UNIVERSITY of RWANDA

COLLEGE OF SCIENCE AND TECHNOLOGY

Regional Centre of Excellence in Biomedical Engineering and e-Health (CEBE)

Assessment of barriers to mobility device usage for people with lower limb disability: Rwanda as a case study

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A Dissertation Submitted to the Regional Centre of Excellence in Biomedical Engineering and e-Health (CEBE), University of Rwanda as partial fulfilment of the requirements for the Master's Degree in Biomedical Engineering.

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DECLARATION

I, MUSHIMIYIMANA Sophie, declare that this dissertation entitled **"Assessment of barriers for mobility device usage for people with lower limb disability: Rwanda as a case study"** is my original work based on research and has not been submitted for any other degree or professional qualification.

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CERTIFICATE

This is to certify that the project entitled "**Assessment of barriers for mobility device usage for people with lower limb disability: Rwanda as a case study**", is a record of original work done by MUSHIMIYIMANA Sophie (Reference number: 221028648), a MSc. Degree student in Biomedical Engineering.

This work has been submitted under the guidance of **Dr. Morufu Olusola Ibitoye** and **Dr. Alfred UWITONZE.**

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ABSTRACT

A disability may set in at any stage of life. Therefore, everyone may be susceptible to physical disability, either temporarily or permanently, at some point in his or her life, and those who live till old age will have difficulties in executing tasks that demand physical abilities, particularly mobility. Hence, lack of aid and support poses a major barrier to participation in society for individuals with physical disabilities. This may lead victims with lower limb physical disabilities to become overly reliant on their family members for the execution of their activities of daily living. This may prevent both the persons with the disability and their family members from becoming economically engaged and socially included. Rehabilitation with mobility devices can alleviate this situation by aiding people with lower limb disabilities to live independent lives in society. However, due to poor awareness in our societies especially in low and medium-income countries (LMICs) such as Rwanda, accessibility to the use of mobility equipment, faces some major challenges. It is in this context that the necessity for mobility gadgets to assist in such a situation is critical and a good research interest. This project aimed to investigate the variety of parameters that are known to influence access to mobility devices. A quantitative and qualitative, descriptive study was conducted to assess the barriers faced by people with lower limb disability using mobility and purposive sampling was used to gather required information. Evidence based on the data collected has shown that the leading factors are the lack of knowledge on an appropriate device for a specific impairment, lack of funds, especially as concerns the victims, geographical restrictions, environmental factors, and so on. It is believed that this study will be able to identify these barriers and present recommendations to improve the situation for promotion and facilitation of access to various inexpensive, easy-to-use and maintain, environmentally friendly mobility devices for people with disabilities living in LMICs including Rwanda.

Keywords: Physical disability, Rehabilitation, Mobility devices; Barriers; and Accessibility.

LIST OF ACRONYMS

ACC: accessibility

AT: Assistive Technology

ANOVA: Analysis of Variance

BAR: Barriers

EICV: Enquete Intégrale sur les Condition de Vie des ménage or in English: Integrated Household Living Conditions Survey

GDP: gross domestic product

GREAT: Global Research, Innovation, Education on Assistive Technology

LMICs: low and medium-income countries

REH: Rehabilitation

MB: Mobility Devices

PD: Physical Disability

RWF: Rwandan francs

SDG: Sustainable Development Goals

UHC: Universal Health Coverage

US$: United States Dollars

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CHAPTER 1. GENERAL INTRODUCTION

1.1 Introduction

The global demand for rehabilitation services is increasing. Current health trends indicate an increase in the demand for rehabilitative health care. People are living longer with chronic communicable and non-communicable diseases, and there is an increase in the number of injuries and people living with the consequences of injuries, as well as an aging population [1].

The equality of opportunity and accessibility, full and effective participation, and inclusion in society is one of the priorities of human rights [2]. Living with a lower limb disability is challenging as mobility and associated ability will be difficult or impossible without support. shows that persons with lower limb impairments have a lower quality of life than people without disabilities. Physical health, social relations, lifestyle in the domains of family, friends, neighbors, psychological state, and degree of independence in terms of mobility are all affected by disability [3]. Because of mobility and body posture issues, people with lower limb limitations face some challenges. Fortunately, assistive device technology can help people with lower limb limitations to overcome many of their challenges [4]. Assistive technology is a broad phrase that refers to a variety of equipment and services that help persons with lower limb impairments. Additionally, creating barrier-free societies for individuals with disabilities is a global goal. However, there are various impediments to individuals with lower limb disability adopting assistive technology around the world, and they appear to be particularly severe in low-income nations[4]. In many nations, limited financial resources have a significant impact on the availability and accessibility of assistive technology. As war and poverty increase, so does the prevalence of disability. However, the requirements of disabled individuals in developing nations are not well understood [5]. In developed countries, the quality of life of disabled persons is gaining attention because it is well understood. As many population health indicators improve in developing countries, the focus should be on enhancing the quality of life of disadvantaged groups. Furthermore, service delivery issues such as referral, evaluation, funding, ordering, product preparation, fitting, adjusting, user training, follow-up, maintenance, and repairs obstruct the use of assistive technology. Because of a lack of resources, machinery, and qualified personnel in many poor nations, mobility device production is done on a small scale or not done at all. Also lack of leadership and governance are also difficulties to the provision of assistive technology in some countries [4]. To expand the use of assistive technology, those who prescribe it, such as surgeons and occupational therapists, must first comprehend the thoughts and experiences of people with disabilities. The introduction of

assistive aids like wheelchairs into people's life can elicit strong emotional reactions. Assistive technology may make a big difference in the lives of people with lower limb disability, allowing them to be more independent by increasing their movement and balance. Although assistive devices have been widely prescribed in recent years, there have been few reviews of the barriers to their use [6].

At the first use of assistive technologies, people with lower limb disability must adjust psychologically, but the importance of their emotional adjustment and attitudes toward technology has not been highlighted [4]. In Rwanda, where life requires hard work for many able-bodied people, disabled individuals confront far more difficulties due to the lack of a disabled-friendly environment.

1.2 Problem statement

People with lower limb disabilities have the same right to mobility and accessibility in their community as everyone else. However, mobility devices are mostly used to help them move around as comfortably as possible. One of the difficulties is selection and affordability of an appropriate mobility device for the user's condition based on their desires, the severity of their disability, and the physical environment in which they live and whether they will be using a device. Evidence shows that the Rwanda government is taking measures to include these people with lower limb disabilities in all aspects of life, such as modifications of infrastructures. However, this effort has not sufficiently been covered in rural areas where roads are not well paved and thus making seamless mobility device access and usage challenging. As a result of this, it is critical to assess the barriers to mobility device usage for people with lower limb disabilities in Rwanda to come up with a guiding document for policy makers.

1.3 Research Hypotheses

Mobility devices play an important role in the lives of people with lower limb disability. However, there are many barriers limiting them to access and use them as required. These include but not limited to their availability on market, affordability, their repair and maintenance, awareness on modern mobility devices, accessibility and psychological status of their users, also demographic constraints pose major barriers as some people live in remote area where roads are not paved or are not there at all and it takes a long journey to reach out easily.

1.4 Objectives

1.4.1 General Objective

This project aims to assess the difficulties related to mobility device usage by people with lower limb disabilities in Rwanda to facilitate their experience and community participation.

1.4.2 Specific Objectives

To achieve the general objective of this project, the following specific objectives are used as guiding points:

- To identify physical barriers in using mobility devices by people with lower limb disabilities.
- To analyze relevant data collected from the affected population from three major rehabilitation centers (i.e., three provinces) in Rwanda.
- To generate the various difficulties' clusters and their peculiarities based on location.
- To establish a possible framework to ameliorate the challenges faced by the victims.

1.4.3 Study Scope

This study focused on adult people living with lower limb disabilities willing to participate in the study. This was done in specialized hospitals and individuals were interviewed on barriers faced in using mobility devices to get data required for this study. Moreover, this raised the awareness of the users to know how to choose what they want and to the manufactures where to improve in their production.

1.4.4 Significance of the Study

This research was intended to improve the lives of people living with lower limb disabilities. The information obtained through the research assists to assess barriers for mobility usage in people with lower limb disability. It provided a cluster of major barriers faced during mobility device usage. The information obtained in this research also enabled to identify these barriers and present recommendations to ameliorate the situation for promotion and facilitation of access to various inexpensive, easy to use and maintain, environmental friendly mobility device for low and medium income countries including Rwanda

1.4.5 Thesis Organization

This Chapter one introduces the research study and this is how the rest of the study is structured. Chapter 2 involves a descriptive literature on the variables under study. Chapter 3 summarizes the research methodology. Chapter 4 presents the results and discussion of the study conducted. Chapter 5 provides the conclusion and recommendation of the thesis.

1.4.6 Summary

The study sees the barriers for mobility device usage faced by people with lower limb disability worldwide, and Rwanda as case study. This Chapter encloses the background to the study, statement of the problem, purpose of the study, study objectives, research questions, hypothesis, scope of study, significance of the study, and organization of the thesis.

CHAPTER 2. LITERATURE REVIEW

Millions of people in the globe live with some sort of impairment, with almost 200 million of them having significant functional challenges [3]. Disability will become even more of a worry in the coming years as its prevalence rises. This is owing to the global growth in chronic health diseases such as diabetes, cardiovascular disease, cancer, and mental health disorders, as well as the aging population's increased risk of lower limb incapacity [4]. The ability of a person to walk. in the community is determined by their functional capacity and the nature of the environment they walk within [7].

Environmental barriers identified include terrain, crowds, climate, building access, parking, attra cting unwanted attention, and finances. Walking aids, transportation, planning, social support and finances were examples of enablers [7].

Prior research on this topic has been limited to individual interviews conducted in Europe. Previo us research may not be applicable to countries with different healthcare provision after amputatio n and different physical community environments [7]. As the number of motorized vehicles (particularly motorcycles) increases, so does the number of accidents in urban areas and this increases the number of injuries including lower limb disability. According to the Kigali Transport Master Plan, 79% of Rwanda's annual accidents occurred in Kigali in 2013 [1].

Historically, disability was primarily viewed as a medical condition or problem within the individual. Since then, disability activists have challenged this medical, or individual, model, recasting disability as primarily a social phenomenon. This social model of disability distinguishes between impairments and disability. It contends that society disables people with disabilities by failing to recognize and accommodate difference, as well as by erecting attitudinal, environmental, and institutional barriers against people with disabilities. Thus, disability results from a complex interaction between health conditions and the environment in which they exist [8]. The Global Disability Action Plan 2014-2021 emphasizes the critical role of assistive technology in the advancement of services and opportunities for people with disabilities [6]. More than one billion people are estimated to require one or more assistive products globally and more than two billion people will require at least one assistive product by 2030 [9]. The GREAT summit was a significant step in the ongoing effort to increase access to good quality and affordable assistive technology on a global scale and to highlight its significance as a tool for achieving the SDGs in a way that is equitable, inclusive and leaves no one behind.

Most African countries do not have a clear picture of the distribution and accessibility of assistive technology. However, the WHO reports that access to appropriate assistive technology

and services is frequently limited in resource-constraint settings such as Africa [9]. Poor availability, quality and affordability of services can lead to unmet needs for many people with lower limb disabilities, resulting in worsening health and functioning. People with disability are also affected by rehabilitation services [10].

This systematic study found that the frequency of publications increased between 2000 and 2020, indicating that AT is becoming more well-known on the international global health agenda. Many data gaps, though, remain unfilled [11].

Poor AT coverage and access in low income countries can be caused by poverty at personal as well as national level and also barriers in the environment, inadequate procurement systems, lack of support services, less service providers, and inadequate training of providers which lead also to inadequate training of the end users [9].

These impediments have been shown to contribute to a loss of walking capacity. Unfortunately, there has been little investigation into the nature of these barriers (e.g., specific barriers within the "physical environment") in the literature, and comparatively few enablers have been identified [7].

To promote inclusivity and purchase, it is crucial to educate the general public about the importance of an environment that is accessible to all members of society [9]. Studies show that living with lower limb disability limits access in the society especially in sport as the requirements for their playground bring additional and special needs thus, authorities should take this into consideration as they also deserve to do some exercises for their wellbeing [12].

In the domain of sport, disabled people are left behind and studies show that progress has been made in developed countries and there have been introduction of competent athletes to train people with disability, however, participation is still low [12].

According to the World Health Organization, approximately 600 million people worldwide live with disabilities of various types, and the number is growing as a result of chronic diseases, injuries, car accidents, falls, violence, and other factors such as aging. Eighty percent of this total live in low-income countries; the majority are poor and have limited or no access to basic services, including rehabilitation facilities [13].

Prosthetic design was frequently mentioned as both a barrier and an enabler for walking in the co mmunity.

Poorly fitting prostheses have also been identified as a barrier to physical activity in veterans wh o have had their lower limbs amputated [7].

Disability trends are heavily influenced by global aging. The link is simple: as people get older, they are more likely to become disabled. About 450000 of people with disability are over 5 years of age according to the National Census conducted in Rwanda in 2002 and they account for

approximately 5% of the total population in Rwanda. The majority of Rwanda's population lives on low incomes and that people with disabilities face additional costs, it is likely that many are living in extreme poverty and insecurity. Also, access to school is still a big challenge. Whereas 41% of people with disabilities had no education, only 20% of people without disabilities had no education [14]. Frequently, public buildings and educational institutions do not meet accessibility standards or have assistive facilities that were established for general use rather than with focus on people with disabilities [9].

Environmental barriers make life difficult for elderly and disabled people to move around because they lack the strength to do so, as well as people with mobility issues who feel unsafe using their equipment there.

These environmental and physical difficulties may result in a loss of independence and the requir ement for extra assistive technology equipment to enhance access to interior and outside services [9].

The high prevalence of walking aid use emphasizes the importance of making better use of existi ng resources to ensure that individuals receive the appropriate devices. The study done in Canada indicate the need to assess the impact of device use in order to better understand how resources s hould be allocated for the prescription and maintenance of walking aids, as well as user training [6]. Studies clearly show that there is a lack of consultation with health care professionals regarding the use of walking aids [15]. It has been proposed that clinical guidelines be developed for health care professionals in order to improve mobility device prescription.

At primary school, children with disabilities have a net attendance rate of 68%, compared to 89% for children without disabilities; at secondary school, the figures are 12% and 22%, respectively. People of working age with disabilities face additional challenges in the labor market. Approximately 52% of people with disabilities over the age of 16 were employed, compared to 71% of the general population [16].

Rwanda has made significant progress in raising the living standards of its people during the last two decades. It is, however, still a low income country, with a GDP per capita of US$ 723 expected in 2016. According to the most recent household survey (EICV4) from 2013/14, average daily spending was just RWF 512 (US$ 0.77 in 2013), while average daily consumption of individuals in the second most wealthy quintile was still low, at roughly RWF 730 (US$1.10 in 2013) [17].

Despite the above figures, some estimates showed that 98% of children with disabilities in developing countries do not attend school and 99% of girls with disabilities are illiterate [18].

The significant unmet need for rehabilitation undermines the social and economic results of health care and obstructs the achievement of Universal Health Coverage (UHC) and Sustainable

Development Goals (SDG)3: "Ensure that all people of all ages live healthy lives and promote well-being [1]. The data portal will make sure that the evaluation is utilized to the fullest extent in support of the global goal by ensuring the improvement of access to life changing products is crucial and achieved and ensure sustainable development targets [19].

This process aims to strengthen rehabilitation leadership and planning, as well as to firmly establish rehabilitation as an essential health service, with mechanisms developed to support the strategic plan's implementation in the coming years [1].

Policies and programs to support the inclusion of healthcare systems for the UHC exist however, they are frequently lacking, or are not implemented or enforced to support people with lower limb disabilities [10].

Rwanda has a comprehensive legislative and policy framework on disability, but it faces difficulties in implementing and enforcing it [14].

Rwanda's Constitution prohibits physical disability discrimination while committing the country to supporting people with disabilities and providing special measures to educate people with disabilities. The legislative framework for the protection of disabled people establishes a number of rights related to linked access to services and employment. However, the law makes no mention of people with disabilities having a right to social protection [14].

The primary impediment to disabled people accessing specialist rehabilitation services is the cost. The Rwandan government intends to expand the Mutuelle Funds health insurance system over the next few years. In the future, all Mutuelle systems should cover the entire cost of rehabilitation and eye-care services, or at least a portion of them. Given that disabled people require more health services than non-disabled people, when it comes to subsidizing Mutuelle system membership, priority should be given to those disabled people who are most in need [8]. Overall, not much is currently known about studies specifically looking into the barriers to the mobility device/aid usage in Rwanda.

2.1. Summary

The reviewed literature showed that there are many challenges on mobility device usage worldwide. This served as the motivation to embark on this research study, especially using Rwanda as a case study**.**

CHAPTER 3. RESEARCH METHODOLOGY

A quantitative and qualitative, descriptive study was conducted to assess the barriers faced by people with lower limb disability using mobility devices including physical environmental barriers to access to public activities will be evaluated in three areas (i.e., one in the urban and two in the rural areas) to assess for unmet needs for mobility device users. The choice of rehabilitation centers was based on a wide range of people with disabilities who attend the centers for rehabilitation services and also looking for mobility devices.

3.1. Sample population

A sample of 42 people with lower limb disabilities attending three rehabilitation centers were used. **Gatagara**, **Rilima** and **Inkurunziza orthopedic hospitals.** These are the most places where rehabilitation is done at national level.

Rilima is reachable from Kigali, in about one hour by private car and is among the institutions found in the Eastern province, Bugesera district. It full name is Centre Orthopédique Sainte Marie Rilima (Saint Mary's Orthopedic Hospital Rilima). It has got 70 beds and these are mostly used for orthopedic cases. This is one of hospitals that specializes in treating pediatric orthopedic problems, including club foot, bow-legs and many other orthopedic conditions.

HVP Gatagara hospital also offers high quality and sustainable education, orthopedic and rehabilitation services to all persons with physical disabilities in partnership with other stakeholders. Healthcare, education and reintegration services in a fiscally responsible manner which contribute to the holistic well-being of the patients and community which it serves Educational and research activities related to the provision of care, education and reintegration of persons with physical disabilities and/or the promotion of health, education and reintegration.

INKURU NZIZA Orthopedic Specialized Hospital is an initiative of INKURU NZIZA Church in Rwanda (Eglise INKURU NZIZA au Rwanda, EIR), commonly known as Brethren Assemblies in other countries such as United Kingdom, Switzerland, Germany, United States, and Canada.

The Inkurunziza Orthopedic Specialized Hospital as established in Rwanda in 1960, with the primary mission of spreading the gospel of Jesus Christ to the whole nation which was further expanded to the assistance of vulnerable groups after the 1994 genocide. In 2007, the church launched the INKURU NZIZA Orthopedic Hospital which focused on providing specialized health care to patients from all over the country, especially people with lower limb disabilities. This was chosen due to its location so that a comparison of challenges faced by people living with lower limb disability could be compared from urban to rural areas.

Another place included people who live in rural and urban areas to compare the range of difficulties they face. All participants with lower limb disabilities with varying age groups were encouraged to voluntarily participate in the study. Before stating, the purpose and duration of the interview was communicated to each participant. Participants were informed that his/her participation will have no negative impact on services usually received in those centers. At any time, participants were eligible to withdraw due to personal issues which may not be disclosed. The process of data collection was done in a period of 2 weeks. Ethical procedures based on the Helsinki declaration on handling human subjects were followed.

3.2. Sampling procedure

The definition of data is the information gathered during the investigation that can be used to create conclusions [20]. A questionnaire with open ended questions was used to identify demographic and health related information regarding the support an assistive device used by participant provide to him/her and a range of limitations caused by that device was also discussed. The range and nature of motion the participant is able to perform and the type of assistive device in use was a key information for this study. Participants were given time to give suggestions of assistive devices he/ she may suggest can improve her/his lifestyle regarding movement and reaching. All participants had a shared experience of participating in rehabilitation at the same facility. Interviews were conducted in a private room at the participating facility [7]. Note that a purposive sampling was used to get respondents.

3.3. Statistical data analysis

The findings from the collected data were analyzed using SPSS (SPSS Inc., Chicago, IL 60606 United States), variables of this study were statistically examined with descriptive; mean and standard deviation were used to test the Variation of variables and present the characteristics of sample data, and explain statistical analysis results. Chi-square was used to find the relationship between variables of this study and linear regression analysis was used to test the hypothesis of this study. A statistical technique called the chi-square test was used to compare actual outcomes with predictions. The goal of this test was to establish whether a discrepancy between observed and expected data is the result of chance or a correlation between the variables one is researching. Also Cronbach's Alpha range was found to be between 0 and 1, with higher values indicating that the survey or questionnaire is more reliable. Internal consistency, or how closely connected a set of objects are to one another as a group, is measured by Cronbach's Alpha. It is regarded as a gauge of scale reliability.

The chi-square is formulated as following:

$$X^2=\frac{\sum(O_i-Ei)^2}{E_i}$$

X^2= chi square

O_i=observed value

E_i=expected value

The Cronbach's Alpha is formulated as following:

$$\alpha=Ncv+(N-1)c$$

Here N is equal to the number of items, C is the average inter-item covariance among the items and V equals the average variance.

CHAPTER 4. RESULTS AND DISCUSSION

This Chapter is meant to report the findings from the collected data which has been analyzed using SPSS. Variables of this study were statistically examined with descriptive; mean and standard deviation to test the Variation of variables present the characteristics of sample data and to explain statistical analysis results. Chi-square was used to find the relationship between the variables of this study and linear regression analysis was used to test the hypothesis of this study. Table 4.1 presents the reliability and validity test for the collected data.

Table 4. 1: Reliability and Validity test

Constructs	**Cronbach's alpha**
Physical disability	.88
Rehabilitation	.83
Mobility devices	.90
Barriers	.81
Accessibility	.89

Sources: *Primary data (2022)*

The Table 4.1 reveals that reliability and validity are at a good level as all variables are above 70%. This shows that collected data provided reliable and valid information. It also indicates that results can be reproduced under the same conditions and the results really do present what they are supposed to measure.

Table 4.2 is for case processing summary.

Table 4. 2: Case processing summary

Constructs	**N**	**Valid percent**
Valid	40	100%
Excluded	0	100%
Total	40	100%

Sources: *Primary data (2022)*

Table 4.2 shows that the total sample size of 40 were participated and no one was excluded. This exposes the quality of relevant results. Table 4.3 below represents the profile of respondents.

Table 4. 3: Profile of respondents

Profile	Description	N	Valid percent
Gender	Male	27	67.5
	Female	13	32.5
Age	18-28	8	20
	29-38	9	22.5
	39-48	8	20
	49-58	6	15
	Above 58	9	22.5
Marital status	Single	12	30
	Married	21	52.5
	Divorced	2	5
	Widowed	5	12.5
Residence	Urban	16	40
	Rural	24	60
Education level	Uneducated	8	20
	Primary school	5	12.5
	Secondary school	9	22.5
	Post-secondary	18	45
Occupation	Self employed	11	27.5
	Employed	12	30
	Jobless	17	42.5

Sources: *Primary data (2022)*

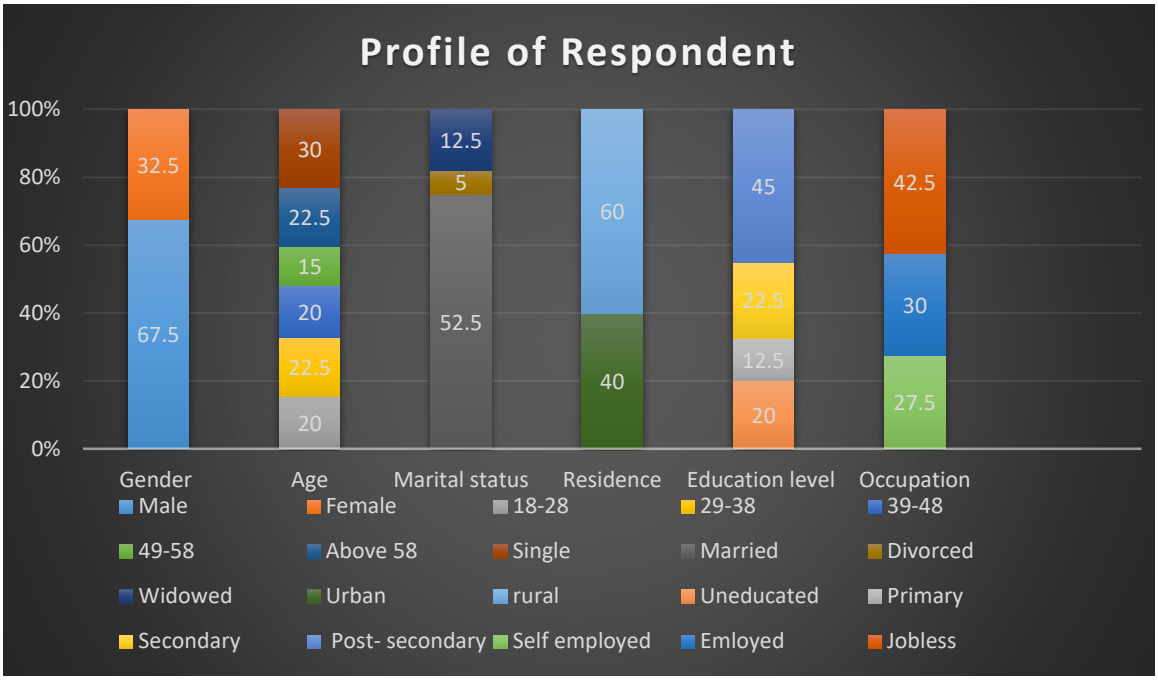

Figure 4. 1: Profile of respondents

Based on Figure 4.1 and Table 4.3, the educational background of respondents is relevant. Most of them were educated except 20%. The number of females is dominated by males which shows that a total of 13 females and 27 males were considered. Respondents aged above 58 and between 28-38 are equal to 22.5% and seem to dominate other age ranges. Numerous respondents are married as this is represented by 52.5%. Looking at their residence, 60% of respondents live in a rural area. A big number of respondents are unemployed. This may be due to the truncated ability to work for different jobs, especially those jobs that require extra power and physical ability. Table 4.4 represents the barriers for mobility device usage assessment.

Table 4. 4: Barriers for mobility device usage assessment

	N	M	σ	Interpretation
Physical disability	40	7.25	2.772	Strong; Heterogeneous
Rehabilitation	40	2.964	5.628	Moderate; Heterogeneous
Mobility devices	40	2.343	2.836	Weak; Homogeneous
Barriers	40	5.153	2.753	Strong; Heterogeneous
Accessibility	40	5.164	2.108	Strong; Heterogeneous

Sources: *Primary data (2022)*

Table 4.4, it is indicated that the mean of 7.25 and a standard deviation of 2.772 of respondents strongly agree that is their appreciation of Physical disability. It is also indicated that the mean of 2.964 and standard deviation of 5.628 of respondents strongly agree with the rehabilitation. The mean of 2.343 and standard deviation of 2.836 of respondents strongly agree with mobility devices. For barriers, the mean of 2.153 and standard deviation of 2.753 of respondents strongly agree. Results from Table 4.4 also indicated that the mean of 5.164 and standard deviation of 2.108 of respondents strongly agree with the accessibility. It shows that some people with disabilities are able to use some mobility devices, but others meet with some challenges and can't use them. Mobility devices are normally too expensive and somehow difficult to buy by the victim as many of them don't have donors and when it comes to the need for a new one it may take up to one to six months to get the new one. In case of damage, it takes more than 30 days to be repaired. The other challenge is that their financial status is not good enough to afford mobility devices by themselves. In their home, stairs, doors, Ramps, and carpets are the most challenging factors for their participation in some activities. Table 4.5 represents the Regression coefficient analysis. Table 4.5 represents the Regression coefficient analysis.

Table 4. 5: Regression coefficient analysis

Model		**Unstandardized coefficients**		**Standardized coefficients**	**t**	**Sig.**
		β	**Std. Error**	**β**		
1	(Constant)	1.205	1.113		1.015	.001
	PD	.435	.205	.408	1.036	.000
	REH	.635	.193	436	1.223	.000
	MD	.427	.213	.422	1.123	.000
	BAR	.661	.302	.431	1.011	.003
	ACC	.517	.117	.413	1.289	000

Sources: *Primary data (2022)*

All the values are calculated on 4 Likert Scale to study the effect of H_1 the target physical disability is positively affected by mobility device usage as it is shown through p= 0.000, β= 0.435 with a standard error of 0.205 and t value =1.036. H_2 Rehabilitation has a strong relationship with mobility device usage, p= 0.000, β= 0.635 with a standard error of 0.193 and t value =1.223. H_3 Mobility device is significant to its usage with p= 0.000, β= 0.213 with standard error of 0.422 and

t-value = 1.123. H_4 Barriers have a great effect on mobility devices usage with p= 0.003, β= 0.661 with a standard error of 0.431 and t value = 1. 011. H_5 Accessibility has a positive significant role in the usage of mobility devices for people with disability, p= 0.000, β= 0.517 with standard error of 0.413 and t-value =1.29

Table 4.6. stands for statistical analysis

Table 4. 6: Statistical analysis (Chi-square test)

	Value	**Df**	**Asymp. Sig. (2-sided)**	**Exact Sig. (2-sided)**	**Exact Sig. (1-sided)**
Pearson Chi-Square	8. 545a	1	.003		
Continuity Correction	6.432	1	.003		
Likelihood Ratio	8.655	1	.003		
Fisher's Exact Test				.003	.003
Linear-by-Linear Association	8.348	1	.003		
N of Valid Cases	40				

**Correlation is significant at the probability value of 0.05 (2-tailed).*

Sources: *Primary data (2022)*

From Table 4.6, the Pearson correlations test indicates that the p value is less than Alpha (.003 ≤ 0.05). Since the p value is less than Alpha, it is indicated that there is a relationship between constructs of this study, there is a positive and very high relationship of 8.545. As indicated, chi-square calculated is 8.545a, while the chi-square tabulated is 3.841 based on the degree of freedom of 1 and Alpha of 0.05. Meanwhile, the chi-square calculated is greater than the Chi-square critical value; the null hypothesis should be rejected. Therefore, this shows a positive and very high correlation that leads to the acceptance of the Alternative hypothesis.

Table 4. 7: ANOVA test

Model	Sum of squares	Df	Mean square	F	Sig.
Regression	9.265	5	1.851	10.919	.000[b]
Residual	2.373	14	.170		
Total	**11.638**	**19**			

Sources: *Primary data (2022)*

a. Dependent Variable: Barriers for mobility device usage

b. Predictors: (Constant), Pd; Reh, Md, Bar, Acc

Based on Table 4.7, the analysis of variance reveals that F is high, it shows that the variation between samples means relative to the variation within the samples. The higher the F, the lower the p value, this leads to significance of constructs as are significant at 0.000[b].

CHAPTER 5. CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The current study demonstrated that lower limb disabilities are a serious concern for people with lower limb disability since it directly affects mobility and accessibility. This was particularly true of all the participants in the study. They were in the age group of 18 - 58 years, the economically productive range of life, and were distressed because their daily lives and income were affected by lower limb disabilities. Psychological suffering was the result of their inability to do day-to-day work or get suitable jobs. While those with assistive devices were able to cover a little job to a certain extent with the challenges, those without assistive devices were helpless and unable to move around even in small areas. Both groups of people mentioned a number of barriers that came in the way of using assistive devices. Poverty and economic constraints, above all, severely limited their access to, and use of assistive technology was also mentioned by many due to fear of getting reinjured.

A purposive sampling technique was used and permitted the selection of participants with a certain type of knowledge and the interviews were conducted in Kinyarwanda which every Rwandan citizen understands and speaks. In qualitative research this is a positive factor because maximum information can be obtained from those with the most relevant experience in the matter. The dealers are unwilling to open outlets in distant areas because of low demand among people with disabilities residing there, again due to poverty and lack of awareness of assistive technology. Those who use assistive devices revealed that they had to face many problems when the devices needed repair. Reliable services are not sufficient, and available services are both costly, delays and unsatisfactory.

Some of the participants in this study had problems in getting their day-to-day work done unless assisted by a caregiver. Some of the participants were afraid of getting injured if they used assistive devices, especially if they had already had that experience.

5.2 Recommendations

Multiple barriers to using assistive technology by people with lower limb disabilities do exist. These need to be addressed by improving local infrastructure and accessibility facilities, heightening public awareness, and ensuring funding and a continuous supply of assistive devices supported by maintenance services. Those who prescribe these devices should communicate and convey information properly to the recipients. Persons with lower limb disabilities should be helped to gain more knowledge about assistive devices, especially about the availability of more modern ones. They should be given support to modify their physical environments to facilitate

their daily activities. Their physical symptoms should be treated to improve physical functioning, and their psychological health should be monitored to improve their mental well-being when using assistive devices.

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APPENDICES

Appendix 1: Mode of Data Collection (Questionnaire)

Assessment of barriers to mobility device usage for people with lower limb disability: Rwanda as a case study

Hello

I am MUSHIMIYIMANA Sophie, a Master's student of Biomedical Engineering, at the Center of Excellence in Biomedical Engineering and e-Health, University of Rwanda.

I am currently conducting a research study with the title **"**Assessment of barriers for mobility device usage for people with lower limb disability: Rwanda as a case study**"** as the requirement for a master's completion in Biomedical Engineering**.**

You have been selected to participate in this study and it is 31 questions that will take about 5 minutes of your time to answer

This questionnaire will allow collecting data that will help me to gain an understanding of barriers that influence access to mobility devices such as a lack of knowledge on an appropriate device for a specific impairment, lack of funds, geographical restrictions, environmental factors, and so on. It is believed that this study will be able to identify these barriers and present recommendations to ameliorate the situation for promotion and facilitation of access to various inexpensive, easy-to-use, and maintain, environmental friendly mobility devices for low and medium-income countries including Rwanda.

Microsoft form is used to allow an automatic completion of the questionnaire to make the work easy.

Thank you in advance for your help

Required

1. What is your gender

- Male
- Female

2. How old are you

- 18-28
- 29-38
- 39-48

- 49-58
- Above 58

3. Marital status of the respondent

- Single
- Married
- Divorced
- Widowed

4. Where do you live?

- Urban
- Rural

5. Level of education completed

- Primary school
- Secondary school
- Post-secondary
- Uneducated

6. Employment status

- Self-employment
- Employed
- Non employed

7. Why did you come to the hospital?

- Rehabilitation services
- Other issues

8. Do you live with a lower limb disability?

- Yes
- No

9. How do you feel about living with a lower limb disability?

10. What was the cause of your disability?

- [ ] Congenital disability
- [ ] Injury
- [ ] Illness or disease
- [ ] Aging,
- [ ] Malnutrition
- [ ] Other occupational accidents

11. What degree of impairment do you have? 1=minor and 4=severe

1 2 3 4

12. Do you know any assistive devices?

- ○ Yes
- ○ No

13. Do you use any?

- ○ Yes
- ○ No

14. If not, why?

15. If yes, Which one do you use?

- [ ] Walking sticks
- [ ] Walking frames
- [ ] Crutches
- [ ] wheelchair
- [ ] Powered Wheelchair
- [ ] Scooter
- [ ] Lower limb orthosis
- [ ] Not applicable

16. How often do you use this device? 1=never and 4=always

1 2 3 4

17. How does it help you? 1=poor and 4=very good

1 2 3 4

18. What has been challenging while using them?

19. Do you have any information about other modern assistive devices that can help you more?

- Yes
- No

20. How did you get the assistive device you have?

- By buying it on myself
- By donors

21. Which problems do you have with getting an assistive device?

22. How long does it last before the need for a new one?

- One month- six months
- Seven month- twelve months
- Thirteen - eighteen month
- Above

23. How long do you wait to get a new one?

- Less than 2 months
- between 2 and 4 months
- Above 4 months

24. In case of damages, how long does it take to repair them?

- 1 to 10 days

- 11 to 20 days
- 21 to 30 days
- Above 30 days

25. Do you get assistance from your family members?

- Yes
- No

26. If yes, which type of assistance do you get?

- Lifting
- Feeding
- Hygiene
- Support for using manual wheelchair
- financially

27. How long does it take to reach the main road? Or public transport?

- 1 -10 minutes
- 11- 20 minutes
- 21-30 minutes
- Above 30 minutes

28. What do you think about exercise?

29. Do you participate in any sports activity?

- Yes
- No

30. If yes, which one of the following do you participate in?

- Swimming
- Sitting volleyball
- Wheelchair tennis

- [ ] Golf
- [ ] Cycling
- [ ]

31. In your home, do the following negatively influence your participation in activities?

- [ ] Stairs
- [ ] Carpet
- [ ] Doors
- [ ] hardwood floors
- [ ] Ramps
- [ ] Handrail
- [ ] Other

Appendix 2: The respondent feelings about mobility device accessibility

they are expensive
It’s not only hard financially to get the device but also the supply is scarce. I have had to rely on local carpenters to design wooden options for me.
Money
Not informed
takes long time to get it
Donors give us old and used items they have
I had no enough money to buy it and I looked for donors to help me
Money
Abazungu tubona babizana
I had no problem because when the doctor prescribed them to me, I brought them from the hospital
I have to wait for donors or charity action from local government
I waited 3 weeks for its fabrication
it takes time for my family to save enough money for it and also waiting for their availability on market because they are not always available
lack of enough money to buy them pushes me to use whatever they provide to me
limited budget and delay to get them once money is available because they have to be imported
waiting for them to be done, and that period was too hard for me and my family because I had to stay in bed when no one was around to move me and primary hygiene was almost not applicable
No Money
I cannot afford it I have to wait for donors
It is not easy to find crunches that fit me at first. I had to wait and look around to find my size
I think a wheelchair can help me but it is expensive. I cannot afford it
It takes time and is also expensive.
It requires taking measurements and waiting for your command. the adjustable ones are expensive to me
they are expensive and I had to come back for it and try if it fits me
It was hard for me to know if there are some donors who can help me, but now I am lucky and I believe that what I will receive will be useful to be
I had no big problem as the accident happened during work and my work insurance covered the cost of them
only waiting for the command was a challenge. they are not local , they needed to be imported
they are expensive and not always available in hospitals and I had to wait for their importation

I had no information about them and my mother heard about them when she was here at the hospital. they registered m on the list of people who need them
The modern ones are expensive. I had to use the wooden crunches and the size is too big for me, they have to adjust
just time to get them and the cost is quite high
they are expensive and it not easy to find your size immediately
I didn't had any challenges getting them because they were available at the hospital
They are expensive and I am no longer able to make money.
NA
I had no problem to find them, they just adjusted on my size
Enough money
I am still collecting money to buy a wheelchair hoping that it will help me more
Poor
Heavy, pain of upper limbs in the armpits
I don't have one yet and I wish it comes quickly maybe it free my family as they have to carry me everywhere
it takes too long to get them. the designer are not many and it delays too much

Appendix 3: The respondent feelings about mobility device usage

It was very hard to get used to moving with it. it is scary and painful at the beginning
The available products are barely adaptive and difficult to handle. I have been at risk of re-injury risks using them. They also tend to slip on cement surfaces.
Difficult for walking
I need a helper to move
Sometimes maintenance is complicated, self-displacement is scary
It's uncomfortable and can't access many facilities
when I want to go out, it requires someone to help me to get to the road as I stay quite far from the road
Ziramvuna cyane
Zirahenze
At the beginning, it was very hard but by the time, I am getting used
the big problem is getting out of the wheelchair and sitting down or going to bed, otherwise, it is very helpful to me even if it requires someone to push me when I go to a place where the floor is not smooth
The primary problem is to fear the first steps with it. i was very scared to get injured again
fearing to get new injury by trying them
they help me but to get used is hard and they are too bad on the slippery floor,
I always have to use them, I cannot go even the shortest distance without them, also, the adaptation to orthosis was not easy
when using them, I fear falling again and getting reinjured
Not faster
It requires someone else to help me. I cannot try it alone
standing in crunches is very scary and also moving in a wheelchair requires someone to push me
I am scared to move and also using the toilet is very hard
As I stay far from the road, it is hard for me to come to the hospital because they have to lift me up to the road. the area is not friendly to me
they have been uncomfortable and the risk to get used is very hard
It is my first-day trying crunches but they are very scary. I am not sure if I will get used to them. Maybe if I had a wheelchair, it would be better for me. but the doctor told me that it will be fine
I cannot move even in
to get used was not easy and the pain was preventing me to try my best to move with them
the first days was very painful and scarring but I am trying and I even resumed the work
They are helpful because without them I could not move from one place to another. even if I cannot resume my work now but at least I can see outside by myself

The wheelchair helps me but only when I am with someone to push me. when I am alone I cannot move from one place to another
They are not comfortable for me and that is why I am here to make some adjustments. maybe if I could do it by myself will be better
painful in the first days and the fear of reinjury is too much
The main challenge is to get used to using them. the fear of reinjury is too high
it's hard to get used and its uncomfortable
I cannot push it on myself and it requires someone else to help me.
NA
The big problem is to get used to it. it is very scary and I was fearing of getting a new injury again
Walking using them, sometimes they break down
It requires me to take those together and when I am tired of using one, I change to another one. but the frames are good but require a flat compound to move on
No stability
Sliding and difficult to walk in stairs
I think it will be the best thing to happen to me when I get it.
the challenge is this I have to have someone around me to assist in putting on the devices on my feet, by now my wife abandoned me saying that she is tired of this endless activities