MEKELLE UNIVERSITY COLLEGE OF HEALTH SCIENCES AND AYDER COMPREHENSIVE SPECIALIZED HOSPITAL, SCHOOL OF MEDICINE DEPARTMENT OF PHYSIOTHERAPY

PREVALANCE AND ASSOCIATED FACTORS OF MUSCLOSKELETAL DISORDER AMONG LOWER LIMB PROSTHESIS USERS IN MEKELLE, TIGRAY, ETHIOPIA (2024/2025).

PRINCIPAL INVESTIGATOR: KIBROM KIDANU (BSC, MSc candidate)

Email: kibromkidanu71@gmail.com

A RESEARCH THESIS SUBMITTED TO THE DEPARTMENT OF PHYSIOTHERAPY COLLEGE OF HEALTH SCIENCES, MEKELLE UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE MASTERS OF SCIENCE IN PHYSIOTHERAPY.

ADVISORS: DAWIT ZENEBE,

GEBRERUFAEL SOLOMON

TEKLEHAIMANOT TEKLE.

JUN 12, 2025

MEKELLE

MEKELLE UNIVERSITY COLLEGE OF HEALTH SCIENCES DEPARTMENT OF PHYSIOTHERAPY SCHOOL OF MEDICINE

PREVALANCE AND ASSOCIATED FACTORS OF MUSCLOSKELETAL DISORDER AMONG LOWER LIMB PROSTHESIS USERS IN MEKELLE, TIGRAY, ETHIOPIA (2024/2025).

A THESIS SUBMITTED TO THE DEPARTMENT OF PHYSIOTHERAPY, COLLEGE OF HEALTH SCIENCES MEKELLE UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE MASTER OF PHYSIOTHERAPY.

PRINCIPAL INVESTIGATOR: KIBROM KIDANU (BSC, MSc candidate)

DATE 12/06/2025

Advisor’s Approval Sheet

Mekelle University

College of Health Sciences

Department of physiotherapy

Advisor’s Approval Sheet

This is to certify that the thesis entitled A cross-sectional study on the prevalence and associated factors of musculoskeletal disorder among lower limb prosthesis users in Mekelle, Tigray, Ethiopia (2024) is submitted in partial fulfillment of the requirements for the degree of MSc with specialization in physiotherapy to the Graduate Program of the College of health sciences Mekelle University and has been carried out by Kibrom Kidanu ID No: 004/13 under my supervision. Therefore, I recommend that the student has fulfilled the requirements and hence hereby can submit the proposal to the Department.

______________________	______________	____________
Name of Major Advisor	Signature	Date
______________________	______________	____________
Name of Co advisor	Signature	Date
______________________	______________	____________
Name of Co advisor	Signature	Date
______________________	______________	____________
Name of examiner	Signature	Date
______________________	______________	____________
Name of examiner	Signature	Date

Declaration

I hereby declare that my MSc thesis is my original work and has not been presented for a degree in any other university and all sources of material used for this thesis have been duly acknowledged.

Name: Kibrom Kidanu

Signature:

Date:

This MSc thesis has been submitted for examination with my approval as thesis advisor

Name:.......................

Signature:.....................

Date:...............................

Examiner’s Approval Sheet

Mekelle University College of Medicine and Health Science, School of Medicine, Department of Physiotherapy**.**

We, the undersigned, members of the Board of Examiners of the final open defense by Kibrom Kidanu have read and evaluated his/her thesis on the prevalence and associated factors of musculoskeletal disorder among lower limb prosthesis users in Mekelle, Tigrai, Ethiopia,2024/2025 and evaluated the candidate. This is to certify that the thesis has been accepted in partial fulfillment of the requirements for the Masters Degree in Physiotherapy.

________________________	________________	_____________
Name of Chairperson	Signature	Date
________________________	________________	_____________
Name of Major Advisor	Signature	Date
________________________	________________	_____________
Name of Internal Examiner	Signature	Date
________________________	________________	_____________
Name of External Examiner	Signature	Date

Final approval and acceptance of the thesis is contingent upon the submission of the final copy of the thesis to the candidate's Department through the office of the Department Graduate Program Coordinator.

Thesis Approved by

________________________	________________	_____________
Graduate Program Coordinator	Signature	Date

Certification of the Final Thesis

I certify that all the corrections and recommendations suggested by the Board of Examiners are incorporated into the final thesis entitled Prevalence and associated factor among lower limb prosthesis users Mekelle, Tigray, Ethiopia,2024/2025 by Kibrom Kidanu.

________________________	________________	_____________
Department Head	Signature	Date

Stamp of the Department of _____

Acknowledgment

I would like to express my sincere gratitude to Mekelle University College of Health Sciences for its support of the Master's program in Physiotherapy, and to the instructors who continuously reviewed my work and provided constructive feedback throughout the research process. I am especially thankful to my advisors, Mr. Dawit Zenebe, Mr. Gebrerufael Solomon, and Mr. Teklehaimanot Tekle, for their invaluable guidance and insightful advice. I also extend my appreciation to the Mekelle Ortho-Physiotherapy Center for their collaboration and support and to all the study participants for their time and contributions.

Table of content

List of tables

List of figure

Abbreviation

CI	Confidence Interval
HRERC	Health Research Ethics Review Committee
LLP	Lower Limb Prosthesis
MOPC	Mekelle Orthopedic and Physiotherapy Center
MSD	Musculo-Skeletal Disorder
NMQ	Nordic Musculoskeletal Questionnaire
ODK	Open Data Kit
SPSS	Statistical Package for the Social Sciences

Abstract

Background: Musculoskeletal disorders (MSDs) affect the muscles, bones, tendons, ligaments, and nerves, leading to pain, disability, and reduced mobility. MSDs have a major health impact on patients with lower limb prosthesis users in their functional and physical activity, which leads to poor outcomes, loss of motivation, loss of mobility, and decreased quality of life. Despite the burden of MSDs among lower limb prosthesis users, there is limited evidence about the burden of MSDs in Ethiopia. This study aimed to assess the prevalence and its associated factors of MSDs among lower limb prosthesis users attending Mekelle Ortho-Physiotherapy Center.

Method: Institutional-based cross-sectional study was conducted from November to May 2024/2025 at the Mekelle Ortho-Physiotherapy Center with a sample size of 401. A systematic random sampling technique and face-to-face interview using a structured Nordic Musculoskeletal Questionnaire (NMQ) were used. The collected data was entered into Kobo collect and analysis using SPSS 27. Binary logistic regression analysis was employed to identify the potential candidates for multivariable logistic regression with a p-value less than 0.25. Finally, multivariate logistic regression analysis was employed and variables with $p <$ 0.05 with 95% CI were considered statistically significant contributors to musculoskeletal disorder.

Result The overall prevalence of MSDs among lower limb prosthesis user patients was 58.35% (95% CI, 53.4–63.2). Factors affecting MSDs smoking (AOR = 2.54; 95% CI, 1.56–4.23), depression (AOR = 4.19; 95% CI, 1.92–9.11), gait abnormality (AOR = 3.00; 95% CI, 1.78–4.85), cause of amputation by trauma (AOR=2.04; 95%CI, 1.04-4.00) and annually prosthesis maintenance (AOR = 3.54; 95% CI = 2.16–5.36) were significantly associated with MSDs among lower limb prosthesis user patients.

Conclusion MSDs are a public health burden among patients with lower limb prosthesis users. More than half of the people with lower limb prosthesis users had reported MSDs. Annually prosthesis maintenance, being a smoker, having depression, and gait abnormalities were the factors significantly associated with MSDs. Thus screening for MSDs, and avoiding the identified factors will help to reduce the occurrence of MSDs.

Keywords: Musculoskeletal disorder, lower limb amputation, lower limb prosthesis, prevalence

1. Introduction

1.1 Background

Musculoskeletal disorders (MSDs) refer to a group of conditions affecting the muscles, bones, tendons, ligaments, and nerves that are crucial for movement and function [1, 2]. These disorders are a major global health burden, causing pain, disability, and impaired mobility. In 2017, the global incidence of MSD rose by 58%, increasing from 211.8 million cases in 1990 to 334.74 million cases. Among these, females experienced a higher incidence, with 180.77 million cases compared to 153.97 million cases in males [3]. Recent studies indicate a significant prevalence of musculoskeletal disorders in individuals who use lower limb prostheses, with reported rates ranging from 52% to 90% [4].

The prosthesis is an artificial device that replaces a missing body part, coordinated by prosthetics and an interdisciplinary team of health care professionals [5]. Prosthetic devices are essential to getting amputees back on their feet and living independently. They allow the user to restore their former abilities and carry out day-to-day activities. Yet even as prosthesis technology continues to advance, the devices still come with a fair number of anatomical and mechanical problems that can make them dangerous to wear for long periods [6, 7].

Musculoskeletal disorders can have a significant impact on the quality of life, mobility, and overall health of prosthetic limb users. Ongoing pain and limitations in function can restrict physical activity and reduce social involvement, often resulting in feelings of isolation and depression [8].

Musculoskeletal disorders characterized by pain and dysfunction in the muscles, joints, and connective tissues, pose a significant concern for individuals who use lower limb prostheses [9]. These disorders can negatively impact the effectiveness of prosthetic limbs, leading to discomfort, reduced mobility, and compromised overall health [9, 10]. Understanding the factors that contribute to these conditions is crucial for developing effective interventions and improving patient care. Several factors have been identified as potential contributors to musculoskeletal disorders among prosthesis users, including improper alignment of prosthetic devices, variations in physical activity, and biomechanical stresses [9, 11].

1.2 Statement of the problem

Musculoskeletal disorder disorders have become an increasingly significant global health issue. Between 1990 and 2017, the number of incident cases of MSK disorders increases by 58%, from 211.80 million to 334.74 million worldwide. This reflects the growing burden of these conditions, which include a range of ailments affecting bones, muscles, and joints, such as back pain, knee pain, and ankle pain. Contributing factors to this increase include population aging, lifestyle changes, sedentary behavior, and rising obesity rates. As MSK disorders continue to impact individuals' quality of life and contribute to disability, addressing this global health challenge has become a key priority for healthcare systems worldwide[12].

The increasing prevalence of lower limb amputations due to trauma, disease, and congenital conditions has led to a growing population of lower limb prosthesis users[13, 14]. While prosthetic limbs significantly improve mobility and quality of life, they also pose a risk of developing MSDs due to altered biomechanics and uneven stress distribution during walking, standing, and other physical activities. These disorders include joint pain, muscle strain, gait abnormalities, and spinal misalignment, which are common among individuals using lower limb prosthetics[15, 16].

Despite advancements in prosthetic design and rehabilitation techniques, many users still report persistent musculoskeletal pain and discomfort, leading to reduced functional performance, mobility, and overall well-being. The mechanical adaptation required to use a prosthetic limb often leads to compensatory postural and gait changes that place additional strain on the unaffected limb, joints, and spine. This issue not only hinders rehabilitation progress but also results in long-term complications such as chronic pain, limited range of motion, and increased risk of secondary injuries [4]. This study aims to assess the prevalence, and risk factors of MSDs among lower limb prosthesis users in Mekelle Ortho-Physiotherapy center, Tigray, Ethiopia.

1.3 Justification of the study

The rationale behind choosing this problem area is the rise in musculoskeletal disorders among prosthesis users worldwide, along with associated risk factors and complications[4]. People who use lower limb prostheses are increasingly experiencing MSDs like joint pain, muscle problems, and back issues. This is because prosthetics can change how they walk, leading to uneven weight distribution and awkward movements. As more people use prostheses, it's vital to understand and tackle these MSDs to ensure they have a good quality of life in the long run[17].

This study is crucial as it addresses the lack of data on MSDs among lower limb prosthesis users in Mekelle, Tigray, Ethiopia. With an increasing number of amputees, understanding the prevalence and risk factors of MSDs is key to improving care and quality of life. The findings has help standardize management protocols at the MOPC, reduce complications, and guide targeted interventions to enhance prosthetic care.

This study benefits multiple stakeholders: prosthesis users, healthcare providers, and policymakers. For prosthesis users, it helped reduce MSD-related pain and disability. Scientifically, it has contribute to the understanding of prosthetic health issues in low-resource settings. Policy-wise, it has inform improvements in healthcare strategies and operational practices, ultimately leading to better health outcomes and quality of life for amputees in Ethiopia.

2. Literature review

2.1 Prevalence of Musculoskeletal Disorders among Prosthesis Users

Musculoskeletal disorders are a common problem among people who use lower limb prostheses**.** Studies have shown that a significant number of prosthesis users experience MSDs, including pain and discomfort in the residual limb, as well as in the hips, knees, and lower back[10].

A cross-sectional study conducted in Italy reported prevalence rates of lower back pain among this population. The study found that 82% of individuals experienced lower back pain post-amputation, with 70% reporting such pain in the last year. Another systematic review done in London revealed that the prevalence of lower back pain of 52%-64% in traumatic amputees, compared to 48%-77% in the general amputee population [18, 19].

A study conducted by the University of Washington's Department of Orthopedic and Surgery found that 70.8% of participants reported experiencing lower back pain, while 63.3% experienced phantom pain [20]. Additionally, another study from the same university examined the prevalence of musculoskeletal disorders among lower limb prosthesis users. It revealed that 39.2% of participants reported lower back pain, and 35.1% reported residual limb pain. Knee pain and shoulder pain were less commonly identified, affecting 27.9% and 21.7% of participants, respectively [21].

A study at the University Medical Centre Rotterdam in the Netherlands found that 26.3% of participants reported experiencing frequent or long-term low back pain (LBP). This highlights how common LBP is among the people included in the study [22] additionally a retrospective study done in Medical University of Vienna who were treated with a unilateral major amputation of the lower limb found Seventeen of 21 patients reported phantom limb and back pain [23].

2.2 Associated Factors of Musculoskeletal Disorders

2.2.1 Socio-demographic Factor among Lower Limb Prosthesis Users

Socio-demographic factors significantly affect MSDs among lower limb prosthesis users. Age is critical, as older individuals often experience more pain [24]. Female sex differences affect more for lower back pain[25, 26] while lower socioeconomic status limits healthcare access, increasing MSD rates[27, 28]. Marital status, education, and religion influence their prosthetic experience and outcomes[27, 29, 30].

2.2.2 Prosthesis factor among Lower Limb Prosthesis Users

Improper fit and alignment of prostheses are significant contributors to MSDs. Misalignment can cause abnormal stress on the residual limb and other joints, leading to pain and discomfort further demonstrating that suboptimal alignment is associated with an increased risk of lower back pain and hip discomfort[9, 31].

Gait abnormalities resulting from prosthetic use contribute to MSDs. Deviations in gait can lead to increased mechanical stress on the remaining limb and joints, exacerbating discomfort and pain. Gait deviations are often linked with higher incidences of knee and lower back pain among prosthesis users[32].

The residual limb is also a crucial factor. Skin issues, such as ulcers and dermatitis, as well as muscular atrophy in the residual limb, can contribute to discomfort and MSDs. Poor residual limb health is often associated with increased pain and functional limitations[16].

2.2.3 Psychosocial and personal factors of musculoskeletal Disorder

Factors such as physical activity levels, and pre-existing musculoskeletal conditions also play a role in the development of MSDs. Users with lower physical activity levels may experience increased stress on their prosthetic components and remaining joints, leading to a higher incidence of MSDs[33, 34].

Depression can reduce motivation for activity and prosthesis care[8, 15] while smoking impacts to increase pain and bone health. The time since amputation and prosthesis use affects adaptation, with overuse causing injuries and underuse leading to weakness[15]. Amputation level impacts strain on the remaining limb[35].

2.3 Conceptual Framework

This conceptual framework was developed based on previous studies conducted on musculoskeletal disorders among lower limb prosthesis users in different place and time .The frame work contains dependent variable which is musculoskeletal disorder and independent variable such as socio demographic factors, prosthesis related factors, psychosocial and personal factors [8, 15, 25-28, 35].

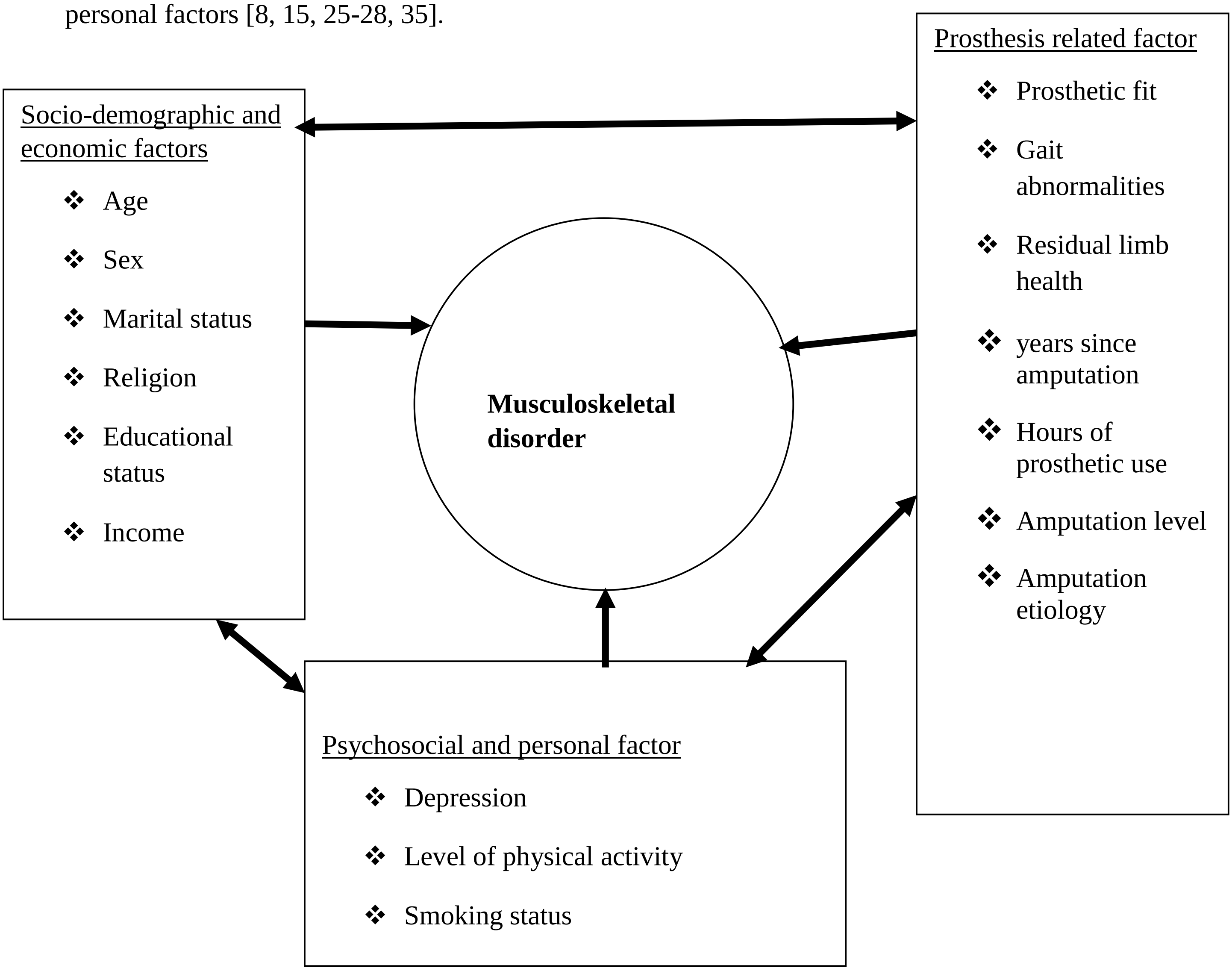

Figure1the conceptual framework showing the factors associated with musculoskeletal disorders among lower limb prosthesis users.

3. Objectives

3.1 General objective

To assess the prevalence and associated factors of MSDs among lower limb prostheses users attending Mekelle Ortho-physiotherapy Center in Mekelle, Tigray, Ethiopia, 2024/2025.

3.2 Specific objectives

To determine the prevalence of MSDs among lower limb prosthesis users.

To identify factors associated with the development of MSDs among lower limb prosthesis users.

4. Methodology

4.1 study area and period

This study was conducted in Mekelle Ortho-physiotherapy Center Mekelle, Tigray; Ethiopia. Mekelle is a special zone and capital of the Tigray Region of Ethiopia. It is located around 780 kilometers (480 mi) north of the Ethiopian capital Addis Ababa, with an elevation of 2,254 meters (7,395 ft) above sea level. Mekelle is the economic, cultural, and political hub of northern Ethiopia. The population of Mekelle is 537,822 (255,962 men, 281,860 women), with a diverse age distribution and approximately equal gender ratios [36]. According to Tigrai Regional Health Bureau, Mekelle has a tertiary hospital, 1 rehabilitation center, 12 public health centers, and 4 public hospitals providing promotive, preventive, curative, and rehabilitative services.

The Mekelle Ortho-Physiotherapy Center, a specialized rehabilitation facility in Tigray, Ethiopia, offers comprehensive care for musculoskeletal and orthopedic conditions, including lower limb amputations. It provides services like physiotherapy, prosthetics, and orthotics to improve mobility and quality of life for patients with disabilities. The center's skilled professionals and work on pre-prosthesis fit and post-amputation care make it an ideal setting to study musculoskeletal disorders among lower limb amputees[37, 38].

4.2 Study design

An institutional-based cross-sectional study was conducted.

4.3 Population

4.3.1 Source of Population

All individuals were using lower limb prostheses at Mekelle Ortho-Physiotherapy Centers.

4.3.2 Study population

Individuals who were lower limb prosthesis users attended MOPC during the study period.

4.4 Eligibility criteria

4.4.1 Inclusion criteria

- Current lower limb prostheses users at the time of study period.
- Individuals who have been fitted with a lower limb prosthesis**,** regardless of duration of use.

4.4.2 Exclusion criteria

- Individuals are unable to understand the study due to severe cognitive impairments.
- Individuals with diagnosed severe health conditions, such as neurological disorders (stroke, Traumatic brain injury), may confound results related to musculoskeletal disorders.
- Individuals with recent trauma, rheumatism, tumors, or other diseases affecting the musculoskeletal system.

4. 5 sample size determination

The required sample size of eligible participants for the study was determined by using a single population proportion formula.

$$N=\frac{\left(z\frac{\alpha}{2}\right)^2 \times p(1\text{-}p)}{d^2}$$

Where: n = the desired sample size.

p = **50%** is taken no recent research conducted in a similar situation in Ethiopia.

d= 5% is the maximum margin of error the researcher is willing to tolerate.

Z= 1.96 is the standard normal deviation value corresponding to the 95% CI.

n= (1.96)2*0.5(1-0.5/ (0.05)$^{2)}$

n=1.96)^{2}x0.5x0.5/0.05)^2

= 3.8416*0.25/0.0025

=0.9604/0.0025=384.16= 384

The initial sample size number was approximately 384 so, the population size under 10.000 this were uses Finite Population Correction (FPC).

Now, apply the finite population correction:

$$N_{corr} = \frac{n}{1+\frac{n-1}{N}}$$

$$n = \frac{384}{1+\frac{384-1}{6915}} = \frac{384}{1+\frac{383}{6915}} = \frac{384}{1+0.0553868402} = \frac{384}{1.0553868402} = 363.84762949 \approx 364$$

The corrected sample size was approximately 364.

A 10% non-response rate was added (36.4 ≈ 37).

The final sample size was 400.4 ≈ **401.**

The sample size for the **second objective** from the associated factor of smoking [39] was calculated the sample size using Epi info -7 based on that

CI = 95%

Power = 80%

Ratio (unexposed –exposed) = 0.5497

%out come in unexposed group =35.4%

%outcome in exposed group = 64.4 %

Based on the above information sample size was **115**

By adding 10 % non-response =11.5≈**12**

Total sample size = 115+12 = **127** so, this sample size to small and it prefer the first sample size population which was 401.

4.6 Sampling technique and procedure

A systematic sampling method was used to select 401 lower limb prosthesis users at the Mekelle Ortho-Physiotherapy Center over two months. All patients who visited the center during this period and met the inclusion criteria were eligible for participation. The number of patients visiting the center over three consecutive days averaged 15, 17, and 16. The total number of patients visiting the center averaging 16 per day was within two months 832, so the sampling interval (k) was calculated as k=832/401=2. A simple random sampling was used to determine the starting point, and then every second patient was selected.

4.7 variable of the study

A) Dependent variable

Musculoskeletal disorder (Yes=1, No=0)

B) Independent variable

- Socio-demographic and economic factors

Age, Sex, Marital status, Religion, Educational status, and average monthly Income.

- Psychosocial and personal factors.

Depression, Level of physical activity, Smoking status, years since amputation, hours of prosthesis use, amputation level.

- Prosthesis related factor

Prosthetic fit, Gait abnormalities, and Residual limb health (e.g. skin).

4.8 Data collection method and instrument

Data collection involved a comprehensive approach utilizing structured questionnaires, standardized assessment tools, and semi-structured interviews. The structured questionnaires captured demographic information, medical history, type of prosthesis, duration of use, and specific questions related to musculoskeletal disorders, employing closed-ended questions for quantitative analysis. Additionally, standardized assessment tools, such as the Nordic musculoskeletal, provide validated measures of pain and disability. Semi-structured interviews enriched the data by gathering depth insights into participants' experiences with musculoskeletal disorders and prosthesis use. Data was collected through face-to-face surveys during rehabilitation services visits by two BSc physiotherapy data was collected for two months, allowing for clarity and assistance when needed, while training was given to the data collector by a senior physiotherapist for one day and the physical investigator supervised throughout the time of data collection.

4.9 Data processing and analysis

After the collection of data, all interviewed questionnaires were checked for completeness, correctness, and internal consistency to exclude missing or inconsistent data. Data entry and analysis were conducted using SPSS version 27, where descriptive statistics, including frequency, and percentage, were computed. Any variable having a significant univariate test with a cutoff point of p-value less than 0.25 was selected as a candidate for the multivariate analysis. Multi-collinearity test was also checked to assess the correlation between the independent variables. The final model was checked for multi-collinearity by a variance inflation factor (VIF). Finally, AOR with a 95% confidence interval at a p-value of <0.05 were reported. The findings of the study were presented in texts, tables, and figures.

4.10 Data Quality Control

To minimize information bias, a pretest was conducted on Mekelle Ortho-Physiotherapy Center 5% of the sample one week before the study to identify and correct any issues with the interview questions and ODK data collection tools. Data collectors undergo thorough training to conduct standardized face-to-face interviews using the Nordic Musculoskeletal Questionnaire and other tools, ensuring consistency in question delivery and neutral, non-leading language. The principal investigator was supervise the process, with daily checks for completeness and accuracy. Missing or incomplete data was manually cleaned, and any inconsistencies across data sources (e.g., questionnaires) were cross-validated. This structured approach ensured reliable, unbiased data collection for the study of musculoskeletal disorders in lower limb prosthesis users.

4.11 Operational Definitions

A. Musculoskeletal disorder is defined as feeling pain or discomfort at any time during the last 12 months in at least one part of the lower back, knee, ankle, and feet[1].

B. Cigarette smoking is the habit of smoking if they ever smoke daily for a month or more at least one stick of cigarettes per day [40].

C. Depression; participants who score ≥5 on "patients –health questioners -9 ‘’ considered as <yes > for depression [41]

D. Physical active – any moderate to vigorous physical activities, performed that require energy expenditure of at least 150 min/week otherwise it is physically active [42].

E. Gait abnormality - deviations from the typical pattern of walking or movement [29].

F. Residual limb health - the condition of the remaining part of the limb following amputation [43].

4.11 Ethical considerations

Ethical approval for the study was obtained from the Health Research Ethics Review Committee (HRERC) of the College of Health Sciences, Mekelle University. Participants were thoroughly informed about the study's purpose and importance, and verbal consent was obtained to ensure their willingness to complete the questionnaires. There are no anticipated risks that could harm participants in any form. Additionally, all information collected was be treated with strict confidentiality, ensuring that individual data is anonymized and securely stored.

4.12 Dissemination and utilization of result

This result was presented and submitted to the Department of Physiotherapy, School of Medicine College of Health Sciences. Copies of the findings were also sent to the Mekelle Ortho-Physiotherapy Center non-governmental organizations can use the data to create educational and strategic plans for musculoskeletal disorder prevention in the future. Publications in peer-reviewed national or international journals and presentations at professional, local, national, and international meetings will be attended.

5. Results

5.1 Descriptive statics

5.1.1. Socio-demographic characteristics of lower limb prosthesis users

This study enrolled 401 study participants with a response rate of 100 % (401). More than half of the study participants, 334(83.3%) were male. The median age of the participants was 25 years and 282(70.3%) were married. 280 (69.8%) completed their secondary school, 358(89.3%) were income level between 4000-7000 Ethiopian birr and 398(98%) were orthodox. Two hundred sixteen-three participants (65.6%) were age group 25-34. (Table: 1)

Table 1: Socio-demographic characteristics of lower limb prosthesis users in Mekelle, Tigrai, Ethiopia, May 2025, (n=401)

Variables	Category	Frequency	Percent	Musculoskeletal disorder	
				Yes	No
Sex	Male	334	83.30%	192(57.5%)	142(42.5%)
	Female	67	16.70%	42(62.7%)	25(37.3%)
Religion	Orthodox	393	98%	233(59.3%)	160(40.7%)
	Muslim	8	2%	1(12.5%)	7(87.5%)
Age group	18-24	35	8.70%	13(37%)	22(63%)
	25-34	263	65.60%	159(60.5%)	104(39.5%)
	Above 35	103	25.70%	62(60.2%)	41(39.8%)
Marital status	Single	282	70.30%	163(57.8%)	119(42.2%)
	Married	117	29.20%	69(59%)	48(41%)
	Widowed	2	0.50%	2(100%)	0(0%)
Educational status	No formal education	8	2%	4(50%)	4(50%)
	Elementary school	62	15.50%	43(69.4%)	19(30.6%)
	Secondary school	280	69.80%	161(57.5%)	119(42.5%)
	Diploma	33	8.20%	19(57.6%)	14(42.4%)
	Bachelors of degree	18	4.50%	7(38.8%)	12(61.2%)

Monthly income in (in Birr)	Below 4000	16	4%	11(68.7%)	5(31.3%)
	4000-7000	358	89.30%	206(57.5%)	152(42.5%)
	Above 7000	27	6.70%	17(63%)	10(37%)

5.1.2 Prosthesis and treatment-related characteristics of lower limb prosthesis users

In the study more than half of the study participants, 224(55.9%) used an exoskeleton type of prosthesis, 344(85.8%) were prostheses used above two years, 257(64.1%) were amputated due to trauma, 379(94.5%) were received education for prosthesis use, 260(64.8%) maintain their prosthesis annually, 367(91.5%) have access to prosthesis fellow up, 244(60.8%) with phantom pain and 216 (53.9%) have left side amputation. Among the study participants, among the MSDs treatment received 201(85.9%) developed MSDs and about 137(34.2%) were participants with gait abnormality (Table 2)

Table 2; Prosthesis and treatment-related characteristics of lower limb prosthesis users in Mekelle, Tigrai, Ethiopia, May 2025, (n=401)

Variables	Category	Frequency	Percentile (%)	Musculoskeletal disorder	
				Yes	No
Duration of prosthesis use	<2 years	57	14.20%	46(80.7%)	11(19.3%)
	>2 years	344	85.80%	188(54.7%)	156(45.3%)
Type of prosthesis	Exoskeleton	224	55.90%	135(60.3%)	89(39.7%)
	Endoskeleton	177	44.10%	99(56%)	78(44%)
Cause of amputation	Medical condition(cancer)	29	7.20%	16(55%)	13(45%)
	Trauma	257	64.10%	175(68%)	82(62%)
	Infection (gangrene)	112	27.90%	41(36.6%)	71(63.4%)
	Vascular (peripheral arterial diseases)	3	0.70%	2(66.7%)	1(33.3%)
Amputation to prosthesis	Immediate (1-3 months)	14	3.49%	9(64.3%)	5(35.7%)
	Intermediate (4-7 months)	137	34.16%	30(21.9%)	107(78.1%)
	Long (above 7 months)	250	62.34%	128(51.2%)	122(48.2%)
Prosthesis hrs. used	Minimal use(1-4hrs)	16	4%	11(68.8%)	5(31.2%)

	Moderate use (5-8hrs)	111	27.70%	25(22.5%)	86(77.5%)
	Extended use (9-12hrs)	274	68.30%	131(47.8%)	143(52.2%)
Side of amputation	Right	185	46.10%	115(62%)	70(38%)
	Left	216	53.90%	119(55%)	97(45%)
Additional upper limb amputation	Yes	23	5.70%	20(87%)	3(13%)
	No	378	94.30%	214(56.6%)	164(43.4%)
Education for prosthesis use	Yes	379	94.50%	221(58.3%)	158(41.7%)
	No	22	5.50%	13(59%)	9(41%)
Prosthetic maintenance	Quarterly	141	35.20%	40(28.4%)	101(71.6%)
	Annually	260	64.80%	194(74.6%)	66(25.4%)
Access to prosthesis follow-up care	Yes	367	91.50%	216(59%)	151(41%)
	No	34	8.50%	18(53%)	16(47%)
Phantom pain	Yes	244	60.80%	176(72%)	68(28%)
	No	157	39.20%	58(37%)	99(63%)
Frequency of phantom pain	Rarely	71	17.70%	38(53.5%)	33(46.5%)
	Occasionally	166	41.40%	134(80.7)	32(19.3%)
	Frequently	7	1.70%	4(57%)	3(43%)
Phantom pain grade	Mild phantom pain (1-3)	72	18%	33(46%)	39(54%)
	Moderate phantom pain (4-6)	166	41.40%	142(85.5)	24(14.5%)
	Severe phantom pain (7-10)	6	1.50%	2(33.3%)	4(66.7%)
Treatment for MSD	Yes	201	85.9%	201(100%)	0(0%)
	No	33	14.1%	33(100%)	0(0%)
Skin problem at the residual limb	Yes	176	43.90%	129(73.3%)	47(26.7%)
	No	225	56.10%	105(46.7%)	120(53.3%)
Skin problem category	Redness of the skin	163	40.60%	122(75%)	41(25%)
	Blister	19	4.70%	12(63%)	7(37%)
	Full thickness	2	0.50%	2(100%)	0(0%)
Gait abnormality	Yes	137	34.20%	122(89%)	15(11%)
	No	264	65.80%	112(42.4%)	152(57.6%)

Prevalence of musculoskeletal disorders (MSDs) among lower-limb prosthesis users by level of amputation. Among prosthesis users, 90.3% of individuals with knee disarticulation reported developing MSDs, compared to 48.3% of those with transfemoral (above-knee) amputations.

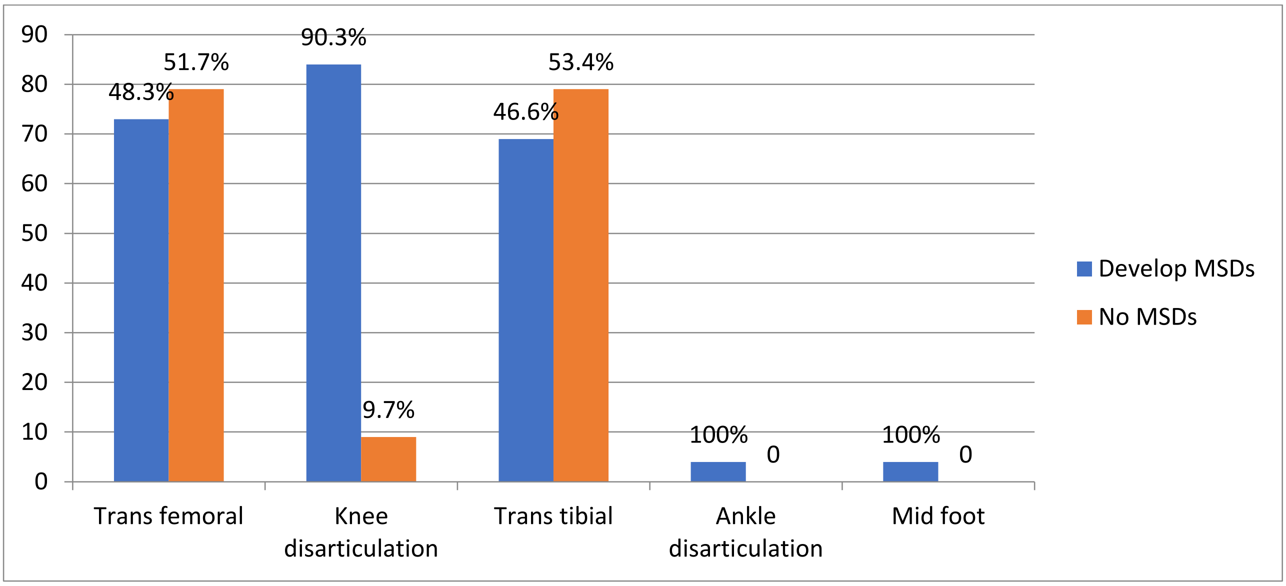

Figure 2.Distribution of musculoskeletal disorder among lower limb prosthesis users in Mekelle, Tigrai, Ethiopia, May 2025, (n=401).

5.1.3 Psychosocial and personal characteristics of lower limb prosthesis users

Among the study participants, 307(76.6%) had reported having depression. Of the study participants, 306(76.3%) were physically active and 177(44.1%) were smokers. Of the total smokers, 124(30.9%) were light smokers (1-5). (Table 3)

Table 3: psychosocial and personal factors of lower limb prosthesis users in Mekelle, Tigrai, Ethiopia, May 2025, (n=401)

Variable	Category	Frequency	Percentile (%)	Musculoskeletal disorder	
				Yes	No
Depression	Yes	307	76.60%	209(68%)	98(32%)
	No	94	23.40%	25(26.6%)	69(73.4)
Physical activity	Physical active	306	76.30%	190(62%)	116(38%)
	Physical inactive	95	23.70%	44(46.3%)	51(53.7%)
Smoking	Smoker	177	44.10%	138(78%)	39(22%)
	Nonsmoker	224	55.90%	96(43%)	128(57%)
Cigar ate consumption	Light smoker (1-5)	124	30.90%	86(69.4%)	38(30.6%)
	Moderate smoker (6-14)	41	10.20%	40(97.5%)	1(2.5%)
	High smoker (15-20)	12	3%	12(100%)	0(0%)

5.2 prevalence of musculoskeletal disorder among lower limb prosthesis users

The prevalence of MSDs among adult lower limb prosthesis users were found 234(58.35%) in the past 12 months (figure 3). The majority of lower limb prosthesis users following MOPC reported a high prevalence of lower back pain 192(47.9%) and Hip pain 182 (45.4%) compared to other body parts (Table 4). In this study the prevalence of MSDs was relatively higher in male participants 192(57.5%) compared to female participants Among those who had experienced MSDs,159(60.5%) were between the age group of 25-34 years old from the disease and treatment factor, participants with skin problem 129(73.3%) and who were having gait abnormality 122(89%). Among the participants who used an exoskeleton type of prosthesis, 135(60.3%) of them developed MSDs.175 (68%) of those who were amputated by trauma and developed MSDs. Among the participants who had MSDs 176(72%) and 122(89%) of them reported being affected by phantom pain and gait abnormality respectively.194 (74.6%) of the participants with MSDs who have maintained their prostheses annually (Table 2).

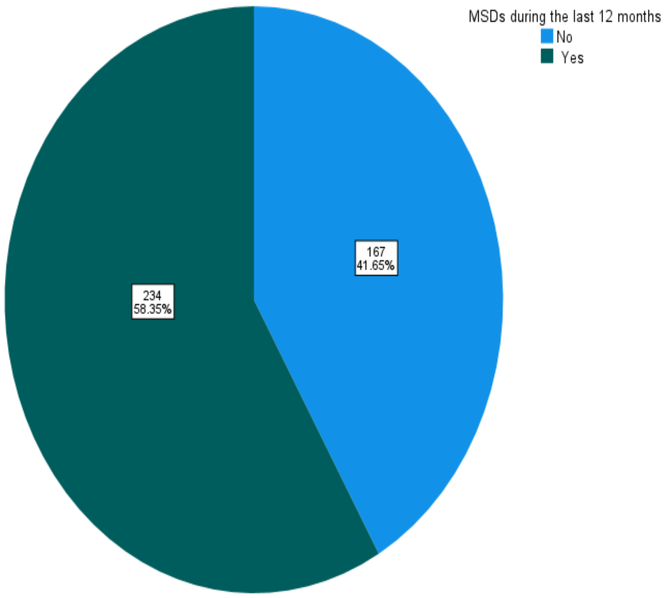

Figure 3; .prevalence of MSDs among lower limb prosthesis users in Mekelle, Tigrai, Ethiopia, May 2025, (n=401)

Table 4. Prevalence of MSDs of lower limb prosthesis users in Mekelle, Tigrai, Ethiopia, 2025, (n=401)

Variable	Category	Past 12 months prevalence of musculoskeletal disorder
Lower back pain	Yes	192(47.9%)
	No	42(10.5%)
Hip	Yes	182(45.4%)
	No	52(12.97%)
Knee	Yes	171(42.6%)
	No	63(15.7%)
Ankle	Yes	138(34.4%)
	No	96(23.9%)
Foot	Yes	120(29.9%)
	No	114(28.4%)

5.3 Factors associated with MSDs among lower limb prosthesis users

In bivariate logistic regression analysis, with cut-off points ($p<0.25$), MSDs associated with age, depression, duration of prosthesis, cause of amputation, frequency of prosthesis maintenance, physical activity, gait abnormality, smoking, amputation to prosthesis, prosthesis hours used, level of amputation.

The multivariate analysis revealed that several independent variables were significantly associated with MSDs from the study participants who developed depression were 4.19 times more likely to develop MSDs (AOR=4.19; 95% CI: 1.92-9.11) compared to non-depression. The study participants with trauma as a cause of amputation were 2.04 times more likely to develop MSDs (AOR=2.04; 95%CI: 1.04-4.00) compared with those caused by medical conditions (cancer).

The lower limb prosthesis users who were attending MOPC having gait abnormality were 3.00 times more likely to develop MSDs (AOR=3.00; 95% CI: 1.78-4.85)compared to those who hadn't gait abnormality. Participants who had annual prosthesis maintenance had 3.54times higher odds of developing MSDs (AOR=3.54; 95% CI: 2.16-5.36), and those who had smoking 2.54 times higher odds of developing MSDs (AOR=2.54; 95%CI: 1.56-4.23) than who had not smoked.

The analysis of factors associated with MSDs among lower limb prosthesis users attending MOPC is presented in (Table 5).

Table 5; .Factors associated with MSDs of lower limb prosthesis users in Mekelle, Tigrai, Ethiopia, May 2025, (n=401)

Variable	Category	MSDS		P-value	COR	95% C.I.for COR		P-value	AOR	95% C.I.for AOR	
		Yes	No			Lower	Upper			Lower	Upper
Age	18-24	13	22		Ref.				Ref.		
	25-34	159	104	.011*	2.587	1.248	5.363	0.872	0.914	0.303	2.751
	Above 35	62	41	.020*	2.559	1.16	5.645	0.995	0.996	0.307	3.228
Depression	Yes	209	98	.001*	5.886	3.511	9.867	.001**	4.189	1.925	9.114
	No	25	69		Ref.				Ref.		
Duration of prosthesis	<2 years	46	11		Ref.				Ref.		
	>2 years	188	156	.001*	0.28	0.144	0.575	0.654	1.432	0.457	4.052
Cause amputation	Medical condition(cancer)	16	13		Ref.				Ref.		
	Trauma	175	82	.073*	1.733	0.932	4.872	.038**	2.041	1.041	4.002
	Infection (gangrene)	41	71	.001*	0.469	0.12	5.213	5.712	3.765	0.788	4.217
	Vascular (peripheral arterial diseases)	2	1	0.317	1.625	0.305	4.382	0.784	1.174	0.374	3.683
Amputation to prosthesis (1)	Immediate (1-3 months)	9	5		Ref.				Ref.		
	Intermediate (4-7 months)	30	107	.002*	0.15	0.012	2.598	0.475	1.914	0.322	10.366

	Long (above 7 months)	128	122	0.345	0.58	0.559	5.263	0.637	0.662	0.119	3.68
Prosthesis hrs. used	Minimal use(1-4hrs)	11	5		Ref.				Ref.		
	Moderate use (5-8hrs)	25	86	.001*	7.568	2.403	13.332	0.117	3.151	0.749	13.252
	Extended use (9-12hrs)	131	143	.113*	2.402	0.813	7.096	0.58	0.678	0.172	2.678
Upper limb amputation	Yes	20	3		Ref .				Ref.		
	No	214	164	.009*	0.19	0.123	2.487	0.575	0.617	0.114	3.344
Frequency of prosthesis maintenance	Quarterly	40	101		Ref.				Ref.		
	Annually	194	66	.001*	7.42	2.19	8.14	.001**	3.54	2.16	5.36
Exercise	Physical active	190	116		Ref.				Ref.		
	Physical inactive	44	51	.007*	0.52	0.193	3.022	0.25	1.536	0.74	3.187
Gait abnormality	Yes	122	15	.001*	11.03	9.75	13.85	.001**	3.00	1.78	4.85
	No	112	152		Ref.				Ref.		
Smoking	Smoker	138	39	.001*	4.71	2.42	5.15	.001**	2.54	1.56	4.23
	Non smoker	96	128		Ref.				Ref.		

NB: COR =crude odds ratio, AOR = adjusted crude ratio, Ref. = Reference,*statistically significant at p-value <0.25, **statistically significant at a p-value <0.05, CI= confidence interval.

6. Discussion

The main aim of this study was to assess the prevalence and associated factors of musculoskeletal disorders (MSDs) among lower limb prosthesis users attending the MOPC in Mekelle, Tigray, Ethiopia. The factors associated with MSDs among these users included depression, cause of amputation, gait abnormalities, prosthesis maintenance, and smoking. Participants whose amputations were caused by trauma were more likely to develop MSDs compared to those whose amputations resulted from medical conditions such as cancer.

In the current study, the overall prevalence of MSDs was found 58.35% (95% CI: 53.4%-63.2%). The finding of the present study is consistent with the musculoskeletal pain study conducted in London 52-64%[18] but, lower than the study conducted in, university of Washington, department of rehabilitation 72.1%[15]. This could be due to the different sample sizes, and different assessment tools of the studies. For instance, the study conducted in Syria which is consistent with this study used a Nordic musculoskeletal questionnaire [44]. On the other way, MSDs are higher in Iran (67.84%) than in this study[45]. This could be due to different study designs and sample sizes.

In contrast, the prevalence of lower back pain among lower limb prosthesis users in this study found 47.9% is lower than the study findings in Italy 82%[19], Netherlands 55%[17], University of Washington 52%[46], university of clinical center Tuzla 89.1%[47]. The discrepancy could be due to the study setting, assessment tool, socio-demographic variation, study participants, and age of study participants. For instance, the study in Italy with small sample size of 239 among lower limb amputation[19].In addition, in study studies done in London[18] and the Netherland[48] systematic review study design was used and the prevalence of lower back pain was 52%-64% and 51% respectively.

On the other hand the prevalence of this study lower back pain at 47.9%, knee pain at 42.6%, ankle at 34.4%, and foot at 29.9% higher than a study conducted by the University of Washington, Department of Rehabilitation Medicine which reported back pain at 39.2% and knee pain 27.9%[15].another study lower than this study conducted in the university of Florida, which reported lower back pain 17%[49]. The discrepancy might be due to better access to health facilities, a good understanding of the impact of avoidance of movement, different types of measurement tools, a good lifestyle, adherence to therapeutic interventions, and educated adult participants.

The finding of our study showed participants who have gait abnormality were 3.00 times more likely to develop MSDs compared to who hadn't gait abnormality. The finding similarity supported previous studies conducted in U.S and Maryland USA [50] [4]. The possible reason might be due to the prosthesis alignment and fit, compensatory movement and due to muscle weakness [4, 10, 51, 52].

This study revealed that participants who maintain their prosthesis annually were 3.54 times more likely to develop MSDs compared to those who maintain quarterly. This finding was supported by previous studies conducted in the USA [4]. The possible reason is due to the postural misalignment, delayed detection fit and comfort, compensatory movement pattern, misalignment prosthesis and reduced physical activity [4, 15, 53, 54] .

This study revealed that participants who underwent amputation due to trauma were 2.04 times more likely to develop musculoskeletal disorders (MSDs) compared to those whose amputation was caused by cancer. This finding is supported by previous research conducted at the University of Washington[55], California[56], Denmark[57], and Kenya[58]. The possible explanation for this association may include the sudden and severe nature of traumatic injuries, which often result in greater tissue damage, irregular stump formation, and increased biomechanical asymmetry. These factors can lead to compensatory gait patterns, postural instability, and ultimately, a higher risk of developing secondary musculoskeletal complications [4, 59-62].

The finding of the present study found that study participants having depression were 4.19 times more likely to develop MSDs compared with those who hadn’t depression. This finding is consistent with studies conducted in different countries. For instance, research conducted in Amhara, Ethiopia reported that depressant participants had about eight times a risk of developing MSDs[63]. A study conducted at the University of Malaysia reported that MSD symptoms were significantly associated with depression [64]. A similar study conducted in Madrid, Spain reports that depression was significantly associated with moderate to chronic musculoskeletal disorder [65]. The possible reason due to depression leads individuals to be inactive, reduces muscle mass, increases fatigability, and finally predisposes to have MSDs from a biological and psychological point of view[66-68]. On the other hand, depression can increase sensibility to pain and then to fear of movement and physical exercise [69].

In addition, this study revealed that smoker study participants were 2.54 times more likely to develop MSDs compared to those who were non-smokers. This finding of the present study was supported by studies done in the USA, IRAN, and the University of Missouri [70-72]. Smokers had significantly greater comorbidity, advanced immunodeficiency, and adverse socioeconomic problems. The possible reason could be due to improper lifestyle, muscle weakness and fatigue, delayed tissue repair, and increased inflammation [73-75].

7. Strengths and limitations of the study

This study contributes to filling knowledge gaps be the strength of the study. This study used an internationally validated tool for the assessment of pain and discomfort. The limitation of this study lack of information about the drug history and psycho-social treatment, which could have influenced the score "patients health questionnaire -9" might affect the study result. The study's existing literature on lower limb prosthesis use is limited. Our study is cross-sectional, which limits our capacity to know the cause-and-effect relation between that variable.

8. Conclusion

This study identified a moderate burden of musculoskeletal disorders among lower limb prosthesis users. The associated factors that have a statistically significant correlation with musculoskeletal disorders among lower limb prosthesis users were annual prosthesis maintenance, gait abnormality, smoking, depression, and cause of amputation by trauma.

9. Recommendations

For Minster of Health/Tigrai, Mekelle zone health office

Minister of Health/Mekelle zone health office shall understand the problem is common and needs to develop preventive strategies and treatment techniques to determine interventions for reducing musculoskeletal disorders and targeting the associated factors such as depression, smoking, and gait abnormality.

For health professionals and prosthetics

The finding of the study highlights the importance of investigation and management of underlying factors like depression, smoking, and gait abnormality in lower limb prosthesis user patients presenting with musculoskeletal disorders. Health professionals need to educate patients attending MOPC about the avoidance of smoking, depression, and gait abnormalities. Finally, healthcare providers and prosthetics should consider early maintenance to reduce musculoskeletal disorders. It is also recommended that physiotherapists focus on early identification and intervention for these factors through rehabilitation plans. Providing continuous education on prosthetic use and maintenance will further enhance long-term outcomes.

For people lower limb prosthesis users

It is recommended for lower limb prosthesis users to engage in physical exercises, and to report and seek treatments for other health conditions like depression.

For researchers and academicians

Further Long-term studies are recommended to track the development of MSDs in prosthesis users over time. Understanding how musculoskeletal issues evolve can guide preventive strategies and interventions.

10. Reference

1. Osborne, A., et al., *Prevalence of musculoskeletal disorders among farmers: a systematic review.* American journal of industrial medicine, 2012. **55**(2): p. 143-158.

2. Osborne, A., et al., *Risk factors for musculoskeletal disorders among farm owners and farm workers: a systematic review.* American journal of industrial medicine, 2012. **55**(4): p. 376-389.
3. *Dreinhöfer K, Watfa Watfa N. The Burden. In: The EFORT White Book: "Orthopaedics and Traumatology in Europe". Dennis Barber Ltd, Lowestoft (UK); 2021. PMID: 36327361.*
4. Knight, A.D., C.L. Dearth, and B.D. Hendershot, *Deleterious musculoskeletal conditions secondary to lower limb loss: considerations for prosthesis-related factors.* Advances in wound care, 2021. **10**(12): p. 671-684.
5. Vinjamuri, R., *Prosthesis*. 2020: BoD–Books on Demand.
6. Selvam, P.S., et al., *Prosthetics for lower limb amputation*, in *Prosthetics and Orthotics*. 2021, IntechOpen.
7. Agamy, H.S., et al., *Effects of Implementing a Self-Care Program for Adults With Lower Limb Prostheses.* Plastic and Aesthetic Nursing, 2023. **43**(1): p. 32-40.
8. Bhutani, S., et al., *Living with amputation: anxiety and depression correlates.* Journal of clinical and diagnostic research: JCDR, 2016. **10**(9): p. RC09.
9. Gailey, R., et al., *Review of secondary physical conditions associated with lower-limb amputation and long-term prosthesis use.* Journal of Rehabilitation Research & Development, 2008. **45**(1).
10. Hewson, A., S. Dent, and A. Sawers, *Strength deficits in lower limb prosthesis users: a scoping review.* Prosthetics and orthotics international, 2020. **44**(5): p. 323-340.
11. Dąbrowski, M., et al., *Clinical and demographic factors influencing the asymmetry of gait in lower-limb prosthetic users.* Symmetry, 2022. **14**(9): p. 1910.
12. Jin, Z., et al., *Incidence trend of five common musculoskeletal disorders from 1990 to 2017 at the global, regional and national level: results from the global burden of disease study 2017.* Annals of the rheumatic diseases, 2020. **79**(8): p. 1014-1022.
13. Okesina, A., et al., *Understanding Lower Limb Amputation: A Review of the Strategies for Healthcare Improvement, Prevention, and Management.* risk. **16**: p. 18.
14. Hughes, W., et al., *Editor's Choice–Trends in lower extremity amputation incidence in European Union 15+ countries 1990–2017.* European Journal of Vascular and Endovascular Surgery, 2020. **60**(4): p. 602-612.
15. Morgan, S.J., et al., *Cross-sectional assessment of factors related to pain intensity and pain interference in lower limb prosthesis users.* Archives of physical medicine and rehabilitation, 2017. **98**(1): p. 105-113.
16. Highsmith, M.J., et al., *Low back pain in persons with lower extremity amputation: a systematic review of the literature.* The Spine Journal, 2019. **19**(3): p. 552-563.
17. Oosterhoff, M., J.H. Geertzen, and P.U. Dijkstra, *More than half of persons with lower limb amputation suffer from chronic back pain or residual limb pain: a systematic review with meta-analysis.* Disability and Rehabilitation, 2022. **44**(6): p. 834-854.
18. Sivapuratharasu, B., A.M. Bull, and A.H. McGregor, *Understanding low back pain in traumatic lower limb amputees: a systematic review.* Archives of Rehabilitation Research and Clinical Translation, 2019. **1**(1-2): p. 100007.
19. Sadowski, P.K., et al., *Low back pain in people with lower limb amputation: A cross-sectional study.* Spine, 2022. **47**(22): p. 1599-1606.
20. Smith, D.G., et al., *Phantom limb, residual limb, and back pain after lower extremity amputations.* Clinical Orthopaedics and Related Research (1976-2007), 1999. **361**: p. 29-38.
21. Morgan SJ, F.J., Amtmann D, Salem R, Hafner BJ. Cross-sectional assessment of factors related to pain intensity and pain interference in lower limb prosthesis users. Archives of physical medicine and rehabilitation. 2017 Jan 1;98(1):105-13.
22. stam HJ, D.A., Bussmann HJ. *, prevalance of lower back pain after transfemoral amputions related to physical activity and other prosthesis-related parameters. .* Disability and rehabilitation, 2004. **794-7**.
23. Döring, K., et al., *How common are chronic residual limb pain, phantom pain, and back pain more than 20 years after lower limb amputation for malignant tumors?* Clinical Orthopaedics and Related Research®, 2021. **479**(9): p. 2036-2044.

24. Wong CK, M.R., Kwok TS, Tsang JS, Leung MY, Funabashi M, Macedo LG, Dennett L, Wong AY, *Prevalence, incidence, and factors associated with non-specific chronic low back pain in community-dwelling older adults aged 60 years and older: a systematic review and meta-analysis.* The journal of pain, 2022 Apr 1. **23(4)**: p. 509-34.
25. Meester, R.J., et al., *Prognostic Factors for Outcome of Fusion Surgery in Patients With Chronic Low Back Pain-A Systematic Review.* Global Spine Journal, 2024: p. 21925682241286031.
26. Beynon, A.M., et al., *Potential risk factors and triggers for back pain in children and young adults. A scoping review, part II: unclear or mixed types of back pain.* Chiropractic & manual therapies, 2019. **27**: p. 1-12.
27. Järnhammer, A., et al., *Living as a person using a lower-limb prosthesis in Nepal.* Disability and Rehabilitation, 2018. **40**(12): p. 1426-1433.
28. Whitley, M.D., et al., *Income as a predictor of self-efficacy for managing pain and for coping with symptoms among patients with chronic low back pain.* Journal of manipulative and physiological therapeutics, 2021. **44**(6): p. 433-444.
29. Maqbool HF, H.M., Awad MI, Abouhossein A, Iqbal N, Dehghani-Sanij AA. . , *A real-time gait event detection for lower limb prosthesis control and evaluation. IEEE transactions on neural systems and rehabilitation engineering.* 2016 Dec 7;25(9):1500-9.
30. Stuckey, R., et al., *Barriers and facilitators to work participation for persons with lower limb amputations in Bangladesh following prosthetic rehabilitation.* Prosthetics and Orthotics International, 2020. **44**(5): p. 279-289.
31. Matsumoto, M.E., et al., *The relationship between lumbar lordosis angle and low back pain in individuals with transfemoral amputation.* Prosthetics and orthotics international, 2019. **43**(2): p. 227-232.
32. Keszler, M.S., et al., *27 "It Hurts, and I'm Not Walking Right.": A Veteran with Back Pain and a Below Knee Prosthesis.* Low Back Pain, 2024: p. 232.
33. Wasser, J.G., et al., *Potential lower extremity amputation-induced mechanisms of chronic low back pain: role for focused resistance exercise.* Disability and rehabilitation, 2020. **42**(25): p. 3713-3721.
34. Allami, M., et al., *Chronic musculoskeletal pain, phantom sensation, phantom and stump pain in veterans with unilateral below-knee amputation.* Scandinavian journal of pain, 2019. **19**(4): p. 779-787.
35. Ashtaputre, A.S., A.S. Gondekar, and G. Varadharajulu, *The Study of Prevalence of Low Back Pain and Its Correlation with Functional Disability in Patients with Lower Limb Amputation.* Journal of Evolution of Medical and Dental Sciences, 2021. **10**: p. 2233+.
36. Kiros, M., S.B. Gebru, and B. Tewelde, *Knowledge, attitude, practice and associated factors towards COVID-19 and its prevention measures among residents of Mekelle City, Tigray Region, Northern Ethiopia: a community-based cross sectional study.* Journal of Public Health, 2024. **32**(3): p. 369-384.
37. Kutty, R.K., et al., *Evaluation of patient's satisfaction level and associated factors of physiotherapy services in mekelle ortho-physiotherapy centre, North Ethiopia: a Cross Sectional Study.* IJPBSF. 8 (1): 1, 2014. **10**.
38. Kutty, R.K. and H. Gebremichael, *EFFICACY OF NEUROMUSCULAR TAPING ALONG WITH CONVEN-TIONAL PHYSICAL THERAPY IN POST AMPUTATION PHANTOM PAIN MANAGEMENT: AN EXPERIMENTAL STUDY.* Int J Physiother Res, 2017. **5**(3): p. 2002-09.
39. Sadowski PK, B.S., Leuzzi G, Sansone LG, Testa M. . *Low back pain in people with lower limb amputation: A cross-sectional study.* Spine. 2022 Nov 15;47(22):1599-606.
40. Ryan, H., A. Trosclair, and J. Gfroerer, *Adult current smoking: differences in definitions and prevalence estimates—NHIS and NSDUH, 2008.* Journal of environmental and public health, 2012. **2012**(1): p. 918368.
41. Löwe, B., et al., *Monitoring depression treatment outcomes with the patient health questionnaire-9.* Medical care, 2004. **42**(12): p. 1194-1201.
42. Warburton, D.E. and S.S. Bredin, *Reflections on physical activity and health: what should we recommend?* Canadian Journal of Cardiology, 2016. **32**(4): p. 495-504.

43. Baumann M, P.C., Brousseau L, Loftsgaarden M, Powell J, Sanders J, Childers WL. PM&R. (4):, *The relationship between residual limb health, motion within the socket, and prosthetic suspension.* 2023 Apr;15. **510-21.**
44. Torbey, A., et al., *Studying the prevalence of musculoskeletal pain among a sample of medical students in Damascus, Syria. A cross-sectional study.* Health Science Reports, 2023. **6**(3): p. e1149.
45. Marzban, H., et al., *Musculoskeletal disorders among bank workers: a systematic review and meta-analysis.* BMC musculoskeletal disorders, 2024. **25**(1): p. 951.
46. Ehde, D.M., et al., *Back pain as a secondary disability in persons with lower limb amputations.* Archives of physical medicine and rehabilitation, 2001. **82**(6): p. 731-734.
47. Kušljugić, A., et al., *Chronic low back pain in individuals with lower-limb amputation.* Bosnian journal of basic medical sciences, 2006. **6**(2): p. 67.
48. Stam, H.J., A.-M.V. Dommisse, and H.B. Bussmann, *Prevalence of low back pain after transfemoral amputation related to physical activity and other prosthesis-related parameters.* Disability and rehabilitation, 2004. **26**(13): p. 794-797.
49. M., R., *secondary physical conditions associated with lower-limb amputation and long-term prosthesis use.* 2008. **vol. ;45:**: p. 15-29.
50. Rábago, C.A. and J.M. Wilken, *The prevalence of gait deviations in individuals with transtibial amputation.* Military medicine, 2016. **181**(suppl_4): p. 30-37.
51. Seth, M., et al., *Gait asymmetry is associated with performance-based physical function among adults with lower-limb amputation.* Physiotherapy theory and practice, 2022. **38**(13): p. 3108-3118.
52. McDowell, C., M. Smyk, and P.S. Sung, *Compensatory strategy between trunk-hip kinematics and reaction time following slip perturbation between subjects with and without chronic low back pain.* Journal of Electromyography and Kinesiology, 2018. **43**: p. 68-74.
53. Merola, M. and S. Affatato, *Materials for hip prostheses: a review of wear and loading considerations.* Materials, 2019. **12**(3): p. 495.
54. Alfatafta, M., *Gait stability and balance strategies of both acquired and congenital lower limb prosthetic users in response to perturbations.* 2020.
55. McDonald, C.L., et al., *Global prevalence of traumatic non-fatal limb amputation.* Prosthetics and orthotics international, 2021. **45**(2): p. 105-114.
56. Barmparas, G., et al., *Epidemiology of post-traumatic limb amputation: a National Trauma Databank analysis.* The American Surgeon, 2010. **76**(11): p. 1214-1222.
57. Ebskov, L.B., *Trauma-related major lower limb amputations: an epidemiologic study.* Journal of Trauma and Acute Care Surgery, 1994. **36**(6): p. 772-783.
58. Abdi, A.A., *Prevalence and Aetiology of Various Levels of Traumatic Limb Amputations Following Traumatic Injuries at Kenyatta National Hospital*. 2023, University of Nairobi.
59. Harandi, V.J., et al., *Gait compensatory mechanisms in unilateral transfemoral amputees.* Medical engineering & physics, 2020. **77**: p. 95-106.
60. Lloyd, C.H., et al., *Strength asymmetry and osteoarthritis risk factors in unilateral trans-tibial, amputee gait.* Gait & posture, 2010. **32**(3): p. 296-300.
61. Schaarschmidt, M., et al., *Functional gait asymmetry of unilateral transfemoral amputees.* Human movement science, 2012. **31**(4): p. 907-917.
62. Kowal, M., A. Starczewska, and A. Rutkowska-Kucharska, *Biomechanical Parameters of Gait after Unilateral Above-knee Amputation. Current State of Research.* Ortopedia, traumatologia, rehabilitacja, 2018. **20**(4): p. 245-256.
63. Mekonnen, Y., et al., *Kinesiophobia and associated factors among people with musculoskeletal disorders in Ethiopia: a multicenter cross-sectional study.* BMC Musculoskeletal Disorders, 2025. **26**(1): p. 55.
64. Ng, Y.M., P. Voo, and I. Maakip, *Psychosocial factors, depression, and musculoskeletal disorders among teachers.* BMC public health, 2019. **19**: p. 1-10.
65. Del Campo, M., et al., *Anxiety and depression predict musculoskeletal disorders in health care workers.* Archives of environmental & occupational health, 2017. **72**(1): p. 39-44.

66. Subrin, S., *Physical and psychological outcome of patient with unilateral lower limb amputation*. 2023, Bangladesh Health Professions Institute, Faculty of Medicine, the University ….
67. Mosharofy, C.M., *Depression and anxiety among knee amputee patients before and after rehabilitation at CRP*. 2020, Bangladesh Health Professions Institute, Faculty of Medicine, the University ….
68. Devan, H., et al., *Exploring factors influencing low back pain in people with nondysvascular lower limb amputation: a national survey.* PM&R, 2017. **9**(10): p. 949-959.
69. Degen, R.M., et al., *Prevalence of symptoms of depression, anxiety, and posttraumatic stress disorder in workers with upper extremity complaints.* journal of orthopaedic & sports physical therapy, 2016. **46**(7): p. 590-595.
70. Tarakji, B., et al., *Adverse effects of smoking on musculoskeletal health.* Missouri medicine, 2017. **114**(4): p. 268.
71. Tajvar, A., A. Ghanbarnejad, and M. Kazempour, *Investigating the Association Between Waterpipe/Cigarette Smoking and Incidence of Musculoskeletal Disorders.* Tobacco and Health, 2023. **2**(4): p. 183-190.
72. Al-Bashaireh, A.M., et al., *The effect of tobacco smoking on musculoskeletal health: a systematic review.* Journal of environmental and public health, 2018. **2018**(1): p. 4184190.
73. Dai, Y., et al., *Association of cigarette smoking with risk of chronic musculoskeletal pain: a meta-analysis.* Pain Physician, 2021. **24**(8): p. 495.
74. Patel, M., et al., *Klotho and smoking–an interplay influencing the skeletal muscle function deficits that occur in COPD.* Respiratory medicine, 2016. **113**: p. 50-56.
75. Khadilkar, S.S., *Musculoskeletal disorders and menopause*. 2019, Springer. p. 99-103.

11. Annex

Annex A

Information Sheet

Project overview

Project Title: prevalence and associated factor of musculoskeletal disorder among lower limb prosthesis users Mekelle, Tigrai , Ethiopia

Duration the project: 7 months

Study area: Mekelle Ortho-Physiotherapy Center

Sponsor: Ayder comprehensive specialized hospital

Investigator: Kibrom Kidanu (BSc physiotherapy)

Project objective: The aim of this study is to assess prevalence and associated factor of musculoskeletal disorder among lower limb prosthesis users in Mekelle, Tigrai, Ethiopia

Duration: The time that needs to complete questionnaire is 10 to 15 minute.

Risk and Confidentiality: There is no risk for anyone who participates in the study. Name, title and work place will not be record anywhere. If you have question or concerns or for information you can call! Please speak to principal investigator – Kibrom. K (BSc Physiotherapy)

Mobile number: +251939186627

E-mail: kibromkidanu71@gmail. Com

Annex B

Consent Form

In signing this document, I as a department head, am giving my consent for patient records to participate in the study. I have been informed that the objective of this study is to assess prevalence and associated factor of musculoskeletal disorder among lower limb prosthesis users Mekelle, Tigrai, Ethiopia. I have understood that participation in this study is entirely confidential. I have been told that my answers to the questions will not be given to anyone else and no reports of this study ever identify me in any way. I understood that participation in this study does not involve risks except the time spent on completing the questionnaire. I understood that Kibrom kidanu is the contact person if I have questions about the study or my rights as a study participant. The following is his contact address.

- Mobile phone- +251939186627
- E-mail-kibromkidanu71@gmail.com
- Dept. Head signature: ____________________
- date: __________________
- Thank You for your willingness to participate!!!

Annex: C

Questionnaires

Participation code...................................

Section A: Demographic Information

S.No.	**Variables**	**Coding categories**
A1	Age	---------------------years
A2	Sex	1. Male 2. Female
A3	Current Marital status	1.Single 2.Married 3.Divorce 4.Windowed 5. others
A4	What is your religious status	1. Orthodox 2. Islam 3. Protestant 4. Catholic 5. Others
A5	What is your Educational level	1. No formal education 2. Elementary school 3. Secondary school 4. Diploma 5. Bachelors of degree 6. Master's degree 7. other
A6	What is your average monthly income/salary in birr?	....

Section – B depression Questionnaires

Question	**Not at all**	**Several days**	**More than half the days**	**Nearly every day**
B1. Little interest or pleasure in doing things	0	1	2	3
B2. Feeling down, depressed, or hopeless	0	1	2	3

B3. Trouble falling or staying asleep or sleeping too much.	0	1	2	3
B4. Feeling tired or having little energy	0	1	2	3
B5. Poor appetite or overeating	0	1	2	3
B6. Feeling bad about yourself—or that you are a failure or have let yourself or your family down	0	1	2	3
B7. Trouble concentrating on things, such as reading the newspaper or watching television	0	1	2	3
B8. Moving or speaking so slowly that other people could have noticed? Or the opposite—being so fidgety or restless that you have been moving around a lot more than usual	0	1	2	3
B9. Thoughts that you would be better off dead, or of hurting yourself in some way	0	1	2	3

Section C: Prosthetic Use

Question	Response
C1. Duration of prosthesis use	**....................**Months/Years
C2. What type of prosthesis use?	1**.** Exoskeleton 2. Endoskeleton
C3.what is your Cause for amputations?	1**.** Medical condition (cancer) 3. Infection (gangrene) 2. Trauma (crushed, burned) 4. Vascular (peripheral arterial disease) 5. Other
C4. Side of body amputation?	1. Right 3. Bilateral 2. Left
C5. What is the time from amputation to prosthesis?	.......................Months/Years
C6. For how many hours per day is the prosthetic typically used?	........................Hour
C7. Level of amputation	1. Trans femoral 3. Trans tibial 5. Mid foot (chopart) 2. Knee disarticulation 4. Ankle disarticulation 6. Other
C8. Do you have additional upper limb amputation?	1. NO 2. Yes
C9. Have you received education on how to properly use and care for your prosthesis?	1. YES 2. NO
C10. Frequency of prosthetic maintenance	1. Weekly 2. Monthly 3. Quarterly 4. Annually 5. Other
C11. Do you have access to follow-up care or support for prosthetic issues?	1. Yes 2. No

Section D: questions related Musculoskeletal Disorders

D1. Have you at any time during the last 12 months had pain or discomfort in any part of a body?

1. Yes
2. No

If yes skip to D1

question	
D1. Do you experience phantom pain (pain in the area of the amputated limb)	YES/ NO if No skip to D4
D2. If yes, how frequently do you experience phantom pain?	Rarely / Occasionally / Frequently / Constantly
D3. On a scale of 1-10, how would you rate the severity of your phantom pain?	------------------------
D4. Do you experience pain in your lower back?	YES/NO
D5. Do you experience pain in your hip?	1. No 3. Yes in the left hip 2. Yes in the right hip 4. Yes in both hip
D6. Do you experience pain in your knee?	1. No 3. Yes , on the non-affected side 2. Yes, on the affected side 4. Yes in both knee
D7. Do you experience pain in your ankle?	1. No 3. Yes on the non-affected side 2. Yes on the affected side 4. Yes in both ankle
D8. Do you experience pain in your foot?	1. No 3. Yes on the non-affected side 2. Yes on the affected side 4. Yes in the both

Section E Questionnaires on Musculoskeletal Pain

Question		

E1. Have you received any treatment for your musculoskeletal pain?	1. YES 2. NO	
E2. Are you experiencing any skin problems with the residual limb?	1.YES 2NO If yes skip to E3	
E3. Have you noticed any changes in the skin?	1.Redness of the skin 2. Blister of the skin 3. full thickness injury to skin (nerve involvement)	

Section 6: Associated Factors

Question	Response
E4. Do you engage exercises in at least 150 minutes for week?	**1.** Yes **2.** No
E5. Have you experienced any gait abnormalities since starting to use your prosthesis?	YES/NO
E6. Do you currently smoke cigarettes?	Yes/No
E7. If yes On average how many cigarettes do you smoke per day?	....

Annex c: .Tigrigna version of questionnaire

□□ □□ □□□ □□□□□ □□□ □□□□□ □□□□□ □□□□□ □□□□□□ □□□□□ □□□□□□□ □□
□□-□□□□ □□□□□ □□□□ □□□/□□□?

1□ □□   **2**□ □□□□□□

□□□□ □□□□□ □□□□ □□□

□□□□□ +251939186627

□□□□ kibromkidanu71@gmail.com

□□□□□ □□□□□   □□□   □□□

□□ □□□□

□□ □□□□ □□.................................

□□□ 1: □□□□ □□□ □□□□□

□.□	□□	□□□
1	□□□	----------------------□□□
2	□□	3. □□ 4. □□
3	□□□□ □□□	1.□□□□□□□□ 2.□□□□□ 3. □□□□□□ 4.□□□ □□□□ □□□□ □□□□ 5.□□□
4	□□□□□	1. □□□□□□ 2. □□□□ 3. □□□□□□□ 4. □□□□ 5. □□□
5	□□□ □□□□□	1. □□□□□□□ 2. 1□ □□□ □□□□□ 3. 2□ □□□ □□□□□ 4. □□□□ 5. □□□

		6. □□□□ 7.□□□
6	□□□□ □□□?	...............................□□□

□□□ – **2** □□ □□□□ □□□□□□ □□□□

□□	□□□□ □□□□□□	□□□ □□□□	□□□□□□ □□□□	□□□□□ □□□□
7. □□□□ □□□□□ □□□□□ □□□ □□□	0	1	2	3
8. □□□□ □□ □□ □□□ □□□□ □□□□□	0	1	2	3
9. □□□ □□ □□□□ □□ □□□□.	0	1	2	3
10. □□□ □□□□□	0	1	2	3
11. □□□ □□□ □□□ □□□	0	1	2	3
12. □□□□□ □□ □□□ □□□□ □□□ □□□ □□□□□	0	1	2	3
13. □□ □□□□ □□□□ □□ □□□□ □□□ □□□□	0	1	2	3
14. □□□□□□□ □□ □□□□□ □□□ □□□ □□□□□□□ □□ □□□□	0	1	2	3
15. □□□□ □□□□ □□□□□ □□□□□ □□□□	0	1	2	3

[illegible] **3:** [illegible]

[illegible]	[illegible]
16.[illegible]	....................[illegible]
17. [illegible].[illegible] ?	1. [illegible] 2. [illegible]
18. [illegible]	1.[illegible] 3. [illegible] 2. [illegible] 4. [illegible] 5.[illegible]
19. [illegible]?	1. [illegible] 3.[illegible] 2. [illegible]
20.[illegible]?	........................[illegible]
21. [illegible]?	.... [illegible]
22. [illegible]?	.........................[illegible]
23. [illegible]	1. [illegible] 3. [illegible] 5. [illegible] 2. [illegible] 4. [illegible] 6. [illegible]
24. [illegible]?	1. [illegible] 2. [illegible]
25.[illegible]?	1. [illegible] 2. [illegible]
26. [illegible]	1. [illegible] 2. [illegible]

	3. □□□ □□□ 4. □□□□ 5. □□□
27. □□□□ □□□□□□ □□□□□?	1. □□ 2. □□□□□□

□□□ **4:**□□ □□□□ □□□□ □□□□□□

28. □□ □□□ □□ □□□ □□□□ □□□□ □□□□□□ □□□ □□ □□□□□ □□□□□□ □□□□

1. □□

2. □□□□□

□□□□ □□ □□□□□□ □□ **29** □□□□

□□	□□□
29.□□ □□□ □□□□□ □□□ □□□□□	**1** □□ **2.** □□□□□ □□□□ □□□□□ □□□□□□ □□ **32** □□□□
30.□□□□ □□ □□□□□□□□ □□□□ □□	□□□□ / □□□□□ / □□ □□
31. .□□ □□□ □□□□□ □□□ □□ 1-10 □□□□ □□□□	-------------------------
32. □□□□□ □□□ □□	□□/□□□□□
33.□□□ □□?	**1.** □□□□□ **3.** □□ □□ □□□□ **2.** □□ □□ □□□□ **4.** □□ □□ □□□□
34 .□□□?	**1.** □□□□□ **3.** □□**,** □□ □□□□□□ □□□ **2.** □□**,** □□ □□□□□ □□□ **4.** □□ □□ □□

35.[illegible]	**1.** [illegible] **3.** [illegible]**,** [illegible] **2.** [illegible]**,** [illegible] **4.** [illegible]
36. [illegible]?	**1.** [illegible] **3.** [illegible]**,** [illegible] **2.** [illegible]**,** [illegible] **4.** [illegible]

[illegible] **-5** [illegible]

[illegible]	[illegible]	
37.[illegible]	**1.** [illegible] **2.** [illegible]**,** [illegible] **39** [illegible]	
38**.** [illegible]	1. [illegible] 2. [illegible] 3. [illegible] 4. [illegible] 5. [illegible]	
39.[illegible]	1. [illegible] 2 [illegible] . [illegible] 40 [illegible]	
40. [illegible]	1.[illegible]	

	2. □□□ □□□□ 3. □□□ □□□□ □□□	

□□□**6:**□□□□□ □□□□

□□	□□□
41.□□ □□□ 150 □□□ □□□□□□ □□□□□	**1.** □□ **2.** □□□□□ □□□□ □□ □□□□□□ □□ 42 □□□□
42. □□□□□□ □□□□□□ □□□□	**1.** □□□□ **2.** □□□□ **3.**□□□□ **4.** □□□ □□□□ **5.**□□□□ □□□ **6.** □□□
43. □□ □□□ □□□□ □□□□□ □□ □□□□ □□□ □□□□□□**?**	**1** □□ **2** □□□□□
44. □□□ □□□□?	**1** □□ **2** □□□□□ □□□□ □□ □□□□□□ □□ 45 □□□□
45. □□□□ □□ □□□□□□ □□□□ □□ □□□□?	....