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AN INVESTIGATION ON SAFETY, COMFORT AND CONVENIENCE OF PEDESTRIAN IN ADDIS ABABA: A CASE OF ARTERIAL STREET'S SIDEWALKS

BY

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JUNE, 2020

ADDIS ABABA, ETHIOPIA

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A Thesis Submitted to the School of Graduate Studies of Addis Ababa University, Ethiopian Institute of Architecture, Building Construction and City Development (EiABC), in Partial Fulfilment for Master's Degree in Urban Planning

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This thesis is submitted to the Ethiopian Institute of Architecture, Building Construction and City Development (EiABC) and to the school of graduate studies of Addis Ababa University in partial fulfillment of the requirements for the degree of Master's of Science in Urban Planning.

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Declarations

I, the undersigned, declare that this thesis is my own original work and has not been presented for a degree or diploma in any other university or institution and all sources of materials used for the thesis have been duly acknowledged, following the scientific guidelines of the Institute.

Addis Ababa

June, 2020

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Confirmation

The thesis can be submitted for examination with my approval as an Institute`s advisor.

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Signature Date

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Abstract

All major cities including Addis Ababa experience heavy pedestrian flows. Because of the shortage of satisfactory sidewalks, pedestrian roadways are often difficult to walk on. Since pedestrians are more vulnerable than other mode users, the primary objective of this research is to develop an understanding of the root cause to safety, comfort and convenience problems while using sidewalks, using pedestrian level of service and user rating methodology. Sidewalks play an essential role in transportation. Sidewalks deliver an isolated safe route for people to walk along a separated trail from motorized traffic movement. Instead of taking traffic flow operation as the assessing standard for pedestrian comfort convenience and safety, this research has studied the methods of assessing pedestrian level of service by analyzing both the pedestrian's subjective perceptions and objective quality of the service. This study has used two types of PLOS methods, the Australian method and the Highway Capacity Manual integrating with both objective measurement and subjective assessment. The study also uses sidewalks with street vendor activities on them. The presence of street vendors along the sidewalk is neutrally considered, neither unimportant nor important. Their existence is noted because of the negative impact they may have on the available space for walking. The subjective assessment is mainly based on the user's rating of pedestrian amenities using 821 individuals in 21 selected sidewalks in order to identify the perception of users for that designated segment. The objective measurement was taken in 21 selected sidewalk parts that are located throughout the city of Addis Ababa in order to identify the service level by fulfilling all the affecting factors required by the two PLOS methods. The results of the study indicate that both the PLOS and the perception assessment describes the studied sidewalks similarly with problem caused by vendor activities, pedestrian volume, and the number of pedestrian who interact with street vendors along with the shortcoming of the street network and sidewalk infrastructure in the form of physical and user characteristics. In order to generate

the necessary elements on the sidewalk, this study recommends focusing on the enormous pedestrian demand based benefits that would derive for more increased walking. The results of the study provide a significant information for interpreting the aspects of the walking environment that mainly influences the PLOS. This information can help city planners to prepare new strategies, policy interventions that enhance the quality of sidewalks and thus making the city more walkable.

***Key Words**: Safety, Comfort, Convenience, Sidewalk, Pedestrian Level of Service, Street Vending.*

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ACRONYMS

AACRA: Addis Ababa City Road Authority

AASHTO: American Association of State Highway and Transportation Officials

AAC TPMO: Addis Ababa City, Transportation Program Management Office

RTA: Road Transport Accident

HCM: Highway Capacity Manual

LOS: Level of Service

PLOS: Pedestrian Level of Service

iRAP: International Road Assessment Program

LRT: Light Rail Train

TPMO: Transportation Program Management Office

WHO: World Health Organization

CHAPTER ONE

1. INTRODUCTION

1.1. Background of the Study

Historically, walking was the most common mode of travel due to the short distances required. Cities of long-ago were small, circular and compact providing a five kilometer or less distance to travel (Lawrence et al. 1995). A fast growth in the metropolitan areas and the high growth of population in cities in the previous century converted the trend and motorized transportation became the dominant mode. This left the world with the vast challenge of congestion and carbon emissions making pedestrian travel harder. In the US, street design and development have included a standard with an introduction of unrestrained use of automobiles. Even though these standards prove to denounces the quality of pedestrian roads in the country, other administrations have adopted them (Neary, 1998). This type of automobile first action has been spreading in the world. Pedestrians have been seen as an obstacle to the motor transportation mode and were forced to be evicted and the sidewalk features were compromised to be dependent on the volume of car traffic (Japan Bicycle Promotion Institute, 1999).

Professionals in the urban planning field have tried to encourage citizens to change their mode choice to non-motorized instead of highly used motorized mode choices (Saelens et al., 2003; Owen et al., 2004; Townsend and Zacharias, 2009). In order to stimulate walking as a preferred mode of travel, it is vital to provide safe and adequate pedestrian travel areas. Soltani and Allan. (2006), in a study of travel forms among dwellers of urbanized areas in areas in Adelaide, Australia, the suburban design character and development patterns could possibly produce changes in modal split.

discussed that, in order to attain walkable cities in the US, it was suggested to: first evaluate conditions of walkability, secondly reread all the regulations and standards, and then research the walking habits in various settings and next step is to stimulate community awareness and obtain their contribution to pedestrian planning finally, encourage collaboration of interdisciplinary education within concerned fields and professions (Southworth, 2005).

Addis Ababa is the capital of the Federal Democratic Republic of Ethiopia and also the seat of the African Union. Some call the city the political capital of Africa. As a consequence, many international and governmental establishments are located in the city. Addis Ababa is not just the political capital but it is also the country's commercial hub.

Ethiopia has recorded rapid economic development in the past decade. Being the economic and political capital of the country, Addis Ababa has also shown massive growth in all perspectives. Addis Ababa has a low population of vehicles compared to cities in developing countries with equivalent population size and also possesses the highest rate of motorization. From 2012/2013 to 2014/2015 (2005 to 2007 Ethiopian Calendar (E.C.)), each year motor vehicle population has registered an average increase of 4.5%. To gear up the economic growth and to cope with the motorization rate, many new roads have been built and the existing roads have been improved. According to Addis Ababa City Road Authority (AACRA) the road coverage in the City reached 20%. And the fact that AACRA followed the ASSHTO which focused on motorized transport, all the infrastructure was planned, designed and constructed without good consideration of pedestrian road users and non-walking activities on the sidewalk.

Since the Addis Ababa City Road Authority (AACRA) formed road planning and designing and construction has been strictly driven from the ASSHTO, more motor based transportation has been adopted into the AACRA standards. This standard supports the development of motorized

infrastructures and urban road construction. AA's roads have been designed for the comfort, safety and convenience of motorized transportation. Less consideration is given to those on foot, even though foot traffic is the highest mode of transportation in the city (AACRA, 2010).

There has been some improved focus on pedestrian travel, but the improvements are not as significant as they need to be. Currently, improved pedestrian based urban transportation systems are being considered so both pedestrian and motorized road users can harmoniously coexist in cities.

The World Health Organization (WHO, 2009) estimates that the African region has the highest Road transport accident (RTA) mortality rate in the world (24.1/100,000 populations vs. 10.3/100,000 in Europe) and 38% of the deaths occur to the vulnerable road users (i.e. cyclists and pedestrians). Furthermore, estimations in Ethiopia show fatality or seriously injured following RTAs are thirty times greater than that of the United States of America.

Addis Ababa, with a population estimated at four million or above, is the largest urban center in Ethiopia. Recently, road traffic crashes, particularly pedestrian crashes have become a challenging problem within Addis Ababa. Addis Ababa has a high proportion of pedestrian casualties. This is due to a combination of very high pedestrian activity and very low levels of pedestrian safety protection. According to the Transportation Program Management Office (TPMO), walking is the dominant mobility mode in Addis Ababa for an estimated 70% of the population. Public transport is the dominant mode for 26% and private motorized transport is the dominant mode for just 4% of the population (Transportation Program Management Office, Annual road safety report 2017/2018).

Only motorized transportation has been highly studied and given proper consideration. The issues of traffic flow, fixed facility and the control system of motorized transportation has been given an enormous amount of attention with less study by different concerned bodies related to non-motorized transportation. The popular pedestrian mode provides health benefits and saves energy resources. Much more focus is necessary to provide safety for this large segment of the population. Numerous researches and studies can be found when it comes to vehicular accidents; pedestrian fatalities and injuries are given less emphasis Pedestrian and sidewalk issues have been treated as secondary issues far too long. It is time to focus on safety issues surrounding pedestrian travel.

1.2. Statement of the Problem

Walking is the predominant mode of travel for 70% of the people in Addis Ababa from these pedestrian fatalities caused by vehicular traffic was 82% as reported in the annual safety report for the years 2016/2017 (2009 Ethiopian Calendar (E.C.). This indicates that pedestrian traffic is not considered during planning, design, construction and maintenance of roads. On most roads in the city pedestrians lack the necessary facilities. On the majority of local roads, pedestrian and motor vehicle traffic are not well segregated. Pedestrian walkways are blocked by roadside utilities like electrical poles, drain pipes and manholes, but the most significant impediment to pedestrian traffic flow are street vendors and sidewalk businesses. One can see sidewalks torn up to bury utilities that are left in rubble or inadequately repaired to an acceptable safety standard. Pedestrians share space with fast moving motor vehicles which increases their risk of injury. This clearly birings a question of safety, comfort and convenience of walkers. The majority of the old roads as well as newly constructed roads are designed and constructed primarily for vehicles without enough safety features to segregate pedestrians from motor vehicles.

Since urbanization is expanding and the population is rapidly increasing in Addis Ababa, transportation can be a big challenge for the city if not planned well. As seen in the figures mentioned earlier, accidents have been increasing, not decreasing, over time as seen in the numbers mentioned earlier, accidents have been increasing, not decreasing.

Transportation has many economic and social components. In urbanized areas, costs are spiraling from the effects of traffic, particularly accidents, but also from congestion, consumption of public space, air pollution, noise and disruption of social and economic interaction. The lack of sidewalk space results in a high number of pedestrian fatalities. This study assesses the causes of these issues and supports the planning of roads to be pedestrian friendly and sidewalks to provide safe and comfortable travel for walkers.

1.3. The Objective of the Study

1.3.1. General Objective

The central objective of this study is to investigate pedestrian safety, comfort and convenience by comparing the satisfaction levels of users and service levels of sidewalks.

1.3.2. The Specific Objectives

The study has the following four specific objectives:

- To evaluate the level of safety, comfort and convenience found on sidewalks for pedestrian road users.
- To assess how pedestrians, perceive the safety comfort and convenience while walking on sidewalks and how it affects their need to travel by foot.
- To find out the major causes affecting the sidewalk safety, comfort and convenience.

- To recommend remedial measures in enhancing pedestrian safety comfort and convenience on the sidewalks.

1.4. Research Questions

The study focuses on the following research questions:

1. What is the level of service of sidewalks regarding their safety, comfort and convenience?
2. Do pedestrians feel safe on sidewalks? Are certain times of the day more or less hazardous than others?
3. Does a sidewalk's comfort and convenience attract pedestrians? Conversely, do crowded and/or hazardous sidewalks repel foot traffic?
4. What are the main causes affecting the safety, comfort and convenience of the sidewalks?

1.5. Significance of the Study

The results of the study will be of great benefit for the following reasons:

This study can give input for further research to be done by scholars interested in the topic and by offering different approaches concerning the issues of safety, comfort and convenience of sidewalks. A researcher can find how the existing pedestrian environment functions along with the condition of sidewalks using three major variables. The effect of sidewalk street vending has been analyzed as to whether the relationship between vendors and pedestrians is positive or not or if street vendors impact pedestrian travel at all. This analysis will help decision makers make informed decisions regarding the future of street vendors. The last thing the researcher determines is the perception of the sidewalk users. Most of the studies done have focused on physical and environmental factors, but the sidewalk user's perception with a good triangulation can help detect the real problems and then ideal solutions can be formed.

The result of this study can change practices in sidewalk planning and construction. For far too long attention on motorized traffic flow has taken precedence. Even though vehicular accidents involving pedestrians will not be a part of this study, it should be noted that walkers are paying a high price. Injuries and death are caused by a lack of attention to the safety of foot traffic patterns the majority of people depend on to navigate life.

The other item that could change as a result of this study is the comfort issue. Comfort, as it is used in this instance, is not a luxurious factor when it comes to this particular topic. Comfort can determine whether the pedestrian chooses to walk or not. Comfortable sidewalks can attract a high volume of walkers which is environmentally friendly. They can also support the economy. If sidewalls are comfortable and convenient, the number of pedestrians using them will naturally increase.

This study can suggest improved polices and standards that are currently in use. As mentioned before, the focus of the city's policy makers has been on motorized transportation. Most of the studies conducted in the city regarding pedestrian safety focuses on vehicle/pedestrian accidents and the physical condition of sidewalks. They do not take into consideration the perception of sidewalk users. This study can help the policy and standard makers understand the following: street vending exists on sidewalks that are designated for pedestrian traffic. The effects of street vendors on pedestrian traffic can be substantial. This study will provide information that can help improve policies relating to pedestrians and street vendors. Oftentimes vendors occupy the entire width of the sidewalk forcing walkers off the sidewalk, sometimes into vehicular traffic. Reduction in total sidewalk width due to a vendor's existence obstructs pedestrian movement. Vendor activities on sidewalks in developing countries are usually are side-by-side and in between permanent shops and road users. A special lane is needed for buyer activities in front of vendor stalls. This sentence

does not make sense. Either delete or re-write. This study focuses on safety, comfort and convenience of pedestrian traffic patterns with an emphasis on the condition of sidewalks. In Addis, sidewalks provide the most common means of pedestrian transportation which is the most used transport mode. This study will also highlight what user satisfaction looks like by measuring a pedestrian's perception of sidewalk safety and convenience.

Planners and governmental bodies can use this study to plan and regulate sidewalks to benefit the majority of the population who use them.

1.6. The Scope of the Study and Delimitation

The main focus of this study is pedestrian safety and comfort on sidewalks situated next to major streets in Addis Ababa. The study areas chosen for the research are the segments of pedestrian sidewalks between two crossings or intersections. The sidewalks to be studied have been selected throughout the city in the north, south, center, east and west. All defined sidewalks are found along major roads and the TPMO mapping of traffic accidents involving pedestrians involve these sidewalks.

1.7. Organization of the Study

This report is divided into six major chapters. The first chapter provides the introductory part starting with generalities and going to specifics in order to ensure a proper framework for the study. It also defines the purpose of the study and outlines problems, hypothesis, research questions, objectives, significance, scope, delimitations and organization of this study. The second chapter consists of the conceptual, experimental, experiential and theoretical discourses that are mandatory for the study in order to grasp the possible knowledge from the related past literature. The literature has been compiled from journal articles, government publications and published books concerning

the issue of pedestrian transportation as it pertains to sidewalks. Chapter three mainly focuses on the data and methods along with the methodology used for the study. Chapter three also discusses the types used for data, methods in collection, methods in analysis, variables, sample size and techniques. The fourth chapter informs the condition of the geographical study area. It includes background information on the city of Addis Ababa with regards to its major transportation issues in order to clarify understanding of the subject being addressed. The fifth chapter contains the results and discussion part of the study. The results are presented in proving and disproving the hypothesis written in the first chapter. Also data is presented and analyzed in one and two variable setups and also with a binary regression followed by the interpretation and result. The sixth and the last chapter contains the conclusion and recommendation given to the study based on the findings.

CHAPTER TWO

2. REVIEW OF LITERATURE

2.1. Introduction

This section of the study accommodates the explanation of crucial terminology and eminently used concepts in the study such as sidewalk, pedestrian, safety, comfort and convenience based theories in order to understand the different explanations given in various conditions. In previous studies various methodologies have been used to analyze the conditions affecting a pedestrian's experience in regards to safety, comfort and convenience. Methodologies use different indexes such as level of service indexes and perception techniques. Consequently, some of the methodologies that have been in practice and are related with this study will be explained in order get an elite methodology that works for this specific study context. Experiences and research projects of other countries are explained and contrasted with each other and the Addis Ababa's studies. Also, related research done in Addis Ababa is discussed followed by the final section that covers the summary and the gaps that are likely to be found with this study.

2.2. Pedestrian Transportation

2.2.1 Pedestrian

Current documents describe 'pedestrian' with varying definitions, but it can generally be defined as an individual walking or in a stroller or on a bicycle or using a wheelchair. It is well known that people have transported themselves by foot along designated or non-designated trails since the beginning of time. Walking is the most primitive form of transportation (Grignaffini et al., 2008).

According to The American Heritage Dictionary (2004), there is no reference of pedestrians as a mode of transport, it just simply defines it as "a person traveling on foot; a walker". This definition can be expanded to represent those walking for non-transportation purposes like recreation,

exercise, shopping, leisure and social interaction. The Compact Oxford English Dictionary (2006) explains a pedestrian as "a person walking rather than traveling in a vehicle." Pedestrian activity is therefore defined as a mode of transport comparable to vehicular modes such as driving or cycling. Pedestrians can walk for different transportation related reasons including getting from origins to destinations, such as from home to work. There are more definitions to the term 'pedestrian' than a dictionary description; it can rather be seen as a life style.

Pedestrian activity can be considered as a culture according to research. The culture of pedestrians and the built-in environmental features promote walkability, active transportation and non-automobile access to social interaction, civic engagement and opportunities for employment, especially in minority, low-income and aging communities (Partners for Livable Communities 2007, Orleans et al. 2009). It is significantly mandatory to define the term because in the field of urban planning the definition of 'pedestrian' strongly influences how they are accommodated in the design of infrastructure in the urban environment showing the definition can make a substantial alteration to the planning and designing of the pedestrian environment (Ria Hutabarat Lo, 2009).

The American Association of State Highway and Transportation Officials (AASHTO) has exemplified efforts to understand and institutionalize planning for pedestrians in the United States. Pedestrians need to be considered in every roadway environment, leading to more to more attention paid to their presence in both rural and urban settings, even though the urban setting is difficult to design with the increasing need for motorized transport. Even so, it is mandatory that provisions be made because of the importance of pedestrians (AASHTO, 2004).

2.2.2 Pedestrians' Needs-Satisfaction

As it is greatly discoursed in various literature, a pedestrian's needs and behaviors are highly related to the comfort and safety of sidewalks. Pedestrians travel for many reasons such as going

to work, school, shopping or for leisure purposes. However, they will only be consistent walkers if pedestrian facilities are available and well maintained. (Mateo-Babiano & Ieda, 2005). Even though pedestrians are mostly driven by utilitarian purposes, the quality of the sidewalk can influence them. Professionals such as planners and designers can provide motivation for a user's mode preference through their designs. Behaviors cannot easily be determined by just design types, but a good design can have a powerful, positive influence on people and a bad design can cause a negative perception (Mumford, 2000). Even though the major factors can't be described clearly in order to identify which cause what, it is essential to focus on the needs and values of a user. Values and Needs can be a consumer behavior driving factors (Vallacher & Nowak, 1994), concerning consumer behavior, products or services have the capacity to satisfy one's needs (Jager, 2000).

Fig 2.1: Level of Pedestrian Need, the lowest is highly mandatory

Source: (Mateo-Babiano & Ieda, 2005)

Based on the human need theory, a pedestrian need hierarchy has been set as mobility, protection, ease and leisure, with identity ascending in an increasing level of satisfaction as shown in the figure above. It indicates that there is a hierarchy to the satisfaction of pedestrians, assuming those lower

in hierarchy must at least be partially satisfied before those higher in order may become an important source of motivation, Mateo-Babiano & Ieda, (2005). The figure illustrates mobility as the lowest and basic function. A pedestrian's safety and protection is the second level. This can be accomplished by decreasing the risk of pedestrian-vehicle conflicts. The third level refers to comfort or convenience which is a state of being carefree. These types of theories encouraged the study of Level of Service regarding pedestrians, currently known as Pedestrian Level of Service (PLOS), which is a qualitative attribute that measures facilitate and the street environment.

2.4. Benefits of Pedestrian Transportation

Pedestrian transportation has many benefits. Pedestrian transportation increases the possibility of social interaction with other walkers on the sidewalk (NZTA, 2009). An increase in pedestrian traffic reflects in decreased vehicle traffic that can significantly impact the environment. Walking means fewer cars on the road resulting in less congestion and lower environmental impact. (South worth 2005). Pedestrian transportation provides a variety of benefits including reduced external costs for the public, user cost savings, increase in efficient land land use, public health, livability of the community and economic development. All these benefits must be considered in urban planning and decision making. The benefits of walking can be discoursed from three viewpoints (Litman, 2004) which are economic, social and environmental. In the section below, the benefits are discussed in these terms as well as addressing the public health benefits.

2.4.1. Economic Benefits

Economic development impacts society's business activity, investments and employment (TDM and Economic Development, 2002). Pedestrian transportation can affect economic development in numerous ways (The Economic Benefits of Walkable Communities, 2001). When benefits of

pedestrian transportation are observed from an economic perspective, walking significantly decreases transportation costs.

Retail businesses benefit greatly from a high volume of foot traffic (Bohl, C. C. Place Making, 2002). A study in Texas shows that Businesses that shifted from motorized access to predominately pedestrian access showed a 71% increase in revenue and twice the employment activity (Miller et al.1999.). This shows that a friendly pedestrian environment can make commercial areas more attractive and offer regional economic enhancement and employment.

Pedestrian transportation has economic rewards for the individual and for society. Providing a good and safe pedestrian environment allows walkers to save on automobile expenses. A study found that individuals in motorized transportation dependent societies dedicate 50% more to transportation expenses than individuals in communities with more sidewalks available for pedestrian transportation (McCann, B., 2000). Motorized vehicle transportation increases public costs through road construction and maintenance, vehicular accidents and traffic congestion. The many demands of motorized transport create a high burden on society compared to non-motorized transportation (McCann, B., 2000). Shifting travel from motorized to non-motorized modes reduces these high public costs (Litman, T. 2000.). Even the simple act of choosing to walk versus a short vehicle trip has economic advantages for both the individual and society.

2.4.2. Environmental Benefits

Walking can be beneficial to the environment by reducing the use of land for roads and parking facilities, reducing energy consumption and lessening pollution. Pedestrian transportation improvement will reduce costs by decreasing the amount of land necessary for motorized transportation facilities and will encourage accessibility by foot by creating clustered land use patterns. (Burchell, R. et.al, 1998.).

These improvements provide economic, social, and environmental benefits. Motorized transportation is the leading contributor to environmental pollution. Environmental benefits of non-motorized transport are numerous. By far the greatest environmental benefit of non-motorized transport is that they bypass the fossil fuel system and enable society to reduce associated pollution along with other negative environmental impacts such as road space and congestion, roadway accidents and noise (R.Rastogi, 2011).

2.4.3. Social Benefits

The social benefits of walking include increased communication among neighbors resulting in community cohesion. Designated pedestrian spaces cost less and preserve the aesthetic of an area. The social context of walking in an urban environment becomes more attractive if pedestrian movement along sidewalks is shared with friends (Staats & Hartig, 2004).

2.4.4. Health Benefits

The overall impact of non-motorized transport on the health of residents is a substantial benefit for many communities. Many studies have used a variety of methods to calculate these impacts. Research has shown that adults that use non-motorized transportation such as walking and bicycling had a lower obesity rate (Cavill, N., Kahlmeier, S., Rutter, H., Racioppi, F., & Oja, P. (2009).). Use of active transportation or non-motorized transportation was also associated with lower rates of diabetes. (Smart Growth America 2015) Such research emphasized how non-motorized transportation might benefit such health concerns (John Pucher, 2010). Pedestrian transportation is considered as exercise according to some studies. (McAuley, Blissmer, Katula, & Duncan, 2000; Plante, Coscarelli, & Ford, 2001). Walking outdoors in the fresh air has better health benefits than indoor exercise (Hug, Hansmann, Monn, Krütli, & Seeland, 2008; Kerr et al., 2006). Public health authorities recognize that some urban outdoor environments discourage

physical activity, including walking, for recreational or transportation purposes (Frumkin, Frank, & Jackson, 2004). Improving pedestrian transportation environments can be a contributing factor to enhancing overall public health.

2.5. Sidewalk and Sidewalk Corridor

2.5.1 Sidewalk

A sidewalk is a paved surface along a road or street that is raised from the street level and separated by a curb (Toole et al. 1999). Sometimes the term 'sidewalk' is used interchangeably with the word 'walkway'. Technically, however, walkways incorporate a broader range unlike a sidewalk (Park and Schofer, 2006).

In Greek and Roman times, pedestrian space was considered a public space allowing the community to relate with each other. One can see the value these cultures placed on the social aspects of walking by viewing areas such as the Greek agora and Roman forum. (Rubenstein, 1992). As times have changed, sidewalks have been developed to meet the functional needs of modern people. Sidewalks were created to separate the carriageway from the building frontage. The primary sidewalk was constructed in order to separate pedestrians from chariots and legionnaires in a place called Pompeii in 200 B.C. (Rubenstein, 1992). According to Sidewalk History, (2003) As sidewalks were developed and streets connected the landscape of urban areas, sidewalks became generative elements uniting buildings (Lillebye, 1996).

2.5.2. Sidewalk Corridor and Environment

The expression Sidewalk Environment is mentioned in many pedestrian and sidewalk related literature. The word Sidewalk Environment indicates the surrounding situations of the sidewalk. There have been different studies using divers indexes for assessing the environment of a sidewalk.

Streets, and more importantly sidewalks, must be pedestrian friendly allowing walkers to safely and efficiently get to where they are going. (Greenberg, 1995). Streets must be planned and designed for the benefit of the community as a whole. By considering pedestrians as major users of public spaces, they should be provided with a higher level of user satisfaction. (Max-Neef, 1992).

2.5.3 Sidewalk Standards

As mentioned above, sidewalks were constructed in 200 B.C. to separate walkers from other moving things (Sidewalk History, 2003). When it comes to sidewalk standards, the earliest written laws concerning streets was in 100 B.C. The streets of Rome were a minimum of 4.5 meters and streets had elevated sidewalks taking up almost half of the total width. This prototype was popular until the 18th century in Europe (Forbes, 1934).

The dimensions of sidewalk standards can vary from country to country and within a country or a city. Measurements fluctuate depending on adjacent land use requirements, the type of street or roadway, predicted pedestrian activity, and the presence of utilities and objects. Based on Hawaii's recognized street classifications, the recommended dimension is a minimum of 1.8 meters wide that allows two people to walk side by side and pass each other. This dimension also comfortably accommodates wheelchair users. And according to the American Disability Act (ADA), sidewalks should be at least 1.5 meters wide. In a guide provided by Malaysian Jabatan Kerja Raya (JKR), the ideal width of a sidewalk is 2.4 meters or greater, and the minimum width is 0.9 meters. Sidewalks or footpaths in the context of urban Australia should be a minimum width of 1.2 meters and an absolute minimum width of 0.9 meters (Austroads 1995).

2.5.4. Sidewalk Standards Addis Ababa

According to the Norms and Standards of the Addis Ababa structure plan outlined in May 2002, pedestrian sidewalks must be provided on both sides of arterial streets and should be raised 15-20 centimeters above the carriage way. The pedestrian capacity on a sidewalk should be a minimum of 30 and the maximum of 50 persons per minute per meter width after deducting approximately 0.9-meter dead width in shopping areas and 0.45 meters elsewhere. Pedestrian sidewalk width should be 2.5-4 meters on one side of a sub-arterial street and alongside a principal arterial it should be 3.5-5 meters.

Table 2.1: Sidewalk standards used in Addis Ababa

Type of Street	Width (in both side of the street in meters)
Principal Arterial (PAS)	7 m - 10 m
Sub-arterials (SAS)	5 m - 8 m
Collector Streets	Less than 2 m
Local Streets	Should be decided based on local condition

Score: Norms and Standards (2002)

2.6. Sidewalk Environment and Affecting Factors of Pedestrian Activity

While pedestrian activity and a good sidewalk are conventionally believed to be essential for a good urban area, there are factors that continue to affect the quality and flow of foot traffic such as obstacles, street vending and the general condition of the sidewalk. There is also the physical environment that involve things like land use restrictions, existing buildings, roads and more (Handy et al., 2002).

The Florida Department of Transportation (FDOT) Quality/Level Service Handbook 2009 states the main factors that can affect pedestrian safety, comfort and convenience are traffic volume,

vehicle speed, type of vehicles, etc. Vehicle-pedestrian interaction causes the highest risk to pedestrian safety as cars are shielded by metal but pedestrians are vulnerably exposed. The surface condition of sidewalks gives pedestrians the perception of safety, comfort and convenience. A study concerning pedestrian behavior done in Karachi, Pakistan, theorized that encroachment can cause a safety issue for a pedestrian that will be lead to the person stepping off the sidewalk and into the street with a high potential of being hit by a motorized vehicle (Khan et al., 1999). Addis Ababa is one of the cites that is observed to have a high amount of street economy. Number of street vendors that encroach on the sidewalk and are also considered a cause of increased crime. (Duneier, 1999). Sidewalk businesses cause congestion and alter the flow of pedestrian movement. Walkers perceive sidewalk vendors as a safety hazard (TRB, 2000).

2.7. Safety Comfort and Convenience While Walking

2.7.1 safety

Under varying conditions, theories have been developed concerning pedestrians and issues like safety, convenience and comfort. It is reported that 5,977 pedestrians are killed in motor vehicle crashes in the U.S. (NHTSA 2017). Even though this number decreased from the previous year, it shows there are safety issues surrounding pedestrian road users. In the 2017 TPMO Annual Report, the death toll of pedestrians in Addis Ababa was listed as 82% of all recorded deaths in 2017.Pedestrian safety issues are a concern in most countries of the world. Statistics show there are more pedestrian safety problems in developing countries than in more developed countries. Most pedestrian-motor vehicle accidents result in fatality for the walker. Solutions to pedestrian safety must take into consideration all factors affecting the safety of walkers.

According to Becho (2016) and his study of sidewalk safety as it relates to crime, the main factors affecting pedestrian safety are the types of building frontage, lighting and mixing different purposes for the sidewalk.

Studies show that people who live in areas that have good pedestrian transportation systems with lower crime rates will be disposed to walk more (Grabosky, 1995). There are many articles that correlate safety to the walking rate. According to Appleyard (2003), pedestrian activity correlates with the level of personal safety within an area. According to Carmona et al., (2003) safety is about victims and the fear of victimization. A safe sidewalk environment, free from personal attack, encourages pedestrian use. Safety is to gain freedom from both physical and emotional hurt (Burton, E. and Mitchell, L. ,2006).

There have been various concepts put forth to ensure pedestrian safety, but the biggest concern for everyone is the incidence of pedestrian-automobile conflicts. The safety of a city's streets and sidewalks is an indicator of whether or not a city can label itself 'safe' (Jacobs ,1961). Safety is the measurement of a good quality of life. According to Lirebo (2014) Some cities provide a safe, healthy quality of life for its citizens; others lack safety seriously impacting a person's daily living. Current planning policies in Australia, the UK and America predominately follow the 'eyes on the street' concept as outlined by Jacobs (1961). This concept increases permeability, higher densities and takes into account mixed uses (Cozens, 2008).

Arguably Newman's (1973) attempts to enhance on Jacobs's viewpoint of crime risk with an argument that greater pedestrian density on sidewalks must be critically evaluated in relation to business accessibility, ebb and flow of activity and the frequency of police patrol. Using this argument, street vendors can be the 'eyes on the sidewalk'. However, the presence of sidewalk

businesses may cause more harm than good by posing a safety hazard by forcing walkers off the sidewalk onto the street (NZTA, 2009).

Safety issues can vary throughout the day. Pedestrian vulnerability is not only with vehicular traffic but walkers can also be targets for criminal activity (Austroads, 2012).

According to Hidayat et al, (2011), walking is the primary mode of transportation in Bangkok and Jakarta, and utility materials are a common sidewalk hazard. This research argues that sidewalk obstruction by street vendors in developing countries causes considerable safety issues for pedestrians. Safety issues can't be only related to direct motor vehicle accidents. Hidayat et al. (2011) noted that street vendors occupy space on the sidewalks resulting in less space for pedestrians to maneuver. Street vendors disturb normal locomotion patterns and speed, thus making it unsafe and uncomfortable for walkers.

2.7.2. Comfort and convenience

Comfort is relief from harm and problematic situations while walking on a smooth sidewalk with easy access (Rahaman et al., 2005). When a sidewalk is barrier-free and exudes a friendly environment, it will provide pedestrians with a high level of comfort (Pushkarev & Zupan, 1969). Sidewalks that are smooth, have easy access and are located in friendly neighborhoods provide pedestrians with a high level of comfort.

Elements of a sidewalk and satisfaction provided by the elements can be measured to ensure pedestrian comfort and convenience. Sidewalks are designed to facilitate unhindered movement of foot travelers in accordance with their needs (Carreno et al., 2002). Satisfaction of the pedestrian provided by the interaction with the environment during a walk leads to comfort (NZTA, 2009).

According to Rubayet_Rahaman et al., (2005), factors that affect the comfort of pedestrians while walking on sidewalks are: quality of pavement and the width of the sidewalk, absence/presence of obstacles, topography, noise pollution, cleanliness, landscaping, weather conditions, continuity of the route and finally, the directness of the route.

2.7.2. Convenience

Convenience of pedestrian is a major factor in where the users chose to walk on, convenience levels were inferred through level of compliance as well; convenience was the predominant reason pedestrians mentioned to choose from one route and the other (Sisiopiku and Akin 2003).

Convenience in sidewalks can promote walking on pedestrian paths (Fortuijn 2003; UK Department of Transportation 1987). Studies indicate that some pedestrian convenience concerns remain under current design standards (National Cooperative Highway Research Program 2011; Stone et al. 2002).

In a study of pedestrian perception shows convenience levels were established qualitatively through carefully worded on-site pedestrian questionnaires developed to ensure a nonbiased approach on crossings and issues such as the waiting time to cross the road, the speeds of vehicles on approach to the roundabout, the general perception of safety at the roundabout, and the use of the existing crossings has been proven to be a problem on their choice. (Candappa et al. 2005).

2.8. Level of Service, Methodologies on Related Researches

The initial idea of Pedestrian Level of Service (PLOS) classification of attributes was created in 1971 as indicated on Fruin, (1971) and was improved over time (Sarkar, 1993; Fruin, 1971; Gerilla and Hokao, 1995; Ramsey, 1997). PLOS is a basic component that draw more attention to the users of the sidewalks (Vuchic, 1981), and denotes qualitative issues that improve sidewalks.

Since walking has been accepted as a transportation mode, various investigative approaches have been used to assess how walkable sidewalks are. Planners have been investigating the walkability of sidewalks and engineers have been investigating the Pedestrian Level of Service (PLOS), both suggesting there is a need for collaboration (Karatas & Tuydes-Yaman, 2018).

Level of Service (LOS) has been used to identify user's behavior in many other disciplines. When it comes to pedestrians, it is known as Pedestrian Level of Service (P LOS) to detect the pedestrian's road user behavior related to space requirements for their activity.

Table 2.2 : Showing the different levels of P LOS measuring standards

Level-of-Service A	Allows each person to choose a desired walking speed and to avoid conflicts with other pedestrians.
Level-of-Service B	Pedestrians begin to be aware of other pedestrians.
Level-of-Service C	Requires minor adjustments to speed and direction by pedestrians to avoid conflicts.
Level-of-Service D	Freedom to select individual walking speed and bypass other pedestrians is restricted. Frequent changes in speed and position are required.
Level-of-Service E	Provides for very crowded walking, at times reduced to shuffling, making reverse or cross-traffic flow very difficult. The speed of virtually all pedestrians is reduced.
Level-of-Service F	A person is likely to be standing stationary in a waiting area or is able to walk only by shuffling. There is frequent, unavoidable contact with other pedestrians.

Source: *American Association of State Highway and Transportation Officials (AASHTO). Roadside Design Guide. 2004.*

In the current practice of sidewalk design in the United States, the Highway Capacity Manual (HCM) provides standards based on the concept of Pedestrian Level of Service (PLOS). Primary standard is the pedestrian space occupancy (density), and the secondary measure are flow rates (speed) (TRB, 2000).

There has been different methodology and models used in order to analyze the safety, comfort and convenience of pedestrians on sidewalks. Methodologies like Pedestrian Environment Analysis, Level of Service, and Pedestrian Perspective have been used in places with various cultures of sidewalk use.

Most of the current level of service measures are based on pedestrian flow, sidewalk dimensions and geometry, sidewalk occupancy, and capacity of the sidewalk. Previous parameters used scales such as movement of pedestrians, approaches, pedestrian traffic and sidewalk geometry (Huang and Chen, 2007; TRB, 2000), quality of the road environment (Sarkar, 2003; Jaskiewicz, 2000) traffic flow operations and physical characteristics (Landis et al. 2001).

Wicramasingh and Dissanayake (2016) identified the influential attributes that force pedestrians to evade the sidewalk forcing them into life-threatening situations. Conjoint analysis was the method used in this study. This is a good approach to analyze a heterogeneous group of subjects as it is a multivariate technique used to understand how respondents develop a preference for products or services. According Wicramasingh and Dissanayake (2016) nine profiles were developed with mutually independent factor attribute levels, so that the pedestrian's behavior evaluation as to why pedestrians avoid sidewalks can be ranked. In this particular study, the Conjoint Analysis (CA) resulted in the appropriate attribute linear levels relation by using Total

Utility Value (TUV) and Pedestrian Preference Score (PPS). By this method, the results indicate "Availability of Obstacles' as being the most influencing. Understanding the methods used in researching PLOS change by attributes, table 2.3 explains the evolution for a better understanding.

Table 2.3.: The evolution of methods used to evaluate a pedestrian level of service

No	Study	Objective of study
1	Gerilla et al. (1995)	LOS based Evaluation of pedestrian facilities
2	Dixon (1996) Gainesville method)	PLOS based infrastructure characteristics
3	Jaskiewicz (2000) (trip quality method)	PLOS based on design aspects on/along sidewalks; subjective evaluation by raters
4	Landis et al. (2001) (SCI model)	Evaluated effectiveness of various PLOS factors based on Perception ; also referred to as a model for designers
5	Muraleetharan et al. (2004)	PLOS determination with identified attributes; analyzing survey data by conjoint analysis
6	Petritsch et al. (2006)	SLOS model based on pedestrian's perception of urban arterials
7	Bloomberg and Burden (2006)	PLOS evaluation project based on HCM in terms of suitability and created pedestrian characteristic database
8	Jensen (2007) (Trafitec model)	Measurement of stated satisfaction for road sections by Pedestrians and bicyclists
9	Tan et al. (2007)	Focused on relation between pedestrians' subjective perceptions and quality of road Physical facilities as well as traffic flow operation

10	Muraleetharan and Hagiwara (2007)	Overall LOS for urban walking environment focusing of concept of total utility value based on Stated preference survey
11	Petritsch et al. (2008)	PLOS model for arterials as part of NCHRP Project; by user-based measures
12	SACOG (2011)	Application of important PLOS measures by approach assessment
13	Vegadiri and Dileep (2012)	Established primary factors and developed PLOS regression model
14	Kang et al. (2013)	Analysis of Pedestrian perceptions of sidewalk LOS by providing a comfortable and safe walking environment
15	FDOT (2013)	PLOS based on traveler perceptions
16	Asadi-Shekari et al. (2013) DPLOS)	Disabled pedestrian level of service for different street hierarchies
17	Sahani and Bhuyan (2013)	PLOS criteria for urban off-street facilities in developing countries
18	Kim et al. (2014)	Behavioral theory-based approach using Personal space concept

Source: Organized by the author (February 2019)

Using the International Road Assessment Program (IRAP) rating system, Addis Ababa City Road Authority (AACRA) assessed 114 kilometers of sidewalks in Addis and found that most of the sidewalk sections assessed were not safe for pedestrians. IRAP rates road sections from 1 to 5 based on the safety provisions afforded to various types of sidewalk pedestrians. Five (5) is the

safest whereas one (1) is the most dangerous sidewalk. Out of the 400 kilometers of sidewalks assessed in Addis Ababa, 55.66% received a 1-star rating and the remaining 44.34% received a 2-star rating. Sidewalks in the city of Addis Ababa are unsafe. They are not well planned, designed, constructed or maintained.

It needs to be pointed out that the study analyzed only the physical infrastructure of the sidewalk segments. There needs to be a study of pedestrian perception that is subjective to the users. According to Jiregna Hirpa (2016), the safety of a pedestrian has been interpreted and analyzed from the motorized transport perspective. The study highlights the causes for pedestrian–vehicular accidents occurring at crosswalks. The sidewalks themselves are not considered. Vehicular speeding, lack of necessary pedestrian facilities and drinking and driving are the main causes of accidents

2.9. Major factors affecting Safety Comfort and Convenience

According to a study pedestrian safety comfort and convenience in a developing country can majorly be affected by inadequate visibility, illegal crossing, alcohol intoxication while driving and walking, pedestrian fatigue, institutional capacity, walking along the roadway, socio-economic factors, poor transport and land use planning, population growth, lack of road safety education, high annual growth of motorization, the proportion of two- and three wheelers in the traffic mix, and poor enforcement of traffic regulation (). All this factors can be considered to be a general affecting factors to the pedestrian users on crossings vehicular bridges, vehicular roadway and also on sidewalks.

Dan Burden, a leading national advocate for more walkable societies and transportation systems, pronounces for many that the pedestrian in the sidewalk environment is subjected to a multitude of factors significantly affecting feeling of safety, comfort, and convenience and this factors may be categorized under three measures describing the roadside pedestrian environment; sidewalk capacity, quality of the walking environment, and the pedestrian's perception of safety, comfort and convenience (Landis et al., 2001).

According to David Mozer, the suitability of roadway segments for pedestrians is based on four primary variables: walkarea width-volume, walkarea-outside lane buffer, outside lane traffic volume, outside lane motor vehicle speed, plus three secondary factors: walk area penetrations, heavy vehicle volumes and intersection waiting time (Mozer, 1994).

A study shows that street vendors commonly occupy space inside the sidewalk width leading to a reduction in total width caused by their existence as an obstruction for pedestrian movements and because the specific characteristics of vendor's activities are taking place in the sidewalk creating a lane for both vendor's, and buyer activities in front of vendor's and it is highly seen in the developing countries (Hidayat et al., 2011).

2.10. The Research Gap

A study has been done in Ethiopia with a concern of pedestrian safety and fatality calming the exposure of pedestrians and the risk factors of crashes were under studied. The study has been done using models for two-way two-lane rural roads and roundabouts in the capital city of the country which are 18 two-way, two-lane road segments and 22 roundabouts respectively (Tulu, 2015). The study lists the identified risk factors and put highway geometric characteristics and site features as spatial variables that can influence the pedestrian safety in Ethiopia. The study focuses

on the safety issues for the vehicular point of view and focuses on crash information's although this can indicate the risk the perception of users of and the sidewalk environment and features are not taken in to consideration.

In a study that has taken in Addis Ababa in which 20 midblock locations were taken as samples based on a convenience sampling approach. A total of 2596 crashes were collected to develop the Poisson and Negative Binomial regression crash models. Result shows there is strong association between road cross-sectional design parameters and road traffic crashes frequency (Tulu, 2018). This virtuous study dose contains the concern of sidewalks unlike many researches along with midblock position and crossing. The study focuses on pedestrian issues related tocrashes only other types of safety issues and the perception of the pedestrian towards safety and other sidewalk qualities are not included.

A study taken place in Addis Ababa to determine the safety perception and safety awareness of the Addis Ababa LRT passengers on station, to undertake safety assessment at pedestrian-rail crossings of the project, in order to identify and manage both the safety issues and their associated solutions using questionnaire survey and a checklist based observational study on a total of 50 passengers with a result saying the platform-train interface accident is a safety issue for the Addis Ababa LRT stations and concerns of safety do exist on the station. (Kurema, 2016) This study dose focuses on safety conditions of pedestrians but the study target only passengers as a target population and the study area is the rail crossing.

A study done on pedestrian injuries in Addis Ababa with an aim to investigate current pedestrian safety problems in Kirkos sub city with a sample pedestrians and drivers being selected randomly and filled out questionnaire with list in categories as follows pedestrian related, driver related, vehicle related and road and environment related. The research concludes the road safety and

pedestrian safety in Addis Ababa needs a strategic mitigation for an urban safety management (Eguale, 2015). The study does consider the safety issue and safety is interpreted only from a crash point of view.

This non-motorized or pedestrian transportation mode alleviates traffic congestion and is environmentally friendly. Addis Ababa is considered to have a high rate of pedestrian transporters according to TPMO (2017/2018) in which 70% of the total is covered by pedestrian transportation users. Even with the high majority of the city's population walking, research on their safety, comfort and convenience is low; more effort is expended on motorized transportation issues. Research shows that 82% of pedestrian road users are vulnerable for fatal crashes and accidents.

This study uses subjective and objective approaches for both triangulation purposes and need assessments. The study of sidewalk safety, comfort and convenience is looked at from the performance requirements of sidewalks as well as the perception users have of the sidewalks. This study can fill the gap between the understudied user's perception of the comfort and safety of sidewalks and other highly covered safety issues by using some level of service measures and perception rating.

Chapter Three

3. Research Methodology

3.1. Introduction

This chapter contains the data and explains the method that is used in this research. The research process diagram and the research design is shown in Figure 3.2; the framework is the general intended image of this research flow. In this chapter the methods used to analyze the collected primary sourced data is set with the main research questions and objectives to show how the data and the questions are connected and analyzed. All the dependent and independent variables with sample size and sampling frame are presented along with the reasoning of each. In order to answer all research questions a quantitative method approach through triangulation of quantitative and qualitative methods has been selected. As the title of this research paper suggests, research is primarily focused on the safety and secondarily on the comfort and convenience of pedestrian experiences on the sidewalks of Addis Ababa.

The central objective of this study is to investigate the quality of sidewalks and integrate those findings with user perceptions. The goal of this research is to determine the Pedestrian Level of Service (PLOS) on sidewalks with sidewalk vendors. Research was done through qualitative and quantitative data using pedestrian perceptions, pedestrian traffic patterns and assessing the pedestrian environment. Pedestrian interviews and other data collections were done on sidewalks with high, medium and low sidewalk vendor activities present. Sidewalk vendors are a part of the city's landscape, yet research focusing on sidewalk vending activities in relation to the safety, comfort and convenience of pedestrians has been overlooked.

3.2. Research Approach and Research Design

A quantitative approach has been used to collect and analyze data concerning pedestrian safety on sidewalks that have sidewalk vendors. This approach has been used to describe the demographic and socioeconomic conditions of a sample population, and also used to show the relationship between the quantified sidewalk points acquired from subjective and objective surveys.

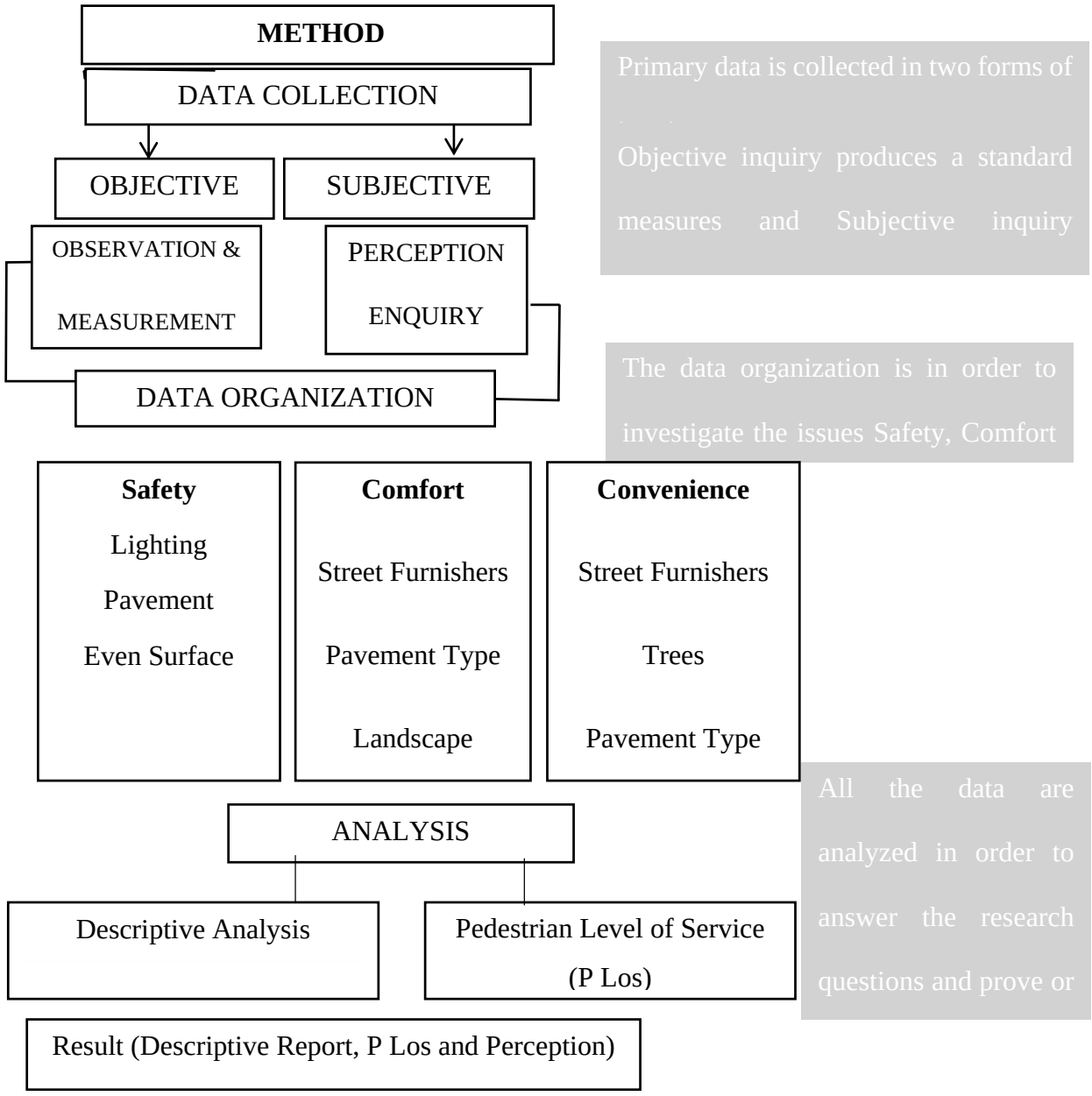


Figure 3.2: Research flow diagram for this study Source: Organized by the author (February 2019)

Using this method, which is based on the quantitative approaches, the data collection and the analysis is shown on the table depicting the research objectives and the approaches used to answer the research questions.

3.3. Source of Data

3.3.1. Data Type and Source

The data that was collected is majorly primary data. The primary data has been collected from all the selected sample areas using subjective and objectives surveys. The subjective survey comprises of questions asked of pedestrians to express how they feel about the sidewalk segments. The objective survey was done by the researcher answering standardized questions to evaluate quality.

3.4. Sampling Techniques and Sample Size

3.4.1. Sampling

Once the sidewalk has been selected, a pedestrian count was done in order to select a sound sample size for the research. The pedestrian count was done manually not only to create a sample size, but also to identify the traffic flow and to differentiate which sections of the study area are high, medium and low volume. The pedestrian count result is an average of 488 people on the sidewalks leading to a sample size on a single segment to be 39 pedestrians, which is 13 percent of the total. The total selected sample size from each study section is 819.

3.4.1. Target Population

In this research the sampling techniques of purposive sampling were combined with systematic sampling. The sites of interest in this case are sidewalks on Primary Arterial Streets (PAS) and Secondary Arterial Streets (SAS) of the city located in different wards identified by direction.

3.5. Data Collection Instrument

3.5.1. Questionnaire

This study employs a set of questions to gather a respondent's perception. The questionnaire elicits answers to questions concerning safety, comfort, convenience, vendor distraction, and sidewalk condition. The first part of the questionnaire covers information about the respondent such as gender, age, monthly income, frequency of walking, and purpose of the trip. All the questions are under the subjective or the objective questionnaire category.

Systematic sampling was used for the sample size. Pedestrian count has been implemented within the selected segments in all the five wards to find a convenient amount of sample, which lead to a result of 39 pedestrian road users when 13 percent of the total of counter is calculated. Pedestrian count was used because the population of interest couldn't be identified using the total population of Addis. The count was done two times a day, seven times a week for two weeks.

Field data was collected in twenty-one selected sidewalk segments in all five wards of Addis Ababa. Data required for the study is pedestrian interviews to gather their perceptions, pedestrian volume count, the number of pedestrians who walk outside the sidewalk, and the number of pedestrians who interact with street vendors. According to the required number of variables for PLOS analysis, the respondents must be greater than 300 (Hair et al. 2006). In this study, there is 821 pedestrians that has participated. Data collection is performed at different time intervals in the day from 10 a.m. to 6 p.m.; and has provided the objective data. The subjective survey was conducted in all the segments which vary in pedestrian level intensity both day and night time.

3.6. Variables

Table 3.1: Showing the variables used and the type of variable.

	Variables	**Type**
1	Gender	Auxiliary
2	Age	Auxiliary
3	Income level	Auxiliary
4	Car Ownership	Auxiliary
5	Health Condition:	Independent
6	Physical Problems Disrupt walking	Independent
7	Cause for route selection	Independent
8	Sidewalk Usage frequency	Independent
9	Comfortable Convenient or No	Dependent
10	Sidewalk Disconcerting Activities and Vending	Independent
11	Quality of sidewalk	Independent
12	Vending vs Walking Space	Independent
13	Comfort Vs Street Vendors Existence	Independent
14	Street Vendors Existence	Independent
15	Pedestrian Traffic Perspective	Independent
16	Sidewalk Width Perspective	Independent
17	Benches Existence	Independent

18	Safety During Day	Dependent
19	Safety During Night	Dependent
20	Slippery and Falling Cause	Independent
21	Violence	Independent

Source: Organized by the author (February 2019)

3.7. Data Analytical Method and Tools

Pedestrian perceptions were analyzed using two models of PLOS with perception methods to identify factors affecting the sidewalk performance. A descriptive analysis was also done using Excel and SPSS. The perception rating has six scales, and is used to compare the user's perception with the pedestrian level of service grading.

3.7.1. Descriptive Analysis

Descriptive analysis was used to describe the study variables. This analysis method uses maps, tables, graphs, charts and reports to understand the data from the study area along with user perceptions and observations.

3.7.2. Model One: HCM

In the HCM method, PLOS scores can be determined by considering different flow-related or capacity-related measures. Pedestrian counts were collected for 3-minutes, as done by Parma et al. (2013) and Maddock et al. (2012). They were later converted into 15-minute values used in the HCM method by simple proportionality. This assessment was done on the 21 segments of the sample. PLOS of the HCM rating uses grading from A to F. This result, along with the Australian method, is compared with the individual users rating data in the table below.

3.7.3. Model Two: The Australian Method

The purpose of the Australian method was to develop a simple model for determining how well paths and sidewalks meet the needs of pedestrians. The model provided opportunities to test the LOS provided by a pedestrian path, as well as determined which factors contribute to low and high LOS, which would create the ability to pinpoint parts of the paths that could be improved to increase the LOS. This method is centered on three types of factors for PLOS determination namely, design or physical factors, location factors and user factors. There are eleven local factors that are distributed within the categories.

Table 3.2.: showing relation of method use with objective.

OBJECTIVE	DATA SOURCE	APPROACH	METHOD	FORM OF ANALYSIS
Investigate what level of Safety, Comfort and Convenience are found on the sidewalks for the pedestrian road users.	Primary Data	Quantitative	Observation and Questionnaire	Tabulation Graphic Description P LOS
Survey how Safe dose the pedestrians feel while walking on the sidewalk during different time of the day.	Primary Data	Quantitative	Observation and Questionnaire	Description (Perception rating)
Analyze how the pedestrian perception is towards the Comfort and Convenience while walking on the sidewalk is affecting their need to travel by foot.	Primary Data	Quantitative	Questionnaire	Description (Perception rating)

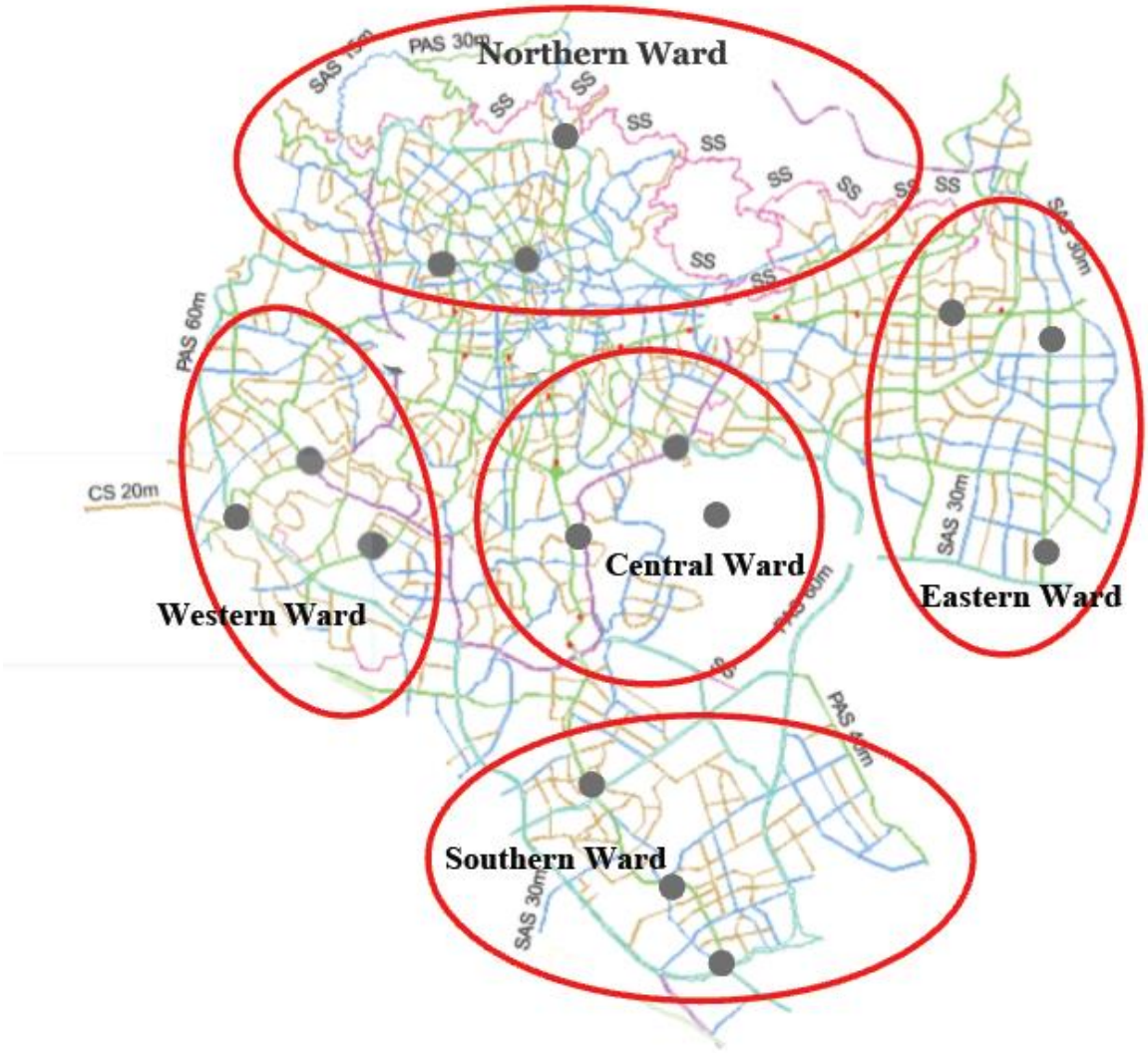
Identify how the street economy or street vendor's activity on the sidewalk is affect the pedestrian activity on the sidewalk.	Primary Data	Quantitative	Questionnaire	Tabulation Graphic Description P Los

Source: Organized by the author (February 2019)

3.8. Procedures of Data Collection

In order to adequately cover all areas of Addis Ababa, the city map has been divided into five main parts: North, South, Central, East and West Wards with a purposive sampling in an attempt to assess the different characteristics of the city. From all the wards the arterial roads have been selected and then observed by identifying various sidewalk segments. ('Segment' as used in this study indicates a portion of sidewalk from one intersection to the next.)

Since the main concern of this research is the safety of pedestrians on the sidewalks within the city of Addis Ababa, the arterial streets were selected as per the urban road level standard and street map of the city. This is because designed sidewalks exist only on arterial streets which are the PAS and SAS. The sidewalk segments of the city are selected based on purposive reasoning; first, the major streets are considered to be the most unsafe for all road users, but more so for pedestrians because of motorized traffic. The second safety concern is the high concentration of street vendors on these main streets, and the third reason is that the main streets are easily accessible for the researcher. A major safety factor is that the majority of the designated sidewalks follow the main avenues and the use of the land around these main arterials have mixed uses. The example of the site selection can be observed in map 3.1.



Map 3.1: Showing the different Wards with the Arterial Roads of Addis Ababa

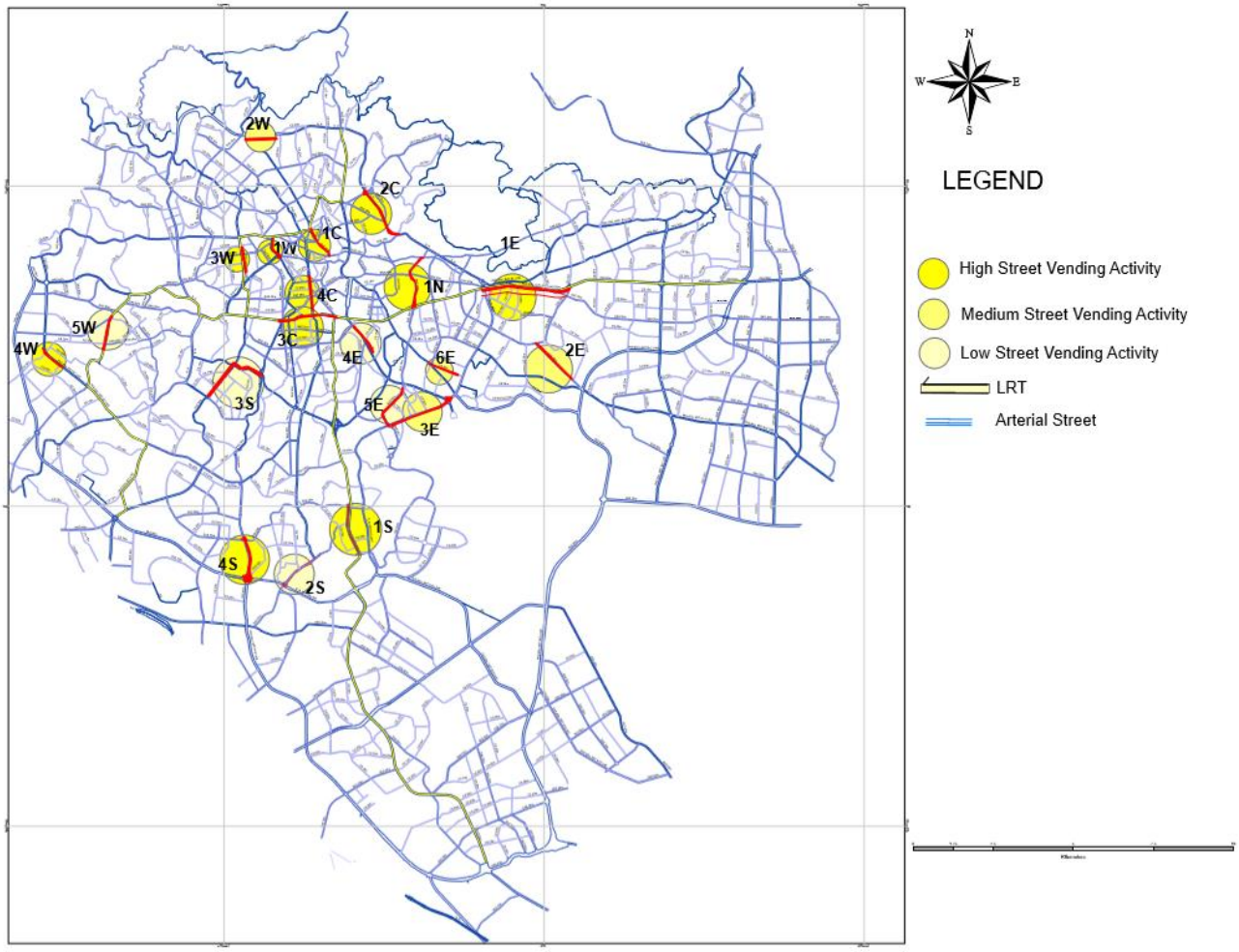
According to AACRA (2010), the total sidewalk length in the city of Addis Ababa is 484,562 meters; the lengths used in the different wards is listed in table 3.1. Five percent of each ward has been calculated in order to find the sample sidewalk segments as is shown on the table below. The five percent total sidewalks are divided into segments with an achievable length ranging from 1 km to 1.3 km each. Based on this, the number of segments is listed in the table below as well. Table 3.1 explains each study section with all the details like total length, road type location name, ward and segment name.

Table 3.3: Showing the site selection technique in the five wards

Ward	**Existing Total Sidewalk Street length in m**	**% 5 of the total Sidewalk in m**	**No of selected**
North	53,719	2,686	2
South	81,831	4,091	4
Central	91,624	4,581	4
East	142,253	7,112	6
West	115,135	5,756	5

Source: Organized by the author (February 2019)

These sample sidewalks are selected based on the following criteria: (1) Sidewalks are available and considered feasible to observe, (2) The volume of pedestrian is considered high, (3) The existence of street vendor activities on the sidewalk.



Map 3.2.: Showing the 21 study segments geographic location with street vendor activity intensity. Source: Organized by the author (February 2019)

Table 3.4: Showing the detailed sampling and study segments.

Sample Segment Name	**Ward**	**Local Name Of segment contained street**	**Segment Name**	**No of segments**	**Length (km)**	**Road Type**
1N	North	From Lem Hotel To Shola Market	Lem hotel to Shola Market	3	1.3	PAS
2N	North	FROM 6KILO TO SHIROMEDA	6 Kilo To US Embassy	4	1.3	SAS

1S	South	From Gotera interchange to Kality RA	Adey Abeba-Abo		1	PAS
2S	South	From Dama Hotel to Hana Mariam RA	Hamsa Simint- Hana Mariam		1	SAS
3S	South	From RR through Karl RA and Puskine RA to Gotera Interchange	Karl RA- Puskine RA		1	PAS
4S	South	from Jemo St.Micheale RA to Kadisco RA	Jemo-Garment		1	PAS
1C	Central	St. George RA-Taytu Hotel	St. George RA-Taytu Hotel		1.15	SAS
2C	Central	From sidist Kilo to Minilik hospital	From 6 Kilo-Minilik hospital		1.15	SAS
3C	Central	From meskel Sq mebrate to Mexico Sq	Mexico Sq-Stadium		1.15	PAS
4C	Central		Lycée Guebre-Mariam-Legehar Station		1.15	PAS
1E	East	From Megenagna to Urael Church	Megenagna Intersection to Lim Hotel Intersection	2	1.15	PAS
2E	East	From mebrat hail to Yerer Goro	From mebrat hail to Yerer Goro	2	1.15	PAS
3E	East	From Megenagna to Bole Michael (Mamo Bridge)	Bole Mikael To BoleAirport	1	1.15	RR

4E	East	From Meskel Sq to Bole airport RA	Hyatt Regency To Dembel City center	5	1.15	PAS
5E	East	From Rwanda embacy juncton to bole Michael RR	East 5 Bole Mikael to Rwanda	5	1.15	SAS
6E	East	Hayat Hospital to Bole Medhane Alem Cathedral	Hayat Hospital -Bole Medhane Alem Cathedral	3	1.15	SAS
1W	West	From T/Himanot Sq to sinima Ras junction	Benin Mosque To T/haimanot Church	1	1.15	PAS
2W	West	From Winget RA to Enkulal fabrica Junction	Winget to Ras Hailu Park	4	1.15	SAS
3W	West		Awtobis Tera-Abnet		1.15	PAS
4W	West		Aierena-Zenebwork		1.15	PAS
5W	West		Torhayloch-Sostkutrmazoria		1.15	PAS

Source: Organized by the author (February 2019)

As the table shows, the sum of PAS and SAS that is found in the city of Addis Ababa is 484,562 when put in length (m) which gives 5% to be 23.2 (km). The table shows the 5% distribution within each segment and ward.

3.9 Background on the Study Area

3.9.1. About Addis Ababa

Addis Ababa is the capital of the Federal Democratic Republic of Ethiopia and the seat of the African Union and United Nations Economic Commission for Africa. Since it is the capital, it is the largest and most urbanized city in Ethiopia. With an estimated population of 3.4 million, the city covers 540 square kilometers and is divided into ten sub-cities (Passmore, J., et al (2010).

Addis has an annual population growth rate of 2.4 and 524,444 vehicles are registered. Vehicle registration increases by 30% annually; however, even with that increase the most common mode of transportation is walking (non-motorized).

3.9.2. Pedestrians

With over 3.4 million people living in Addis Ababa, 70% of the population uses walking as their mode of transportation, 26% use public transport and 4% use private transport. This starkly highlights that walking is far and away the most common mode of transportation making Addis Ababa a city of walkers, not drivers. According to Addis Ababa Transport Program Office Management (TPMO), road traffic death has been increasing steadily over the past five years when calculated per 100,000 people. From 2014-2017, pedestrian fatalities made up 82% of all deaths. 57% of total vehicle-pedestrian accidents occur during the day, 18% happen on well-lit roads, and 20% happen at night. Pedestrian traffic is high, but pedestrian safety is very low.

Table 3.5.: Crashes by character

Characteristic		Hospital records Deaths (%)	Police records Deaths (%)
Gender	Total	64 (10%)	463 (74%)
	Male	52 (81%)	348 (78%)
	Female	12 (19%)	99 (22%)
Age	<15	2 (3%)	31 (7%)
	15-44	39 (61%)	244 (60%)
	45-64	15 (24%)	91 (22%)
	>65	7 (11%)	41 (10%)
Road user type	Pedestrian	47 (82%)	368 (80%)
	Car/Taxi Occupant	9(16%)	86 (18%)
	Bicyclist	1(2%)	6 (1%)
	Motorcyle rider	0	3(0.6%)

Source: Road safety annual report annual report from TPMO (2017)

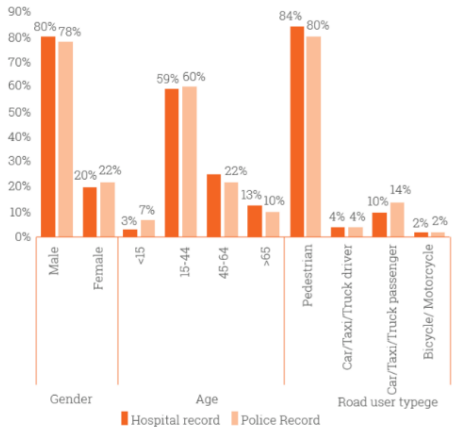
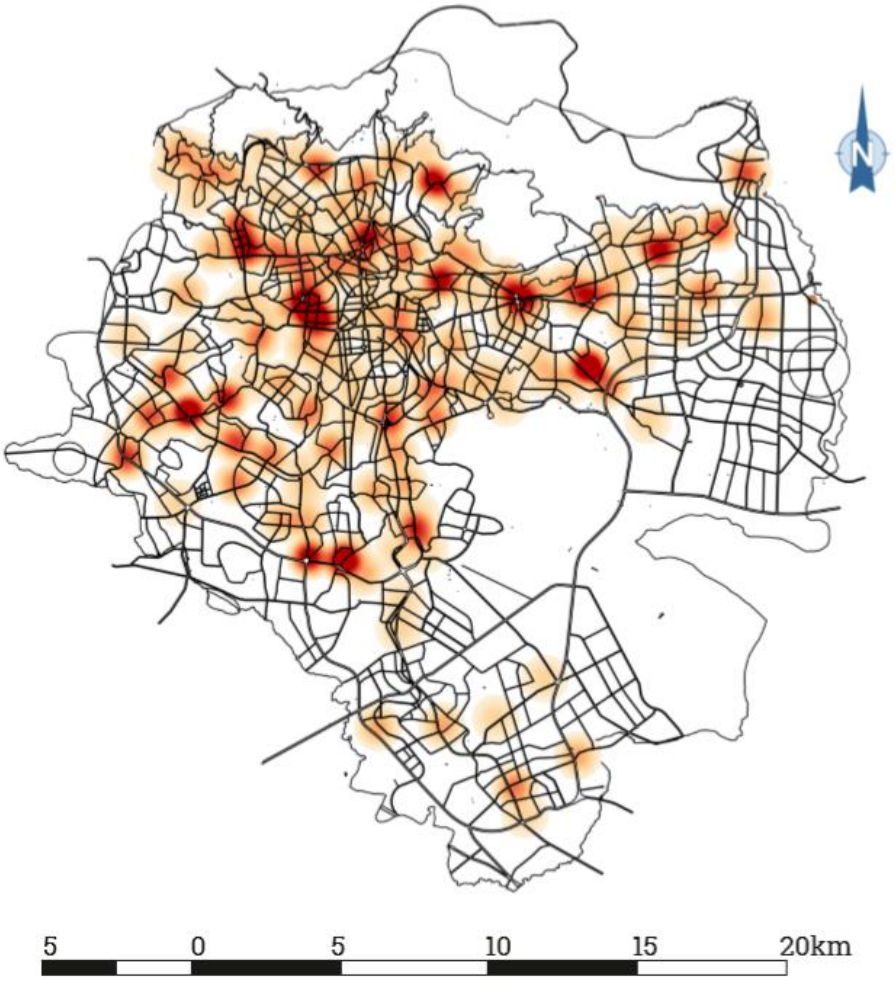


Fig 3.2: showing the percentage of crashes

Source: Road safety annual report annual report from TPMO (2017)

Hospital and police provide the most accurate reporting. According to the table above, both sources show there is a high number of pedestrian deaths even if the exact circumstances cannot be determined. It clearly shows that venerable road users do not have a safe environment.

And the death occurrence compared with Gender Age and Road User Type is shown in Figure 4.1 above. As it can be observed from the Addis Ababa Transport Program Office Management (TPMO) map, geographically mapped pedestrian crashes are evenly distributed.



Map 3.3: Sowing the geographic distribution of pedestrian crashes

Source: Road safety annual report annual report from TPMO (2017)

3.9.3. Roads and Sidewalks of Addis Ababa

The roads of Addis Ababa have evolved over the centuries from small width roads accommodating animals and horseback transportation to the high capacity major roads of today such as the Primary Arterial Street and the Ring Road.

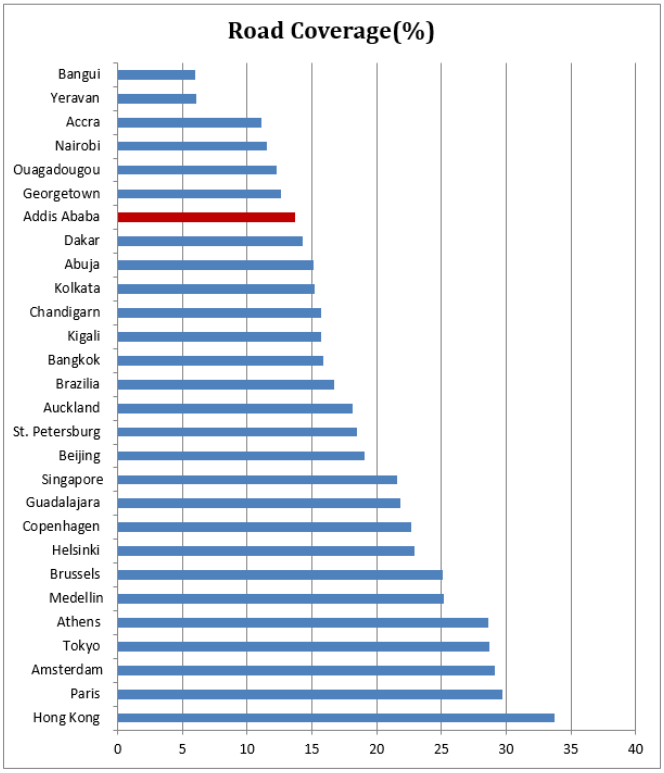


Fig 3.3.: Showing the road coverage with other cities

Source: the road coverage report of AACRT (2018)

According to AACRs annual report (2016/2017) recording the total road coverage of the city of Addis Ababa is 3,761 kilometers collectively with roads varying in width. And when the road coverage is measured in comparison to the area of the city, only 18.45% has road access.

Let's take a look at the breakdown of roads in Addis Ababa. The Ring Road (RR) is 37 km (1%); Primary Arterial Street (PAS) is 290 km (8%); Secondary Arterial (SAS) is 164 km (4%), Collector

Street (CS) is 215 km (6%) and finally the largest share is the Local Street (LS) with 3,055 km of roads and makes up 81% of the total. Sidewalks are considered as part of the road system in Ethiopia. According to Addis Ababa City Road Authority (AACRA), there is a total of 3,018,319.7 m/sq. in area and 636,833.8 meters of sidewalk constructed with various widths and materials.

Sidewalks in the city of Addis Ababa are classified into five types with hierarchically defined widths. All sidewalks are required to be constructed and maintained according to the requirements of the main street classification. As a result, in this section all sidewalks will be viewed in reference to the main classification. Putting sidewalks as an integral component of streets should mean they are designed for pedestrian safety, comfort, access and mobility by separating the sidewalk from the main street both horizontally and vertically. Pedestrian safety increases when sidewalks and walkways are separated from vehicle traffic by raised curbs and the sidewalk is sufficiently wide enough to accommodate the foot traffic.

A sidewalk is the space within the right-of-way dedicated to pedestrian travel. Hawaii State Statutes define a "sidewalk" as that portion of a street between the curb lines, or the lateral lines of a roadway, and the adjacent property lines intended for use of pedestrians (Hawaii Revised Statutes 291C-1). What the main road is made of should hint at the quality of the sidewalk. Below is an interesting chart showing different road materials over the years.

Table 3.6: Showing the road coverage by material through different years.

	Material	Before 1991	1991-2012	2018
1	Asphalt	514	1807	2442
2	Cobble		227	1984

3	Gravel	989	1777	509
4	Care Stone			220
5	Earthen			298
Tot		1503	3811	5453

Source: Taken from the road coverage report of AACRT (2018)

Table 3.7: Showing the road coverage by direction.

	Road Class	East	West	North	South	Central	Total
1	RR(Ring Road)	7.4	13.385	4.2	11.85		**36.835**
2	PAS(Primary/Principal Arterial Street)	70.716	37.178	40.932	65.861	75.7	**290.387**
3	SAS(Secondary Arterial Street)	20.07	22.882	60.505	17.698	43.2	**164.355**
4	CS(Collector Street)	66.482	35.638	37.102	49.3	26	**214.522**
5	LS(Collector Street)	566.416	701.917	701.69	828.108	256.85	**3054.981**
Total		**731.084**	**811**	**844.429**	**972.817**	**401.75**	**3761.08**

Source: Taken from the road coverage report of AACRT (2018)

Table 3.8: Showing the sidewalk coverage in meters by direction

Sidewalks of Addis Ababa		
Region	**Sum in length,(m)(in Asphalt, Cobble and Tiles)**	**Coverage in area (m2)**
South	136,567.0	717,541.0
West	87,521.3	318,337.5
North	87,650.7	506,952.4
Central	172,225.5	728,951.4

East	152,369.3	746,537.3
Total	636,833.8	3,018,319.7

Source: Taken from the road coverage report of AACRT (2018)

CHAPTER FOUR

4. RESULT AND DISCUSSIONS

4.1. Introduction

This chapter contains a description and empirical analysis of the data which has been collected using subjective and objective inquiries that grasp the perceptions of users and the conditions of sidewalks. The subjective data has been analyzed both descriptively and empirically using tables and graphs and PLOS has been done as well. The reporting structure of this section first contains the data analysis description for all the subjective data collected from 819 pedestrian road users. Information is also compiled from each ward (North, South, Central, East and West), followed by the final analysis. The section of the report outlining the objective data analysis is done by descriptive analysis as well as the PLOS for each of the 21 segment samples.

The first data collection method is analyzed from the subjective responses of pedestrians. The intention is to use their perceptions to better provide a good sidewalk experience and thus increase healthy walking. Enhancing the built sets and street outline, based on how pedestrians perceive the issues, is a priority to promote walking in urban precincts (Koohsari et al., 2013).

The second data collection method is analyzed based on standards and formulas used worldwide like the pedestrian level of service of the HCM and pedestrian level of service of the Australian method compared with the perception rating.

4.2. Descriptive Analysis

4.2.1. Socioeconomic Health and Physical Conditions of the Pedestrian Road User Respondents

For the purpose of this study, subjective data collected from 819 individual pedestrian road users has been used. In this section there is a descriptive analysis report for all the 819 without being classified as to which ward they belong. Eight-hundred nineteen (819) pedestrians were interviewed on different segments of the sidewalk. Twenty-three questions were used containing both dependent and independent variables covering socioeconomic status, physical health and the person's perception of the different variables concerning sidewalk quality. Out of 819 people interviewed, 62.4% were female

As it can be seen in Figure 4.1, the age group of 30-39 provided most of the interview information. This demographic can be presumed as the ideal in terms of capacity, purpose and ability to walk.

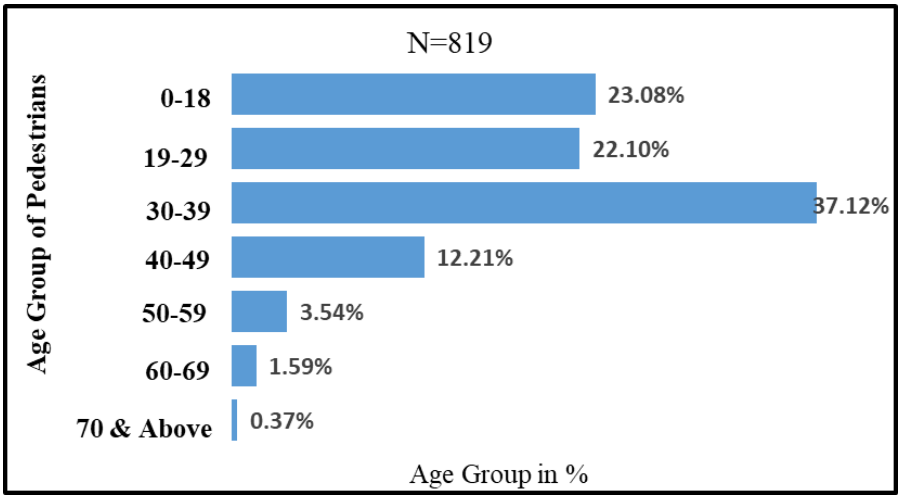


Figure 4.1: The Age Group of the Respondents

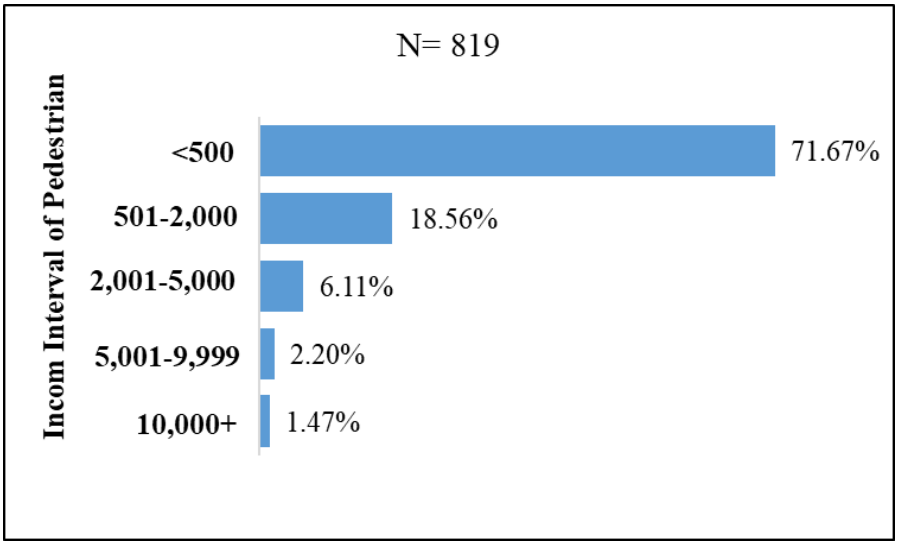


Figure4.2.: The Income Level of the Respondents

The interview results from all five wards regarding income levels of pedestrians shows that three-fourths of the walkers earn below 500 birr a month.

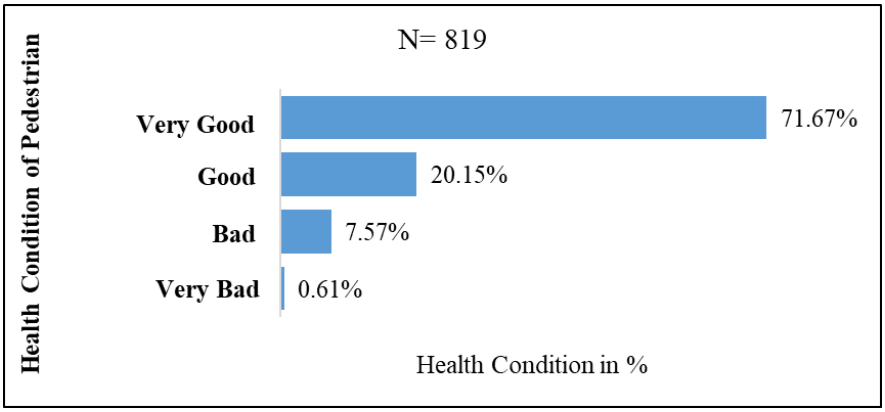


Figure4.3.: The health condition of the Respondents

Health conditions can affect a person's opinion about walking, even affecting walking behavior. In order to determine whether health has anything to do with the responsiveness of pedestrians, a question about health was included in the interview. A high majority responded that their health was good/very good.

4.2.2. Pedestrian Experience on the sidewalk

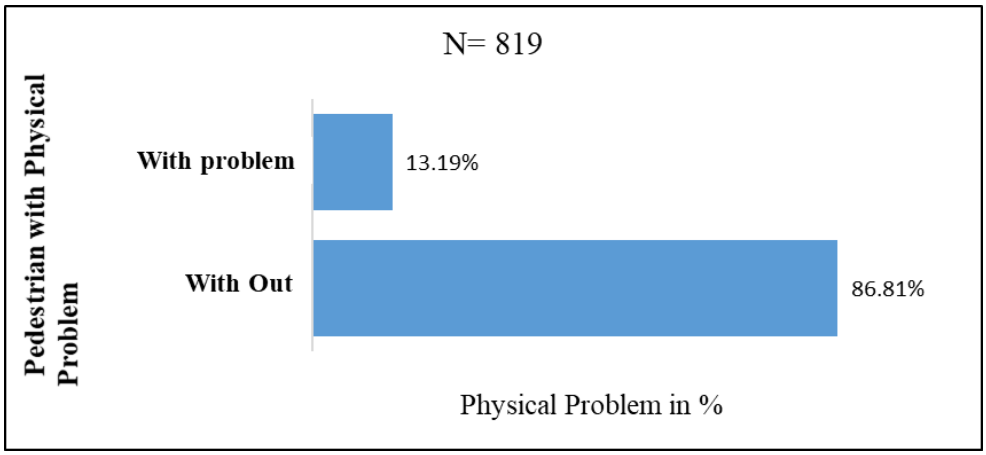


Figure4.4.: The Condition of Physical problems that disrupt walking of the Respondents

The study wanted to determine if people using sidewalks contained a group with physical disabilities. Of those interviewed, 86.81% said they had no physical disabilities. Those that had physical disabilities (13.19%) said their sidewalk experience was a negative one, indicating the need for mitigating action to accommodate their handicap.

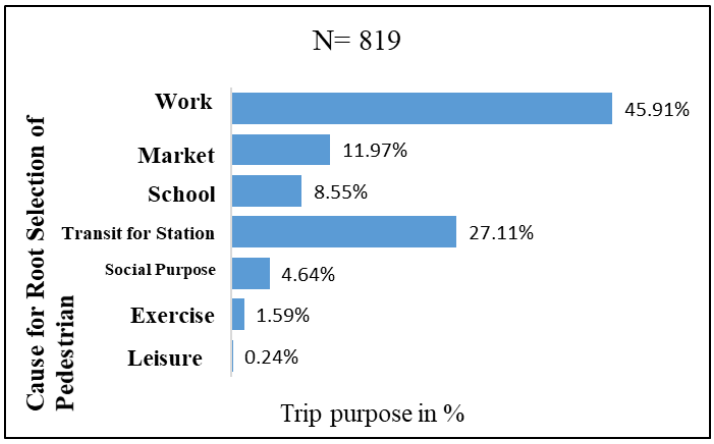


Figure4.5. Pedestrian Road User Trip Purpose.

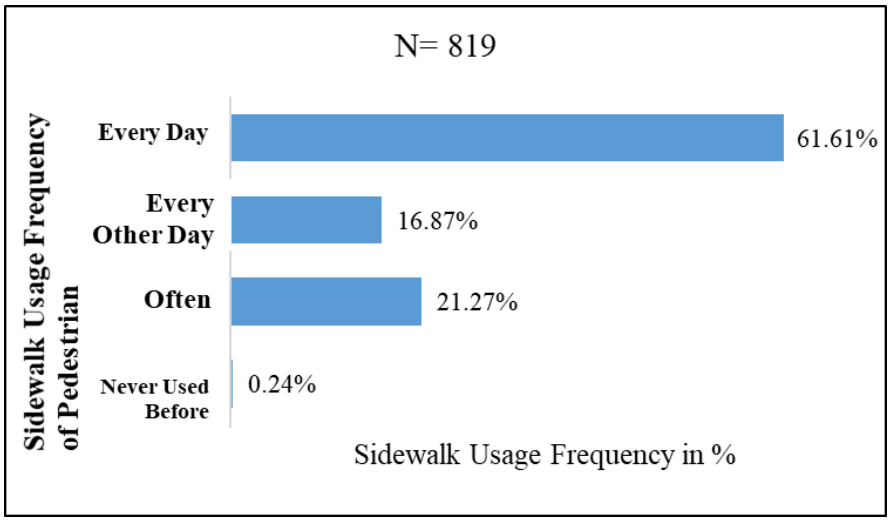


Figure 4.6.: Respondents Frequency of Sidewalk Use

As can be seen in Figure 4.5, the highest reason to use a particular sidewalk is work related (46%), followed by the need to transition to a transportation station (27.11%). This shows that the sample sidewalks or paths are serving an important purpose and the users cannot necessarily be classified as users with a choice to use the sidewalk. And in Figure 5.6, out of 819 people, 60% said they used that specific sidewalk every day, and more than 16% said they use the sidewalk every other day.

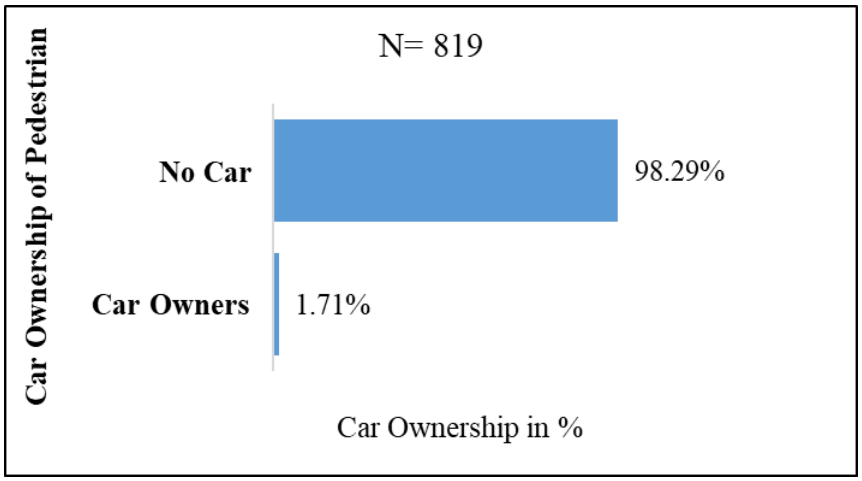


Figure 4.7: The Respondents Car Ownership

From the 819 pedestrians taken as a sample only two percent own a car; the overwhelming majority of the people do not own a car as it can be observed in Figure 4.7

Table 4.1. Summary of the General Descriptive Analysis

	Variables and Code	**Type**	**Unit**	**Mean**	**Mode**	**Std. Dev**
1	Gender(1,2)	Independent	Nominal	1.623	2	0.484
2	Age:(1-7)	Independent	Ordinal	2.572	3	1.195
3	Income level:(1-5)	Independent	Ordinal	1.432	1	0.822
4	Car Ownership:(0-1)	Independent	Binary	0.017	0	0.129
5	Health Condition:(1-4)	Independent	Ordinal	1.371	1	0.649
6	Physical Problems Disrupt walking(1-2)	Independent	Nominal	1.868	2	0.338
7	Cause for route selection:(1-7)	Independent	Nominal	2.383	2	1.489
8	Sidewalk Usage frequency:(1-4)	Independent	Ordinal	1.6	1	0.824
9	Comfortable Convenient or Not:(1-2)	Dependent	Ordinal	1.84	2	0.366
10	Sidewalk Disconcerting Activities and Vending:(1-6)	Independent	Nominal	2.289	2	0.912
11	Quality of sidewalk: (1-5)	Independent	Ordinal	2.877	3	0.837
12	Vending vs Walking Space: (1-5)	Independent	Ordinal	2.349	2	1.152
13	Comfort Vs Street Vendors Existence: (1-5)	Independent	Ordinal	1.776	2	0.826

14	Street Vendors Existence: (1-5)	Independent	Ordinal	1.671	1	0.835
15	Pedestrian Traffic Perspective: (1-5)	Independent	Ordinal	2.399	2	0.87
16	Sidewalk Width Perspective: (1-5)	Independent	Ordinal	3.117	3	0.758
17	Benches Existence: (1-2)	Independent		1.38	1	0.485
18	Safety During Day: (1-2)	Dependent		1.336	1	0.472
19	Safety During Night: (1-2)	Dependent		1.672	2	0.469
20	Slippery and Falling Cause: (1-2)	Independent		1.515	2	0.5
21	Violence: (1-2)	Independent		1.484	1	0.5

4.3. Descriptive Analysis by Ward

In this part of the analysis, different related variables are compared and discussed for each ward. Analyzing the data for individual wards helped understand the difference of the results as the character of each location changes. Addis Ababa is known for its diversity and the different locations also contain unique characteristics; therefore, the analysis will naturally point out the differences of each section of the city. There are five wards identified by their location, namely North, South, Central, East and West, each containing a different number of segments. The North has two segments and the next two, the South and Central, contain four each, East has six and West has five.

4.3.1. Northern Ward Descriptive Analysis

In the Northern arterial road sidewalk segments, two samples have been taken based on the proportion of sidewalk road length. This region contains the smallest segment sample indicating that the area covered by arterial street and sidewalk is smaller relative to the other wards. The map

and the other information on the segments are described in Table 2. The total number of pedestrian road users within the ward is 78 pedestrians.

Table. 4.2: The sample of the Northern ward

Map of Northern Ward	Name of segment	Distance by m	Total=N
	Lem hotel to Shola Market: N1	1,300	39

	Ykatit 12 Sq To US Embassy: N2	1,300	39

One of the variables seen as a characteristic of Addis Ababa's sidewalks are the activities that are going on or within the sidewalk at the same time people are actively walking, which is the purpose of the path. So in order to understand the influence that the non-walking activities are having, there is a question of perception towards the different activities.

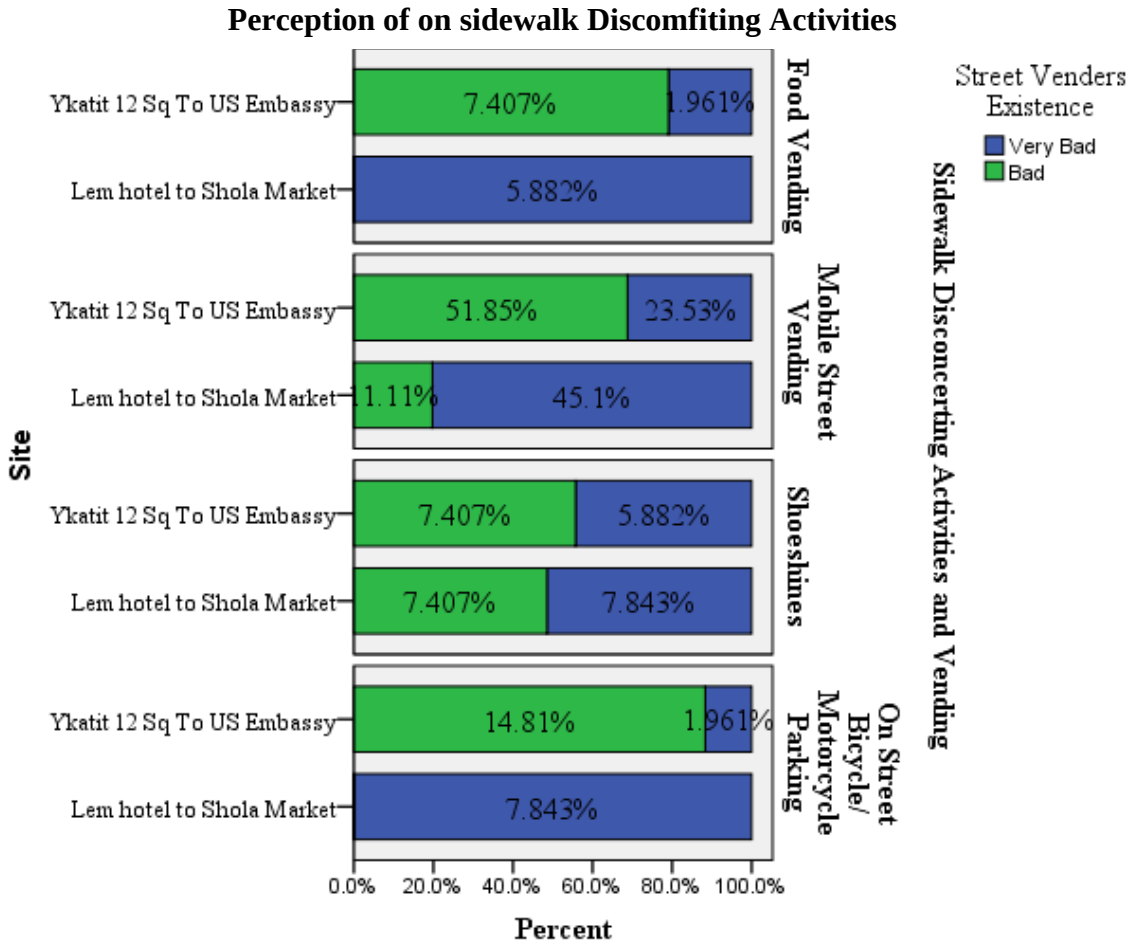


Figure 4.8: The relation of comfort and convenience with non-walking activities

Figure 4.14 shows that the highest activity that is discomfiting for pedestrians on the North Ward is the mobile street vending activity. This result is similar to the general analysis provided in the previous section. Both N1 and N2 pedestrian road users have rated mobile street vending to be higher in the most negative rating scale namely Very Bad and Bad.

It is believed that perception is a way to understand the user and, in the case of this study, users' perceptions can be utilized to make sidewalk travel enjoyable, thus making walking more

attractive. As can be seen in Figure 15, 91 percent of pedestrian road users have no physical limitations and almost half of those interviewed are satisfied with the existing benches. However, 71 percent say they are not comfortable and it is not convenient for them to walk on this North Ward sample segment, suggesting there are other sidewalk environment issues disrupting their activity. Violence is lower in comparison to other causes, but 60 percent of the people do not feel safe because of slipping and falling. Safety issues understandably increase at night, but daytime safety concerns are rather high at 45 percent. As the results indicate, the answers given to the research questions came back highly negative, discouraging walkers in the long-run.

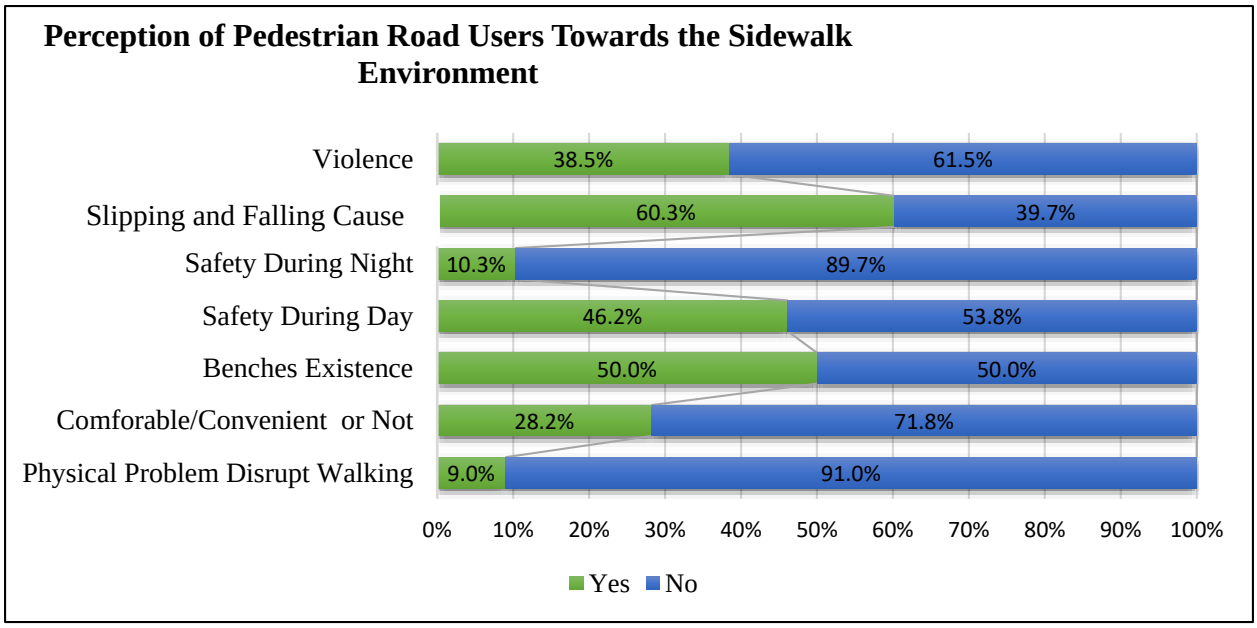


Figure 4.9: The perception of road users towards the walking environment

4.3.2. Southern Wared Disctiptive Analysis

In the Southern arterial road, four sidewalk segment samples have been taken based on the proportion of sidewalk road length in the city. This ward contains average sample segments. A

map and other information on all four segments are described in Table 3. The total number of pedestrian respondent road users within the ward is 156 pedestrians.

Table 4.3. Southern Ward Descriptive Analysis

Map of South Ward	Name of segment	Distance by m	Total=N
	Adey Abeba-Abo: S1	1,000	39
	Hamsa Simint-Hana Mariam: S2	1,000	39
	Karl RA-Puskine RA S3	100	39

	Garment RA- Lebu Mabrat Haile Sq S4	1,000	39

As has been previously described, a user's perception of sidewalk safety has been measured with a number of variables. In the South Ward, 156 were interviewed with results recorded in Figure 5.16. Similarly, to the North Ward's results, physical problems are of low concern and satisfaction of benches is high at 75%. Comfort and convenience are the most troublesome with 83% of those interviewed responding negatively. Factors other than physical disability or benches must have affected the comfort of their sidewalk experience.

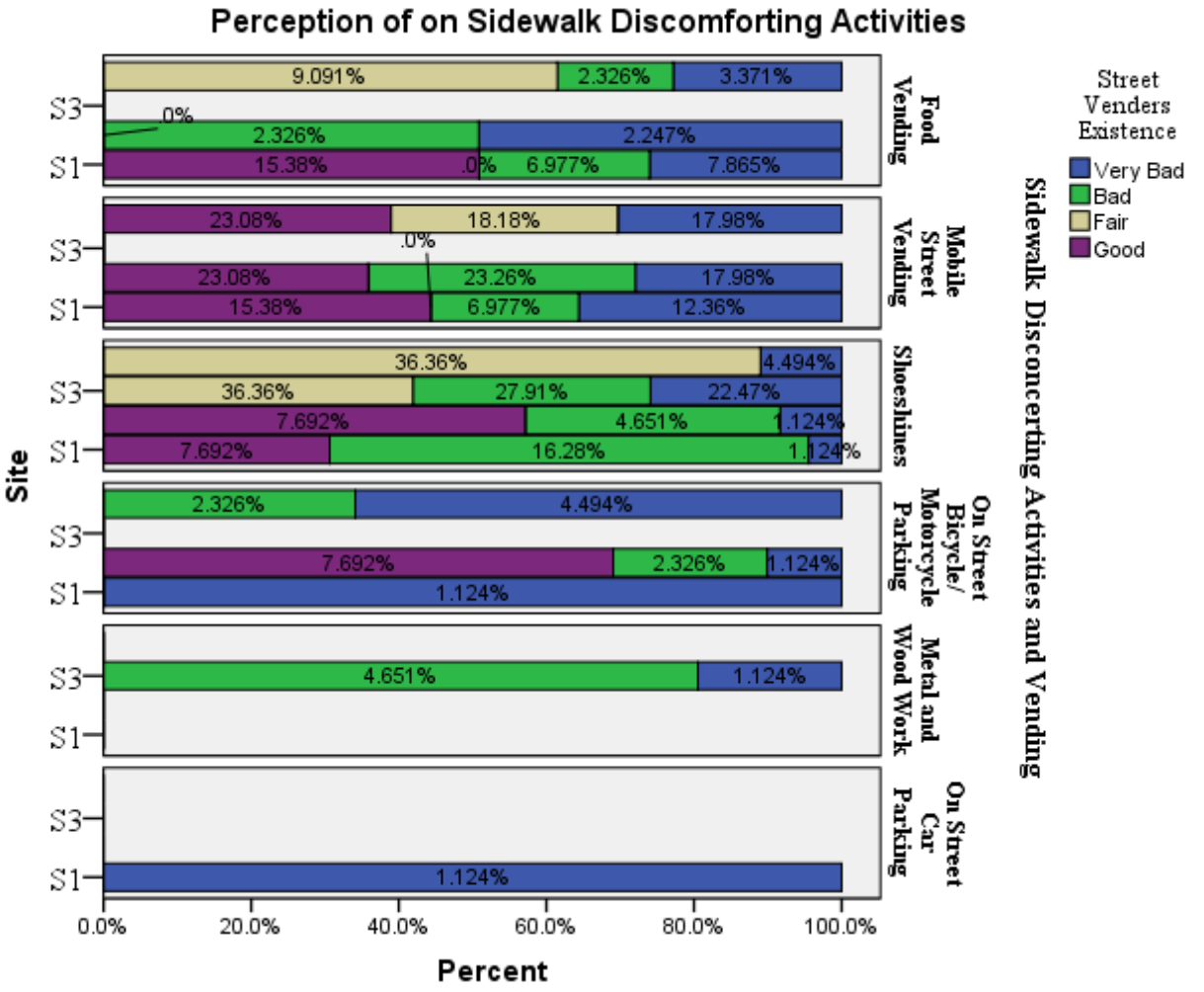


Figure 4.16: The Relation of Comfort and Convenience with Non-Walking Activities

According to Figure 4.16 the non-walking activities are major a negative influence to the comfort of users, some of the users in three of the segments has responded supporting the vending activities. Figure 4.17 displays fifty-five percent of all respondents do not feel safe at night and 30 percent do not feel safe during the day. Violence certainly affects feelings of safety, and 60% of 156 respondents indicated their fear of violence. Slipping and falling concerns are also high at 68%. These two indicators explain why pedestrian road users do not feel safe.

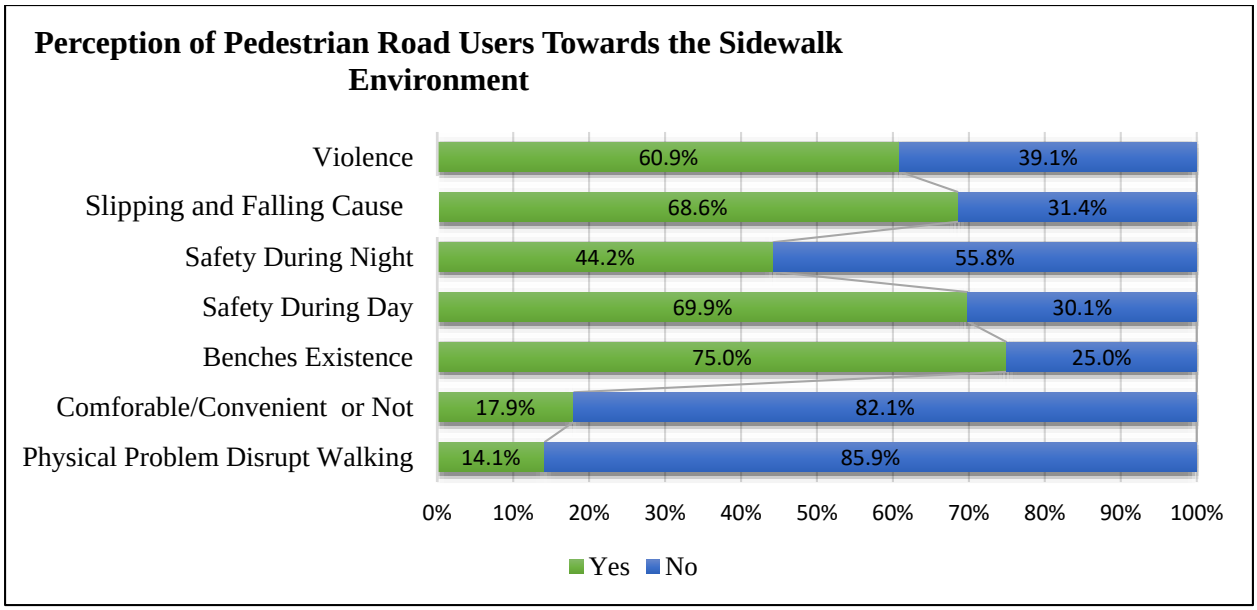


Figure 4.17: Perception of road users towards the walking environment

Pedestrian perceptions of comfort and convenience is not favorable as shown in Figure 5.18. It is clearly seen that the existence of street vendors is rated very bad (57%) and bad (27%). Pedestrian traffic congestion is the highest of all with 100% of respondents claiming that as a major impediment on sidewalks. Even if sidewalk quality inclines to fair or good by a total of 81% and 82% respectively, the existence of street vendors taking up walking space inclines to the negative bad and very bad rating.

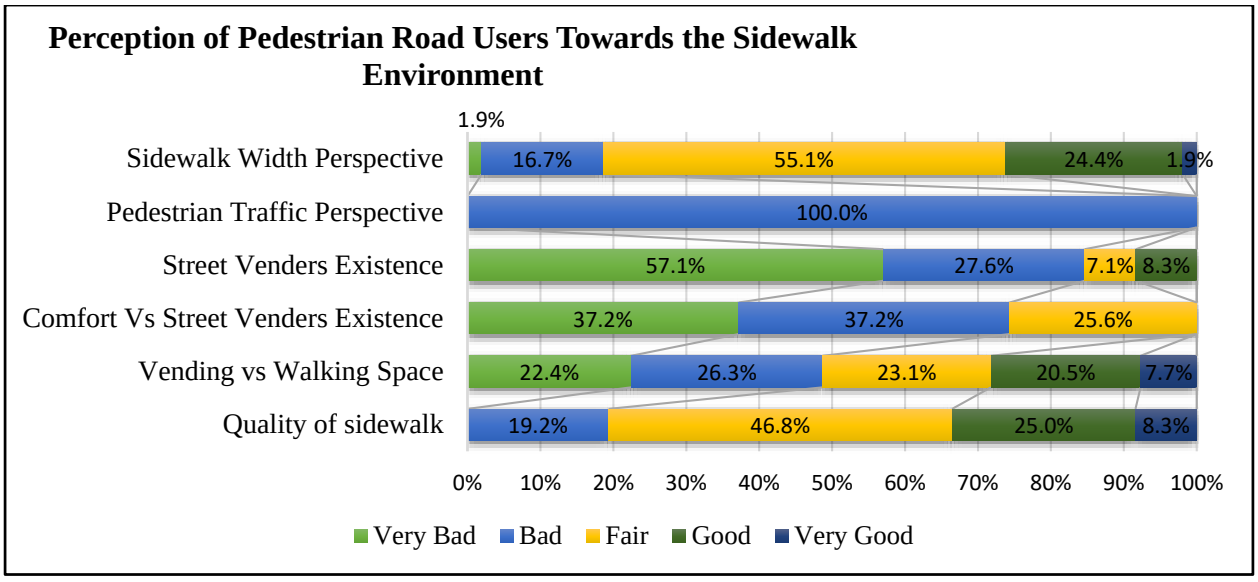


Figure 410: Showing the perception of road users towards the walking environment activities

4.3.2. Center Ward Descriptive Analysis

The Central Ward contains four arterial sample areas of road; sidewalk segments have been taken based on the proportion of sidewalk road length of the city. The map and the other information on all four segment sites are described in the table below. The total number of pedestrian road users within the ward is 156.

Table. 4.4: The sample of the Central ward

Map of Central Ward	Name of segment	m	N
	St. George RA- Abuna Petros Sq: C1	1,150	39

	Yecatit 12 RA to Minilik II hospital: C2	1,150	39
	Mexico Sq- Stadium: C3	1,150	39
	Lycée Guebre- Mariam- Legehar Station: C4	1,150	39

One of the major questions posed to respondents was which type of sidewalk non-walking activities most interfered with their comfort. All the segments, namely C1, C2, C3 and C4, reflect answers that fall to a more negative perception of sidewalk activities. As the graph in Figure 5.19 shows, not all of the respondents think that vending on the sidewalk is a bad idea. Mobile street vendors compared with food vendors are rated to be fair (30%) and good (22%). C4 and C3 appear to like the vendors in comparison to other activities. Overall shoeshiners received the highest very bad and bad ratings followed by mobile street vending and food vending respectively

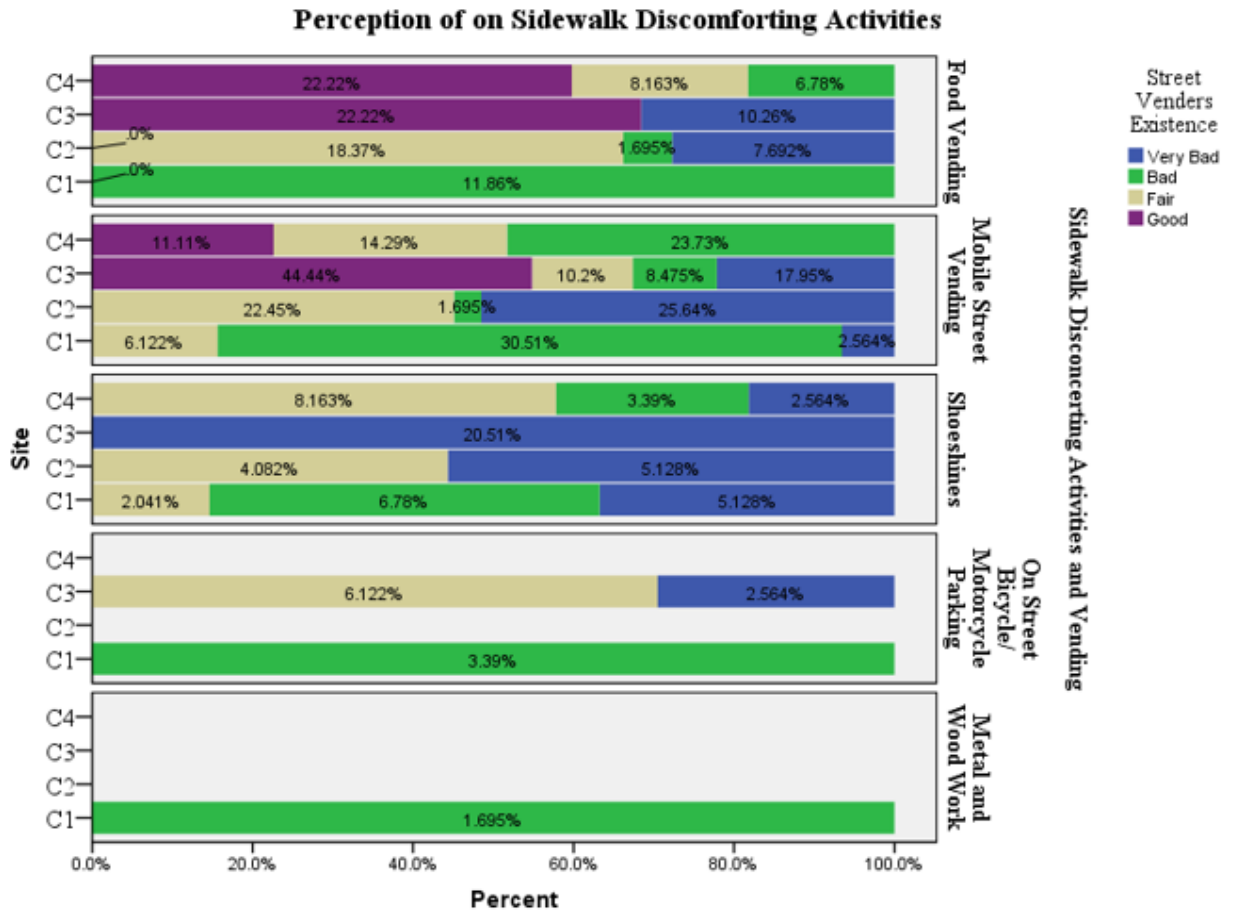


Figure 4.11: Showing the Relation of Comfort and Convenience with Non-Walking Activities

Figure 4.19 shows that users in C4 and C3 responded food vending and street venders are good activities but the majority responded the non-walking activist are discomfiting. In the perception measurement the graph in Figure 5.20 shows once again that physical problems that could disrupt walking are not an issue; 96% of the respondents do not have physical problems. Only 16% of people felt the sidewalk was comfortable and convenient, while 75% of them were happy with the benches on sidewalks. A high percentage of the people (84%) felt safe during the day with only 28 percent feeling safe at night. Of the 156 respondents, 62 percent rated violence as high risk.

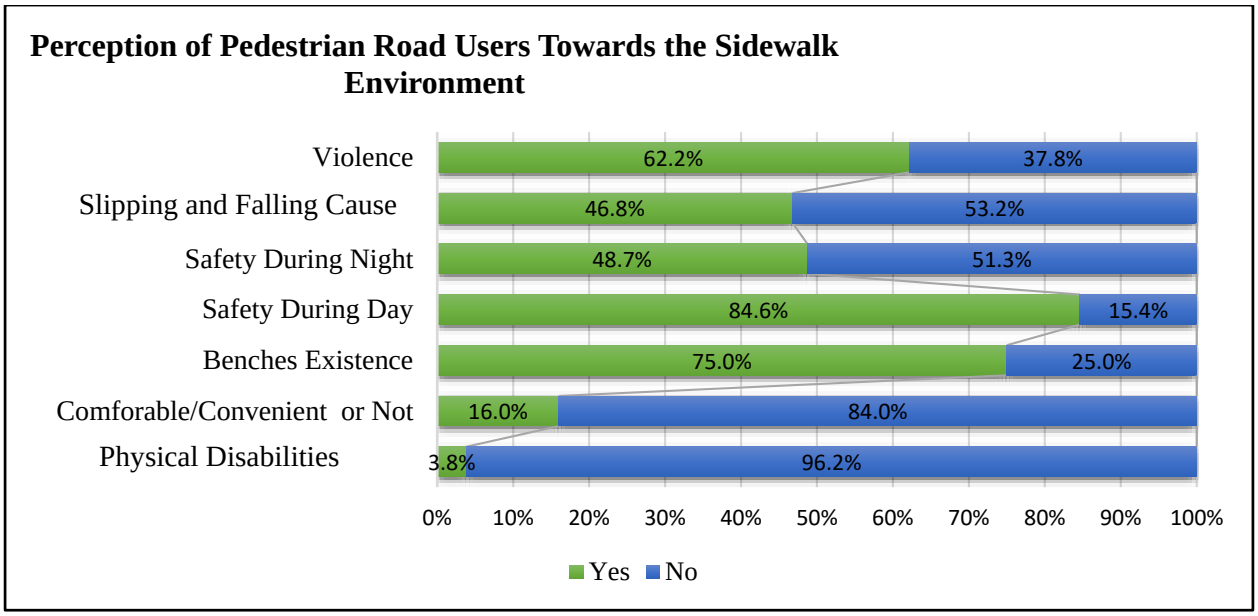


Figure 4.12: showing the perception of road users towards the walking environment

The overall ratings in Figure 4.21 lean more to positive perceptions with fair and good ratings garnering 68% of the totals. Pedestrian traffic congestion is 100% bad, but the quality of the sidewalks is considered fair by 39 percent and bad by 31 percent of the respondents. The results that attract the most attention are the three categories related to sidewalk vendors: vendor existence, comfort versus vending and walking space versus vending. All received a high percentage of negative ratings of 62%, 86% and 65% respectively. This shows that vending causes discomfort to pedestrians. Vendors, along with congested traffic, are the two main issues lowering the quality of walking.

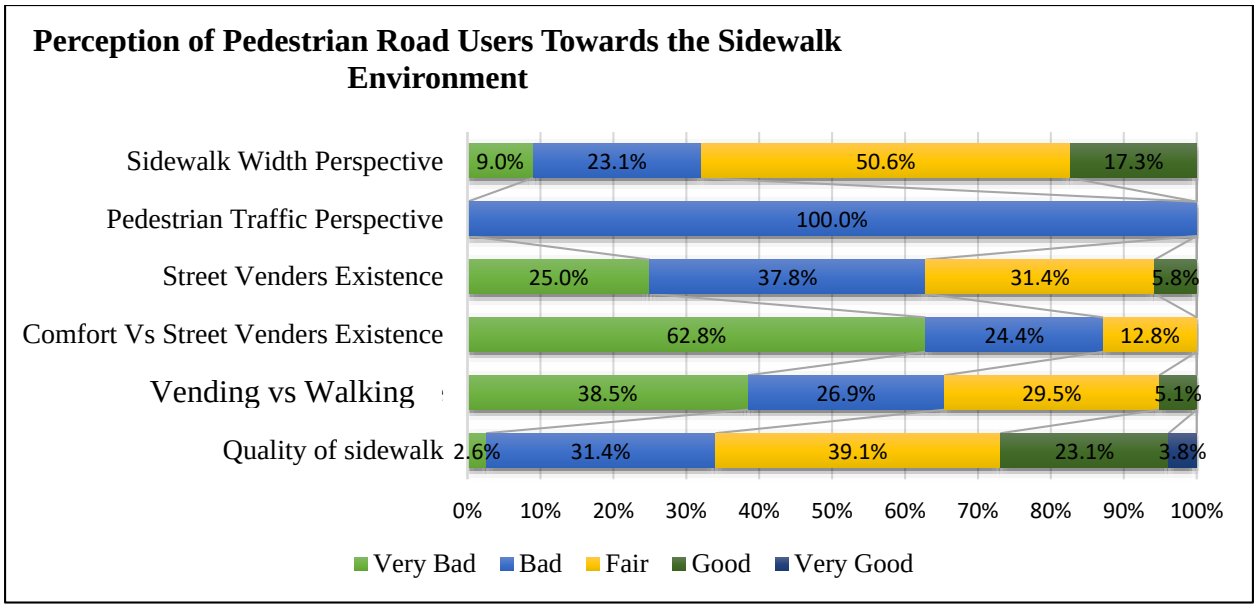


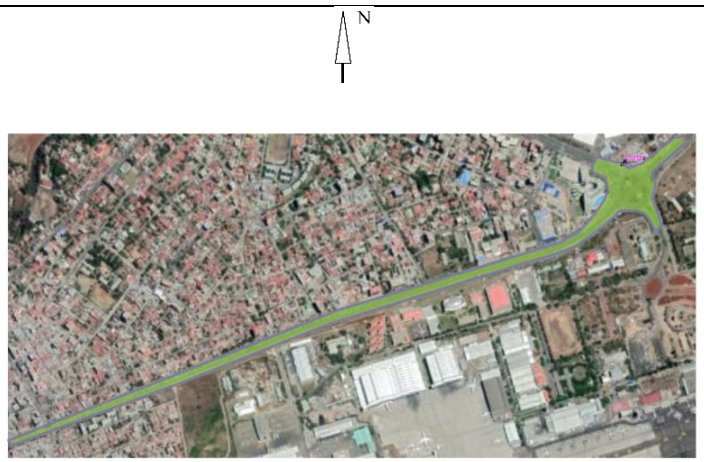
Figure 4.13: showing the perception of road users towards the walking environment activity

4.3.2. East Ward Descriptive Analysis

In the East Ward arterial road, there are six sidewalk segment samples. The sample is based on the proportion of sidewalk, road length that takes place in the ward from the total of Addis Ababa. This ward contains the largest number of sample segments indicating there are more arterial streets and sidewalks in comparison to the other wards. The map and the other information about the six segment sites are described and listed in the table below. The total number of pedestrian road users within the ward is 234 pedestrians; the ward also contains the highest number of pedestrian road user respondents.

Table. 4.5: The sample of the East ward

Map of East Ward	Name of segment	Distance by m	Total=N
	Megenagna Intersection to Lim Hotel Intersection E1	1,500	39
	Mebrat hail to Yerer Goro E2	1,500	39
	Hyatt Regency To Dembel City center E3	1,500	39

	Bole Mikael Sq To BoleAirport Sq E4	1,500	39
	Bole Mikael Sq to Rwanda Sq E5	1,500	39
	Bole Braas Sq to EdnaMall Sq E6	1,500	39

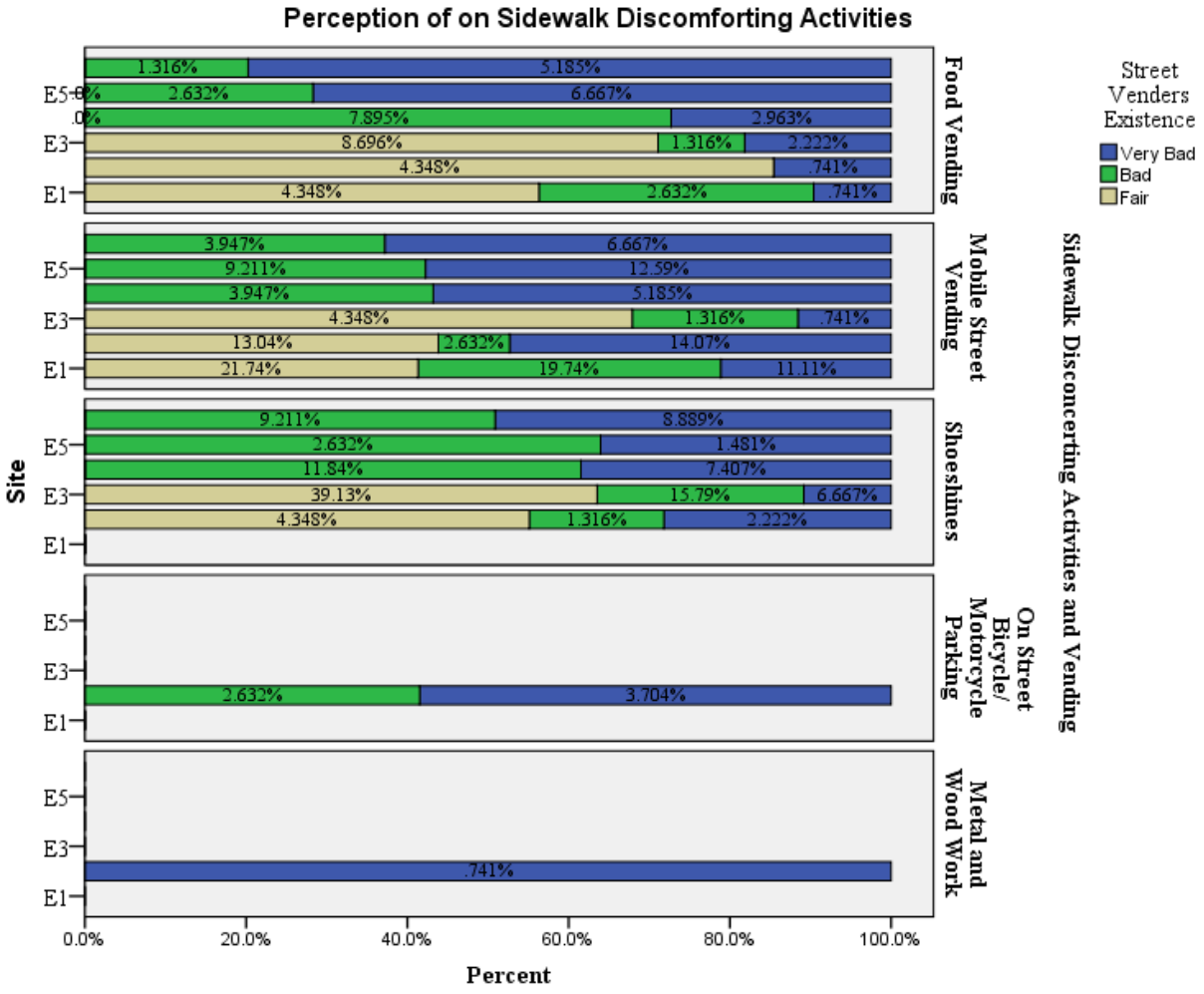


Figure 4.14: Showing the relation of comfort and convenience with non-walking activities

Figure 4.22 shows the non-walking activities are highly affecting the waking activity, according to the perception of users. All the users responded the five non waking activist are discomfiting by responding bad, very bad and fair. Figure 4.23 shows the highest number without physical problems (88%), 84% were dissatisfied with comfort and convenience, and 83% said there was a lack of benches along the sidewalk. It can be interpreted that a low comfort rating is proportionate to a lower bench count. E1, E2, E3, E4, E5 and E6 are highly rated for comfort and convenience. Only 33 percent of pedestrians feel safe walking at night with 52 percent feeling safe walking in

daylight but fear of violence and slipping and falling are relatively lower in the North, Central and Southern wards.

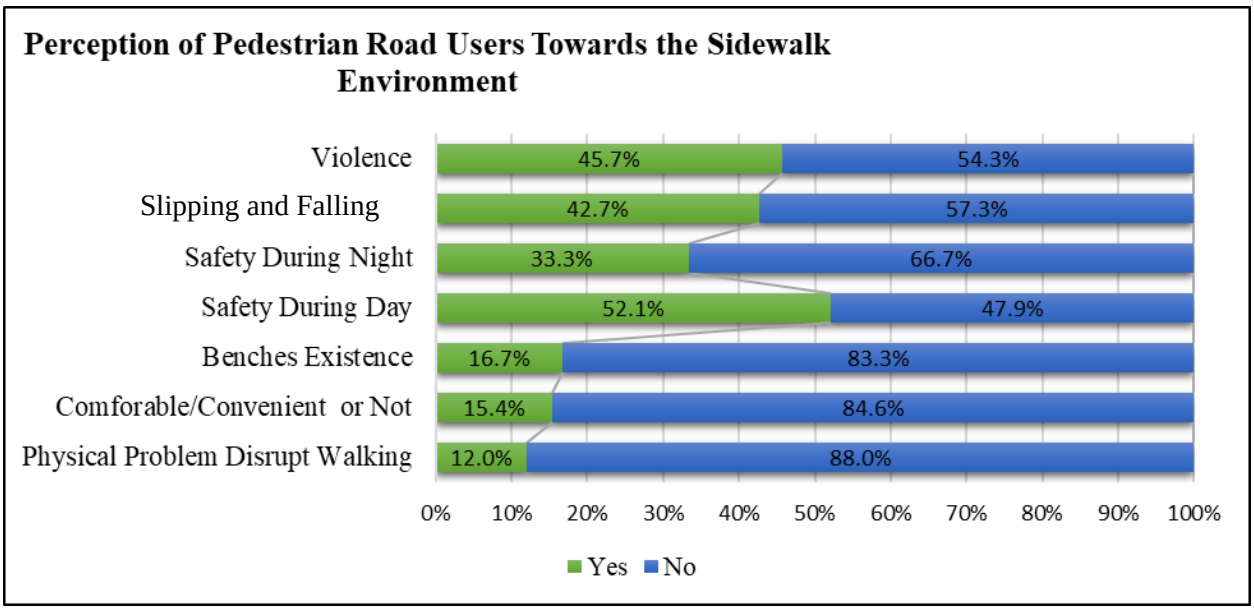


Figure 4.15: Showing the Perception of Road Users Towards the Walking Environment

Figure 4.24 reveals that sidewalk width is satisfactory receiving a 46% fair rating and 35% good rating. Pedestrian traffic congestion, however, was rated bad by all respondents. The existence of sidewalk vendors is rated very bad, and when respondents were asked how vendors impact their walking comfort, 40% rated this very bad and 27% rated it bad. Street vendor impact on the walking space received a very bad rating of 31%. This study shows that the problems on sidewalks result from the congestion of activities, not the standards and amenities of the sidewalks themselves.

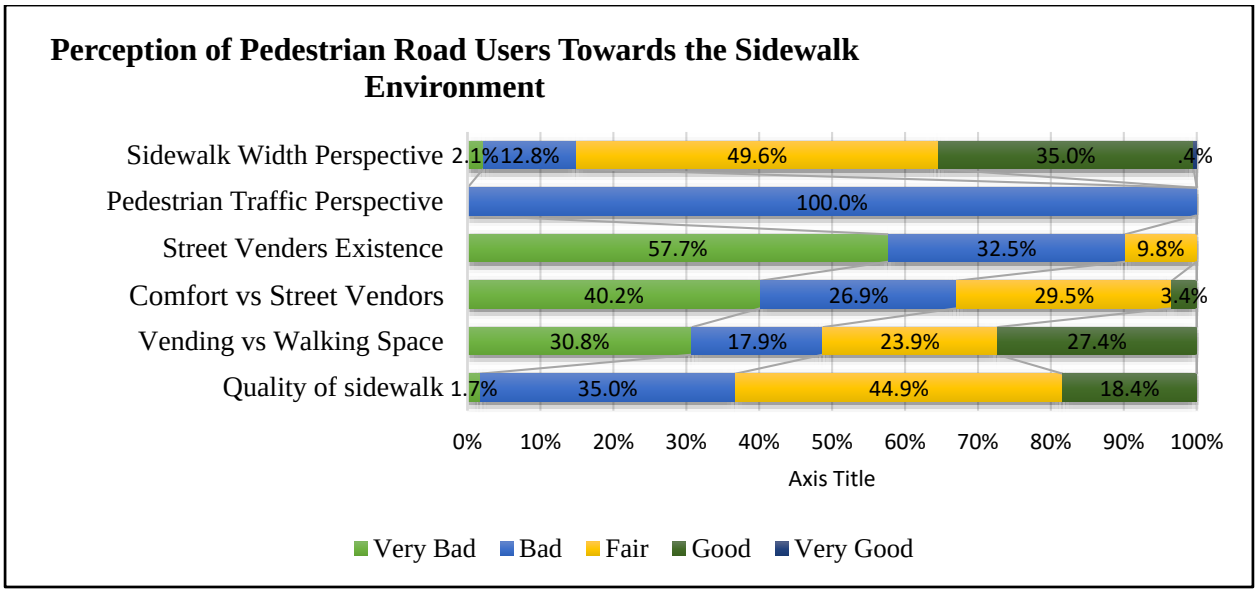


Figure 4.16: Showing the perception of road users towards the walking environment activity

4.3.2. West Ward Descriptive Analysis

In the West arterial road, five segment samples are used, the second highest segment number after the East Ward. The map and other information on the site are described in the table below. The total number of pedestrian road user respondents is 195.

Table. 4.6: The sample of the West ward

Map of West Ward	Name of segment	Distance by m	Total=N
	Benin Mosque To T/haimanot Church S1	1,500	39

	Winget Sq to Ras Hailu Park S2	1,500	39
	Awtobis Tera Sq-Abnet Hotel S3	1,500	39
	Ayertena Sq - Zenebework Sq: S4	1,500	39
	Torhayloch Sq- Sostkutrmazoria: S5	1,500	39

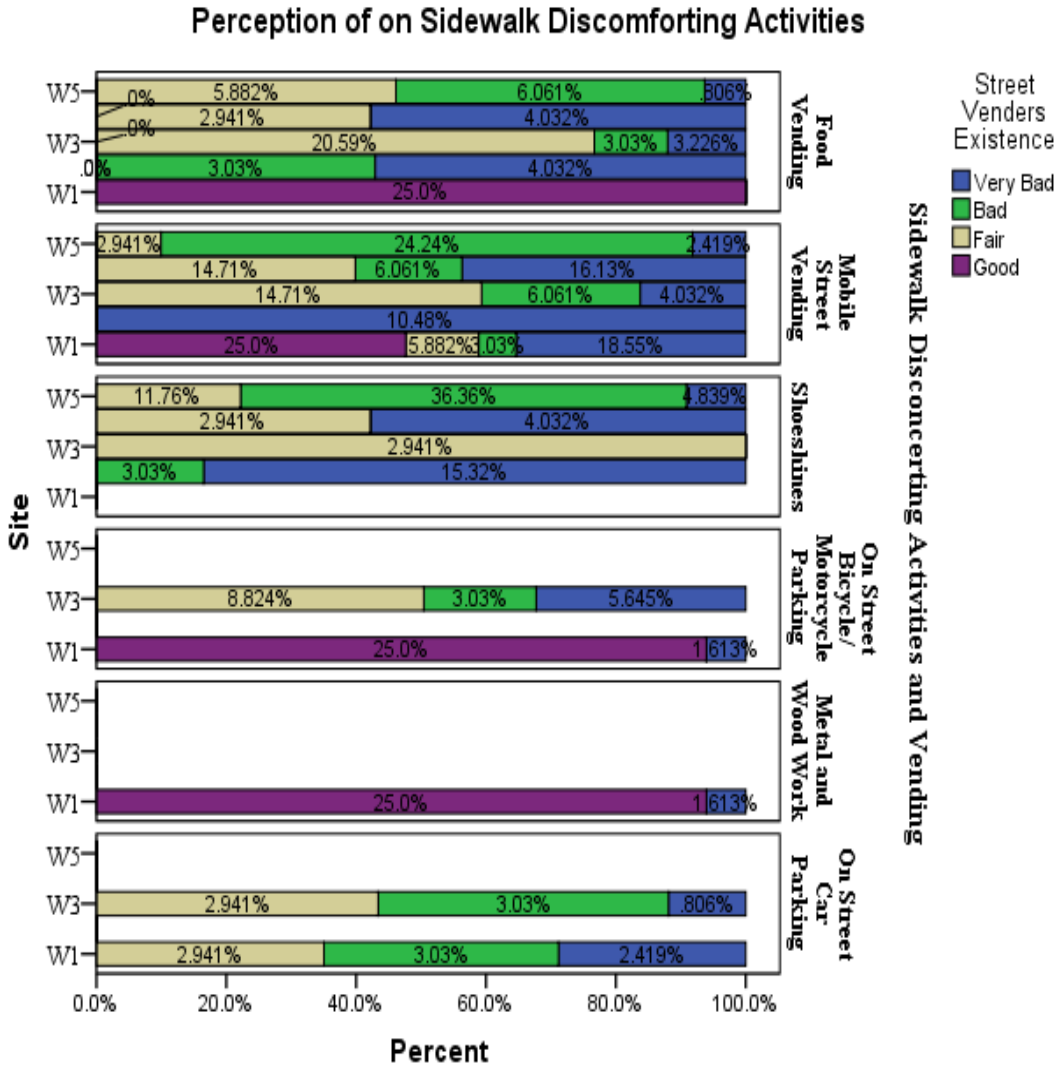


Figure 4.17: Showing the relation of comfort and convenience with non-walking activities

Figure 4.25 shows the non-walking activities are affecting the waking activity. Users responded the five non waking activist are discomfiting by more than 50% responding bad and very bad except for W1 users mentioned good to four of the activist. According Figure 5.26 violence is present, 47 percent of the respondents, but compared to the other wards the percentage is lower. Likewise, the results of this study show there are other factors other than physical problems or

sidewalk amenities that cause pedestrian discomfort. Pedestrian perception of safety during the day is high (73% feel safe), but only 19% feel safe at night which is low compared to other wards.

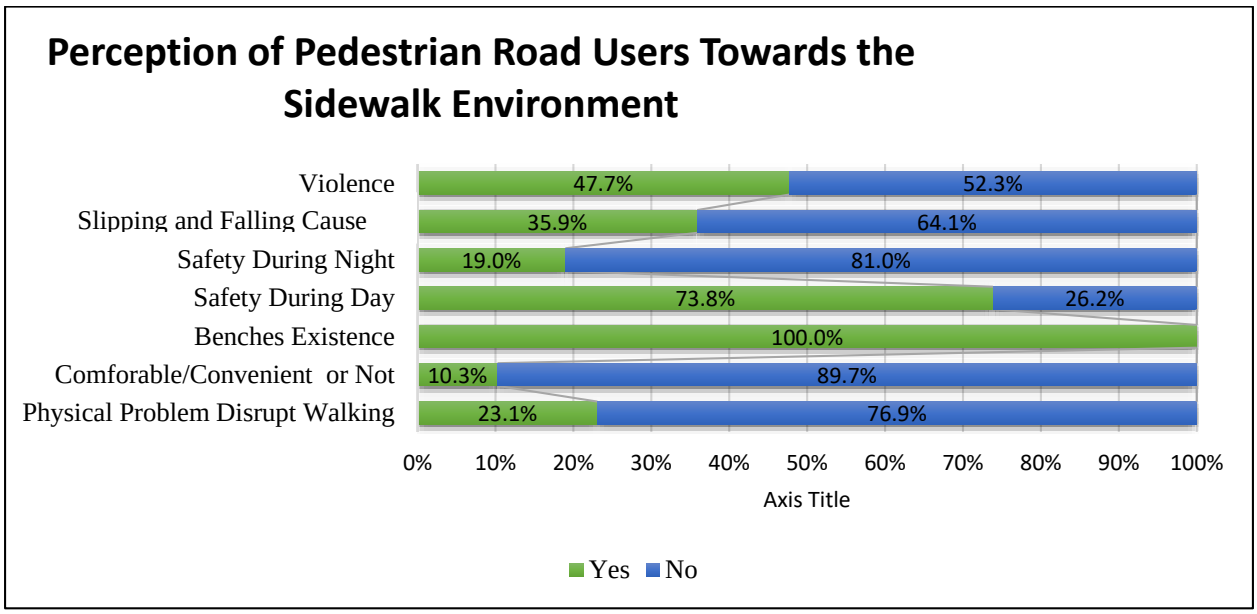


Figure 4.18: Showing the perception of road users towards the walking environment

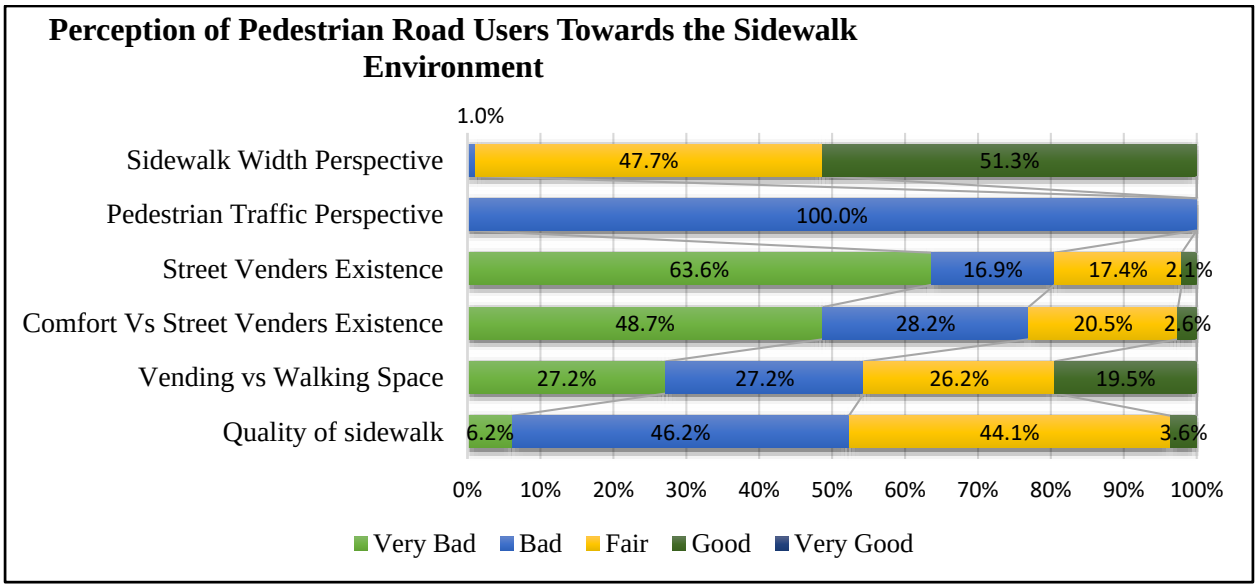


Figure 4.19: Showing the perception of road users towards the walking environment activity

4.5. Pedestrian level of Service

The concept of Pedestrian Level of Service (PLOS) is frequently used to objectively quantify the wellness of a sidewalk which accommodates pedestrians. A level of service can be defined as a measurement of the quality of service or an overall assessment of sidewalks that include the facilities such as street trees, curbs, lights, benches and can also be described to be "a quantitative stratification of a performance measure or measures that represent quality of service'' (Kang et al., 2013, p. 11). Since the 1990s researches have suggested a method in which evaluating PLOS based on other characteristics of trip quality (Jaskiewicz, 2000, pp. 1-14). Safety, comfort and convenience have been considered (Sarkar, 1993; Henson, 2000; Khisty, 1994). These environmental, geometry and behavioral factors may be used alone or in combination with the capacity approach.

In order to make it a convenient and working model, both capacity-based and street characteristics approach has been used that include other measurements beyond just volume and capacity. Although the quantitative measures: flow, speed, and density affect factors like the ability to choose walking speeds and bypass slower pedestrians are good factors, the HCM makes it clear that additional environmental factors, such as comfort, safety, convenience, economy, and security should be taken into account because these factors contribute to the PLOS.

In order to investigate the quality of sidewalks, many factors must be taken into consideration. Safety (are there gaps or obstacles in the sidewalk path?), capacity (are sidewalks wide enough?) and comfort (is sidewalk walking pleasant?) are characteristics of Addis Ababa sidewalks that measure sidewalk effectiveness. Dependent variables that affect comfort and convenience include weather protection, direct arcade pathways, the degree and type of street activities as well as other features making pedestrian travel easy and uncomplicated. Separation of pedestrians from

vehicular traffic, adequate lighting, open lines of sight and the degree and type of sidewalk activities all are factors impacting the safety and security of sidewalk travelers.

4.5.1. Pedestrian level of service models

Two types of models have been used in order to understand sidewalk capacity and quality of safety, comfort and convenience. For capacity the HCM has been used and for quality the Australian PLOS model was used. It is presented by comparing it with the pedestrian road users rating of satisfaction.

4.5.2. PLOS Ratings with Two Models of Calculation

4.5.2.1. Model One: HCM

Example: Location N1, which was located on the North Ward, namely "Lem Hotel to Shola Market", has a width of 2 m with the highest 15-minute pedestrian volume of 439 making the PLOS rating by the HM method as:

$$PLOS_{N1} = \frac{V_{15}/15}{W} = \frac{439/15}{(2)} =$$

$PLOS_{N1}$ = 14.63 p/ min/m : Score<5: $PLOS_{N1}$ = D

Table 4.7: Showing sidewalk PLOS rating criteria for HCM methods

PLOS Grading	HCM method flow rate (p/ min/ m)
A	Score ≤ 5
B	5 Score ≤ 7
C	7 Score ≤ 10
D	10 Score ≤ 15
E	15 Score ≤ 23
F	Score ≤ 23

The example shown of N1 is grouped into the PLOS level D in the HCM method according to the table's description.

4.5.2.2. Model Two: The Australian Method

Example: Location N1, which is located on the North Ward, namely "Lem Hotel to Shola Market", was found as follows with the Australian method:

Table 4.8: showing the grading of the Australian Method Factors and Measuring method used for N1.

Category LOS	LOS Factor	Method of Measurement	Value	No of Points	Weight	Weight Score
Design or physical Factors	Path Width	Measure during site visit	2m	2	4	8
	Surface Quality	Examine during site visit	Many cracks and bumps	0	5	0
	Obstructions (per km)	Count during site visit	Some low hanging trees	3	3	9
	Crossing Opportunities	Assess during site visit	Path on two side of the road, with no kerb ramps	0	4	0
	Support Facilities	Examine during site visit	None	0	2	0

Location Factors	Environment Potential for	Assess from street directory maps and on a site visit	Reasonable	3	2	6
	Connectivity	Assess from street directory maps and on a site visit	Very Poor	1	4	4
	Vehicle Conflict (per km)	Count on a site visit	Approx. 13	2	3	6
User Factors	Pedestrian Volume	Local Government statistics or count on a site visit	Assume less than 80 per day	4	3	12
	Mix of Path Users	Count during on a site visit	Mostly pedestrians, assume approx. 80%	3	4	12
	Personal Security	Assess during site visit, preferably at night	Poor, limited lighting	1	4	4

Source: Adopted from the Australian model

Table 4.9: showing the grading of the Australian method

PLOS Grading	Range of Scores
A	132 ≤
B	101 ≤ 131
C	69 ≤ 100
D	37 ≤ 68
E	36 ≥

Therefore, according to this Australian method, grading shown on table 5.9 shows the total weight score is 51, this example N1 is a D level. How it is pointed and measured is indicated in table 5.9 and the grading on table 5.10

Source: Adopted from the Australian model

Example: Location N1, which is located on the North Ward, namely "Lem Hotel to Shola Market", was also examined with five rating grades.

Table 4.10: Models rating used

Perception	Scores
A	Excellent
B	Good
C	Average
D	Poor
E	Very Poor

Therefore, according to the perception rating, this example, N1, is a D level.

Source: Adopted from the Australian model

4.5.2.3. Model Three (Perception): Rating based on user perception

PLOS rating with different models and User rating as comparison

Table 4.11: Result of all models rating, the two PLOS results and the perception rating.

Ward	Segment Name	HCM Method	Australian Method	Users Rating

North	N1	D	D	D
	N2	C	D	C
	Total	D	D	D
South	S1	E	D	E
	S2	C	D	C
	S3	B	C	B
	S4	C	D	C
	Total	D	D	C
Central	C1	C	D	D
	C2	D	E	E
	C3	C	D	E
	C4	C	D	E
	Total	C	D	E
East	E1	B	E	E
	E2	C	D	D
	E3	C	D	C
	E4	B	C	B
	E5	C	D	D
	E6	C	D	D
	Total	C	D	D
West	W1	D	E	E
	W2	C	E	D
	W3	E	E	E

	W4	D	E	E
	W5	D	D	D
	Total	D	D	E

As the results in the table show, the Australian Method PLOS and the perception quality rating shows the service gained by most of the segments is low compared to the HCM method. The HCM method does not show the highest quality, but has varied from B grade to E grade with F being the lowest grade; there is no segment with the F grade.

As the sources listed above demonstrate, the HCM method grade is based on Volume and Flow rates. And since the characteristics of pedestrians and their paths differ from region to region incorporating many variables, the HCM method cannot be the only measuring technique.

It can be concluded that the perception and the Australian method are more suitable to evaluate the conditions of Addis Ababa's sidewalks because of the similarity of the score and the evaluation points flow, best characterized with the segments.

CHAPTER FIVE

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusion

This research uses two different pedestrian LOS methods, namely the Australian method and the Highway Capacity Manual (2010) method. These methods compare user perceptions with the current safety, comfort and convenience of sidewalks in Addis Ababa. Objective and subjective questionnaires were used to gain understanding of the user's perception and the actual condition of the sidewalk environment. The results generated from this analytical process lead to several conclusions.

The aim of this study is to assess sidewalk safety by focusing on the sidewalk environment and sidewalk development as it relates to the comfort, safety and convenience of pedestrian users. According to Loukaitou (2001) in sidewalk environment; darkness and lack of windows opening onto the sidewalk and more can be safety factor that make them susceptible to crimes also describes environmental conditions that individuals perceive as ''cues to danger'' such as lack of familiarity and the presence of others. This literature attributes darkness, desolation, bushes, and low lighting in public areas as factors negatively impacting safety concerns. These influences have been considered in this study, but they are not the only sidewalk safety issues in Addis. Jacobs (1961) encouraged mixed land use in where the streets are in order to enlighten natural flow of people for surveillance on sidewalk. This hypothesis is undeniably true. The sidewalks studied in Addis are located in mixed land use with almost all sidewalks containing street vendors who engender enough activity to circumvent safety problems.

Safety, comfort and convenience can also be observed from the condition of the sidewalk itself. Safety is the extent to which pedestrians can move freely on sidewalks with freedom from physical and/or emotional harm. (Burton, E. and Mitchell, L. ,2006). According to Hidayat et al. (2001), street vending appears to be an obstruction that causes the most problems regarding pedestrian safety along with pavement conditions. The existence of street vendors, other obstacles on the path and the physical condition of sidewalks contribute to an unsafe walking environment. In conclusion, even if sidewalks have a high volume of foot traffic and have other negative influencers such as low lighting, users attribute their lack of comfort, safety and convenience to the poor quality of the sidewalks and the activities of street businesses. Street vendors take up valuable walking space forcing pedestrians to step off the sidewalk into vehicular traffic causing serious accidents.

This study observed that although there is congested pedestrian traffic on most of Addis' sidewalks, there is not a clear understanding of whether walkers are using the sidewalk by choice or not. High dissatisfaction among a majority of pedestrian road users leads to the conclusion that people are not attracted to sidewalks. This observation can potentially result in walkers seeking other modes of transportation over time. Two levels of service measuring methods have been applied in this study to achieve reasonable results.

The P LOS results have also been compared with the satisfaction rating of the users for an even more realistic result. It can be concluded that the level of service is low by 85%.

5.2. Recommendation

Even if the sidewalk is simply a transportation mode, it affects various indexes that need to be dealt with in order to solve the problems influencing pedestrian safety, comfort and convenience.

Based on the results and conclusions, recommendations are framed to address sidewalk safety, comfort, convenience, environment and quality with special attention given to street vending.

The following paragraphs will demonstrate short-term, immediate remedial measures, and possible long-term design and planning strategies. The deficiencies are listed in the short term paragraphs along with short term remedial measures. Long-term design and planning strategies which will sustain the principles of an improved overall pedestrian environment are also provided.

Short Term Recommendations: Safety, Comfort and Convenience

Sidewalk science has numerous components that impact safety recommendations. In all the studied sidewalks, no buffer between vehicles and pedestrians is provided. Buffers such as street furniture or landscaping would provide a much-needed buffer without reducing the necessary sidewalk width. There are also no aids to enhance safety and convenience for the disabled. The provision of tactile aids, audible signals, curbs and ramps that are wheelchair accessible would create a welcoming and safe environment for those with physical handicaps. The width of most sidewalks is inadequate to accommodate street furniture and the many other non-walking activities that occur. In selected places, the option to widen sidewalks to accommodate street furniture and other activities could be considered. Street furniture, street vendors and illegal parking encroach on sidewalk space. Vehicles need to be removed from all sidewalks and enforcement upheld. Uneven sidewalks and broken paving materials are safety risks and need to be repaired immediately. Some sidewalks pose a risk for slipping and tripping; these situations should be addressed with non-slip paving materials. The introduction of sidewalk lighting will greatly reduce crime and increase general safety.

Currently, streets are mainly designed to accommodate vehicular traffic, but it is imperative that an overall plan be introduced that takes into consideration foot traffic.

Walkway width is extremely inadequate on some sections; therefore, sidewalks need to be widened to adhere to basic standards. Planting trees and shrubs would do two important jobs: reduce air pollution and provide a buffer between sidewalks and motorized traffic. Seating areas also need to be provided on all sidewalks based on industry standard recommendations.

Long Term Recommendations: Safety, Comfort and Convenience

A uniform landscaping design for the city's sidewalks should be developed to ensure compliance with national accessibility guidelines. A code needs to be developed for the city so that contextual guidelines can be prescribed to ensure compliance with national guidelines and policies. Regular sidewalk maintenance needs to be undertaken to include maintenance of the drainage infrastructure. This maintenance needs to be systematic and stringently enforced.

Development of a code that addresses vehicular traffic throughout the city is imperative so contextual guidelines can be prescribed. Pedestrian-scale sidewalk lighting needs to be installed for reasons already stated. A standardized street furniture code should be drafted and implemented in Addis Ababa as well as other major cities in Ethiopia.

Recommendations for the sidewalk environment based on character of the sidewalk

The planning bodies must take into consideration the needs of pedestrians who make up the majority of travelers. Appropriate sidewalk width, safe surface conditions, fewer obstructions on the walkway, the presence of designated pedestrian crossings, buffer zones between sidewalks and traffic lanes, proper lighting and shade trees will provide a safe, inviting environment for the people in Addis who depend on foot transportation. In addition to foot traffic, other non-walking sidewalk activities must be considered in planning. Sidewalks in Addis are characterized by the presence of economic activities that obstruct the walking space. Vendors rely on sidewalk traffic

for their livelihood, thus removing them to a market place does not work. Planners could endorse the option of widening sidewalks to accommodate both walkers and vendors. A line or fence could be created for vendor space, with compliance enforced by law.

Recommendations towards Standards

City guidelines do stipulate the proper width of sidewalks in all the road types. However, revealed in the samples taken in this study, the guidelines are not implemented or are plagued with maintenance problems. Similarly, the (ASHTO) specifications for sidewalks reflect a commendable attitude towards the safety of pedestrians, but the standards set forth have not been practically implemented. The report of the (AACRA) specifies guidelines for sidewalks and pedestrian facilities which are at variance with some of the (ASHTO) guidelines. Thus, a comprehensive codebook for pedestrian facilities similar to other guidelines such as Standards Australia Manual, Portland Pedestrian Design Guide, Florida Green Book and the FHA's Pedestrian Facilities Users Guide, should be developed by (AACRA). Further, compliance to this code should be strictly enforced.

Recommendations towards Policies

Planning can be implemented with the help of policy makers. Policies giving priority to pedestrians have not been clearly laid out, and what has been stated is not necessarily translated into ground reality. Even though TPMO theoretically gives priority to the construction of pedestrian paths in some parts of the city, few results have been achieved.

Many programs have been set up with workshops on how to improve the city's public transportation infrastructure, but improvements for non-motorized transportation, like pedestrians,

remain largely on study. Thus, audits of national programmers should be more stringent to ensure that the stated objectives of the concerned policies are achieved.

Recommendation for future studies

Further research could include variables that were not surveyed in this research model in order to improve the prediction of future outcomes. A larger sample size might be needed. The model used for this thesis can be applied to other cities to provide a more comprehensive understanding of the relationship between pedestrian perceptions, sidewalk environment/condition, and level of service.

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ANNEXES

Annex *A*. Survey Questionnaires *(Subjective)*

Name_____Date_____Time_____

I Subjective assessment of pedestrian safety

1. What is your Gender? ☐ Male ☐ Female
2. What age group best describes you? ☐ 0 -18 ☐ 19-29 ☐ 30-39 ☐ 40-49 ☐ 50-59 ☐ 60-69 ☐ > 70
3. Income level ☐ < 500 ☐ 500 – 2,000 ☐ 2,000 – 5,000 ☐ 5,000 – 10,000 ☐ > 10,000
4. Car ownership ☐ Yes ☐ No
5. Health condition ☐ Very Good ☐ Good ☐ Fair ☐ Poor
6. Do you have a physical condition that affects your ability to walk? ☐ Yes ☐ No
7. Trip purpose ☐ going to work ☐ Going to Market ☐ Going to School ☐ for transitions station ☐ Visit ☐ Exercise ☐ Enjoy the outdoors
8. How frequently do you use this sidewalk? ☐ Frequently ☐ Occasionally ☐ Very Rarely ☐ Never
9. What are the activities on the sidewalk you find discomforting? ☐ Street foods vending ☐ Bicycling on the sidewalk ☐ Street retailing ☐ Motor vehicles parking on the sidewalk ☐ Street shoe shiner ☐ wood and metalwork's on the sidewalk
10. Are you satisfied with the quality of the sidewalks? ☐ very dissatisfied ☐ moderately dissatisfied ☐ slightly dissatisfied ☐ slightly satisfied ☐ Neutral

11. Sidewalk standard perception ☐ Yes ☐ No ☐ Neutral
12. Are you satisfied with the space you have to avoid the vendor's obstruction without decelerating your pace? ☐ Yes ☐ No ☐ Neutral
13. Do you feel comfortable walking through this sidewalk with the presence of street vendors? ☐ very uncomfortable ☐ uncomfortable ☐ slightly uncomfortable ☐ comfortable ☐ very comfortable
14. Are you interested in goods sold by vendors along this sidewalk? ☐ Very uninterested ☐ Uninterested ☐ Neutral ☐ Interested ☐ Very interested
15. Do you agree the number of pedestrians in this sidewalk is too large, causing this sidewalk to be crowded? ☐ Agree Slightly ☐ Disagree Strongly ☐ Disagree Moderately ☐ Disagree Slightly ☐ Neutral
16. Do you think the total width of the sidewalk is satisfying? ☐ very dissatisfied ☐ dissatisfied ☐ satisfied ☐ dissatisfied ☐ very satisfied ☐ Neutral
17. Are there any benches or other places to rest along the sidewalk? ☐ Yes ☐ No
18. Do you feel safe walking on this street during the day? ☐ Yes ☐ No
19. If, Yes or No, why_____
20. Do you feel safe walking on this street at night? ☐ Yes ☐ No If, Yes or No, why_____
21. Do you feel safe from trips, slips and falls? ☐ Yes ☐ No
22. Do you feel intimidation or physical attack? ☐ Yes ☐ No If, Yes or No, why_____
23. How often do you face obstruction while walking? ☐ Always ☐ About half the time ☐ Never
24. What is your suggestion on how to improvement the sidewalk quality?
25. _____

_____

Annex B. Survey Questionnaires *(Objective)*

II Objective assessment of the sidewalk pedestrian environment

Survey Person_____Date_____Time_____

1. What are the surrounding land use typology?

a. Purely residential b. Purely commercial c. Service

d. Mixed e. Other_____

2. Types of activities found on the side walk?

	A lot	Some	Little	None
1. Street food vending				
2. Street retailing				
3. Street shoe shiner				
4. Bicycle driving				
5. Motor vehicles on the sidewalk				
6. Motor vehicles parking				
7. Bicycles parking				
8. working (as a workshop)				

3. How is the intensity of activities on/by the sidewalk?

a. Very high activity b. High Activity c. Low activity

d. Very low activity e. No activity

4. How is the pedestrian traffic around sidewalk?

a. Very high activity b. High Activity c. Low activity

d. Very low activity e. No activity5. Is there a street light? a. Yes b. No

6. Is the street light working? a. Yes b. No c. Partially

7. Street furniture

Street Furnishers	**Yes**	**No**	**Amount**	**Arrangement(Good/Fair/Bad)**	**Condition(Good/Fair/Bad)**
Tree					
Garbage bins					
Benches					

8. Is the sidewalk/path clear of brush, broken glass, debris and unsightly garbage?

a. Very clear b. Clear c. Fairly clear d. Not clear

9. Are there curbs to separate the sidewalk/paths from the street?

a. Yes b. No

10. Are the sidewalks/paths wide enough for adults walking side by side?

a. Yes b. No

11. How good is the sidewalk for users with mobility aide?

a. a. Excellent b. Very Good c. Good
b. d. Fair e. Poor f. No Pavement

12. How is the condition of the pavement on the sidewalk?

a. Excellent b. Very Good c. Good

d. Fair e. Poor f. No Pavement

13. HCM PLOS variables

Segments	Volume	Width
1N		
2N		
1S		
2S		
3S		
4S		
1C		
2C		
3C		
4C		
1E		
2E		
3E		
4E		
5E		
6E		
1W		
2W		
3W		
4W		
5W		

13. Australian Method PLOS variables

Category LOS	LOS Factor	0	1	2	3	4
Design or physical Factors	Path Width					
	Surface Quality					
	Obstructions (per km)					
	Crossing Opportunities					
	Support Facilities					
Location Factors	Connectivity					
	Environment Potential for					
	Vehicle Conflict (per km)					
User Factors	Pedestrian Volume					
	Mix of Path Users					
	Personal Security					

Annex C. Coding (Subjective)

Gender:

1=Male

2=Female

Age:

1= 0-18

2=19-29

3=30-39

4=40-49

5=0-59

6=60-69

7=70 and above

Income:

1= <500

2=501-2000

3=2001-5000

4=5001-9999

5=10000+

Car Ownership:

1=Yes

2=No

Health Condition:

1=Very good

2=Good

3= Bad

4=Bad

Physical Problem Disrupt Walking:

1=Yes

2=No

Cause for route selection:

1= To Work

2= To Market

3= To School

4= Transport Station Transition

5= For leisure

6= To Exercise

7= Leisure

Sidewalk usage frequency:

1= Every day

2= Every Other Day

3= Often

4=Never Used It

Sidewalk Disconcerting Activities and Vending

1= Food Vending

2= Mobile Street Vending

3= Shoeshines

4= On Street Bicycle/ Motorcycle Parking

5=Metal and Wood Works

6= On street Car Parking …….

Quality of sidewalk:

0= No Respond

1= Very Bad

2= Bad

3= Fair

4= Good

5=Very Good

Perspective of Sidewalk Standard:

0=No Respond

1=Good

2=Bad

Vending vs Walking Space:

1= Very Bad

2= Bad

3= Fair

4= Good

5= Very Good

Comfort Vs Street Vendors Existence:

1= Very Discomforting

2= Discomforting

3= Fair

4= Comforting

5= Very Comforting

Street Vendors Existence:

0= No Respond

1= Very Bad

2= Bad

3= Good

4= Very Good

Pedestrian Traffic Perspective:

0= No Respond

1= Very Bad

2= Bad

3= Good

4= Very Good

Sidewalk Width Perspective:

0= No Respond

1= Very Bad

2= Bad

3= Good

4= Very Good

Benches Existence:

1= Yes

2= No ……

Safety During Day:

1= Yes

2= No ……

Safety During Night:

1= Yes

2= No

Slippery and Falling cause:

1= Yes

2= No ……

Violence:

1= Yes

2= No

How frequent Face Obstacles:

0= Often

1= All the time

2= Never

……..

Annex D. Coding for (Objective)

land use typology

1. Purely residential
2. Purely commercial
3. Service
4. Mixed
5. Other

Intensity of activities on/by sidewalk

1. No activity
2. Very low activity
3. Low activity
4. High Activity
5. Very high activity

Pedestrian traffic

1. No activity
2. Very low activity
3. Low activity
4. High Activity
5. Very high activity

street light existence

1 Yes

2 No

Street light working

1 Yes

2 No

0 Partially

Clear of brush, broken glass, debris and unsightly garbage

1 Not clear

2 Fairly clear

3 Clear

4 Very clear

curbs to separate

1 Yes

2 No

wide enough for adults

1 Yes

2 No

sidewalk for users with mobility aide

c. No Pavement
d. Poor
e. Fair
f. Good
g. Very Good
h. Excellent

condition of the pavement

1 No Pavement
2 Poor
3 Fair
4 Good
5 Very Good
6 Excellent

Activities on side walk(Table)

Street food vending

1 A Lot
2 Some
3 Little
4 None

Street retailing

1 A Lot
2 Some
3 Little
4 None

Street shoe shiner

1 A Lot
2 Some
3 Little
4 None

Bicycle driving

1 A Lot
2 Some
3 Little
4 None

Motor vehicles on the sidewalk

1 A Lot
2 Some
3 Little
4 None

Motor vehicles parking

1 A Lot
2 Some
3 Little
4 None

Bicycles parking

1 A Lot
2 Some
3 Little
4 None

working (as a workshop)

1 A Lot
2 Some
3 Little
4 None

Street Furniture (Table)

Existence

1 Yes

2 No

Australian Method Variables Value(Table)

Arrangement

1 Bad

2 Fair

3 Good

Condition

1 Bad

2 Fair

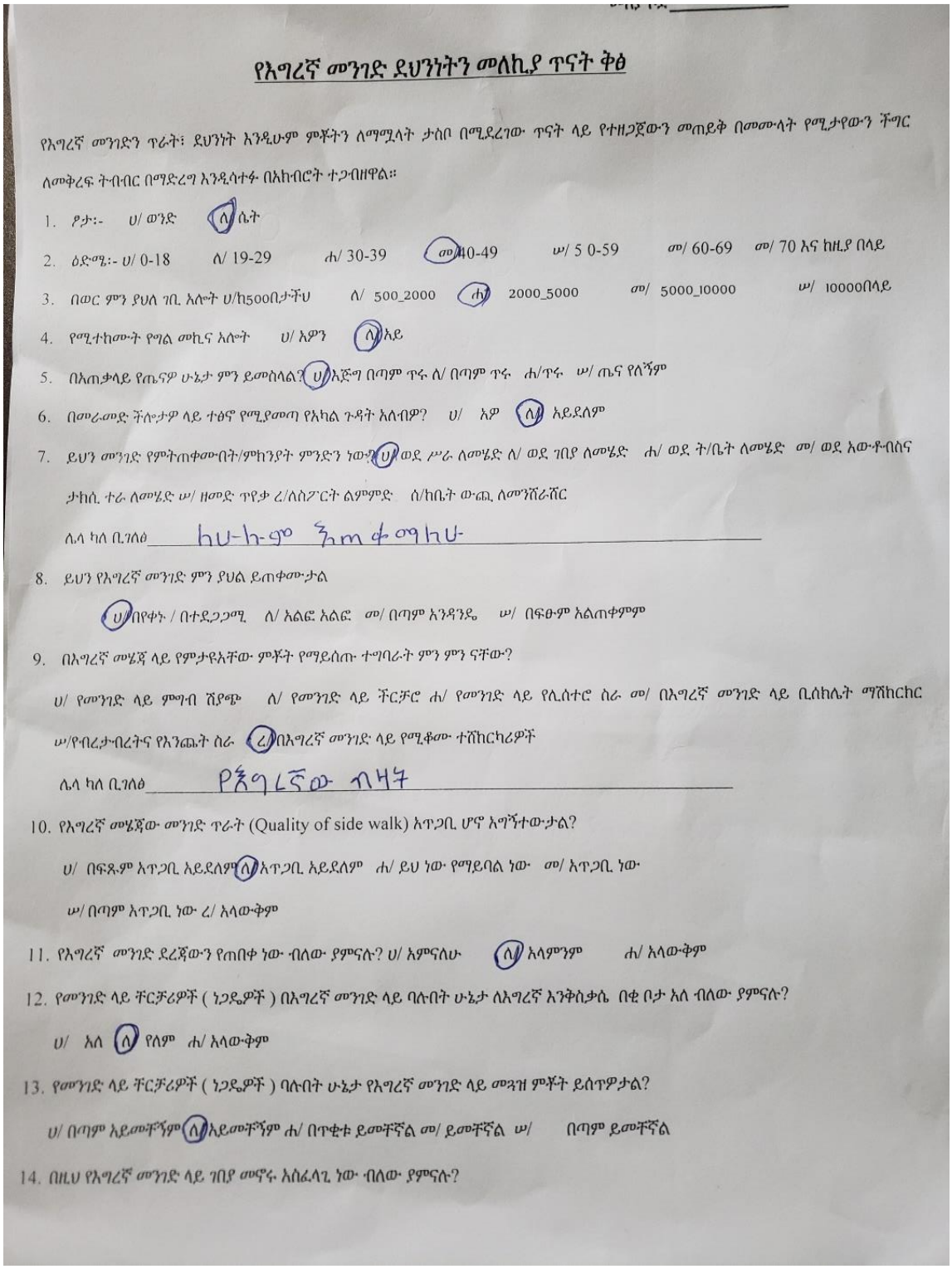
3 Good

Weight	**0**	**1**	**2**	**3**	**4**
4	No pedestrian path	0-1m	1.1-1.5m	1.6-2m	2m<
5	Unsealed/Cracks/Bumps	Poor quality	Some bump and cracks	Reasonable quality /acceptable standard	Continuous surface with very few bump
3	21+ Obstruction/ KM	11-20 Obstruction/ KM	5-10 Obstruction/ KM	1-4 Obstruction/ KM	No obstruction
4	Not provided	Some provided	Some located and reasonably located but need more	Adequate crossing facilities are provided and are reasonably located	Dedicated pedestrian crossing facilities
2	Non existent	Few provided poor location	Few provided and reasonably well located	Several provided and well located	Many provided and well located
4	Non existent	Poor	Reasonable	Good	Excellent

2	Unpleasant environment & close to traffic	Poor environment in 1m kerb	Acceptable environment 1-2 kerb	Reasonable environment 2-3 from kerb	Pleasant environment pedestrians more than 3m from kerb
3	Severe, more than 25 conflict points/KM	Poor situation 16-25 conflict points/km	10-15 potential vehicle conflict points/km	Reasonable 1-10 or less conflict points/km	No vehicle conflict opportunities
3	More than 350/day	226-350/day	151-225/day	81-150/day	>80/day
4	Majority of path users are non-pedestrians	Approx 51%-70% of path users are non-pedestrians	21%-50% path users are non-pedestrians	Less than 20% path users are non-pedestrians	Pedestrian only
4	Unsafe	Poor	Reasonable	Good	Excellent security provide

Annex E. Pictures showing the Current Addis Ababa's sidewalks Condition

Annex F. Pictures Showing the Subjective Questioner Used in the Research



የእግረኛ መንገድ ደህንነትን መለኪያ ጥናት ቅፅ

የእግረኛ መንገድን ጥራት፣ ደህንነት እንዲሁም ምቾትን ለማሟላት ታስቦ በሚደረገው ጥናት ላይ የተዘጋጀውን መጠይቅ በመሙላት የሚታየውን ችግር ለመቅረፍ ትብብር በማድረግ እንዲሳተፉ በአክብሮት ተጋብዘዋል።

1. ፆታ፡- ሀ/ ወንድ (ለ/ ሴት

2. ዕድሜ፡- ሀ/ 0-18 ለ/ 19-29 ሐ/ 30-39 (መ/ 40-49 ሠ/ 5 0-59 መ/ 60-69 መ/ 70 እና ከዚያ በላይ

3. በወር ምን ያህለ ገቢ አሎት ሀ/ከ500በታችሀ ለ/ 500_2000 (ሐ/ 2000_5000 መ/ 5000_10000 ሠ/ 10000በላይ

4. የሚተከሙት የግል መኪና አለት ሀ/ አዎን (ለ/ አይ

5. በአጠቃላይ የጤናዎ ሁኔታ ምን ይመስላል? (ሀ/ እጅግ በጣም ጥሩ ለ/ በጣም ጥሩ ሐ/ጥሩ ሠ/ ጤና የለኝም

6. በመራመድ ችሎታዎ ላይ ተፅኖ የሚያመጣ የአካል ጉዳት አለብዎ? ሀ/ አዎ (ለ/ አይደለም

7. ይህን መንገድ የምትጠቀሙበት/ምክንያት ምንድን ነው? (ሀ/ ወደ ሥራ ለመሄድ ለ/ ወደ ገበያ ለመሄድ ሐ/ ወደ ት/ቤት ለመሄድ መ/ ወደ አውቶብስና ታክሲ ተራ ለመሄድ ሠ/ ዘመድ ጥየቃ ረ/ለስፖርት ልምምድ ሰ/ከቤት ውጪ ለመንሸራሸር

ሌላ ካለ ቢገለፅ ከሀ-ከ-ም እመፋማከሀ-

8. ይህን የእግረኛ መንገድ ምን ያህል ይጠቀሙታል

(ሀ/ በየቀኑ / በተደጋጋሚ ለ/ አልፎ አልፎ መ/ በጣም አንዳንዴ ሠ/ በፍፁም አልጠቀምም

9. በእግረኛ መሄጃ ላይ የምታዩአቸው ምቾት የማይሰጡ ተግባራት ምን ምን ናቸው?

ሀ/ የመንገድ ላይ ምግብ ሽያጭ ለ/ የመንገድ ላይ ችርቻሮ ሐ/ የመንገድ ላይ የሊሰተሮ ስራ መ/ በእግረኛ መንገድ ላይ ቢሰክሌት ማሽከርከር

ሠ/የብረታብረትና የእንጨት ስራ (ረ/በእግረኛ መንገድ ላይ የሚቆሙ ተሽከርካሪዎች

ሌላ ካለ ቢገለፅ የእግረኛው ብዛት

10. የእግረኛ መሄጃው መንገድ ጥራት (Quality of side walk) አጥጋቢ ሆኖ አግኝተውታል?

ሀ/ በፍጹም አጥጋቢ አይደለም (ለ/ አጥጋቢ አይደለም ሐ/ ይህ ነው የማይባል ነው መ/ አጥጋቢ ነው

ሠ/ በጣም አጥጋቢ ነው ረ/ አላውቅም

11. የእግረኛ መንገድ ደረጃውን የጠበቀ ነው ብለው ያምናሉ? ሀ/ አምናለሁ (ለ/ አላምንም ሐ/ አላውቅም

12. የመንገድ ላይ ችርቻሪዎች (ነጋዴዎች) በእግረኛ መንገድ ላይ ባሉበት ሁኔታ ለእግረኛ እንቅስቃሴ በቂ ቦታ አለ ብለው ያምናሉ?

ሀ/ አለ (ለ/ የለም ሐ/ አላውቅም

13. የመንገድ ላይ ችርቻሪዎች (ነጋዴዎች) ባሉበት ሁኔታ የእግረኛ መንገድ ላይ መጓዝ ምቾት ይሰጥዎታል?

ሀ/ በጣም አይመቸኝም (ለ/ አይመቸኝም ሐ/ በጥቂቱ ይመቸኛል መ/ ይመቸኛል ሠ/ በጣም ይመቸኛል

14. በዚህ የእግረኛ መንገድ ላይ ገበያ መኖሩ አስፈላጊ ነው ብለው ያምናሉ?

ሀ/ በጣም አያስፈልግም ለ/ አያስፈልግም ሐ/ ገለልተኛ ነኝ (መ/) አስፈላጊ ነው ሠ/ በጣም አስፈላጊ ነው

15. በእግረኛ መሄጃው መንገድ ላይ ብዙ እግረኞች በመጓዛቸው ምክንያት መጨናነቅ አለ ብለው ያስባሉ?

(ሀ/) በጣም ይጨናነቃል ለ/ ይጨናነቃል ሐ/ አይጨናነቅም መ/ በጣም አይጨናነቅም ሠ/ አላውቅም

16. የእግረኛ መሄጃ መንገድ አጠቃላይ ስፋት አጥጋቢ ነው ብለህ ታስባለህ?

ሀ/ በጣም አጥጋቢ አይደለም (ለ/) አጥጋቢ አይደለም ሐ/ አጥጋቢ ነው መ/ በጣም አጥጋቢ ነው ሠ/ አላውቅም

17. በእግረኛ መሄጃው መንገድ ላይ አግዳሚ ወንበር ወይም ሌላ ማረፊያ ቦታ አለ? (ሀ/) አዎ ለ/ የለም

18. በቀን በዚህ መንገድ ላይ ሲሄዱ ደህንነት ይሰማዎታል? (ሀ/) አዎ ለ/ አይደለም

አይደለም ካሉ ለምን? በጥንቃቄ ካሄዱኩበት

19. በምሽት / በሌሊት በዚህ መንገድ ላይ ስትሄድ ደህንነት ይሰማሃል? ሀ/ አዎ (ለ/) አይደለም

አይደለም ካልክ ለምን? ከሌቦች ዝርፊ ስለሚሆን

20. የእግረኛው መንገድ ከሚያንሸራትቱና ከሚያደናቅፉ ነገሮች የፀዳ ነው ብለው ያስባሉ? ሀ/ አዎ (ለ/) አይደለም

21. በዚህ የእግረኛ መንገድ ላይ ከትንኮሳና በአካል ላይ ከሚደርስ ጥቃት ደህንነት ይሰማዎታል? (ሀ/) ይሰማ ኛል ለ/ አይሰማኝም

አይሰማኝም ካሉ ለምን? __________

22. የእግረኛውን መንገድ በተገቢው ሁኔታ ከመጠቀም የሚያግዱ ነገሮች እና መሰናክሎች ምን ያህል ያጋጥምዎታል?

ሀ/ ሁልጊዜ (ለ/) አንዳንድ ጊዜ ሐ/ በፍፁም

23. ጠቅላላ የእግረኛ መንገድ ጥራት፣ ደህንነትና ምቾት እንዴት ሊሻሻል ይችላል ብለው ያስባሉ?

የእግረኛ መንገዱን ስፋት በመጨመር ፣ እግረኛ የሚበዛው አንዳንዴ ታክሲ በማጣት ስለሆነ የትራንስፖርት ፍሰቱን በመጨመር፤ የእግረኛም ሆነ የተሽከርካሪን መንገድ ጎላትና ስፋት በመጨመር ፣ በእግረኛ መንገዱ ላይ ተሽከርካሪ ባለማቆም ፣ የእግረኛ መንገዱ ላይ የሚገኙት ዕቃዎችን ባለመገለገል እና ንግዶችን በየመንገዱ ላይ ባለመቀጠር ሊሻሻል ይገባል።