ADDIS ABABA UNIVERSITY

ADDIS ABABA INSTITUTE OF TECHNOLOGY

SCHOOL OF GRADUATE STUDIES

SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING

Assessment on Challenges at Intersections for People Living with Disability: In the case of Addis Ababa City

A Thesis Submitted to School of Graduate Studies of Addis Ababa Institute of Technology in Partial Fulfillment of the Requirements for Master Degree in Road and Transport Engineering

By:

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DECLARATION

I declare that this thesis is my original work and has not been presented in any other university for achieving master's degree also sources of data used in this have been definitely acknowledged.

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ABSTRACT

As all of the people living in the world, people living with disability also have interest and right to move freely without any obstacle. Conventions in the world support these rights of disabilities by developing policies that force to develop inclusive infrastructures, but the reality is opposite. Because of inaccessibility they face different problems throughout their life also the researches in this sector is very low by considering the above factors and to contribute some part in this area this research is conducted. Objectives of the research are to evaluate intersections crossing areas inaccessible for people living with disability, identification of main challenges that affect them during crossing and recommend ideas on improving crossing areas. For fulfillment of objectives questionnaires, observation, checklist and semi-structured interview as primary data sources in addition to secondary data sources used. Multi stage sampling for choosing subjects and crossing points at intersections purposively selected then by using quantitative and qualitative method collected analyzed, finally by using ordinal logistic regression model i.e. Wheelchair users faces difficulty of accessing intersections 2.19 times and Crutch users 0.76 times lesser than Orthopedic/prosthetic user also PWD who thought drivers' behavior is fair faces difficulty in accessing intersections 0.45 times lesser than who thought it is unfair. Speed of cars in non-signalized intersections, unavailability of curb ramps and inappropriate structure of curb ramps are the main factors that affect comfort of people with disability also 38.2 % of respondents feel unsafe while using signalized intersections the rest 61.8% feel safer in it but in the case of non-signalized intersections 66.4% feel unsafe and rest 33.6% feel safe. Improving accessibility for them shall be achieve by working in collaboration among all stakeholders and whole community.

Key Words: Accessibility, Mobility, Disability, Intersections

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LIST OF ABBREVATIONS

AASHTO – American Association of State Highway and Transportation Officials

ANOVA – Analysis of Variance

APS – Accessible Pedestrian Signal

AU – African Union

BOLSA – Bureau of Labour and Social Affairs

CBD – Commercial business district

CPS – Countdown Pedestrian Signal

CSA – Central statistics agency

ERA – Ethiopian Roads Authority

FHWA – Federal Highway Administration

ICED – Infrastructure & Cities for Economic Development

ICPS – Inter-censual population survey

ILO – International Labor Organization

MUTCD – Manual on Uniform Traffic Control Devices

OECD – Organization for economic co-operation and development

PUFFIN – Pedestrian User Friendly Intelligent

PWD – People Living with Disability

SDOT – Seattle Department of Transportation

SPSS – Statistical Package for Social Sciences

TRIPS – Transport Innovation for Disabled People needs Satisfaction

TxDOT – Texas Department of Transportation Research and Technology Implementation office

UN – United Nations

UNECA – United Nations Economic Commission for Africa

UNDP – United Nations Development Program

UN CRPD – United Nations Convention on the Rights of Persons with Disabilities

VRU – Vulnerable Road Users

WHO – World Health Organization

CHAPTER ONE: INTRODUCTION

1.1. Background of the study

"Disability is the umbrella term for impairments, activity limitations and participation restrictions which is interaction between an individual health condition and that individual contextual factors including environmental and personal factors" (WHO, 2011). The concept of the report revolves around not only disability happens because of problems on body structures but also by behavioral and environmental obstacles that restrict them to actively participate and enjoy their rights as it excludes them also OECD (1998) report agrees with this idea as challenge faced by PWD is not only by their restricted ability also by inaccessible infrastructures they use in their day to day activity. Even if the definition given could have same background it is different among countries this case makes difficult to know exactly number of people living with disability also type of recording around the world is not the same but estimations by WHO (2015) estimated that one billion people with disabilities lives around the world which accounts 15% of the world population from this number 80% of them lives in developing countries. Despite their number is many planned, designed and built infrastructures are not easily accessible by them in most of countries specially developing countries. Even if consideration has been improved now at times through the world to have transport systems that can be equally used among different types of users with having different characteristics more efforts should be needed in the future times.

Inaccessible transport infrastructures are some type of environments in the transport system that are not comfortable for people with disabilities also these facilities create barrier for children's, elderly, women and people that have limited movement problem. Uncomfortable road crossing infrastructures affect the disability him/herself, family, society and also the country as they are not involved with in the society activities and cannot fulfill their needs and wants by their own because the infrastructure may affect their activity and they will fear of using it. So country will lose financial and other benefit from their performance because their talent and ability to perform things will stay home with

them. FHWA (2018) described as crossing the road is stressful experience for PWD as the traffic system not always designed with their needs in mind. Julie Babinard et.al (2012) states that participation of people with disabilities in economic, social and political scenarios can be achieved by improving access and mobility in transport system. Also as inaccessibility of transport facilities affects all of the society in one and another way making systems accessible will benefit wider scope of the society because of restricted participation of PWD not only affect them also all of society for more description Ronald & Jim (2004) described costs of disability which have three components: direct costs of treatment, indirect costs to those who are not directly affected and opportunity costs of income foregone from capacity.

Tessema (2017) determined that in Ethiopia particularly in the case of Addis Ababa people with disability faces problem in transport system as the built environments are inaccessible or have lack of accessibility. The transport system consists of transport modes also transport facilities like walkways, crossing areas and also traffic control devices such as traffic signals. Some of the problem existing are the pedestrian crossing areas are not comfortable for people with disabilities regarding to their structure, traffic signals are not communicable with some type of disabilities types and their crossing speed and time given for crossing clashes sometimes. More of intersections are key elements in road facility that special concern must be given as interaction between different type of road users interact without any protection (Eleni et al., 2017) also it is a place that pedestrians with different ability cross the road, because of this factor UNDP (2010) claimed street crossings as key place of pedestrian facilities. In the case of disabled pedestrians, they could be more vulnerable and feel unsafe while crossing intersections which are not accessible for them which do not have facility that ease their movement because they could experience longer time for crossing. In being of having crash risk on pedestrian's, pedestrian safety can be improved by designing and understanding pedestrian crossing behavior by increasing accessibility and reducing conflicts between pedestrians and drivers in signalized intersection (Fady,2020).

In order to solve problem of inaccessibility having universal design in the system serves as solution, “universal design is the design of products and environments to be usable by all people to the greatest extent possible, without the need for adaptation or specialized design” Julie Babinard et.al (2012). Concept of universal design also focuses on making pedestrian crossing areas accessible not only for people with disabilities but also for other types of pedestrians. Accessibility describes the ability with which goods, services, activities, and destinations can be reached, which are referred to as opportunities. From the standpoint of transportation planners, mobility, particularly vehicle travel, is emphasized. Increased roadway capacity and design speeds, enhanced transportation systems, increased parking facility capability and accessibility, and greater vehicle safety can all help to improve accessibility (Alkhansa.M.R. Aljanzouri et al. (2014)). Accessibility design is fundamental to the walking environment because all pedestrians with or without disability benefit from it (Donna (2004); Agarwal & Steele (2016)). Proper accessibility requires taking into consideration not only transport issues but also land use planning, urban planning, building, maintenance and other issues.

Katsumi Tokuda (2001) described people with travel difficulties as those who are misinterpreted or neglected by those around them or who have challenges to travel caused of institutional and physical barriers, such as wheelchair users. Illegal parking as a barrier, steps, rough terrain, billboards, commodities, and trash cans on sidewalks, improperly installed ramps, textured pavement blocks as a barrier to wheelchair users if installed incorrectly, and unsuitable positioning of traffic light buttons are some of the barriers commonly faced by them.

Researches related to crossing behavior of pedestrians in case of people without disability and related to transportation problems creating barriers for people with disabilities focusing on more on transportation modes and infrastructures totally have been made but in the case of giving emphasis on crossing behavior and infrastructural problems in signalized and non-signalized intersections has not been done mainly for people with disability type which have difficulty to physical mobility specifically wheelchair, crutch and

prosthetic/orthopedics users, by taking above factors into consideration and still number of disabilities is increasing by different factors this title chosen to be done.

1.2. Statement of the problem

This research conducted to evaluate crossing facilities for people with disability that have difficulty at crossing points including signalized and non-signalized intersections in Addis Ababa, Ethiopia. According to Rahel (2017) some of the problems in road infrastructures are lack of wheel chair ramps, intersection without curb ramps, poor street and pedestrian signals, cracked and dangerous pavement are some of the problems that people with disability faces specifically in the case of intersections existing problems are difficulty in crossing road, unsuitable street crossings and pedestrian signal, intersection without curb ramps. Identifying the problems in intersections for pedestrians' PWD is important because these areas are source of traffic accidents, reason for congestion (Yemsrach (2019); Zhuang et al. (2020), (Zhu et al. 2013; Gang et al,2011)) and to consider people who faces disability by traffic accidents, research by Debela and Retta (2021) discovered that from 1967-2018 number of 73,433 people faces serious road traffic accidents and become disabled because of road traffic accidents, BOLSA (2004) shown that 6% of disability cause in PWD in Addis Ababa were road traffic accident also WHO (2004) agrees with this idea that around 90% of the world disability faced life caused by road traffic crashes on pedestrians. Also One of the factor in Urban road environment for rising number of road traffic accident is lack of proper pedestrian facilities as UNECA (2020). Based on world report on disability (2011) states it is human right issue plus it is situation that everybody could face in life for short period of time or for the rest of his/her life time and considering PWD that are struggling with the problems in their day to day activity. Though considering every citizen in designing, planning and constructing of road infrastructures is compulsory task and standardized criteria when we see it from implementation side it lacks of commitment and have accessibility problem for people with disability more effort needed so this research may fill the gap between government and PWD as it examines crossing facilities in road infrastructures and shows existing condition which is barrier for them like unavailability of ramp facility, uneven curbs, changes in level, insufficient width of refuge islands,

obstructions near to and at crossing areas also shortage of time given to cross at signalized intersections. Respectively this type of research helps to identify data and information play an important part in functional infrastructure since they help to identify existing issues for people with disabilities who use it and be one of important consideration for inclusive planning.

1.3. General Objective

Main objective of the research was to evaluate accessibility of crossing facilities in intersections for people with disability having mobility impairment.

1.4. Specific Objectives

Objectives that are listed below are other specific objectives the study focused on:

- Evaluation of crossing areas(facilities) to check accessibility for PWD.
- Identification of main factors that affect PWD during crossing roads.

1.5. Research Question / hypothesis

Objectives	Research question/hypothesis
Evaluation crossing areas(facilities) to check accessibility for people living with disability	What type of problems exists in facilities (crossing area) at signalized intersections and non-signalized intersections that are inaccessible for people living with disability?
Identification of main factors that affect pedestrians with disability during crossing roads.	Ho: no significant difference in in type of challenge among different types of aid device users

	H1: significant difference in type of challenge among different types of aid device users

The following are research questions/ hypothesis based on objectives of the study

Table 1-5 Research objectives

1.6. Significance of the study

The study could be significant for the following bodies for the listed significances:

- People living with disability that uses wheelchair and crutches as their problem is going to be studied and if changes made based on recommendations
- Family of PWD will be advantageous as the movement of their family members having disability problem uses signalized intersection independently
- Transport bureaus in the city benefited as it shows the gap about existing facilities and wants of PWD
- Transport planners and transport policy makers also can get some sort of information about existing situation and what they should do in the future.
- Lastly researchers will be benefited as it can be background information for them for further researches.

1.7. Scope of the study

The study evaluated the crossing facilities for people with disability that use wheelchair, crutches and orthopedic/prosthetic users that have difficulty in mobility at signalized intersections and non-signalized intersections and also identified main factors that affect them during crossing roads. Because of consideration of time, resource and other factors crossing assessment held on crossing points and wheelchair, crutches and orthopedic/prosthetic users that have difficulty in mobility only also factors recognized regarding to age, aid type and gender.

1.8. Organization of the research report

These paper consists of five units. The first unit gives important information about the research and the second part is literature review that describes about the points that are related to the research after that the third unit is research methodology and description about the study design. The forth unit is about result and discussion that shows about respondents' biographical information and other points that answer the research objectives and discussion about the study. The last unit is conclusion and recommendation which will give suggestion based on the result obtained from the collected information or data.

1.9. Operational definition of terms

In this research the following words are used in this type of context.

- Disability: a condition that damages person's physical ability or doing things in normal way.
- People with disability (PWD): person who lives in a condition that damages or limits person's physical ability of movement.
- Accessibility: transport infrastructure that can be easily used by all types of road users specially people having problem in movement because of disability faced by them.
- Mobility: movement from one place to another place by pedestrians to fulfill their needs.

CHAPTER TWO: LITERATURE REVIEW

2.1. Overview on Disability

The definition of disability and the number of people living with disabilities varies by country and the indicators used, but the context for disability definition is shifting to a social model, which suggests that disability is a complex social and environmental construct largely imposed by societal attitudes and obstacles in human development. (Ronald & Jim (2004); WHO (2011); Iudici et al. (2017)).

TRIPS (2020) described disability based on three models among it, social model and medical model are discussed under this title. Medical individual model views disability as a personal issue despite the fact that the barriers they face in everyday routines are due to physical, intellectual, sensory, or mental impairments; this model aims to rehabilitate or reduce the impairment in order to reunify the person into general society. Social model distinguished between impairment and disability as Impairment is a functional barrier in an individual caused by factors such as physical, mental, or sensory impairment and disability is a failure of possibilities or restriction due to inequitable level with others due to a variety of barriers such as physical environment, social attitudes, communication, and organizational structures.

Disabled people, according to the OECD (1998), are those who have a physical, sensory, or mental impairment that affects their ability to move. Pedestrians, with or without artificial aids, or in wheelchairs, are the most common, however cyclists may also be present.

According to the World Health Organization and the International Labor Organization definitions cited in the Federal Democratic Republic of Ethiopia's country profile on disability, "disability" is defined as "any person unable to ensure a normal life by himself or herself, as a result of a deficiency in his or her physical or mental capabilities."

In the Ethiopian Transitional Government's "Negarit Gazeta," proclamation number 101 of 1994, "a disabled person" was defined as "a person who is unable to see, hear, or speak, or who is suffering from mental retardation or injuries that limit him or her due to natural or manmade causes; provided, however, that the term does not include alcoholics, drug addicts, or those with psychological problems."

2.1.1 Policies related to infrastructure that pertaining PWD

Because accessibility of infrastructures for people living with disabilities has become a human right issue (Ronald & Jim (2004); WHO (2011)), there are various policies, guidelines, and standards that support accessibility of infrastructures for people living with disabilities globally and nationally. According to WHO (2011), disability is a human rights issue, as evidenced by a number of international documents, including the World Programme of Action for Disabled People (1982), the Convention on the Rights of the Child (1989), and standard rules on the equalization of opportunities for people with disabilities (1993).

Disability is a human rights concern, according to WHO (2011), because:

- People with disabilities face disparities, such as being denied equal access to health care, job, education, or political engagement.
- People with disabilities face violations of dignity, such as being subjected to assault, abuse, prejudice, or disrespect as a result of their handicap.
- Some disabled persons are denied autonomy, such as when they are sterilized against their will, kept in institutions against their will, or deemed legally incompetent due to their condition.

According to the OECD (1998), "building a physically accessible environment for PWD is not just a safety measure, but also a basic move to treat the disabled with equity and fully integrate them into society."

In Article 14 of the African Road Safety Charter, it is stated that the requirements of vulnerable road users must be considered in the planning, design, and provision of road infrastructure.

Another document that supports global accessibility of PWD is the American act of disability act title II regulations (2010), which state that;

- A public entity shall take reasonable steps to ensure that communications with members of the public with disabilities are as effective as communications with others.
- A public entity must provide adequate auxiliary aids and services where necessary to ensure that people with disabilities have an equal chance to participate in and benefit from a public entity's service, program, or activity.

  When it comes to Ethiopia, the government has enacted and implemented a variety of laws, regulations, and standards dealing to individuals with disabilities, including some that are related to infrastructures, according to ILO (2013).

- Ethiopia's Federal Democratic Republic enacted its constitution in 1995, the State is responsible for providing required rehabilitation and support services for people with disabilities, according to Article 41(5) of the Constitution.
- Building Proclamation No. 624/2009 mandates accessibility in the design and construction of all structures to guarantee that they are suitable for physically challenged people.
- Ethiopia issued Proclamation No. 676/2010 ratifying the United Nations Convention on the Rights of Persons with Disabilities (UN CRPD).
- Ethiopia's National Plan of Action for Persons with Disabilities (2012-2021) strives to make the country more inclusive. It addresses the needs of Ethiopians with disabilities for comprehensive rehabilitation services, equal access to school, skill training, and employment, as well as full engagement in the lives of their families, communities, and country.

2.2. Pedestrians with Disability as Vulnerable road user

A pedestrian is anyone who travels by foot for at least part of their journey. A pedestrian may use wheelchairs, motorized scooters, walkers, canes, skateboards, and roller blades, among other modifications and aids to walking. (WHO (2013); OECD (1998))

SWOV (2012), cited AVV (2003) used three criteria to classify road users as vulnerable road users: the amount of external protection, task capability, and resilience. As a result, disabled road users who are less skilled due to social or cultural circumstances are classified as vulnerable road users.

Vulnerable road users are those who are "particularly at risk in traffic, such as walkers, cyclists, motorcyclists, and passengers on public transportation." This category may include children, the elderly, and the disabled" (African road safety charter; OECD, 1998).

Iudici et al. (2017) defined vulnerable, citing Lord Chancellor's Department (1997), as a person who requires or may require community help and is unable to protect himself or herself from external harm due to disability or mental or physical illness. According to Eleni et al. (2017), disabled pedestrians are the most vulnerable road users in the transportation system.

2.2.1. People living with disability risks of accidents

According to WHO, Zhuang et al. (2020) (2018) Pedestrians were responsible for 23% of all traffic deaths in the United States; in Africa, this number rises to 40%. According to the Federal Police Commission (2019), 14,194 people died in crashes in Ethiopia between 2016 and 2018, with 22,647 serious injuries and 21,159 minor injuries. Pedestrians are the most vulnerable group, according to a report by the Addis Ababa Transport Bureau in 2018 road traffic fatalities account for 80–90% of fatalities in Addis Ababa (UNECA,2020). According to Tulu et al. (2013), pedestrians account for 55 percent of all fatal crashes in Ethiopia each year. As previously stated, PWD are major types of road users who are considered vulnerable, and these cases can be related to accident risks. Pedestrians with

disabilities are at a higher risk of injury or death, according to Stolker et al. (2015), even if they make up a smaller percentage of total pedestrians. According to a study by Xiang et al. (2006), impaired pedestrians aged 5 to 17 were five times more likely to be involved in a collision compared to those without disability. Even if pedestrian crash risk is a main concern specially in developing countries studies on identifying risk of crash is limited (Tulu et al., 2013).

PWDs are often pedestrians, according to the OECD (1998), albeit the crash risks mentioned for pedestrians may also apply to them. Pedestrian crash risks in developing countries, according to Tulu et al., (2013), include walking at night, pedestrian fatigue, illegal crossing behavior, walking on main roads rather than sidewalks, violation of traffic rules, pedestrian crossing in red phase, population growth rate, and motorization. The listed risks can be seen from the perspective of PWD, who prefer to use the main road over the walkway because walkways are inconvenient for them, and who, due to a lack of knowledge of the present condition, engage in illegal crossing behavior and cross in the red phase. Another risk is that as the population grows, the number of PWD is expected to rise for a variety of reasons, including normal population growth and road traffic accidents. Tulu et al. (2013) find techniques to limit the hazards of pedestrian crush by identifying pedestrian accident risks and providing approaches to reduce such risks. Engineering that focuses on creating accessible pedestrian amenities such as accessible paths and crossings. Education includes teaching people how to respect traffic rules and avoid crossing the street illegally. Enforcement with accessing infrastructures, with sanctions for those who do not comply, and a combined strategy of the specified appropriately building and reconstructing facilities for pedestrians might be a method to reduce infrastructure inaccessibility for individuals with disabilities. According to Constant A & Lagarde E (2010), injury prevention interventions targeting VRU in low and middle income countries must overcome additional challenges related to cost, feasibility, and sustainability, as well as a higher level of traffic mix with an already high and increasing proportion of VRUs, even if working for them is a difficult task.

2.2.2. Characteristics of disabled pedestrians

To properly service pedestrians with impairments, different forms of disabilities must be taken into account during design. Nonexistent or poorly maintained pavements, inaccessible overpasses or underpasses, crowded pavements, physical lack of traffic control, lack of aids at street crossings for people with sensory impairments, and dangerous local traffic behaviors are all identified as challenges for PWD by Anjlee & Andre (2016). The following are the major sorts of disabilities that should be considered when designing signalized crossings based on several references for identifying disability type:

Mobility impairment: Some people with these impairments use aids such as crutches, wheel chairs, scooters, and canes, but others may not, despite the fact that they walk slowly and with difficulty. Stairs, curbs, and raised channelizing islands are major roadway obstructions for these people (AASHTO, 2011). In addition to the challenges listed above, OECD (1998) quoted Yoshitaka (1992) as citing weather circumstances such as rain and the inability to use public transportation as obstacles for these pedestrians.

Visual impairment; V. Tennakoon et al. (2020) identified the following factors as barriers to PWD movement: a congested road system, fast cars, pedestrian amenities such as pavements and walkways, and supportive features like as audible signals. Intersections are the most difficult transportation aspect for people with this sort of impairment, thus utilizing an audible method and a detectable warning strip could be an option to help these people (AASHTO (2011); Eleni et al., (2017)).

2.3. Accessible Road Infrastructures

Accessibility is a concern that allows people of all abilities to use all parts of the infrastructure system and facilities at all times; it is not a separate or exclusive problem. Accessible infrastructures on the road are facilities that can be used easily and comfortably by people with disabilities and others. (Donna (2004), Anjlee & Andre (2016)). Universal design is the design of products and environments to be usable by all people, which simplifies life for people of all ages and abilities by making products, communications, and

the built environment more usable for a wider range of people. Accessible road infrastructures also have a standard of being universal design as it is a key to including people living with disabilities to enjoy their rights and participate in social life. Universal design is the design of products and environments to be usable by all people, which simplifies life for people of all ages It benefits not just those with disabilities, but also people with limited mobility, children, pregnant women, people with linguistic difficulties, and people who are carrying heavy luggage (Anjlee & Andre (2016); Ronald & Jim (2004)).

ICED report explains Universal design principles as:

- Equitable application: beneficial and marketable to people of various abilities.
- Usability flexibility: caters to a wide variety of interests and abilities.
- Easy to use: whatever of the user's experience, expertise, language skills, or relative density, the design is easy and effective to use.
- Perceptible information: a design that fully reflects necessary relevant data, regardless of the user's sensory ability or the surrounding circumstances
- Error tolerance: a design that reduces the risks and negative repercussions of unintentional or unplanned acts.
- Minimal physical effort: a design that allows for convenient enjoyable, and fatigue-free operation.
- Size and space for approach and use: independently of the user's body size, posture, or mobility, design that gives suitable size and space for access, reach, operation, and usage.

2.3.1. Factors for inaccessible infrastructure

The existence of inaccessible infrastructure for PWD is due to a variety of circumstances. According to Anjlee and Andre (2016), inaccessibility in infrastructure occurs as a result of decision makers' lack of information and comprehension of current difficulties at facilities. Furthermore, planners and designers missed out on the potential to make facilities

accessible due to a lack of involvement from bodies that experience problems during the design, planning, and implementation phase. Further, Ronald & Jim (2004) demonstrated that costs and complexity for managing disability needs were exaggerated, implying that these may be additional reasons in the occurrence of inaccessibility. The initial trigger to take a trip for pedestrians is generally the environment. The issues that participants have reported are frequently an integration of design and construction practices, malformed or unsatisfactory facility management, and physical landscapes of the terrain, lack of sidewalks and paved sidewalks that are appropriately maintained limits the mobility of PWD (Alkhansa.M.R. Aljanzouri et al. (2014)).

2.3.2. Effects of inaccessible infrastructure

Identifying consequences is challenging due to the difficulty in quantifying the economic and social costs of impairment, which include both direct and indirect expenses (WHO,2011). BOLSA (2004), main challenge than other challenges about 38.6% by PWD is un comfortability of the environment for movement. Transportation disability is one of the major impacts of these types of infrastructures, which excludes PWDs from easily accessing transportation facilities, excludes PWDs from society, degrades quality of life and human rights, and impacts the lives and life choices of any disabled people, such as access to education, employment, health services, social events, and leisure activities (Tessema (2017); Anjlee & Andre, 2016). Furthermore, when social protection systems are inadequate or non-existent, poverty is one of the consequences of disability. Disability and poverty have a bidirectional relationship; disability raises the likelihood of poverty, and poverty raises the risk of disability. Despite the fact that it is regarded as a violation of their universal rights and freedoms as well as being economically rational. Minorities and vulnerable people are handled differently in different societies (Ronald & Jim (2004); WHO (2011)). Disability affects a much broader population than just a small proportion of the general population; it affects, constricts, or limits a much bigger population due to obligations to PWD; environmental barriers affect PWD's family and community as well (Anjlee & Andre (2016), Ronald & Jim (2004)).

2.4 Pedestrian facilities accessible for PWD

Pedestrians are the primary road users and, as AASHTO (2011) states, the "lifeblood of urban areas," so provision must be made for them. At the same time, designing, planning, and constructing facilities that are comfortable for them without causing exclusion is required. Fady (2020) agrees that constructing pedestrian facilities is a critical responsibility because pedestrians are the most important component of the transportation system. Pedestrian facilities that are designed with all types of pedestrians in mind can also improve their safety by lowering the danger of a collision. Sidewalks, crosswalks, traffic control features, curb ramps and cuts for older walkers and people with disabilities, bus stops, stairs, elevators related to these facilities, and road design features that support PWD include tactile paving, curb ramps, connected routes, information and signage in braille and audio format, flat and wide walkways, pedestrian and traffic signals, and pedestrian and traffic signals (V. Tennakoon et.al (2020); AASHTO (2011).).

The following are critical components of pedestrian facilities that should be included in practitioners' designs, according to FHWA (2013):

Pedestrian route: make sure there are no barriers, impediments, or hazards on the routes and crossings. Ensure that curb ramps, transit stations, and devices like pushbuttons are well-placed and meet accessibility requirements.

Exposure to traffic: make it apparent where pedestrians should cross and what actions they should take when they do so. Reduce pedestrian exposure to competing traffic by keeping the crossing distance as short as possible, ensuring that the crosswalk is a straight continuation of the pedestrian's travel path, and providing refuges where possible.

Roadside feature: Provide a buffer between the closest vehicular travel lane and the pedestrian route with roadside elements. To allow appropriate area for pedestrians waiting to cross, keep corners clear of barriers. Ensure that automobiles do not encroach on pedestrian areas by designing corner radii.

Visibility and conspicuity: Maintain adequate lines of sight between drivers and pedestrians, especially at crosswalks, to ensure that pedestrians and traffic are mutually visible. When intersection illumination is available, organize it so that pedestrians have a positive contrast.

Level of service: provide suitable and regular crossing intervals and reduce pedestrian wait times.

2.4.1. Traffic signal

The right of way is assigned to various movements for defined lengths of time in intersections to govern crossing or merging traffic (ERA (2013); AASHTO (2011)). Visibility of traffic signals, separated pedestrian signals, and accessible signals placed by engineering judgments and specifications for pedestrians should be considered in the stage of designing the road by focusing on junction location and geometry signal faces shall be visible to pedestrians by pedestrian signal heads or a vehicular signal face for concurrent vehicular movement, as well as number and arrangement. (AASHTO (2011); ERA (2013); MUTCD (2009)).

When appropriate, pedestrian signs that give information in non-visual formats such as audio tones, voice messages, or vibrating surfaces should be available. Pedestrians should have enough time to cross the road by altering traffic control signal functioning and timing to allow enough crossing time every cycle, or by installing pedestrian detectors. (UNDP (2010); MUTCD (2009)).

Pedestrian safety should be a key element that must be considered in traffic signal because in these areas there is a higher concentration of vehicles, there may be vast, influential, and quick moving vehicles, and they face motorized elements without any protection, so they are considered vulnerable in these areas, particularly at major junctions (FHWA (2013); AASHTO (2011); ERA (2013)). Pedestrian crossings at intersections, according to Yemsrach (2019), are contributing to the present cumbersome traffic flow system, which

leads to congestion. Congestion has an impact on the lives of road users, as well as the city's convenience and quality.

2.4.2. Islands

The space between traffic lanes is used to regulate vehicle movement and provide a place of safety for pedestrians. It also serves as a refuge and traffic control device, reducing pedestrian crossing times and reducing conflicts between road users. At a crossroads, the median or outer divide is referred to as an island. There is no single physical type; it might range from a raised curb to a painted or thermoplastic-marked pavement area. Channelization, division, and refuge are three functions (AASHTO (2011); ERA (2013)).

2.4.2.1 Refuge island

A pedestrian refuge island is one that is located at or near a crosswalk or cycling path that assists and protects walkers and cyclists crossing the road. In urban areas, raised curb corner islands and divisional islands, as well as rural channelizing islands, can be used as pedestrian refuge areas, allowing pedestrians to find an adequate gap in one direction of traffic at a time, allowing them to stop, if necessary, in the center island or median area and wait for an adequate gap in the other direction of traffic before crossing second half of the street. (MUTCD (2009); AASHTO (2011)).

According to the Federal Highway Administration, where refuge islands are most effective:

- wide, two-way streets (four lanes or more) with high traffic volumes, high travel speeds, and big pedestrian volumes are typical conditions
- Wide roadways with frequent crossings of the elderly, people with disabilities, and children.
- Inadequate green signal phasing time for pedestrian crossings.
- Wide, two-way junctions with high traffic volumes and a large number of pedestrians crossing.
- Demands for low-volume side-street traffic with inadequate green time to cross

As FHWA regions between the curb and the curb should be at least 6 feet wide, with a minimum width of 4 feet between the curb and the curb. The island should be at least 12 feet long or the crosswalk width, whichever is greater. The island should be at least 50 square feet in size. The placement and width of crosswalks, the location and size of transit loading zones, and the availability of accessible ramps all influence the size of refuge islands. When it comes to bicycles, refuge islands should be at least 1.8 meters wide (AASHTO,2011).

2.4.3. Curb ramps

Pedestrian facilities must be easily accessible and usable by PWD, according to several standards. People who use wheelchairs require curb ramps to get from the sidewalk to the street. These facilities, however, may provide a barrier to people with visual impairments, necessitating the installation of audible warnings. AASHTO (2011) and FHWA (2013) both recommend that where the curb has been removed, detectable warnings be installed to advise visually impaired pedestrians that they have arrived at the street/sidewalk interface.

The minimum curb ramp width is 1.2 meters, and the maximum curb ramp grade is 8.33 percent. At the top of each curb ramp, a flat landing area of 1.2 m by 1.2 m should be provided. There must be 0.6 m detectable warning strips at the bottom of curb ramps, and the cross slope must not exceed 2.0 percent. Curb ramps can be perpendicular, diagonal, parallel, combination, or depressed corners, depending on the structural design and how they are positioned relative to the sidewalk or street (AASHTO (2011); FHWA (2013).

Curb ramp placement should be properly matched with pedestrian crosswalk lines. The curb ramp's bottom should be within the parallel crosswalk lines. Without warping in the sidewalk or curb ramp, the bottom of the curb ramp should be perpendicular to the face of the curb or bottom grade break. Curb ramps should be provided at all intersections where the public sidewalk ends and pedestrian travel is restricted, such as intersections, midblock crosswalks, medians and islands traversed by crosswalks, alleys, accessible parking aisles,

passenger loading zones, and locations where the public sidewalk ends and pedestrian travel is restricted. (AASHTO (2011); TxDOT (2009))

2.4.4. Crosswalk markings

Define and delineate routes for pedestrians crossing roadways on approaches to and within signalized crossings, as well as on approaches to other intersections where traffic stops. Solid white lines that mark crosswalks must be at least 6 inches wide and no more than 24 inches wide. For both marked and unmarked crosswalks, detectable warning surfaces are necessary where curb ramps are erected at the intersection of sidewalks and the roadway (MUTCD, 2009).

2.4.5. Detectable warnings

The Federal Highway Administration (2013) defines a standardized surface feature as one that is integrated into or applied to walking surfaces or other features to alert visually impaired people to potential risks. To warn people with visual impairments of potential hazards, detectable warnings shall be placed at the bottom of curb ramps and other locations such as depressed corners, raised crosswalks and raised intersections, borders of medians and islands, and at the edge of transit platforms and railroad tracks crossing the sidewalk. It should also be placed across the entire width and length of the ramp. A pattern of truncated domes is constructed into or applied to walking surfaces to create detectable warning surfaces. The domes create a distinct surface that can be detected with a cane or underfoot. Where curb ramps and blended transitions lack other tactile indicators generally provided by a curb face, this surface informs visually challenged pedestrians in determining the boundary from sidewalk to street (FHWA (2013); UNDP (2010)).

2.4.6. Road hump

According to UN (2003), road humps are raised road surfaces at pedestrian crossings to the same level as the footpath, allowing wheelchair users to avoid height variations. This feature aids in lowering the speed of oncoming traffic.

2.5. Accessible facilities at signalized intersections

2.5.1. Extended push features

The primary objective of these devices, also known as APS (accessible pedestrian signals), is to assist visually impaired walkers by providing information that is provided in visible WALK signals in an auditory, spoken, or vibrotactile manner signaling the crossing phase. It gives pedestrians access to a single piece of data that they may use to make the best decision about when it is safe to cross the roadway. Intersection signalization, existence and placement of push button, starting and duration of WALK interval, direction of crosswalk and location of destination curb, intersection geometry, and intersection street name are some of the non-visual information offered by APS to pedestrians. (Donna (2004); SDOT (2017); Jordi (2019)).

Janet and Lukas (2005) quote MUTCD as describing four types of APS: pedhead mounted, pushbutton integrated, receiver based, and vibrotactile. Pedhead mounted is the most extensively utilized of the four, with speakers attached to traffic lights.

According to TxDOT (2009), the installation of APS at signalized locations should be based on an engineering study that takes into account the following factors: potential demand for accessible pedestrian signals, a request for accessible pedestrian signals, traffic volumes during times when pedestrians may be present, including periods of low traffic or high turn on red volumes, and the complexity of traffic signal phasing.

2.5.2 CPS

CPS are an optional element that can be used to convey additional information to pedestrians at a pedestrian crossing, according to TxDOT (2009). They give a visible representation of the time left in the pedestrian change period to pedestrians approaching and using the crossing. These features assist pedestrians in deciding whether or not to cross by displaying the remaining time and making them feel safe while crossing because they have decided ahead of time and will not be afraid of vehicles from all sides.

2.5.3. Pedestrian user friendly intelligent crossings

Also known as PUFFIN crossings, these crossings use a pressure sensitive mat or an infrared sensor in the crossing area to identify pedestrians. Sensors are used in these crossings to identify people in the crosswalk and to extend the signal phase if the pedestrian need additional time to cross. Without needing the pedestrian to press a button, passive detection sensors identify the presence of a pedestrian in a position indicating a wish to cross. Some passive detection systems can track a pedestrian's progress as they cross the road, allowing them to lengthen or decrease specified pedestrian timing periods (MUTCD ,2009).

2.5.4. Safe intersection crossing application

The smart phone app will provide accessible interfaces that will allow pedestrians to communicate personalized intersection crossing constraints to the signal system, ensuring that enough crossing time is allocated, to receive geometric and obstacle information about the intersection that will aid safe crossing, and to be alerted when a crossing movement indicates safety concerns. When appropriate, real-time monitoring of crossing performance will be employed to automatically prolong the green time. At signalized intersections, it provides safe crossing assistance for all type of travelers including people with visual, cognitive, hearing and mobility disability and key focus areas include signals, all types of vehicles and assistive devices (FHWA,2018).

2.6. Walking speed of pedestrians

Walking speed is an important consideration in the design of any pedestrian facility, particularly at crosswalks, where it is an important element in traffic signal design. Pedestrian walking speeds vary by gender, age, location (midblock vs. intersections), air temperature, time of day, trip purpose, and physical ability (Fady (2020); AASHTO (2011)). In signal design, the 15th percentile of the pedestrian walking speed distribution is utilized as the pedestrian walking speed, presuming that 85 percent of walkers can walk faster; however, in some places, the mean pedestrian walking speed or crossing speed will

be considered (Fady ,2020). The average pedestrian walking pace is between 0.8 and 1.8 meters per second. 0.9m/s should be used during design in locations with a lot of elderly individuals. The American Society of Highway and Transportation Engineers (AASHTO) published a report in 2011 that According to the FHWA (2009), a walking speed of 3.5 feet per second to at least the far side of the traveled way or to a median of sufficient width for a wait, and a walking speed of 4 feet per second to at least the far side of the traveled way or to a median of sufficient width for a wait, may be used to evaluate the efficiency of pedestrian clearance times at locations with extended push functions.

According to Fady (2020), the 15th percentile walking speed in Turkey was 1.07m/s, the mean walking speed in Singapore was 1.23m/s, and the mean and 15th percentile walking speeds in Jordan were 1.34 and 1.11m/s, respectively. At signalized junctions in Palestine, the study determined that the mean and 15th percentile walking speeds were 1.35 and 1.06 meters per second, respectively. According to Jordi (2019), who cites Gates et al. (2006), impaired pedestrians who use motorized wheelchairs travel at the same speeds as senior pedestrians. The mean walking pace of elderly pedestrians using walkers or canes at signalized intersections was 3.1 feet per second, with a 15th percentile speed of 2.4 feet per second, according to Arango and Montufar (2008). According to Arango and Montufar (2008), the average walking pace of elderly pedestrians who use walkers or canes at signalized intersections is 3.1 feet per second, which removes 90% of all pedestrians with canes or walkers from MUTCD editions that utilize 4.0 feet per second.

2.7. Principles to overcome challenges of inaccessible infrastructures

Planning and design techniques including PWD, according to Anjlee and Andre (2016), are some of the recommendations to overcome problems and provide an accessible environment for PWD. Monitoring and enforcing existing accessibility legislation, developing campaigns and educational programs to improve policies, practices, and the use of services, contributing local knowledge such as pedestrian crossing locations on busy/dangerous streets, and providing separate lanes and paths for wheelchairs. Commitments to providing accessibility are also methods for overcoming problems faced

by disabled pedestrians. According to Anjlee & Andre (2016), assigning a senior member of staff responsible for accessibility at various stages, preparing a document on how accessibility was achieved, and incorporating accessibility throughout the project are the three points that create commitment to accessibility during planning and engineering design.

Uromi and Mazagwa (2014) propose the following solutions for African states: develop and execute national policies, programs, and legislation to enhance inclusiveness of PWDs, encourage PWD participation in the economic and social development process, and facilitate PWD representation by themselves in all public decision-making processes, to improve assistance for disabled people, boost extraordinary measures for children, youth, women, and the elderly PWD, guarantee and increase access to rehabilitation, education, training, employment, sports, culture, and the surrounding environment, preserve and support disability rights as human rights, assist and allocate resources for disabled people.

And according Ronald and Jim (2004), properly carrying out at the planning and construction phases to minimize costs for making accessible environments is one of the factors that support implementation because the cost of these types of facilities is overestimated, and rebuilding is expensive, so to avoid infrastructure inaccessibility due to cost, proper planning during the early stages and implementing can be beneficial. The following are strategies to alleviate these problems the first is to establish laws and regulations to construct roads that are accessible by persons with disabilities, to have disability related association participate in construction designs and Use of clearly written alphabets (Country profile on disability Federal Democratic Republic of Ethiopia, 2002).

2.8. Gaps identified from previous researches

Under this title, two studies have been published: one on the evaluation of the disabled transportation system vs policy implementation in Addis Ababa, and the other on the transportation challenges of people with disabilities and policy issues in Addis Ababa seen. This research could fill the gap because it differs from the previous two in that both of them

focused on the entire transportation system, not just crossing facilities, even if they can be included under it specifically factors can be called challenges for PWD also for who have mobility impairment using crutches and wheelchairs or none of the two but have difficulty moving in signalized and non-signalized intersections that are not separately ranked also data analysis method differs from both.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1. Description of study area

Under this title description about study area and locations used for evaluation of intersections that are signalized and non-signalized intersections are described.

3.1.1. Addis Ababa

The study conducted in the largest and capital city in Ethiopia which is Addis Ababa city. Place for living to 17% of total urban's population in Ethiopia as Addis Ababa non-motorized transport strategy (2018). Based on 2007 national census population number of the city was 2,738,248 but now in 2011 it is estimated that the projection will be 3,773,999 (Central statistics agency,2010; 2021). From these number the total amount of people living with disability accounts 32,630 people which 17,931 are males and the rest 14,699 are females. BOLSA (2004) identified that majority number of PWD in the case of Addis Ababa were people having problem regarding to leg which were 32.2%. Addis Ababa city has been divided in to ten administrative sub cities and one hundred sixteen woredas recently one sub city has been added. The city located at 90 1'48''N 380 44' 24'' E with having 2,355 meters' elevation.

According to the Addis Ababa non-motorized transport strategy (2018), walking and public transportation account for about 85 percent of trips taken in the city, with personal motor vehicles accounting for the remaining 15%, despite the fact that the situation appears to favor a car-oriented approach that prioritizes vehicle speed over pedestrian safety. Congestion, traffic accidents, and air pollution without pedestrian safety are all hallmarks of the city's transportation system.

3.1.2. Intersections used for observation

In Addis Ababa, intersections with high pedestrian and vehicle traffic were chosen at random for examination. Even though the focus of this study was on Megenagna, Shola, Mikael, Ethio – China, Kazanchis, Mexico, Tikur Ambesa, and Beherawi, a number of non-signalized and signalized intersection crossing facilities in Addis Ababa were studied during describing behavior of intersections. The explanation below depicts the locations of the analyzed intersections.

African union intersection

The following facilities are found in this signalized intersection which is more accessible than others: raised channelized island (refuge island), ramp that is labeled in islands, visibility of signal to pedestrians, counting signal, availability of zebra crossing with sufficient width and clear zone for pedestrians to cross, but the following facilities are not found: audible signal, detectable warnings, and pushbutton features.

Figure 3.1.1 AU intersection

Mikael intersection

Raised refuge island characterized by narrow width and filled with water in rainy season also can't accommodate all pedestrians passing at once, ramp in medians totally not found and curb ramps are not smooth enough for them, zebra crossings are faded and not accessible for wheelchair users as ramp in median is not found. There are no supported elements such as audible signal, detectable alerts, road bump, or pushbutton functions.

Figure 3.1.2 Mikael intersection

Ethio-China intersection

The presence of the following features helps to make this signalized intersection accessible: a leveled channelized island, a pedestrian signal with good visibility, a zebra crossing with sufficient width, and a clear zone. However, keep in mind that the following are issues in the intersection: zebra crossings are faded, refuge islands entrance is blocked by bollards which needs maintenance, which makes it difficult for PWD to get in, and it may also cause accidents.

Figure 3.1.3 Ethio-china intersection

Megenagna Intersection

This intersection, also known as the Diaspora intersection, is a non-signalized roundabout that is used by many people because it is one of the city's main thoroughfares. Even though it is used by dozens of people with physical abilities and necessity, it should be in compliance with universal accessibility standards to accommodate all without alienation. However, the reality is quite different, with serious issues affecting primarily the movement of people with disabilities, such as curbs and islands without ramps, poorly constructed ramps, and zebra crossings that are not visible. Ramps will need to be rebuilt.

Figure 3.1.4 Megenagna intersection

Shola Intersection

The area is one of the largest markets, with a lot of people and automobiles moving about. Because the location may be reached by PWD, the crossing must be accessible as well. It is a signalized intersection with issues such as a counting signal not being available, a curb without a ramp, a raised median without a ramp, narrow medians to accommodate pedestrians using various assistive devices, and a pedestrian signal that is not functional. The aforementioned problems may allow persons with mobility impairments to use the crossroads without fear of a traffic collision, but they may put them at risk when vehicle traffic is heavier, and refuge islands are difficult to access due to ramp facilities.

Figure 3.1.5 Shola intersection

Kazanchis Intersection

Intersection with a traffic signal and the criteria specified below in the road to Fulwuha, there is no raised channelized island, a faded zebra crossing, a broken pedestrian signal, and an unstructured curb ramp facility. Providing signals for pedestrians to work, making visible zebra crossings to allow pedestrians room, and reconfiguring ramp facilities were all necessary to improve PWD mobility.

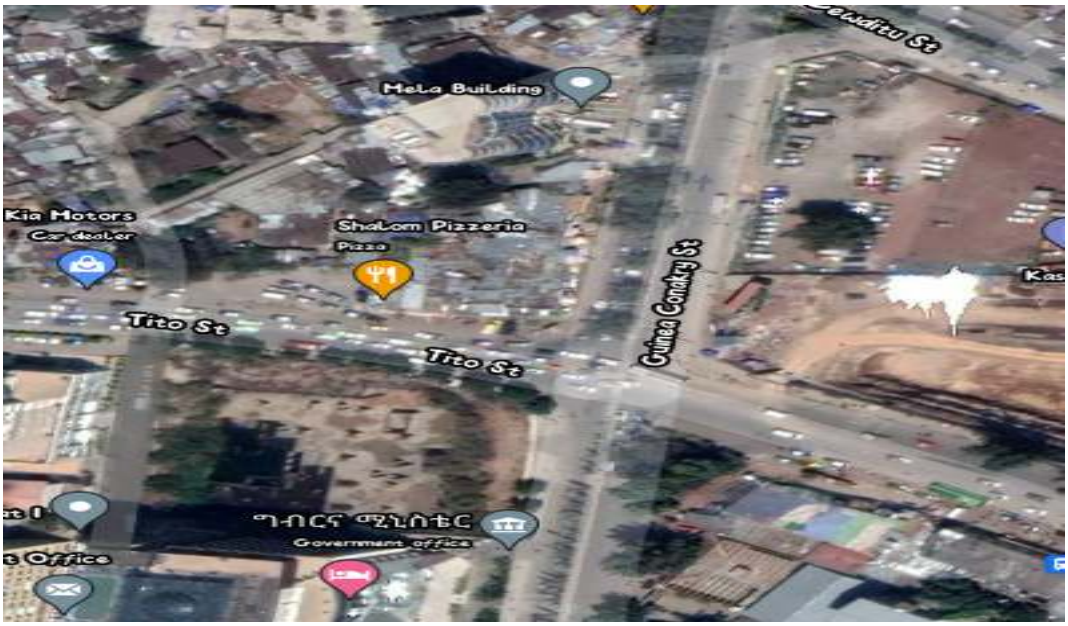


Figure 3.1.6 Kazanchis intersection

Mexico Intersection

Intersection with congested traffic and a malfunctioning traffic light, as more people are likely to move through this area, making it accessible is required. The following issues have been identified: faded zebra crossings, ramp comfortability is in question, non-functioning pedestrian signals, street vendors obstructing traffic, and taxis using zebra crossings for loading purposes. To address these issues, infrastructural and practical traffic rules improvements are required.

Figure 3.1.7 Mexico intersection

Tikur Ambesa Intersection

The listed points can be considered as problems for PWD in that area: pedestrian signal unavailability, ramp structure no comfortability in one side which is filled with water during rainy season, and parallelism of zebra crossing is not done in a way to beherawi. Even though car traffic is heavier, the widths of roadways that make pedestrian signals work will reduce the stress of crossing pedestrians. Making a parallel zebra crossing also gives pedestrians a clear path and reduces confusion during crossing.

Figure 3.1.8 Tikur ambesa intersection

Beherawi Intersection

Because this is the most complicated sort of signalized crossroads for pedestrians, special concern must be given to them, particularly for people with disabilities. PWD has numerous obstacles, including non-functioning pedestrian signals, a channelized island with an inadequate ramp construction, and the invisibility of zebra crossings.

Figure 3.1.9 Beherawi intersection

3.2. Research procedure

Through the three steps shown below in the figure overall procedure of study takes place.

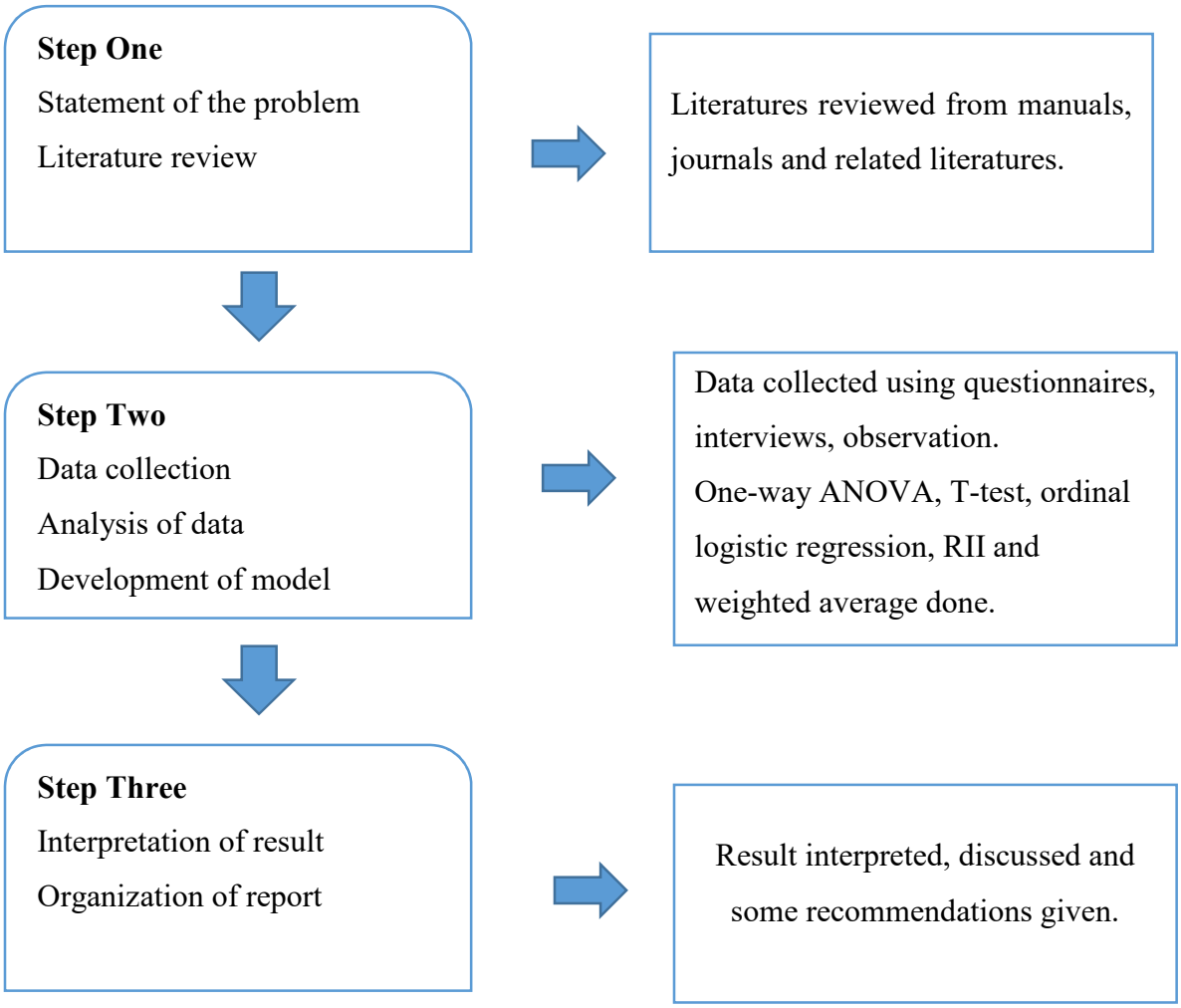


Figure 3.2. Research procedure

3.3. Data Sources

The study included both primary and secondary data sources. Questionnaires, interviews, observations, and evaluations were the first data sources employed to gather meaningful information from the study's subjects. Secondary data sources are utilized to organize what is said about the research issue in other documents, researches, policies, standards, and regulations.

3.4. Data Collection Methods

Questionnaires, observation, checklists, interviews, and audio recording were utilized to collect data for the study. The type of data gathering strategy used is determined by the study's aims.

Questionnaire: both open-ended and closed-ended questionnaires are used to collect information from individuals about challenges in crossing locations of intersections for people with impairments. Physically disabled people in Addis Ababa who use wheelchairs, crutches, and prosthetics/orthopedics provided samples.

Observation: is another tool for gathering information and analyzing the current situation in crossing points by being present in the area. It helps to identify how PWD uses research focus areas and what types of challenges exist in city intersections.

Checklist: it was developed to check standards that could be included or exist in crossing points to assist and have comfortable environment for people with disabilities. Using the checklist identified intersections to be evaluated are examined.

Interview: Another form of data collecting involving study subjects and relevant bureau officials is the interview. They were asked several questions pertaining to the study's goal, and their ideas were incorporated into the study.

Audio recording & photo: were utilized to capture interviewees' responses based on their willingness, as well as to photograph deficiencies in the research area's amenities.

3.5. Sample Size and Sampling Techniques

Sampling Technique

To be more effective, this study used a multistage sampling strategy. Initially, using the purposive sampling approach, research subjects for the questionnaire were picked from organizations where they could be easily identified, and then randomly participants were

chosen under each organization using the simple random method. Purposively chosen crossing places, including signalized and non-signalized junctions, where study subjects can be discovered in greater numbers than at other intersections and which are inaccessible to study subjects.

Sample Size

Questionnaire: study subjects for questionnaire were physically disabled people using wheel chair or crutch also none of the above but have physical impairment in moving. According to Kothari (2004) for small population sample size can be determined randomly using the formula:

$n = \frac{Z^2 pqN}{e^2 (N-1)+Z^2 pq}$ where p = sample proportion, q = 1-p

e= sampling error, Z = level of confidence,

n= sample size, N = population size (number of PWD in the category).

Based on CSA (2007) population number for non-functional lower limbs, standing, walking = 11,820 and body movement difficulty = 2,404. so, p = 14224/2,738,248 = 0.005, q =1-0.005 = 0.995, z =1.96 at 95% confidence level, e = 0.02

n for physically disabled category = 48 people

Questionnaire design: The questionnaire was designed in three parts: the first discusses background information about respondents, including socioeconomic characteristics; the second part used a rating system to rate twelve identified intersection challenges for PWD; and the third part included generalized questions to learn about their performance on overall facilities.

Interview: There were eight people in the interview, as well as five officials from the responsible transportation departments.

Observation: Observation is used at various crossing places throughout the city to check for problems at additional junctions in addition to the ones that have been reviewed.

Evaluation: A checklist was designed to assess the facilities at signalized and non-signalized junctions, with the goal of determining which types of amenities should be added in intersections to improve accessibility and inclusivity.

3.6. Data Analysis Technique

With the study's objectives in mind, data collected through observation, semi structured interview, and evaluation were systematically presented using both quantitative and qualitative data analysis methods. Data from the questionnaire was analyzed using quantitative analysis, while data from interviews, observation, and checklist were analyzed using qualitative analysis. Ms Excel and SPSS are two software programs that were used in this study. Ms Excel was used to analyze and develop frequencies, tables, and charts, as well as calculate the relative importance index (RII) and weighted average (WI), and SPSS was used to convert collected data from the questionnaire into meaningful data for calculations such as one-way ANOVA, Sampled paired T-Test, and ordinal logistic regression.

The relative importance index technique was utilized to rank the problems that PWDs face when using junctions, with the challenges being scored on a Likert scale from one to five. Age, assistive device utilized, gender, and travel frequency were all taken into account while ranking challenges to see which ones were the most difficult for each category by employing relative relevance index values for each category inside the group, a weighted average computation is used to rank problems for the specific group in common. The one-way ANOVA was used to determine the relationship between difficulty of accessing intersections and the aid device used by respondents, and the sampled paired T-test was used to determine whether there was a significant difference in difficulty of accessing intersections between behavior of drivers. Ordinal logistic regression was used to create

the model, using the difficulty of obtaining the intersection as a dependent variable and the other two variables as independent variables.

3.7. Ethical Consideration

The following ethical problems were examined during the research procedure. The goal of the study was explicitly described to the respondents in order to acquire informed permission. Information gathered from respondents was promised to be kept private, and respondents were chosen based on their willingness to participate in the study. It was necessary to make the necessary measures to ensure that the languages used in the data collection instruments took into account the psychology of the participants.

CHAPTER FOUR

4. Results and Discussion

4.1. Background information of respondents

Total background information about respondents included in the research using questionnaire are described below in table 4.1.

Serial no	Characteristic	Description	Male	Female	Total
1	**Aid Devices**	Wheelchair	43	4	47
		Crutches	34	17	51
		Orthopedic/prosthetics	9	3	12
		Total	86	24	110
2	**Age**	Children (0-14 years)	4	1	5
		Youth (15-24)	24	9	33
		Working age (25-64)	55	12	67
		Elderly (> 65 years)	3	2	5
		Total	86	24	110
3	**Educational background**	Illiterate	6	4	10
		Primary School	26	3	29
		Secondary school	26	9	35
		College and above	28	8	36
		Total	86	24	110
4	**Employment Status**	Employed	19	10	29
		Unemployed	18	6	24
		Student	28	8	36

		Retired	21	0	21
		Total	86	24	110
5	**Monthly Income**	1100 – 5000 birr	11	9	20
		5001 – 10000 birr	6	3	9
		More than 10000 birr	2	0	2
		None	67	12	79
		Total	86	24	110
6	**Transport mode**	Private	6	1	7
		Public	39	18	57
		Walking	41	5	46
		Total	86	24	110
7	**Travel Frequency**	Once in a week	16	2	18
		2 – 4 days in a week	40	10	50
		> 5 days in a week	30	12	42
		Total	86	24	110

Table 4.1.1 Background information of respondents

Based on the information in the table above, a total of 110 respondents were included in the study via questionnaire, with 86 of them being boys and 24 being girls, with the majority being boys. This could be due to the fact that boys make up the majority of the PWD population. According to BOLSA (2004), the number of PWD in Addis Ababa was 10003 (55.3%) male and 8073 (44.7%) female. It is also known that male participation is more obvious in various activities such as educational activities, involvement in organizations, as well as movements or travels.

As per the aid device used by respondents, the majority use crutches, 47 use wheelchairs, and the remaining 12 use orthopedics/prosthetics. This can be related to research done on PWD at the Addis Ababa level, where PWD using wheelchair 16.1%, prosthetic/orthopedics 10.9 percent, and crutch/bludgeon/cane 67 percent (BOLSA, 2004).

Also, according to BOLSA's research, using these supportive or aid devices by people with disabilities is costly for them, so they cannot easily access them. As a result, their mobility and participation in various social, economic, and personal activities will be limited.

Age structure of the respondents classified into four groups for the purpose of this study which are children that are aged between o to 14, Youth who have age between 15 to 24, working age that is about 25 to 64 and elderly who aged are above 65, the number of participants were 5, 33, 67 and 5 respectively. Therefore, majority are with in working age group though by facilitating and making infrastructures of transport system Ethiopia as a country also they themselves can be productive even their life standard can be improved, these facilitating accessible environment which satisfy universal accessibility standard benefits not only working age groups to show their potential but also for all of i.e. for youth and children to engage in educational institutions for having subsistent knowledge and elderly to live their lives without depending on others to move from one place to other. ICPS (2012) demonstrates the age distribution of Ethiopia which is 44.5% are 0 – 14, 20% 15 – 24, 32.5% 25 -64 and 3.2% above 65 years which is major groups with having more number are children and working age though this study's age group relies with it. As BOLSA (2004), number of PWD in Addis Ababa based on age group were 1062 males are aged between 0-14 years, 3493 between 15-29 and 5448 are above 30 regarding to female 910 are aged between 0-14 years,2993 between 15-29, 4170 are above 30, it was shown on the research that majority of PWD are aged between 30 to 59 then followed by 19 – 29 which is the worker age group as similar with this study.

BOLSA (2004) determined that in educational status majority of PWD 42.4 % were illiterates, 39.7 % finished primary school, 6.6% finished secondary school, 5.1 % having college and above status also the left population were who can write and read only relatively in this research 36 were having status college and above, 35 finished secondary school, 29 finished primary school and 10 were illiterate. Number of PWD having educational status which is different from BOLSA report observed because of sampling technique used in this research which was purposively selecting subjects on areas where

participants can be found more i.e. focused on PWD which are university students and respondents from center for military affected soldiers.

Employment status of respondents were 29 Employed, 24 unemployed, 36 students and 21 retired respectively, BOLSA (2017) showed that only 23% of PWD in Addis Ababa have regular job the rest are jobless. Beside that ICPS (2012) shown that from total economically inactive population in Ethiopia 0.8% is because of their disability. With having disability additionally impairment caused by inaccessibility of infrastructures could plays role in increasing inactive population regarding to economic activity these creates burden on country's economy so by designing comfortable infrastructure for them opportunity in engaging private, public or governmental organizations may happen therefore it may help economy of country indirectly. In relative to income of respondents in this research the majority doesn't have income as most of them are students and retired the rest have income which is smaller about between 1100 to 5000 this is because of they engage in activities with having lesser income because of their education status.

Transport mode used by participants were public transport which are 57 of them, 46 of them walking and 7 uses private transport although Tessema (2017) fronted that most used type of transportation is public transportation. Majority of wheelchair users reported as they use walking which is by using their wheelchair as most of the transport options are not comfortable and accessible to them plus payment for transports may not be easy for them as their economic status may not fit. Also one of the respondent said that:

"How can I use public transports than walking with my wheelchair? as most of transports are not comfortable for us."

The respondents said that with being in not good mood because public transports like buses, taxis or minibuses are not easily gotten plus not comfortable to be used by PWD regarding to their distance from ground without supportive structure to enter for them, payments could be expensive for them, attitude of service providers to transport them because PWD needs more space and not easily load and unload therefor they choose to use walking as

main mode of transportation. Beside this most comfortable type of public transport is "sheger bus" others are not as much as it based on their information. As their movement depends on walking road environments including walkways intersections and crossing structures should be designed to the level satisfying their want. Also they use walking for refreshment purpose and to keep their health safe.

Travel frequency of participants were 50 for 2-4 days in a week, 42 for ≥ 5 days in week and the rest for 1 times in a week. From side of gender 16, 40 and 30 for travel frequency once in a week, 2-4 days in a week and 5 and more times in week for male and 2,10 and 12 for female respectively. Tessema (2017) showed similar which is significant pattern of travel frequency by PWD relative to this research though researches clarifies PWD movement or frequency of trips this supports that strong concern shall be given for road infrastructures including intersections should be designed in a manner including them more and more.

Purpose of trips which is mostly experienced by respondents in their day to day activity is organized on table below, which is majority of respondents goes to market areas followed by school the work areas accordingly Tessema (2017) in line with this result that majority movements of PWD are to work, school, shopping purposes.

Purpose of Trips

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	school	34	30.9	30.9	30.9
	market	43	39.1	39.1	70.0
	recreational	3	2.7	2.7	72.7
	work	23	20.9	20.9	93.6
	Religious &Health centers	7	6.4	6.4	100.0
	Total	110	100.0	100.0	

Table 4.1.2 purpose of trips

4.2. Issues related to crossing in intersections

Under this title organized information from the study is regarding to crossing place in intersection, crossing time efficiency and when they cross at signalized intersections of respondents.

4.2.1. Crossing place in intersection

Including signalized and non-signalized intersection crossing area for purpose of crossing from one side to other by respondents were one of the focus of the study which is zebra crossing permitted for pedestrians and any place which is comfortable for them without zebra crossing.

Gender of respondents * Crossing place in signalized intersection

		Crossing place in signalized intersection		
		zebra crossing	any place	Total
Gender of respondents	Male	84	2	86
	Female	24	0	24
Total		108	2	110

Table 4.2.1.1 Crossing place in signalized intersection according to gender

Gender of respondents * Crossing place in non-signalized intersection

		Crossing place in non-signalized intersection		
		zebra crossing	any place	Total
Gender of respondents	Male	69	17	86
	Female	21	3	24
Total		90	20	110

Table 4.2.1.2 Crossing place in non-signalized intersection according to gender

As above table shows that majority of respondents uses zebra crossing than crossing any place in intersections and also number of males choose to cross anywhere even if it is signalized or non-signalized intersection than females is higher this is because of different factors including male characteristic in nature i.e. researches shows that males are more introduced to break traffic rules than females.

If the crossing facility including ramp facility and refuge islands are not comfortable for easily accessing by different type of aid device users they could use any place to cross, this condition makes them in risk for traffic accident as the drivers are not aware of they use that place as there is no zebra crossing and also creates congestion when pedestrians uses other places than zebra marks in CBD areas. More of wheel chair users are faced with this condition as they need ramp facility for crossing specially in non-signalized intersections it is higher as most of time this area would not have proper ramp facility, the table below illustrates this condition. Improving accessibility of ramps and medians helps to improve this condition and make them feel safe.

		Crossing place in non-signalized intersection		
		zebra crossing	any place	Total
Aid device used by respondents	wheelchair	34	13	47
	crutch	45	6	51
	Prosthetic/orthopedics	11	1	12
Total		90	20	110

Table 4.2.1.3 Crossing place in non-signalized intersection according to aid device used

		Crossing place in signalized intersection		
		zebra crossing	any place	Total
Aid device used by respondents	wheelchair	46	1	47
	crutch	50	1	51
	Prosthetic/orthopedics	12	0	12
Total		108	2	110

Table 4.2.1.3 Crossing place in signalized intersection according to aid device used

When this condition seen from the point of age group more of youth and working age groups breaks rule of using zebra crossing in non-signalized intersection and similarly youth does not imply it in signalized intersection i.e. the table below shows this fact, different related literatures also supports this concept which is youths and working age groups are that do not follow different type of traffic rules and regulations that is why more of traffic accident risk is greater on them.

		Crossing place in signalized intersection		
		zebra crossing	any place	Total
Age of respondents	less than or equals to 14	5	0	5
	15 - 24	31	2	33
	25 - 64	67	0	67
	greater than equals to 65	5	0	5
Total		108	2	110

Table 4.2.1.4 Crossing place in signalized intersection according to age group

		Crossing place in non-signalized intersection		
		zebra crossing	any place	Total
Age of respondents	less than or equals to 14	4	1	5
	15 - 24	28	5	33
	25 - 64	55	12	67
	greater than equals to 65	3	2	5
Total		90	20	110

Table 4.2.1.5 Crossing place in non-signalized intersection according to age group

4.2.2. Crossing time efficiency

This subtitle explains the green time offered in signalized intersections, which is inclusive of all road users, including PWDs who use mobility aids. Even though the time granted for pedestrians to pass is based on norms that are considered inclusive, respondents have expressed displeasure, as indicated in the chart below. Obviously, as the results show, wheelchair and crutch users are more dissatisfied with the time allotted for them to pass. This could be due to infrastructure that is inconvenient for them, which may lengthen the time allotted for them to pass because they exert more effort while using infrastructure such as ramps and require more time than other pedestrians.

Aid device used by respondents * Crossing time efficiency in signalized intersections

		Crossing time in signalized intersections			
		too much	about right	too little	Total
Aid device used by respondents	wheelchair	2	29	16	47
	crutch	0	35	16	51
	Prosthetic/orthopedics	0	7	5	12
Total		2	71	37	110

Table 4.2.2 Crossing time efficiency

The following ideas were raised by respondents according to insufficiency of crossing time given for them at signalized intersections: in time where pedestrians volume is peak in some areas green phase for pedestrians is less even there are conditions which vehicles start to move even pedestrians specifically PWD did not finish crossing, these case is more raised by mothers of PWD child's as their attention distract by other things and limited movement.

4.2.3. Crossing phase

Phase where PWD pedestrians pass on at signalized intersections which is about at green phase for pedestrians and at any time are considered cases in relation to age and gender of

respondents. Males and aged groups in working age do not obey waiting green time and passing at permitted stage as above cases similarly in this case nature of their behavior plays role in not respecting traffic rules.

Age of respondents * When do you cross in signalized Intersections

		When do you cross in signalized Intersections		
		green time for pedestrians	any time	Total
Age of respondents	less than or equals to 14	5	0	5
	15 - 24	31	2	33
	25 - 64	64	3	67
	greater than equals to 65	4	1	5
Total		104	6	110

Table 4.2.3.1 Crossing phase in signalized intersection regarding to age

Gender of respondents * When do you cross in signalized Intersections

		When do you cross in signalized Intersections		
		green time for pedestrians	any time	Total
Gender of respondents	Male	82	4	86
	Female	22	2	24
Total		104	6	110

Table 4.2.3.2 Crossing phase in signalized intersection regarding to gender

4.3. Safety of PWD pedestrians in intersections

The following issues are included under this topic which are about accessibility of intersections, needing help from others while using intersections and safeness at intersections.

4.3.1. Accessibility of intersections

It concerns respondents' views on intersection accessibility for all types of road users by taking into account structures and amenities in crossroads to meet all types of users' needs. Consideration of crossroads as inaccessible may vary by age group, with working age groups being the most likely to believe intersections are inaccessible, implying that they may be more active than others. As indicated in the graph below, the majority of respondents in the study believe that the majority of crossings in the study are inaccessible to them, as well as other road users.

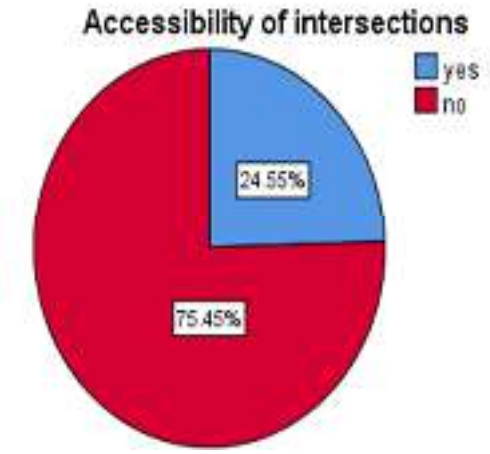


Figure 4.3.1 Accessibility of intersections

4.3.2. Assistance in intersections

Another issue with PWD road users as pedestrians accessing intersections is the need for assistance from others to make it easier for them to use both types of intersections. Needing assistance is more common in non-signalized intersections than signalized intersections due to structural and facility deficiencies that make it difficult to provide effective service to them.

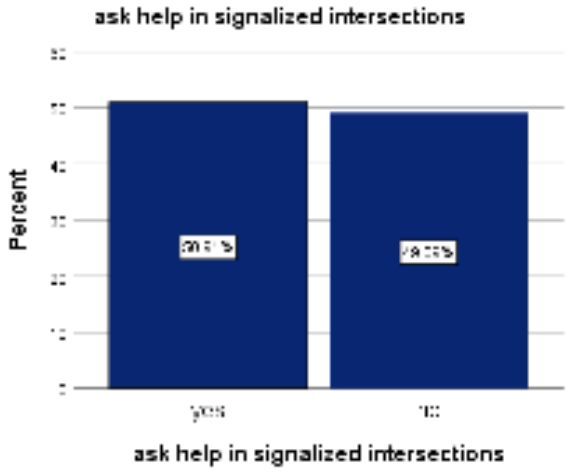


Figure 4.3.2.1 assistance in signalized

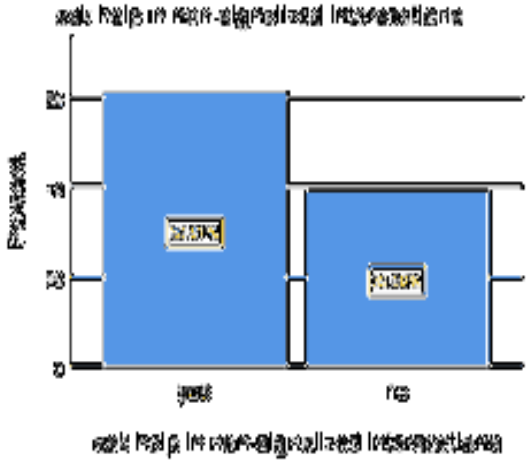
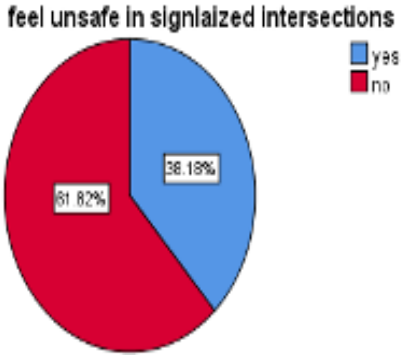


Figure 4.3.2.2 assistance in non-signalized

Crutch users, followed by wheelchair users, and then Orthopedic/prosthetic users, ask for help in an orderly manner in non-signalized intersections, implying that crutch users require more assistance from others in these types of intersections because car speeds are higher in these areas, and they can't wait for drivers to pass, which may take longer. Tessema (2017) also found that the majority of PWDs require assistance from others, including family members, when utilizing highways since they are inaccessible to them. Also, the majority of participants in this study noted that the importance of traffic policies, pedestrian policies, and student traffic policies in assisting them when crossing junctions, unless it would take them longer to pass.

4.3.3. Safeness in intersections

As intersections are not easily accessible for PWD and also behavior of pedestrians and drivers towards them these users feel more unsafe in intersections while crossing the road. signalized intersections are more chosen as safer than non-signalized intersections by respondents. Based on the figure below majority of them feel safer in signalized intersections and more of them feel unsafe in non-signalized.



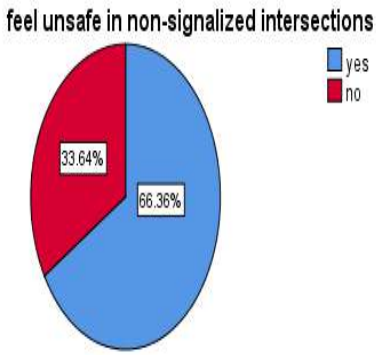


Figure 4.3.3.1 safety in signalized Figure 4.3.3.2 safety in non-signalized intersection

Different variables, such as road infrastructure characteristics and road user behavior, contribute to the lack of safety at intersections. As previously stated, their reasons for feeling insecure include: difficulty in accessing facilities, speed of cars, covered vehicles following others, unavailability of street light in some areas, awareness limitations on accessing facilities, and when traffic signals are not working or only give yellow light at night (early in the morning).

These feelings of insecurity are felt not just at intersections during crossings, but also throughout the road infrastructure, including sidewalks, as a result of the dread of traffic accidents and the lack of protection for them as a result of their need to utilize the roads. Based on their responses, they felt unsafe and decided to change the way they use roads, i.e. choosing times when there is less traffic to reduce their risk of an accident. Their perspective is correct because, according to Tulu et al. (2013), most traffic accidents occur during the daytime, which occurs during movement between home and work/school in the morning and afternoon, so choosing other hours for non-essential purposes may be good for PWD.

4.4. Accidents in intersections

One of the situations covered with participants in the questionnaire was if they had been involved in a traffic accident when using intersections, which 9.1 percent of them had. Eight of the victims of traffic accidents were male, while the other two were female. In

terms of age, nine of the victims were in the working age group, while the last one was a youth. This case can be shown from the perspective of following traffic rules and regulations such as using zebra crossings and passing in green time for pedestrians, though based on the above results these two variables, males and age groups in working age, do not follow traffic rules mostly in addition. Males and people in their working years are more likely to be involved in traffic accidents than others.in this case further this condition is true in Ethiopia context as pedestrian and even as a driver males aged 18-30 are victims of traffic accidents than others according to Tulu et al. (2013). Some of the reasons raised by victims of these type of traffic accidents was: speeding, not giving priority for pedestrians, covered car behind the other and lesser time for pedestrians in signalized intersections.

4.5. Behavior of drivers

Attitude of drivers towards to pedestrians which are PWD organized in this section by taking into consideration that they can give them priority, respecting them and giving time for to pass without interruption. Majority of respondents about 71 from the total responded that they have fair behavior but the rest 29 explained behavior of drivers is unfair for them these conditions plays its role in making intersections difficult place for PWD while crossing and to need help from others. Some of the reasons for claiming drivers as unfair are: unwillingness to give priority for pedestrians, greedy behavior and unrespect for pedestrians even insulting them and not having patience.

Drivers that are explained as having unfair behavior are mostly taxi drivers and young drivers by respondents which characterized by having speed, not giving priority for pedestrians and passing beside other cars without proper way or overtaking these conditions can be backed up according to Tulu et al. (2013) that males, in working age, truck and taxi drivers are responsible for traffic accidents than females also identified unfair behaviors of drivers speeding, improper overtaking and not giving priority for pedestrians are the major causes for road traffic accidents in Ethiopia.

4.6. Response rate of challenges faced by participants in intersections

Twelve challenges were identified based on observation, literatures and interviews as major problems faced by PWD while using intersections including signalized and non-signalized, these challenges were putted in Likert scale method to be rated by respondents also these challenges are for people with disabilities using different aid devices included in this research wheelchair, crutch and orthopedics/prosthetic. These problems create discomfort for the movement PWD and make mobility as a difficult task through their day to day activity plus made them to depend on other people top help them. The frequency of answers on challenges shown table and chart below expressively for each challenge also relative importance index (RII) calculated to rank the challenges based on respondents' response.

Problems	Extremely	Very	Moderately	Slightly	Not at all	Total
Pedestrians don't let to pass	31%	14%	27%	10%	18%	100%
Unavailability of curb ramps	46%	23%	13%	9%	9%	100%
Inappropriate structure of ramps	38%	27%	17%	10%	7%	100%
Narrow width of refuge islands	28%	25%	25%	9%	13%	100%
Unavailability of medians(refuge islands)	29%	30%	23%	10%	8%	100%
Unwillingness of persons to give support	5%	8%	21%	25%	42%	100%
Speed of cars in signalized intersections	27%	26%	23%	12%	12%	100%
Lack of pedestrian signals	24%	29%	24%	14%	10%	100%
Lack of signal that countdown	32%	26%	20%	12%	10%	100%
Unavailability of road hump	37%	22%	18%	11%	12%	100%
Wider crossing distance of roads	22%	24%	31%	18%	5%	100%
Speed of cars in non-signalized intersections	66%	26%	7%	0%	0%	100%

Table 4.6.1 Response rate of respondents

Speed of cars in non-signalized intersection, unavailability of curb ramps, structure of ramps is among challenges rated higher which is extremely and unwillingness of persons to give support pedestrians don't let to pass and narrow width of refuge islands are among challenges that have higher response rate which is not at all, means that these challenges have lesser impact. Graphically this phenomenon seen below.

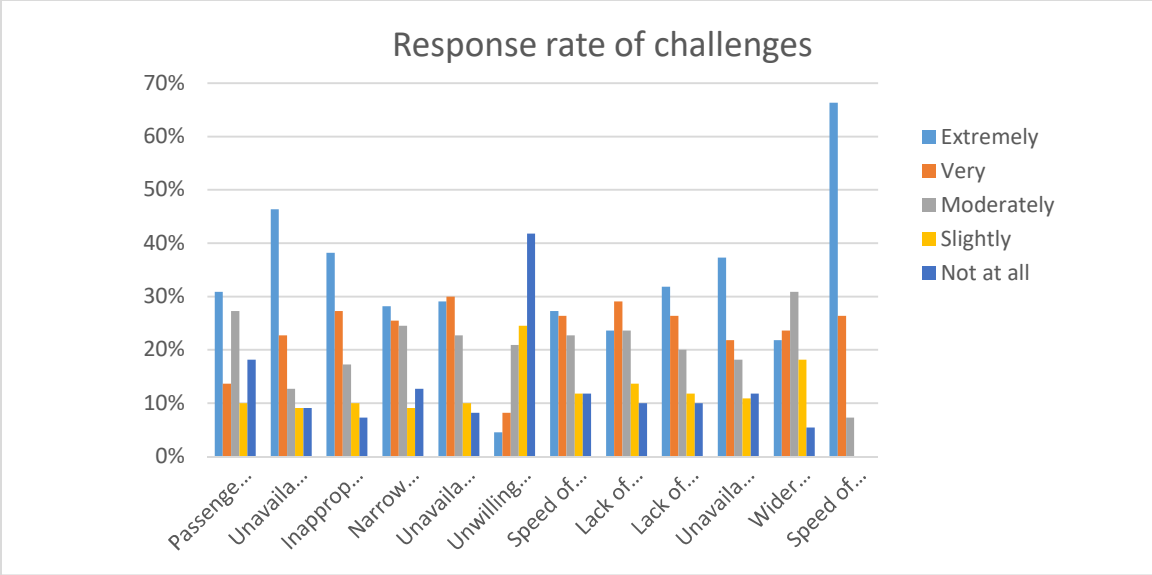


Figure 4.6.2 Response rate of respondents

4.6.1 Relative importance index (RII) for challenges

Using three steps RII for challenges based on frequency of challenges response rate is calculated. The first step shows actual response rate of challenges the second step shows value of each scales with multiplying respecting to their value lastly calculated RII and rank of challenges put.

Step 1: Response rate of challenges

Problems	Extremely	Very	Moderately	Slightly	Not at all	Total
Passengers don't let to pass	34	15	30	11	20	110
Unavailability of curb ramps	51	25	14	10	10	110
Inappropriate structure of ramps	42	30	19	11	8	110
Narrow width of refuge islands	31	28	27	10	14	110
Unavailability of medians(refuge islands)	32	33	25	11	9	110
Unwillingness of persons to give support	5	9	23	27	46	110
Speed of cars in signalized intersections	30	29	25	13	13	110
Lack of pedestrian signals	26	32	26	15	11	110
Lack of signal that countdown	35	29	22	13	11	110
Unavailability of road hump	41	24	20	12	13	110
Wider crossing distance of roads	24	26	34	20	6	110
Speed of cars in non-signalized intersections	73	29	8	0	0	110

Table 4.6.1.1 Response rate of respondents

Step 2: Response rate of respondents multiplied by each respective scale of value

Problems	Extremely	Very	Moderately	Slightly	Not at all	Total
Passengers don't let to pass	170	60	90	22	20	362
Unavailability of curb ramps	255	100	42	20	10	427
Inappropriate structure of ramps	210	120	57	22	8	417
Narrow width of refuge islands	155	112	81	20	14	382
Unavailability of medians(refuge islands)	160	132	75	22	9	398
Unwillingness of persons to give support	25	36	69	54	46	230
Speed of cars in signalized intersections	150	116	75	26	13	380
Lack of pedestrian signals	130	128	78	30	11	377
Lack of signal that countdown	175	116	66	26	11	394
Unavailability of road hump	205	96	60	24	13	398
Wider crossing distance of roads	120	104	102	40	6	372
Speed of cars in non-signalized intersections	365	116	24	0	0	505

Table 4.6.1.2 Response rate of respondents multiplied value

Step 3: RII calculated using formula by dividing calculated value in step two to A*N

Problems	E	V	M	S	N	Total	N	A*N	RII	Rank
Passengers don't let to pass	170	60	90	22	20	362	110	550	0.66	10
Unavailability of curb ramps	255	100	42	20	10	427	110	550	0.78	2
Inappropriate structure of ramps	210	120	57	22	8	417	110	550	0.76	3
Narrow width of refuge islands	155	112	81	20	14	382	110	550	0.69	7

Unavailability of medians(refuge islands)	160	132	75	22	9	398	110	550	0.72	4
Unwillingness of persons to give support	25	36	69	54	46	230	110	550	0.42	12
Speed of cars in signalized intersections	150	116	75	26	13	380	110	550	0.69	7
Lack of pedestrian signals	130	128	78	30	11	377	110	550	0.69	7
Lack of signal that countdown	175	116	66	26	11	394	110	550	0.72	4
Unavailability of road hump	205	96	60	24	13	398	110	550	0.72	4
Wider crossing distance of roads	120	104	102	40	6	372	110	550	0.68	10
Speed of cars in non-signalized intersections	365	116	24	0	0	505	110	550	0.92	1

Table 4.6.1.3 RII for challenges

Based on frequency of response rate for each challenge RII calculated from all of identified challenges thus the first challenge for respondents that occurs in intersections is speed of cars in non-signalized function followed by unavailability of curb ramps in intersections also the last ranked challenge which is faced by PWD in their movement is unwillingness of people to give support in intersections that means most of the time people have willingness to give support or assist them in intersections.

Speed of cars in Non- signalized intersections

The first challenge for PWD while using non signalized intersections is speed of cars, while the drivers are in hurry to pass the intersection and being in competition with each other

they will not give priority for the pedestrians specially PWD as they could take longer time for crossing the road. Also this case raised in references among one of the problem in signalized intersections. This condition will create accident with cars and also PWD, some of the ideas raised by respondents about this factor were: in non-signalized intersections most of drivers does not give priority for pedestrians and respect traffic rules, speed of cars is higher as there is no traffic signal that force them also taxi drivers are suspected more for these type of behaviors.

Among the common challenges in world also in Ethiopia major cause for traffic accident is speeding so this condition should take into consideration and be take care of to reduce loss happened by it and also to facilitate movement of PWD pedestrians. Tulu et al. (2013) speeding was reason for 45.9 % of fatal and injury traffic accidents in Ethiopia. Speeding as a factor is not only in non-signalized intersections also in non-signalized intersections, Addis Ababa non-motorized transport strategy (2018) proposed that reducing width of corner radii can minimize speed of vehicles in intersections and cause for speeding can be longer.

Unavailability and inappropriate structure of ramps

These ramp structures help the movement of subjects considered in this study specifically more for wheelchair users. Unless this facility built in the road crossing areas it could be difficult for wheelchair users also people with difficulty in movement. In the case of crossing areas in intersections this ramp facility should be obtained between pedestrian walkways and zebra crossings. Mostly in the city of Addis Ababa this aid structures are rare even if it is found the slope also the structure is not comfortable for the users. Previous researches also raised as this problem is common in the roads and being problem for PWD.

In the time of it is not available or properly structures wheelchair users forced to use side of main roads for vehicles because they can't easily enter and leave also use zebra crossings and walkways though this challenge may create risk for PWD using into facing traffic

accident, to take more time for crossing and difficulty in their movement. Respondents answered that because of this reason they choose to use side of asphalt than walkways.

Picture 4.6.1.1 Zebra crossing without ramp in AU

Picture 4.6.1.2 Uncomfortable curb ramp structure in Mikael

Picture 4.6.1.3 Medians (refuge islands) without proper ramp in Diaspora

Picture 4.6.1.4 Zebra crossing without ramp in Diaspora

Picture 4.6.1.5 Curb without ramp in shola

Picture 4.6.1.6 Crossing ramp filled with water in tikur ambesa

Road humps which can be in balanced with walkways helps for PWD as ramps are not found, it can be helpful for pedestrians with difficulty in movement as there is no up and down while they are crossing road.

Unavailability and narrow width of medians (refuge islands)

Medians or refuge islands helps for safety of pedestrians that are crossing the road to stay and wait until safe moment for them come to cross though this structures shall be in sufficient width to accommodate different types of passengers including PWD using aid devices like wheelchair. At the time of medians having narrow width it may not

accommodate fully the wheelchair also if the number of pedestrians crossing in one time is high so it may block somehow the traffic and creates congestion also stress for the users.

Medians can be used as refuge area for pedestrians also to separate vehicle movement from opposite directions also have its own contribution to traffic accident in Ethiopia Tulu et al. (2013). Addis Ababa non-motorized transport strategy (2018) explains uses of medians or refuge islands for facilitating movements in intersections and reduce lane width to vehicles for safe movement of road users. Providing medians with safe ramp and width to accommodate pedestrians crossing may help to minimize traffic accidents and loss of people lives happening because of unavailability or sufficiency problem of these facility.

Picture 4.6.1.7 Median without ramp and narrow without proper structure in Mikael

Picture 4.6.1.7 Blocked crossing with bollards needs maintenance in Ethio-China

Picture 4.6.1.8 Medians (refuge islands) without ramp in Diaspora

Picture 4.6.1.9 Medians (refuge islands) without ramp in Shola

Lack of Pedestrian Signal

Signals for pedestrian is useful for users as it is parallel to their direction and also more comfortable to see as the height or signs represent more for pedestrians. In the areas without pedestrian signals mostly pedestrians that are crossing doesn't give emphasis for the main signal as they thought it is for vehicles also the pedestrian signals could give more meaningful interpretation for pedestrians, by considering the above factors it can be said that it is important for pedestrians also the result of this study shows that.

In addition to pedestrian signal availability, counting pedestrian signal may have role for facilitating crossing of PWD as it shows them time left for them to cross the road by considering the available time they will decide to pass or not. But in the case of it is not found the green time may start before they finish crossing as they do not know time left, this condition creates stress on them.

Wider crossing distance

While crossing the road that have wider length this may be difficult for PWD with physical mobility problem as they should move faster also by seeing cars movements in intersections. This condition would be more difficult in areas where there are no traffic

signals because the speed of cars would be higher and having priority given by drivers to pass will be lower. At areas with wider crossing distance speed limit should be properly managed or traffic signals shall be introduced. These conditions are also supported by Addis Ababa non-motorized transport strategy (2018) which intersections with limited size of movements and lane width minimized improves traffic movements and slow speed of vehicles in intersections that has advantage to safe movement of users. Though it is known wider crossing distance cause stress, confusion and safety problem for pedestrians including PWD.

Picture 4.6.1.10 Unparalleled crossing in tikur ambesa

Pedestrians that don't let to pass

This challenge happens when there is more number of pedestrians passing the road at the same time therefore priority for PWD will be less as everyone is in hurry to pass so congestion among pedestrians happen though it will be difficult for PWD. unwillingness of people to help also another problem as there is more passengers are passing also in time of unavailability and un comfortability of ramps so understanding them and helping as possible should be made.

Picture 4.6.1.11 Uncomfortable ramp structure in mexico and taxi using zebra crossing

4.6.2 Relative importance index (RII) for challenges according to gender

Based on frequency of response rate for each challenge RII calculated for all of identified challenges according to gender then using weighted average method rank for challenges calculated thus the first challenge for respondents that occurs in intersections is speed of cars in non-signalized function and the least is unwillingness of people to give support which is faced by both genders of PWD in their movement.

Problems	RII Female	Rank Female	RII Male	Rank Male	WA	Rank
Pedestrians don't let to pass	0.64	11	0.66	10	0.66	11
Unavailability of curb ramps	0.76	2	0.78	2	0.78	2
Inappropriate structure of ramps	0.75	3	0.76	3	0.76	3
Narrow width of refuge islands	0.75	3	0.69	8	0.70	7
Unavailability of medians(refuge islands)	0.74	5	0.72	6	0.72	4
Unwillingness of persons to give support	0.34	12	0.44	12	0.42	12
Speed of cars in signalized intersections	0.66	10	0.70	7	0.69	8
Lack of pedestrian signals	0.68	8	0.69	8	0.69	8
Lack of signal that countdown	0.68	8	0.73	4	0.72	4
Unavailability of road hump	0.72	7	0.73	4	0.72	4
Wider crossing distance of roads	0.73	6	0.66	10	0.68	10
Speed of cars in non-signalized intersections	0.92	1	0.92	1	0.92	1

Table 4.6.2. RII for challenges according to gender

Narrow width of refuge islands, speed of cars in signalized intersections, unavailability of ramp and lack of signal that countdown and wider crossing distance of roads are challenges in intersections that have major different as a being challenge between male and female. Most of the listed above problems have more effect in males which is may be related to their travel frequency is more days in a week and mostly mode used for transportation is walking for them also researches studied that males have mobility higher than females.

4.6.3 Relative importance index (RII) for challenges according to aid device

Based on frequency of response rate for each challenge RII calculated for all of identified challenges according to aid device thus the first challenge for respondents that occurs in intersections is speed of cars in non-signalized function which is faced by all of PWD using wheelchair, prosthetic/orthopedic and crutch users in their movement.

Problems	RII for W	Rank for W	RII for C	Rank for C	RII for p/o	Rank for p/o	WA	Rank
Pedestrians don't let to pass	0.67	9	0.67	6	0.57	6	0.66	11
Unavailability of curb ramps	0.86	2	0.70	5	0.77	3	0.78	2
Inappropriate structure of ramps	0.82	3	0.70	5	0.75	4	0.76	3
Narrow width of refuge islands	0.70	7	0.72	3	0.57	6	0.69	7
Unavailability of medians(refuge islands)	0.75	4	0.72	3	0.63	5	0.72	4
Unwillingness of persons to give support	0.45	10	0.40	9	0.40	7	0.42	12
Speed of cars in signalized intersections	0.71	6	0.65	8	0.78	2	0.69	7
Lack of pedestrian signals	0.68	8	0.71	4	0.63	5	0.69	7
Lack of signal that countdown	0.73	5	0.72	3	0.63	5	0.72	4
Unavailability of road hump	0.70	7	0.74	2	0.75	4	0.72	4
Wider crossing distance of roads	0.71	6	0.66	7	0.63	5	0.68	10
Speed of cars in non-signalized intersections	0.94	1	0.90	1	0.92	1	0.92	1

Table 4.6.3. RII for challenges according to aid devices

Wheelchair users and orthopedics/pediatrics are more affected than crutches users in challenges related to ramp facility as their disability types needs more comfortable facility without up and downs also these problems are similar for crutch users but as their supporting device helps their movement than others. Regarding to unwillingness of people to give support for orthopedics/pediatrics as a challenge is lesser than the two because their

disability type needs lesser support from others but wheelchair users and crutch users may need support because of having lesser speed during crossing road and takes more time they need someone who stops vehicles to give priority for them.

4.6.4. RII for challenges according to travel frequency

Based on frequency of response rate for each challenge RII calculated for all of identified challenges according to travel frequency thus the first challenge for respondents that occurs in intersections is speed of cars in non-signalized function which is faced by most users having different travel frequency PWD in their movement.

Problems	RII for 1 day in a week	Rank for 1 day in a week	RII for 2-4 days in a week	Rank for 2-4 days in a week	RII for ≥5 days in a week	Rank for ≥5 days in a week	WA	Rank
Pedestrians don't let to pass	0.67	8	0.65	8	0.67	10	0.66	11
Unavailability of curb ramps	0.82	2	0.74	2	0.80	2	0.78	2
Inappropriate structure of ramps	0.77	3	0.74	2	0.78	3	0.76	3
Narrow width of refuge islands	0.68	7	0.64	9	0.77	4	0.69	7
Unavailability of medians(refuge islands)	0.69	6	0.70	3	0.77	4	0.72	4
Unwillingness of persons to give support	0.44	10	0.46	10	0.36	11	0.42	12
Speed of cars in signalized intersections	0.69	6	0.69	4	0.69	9	0.69	7
Lack of pedestrian signals	0.72	5	0.65	7	0.71	8	0.69	7
Lack of signal that countdown	0.77	3	0.67	5	0.75	6	0.72	4
Unavailability of road hump	0.73	4	0.69	4	0.76	5	0.72	4
Wider crossing distance of roads	0.62	9	0.66	6	0.72	7	0.68	10
Speed of cars in non-signalized intersections	0.94	1	0.92	1	0.91	1	0.92	1

Table 4.6.4. RII for challenges according to travel frequency

Narrow width of refuge island is more challenge for people having travel frequency lesser than five days in week which can be because of having lesser experience in crossing they could face unsafe feeling and fear as they are not protected enough by these infrastructures.

Lack of signal that countdown is stronger challenge for people having travel frequency one times in a week as they could not guess effective time for them to finish crossing the road based on their experience they need information to determine whether to cross or not with their remaining time. wider crossing distance is problem for pedestrians having more than 2 days' travel frequency in a week because energy required to finish crossing the road is redundant through the week and stress during crossing because of unsafety feeling is higher for them.

4.6.5 Relative importance index (RII) for challenges according to age group

As frequency of response rate for each challenge RII calculated for all of identified challenges according to age groups thus the first challenge for respondents that occurs in intersections is speed of cars in non-signalized function which is faced by most users having different travel frequency PWD in their movement.

Problems	RII for 0-14	Rank for 0-14	RII for 15-24	Rank for 15-24	RII for 25-64	Rank for 25-64	RII for ≥ 65	Rank for ≥ 65	WA	Rank
Pedestrians don't let to pass	0.52	11	0.68	8	0.79	2	0.60	8	0.74	4
Unavailability of curb ramps	0.68	8	0.78	2	0.79	2	0.60	8	0.78	2
Inappropriate structure of ramps	0.68	8	0.75	3	0.78	4	0.64	6	0.76	3
Narrow width of refuge islands	0.68	8	0.71	4	0.69	9	0.72	5	0.69	8
Unavailability of medians(refuge islands)	0.84	3	0.65	9	0.74	5	0.84	3	0.72	5

Unwillingness of persons to give support	0.28	12	0.43	12	0.44	12	0.24	12	0.42	12
Speed of cars in signalized intersections	0.84	3	0.70	6	0.69	9	0.48	11	0.69	8
Lack of pedestrian signals	0.84	3	0.65	9	0.70	8	0.56	10	0.69	8
Lack of signal that countdown	0.92	2	0.65	9	0.72	7	0.88	2	0.72	5
Unavailability of road hump	0.76	6	0.69	7	0.73	6	0.76	4	0.72	5
Wider crossing distance of roads	0.72	7	0.71	4	0.66	11	0.64	6	0.68	11
Speed of cars in non-signalized intersections	0.96	1	0.88	1	0.93	1	0.96	1	0.92	1

Table 4.6.5. RII for challenges according to age group

Youths are more affected by speed of cars in signalized intersections than other age groups as they fear of vehicles in speed may depend on their age also lack of pedestrian signal, countdown in signal and narrow width of refuge islands are similar cases as they need facility that make their movement safe and supportive for them. Pedestrians don't let to pass is major challenge for PWD in age group of working that is because of having more travel frequency than others and their wants to accessibility of transport facilities is stronger and organized from other experiences in addition to behavior of this groups could be different from others.

4.7. Difficulty in Accessing intersections

4.7.1. Difficulty in accessing intersections based on aid devices

By using one-way ANOVA, the hypothesis of that there is a difference in difficulty in accessing intersections or not between different type of aid device users included with in the research are checked.

Ho: no significant difference difficulty in accessing intersections among aid devices used

H1: significant difference difficulty in accessing intersections among aid devices used

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
Aid device used by respondents	110	100.0%	0	0.0%	110	100.0%
Difficulty in accessing intersections	110	100.0%	0	0.0%	110	100.0%

Table 4.7.1.1 summary of cases

Difficulty in accessing intersections

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly	7	6.4	6.4	6.4
	Moderately	20	18.2	18.2	24.5
	Very	42	38.2	38.2	62.7
	Extremely	41	37.3	37.3	100.0
	Total	110	100.0	100.0	

Table 4.7.1.2. difficulty in accessing intersections

Aid device used by respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Wheelchair	47	42.7	42.7	42.7
	Crutch	51	46.4	46.4	89.1
	Orthopedic/prosthetic	12	10.9	10.9	100.0

Total	110	100.0	100.0	

Table 4.7.1.3. aid device used by respondents

ANOVA

Difficulty in accessing intersections

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5.597	2	2.798	3.609	.030
Within Groups	82.958	107	.775		
Total	88.555	109			

Table 4.7.1.4. One-way ANOVA result

Post hoc test

Multiple Comparisons

Dependent Variable: Difficulty in accessing intersections

	(I) Aid device used by respondents	(J) Aid device used by respondents	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Tukey HSD	wheelchair	crutch	.476*	.178	.023	.05	.90
		orthopedic/prosthetic	.319	.285	.504	-.36	1.00
	crutch	wheelchair	-.476*	.178	.023	-.90	-.05
		orthopedic/prosthetic	-.157	.283	.844	-.83	.51
	orthopedic/prosthetic	wheelchair	-.319	.285	.504	-1.00	.36
		crutch	.157	.283	.844	-.51	.83
LSD	wheelchair	crutch	.476*	.178	.009	.12	.83
		orthopedic/prosthetic	.319	.285	.265	-.25	.88
	crutch	wheelchair	-.476*	.178	.009	-.83	-.12
		orthopedic/prosthetic	-.157	.283	.580	-.72	.40
	orthopedic/prosthetic	wheelchair	-.319	.285	.265	-.88	.25
		crutch	.157	.283	.580	-.40	.72
Games-Howell	wheelchair	crutch	.476*	.178	.024	.05	.90
		orthopedic/prosthetic	.319	.276	.495	-.39	1.03

	crutch	wheelchair	-.476*	.178	.024	-.90	-.05
		orthopedic/prosthetic	-.157	.277	.839	-.87	.55
	orthopedic/prosthetic	wheelchair	-.319	.276	.495	-1.03	.39
		crutch	.157	.277	.839	-.55	.87

*. The mean difference is significant at the 0.05 level.

Table 4.7.1.5. Post hoc test result

Interpretation

The ANOVA result based on report of SPSS shows that P values are less than the significant level determined 0.05 which is .03 < .05 therefore the null hypothesis is rejected and the alternate hypothesis i.e. significant difference difficulty in accessing intersections among aid devices used is accepted. By using the post hoc test result significant difference in which aid device is shown that is between wheelchair users and crutch users.

4.7.2. Difficulty on accessing intersections based on response on behavior of drivers

To test if there is a significant difference in value of difficulty in accessing intersections calculated from the major three identified challenges between response on behavior of drivers the following paired sample T-test was performed and result is shown below.

Ho: no significant difference difficulty in accessing intersections between response on behavior of drivers

H1: significant difference difficulty in accessing intersections between response on behavior of drivers

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
difficulty in accessing intersections	110	100.0%	0	0.0%	110	100.0%
behavior of drivers	110	100.0%	0	0.0%	110	100.0%

Table 4.7.2.1 case process summary

Difficulty in accessing intersections

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly	7	6.4	6.4	6.4
	Moderately	20	18.2	18.2	24.5
	Very	42	38.2	38.2	62.7
	Extremely	41	37.3	37.3	100.0
	Total	110	100.0	100.0	

Table 4.7.2.2 difficulty in accessing intersections

Behavior of drivers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Fair	71	64.5	64.5	64.5
	Unfair	39	35.5	35.5	100.0
	Total	110	100.0	100.0	

Table 4.7.2.3 behavior of drivers

Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Dev	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Difficulty in accessing intersections	2.709	.942	.090	2.531	2.887	30.168	109	.000

Table 4.7.2.3 paired sample test result

Interpretation

The paired sample T- test result based on report of SPSS shows that P values are less than the significant level determined .05 which is .00 < .05 therefore the null hypothesis is rejected and the alternate hypothesis i.e. significant difference difficulty in accessing intersections between response on behavior of drivers is accepted. Behavior of drivers by

respondents which is claimed as unfair plays role in challenge of speed of cars in non-signalized intersections that is why there is significant difference among response on behavior of respondents.

4.8. Ordinal logistic regression

This regression held under this title which is often called ordinal regression used to predict an ordinal dependent variable given one or more independent variables. It uses interactions between dependent variable and independent variables.

Dependent variable: difficulty in accessing intersections for PWD (1 = not at all, 2 = slightly, 3 = moderately, 4 = very and 5 = extremely), the following table shows information about the dependent variable.

Difficulty in accessing intersections

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	slightly	7	6.4	6.4	6.4
	moderately	20	18.2	18.2	24.5
	very	42	38.2	38.2	62.7
	extremely	41	37.3	37.3	100.0
	Total	110	100.0	100.0	

Table 4.8.1. result of difficulty in accessing intersections

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Difficulty in accessing intersections	110	2	5	4.06	.901
Valid N (list wise)	110				

Table 4.8.2. descriptive statics of difficulty in accessing intersections

Independent variables: aid devices (1= crutch,2= wheelchair, 3= orthopedic/prosthetic) and behavior of divers (1 = fair, 2 = unfair).

Aid device used by respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Wheelchair	47	42.7	42.7	42.7
	Crutch	51	46.4	46.4	89.1
	Orthopedic/prosthetic	12	10.9	10.9	100.0
	Total	110	100.0	100.0	

Table 4.8.3. frequency of aid device users by type

Behavior of drivers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Fair	71	64.5	64.5	64.5
	Unfair	39	35.5	35.5	100.0
	Total	110	100.0	100.0	

Table 4.8.4. frequency of response on behavior of drivers

There are four assumptions for applying this model, which are:

1. Dependent variable should be measured at ordinal scale.
   - In this case the dependent variable is also in ordinal scale.
2. Independent variables should be continuous, ordinal or categorical.
   - This assumption is met as the independent variables listed above fell under this category.
3. There is no multi collinearity among independent variables.
   - Assumption of multi collinearity checked as using Spss as shown the table below and it passes the test as the calculated VIF (variance inflation factor) are in accepted range between 1 and three which is one.

Coefficients

Model	Collinearity Statistics	
	Tolerance	VIF
Behavior of drivers	1.000	1.000

Dependent Variable: Aid device used by respondents

Table 4.8.5. multi collinearity test

4.There have to be proportional odds.

- This is going to be calculated later but for now recognized as the assumption is met.

Case Processing Summary

		N	Marginal Percentage
Difficulty on accessing intersections	Slightly	7	6.4%
	Moderately	20	18.2%
	Very	42	38.2%
	Extremely	41	37.3%
Behavior of drivers	fair	71	64.5%
	unfair	39	35.5%
Aid device used by respondents	wheelchair	47	42.7%
	crutch	51	46.4%
	none	12	10.9%
Valid		110	100.0%
Missing		0	
Total		110	

Table 4.8.6. case processing summary

Interpretation

The above listed table describes about variables included in the model and their value, the dependent variable measured in a scale from slightly, moderately, very and extremely which their number is 7,20,42 and 41 respectively. The independent variable behavior of drivers scaled with fair and unfair, 71 and 39 respectively and the other independent variable is aid devices used by respondents. The total number of observation which are included in the model are 110 there is no missing value which is not included.

Parameter estimates

Parameter Estimates

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Threshold	[difficulty = 2]	-3.179	.702	20.499	1	.000	-4.556	-1.803
	[difficulty = 3]	-1.582	.616	6.586	1	.010	-2.789	-.374
	[difficulty = 4]	.217	.596	.132	1	.716	-.952	1.386
Location	[Behavior=1]	-.801	.384	4.357	1	.037	-1.553	-.049
	[Behavior=2]	0[a]	.	.	0	.	.	.
	[Aid=1]	.781	.605	1.662	1	.197	-.406	1.967
	[Aid=2]	-.278	.592	.221	1	.639	-1.439	.882
	[Aid=3]	0[a]	.	.	0	.	.	.

Link function: Logit.

a. This parameter is set to zero because it is redundant.

Table 4.8.7. parameter estimates

Interpretation

The following listed variables are considered as referential variable for its own specific group which are orthopedic/prosthetic user, responded fair to the behavior of drivers are referential to crutch user and wheelchair user, responded unfair to the behavior of drivers respectively.

As the estimate value is – .278 shows crutch users are lesser affected by difficulty of accessing intersections than orthopedic/prosthetic users and .781 shows wheelchair users are more affected by difficulty of accessing intersections than orthopedic/prosthetic users. In the case of response to the behavior of drivers' respondents that thought the behavior of drivers is fair face less difficulty than it is unfair.

Serial no	Types of variable	Estimate	Exponential value
1	Wheelchair user	.781	2.19
	Crutch user	- .278	0.76
	Orthopedic/prosthetic user	0	1
2	Fair	-0.801	0.45
	Unfair	0	1

The above table explained as wheelchair users faces difficulty of accessing intersections 2.19 times more than Orthopedic/prosthetic user, Crutch user faces difficulty of accessing intersections 0.76 times lesser than Orthopedic/prosthetic user. PWD who thought drivers' behavior is fair faces difficulty in accessing intersections 0.45 times lesser than who thought it is unfair.

The significance value shows that there is significance between the variable towards the challenge if it is less than determined value .05. The P value for behavior of drivers is less than determined significance level 0.05 therefore it is significant to the model.

Model fitting information

Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	67.026			
Final	54.486	12.540	3	.006

Link function: Logit.

Table 4.8.8 model fitting information

Interpretation

Significant value must be less than 0.05 then reject null hypothesis, in this case it is .006 less than determined and reject null hypothesis i.e. rejecting null hypothesis which is no significant difference between baseline model to final model, accept that there is significant difference. The baseline model is without any independent and final model is with all possible independent variable.

Goodness of fit

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	13.689	12	.321
Deviance	15.821	12	.200

Link function: Logit.

Table 4.8.9 goodness of fit

Interpretation

Pearson and deviance values must be greater than .05 significance value determined, so in this case both values met the assumption, these fit tests means that the absorbed data is consistent with the fitted model and accept null hypothesis. Null hypothesis describe that the observed data is having goodness of fit with the fitted model.

Pseudo R-square

Pseudo R-Square

Cox and Snell	.108
Nagelkerke	.118
McFadden	.047

Link function: Logit.

Table 4.8.10 pseudo R-square test

Interpretation

This condition means that R- Square indicates the proportion of the variance explained by the independent variables on the dependent variable in the regression model. Different explanations given by different references about the values shall be during ordinal logistic regression. The value of three will be between o and 1 as seen in the above.

Test of parallel lines

Test of Parallel Lines[a]

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	54.486			
General	47.221	7.264	6	.297

The null hypothesis states that the location parameters (slope coefficients) are the same across response categories.

a. Link function: Logit.

Table 4.8.11. test of parallel lines

Interpretation

It is proportional odds assumption in Spss which is main assumption for ordinal logistic regression. The significance value must be greater than 0.05, if the sig value satisfies this condition, reject the null hypothesis which means location parameters are not same across response categories also the above case with having p value .297 > .05 null hypothesis rejected so the main assumption for the model is checked and pass.

4.9. Interview Results

4.9.1. Interview one

Background information about interviewee

Characteristic	Description about interviewees	Frequency
Age	25 – 64 years	7
Travel frequency	2 – 4 days in a week	7
Frequent place of movement	Religious, School and market places	7
Gender	Male	3
	Female	4
Employment status	None	4
	Retired	3

Table 4.9.1 Background information about Interviewee

Female participants were mother of child's that have difficulty in moving, interview with them have been held to understand how crossing intersections going in their cases, asking their mothers is needed because most of their movement is with their mom's plus they carry them in their back, also the child's can't explain well about the problems and considering them in this research is needed as they are also victims.

Based on discussion with participants the following information is organized. In considering signalized and non-signalized intersections the signalized ones are better for them as it gives space and time for pedestrians with giving concern for drivers about pedestrians. According to their response in using non signalized intersections they need support from other also student traffic policies, traffic policies and also drivers as there are drivers does not give priority for them to cross, wait for minutes to have opportunity to cross and fear of passing cars but in the case of signalized intersections these cases are minimized. Majority of them responded that time given to pass in traffic signals are sufficient for them but sometimes more time may have needed if child's walk by their own.

Regarding to challenges they face in intersections speed of cars, unavailability and not proper structured curb ramps, not having priority in non-signalized intersections, pedestrians number crossing once if it is more, unavailability of leveled structure in medians (refuge islands), medians width and unavailability, height difference between zebra crossing and medians are main challenges. Additionally, some of them raised attitude of drivers as a problem while using intersections because of not giving priority to cross, treat with unfair behavior, insult them for not passing quickly also drunk driving and speeding.

4.10. Common Identified Challenges

Based on site visit done in the listed intersections the following challenges that can be difficulty for PWD are identified, common challenges which found in most of intersections are narrow width of medians, not having ramp structure at all and with un proper ramp in medians which creates difficulty for them specially for wheelchair users, lack of availability of ramp in zebra crossing which is in determined crossings areas for pedestrians at intersections there is height difference between pedestrian walkways and crossings then crossings to medians which does not have ramp structure at same time not treated by road hump this can be a great challenge for users to use zebra crossings effectively also with having comfortable flat area can serve as ramp filled with water at rainy seasons. Even if zebra crossings have enough width to accommodate passing pedestrians most of zebra crossings in intersections were faded and not easily seen. Another common problem in signalized intersections were even if the facility for pedestrian signal were put but it was not working, also signals that can count were not counting time left to pass for pedestrians. Also in addition to above challenges number of pedestrians crossing at one time as high it creates complexity for PWD. They are facing these challenge in their activity though this could be reason for poor usage of zebra crossing, happening of accidents in the time they choose to use for crossing which having lower steepness but not safe for crossing also creates traffic congestion as the movement of passengers for crossing is not only in determined places rather any place they want. Beside above identified challenges at the ramp area connecting pedestrian walkways and zebra crossing in one side taxi uses as

loading passenger's area also vendors using crossing facility blocks passage of pedestrians and created some sort of difficulty in traffic.

Additionally, other challenges identified in common were now a times the medians divided by small poles shown above in the pictures, these poles have been crushed by traffic accidents and blocked the ramp area for PWD also the width between two consecutive poles should be properly taken into consideration as some of them are very narrow not comfortable for different type of aid user PWD easily. Also this poles block efficient movement of pedestrians in refuge islands.

4.11. How to solve challenges for PWD in intersections?

This part organized from response collected from participants on how the problems they are facing in intersections can be solved most of them thought as infrastructures must be modified by responsible government body also implementation of traffic rules and regulations on drivers should be strong according to giving priority for pedestrians and speed of vehicles, awareness creation program for people in charge of construction of roads to feel about challenges of PWD and make improvement on the environment, designing and constructing to fulfill accessibility for all, fast response shall be given for comments raised by representatives of PWD, respecting traffic rules and regulations by road users and forcing them by different mechanisms to follow it, drivers' attitude changes for taking care of their and other road users life, improvement on timing given for crossing at traffic signals. In addition to above points raised by respondents for solving challenges faced by PWD in intersections specifically and other road infrastructures the following can be way: always taking people living with disability into consideration is needed during designing and building road infrastructures, roads that were built before which are uncomfortable for people living with disability their quality should be improved, more studies on this area and finding more solutions are must in the future, government agencies of different bureau should work with collaboration during building road, taking actions on illegal traders using the pedestrian walkway, removing obstacles and building standard road facilities.

CHAPTER FIVE

5. Conclusion and Recommendation

5.1 Conclusion

Even though there are a number of policies that support PWDs, such as the constitution and infrastructure plans for the transportation sector, which consider accessibility issues in universal accessible standards, the implementation needs more work because it lacks proper enforcement and monitoring, which is why we are seeing challenges that can determine movement and back them up in various activities. According to BOLSA (2017), inaccessible infrastructures have made life tough for PWD in Addis Ababa, despite the fact that it harms their livelihood and contributes to the country's development. Comfortable road infrastructures contribute to society's quality of life, can facilitate a sense of ownership among all members of society, including PWD, increases inclusiveness in society, creates opportunities for people with disabilities to participate in various political, economic, and socioeconomic activities, and also builds the psychology of people with disabilities to move around the country for various purposes.

Some identified challenges or causes for incorporating PWD necessities in built infrastructures by making accessible facilities for their movement are: not defining (knowing) exact location of zebra crossings in designing stage as a result curbs will not be cut and ramps not constructed and changing location of zebra crossing which were determined in designing stage, not implementing as it is proposed in design phase (deviation from the design), not taking accessibility (inclusiveness) as a major issue by stakeholders in construction process of the facilities, lack of study and information on facilities accessibility problem for PWD that show them its effects also showing existing challenges for them by the bureaus, lack of awareness about policies supporting accessibility issues in road construction, not proper follow up in how well the policies are implemented, safety studies done by responsible transport bureau more focuses on crush studies not giving important attention for accessibility of facilities (comfortability) for PWD, these construction of facilities is worked by jointly and independently between

transport bureaus in the city like AACRA and TPMO so it lacks continuity (similarity) on different intersections in the city, and lacks of fast maintenance in facilities that are damaged and not functional because of it is done by third party by reconstructing so in time of finding and giving contract for some period of time for that body it creates gap. Therefore, all responsible bodies engaged in designing and constructing process of road facilities specifically intersections are responsible for making facilities accessible for PWD also policies designed to inclusiveness should be forced to be implemented likely PWD federations have to ask government and transport bureaus continuously by making this issue as one of their working area for achieving accessibility.

Intersections are one of infrastructures in the road that creates unsafe feeling for pedestrians as the facilities are not properly designed and built by taking into different type of road users including PWD with different type of impairment, children and old people. Unless the structures of facilities are comfortable and vehicles using it are not speedy crossing intersections could be stressful moment specially for PWD. In this study by identifying different challenges at intersections for PWD respondents asked how they feel on signalized and non-signalized intersections, 38.2 % of respondents feel unsafe while using signalized intersections the rest 61.8% feel safer in it but in the case of non-signalized intersections 66.4% feel unsafe and rest 33.6% feel safe as their response was they will take care of their selves and did not expect priority from drivers. The reasons for feeling insecurity at intersections depends on speed of cars, accessibility of intersections for PWD with different aid type, availability of traffic polices or other facilitators, functionality of traffic signals and also improper movement of vehicles. Regarding because of this safety problem and challenges it may make them to ask help from others while using intersections, majority of respondents said that they ask help from others in accessing in both signalized and non-signalized intersections but the case is higher in the second type.

Another issue that must be taken into account regarding to intersections is accessibility for all type of road users including PWD, in this research majority of respondents 75.5% responded that they don’t think the intersections in the case of Addis Ababa are not accessible for all, these can be related to the problems or challenges identified based on

site visit as the defects in infrastructures affect accessibility of facilities also creates feeling that they are not treated well during planning and construction of roads or as they are excluded groups. In addition to safety and accessibility issue explained above, challenges in intersections has part in facing traffic accidents in that areas, 9.1% of respondents responded that they faced traffic accident while using intersections with having different causes but as their response drivers were responsible for to happen it. Also other issue that were raised was crossing time sufficiency, 33.6% of respondents respond that green time given for them is not sufficient, 64.5% time is sufficient for them but the rest says that it is more than enough. In addition to those factors 35.5 % of respondents think as behavior of drivers is unfair so even if 65.5% think as the driver's behavior is fair drivers have to work on themselves.

Challenges identified in intersections creates impairment for PWD with physical movement limitation are the following according to their rank Speed of cars in non-signalized intersections, Unavailability of curb ramps, Inappropriate structure of ramps, Unavailability of medians (refuge islands), Lack of signal that countdown, Unavailability of road hump, Narrow width of refuge islands, Lack of pedestrian signals, Speed of cars in signalized intersections, Wider crossing distance of roads, Passengers don't let to pass and Unwillingness of persons to give support. According to age, gender, travel frequency and aid devices used the rank had been done which is seen slight difference.

Identified challenges can be organized to two categories infrastructural challenges and traffic behavioral challenges, infrastructural challenges include unavailability of curb ramps, Inappropriate structure of ramps, Unavailability of medians (refuge islands), Lack of signal that countdown, Unavailability of road hump, Narrow width of refuge islands, Lack of pedestrian signals and Wider crossing distance of roads, and traffic behavioral challenges are speed of cars in non-signalized intersections, Speed of cars in signalized intersections, Passengers don't let to pass and lack of willingness of persons to give support. More impact can be identified for infrastructural challenges as their rank is in first places than traffic behavioral challenges specific to being challenge for PWD while accessing intersections. Speed of cars and not giving priority for pedestrians also may have

role in changing life style of people living with disability because they worry about themselves and choose to stay home to protect themselves also may change time they want to access the road, one of the participant said that he would not use the road any time he wants rather he choose when traffic number is less. Evaluation on intersections taken to existence of facilities accessible to people with disability observed that lack of and improper structure of ramps in medians and curbs, less visibility of zebra crossings, width of medians and their availability, not working pedestrian signals and lack of supportive devices may help to PWD are the common challenges observed in intersections at study area. These challenges can be solved by proper planning and construction of intersections by taking into consideration PWD and also reconstructing inaccessible intersections, maintenance and follow-up on intersections additionally implementation of traffic rules and regulations regarding to speeding and giving to priority for pedestrians shall be strong in order to create accessible intersection for all, to avoid feeling of being excluded on PWD in intersections, to make them secure and reduce traffic accidents.

There is a significant difference in difficulty of accessing intersections between users of different aid devices which are orthopedics/prosthetic, wheelchair and crutch and also same result observed between behavior of drivers and difficulty in accessing intersections. Based on calculation of ordinal logistic regression crutch users are lesser affected by difficulty of accessing intersections than orthopedic/prosthetic users and wheelchair users are more affected by difficulty of accessing intersections than orthopedic/prosthetic users. The significant variable to the model is behavior of drivers with the calculated value of significance level even it doesn't means type of aid device used by may not have part in difficulty of accessing intersections.

5.2 Recommendation

Creating safe environment on movement of PWD shall not be only left to responsible body of government rather every individual have to play its role as the challenges they face on intersections not only focus on infrastructural challenges but also traffic behavioral challenges. Responsible government body shall plan, construct, do maintenance and improve signalized and non-signalized intersection by taking them into consideration well also works to implement traffic rules and regulations governing drivers at intersections plus improve follow-up implementation of rules for speeding and drunk driving. Additionally, the following concepts shall be applied: Having discussion with stakeholders responsible for representing PWD in construction as well as designing facilities shall be done correctly, as an individual or as a group or by their bureaus PWD should ask and take their challenge for respective transport bureaus about accessibility for them, strategies that help to implement designed policies in to the ground should be done, different stakeholders in design and construction process should be in the page to work about accessibility (inclusiveness) issue with having similar concern, awareness creation should be worked more for the stake holders engaged in road planning, designing, construction and maintenance, transport bureaus that are responsible of constructing these facilities should have a team under their specific unit that studies and examines accessibility of constructed roads under them and how it can be modified, safety studies done by TPMO also should give proper attention for accessibility(inclusiveness) case also. As an immediate intervention ramps can be used which are portable in intersections also in transport modes to give access for PWD. Also drivers should give priority for pedestrians specially PWD in non-signalized intersections and also in signalized intersection if their crossing time is not enough for them with respecting them. Pedestrians should help as their support needed by PWD during crossing intersections and also give them priority and enough space at areas with higher number of pedestrians that cross rather than crossing without considering them. NGO's working on empowerment of PWD in their economic, social and educational capacity should collaborate and work with government in making accessible intersections for them as their movement be must be safe and comfortable to be involved well in activities of economic, social and to become successful unless empowerment of PWD

could be eliminated. Technologic institutions shall also design and develop easy to use, not expensive and simple ramp facility that can be installed in intersections.

For future researchers in the following areas can be worked, challenges faced by PWD with sight impairment and hearing impairment in intersections, crossing time model for PWD in signalized intersections and technologies to improve safety of people with disability as pedestrians.

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APPENDIX ONE

Addis Ababa Institute of Technology

School of Civil and Environmental Engineering

Department of Road and Transport Engineering

Dear respondent, the objective of this study is to assess challenges faced by pedestrians that are living with disability at signalized and non-signalized intersections for the partial fulfillment of MSc degree in Road and Transportation Engineering. Any information you provide will be held in strictest confidence and be used for academic purpose only. Thank you!

Part one: Background information of participants.

1. Gender

   Male ☐ Female ☐

2. Age

   ≤14 (children) ☐ 15-24 (Youth) ☐ 25-64 (Working age) ☐

   65 & older (elderly) ☐

3. Educational background

   Illiterate ☐ elementary ☐ high school ☐

   college & above ☐

4. Employment status

   Employed ☐ unemployed ☐ student ☐

5. Monthly income

   1100-5000 birr ☐ 5000 – 10000 birr ☐ 10000-15000 ☐

6. what type of transportation you use mostly?

   Private car ☐ public transportation ☐ walking ☐

Part two:

1) what are the existing challenges you face at signalized intersections? Please rate them.

Problems	**E**	**V**	**M**	**S**	**N**
Pedestrians don't let to pass (according to more number of them)					
Unavailability of curb ramps					
Inappropriate structure of ramps					
Narrow width of refuge islands					
Unavailability of medians(refuge islands)					
Unwillingness of persons to give support (according to pedestrians)					
Speed of cars in signalized intersections (considering to not giving priority for pedestrians)					
Lack of pedestrian signals					
Lack of signal that countdown					
Unavailability of road hump					
Wider crossing distance of roads					
Speed of cars in non-signalized intersections (considering to not giving priority for pedestrians)					

N = Not at all, S = slightly, M= Moderately, V = Very, E = Extremely

- How much you estimate crossing time given for you in signalized intersections?

  Too much ☐ About Right ☐ Too Little ☐

- Do you think traffic signals & compound around them accessible also comfortable for you?

  Yes ☐ No ☐

- Are there any challenges you face at signalized intersections in addition to the above listed?

  …….

- Are there any challenges you face at non-signalized intersections in addition to the above listed?

  …….

Part three: Generalized questions

1. How often do you travel?

   Once in a week ☐ 2-4 days in a week ☐ ≥ 5days in a week ☐

2. In what type of place, you travel frequently?

   School ☐ Market places ☐ Recreational area ☐

   Religious & Health centers ☐

3. When do you cross at signalized intersections?

   Green time for pedestrian ☐ any tim ☐

   If you choose any time why? …….

4. Where do you cross the road at signalized intersections?

   Any plac ☐ zebra crossin ☐

   If you choose any place why? …….

5. Where do you cross the road at non-signalized intersections?

   Any plac ☐ zebra crossin ☐

   If you choose any place why? …….

6. How you Characterize behavior of drivers while you cross intersections taking into consideration how they act and giving priority also respect for pedestrians specially you?

   Fair ☐ Unfair ☐

7. Do you ask help from others during you cross signalized intersections?

   Yes ☐ No ☐

8. Do you ask help from others during you cross non-signalized intersections?

Yes ☐ No ☐

9. Do you feel unsafe while you cross signalized intersections?

   Yes ☐ No ☐

10. Do you feel unsafe while you cross non- signalized intersections?

    Yes ☐ No ☐

11. Had you ever faced an accident while you cross intersection?

    Yes ☐ No ☐

    If your answer is yes, what was it?.....

12. What do you think how the problems in intersections can be solved?

APPENDIX TWO

Checklist for Signalized Intersection

Date …… Place …….

Facility	Available	Not available	Remark
Curbs			
Raised channelized island			
Channelized island without ram			
Curb ramp			
Visibility of signal			
Sound of signal (audible)			
Counting signal			
Sufficient crosswalk width			
Availability of zebra crossing			
Clear zone			
Detectable warnings			
Pedestrian signal			
Aid devices			
Road hump			
Pushbutton feature			

APPENDIX THREE

Checklist for non-signalized intersection

Date …… Place …….

Facility	Available	Not available	Remark
Curbs			
Raised channelized island			
Channelized island without ramp			
Curb ramp			
Sufficient crosswalk width			
Availability of zebra crossing			
Clear zone			
Road hump			

APPENDIX FOUR

Interview for official

1. By what type of standard traffic signals are made?
2. Does the traffic signals in all places has similar characteristics?
3. Do you think the traffic signals in intersections and non-signalized intersections are inclusive?
4. By what method the intersections are evaluated to know its accessibility for disabled pedestrians?
5. Do disabled pedestrians informed and participate during installing signalized intersections?
6. Does the green phase allocate time for pedestrians is sufficient for disabled pedestrians also?
7. What type of problems exist in intersections for disabled pedestrians?
8. What do you think how the problems can be solved?
9. Did any organization or people raised question or asked formally about the problems?