JCEC
THE JOURNAL OF ENGINEERING AND EXACT SCIENCES

OPEN ACCESS

The Journal of Engineering and Exact Sciences – jCEC, Vol. 10 N. 06 (2024)
journal homepage: https://periodicos.ufv.br/jcec
eISSN: 2527-1075
ISSN: 2446-9416

Assessment and Modelling of Walk Trips in Akure, Nigeria

Article Info:
Article history: Received 2024-06-07 / Accepted 2024-08-22 / Available online 2024-09-12
doi: 10.18540/jcecvl10iss6pp19666

Yinka Benjamin Oluwadiya
ORCID: https://orcid.org/0009-0006-6596-0856
Civil, Construction and Environmental Engineering, Marquette University, USA
E-mail: oluwadiyay@gmail.com
Arafat Ayodeji Adeowu
ORCID: https://orcid.org/0009-0000-9942-859X
Industrial and Systems Engineering, Northern Illinois University, Illinois, USA
E-mail: arafatadeowu@gmail.com
Emmanuel Femi Adebayo
ORCID: https://orcid.org/0009-0005-2522-4507
Department of Civil Engineering, Federal University of Technology, Akure, USA
E-mail: emmanueladebayo2504@gmail.com
Adekunle Isaac Omole
ORCID: https://orcid.org/0009-0000-7365-9672
Transportation and Urban Infrastructure Studies, Morgan State University, USA
E-mail: adomo4@morgan.edu
Musa Odunayo Sabit
ORCID: https://orcid.org/0009-0003-7950-5908
Civil Engineering, University of Kentucky, USA
E-mail: mosa227@uky.edu
Olatunji Akhigbe Akinyeye
ORCID: https://orcid.org/0009-0008-0453-2959
Industrial Management and Technology, Texas A&M University-Kingsville, USA
E-mail: olatunjiakinyeye@gmail.com

Abstract
The study examined and modeled the walking behavior patterns of residents in Akure, Nigeria. A multi-stage sampling approach was used to collect relevant data for assessing and modeling the walking trip patterns. The questionnaires were administered to 300 participants between May to November 2019 (6 months) across three primary residential neighborhoods in the city; high-density, medium-density, and low-density areas. The obtained data were analyzed using SPSS software and subsequently modeled using multi-variable regression techniques. The study found that 48.7% of the sampled population preferred to walk, and 49.7% perceived walking as an alternative to motorized trips. Significant differences were observed in the socioeconomic characteristics of residents, such as age and income, across the residential zones ($F = 54.731$, $p<0.001$; $F = 68.278$, $p<0.001$). The key factors that greatly influenced decision of respondents to walk included socioeconomic factors, such as income, personal car ownership, educational qualifications, and employment status, with age and sex being the least significant socioeconomic determinants. Generally, the factors that motivated respondents to choose walking as a travel mode included its relative affordability, the lack of personal vehicles, awareness of health benefits, safety and security concerns, avoidance of motorized traffic congestion, and favorable weather conditions. The findings of this study have important implications for transportation planning. The paper recommends the

need to incorporate non-motorized spaces and walkways into various levels of urban planning and implementation to foster a more walkable environment and encourage active transportation in the city.

Keywords: Akure. Behavior pattern. Socioeconomic. Walking trip

1. Introduction

Human movement is inevitable and as such due to advancements in technology we have crossed the borders of the primitive era where our primary mode of transport is by walking, we used animals for our transportation, we developed bicycles, and then we got the era of transportation where we use motorcycles, cars, airplanes, ships and all other motorized media for our transportation. This transformation cycle from trekking to the use of motorized mediums depicts we will forever find a way to improve one of our basic characteristics, movement. Despite the growth from walking being our sole form of transformation to motorized trips, walking can never be scrapped off because for most individuals walking is our major means of transportation used for our daily activities (Agrawal and Schimek, 2007; Delclòs-Alió *et al*., 2022; Mashrur *et al*., 2022). Moreover, as traffic increases, it is in the best interest to collect and analyze the inflow and outflow of traffic, and its characteristics and predict its movement within such locations (Goulias *et al*., 1990; Huang *et al*., 2023; Wang *et al*., 2023). This movement is otherwise known as trip chain, which is further explained as a series of linked trips that start from a specific origin and end at various destinations, forming a framework that shows the interrelationship among travel characteristics. Adebola *et al*. (2015) defined a trip as the movement from a single origin to a single destination. (Rahman R & Ben-Edigbe J, 2015) defined a trip as a journey made by an individual between two points by a set of combined travel modes. Tribby *et al*. (2017) explored the relationship between built environment characteristics and pedestrian travel behavior. They compare various metrics and model designs to gain insights into how different factors influence walking trips. López-Lambas *et al*. (2021) conducted a street and online survey in the city of Madrid to gather information about different mobility habits, focusing on pedestrian mobility and on the respondents' perceptions of urban area in South-Western Nigeria, highlighted the need for better planning and development strategies for non-motorized transportation in Sub-Saharan Africa.

This interdisciplinary study drew upon techniques and approaches found useful in fields such as operations research, geography, transportation, and urban planning to explain and analyze the road network with the purpose of determining the relative accessibility of arterial roads for pedestrians (Chen *et al*., 2024; Kling, 2023). It is believed that the techniques utilized in these cognate disciplines can be extended to other studies, thereby facilitating the cross-pollination of research ideas across various fields. Furthermore, the study emphasizes the necessity of developing a technique that may be employed in the assessment and modeling of walking trips, thereby establishing it as a viable and determinable area of research.

The research aims to apply the developed model, which addresses both work-related and non-work (home-based) trips, to estimate and predict the overall walking trip demand at a tract level. The study will address identified knowledge gaps by statistically analyzing pedestrian operational behavior, pedestrian volumes, trip times, trip patterns, and existing walking infrastructure, and then modeling the trip patterns to propose solutions to address traffic-related inadequacies, such as congestion and poor facilities, in selected regions of Akure, Nigeria. The objective also includes revitalizing methodologies for modeling demand for walking and examining the connections between various elements, including socio-economic factors, the built environment, and walking behavior. From this analysis, a conceptual framework is crafted to illustrate how walking frequency correlates with socio-economic indicators and characteristics of the built environment. Models predicting walking trips are formulated and authenticated using Census information. Following this, an estimation of the aggregate number of walking trips at the tract level is conducted.

Assessing the elements that either promote or hinder pedestrian activity holds critical importance for safeguarding public health, informing urban transportation planning, and guiding investments in transportation infrastructure. Yet, a significant scarcity of empirical research exists on pedestrian journeys in Nigeria, a country where walking remains a predominant mode of transportation. This gap emphasizes the pressing need for empirical inquiries to understand the factors that shape Nigerians' decisions to walk. A well detailed understanding of these factors can mobility. In view of the identified research gaps and the broader significance of understanding pedestrian activity patterns, a timely research initiative has been launched. This study focuses on the evaluation and modeling of pedestrian movements in Akure, a prominent urban center in Nigeria.

1.1 Study Area

Akure, situated in the southwestern part of Nigeria, spans a geographical area of 991 km². The city became the capital of Ondo state on February 3, 1976, due to a decision by the military regime, which led to the establishment of numerous governmental agencies and state-owned enterprises. The official launch of the state in April 1976 brought a surge in immigration, unexpectedly boosting the city's population. This surge in population also led to a heightened demand for housing and transportation infrastructure. According to the 1991 population census, Akure had a population of 253,365 and a housing density of 62,326. By the 2006 census, the population of Akure had grown by 39.41%, reaching 353,211, with the housing density increasing to 86,888. This rapid urban growth and the accompanying pressures on the city's infrastructure highlight the need for comprehensive research and planning to address the evolving transportation and mobility challenges faced by Akure and its residents.

According to the map of Nigeria (see Figure 1), Akure is connected to other parts of the country through a road network system that provides easy accessibility to major urban centers within the state, such as Ondo to the south, Owo to the east, and Ado-Ekiti to the north, all within a 50-kilometer radius of Akure. Towns located within a 100-kilometer radius of Akure include Ikare, Ikole-Ekiti, Ijero-Ekiti, and Okiti-Pupa.

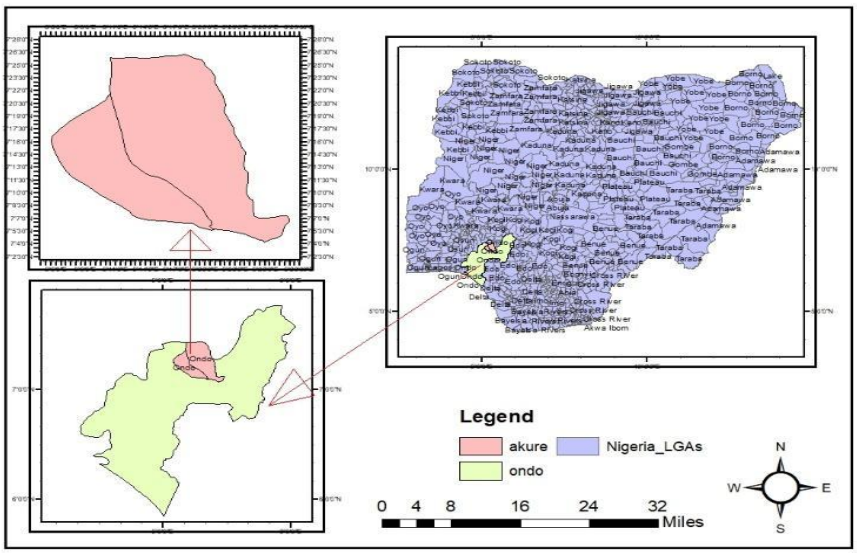


Figure 1- Geographical Map of Nigeria Showing the Study Area

2. Materials and Methods

The research methodology involved the distribution of questionnaires, conducting personal interviews, making observations, and reviewing secondary materials from transportation agencies and scholarly publications. This comprehensive approach was aimed at gathering detailed insights on aspects such as trip generation, points of origin and destination, attractions for walking, cost considerations, safety of pedestrian routes, obstacles to walking, and the motivations behind individuals' choice to walk.

An initial reconnaissance investigation preceding the substantive study revealed that the target area is densely populated with individuals of varying ages, who demonstrate a high level of engagement in pedestrian activities, thereby generating considerable pedestrian traffic between their respective points of origin and destinations. In order to amass data for the analysis, both primary and secondary data sources were adopted. Primary data were collected on-site through the deployment of research instruments such as structured questionnaires, face-to-face interviews, and systematic observations, this was done in May to November 2019. Meanwhile, secondary data were acquired from an array of scholarly and institutional sources, including academic reports, textbooks, peer-reviewed journals, conference proceedings, and digital platforms. Further, pertinent data were also solicited from state transportation authorities, covering policies related to pedestrian movements, infrastructure catering to walkers, and urban planning documents.

2.1 Study Approach

In the first phase, every residential area in Akure was identified. Following that, these areas were organized into three categories based on residential density: low, medium, and high. From each density category, one area was chosen at random, resulting in the selection of three areas representing each density level. Within each chosen area, four major roads or streets were identified as shown in Figure 2 and selected randomly. Every household on these streets was counted, and half were chosen at random for the study. This process resulted in 313 households being sampled, with 300 questionnaires ultimately being collected.

The High-Density Residential District is characterized by a density exceeding 200 people per hectare, typically found in the city's central areas. This zone includes neighborhoods such as Arakale, Ayedun Quarters, Ijoka, Oja-Oba, and Odo Ikoyi. The Medium-Density Residential District has a density ranging between 100 and 200 people per hectare, encompassing wards like Oke-Aro, Orita-Obele Leo, Araromi, and Champion. The Low-Density Residential District, with a density of 60 to 100 people per hectare, is located in the Government Reserve Areas (GRA), indicating planned communities. This category includes places like Arakale, Ijapo Estate, Alagbaka Estate, Oba-Ile Avenue, and Idofin.

The study selected Ijoka, Oke Aro, and Oba-Ile as the representative neighborhoods for the high-density, medium-density, and low-density residential zones, respectively. The number of households surveyed in each zone - 129 in the high-density Ijoka, 100 in the medium-density Oke Aro, and 84 in the low-density Oba-Ile - are considered indicative of the broader situation in each respective zone, as detailed in Table 1. By focusing on these three distinct residential zones, the study aims to capture the nuanced variations in walking activity, socioeconomic factors, and built environment characteristics that may influence pedestrian movements across Akure's diverse urban landscape.

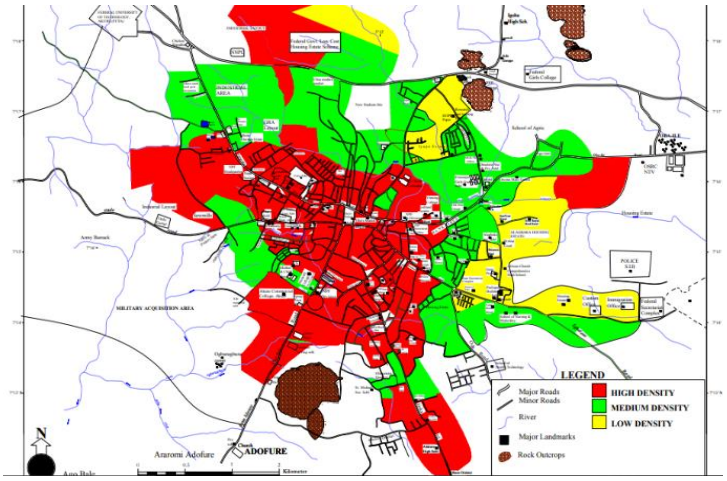


Figure 2- Map of Population Density Distribution of Akure

Table 1- Akure Capital City and the Chosen Residential Zones for Questionnaire Administration.

Density Areas	Area	Streets	No of Buildings per/street	No of Houses (45%)
LOW	OBA ILE	Ejioba High Sch	46	20
		OSRC.	52	23
		Mission Rd	49	22
		C/S Road	43	19
MEDIUM	OKE ARO	Igbalaye street	56	25
		Adesida Str.	61	27
		Afunbiowo Str.	49	22
		Omudan Street	59	26
HIGH	IJOKA	Sunday Bustop	89	40
		Iyaniwura	83	37
		Breeze F.M	47	21
		Ijomimo	69	31
Total				**300**

The study employed a basic random sampling approach to select survey participants. Four streets within each designated area were randomly picked, and the interviews were conducted with either the head of the household or, in their absence, another member of the household. The questionnaires were given out and completed through face-to-face interactions.

2.2 Survey Instrument

The data were gathered using a questionnaire, which included both open-ended and closed-ended questions. Open-ended questions were utilized for continuous variables to ensure flexibility during the analysis phase. Drawing on insights from prior research and knowledge of the study area, the questionnaire addressed respondents' socioeconomic profiles, motivations for choosing to walk, and deterrents to their willingness to walk. This study analyzed the travel behaviors of individuals aged 18 and above, who are generally capable of traveling without assistance. Since the minimum age to obtain a driving license in Nigeria is 18, these adults may have access to a broader selection of transportation options than minors.

Data collected from questionnaire: Independent variables comprised factors such as the distance of walk trips, employment categorized by type, household counts, elements fostering pedestrian-friendly environments (such as parks and the overall quality of pedestrian spaces), obstacles to walking (including terrain, highways, and areas dominated by industrial employment), and characteristics of the travelers. The collected data also includes trip time, trip distance, demographics, departure location, arrival location, purpose of trips, trips pattern, and why respondents choose or prefer to walk. (i) Economic and Social Data: Job title, Age, Marital Status, Career Level, Earnings, Quantity of Vehicles Possessed, Vehicle Model, Purchase Price of the Vehicle, and Service Histories. (ii) Information on Trips: Type of trips, Time of making the trip, Purpose of trip, Modal choice, Trip distance, cost of trip, walking facilities, trip time, frequent destination location, and Departure location, trip attractions etc. (iii) Walk Trip Cost Analysis: Cost of motorized trip, motorized trip time, daily savings on motorized trips, etc. (iv) Walk Trip Security: Safety from crimes, safety from pedestrians, Safety from accidents due to motorized trip elements, etc. (v) Reasons for Walking: health benefits, non-ownership of a personal vehicle, relative cheapness etc. (vi) Challenges hindering walking: physical disabilities, adverse weather conditions, concerns about safety and security, and the lack of pedestrian infrastructures.

2.3 Data Analysis

The statistical computer software such as SPSS version 16 and Microsoft Excel are employed to analyze the data. A linear regression model was calibrated to show the relationship between respondents' socio-economic factors (sex, age, income, etc.), trip safety factors, cost analysis, environmental friendliness and many other factors on their decision to walk or not.

3. Results and Discussions

3.1 Socio Economic Profile of Respondents

Socioeconomic factors significantly influence residents' transportation preferences. Therefore, an examination of certain socioeconomic attributes of the participants was conducted to enhance our comprehension of their walking trip patterns. These attributes include age, gender, marital status, ownership of private vehicles, level of education, income, and employment status. Details about these factors are presented in Figure 3, respectively.

(a) (b)

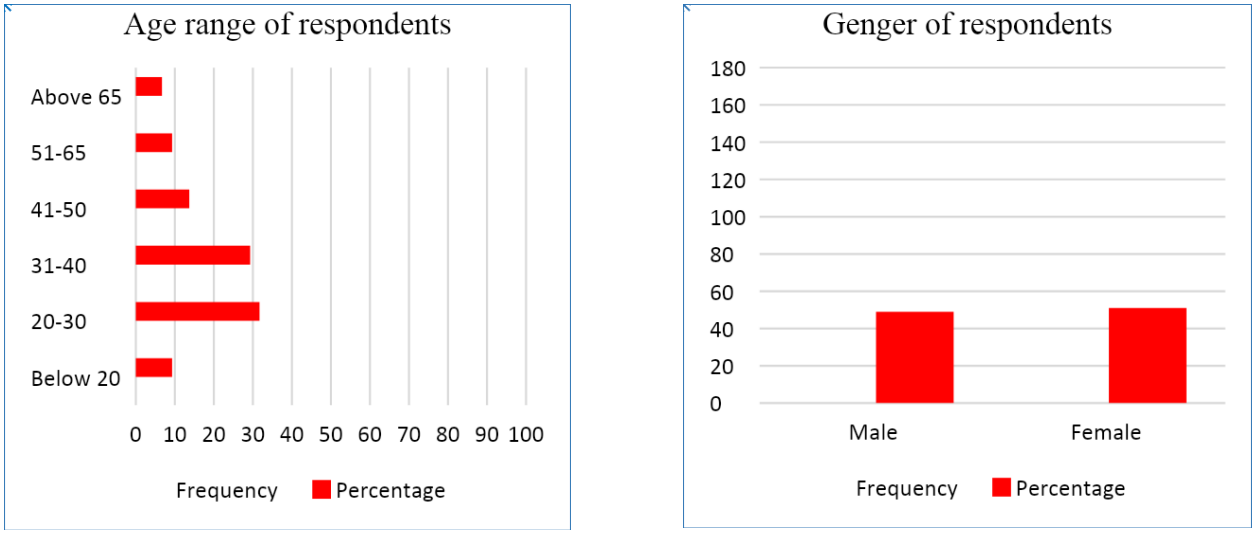


Figure 3- (a) Age range of respondents (b) Gender of respondents

The distribution by age among survey participants indicated that the largest segment fell within the 20–30-year range, representing 31.7%. This was closely followed by those aged 31–40 years, making up 29.3%. The average age of participants was 38 years, with a significant variation in age distribution noted across different residential areas ($F = 54.731$, $p<0.001$). The gender split among respondents was nearly even, with males representing 49% and females 51%. The survey indicated high levels of literacy among the participants, as all had received at least a primary education, with 10.3% at this level. Remarkably, almost 65% possessed qualifications higher than secondary school, as presented in Figure 4.

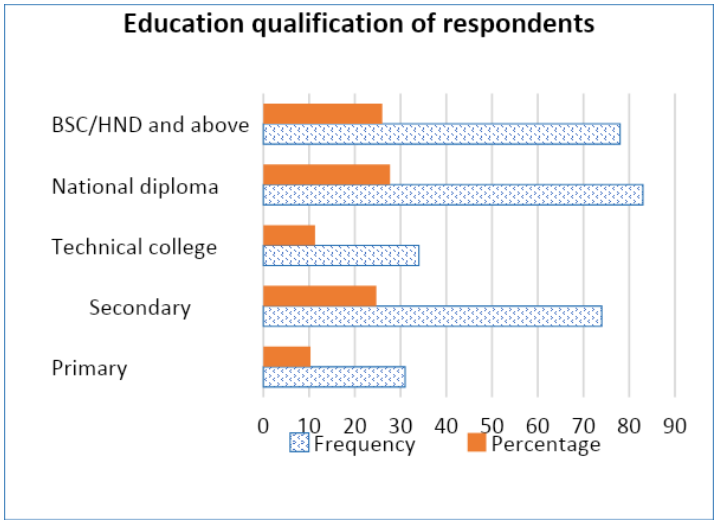


Figure 4- Educational qualifications of respondents

The employment status of the survey respondents showed that a significant portion were engaged in trading activities (19.7%), followed by those working as artisans (17.7%) and civil servants (12.7%), as illustrated in Figure 5. Overall, nearly 70% of the respondents were employed, while 20.6% were currently unemployed.

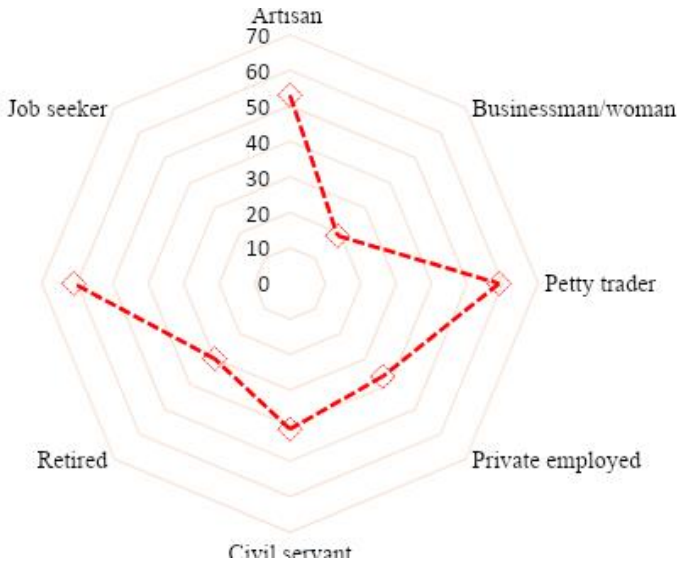


Figure 5- Graphical representation of occupation of the respondent

The survey highlighted that a significant majority, 74%, of participants received a monthly income ranging from 20,000 to 70,000 naira (see Figure 6). A mere 6% had monthly earnings exceeding 80,000 naira. Income levels varied notably across different housing density areas in the city ($F = 68.278$, $p<0.001$), with average monthly earnings reported at 32,485.35 naira for high-density areas, 54,438.76 naira for medium-density, and 69,874.89 naira for low-density areas. The overall average income per month for the surveyed group stood at 36,525.34 naira.

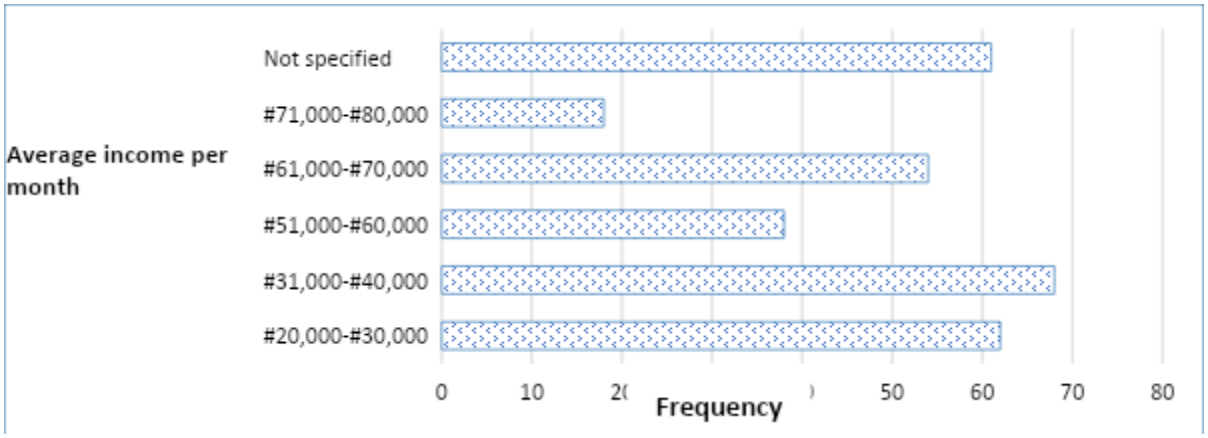
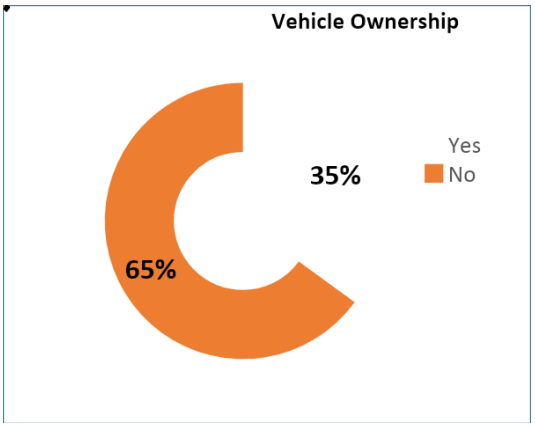


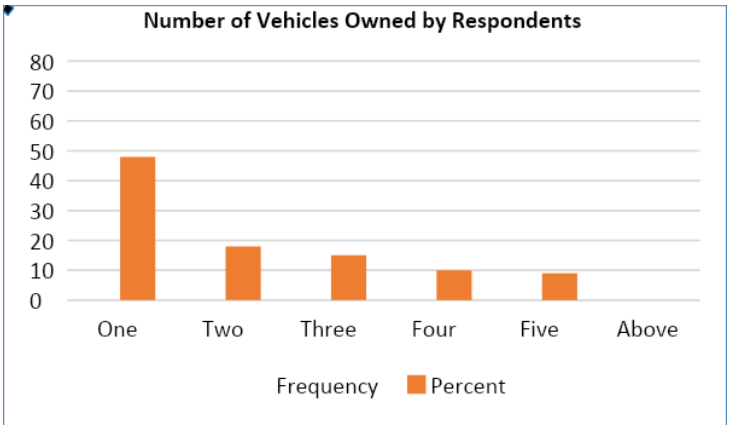
Figure 6- Graphical representation of Respondents' Average Income

The prevalence of private vehicle ownership was unexpectedly low among participants, with close to 65% not owning any and only 35% owning one, as presented in Figure 7(a). Among this 35% (equivalent to 105 individuals), there was a total tally of 150 vehicles. Figure 7(b) shows the number of vehicles owned by respondents. Buses appeared to be quite unpopular, with a mere ten buses reported, as illustrated in Figure 7(c). In terms of vehicle type distribution, 56.7% were cars and 33.3% were motorcycles. Further details on the variety of vehicles owned revealed that there were five buses and ten bicycles among them, as shown in Figure 7(c), with no instances of tricycle ownership reported.

(a)



(b)



(c)

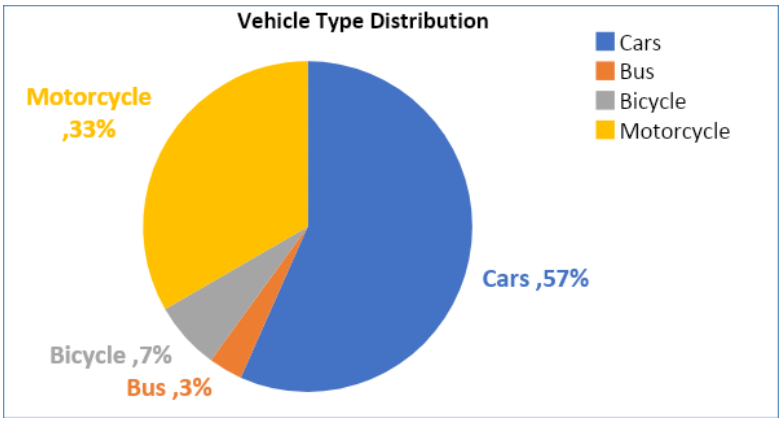


Figure 7- (a) Graphical representation of average income of respondents (b) number of vehicles owned by respondents (c) vehicle type distribution

3.2 Socioeconomic Justification

Socio-economic characteristic is a major factor that determines travel mode choice, these characteristics include age, sex, occupation, income, car ownership, etc.

Age: Most of the respondents are between 18-50 yrs. which directly translates to a high chance of active travel amongst the young population. Of the total 84% within this age range, 55.9% preferred to walk or saw walking as an alternative to motorized trips. In contrast, of the total 16% respondents between 51 and above years, only 2.4 % preferred to walk as shown in Figure 8(a) According to the above data, it can be concluded that age is a walk trip preference determinant in the study area, Akure.

Sex: According to the analysis in the study area, sex does not greatly determine walk trips. Of the 51% female, 56.5% preferred to walk which is quite similar to the 58% recorded amongst males as illustrated in Figure 8(b).

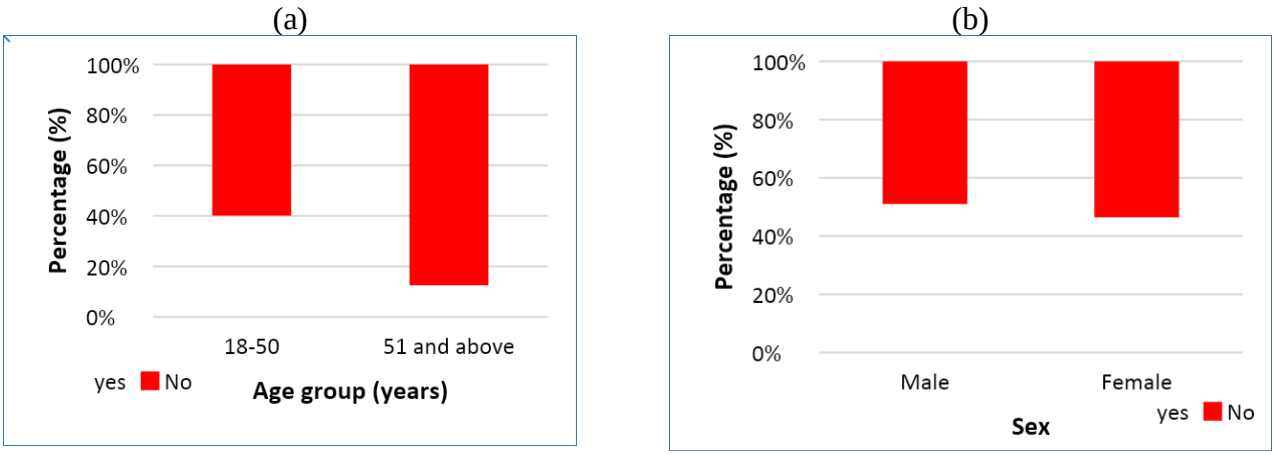


Figure 8- (a) Comparison of age group of respondents and walking Preference (b) Walking Preference and Sex

Educational Qualifications and Employment Status: A justifiable variation was not recorded on the impact of educational qualifications on respondents' choice of walking as a mode choice. However, a bit of variation was recorded in employment status. Active travelers who prefer to walk were mostly petty traders (55.9%), followed by job seekers (47.5%), artisans (39.6%), and civil servants (36.5), the lowest was recorded amongst retirees (30%) described in Figure 9.

It can thereby be concluded that employment status is amongst the major socio-economic characteristics that strongly influence the choice of walking as a travel mode amongst respondents in the study area.

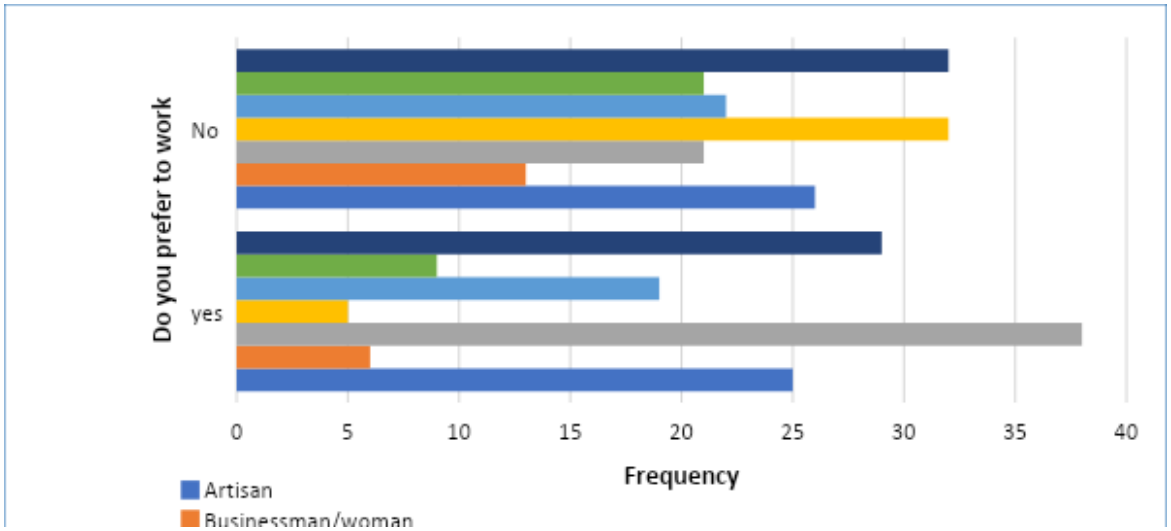


Figure 9- Comparison of walking preference with occupation

3.3 Origin and Destination of Walk Trips

The most predominant origin of walk trips according to respondents' analysis was from home as most of the walk trips emanated from home to their usual walk trip location. However, there is an unambiguous walk trip destination disparity in the study area. The most predominant destination location according to the survey includes schools, social/personal destinations, workplaces (including offices, shops, artisan shops, etc.), restaurants, walking to public transport, and others. Personal/ social destinations grossed the highest frequency, then public transport and workplaces being the third in the rank as shown in Figure 10(a). The reason for walking to public transport and workplaces grossing the highest frequency is not far-fetched; as in Table 2 and Figure 10 (b), 47.7%

of respondents claim not to have motorable access from their home to the main road where they can board public transport, others specify there is no public transport system to convey them to the main road and as such, they had no choice than walk to the main road. In addition, from Figure 10(a), the workplace made it to the first three ranks as most respondents were employed: civil servants, artisans, and petty traders. The artisans and petty traders have their shops near their houses at about 100m on average, so they embark on walking instead of motorized trips to reach their destination. Trade and commercial purposes grossed the highest purpose of walking as shown in Table 2 More reasons for this selection will be discussed subsequently.

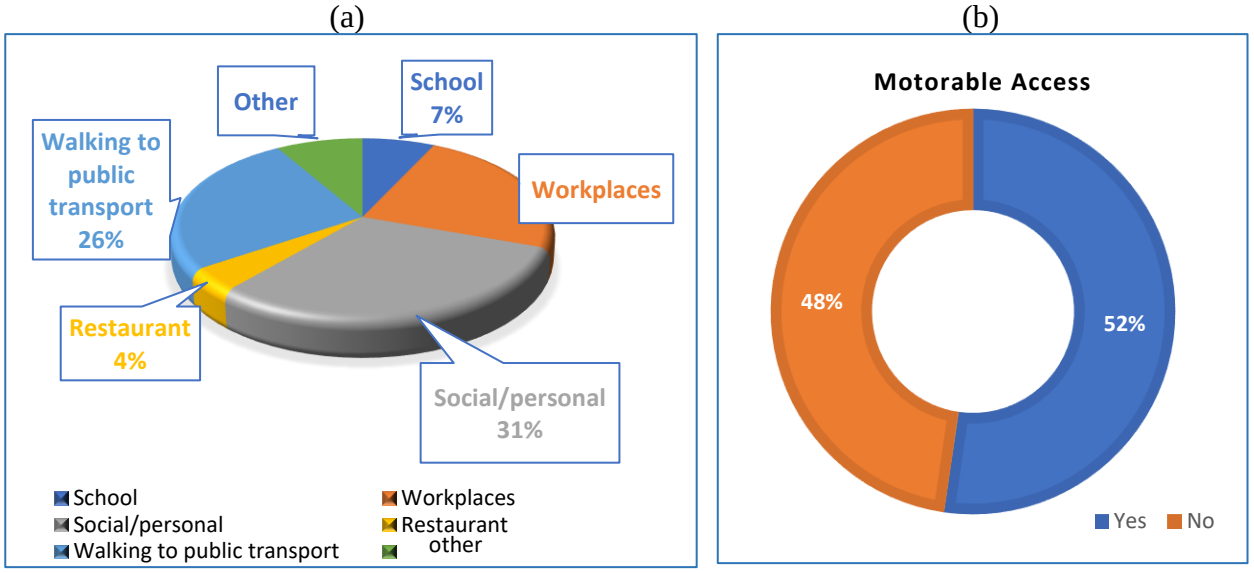


Figure 10- (a) Destination of usual walk trips (b) Motorable access from home to the main road.

Table 2- Respondents Purpose of Walking.

Purpose	Frequency	Percent
Domestic	40	13.3
Commercial	65	21.7
Trade	80	26.7
Personal	69	23.0
Leisure	32	10.7
Others	14	4.7
Total	**300**	**100.0**

3.4 Trip Attraction

According to various literature reviews, trip attraction is also a determinant of active travel. Walk trip attraction includes tourism, beautiful view of the environment, etc. Four factors were accessed in the study area. These attractive factors include the availability of shortcuts, beautiful view of the environment, to take conversant of the environment and for leisure and recreational purpose. The various factors were analyzed using the mean–standard deviation approach and then ranked appropriately as shown in Table 3.

From Table 3, the availability of shortcuts is the major active walk trip attraction determinant, leisure and recreation being the second rank, and beautiful view of environment and to take conversant of the environment takes the third and fourth rank respectively. Preliminary survey shows there are several shortcuts in the streets of the study area, most of these shortcut's links to the main road- reducing travel time to the main road and ultimately increasing the chance of the respondents decide to walk to the main road. In addition, inferring from Table 4, 43.6% of

respondents walk for recreational and leisure purpose, thereby complementing leisure and recreation purpose being on the second rank.

Table 3- Walk trip attraction

TRIP ATTRACTION	*MEAN*	*STDEV*	*RANK*
Do you decide to walk due to availability of shortcut?	*3.0891*	*1.22690*	*1*
Do you decide to walk to have a beautiful view of the environment?	*3.0624*	*1.20401*	*3*
Do you decide to walk to be able to take conversant of the environment?	*3.0363*	*1.29773*	*4*
Do you decide to walk for leisure and recreation purpose?	*3.0695*	*1.21462*	*2*

Table 4- Walk for recreational purpose

Response	**Frequency**	**Percent**
Yes	139	43.6
No	161	3.7
Total	**300**	**100.0**

3.5 Preferred Walk Trip Time

The most preferred walk trip time is also an active determinant of the decision on choosing walking as a travel mode. Walk trip time was studied among respondents. The most preferred walk trip time depicts a replica of other walk trip times as in other literature. The most preferred walk trip time is the morning (27% as in Table 5); this can be associated with the cool and favorable weather in the morning compared to the afternoon, and lower risk of thefts and crimes compared to walking at night. 26.7 % of the respondents are indifferent and can embark on walk trips anytime.

Table 5- Preferred walk trip time

Time preferred	**Frequency**	**Percent**
Morning	81	27.0
Afternoon	67	22.3
Evening	65	21.7
Anytime	80	26.7
None	7	2.3
Total	**300**	**100.0**

3.6 Trip safety and security

Table 6 and Table 7 shows security factors contributing to general trip safety and security. Through observation and analysis of Table 6 and 7, it can be inferred that the condition of walk trips in the study area is generally safe from accidents, thefts, and crimes.

Table 6- Safety and Security I

SAFETY	*SA*	*A*	*N*	*DS*	*SD*
The streets in my neighborhood are brightly illuminated during nighttime	*43*	*79*	*76*	*59*	*43*
People in their homes can readily observe walkers and cyclists on the streets of my neighborhood.	*34*	*87*	*78*	*65*	*36*
When walking in my neighborhood, I encounter and converse with other individuals.	*24*	*83*	*92*	*69*	*32*
My neighborhood experiences a significant level of crime.	*39*	*31*	*65*	*86*	*79*
The level of crime in my neighborhood renders daytime walks unsafe.	*31*	*30*	*83*	*83*	*73*
The prevalence of crime in my neighborhood compromises the safety of nighttime strolls.	*24*	*32*	*93*	*63*	*88*

Table 7- Safety and Security II

SAFETY	*SD*	*D*	*N*	*A*	*SA*
Do you think you are safe while walking?	*35*	*44*	*68*	*76*	*77*
Are you safer while walking compared to motorized trips?	*33*	*38*	*75*	*70*	*84*
Are you physically active to embark on walk trips?	*32*	*37*	*66*	*78*	*87*
On your locality main road, is there any walk trips facility provided?	*28*	*27*	*81*	*86*	*78*
Do you think motorized road users are protective of pedestrians?	*42*	*35*	*78*	*63*	*82*
Do you think motorized users are watchful of traffic rules protecting pedestrians?	*34*	*39*	*77*	*67*	*83*
Do you feel you are safe from accidents, thefts and other risks while walking?	*30*	*40*	*88*	*80*	*62*
The heavy traffic on my street significantly detracts from the enjoyment or ease of walking in my neighborhood.	*35*	*78*	*73*	*75*	*39*
There is so much traffic along nearby streets that it makes it difficult or unpleasant to walk in my neighborhood	*32*	*28*	*76*	*76*	*88*
The nearby streets are so congested with traffic that walking in my neighborhood becomes challenging or unenjoyable. Additionally, the traffic speed on my street tends to be low, typically 30 mph or less.	*29*	*75*	*95*	*77*	*24*
Traffic speeds on the majority of surrounding streets generally do not exceed 30 mph.	*32*	*41*	*74*	*84*	*69*
In my neighborhood, the majority of drivers surpass the established speed limits when driving.	*33*	*70*	*84*	*76*	*37*
My neighborhood is equipped with pedestrian crossings and signals to assist walkers in navigating through busy streets.	*30*	*72*	*81*	*75*	*42*
Crosswalks in my neighborhood provide a sense of security to pedestrians when they cross busy roads.	*42*	*68*	*67*	*77*	*46*
When walking in my neighborhood, there are a lot of exhaust fumes (such as from cars, buses)	*27*	*79*	*92*	*70*	*32*

3.7 Cost Analysis

A handful percentage of the respondents decide to walk to save money from motorized trips. This claim was made majorly by petty traders and artisans whose shop is near the place of work. However, on thorough analysis, the maximum amount saved daily by these traders is about 100 naira (To and Fro movement from the shop and home). Table 8 shows the monthly amount respondents claim to save from motorized trips. These claims are not factual as respondents are not sure of how much they save. Nonetheless, they do ascertain the fact that they save money when they decide to walk instead of embarking on motorized trips.

Table 8- Amount saved per month while trekking

Amount saved (Naira)	Frequency	Percent
2,000 - 5,000	86	28.6
6,000 - 9,000	54	18.0
10,000	62	20.7
11,000 - 15,000	48	16.0
None	50	16.7
Total	**300**	**100.0**

3.8 Trip Distance

The most frequent walk trip distance taken by respondents is about 101-150m (see Table 9), this is so because most respondents walk to get to the bus stop and to their place of work (in case of the petty traders and the artisans) which is within 101-150m in distance.

Table 9- Distance preferred to walk by respondents

Distance	Frequency	Percent
50m-100m	65	21.6
101m-150m	69	23.0
210m-250m	62	20.7
260m-300m	40	13.3
400m-600m	50	16.7
1km above	14	4.7
Total	**300**	**100.0**

3.9 Walk Trip Facilities

There are no active provisions for pedestrian and walkers in the study area. No conscious provisions were made for active travelers in the study area. However, respondents use walk shoulder, estate roads (in the low-density area), footpaths and the few available pedestrian walkway. Pedestrian facilities are as shown in Figure 10.

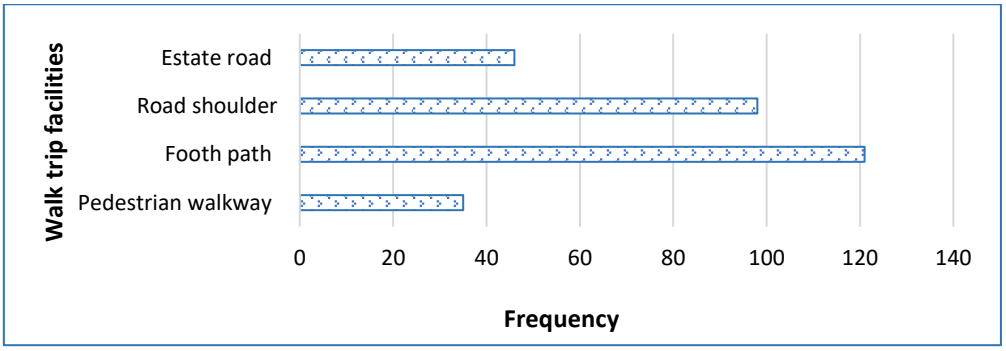


Figure 10- Walk trip facilities

Respondents who participated in the survey identified various factors that influence their preference to walk over using other forms of transportation, with the impact of these factors detailed in Table 10. Cost-effectiveness was the leading reason, scoring a mean value of 3.1510, making it the most significant influence on the decision to walk. This was closely followed by not owning a personal vehicle and the brevity of the journey, which scored 3.0267 and 3.0200, respectively. Additional influences included the state of the roads (particularly in relation to traffic congestion), ease of access, considerations of safety and security, recognition of health benefits, and the presence of pedestrian infrastructure, with mean scores of 3.0100, 3.000, 2.9833, 2.9733, and 2.9500, respectively, as shown in Table 10.

Table 10- Reasons for walking

FACTORS	***MEAN***	***STDEV***	***RANK***
I walk because I think walking has health benefits	*2.9733*	*1.20513*	*7*
I walk because I do not have a personal vehicle	*3.0267*	*1.22922*	*2*
Do you walk because of the relative cheapness of walking	*3.1510*	*1.27619*	*1*
easy access	*3.0000*	*1.21292*	*5*
Walk trips are quite safer, that's why I walk	*2.9833*	*1.14926*	*6*
I walk only when the distance is short/trip length	*3.0200*	*1.15952*	*3*
I walk because of the availability of pedestrian facilities and encouraging environmental workability	*2.9500*	*1.24338*	*8*
I walk in order to avoid traffic congestion	*3.0100*	*1.17355*	*4*

3.10 Barriers to Walking

According to the survey respondents, several factors influenced their decision to walk rather than use alternative modes of transportation. The relative significance of these factors is summarized in Table 10. The factor that had the strongest influence, with a mean value of 3.1510, was the low cost of walking compared to other options. This was followed by the lack of personal vehicle ownership and the short distance of trips, with mean indices of 3.0267 and 3.0200 respectively. Other influential factors included road conditions in terms of traffic congestion (3.0100), ease of access (3.000), safety and security considerations (2.9833), awareness of health benefits (2.9733), and the availability of pedestrian infrastructure and facilities (2.9500).

Similarly to how certain factors motivate respondents to choose walking over other modes of transportation, there exist identified impediments to walking within Akure. The impact levels of these barriers are detailed in Table 11. The possession of vehicles was pinpointed as the primary obstacle to pedestrian movement in Akure, with a mean rating of 3.1333 from survey participants. The inherent slower pace of walking was considered the next most considerable hurdle (mean 3.1300). Following this, the lack of facilities for pedestrians, the crowdedness of roads, issues related to safety and security, inclement weather conditions, health or physical challenges, and difficult terrain or topography were ranked from third to eighth based on their average influence, with mean scores of 3.100, 3.0767, 3.0067, 2.9800, 2.8967, and 2.8567, respectively.

Table 11- Barriers to Walking

FACTORS	MEAN	STDEV	RANK
Physical disability/Health issues	2.8967	1.22663	7
Unfavorable weather	2.9800	1.20571	6
Safety and security issues	3.0067	1.25081	5
Absence of pedestrian facilities	3.1000	1.23359	3
Relative slowness	3.1300	1.21424	2
Road busyness	3.0767	1.25640	4
Unfriendly terrain/topography	2.8567	1.29564	8
Vehicle ownership	3.1333	1.26866	1

3.11 Predictors of walking as a travel mode choice in Akure

This model was developed with walking (chosen as a means of travel) serving as the dependent variable, and the predictors or independent variables were the established factors influencing the choice of walking as identified from various literature reviews and corroborated in this study through the use of mean-standard deviation ranking. Aggregate scores were calculated for each determinant to form an overall metric for walking trip frequency. These categorical answers were subsequently converted to interval data for further analysis. Through regression analysis, a model was formulated to depict patterns of active travel within Akure, aiming to empirically elucidate the rationale behind opting to walk in Akure. This regression model encapsulates the various determinants influencing the selection of walking as a travel option.

The stepwise regression method was employed to select only the relevant predictors for the model, resulting in the retention of five out of the nine initial predictors that influence walking habits in Akure. These included non-ownership of a personal vehicle, income, employment status/occupation, trip length, and perceived health benefits.

Conversely, predictors such as age, lack of pedestrian facilities, road quality, and physical capability were not included in the model. Table 12 reveals that not owning a personal vehicle emerged as the most significant factor affecting walking in Akure, indicated by R and R2 values of 0.742 and 0.551, respectively, and a significant F Ratio of 23.182, suggesting that this predictor alone explains over 55% of the variance in walking behavior. This finding suggests a strong link between not owning a private vehicle and reliance on walking, highlighting a potential trend towards car dependency among those who own vehicles in Akure. Adding income as a predictor increased the R2 value to 0.643, signifying that together, the absence of private vehicle ownership and income levels account for more than 64% of the variance in the choice to walk. Additionally, factors such as employment status, travel costs, and health benefits contributed an additional 4.6%, 2.3%, and 0.7% to the model, respectively, culminating in a total explained variance of 71.9% for the decision to walk. Therefore, 28.1% of the variance in walking decisions remained unexplained by the model. The coefficients for the five retained predictors were 0.501, 0.227, 0.177, 0.277, and 0.185, respectively, with a regression equation constant of 1.767, as shown in the analysis. Thus, the regression equation formulated to predict walking in Akure is presented as follows.

$$Y = 1.767 + 0.501X_1 + 0.227X_2 + 0.177X_3 + 0.277X_4 + 0.185X_5 \quad (1)$$

where Y is walk trip preference, X_1 is having no personal vehicle, X_2 is income, X_3 is Employment Status

X_4 is Travel costs and X_5 is Health benefits.

The equation clearly highlights that the key factors driving the choice of active travel in Akure include not owning a personal vehicle, individuals' income, their employment status, the costs associated with travel, and the benefits to health. It underscores the challenge of overlooking the socioeconomic attributes of individuals when considering their preference to walk. This observation is in line with Litman's (2016) earlier research findings, which pointed out that factors such as age, physical fitness, income, level of education, pet ownership, possession of vehicles and driving licenses, expenses related to travel, available infrastructure, condition of roads, length of trips, patterns of land use, promotional efforts, and community support play a crucial role in influencing the demand for active travel.

Table 12- Predictors of Walking

Factors	Beta	R	R^2	F Ratio	Sig
Non possession of vehicles	0.501	0.742	.551	23.182	0.00
Income	0.227	0.802	.643	19.762	0.00
Employment status	0.177	0.830	.689	17.987	0.05
Travel cost	0.277	0.844	.712	11.834	0.011
Health Benefits	0.185	0.848	.719	7.325	0.009

4. Conclusion

This study explores the determinants of travel mode choices in Akure, Nigeria with specific reference to walking. Walking, like other transport modes, is that its prevalence is only partly related to its health advantages and relatively low cost and is instead influenced by a range of social, economic and environmental factors. The main determinants were health benefits awareness, travel distance, car ownership, safety concerns, pedestrian infrastructure, and weather conditions. Car ownership, distance travelled, income and awareness of health benefits were identified as the five most important determinants in statistical analysis. SPSS statistical tool was explored for the data analysis and multi-variable regression techniques were used to model the data. The results show that 48.7% of the sampled population preferred to walk and 49.7% viewed walking as a substitute for motorized travel showing a significant difference in socioeconomic characteristics such as age ($F = 54.731$, $p < 0.001$) and income ($F = 68.278$, $p < 0.001$) were significantly different in residential zones. However, the study also depicts barriers such as distance, weather and a marked lack of pedestrian ways, especially in terms of bike lanes and sidewalks, the report stresses the importance of better infrastructure and safety to encourage walking and highlights a troubling pattern of transportation investments showing a preference toward motorized vehicle travel over pedestrian facilities. The study, therefore, suggests an integrated approach to promoting active travel in Akure from public awareness programs that teach residents on beneficial aspects of walking and cycling, to the integration of a range of active-planning facilities such as bike lanes, sidewalks, and pedestrian crossings to traffic facilities. Also recommended are traffic calming measures such as reduced, regulated speeds and urban design elements that are supportive of active modes of mobility. Finally, the study advocates for a shift in transportation policy by integrating active travel planning into a broader urban planning scheme, prioritizing active travel will enable Akure environment a more sustainable and livable city for its residents

The research confirmed that the choice of travel mode, including the decision to walk, hinges on various elements such as socioeconomic and social factors, availability of pedestrian facilities, and concerns about safety and security. It can also be drawn that walking and similar non-motorized means of transport aren't widely chosen as primary modes of travel within the city. Yet, intriguingly, there exists a segment of the population that engages in walking for leisure and recreational reasons, motivated by the health advantages it offers. This tendency could likely be linked to the high level

of education among the survey participants, suggesting they are well-informed about the health rewards associated with walking

References

Adebola, B. A., Adebayo, O., & Emmanuel, M. A. (2015). Modelling the Effect of Income and Car Ownership on Recreational Trip in Akure, Nigeria. International Journal of Scientific Engineering and Technology, 4(3), 228–230.

Agrawal, A. W., & Schimek, P. (2007). Extent and correlates of walking in the USA. Transportation Research Part D: Transport and Environment, 12(8), 548–563. https://doi.org/10.1016/J.TRD.2007.07.005

Chen, M., Cai, Y., Guo, S., Sun, R., Yang, S., & Shen, X. (2024). Evaluating implied urban nature vitality in San Francisco: An interdisciplinary approach combining census data, street view images, and social media analysis. Urban Forestry & Urban Greening, 95, 128289. https://doi.org/10.1016/J.UFUG.2024.128289

Delclòs-Alió, X., Rodríguez, D. A., Medina, C., Miranda, J. J., Avila-Palencia, I., Targa, F., Moran, M. R., Sarmiento, O. L., & Quistberg, D. A. (2022). Walking for transportation in large Latin American cities: walking-only trips and total walking events and their sociodemographic correlates. Transport Reviews, 42(3), 296–317. https://doi.org/10.1080/01441647.2021.1966552

Goulias, K., Pendyala, R., & Kitamura, R. (1990). Practical Method for the Estimation of Trip Generation and Trip Chaining.

Huang, X., Zhang, B., Feng, S., Ye, Y., & Li, X. (2023). Interpretable local flow attention for multi-step traffic flow prediction. Neural Networks, 161, 25–38. https://doi.org/10.1016/J.NEUNET.20

Kling, N. (2023). Linking situational analysis to architecture and urbanism. An interdisciplinary perspective. Forum Qualitative Sozialforschung, 24(2). https://doi.org/10.17169/FQS-24.2.4084

López-Lambas, M. E., Sánchez, J. M., & Alonso, A. (2021). The walking health: A route choice model to analyze the street factors enhancing active mobility. Journal of Transport & Health, 22, 101133. https://doi.org/10.1016/J.JTH.2021.101133

Mashrur, S. M., Wang, K., & Habib, K. N. (2022). Will COVID-19 be the end for the public transit? Investigating the impacts of public health crisis on transit mode choice. Transportation Research Part A: Policy and Practice, 164, 352–378. https://doi.org/10.1016/J.TRA.2022.08.020

Rahman R, & Ben-Edigbe J. (2015). Impact of Multilane Median Openings Zone on Travel Speed. Jurnal Teknologi, 73(4), 2180–3722. www.jurnalteknologi.utm.my

Tribby, C. P., Miller, H. J., Brown, B. B., Smith, K. R., & Werner, C. M. (2017). Geographic regions for assessing built environmental correlates with walking trips: A comparison using different metrics and model designs. Health & Place, 45, 1–9. https://doi.org/10.1016/J.HEALTHPLACE.2017.02.004

Wang, K., Liu, L. B., Liu, Y., Li, G. Bin, Zhou, F., & Lin, L. (2023). Urban regional function guided traffic flow prediction. Information Sciences, 634, 308–320. https://doi.org/10.1016/J.INS.2023.03.109