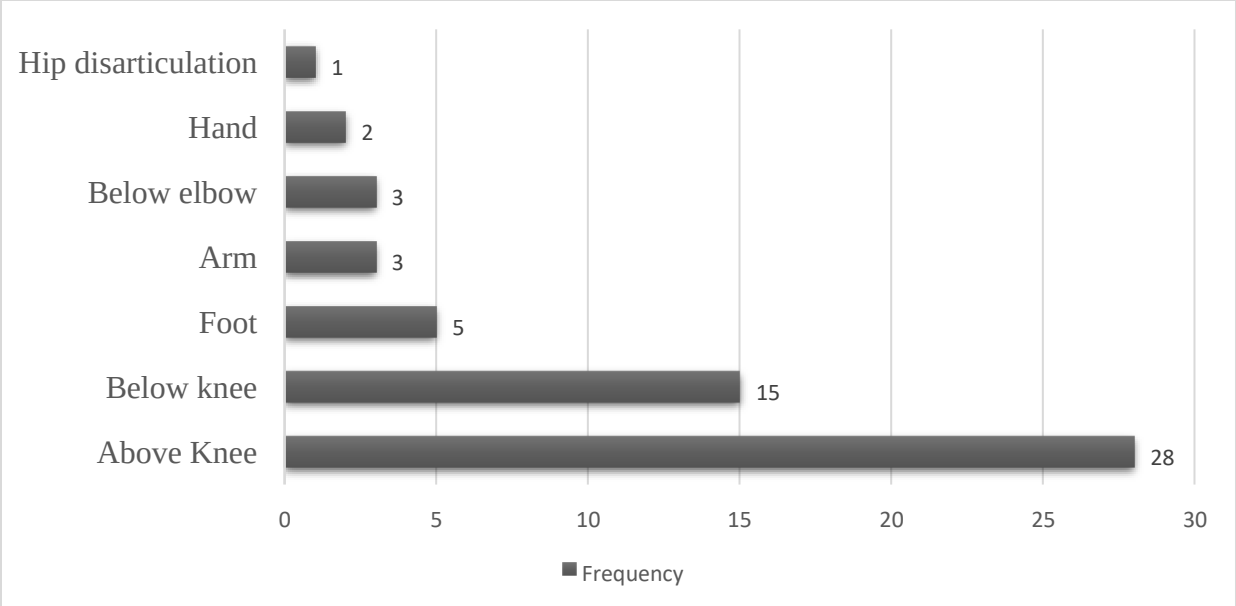

Figure 3. Site and level of major limb amputation among patients who underwent amputation in orthopedic and traumatology departments of selected hospitals from September 11, 2020 to August 28, 2022.

5.4.2.2 Distribution of the amputation by its indications among sex and age groups

In current study majority of limb amputees were males 42(77.7%) and all indications for amputation was prevalent among male amputees. Most of limb amputation had done among age groups 61-75 years old which accounts for 42.9% of cases among age groups, followed by age groups above 75 years old which accounts for 31.2% of cases among age groups. The cause for majority of amputation among age groups above 46 years was diabatic foot ulcer followed by PAD which was done in 18 and 10 cases respectively and the cause of majority of amputation among age groups less than 30 years was trauma which was done in 10 cases.

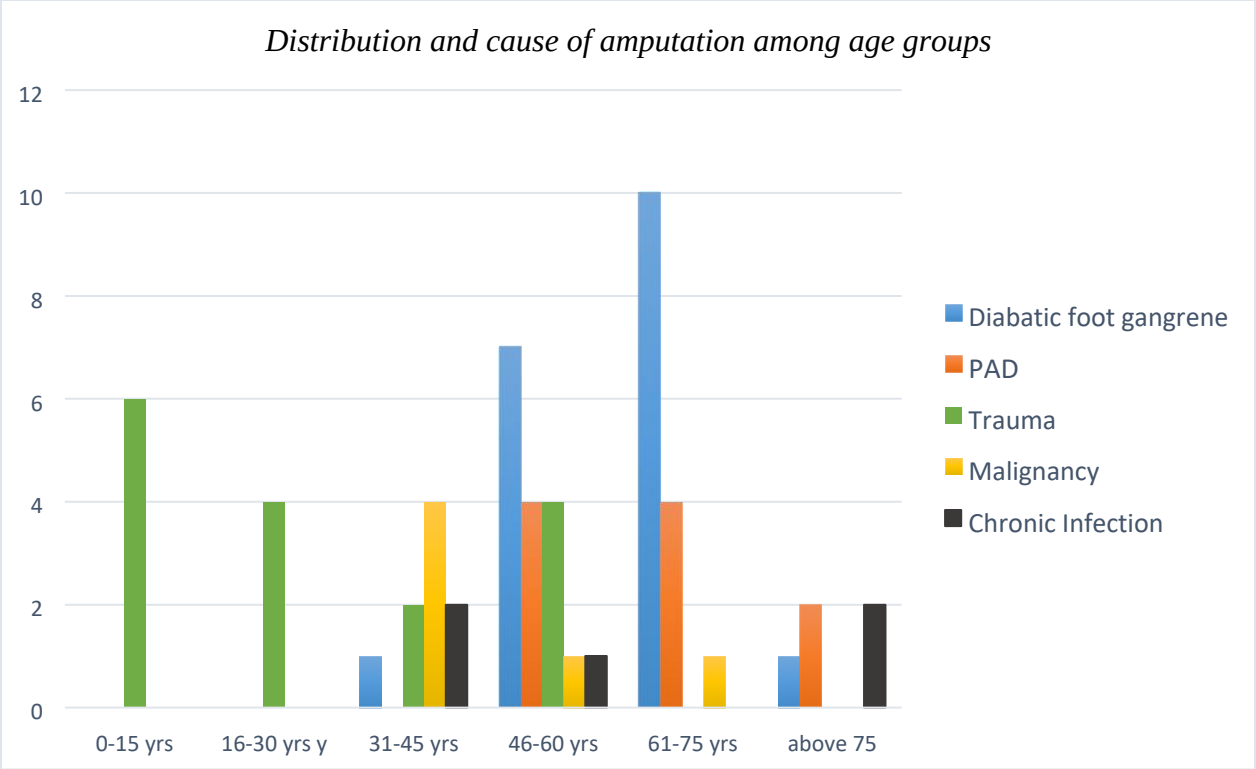

Figure 4. Distribution of amputation by age among patient undergone amputation in orthopedic and traumatology departments of selected hospitals from September 11, 2020 to August 28,2022.

5.5 Factors associated with amputation

In this study, independent variables such as age, sex, previous history of amputation, smoking history, alcohol intake, presence of trauma, malignancy, infection and chronic medical illness were analyzed first by bivariable analysis. depending on the p-value of this analysis six variables i.e. age, smoking history, history of traumatic bone fracture, presence of diabatic foot ulcer, malignancy and chronic infection were identified as candidate variables for the multivariable analysis for limb amputation. Age, chronic infection, malignancy, and diabatic foot ulcer were showed significant association with amputation in multivariable analysis.

The result of the multivariable analysis indicated that age, chronic infection, malignancy and diabatic foot ulcer were independent determinants associated with major limb amputations. An increase in age by one year was associated with an increased likelihood of amputation by

1.041times [AOR=.1.041; 95% CI: 1.021, 1.062)]. Also, when compared with traumatic cause of amputation, the odds of limb amputation were 20.883 times higher in malignancy [AOR= 20.883 ;95% CI: 20.883 (4.626, 94.265)]**,** 4.812 times higher in patients presented with chronic infection [AOR= 4.812; 95% CI: (1.683, 13.760)], and 4.973 times higher in patient presented with the diabatic foot ulcer [AOR= 4.973;95% CI: (1.645, 15.038)].

Table 8*:* factors associated with major limb amputation in patients underwent procedure at orthopedic surgery and traumatology department of *selected* hospitals from September 11, 2020 to August 28,2022.

Variables	**Category**	**Frequency & percent**	**Bivariate analysis (cor)**	**Multivariate analysis (aor)**	**P-value**
Age		386 (100%)	1.049 (1.033, 1.065)	1.041(1.021, 1.062)	.000*
Smoking status	Nonsmokers	353(91.5%)	1	1	
	Smokers	33(8.5%)	.292 (.142 .600)	.698 (.128, 3.793)	.677
Causes for Admission	Trauma	202 (52.3)	1	1	
	Malignancy	14 (3.6%)	18.636 (5.605, 61.966)	20.883 (4.626, 94.265)	.000*
	Chronic infection	45 (11.7)	3.872 (1.915, 7.827)	4.812 (1.683, 13.760)	.003*
	Diabatic foot ulcer	31 (8 %)	8.128 (3.692, 17.895)	4.973 (1.645, 15.038)	.004*

6. DISCUSSION

This study was a retrospective hospital-based cross-sectional study, conducted in the Orthopedic Surgery and Traumatology Departments (OSTD) of three public Hospitals involving viewing records of three hundred eight six (386) patients from July 15/2021-August 28/2022.

The results of this study demonstrated that an estimated prevalence of major limb amputation was found to be 14.8%, predominantly amputated limb was major lower limb, frequent site of amputation was above knee amputation, and leading cause of amputation was Diabatic foot ulcer among patients admitted to the OSTD of three public Hospitals in Addis Ababa.

The prevalence from a result of the current study is in line with the similar studies that previously carried out in the Republic of Congo over10 years and study done Canada over 14 years, which reported that the prevalence of limb amputation to be 14.69% and 14.41% respectively (26, 28). It is higher when compared with the studies done in the Rwanda which reported the prevalence of amputation to be 3.08% (29). But its lower when compared to the study done in a tertiary Hospital in South East Nigeria which showed the prevalence of major limb amputation among all orthopedic surgeries within the study period to be 21.8% (49) and in England between 2003-2009 that showed the prevalence of amputation to be 26.3 % (27). The possible reason for these discrepancies could be due to the method of research that used, sample size included, difference in length of study period and different in burden of amputation in different countries due to differences in cause of amputation. In case of the study done in Rwanda they compare prevalence among all patients undergone surgical procedure during study period at surgery department and also included all amputation case during study period.

The current study indicated that the predominant limb amputation was major lower limb amputation (87.1%), which is similar but differ in percent from study done in northern Ethiopia at Ayder hospital in Mekelle city which showed that the commonest type of amputation was major lower limb amputation (58.6 %)(35) and study done at the Tikur Anbessa specialized Hospital which reported 83 (76%) of the patients had lower limb amputation and 27 (25%) had upper limb amputation(43).

The difference in percent may be due to difference in study method and sample size which could be expressed by fact that previous studies were included all amputated patients during

study period. It is also almost similar with study done in Nigeria which shows that 98(84.8%) amputations were done in the lower limb while 17(15.2%) were in the upper limb and with study done over the 14 years (2006–2019), in Saskatchewan Canada, in which 4895 (83.4%) amputation were LEA, and 973 (16.5%) were UEA (26). But, the result of the current study was contrary to the study result done among pediatric age group in Tikur Anbessa Hospital, Addis Ababa, Ethiopia, that reported upper limb amputation were more common than lower limb amputation in which 25/99 (24.5%) were below elbow amputations and 24/99 (23.5%) were above elbow amputations (44). The possible reason for this could be, the previous study done solely on pediatric age group and the leading cause for amputation were complicated trauma unlike the current one in which leading cause for amputation were diabatic foot gangrene.

In the present study, the frequent site of amputation was above knee amputation (49.1%) followed by below knee amputation (26.3%). The finding is almost similar with findings of a study conducted in Northern Ethiopia Mekelle city Ayder Hospital, in which most amputated level was AKA (35.6%) followed by BKA (23%) (35) and Northwestern Cameroon in which above-knee amputations was the most common procedure, accounting for 58 (33.7%) of the total extremity amputations (50). And it is also in line with a study that carried out in England where Overall, more above than below knee amputations were performed (ratio of AK:BK; 1.1:1) (27) and in Southwest Finland in which 80.1% of cases, the primary major LEA level was AKA followed by BKA in 19.9% cases (32). However, this result didn't agree with the study done at tertiary hospital in Northwestern Tanzania which reported that ratio of below knee amputation to above knee amputation was 1.2**:** 1 (4) and study done in tertiary care center in Malawi which also reported BKAs were the most common procedure, accounting for 271 or 43% of surgeries, followed by AKAs 213, or 33.8% (34). These discrepancy shows choice of level of the limb amputation varies but according to the different literature's planning of the of appropriate level of amputation mostly depends on the factors such as tissue viability, micro and macro vascular circulation, cardiac demand and energy expenditure, and anatomical and biomechanical functioning of stump (51). In case of pathology, vascular disease such as atherosclerosis, the gangrene process proximal to toes, and low wound healing capacity of patient makes above knee amputation obligatory (52).

In contrary to the other studies in our country which reported that the leading cause of limb amputation was trauma (35, 43, 44), the most common cause of amputation in current study at selected hospitals was diabetes foot ulcer 19 (35.2%), followed by trauma 14(25.9 %) but it correlates to some studies done in other place, in Africa and other parties of the world. Study done in a tertiary hospital in northwestern Tanzania reported that complication of diabetes mellitus was the main indication for the major limb amputations in 68 (41.9%) patients followed by trauma in 62 (38.4%) patients (4). The study carried out in Ghana also reported similar results which indicated that Diabetic vasculopathy was the most typical cause of limb amputation in 50 cases (44.6%), followed by trauma in 41 cases (36.6%) (53). The possible reason for this might be due to the high prevalence of type-2 DM in Ethiopia with inadequate awareness and increasing risk factors such as the change in the lifestyle of the population over recent decades due to advancement in infrastructure and technology, sedentary lifestyle in an urban area, poor control of hyper and hypoglycemia, poor hygiene, inappropriate footwear, an incompliance with the treatment regimen, overweight and obesity as indicated in different literatures (54, 55).

In addition, according to some literatures reports, in developing countries, foot ulcers and amputations are very common as a result of poverty, lack of sanitation and hygiene, and barefoot walking that interacts to compound the impact of diabetic foot damage (56).

In current study the result from the multivariable analysis indicated that age, presence of malignancy, chronic infection, and diabetic foot ulcer were variable that shows significant association with the limb amputation. These findings are in line with study done in Indonesia at Jakarta general hospital which reported that diabetes mellitus, chronic infection such as skin necrosis, and gangrene were the risk factors significantly showed association with limb amputation ($p < 0.005$) (47). It is also similar to a meta-analysis study result reports on risk factors for lower extremity amputation in patients with diabetic foot ulcers in which variables like, a history of foot ulcers ($P<0.00001$), chronic infections like osteomyelitis and gangrene ($P<0.00001$) were associated with an increased risk of limb amputation (45). The current study also in line with study done in United State of America that reported, the risk of amputation increases with age, regardless of etiology, sex, and race (17).

7. LIMITATIONS OF THE STUDY

Although the current study has provided insight into magnitude, pattern of the major limb amputations and its associated factors in selected hospitals, these findings were based on only three hospitals and are the reflective of this catchment population. So, generalization of these findings to a general population is beyond the scope of this study which requires population-based study that includes a large sample size.

Additionally, due to the poor recording of patient's information and data management system in the study hospitals, some other potential confounding variables such as; nutritional status, BMI, and physical activity that may affect amputation were not included under the study.

8. CONCLUSION

This study is aimed to assess the prevalence and pattern of major limb amputation and its associated factors. The findings of this study showed that, the prevalence of amputation to be 14.8 % and male accounts for more than three fourth of cases. Most of the limb amputation had done among age groups 61-75 years old. The lower limb was the most predominantly amputated limb and above knee amputation was the most frequently done amputation level in the current study. The common cause of amputation was diabetic foot ulcer and it is common among adult age groups.

In the current study multivariable analysis revealed that an increase in age, chronic infection, malignancy, and diabetic foot ulcer were independent factors that showed significant association with the major limb amputation.

9. RECOMMENDATIONS

Based on gathered data and the results demonstrated by this study, the following suggestions are forwarded for the following stalk holders and concerned bodies.

public health planners, and health service providers:

- ✓ Specific activities should be planned focusing on prevention of the diabetic foot ulcer
- ✓ Age specific prevention activities should be planned against risk factors associated with limb amputation
- ✓ Establish national rehabilitation center for people with amputated limb
- ✓ Allocate adequate budget for preventive activities, hospital care and rehabilitation services.

public transportation policy makers and public transportation providers:

- ✓ Clear policies and guidelines should be established regarding provision of safe, secure, comfortable and inclusive transportation for people with amputated limbs.

Governmental, NGOs and private sectors involved in providing prosthetic limb and walking aid devices:

- ✓ Should supply prosthetic limb and other walking aid devices that are safe, comfortable and appropriate for the level of the amputated limb.

Researchers should consider:

- ✓ Conducting population-based prospective studies that involve a large sample size to generate more representative data concerning limb amputation.

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ANNEX I: CHECKLISTS

S No	Coding Categories	Questions and filter	Skip	Code
Section I. Socio-demographic characteristics				
1.1	What was the patient age?	Age (in years): _____		
1.2	Sex of the patient.	1. Male 2. Female		
1.3	Residency	1. Rural 2. Urban		
1.4	Address/region	1. Addis Ababa 2. Oromia 3. Amhara 4. SNNP 5. Diredawa 6. Afar 7. Benshangulgumz 8. Somale 9. Harari 10. Tigray 11. Sidama 12. Gemballa 13. Southwest		
1.5	Occupation	1. Government employee 2. private employee 3. Soldier 4. Daily labor 5. Sportsmen 6. Driver 7. Others (Specify)		
Section II. Risk factor assessment				
2.1	Did the patient has Hx of trauma?	1. YES		
		2. NO	If no skip to Q*2.6	

2.2	What type of trauma is it?	1. RTA 2. Fall down accident 3. Gun-shot 4. Burn 5. Emaciating injury 6. Other		
2.3	Does the patient bite by an animal?	1. YES		
		2. NO	If no skip to Q.2.6	
2.4	What type of animal was it?	1. Snake 2. hyena 3. Dog 4. Others(specify)		
2.5	Site of bite	1. Upper extremity 2. Lower extremity 3. Others (specify		
2.6	does the patient ever diagnosed with DM?	1. Yes		
		2. No	If no skip to Q.2.8	
2.7	Did the patient have a diabetic foot ulcer?	1. Yes		
		2. No		
2.8	Does the patient smoke?	1. Yes		
		2. No		
	Does the patient drink alcohol?	1. Yes		
		2. No		
2.9	Does the patient have any of the following infections?	1. Gas gangrene	Circle the diagnoses the patient has.	
		2. Chronic osteomyelitis		
		3. Wet gangrene		
		4. Leprosy		
		5. Necrotizing fasciitis		

2.10	Does the patient have any limb malignancy?	1. YES 2. NO		
2.11	Does the patient have any PVD?	1. YES		
		2. NO		
2.12	Which type?	1. Diabetic 2. Non-diabetic		
Section III. reason for hospitalization and questions related to amputation				
3.1	What was the Reason for hospitalization?	1. Bone fracture 2. Chronic infection 3. Malignancy 4. Tissue injury 5. Dislocation 6. Bullet Injury 7. Diabatic foot ulcer 8. Others (specify)	Circle one or more answer(s)	
3.2	What kind of operation was provided for the patient at hospitals?	1. Hemostasis secure and soft 2. tissue repair 3. Reduction and splint age 4. Debridement 5. Amputation 6. Fasciectomy 7. Others----------	If other than amputation selected stop	
3.3	If amputation was selected, what type of operation was it?	1. Elective 2. Emergency		
3.4	What was the indication for amputation?	1. Trauma 2. Chronic infections 3. PVD 4. Malignancy 5. Other		
3.5	Which limb was amputated?	1. Unilateral upper limb 2. Bilateral upper limb 3. Unilateral Lower limb 4. Bilateral Lower limb 5. Combination		

3.6	What is the amputation level for any of the chosen limbs?	1. Fingers 2. Hand 3. Below elbow 4. Elbow disarticulation 5. Arm 6. Shoulder 7. Toes 8. Foot 9. Ankle disarticulation 10. Below knee 11. Knee disarticulation 12. Above knee 13. Hip 14. Others (Specify)		

Source (8-31) Q* = Question.