Correlation of the Socio-Demographic Variables to Travel Behaviour and Mode Choice in Cities of Least Developed Countries- Case Study, Urban Neighbourhoods in Aden, Yemen

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***Abstract*— This case study focuses on the city of Aden, Yemen, where a large segment of the population relies on the semi-formal public transportation due to various sociodemographic and economic factors. The study specifically investigates the inner urban area of Al Mansoura in Aden. To understand travel behavior and mode choice in this area, the research employs a mixed methodology that combines qualitative and quantitative approaches through a case study design. Primary data about the area of interest were collected through field observations, interviews, questionnaires, GIS mapping, and street audits. In addition, a novel mapping of the semi-formal transportation lines was produced for the first time in the city. Both quantitative and qualitative data were analyzed using statistical analysis methods. The results indicate a correlation between sociodemographic variables and travel behavior and mode choice, particularly in terms of income and gender. Low-income individuals tend to use public transport, while those with higher incomes prefer private vehicles. Additionally, females generally drive less than males and generally have less mobility due to cultural and educational factors; fewer responsibilities outside the home. However, a small number of females who use private vehicles tend to work.**

Keywords— *Mobility, travel behavior, semi-formal transportation, sociodemographic variable, Al Mansoura Aden*

I. Introduction

Mobility enables people to access goods and services as well as jobs, markets, family, friends, which enhance the quality of life. The needs are closely related to social and economic interaction, so people conduct activities in different places due to economic opportunities, social and familial ties, and/or lifestyle preferences. However, it is very difficult to concentrate all the needs and opportunities within walking distance of residential locations; hence, the need for mobility and transportation. Not every individual can drive a car, and many of those who can do so do not have the financial means to cover the costs of car ownership, especially since cars are depreciating assets that lose value with time, so the travel behavior and choice mode of transport (public transport private vehicles) is affected by the socio-demographic variables. Yemen is a developing country, which characterized as low-income population as well as have semi-formal transportation system refers to a type of public transit that operates with less regulation than formal public transportation systems. In Aden, the only operational form of public transportation is privately owned buses. There are no other modes of public transportation, such as trams or trains. Privately owned buses and taxis provide a source of income for thousands of families. This traditional system is characterized as semi-formal and demand-driven, with a low barrier to entry. The role of the local branches of the Ministry of Transportation is confined to limited organizational, taxing, and regulatory aspects. Despite the efficacy of the transport system in Aden, where the transportation system is accessible in the urban centers, inhabitants have observed several growing inefficiencies that impact the quality of public transportation and encourage many households to acquire private cars.

II. Problem Statement

The city of Aden has recently witnessed an increase in the number of private vehicles in recent years, increasing congestion rates and putting an upward pressure on fuel prices. On the other hand, a large segment of the population depends on public transportation. Also, most of the districts of the city of Aden, like other districts of Yemen, suffer from the lack of integrated master planning between urban design and transportation, resulting in inefficiency of transport system. Therefore, this study seeks to determine if the sociodemographic and economic variables have a correlation with the travel behavior, the mode choice, and the possibility of treatments to reliance on sustainable transportation patterns such as walking and public transportation by improving the transport system efficiency and enhance the urban design that

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have several environmental benefits (reducing emissions) economical (reducing bottlenecks traffic and reduce wasted time on the roads) and social (reducing expenses spent on transportation by private vehicles).

III. Hypotheses

The hypotheses of this study suggest that sociodemographic and economic variables influence travel behaviors and travel choices.

IV. The Research barriers

The researchers encountered several challenges in this study, particularly in terms of data collection. These challenges were mainly due to the following reasons.

A. The lack of foundational academic studies that cover the context of the study in Aden led the study to focus on establishing the general picture of the relationship between public transportation and subjective sociodemographic and economic variables and travel behaviors.

B. Literature Review: The literature review was limited by the lack of similar studies in similar contexts. Hence, the literature review explored subjective sociodemographic economic concepts that can only be adopted with caution. These include the investigation of the proper frameworks to analyze the subjective sociodemographic economic variables.

C. There is no official data related on in mapping of the semi-formal bus tracks, so most maps were produced by in this research via field surveys.

D. The lack of subjective sociodemographic economic information for the population, which led to relying on the distribution of questionnaires for sample size in the study area. In short, most of the data was obtained through field visits, distribution of questionnaires for the sample size in the study and street audit, and interviews with stakeholders, but all these obstacles did not hinder the researchers in conducting this preliminary study.

V. The Research limitation and scope

The area of the study located in Al Mansoura district which is considered one of the districts in Aden governorate in Yemen. The investigated area consists of two neighborhood units (513 and 516) (locally called the Al Mansoura blocks). It is a part of the Al Mansoura district. There are types of sample size on related with passengers who use private vehicle and public transport. The same size is 276 respondents the number of respondents required was 276 respondents. the responses from females were 50% (138 out of 276) and from males were also 50% (138 out of 276).

VI. Methodology

The objective of the study is to investigate the impact of individual sociodemographic economic variables on the travel behavior and mode choice. This paper uses a mixed method based on qualitative and quantitative research. Both quantitative and qualitative data were analyzed using the tabulated statistical analysis methods and were projected onto the GIS results to correlated the urban planning perspective with the perception and experiences of the those surveyed.

A. The Case Study Design

The study was conducted in the inner urban area of Al Mansoura district that is in Aden governorate the temporary capital of Yemen (see Figure 1). The area of interest is considered one of the oldest part and connects most parts of the district to each other this research relies on case study as the best way to investigate the hypotheses of the impact of subjective sociodemographic economic variables on travel to understanding travel behavior and modes of mobility.

Figure 1 Location of Yemen and Aden Governorate Using QIS. Source Researchers

B. The Sample Size

This study uses subjective sociodemographic economic surveys, where the study focused on an area with population 19688 inhabitants to investigate the sociodemographic and economic variables. The respondents were households that live within the studied area.

To archive the sample size by using the population. Sampling was calculated based on the formula of Yamane T.

$$n = \frac{N}{1 + Ne^2}$$

N=19688

Where: N = population size (in this research N= 19688 total number of inhabitants)

e = level of the error coefficient (±6%)

n = respondents (sample size)

The number of respondents in the collected sample yielded an error of 6% and a confidence level of 94%; hence, the number of respondents required was 276 respondents; the responses from females and males, and all the respondents' classifications are students, employees, and un-employees. These sets of completed responses were taken as samples from the population.

C. Data Collection And Analysis

1) Primary Data

The primary data used in this study are quantitative and qualitative data collected directly and indirectly using a mix of methods and tools such a questionnaire, field observations (including street audits), formal interviews, and GIS mapping. Each tool is discussed in the following sections.

- **Questionnaire (Sociodemographic and economic factors survey)**

The socio-demographic and economic survey consisted of 27 questions that aimed to understand the transportation choices of the residents of Al Mansoura district in the investigated area so the survey targeted the population, which mostly lives and works inside it. The questionnaire anonymous and does not collect any private identifiers, and the respondents have the right to not respond and withdraw from the study at any time. The survey first was conducted by KoboTool Box platform and distributed first online as a test, then distributed face to face with the help of trained research assistants aside from the self-filling approach during 4 days. And it was available in one language, Arabic, the native language of the population of Aden.

The survey aimed to correlate the primary social determinants, namely, gender, age, income, and family status, with the choice of transportation mode. And to investigate the impact of gender on transportation behaviour as one of the sociodemographic and economic variables, the researchers targeted an equal number of modes of transportation users. Males and females, 138 males and 138 females, constituting a sample of 276 respondents. The Table 1 shows the primary mode of transportation amongst the respondents was public transportation (206 respondents, 74.6%), while the remaining considered private vehicles the primary mode. Table shows the gender composition and how it relates to gender. It can be noticed that more men (55) have access to private vehicles than women (15). Females use public transportation more than males and have less access to private cars.

Table 1. Choice of the primary mode of mobility

	Type of mobility	
Gender	Number of people using Private Vehicle	Number of people using public transport
Female	15	123
%	21.4%	59.7%
Male	55	83%
%	78.6%	40.3%
Total	70	206

- **Field Trip Surveys (Field Observations)**

This method is used to collect data about both the transport system and the Urban design and analyze it and distribute the survey. Also, it used to assess the street audits from the researchers' point of view. The field trip surveys traced the bus pathways, state of the streets, and the pedestrian movement patterns on the streets. Critical street infrastructure is evaluated in the streets subject to this study,

- **Geographic information System (GIS)**

This tool was used to draw most of the maps such as the location of the area, the transportation tracks from the Al Mansoura to all the other districts, walking distance to get public transport, the location of the unofficial bus stand, and other maps to give a better understanding of all the important points in the study. In this study, the current pathways of the buses are also mapped from the observed field trips.

- **Interviews**

Formal interviews were conducted to gather more detailed information that focused on urban design in the investigated area with stakeholders in the relevant authorities as in Appendix 1. In addition, the researchers informally conversed with drivers of buses regarding their profitability. Their names are not shared for reasons of privacy. The interviews focused on profitability and livelihood potential, and financial stressors that affect their willingness to pursue this line of work.

2) Contextual Secondary Data

The literature review that used in this study consists of studies conducted outside the country, where is no peer-reviewed on the topic of public transportation in to the best of knowledge of the researchers, and were mainly utilized to identify sociodemographic variables that most likely to show a correlation with the mode choice. The literature explored the

background of research on the subjective sociodemographic economic variables and its influence on travel behavior and transportation choices and demonstrates why a topic is significant to a subject area. Papers from questionable sources, such as predatory journals, were not considered.

VII. *THEORETICAL FRAMEWORK*

A. Identification Of Influential Soico-Demographic Variable

As known, many studies address the impact of socio-demographics on travel behavior, and all of these studies assert that there is a strong link between travel behavior, travel mode choice, and socio-demographic characteristics. (Income, age, education, gender, household size, occupation status, and even ownership, driving license, attitude, marital status, etc.[1]. Socio-demographic factors have an impact on travel demand and choice, contribute to the decision to use non-motorized travel (NMT)—particularly walking—and can influence the specific route choice within a neighborhood[2]. These route-level factors include perceptions of safety, comfort, sensory pleasure, and a sense of belonging[3]. Sociodemographic characteristics (gender, age, family structure, and educational and occupational groups) have a significant impact on travel behavior components, where private transport is dominant compared with other modes of travel due to a lack of diverse options for urban travel, old vehicles and infrastructure, traffic congestion, and unequal access to travel facilities area[4]

Below is a literature analysis of the most critical socio-demographic factors that have shown a significant correlation with mobility patterns.

B. Gender

Gender is one of the key socio-demographic variables that can influence travel behavior and mode choice. Understanding travel behavior by gender will help better design transportation policies that are efficient and equitable. Many Travel behavior studies have established several trends on the distinctly different travel patterns by gender. Most studies have focused on gender transport differences in the areas of transport mode, time of travel, trip purpose, and travel distance. Women were found to have shorter commute distances compared with males which mean have less energy consumption and less CO2 emissions, have fewer work trips and more non-work such as shopping and child care, and females choose more flexible modes, depending on other social characteristics, such as age, income, household size or number of dependents. Most women in the cities prefer public transport and taxi services to cars more than men, and they are more willing to reduce vehicle use than men, despite the fact that public transport services in most cities are still unsafe. because females are more dependent on their other family members, while males are less dependent[5]

C. Income

Household income is linked to travel behavior and has a strong impact on the mode of transportation used for commuting[6].There is a mixed relationship between walking, cycling, and public transport and private vehicles, where greater rates of walking, cycling, and using public transport occur in low-and medium-income households compared to high-income households who tend to have a private vehicle[7]High income own car consume higher energy related to transport .As income levels increase, people switch from walking to riding a vehicle for longer trips[8]Males and females belonging to the low-income group are more dependent on non-motorized transport, such as walking[9]. On the other hand, when the income allows it, women rely more on the use of private motorized transport instead of public transport in Casablanca. However, the particular status of women in some households as breadwinners and reproducers, as well as the socio-cultural context of the city, shape their mobility and the choice of their activities. Travel mode choice in Casablanca is more income-based than gender-based. This situation is linked to a particular socio-cultural context in the city (and the country), which sees the car as the safest and most convenient transport mode, especially for long-distance trips (more than 10 minutes). Women in the highest income groups perform more trips than men due to their position in the household, as they are responsible for family maintenance tasks in addition to working outside the home[10].

D. Age

Travel behavior is influenced by age. Children, adolescents, adults, and the elderly all have different travel habits, which are negatively associated with non-motorized transportation and transit use[8]. Middle and older age groups have fewer active travelers compared to their younger counterparts[11]. The chances of choosing to walk and use public transport over a car as the preferred mode are higher for the age group of 11–20 due to being students, followed by the age group of 21–30, compared to the age group of 31–40. While the chances of choosing a bike over a car are higher for the age group of 21–30, it is because, with the increase in age, people's preferences always shift from walking to their own vehicle, and the young generation prefers to drive more[12]. Younger adults were found to be more likely to cycle at least once a week in their neighborhood[13]. Car ownership among households with heads over the age of 40 still persistently increased from 0.63 to 0.69. This phenomenon reflects the fact that demographic

factors will be important determinants of future vehicle demand[10].

E. Car Ownership

Owning a vehicle in a household is positively associated with VMT and negatively associated with VMT. Car ownership increases trip frequency, linked to the mode of commuting, and car ownership is also linked to land use patterns, which could explain some of the differences in travel patterns between regions[14]. For example, in the Puget Sound region of Washington State in the US, lower household vehicle ownership is related to greater street connectivity, bus stop density, and a composite index of non-motorized accessibility after controlling for other variables. Households in areas that can support non-motorized and transit travel may choose not to own a car, or those who cannot afford to own a car may choose to live in areas with alternative transportation[15]. Higher car ownership leads to increased travel volume, energy consumption, and traffic congestion, negatively impacting the environment[10]. Reduce the use of private cars and boost the use of more environmentally friendly forms of transportation like walking, bicycling, and public transportation. The provision of good access to transportation and connectivity eases the movement of people swiftly and comfortably, which is one of the characteristics of a livable city[16]

F. Driving Licenses

The ownership of a driver's license is linked to the style of commuting. People who take the bus do not have a driver's license, while those who share automobiles to get to work come from families with several driver's licenses so having licensed drivers was negatively associated with non-motorized miles travelled[17].The chances of choosing public transport over the car are higher, followed by walking and biking for people with a driving license. In relation to a study that examined the joint influence of multiple attributes, including land use, socio-demographics (gender, age, occupation, income, and vehicle ownership), and travel information on travel behavior and particularly preferred travel mode, the result shows that a driving license has a strong impact on travel behavior and preferred travel mode[12].

G. Work Statues

There is a link between job ratio and per-trip transportation energy use[18].The average travel time increases as the number of workers increases, this reflecting the fact that in households with many workers and do not live close the work consume more time and transport energy using . As the number of workers increases and the frequency of journeys increases, so does the average commute time[19]. Part-time workers travel more frequently than full-time workers because they are occupied with other duties such as grocery shopping or escorting children or the elderly[20]The chances of choosing to walk or ride a bike over the car are higher for the students compared to the government employees, while there are fewer chances of choosing public transport over the car for the group having private jobs compared to the government employees[12]

H. household size

Household size is strongly associated with travel, which is intuitive since every individual within a household contributes to household-level travel. In a King County study, the total household size was positively related to VMT in a King County study[21]. Households in the entire 4 counties Puget Sound area have shown a positive correlation between the number of household members, the number of workers, and the number of licensed drivers with vehicle miles travelled (VMT). Additionally, as household size increased, the probability of the household having zero non-motorized trips. But, for households with non-zero non-motorized trips, household size also associated with a greater number of non-motorized trips[15].

VIII. FIELD STUDY

Al-Mansoura district is one of the eight districts in Aden city, with a population of 175,345 and an area of 1,010 hectares, and a density of 174 pop/ha in 2019. It is considered the second-largest district in the city[22] . In the recent period, especially after the 1990s, the district has witnessed a very large construction boom and an increase in the number of buildings, especially commercial buildings and service buildings such as hospitals, clinics, and commercial shopping malls. The area of study is located in two neighborhood units (513, 516) (locally called the Al-Mansoura blocks). It is the oldest part of the Al-Mansoura district with a medium-sized area. (See **Appendix 1**). According to the GIS mapping, the area of the investigated area is 113.15 hectares and the population in the area of the study is 19,688 residents, which is considered high density according to the guidelines for urban planning standers[23].

Figure 2 illustrates location of the investigated area. Source (Researchers using GIS mapping)

The investigated area is surrounded by four main streets: from the north, Jail street; from the east, Al-Mansoura local streets; from the south, Jamila streets; and from the west, Ninety streets. (See **Appendix 1**,Figure 3)

Figure 3 the types of streets in the investigated area

A. Urban Passenger Transport System

In general, urban passenger transport consists of private vehicles, taxis, public transport (buses only) and active transport (walking). In the past, the public transportation system was sponsored by the government through the Ministry of Transportation, and the public transport in Aden in general is buses (known as mini vans in other countries). However, the ownership of the transportation system has moved into private hands, operating privately owned buses and taxis and providing a source of income and livelihood to their families. The role of the government is limited to only supervisory and organizational interventions from the local authorities and taxation. The existing transportation system Still a source of livelihood for hundreds of families in Aden and many more in Yemen. Making sure that their job is profitable is essential to combating poverty for this large segment of society and to the continuation of this service that enables most people in Yemen to move daily at a low cost. The cost of a one-way trip within the same district/area is 200 RY (14 US cents), and the trip to another district/area is 400 RY (28 US cents). In comparison, a liter of fuel costs 1100 RY (78 cents). Hence, private transportation only makes sense with a large number of passengers such as a large family, but it is costly for the mobility of a single individual. This is a very important socio-economic aspect that is usually not considered in the design of any sustainable interventions in the future in the urban planning of the city. While the system is far from perfect, it was developed organically as a local solution for transportation and was driven by the independent worker force, and demand from the population, with only minimal regulations that mostly focused on tax collection and minimal organization of traffic at congestion points.

The bus tracks are available only in the two main streets (Ninety and Al-Mansoura streets) and one collector street (Jail Street) and are absent in the last collector street (Jamila Street), which makes the residents of the area walk to the other three streets (see Figure 4).

Figure 4 illustrates the walking distance from Jamila Street to the other three streets where there are bus tracks. Source Tree researchers (using GIS mapping)

However, there are not any bus stations or bus stops where the buses stop, which creates congestion.as well as there is not a public transport lane. The transportation system in Aden, as in other Yemeni cities, is characterized by the freedom to stop and pick up passengers wherever there is a possibility, with little intervention from the municipality. which makes the mobility of citizens easy compared with official bus stops that need time to move, where most buses stop at any corner of the street to pick up the riders, and most riders are in a hurry all the time and do not want to wait at the bus stop or bus station.

Figure 5 illustrates the location of the unofficial bus stand and bus tracks around the investigated area. Source: the researchers (using GIS mapping)

In relation to the first destination (distance to the bus stop), in the past before 2011, there were bus stations, and all the riders walked to get buses to their destination. It served many other areas, but the riders did not prefer the bus station because

they preferred to conserve time. Now, unfortunately, the land plot use has been changed to a square public activity. Access to public transport can be obtained by walking to three streets: Jail Street, Ninety Street, and Al-Mansoura to get public transport (bus) easily. Also, access to public transport is not equal for all residents in the area where the resident along Jamila Street walks to the other three streets to get public transport; currently, work is under way with local authorities on activating buses on this street.

Table 2 Distance to the transit by walking and waiting for transit

The straight-line distance from the house to the nearest bus stop (m) *	Time of walking to the transit station in minutes	Waiting for transit in minutes
750	10	4
500	7	
250	4	
130	3	
80	2	
60	1.5	
Note* :1 Using google earth nearest bus stop (m) **Note2: There is Official Bus Stop** **Note3: The density of service near the bus stop is high**		

The table above shows that some who live along Jamila Street walk 750 meters to Jail Street due to as mentioned previously there is no bus track in Jamila Street, so they walk this distance to get a bus, while the citizens who live near Ninety Street walk there, similar to the citizens near Al-Mansoura Street.

In the past, there was a bus with a capacity of 24 seats that passed along the local street and had a starting and ending point, as shown in the figure below, which meant it had a fixed track, but unfortunately, after the war in 2015, this track was cancelled for security purposes (see Figure 6).

Figure 6 illustrates In-trip track before war 2015.Source (the researchers using GIS mapping)

For the destination from the investigated area to other districts there are two direction of destination, one related with the following districts: Khormakser, Carater, Malla, Twahi, and Al-Qaloua. See Figure 7 while the other direction related with the following district AL-Shikothman,Enmma,AL-Shab,AL-Borikq see Figure 8. This means the public bus riders can reach all the district without any difficulties.

Figure 7 Destination to Khormakser, Carater, Malla. Source: the researchers (Using GIS mapping)

Figure 8 Destination to AL-Shikothman,Enmma,AL-Shab,AL-Borikq. Source: the researchers (Using GIS mapping)

Related with the capacity of the buses is small; all the buses used are for 7–9seats, but the majority of seats in the area are mini buses with 7 seats, see **Error! Reference source not found.** .

Figure 9 Types of buses using .Source: the researchers

Related with public transport satisfaction 206 who using public transport are not satisfied while 70 or respondents who suing private vehicle are not satisfied at all.

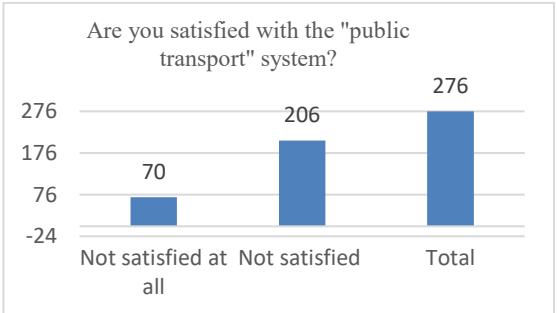

Figure 10 illustrates the satisfied with the public transport system

B. Demographic composition in the light of transportation mode choice: Gender, AGE, INCOME and family status

The age distribution also revealed an interesting pattern in car and public transportation usability. An overwhelming majority of public transportation users are young (18–28). Younger people find it easier to move by public transport, and they usually earn less income, especially if they are students and do not have a driving license, especially if they are under the age of 18. Car users are usually middle age (29 Age (29-39), 27 Age (40-59) and earn more income. However, most of having private vehicle their income ranges from medium to high.

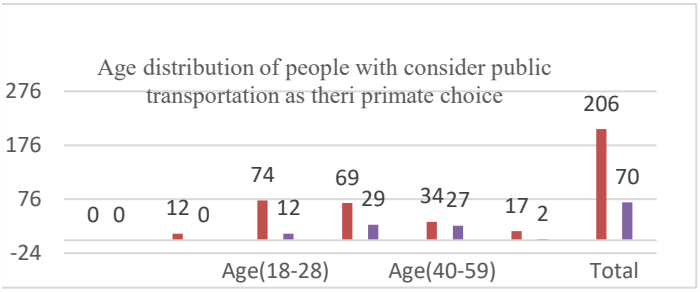

Figure 11 Age distribution of people who consider public transportation or Private Vehicle as a primary mode of transportation

In addition, the respondents were asked about their income through self-reporting and consideration. It can be inferred that the richer the person, the more likely they are to adopt a private vehicle as their transportation mode. Low-income people are very unlikely to have private transportation means, while people with higher incomes are more likely to acquire a car.

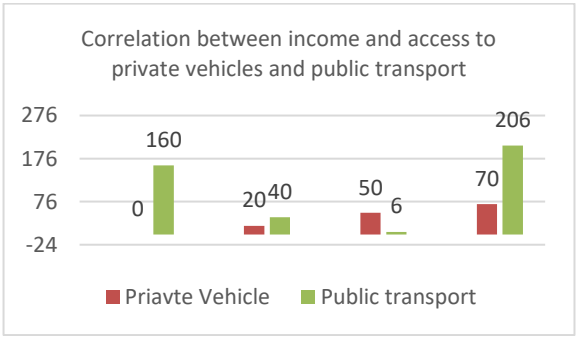

Figure 12 Correlation between income and access to private vehicles and public transport

The social marital status of people with cars is also a predictor of their motivation to acquire a private car. Most of them are married, and have children and their income level is medium to high. Private cars provide a level of freedom of movement and privacy without cramming with other

passengers. Few single have private cars due to their responsibility where most of them are females and work outside a lot .Related to public transport users are singles and married couples with or without children using public transport due to their income.

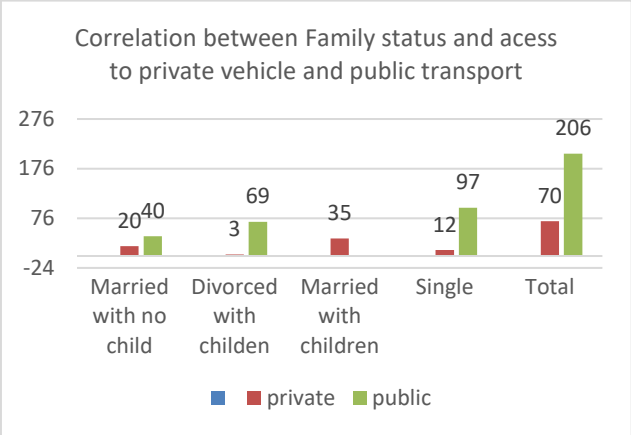

Figure 13 Family status of people who use private transportation or public transport as their primary modal choice

Related with education variables according to the survey there is no relation between the transport mode choice and the education level.

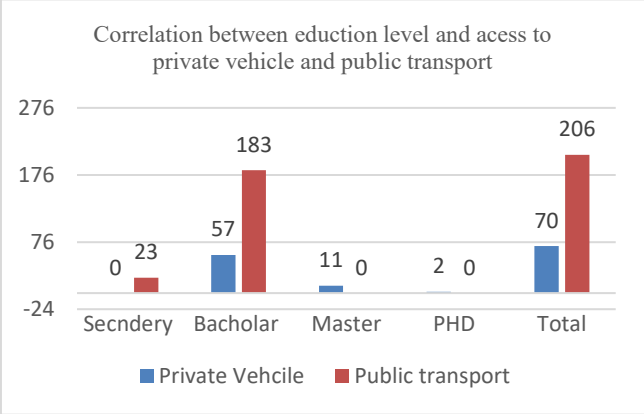

Figure 14 Correlation between education level and access to private vehicle and public transport

An optional question was proposed, which was the classification of income and how it affected their choice of transportation mode, as shown in Table 3 below.

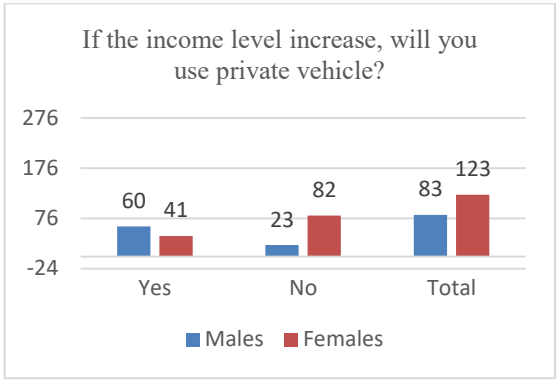

Figure 15 Correlation of income and gender, and preferred choice of transportation modes

Table 3. Correlation of income and geneder, and prefered choice of transportation modes

Question	Respondents' breakdown	Reasoning
For low income, medium and high income because using public transport (males). And if the income level increase, will you use private vehicle?	60 M(low-income)	They cannot bear the expenses of the car and the maintenances. If the income increase, they will change the travel mode choice
	5 M(medium) 3 M(high)	They say no since they are still students and don't own driving license now
	15M (medium income and single)	They cannot bear the expenses of the car and the maintenances. They will not change; they do not want to lose their money on cars
For low income, medium and high income why using public	60 F(low-income) + 1 F(high)	They cannot bear the expenses of the car and the maintenances; they will not change due to the cultural of the family

transport (females). And if the income level increase, will you use private vehicle?	40 F (low-income)	They cannot bear the expenses of the car and the maintenances. they will change due to they travel for work
	1 F(high)	She will change if her family change their opinion
	13 F(medium)	They say no, they will not change the travel mode choice due to the cultural of the family
	3F(medium)+1 F(high)	They say no due to they are students, don't own driving license now
	4F (medium income)	They say no due to they do not work so no need to own car
Notes: Male(M)- Female(F)		

C. The Trip Purposes

Investigating the trip purposes reflected how the respondent travel within and outside the investigated area as well as the effectiveness of the land mix uses within and the effectiveness of the public transportation system to cover a myriad of needs for trips. A Table 11 shows the easiest mode of transportation for at least one of the major trip purposes.76% of respondents find walking to be the easiest mode of transportation to access at least one of their trip purposes inside the investigated area, and use of private cars was registered as the least convenient method of traveling inside the investigated area.

Table 4. Easiest ways to access your destinations within the investigated area

Easiest way to access the destination	The Number of People	%	The Reasons for trip, ranked by most frequented to the least
Walking	210	76 %	Visiting neighbors
			Daily needs such as Grocery shopping…etc,
			Work
			pray
			Study
			Work
			treatment
			Work
Public transport	46	17 %	Visiting acquainted, friends
			work
Private cars	20	7%	Shopping for specific types of shopping such as mobile and electronic shops, Vegetables, fruit, Chicken and fish market, building material shops, and Malls, big Centers, big shops and the shops that has service and goods are not available in the investigated area
			Study
Total	276	100 %	

The type of purpose for which the trip takes place also influences their trip choices. The top reasons for in-district trips were rarely related to work but rather social functions, shopping, and other daily needs. For private car drivers, public transport is very important to access work.

Table 5. Types of amenities inside the district of Al Mansoura based on their destination classification.

Mobility types	The Number of People	%	The Reasons for trip
Public transport	206	74.6%	Visiting acquainted, friends out the investigated area
			Malls, big Centers, big shops and the shops that has service and goods are not available in the investigated area
			Work
			Study
			treatment
Private car	70	25.4%	work
Total	276	100%	

D. Urban Design Elements Assiciated with Walkablity

The street audits are used to assess the urban design conditions by the researchers, for accessing of an external environment as well as the transit usage. Street audits are often

undertaken when considering the needs of pedestrians as a form of transport. These effect of these characteristics on travel behavior are shown in the table below:

Table 6 the street audit of the streets

Type of streets Characters	Local Street	Collector Streets		Main streets	
		Jail street	**Jamila Street**	**Al-Mansoura streets**	**Ninety Street**
Asphalted	3	5	4	4	5
Safety of streets (Recording cameras)	1	1	1	1	1
Safety of streets (Lighting)	2	4	2	4	5
Traffic sign	1	1	1	1	3
cross-zebra	1	1	1	1	2
Speed Pump	5	1	2	2	2
Parking	1	1	1	1	1
On-road Landscape	1	2	1	4	4
Walkability Pattern	2	2	2	5	5
Mix-Land-use along the street	5	4	2	4	3
Amenities	1	1	1	1	1
Continuity & Connectivity (Well-connected grid networks)	5	5	5	5	5
(Intersections of streets per square kilometer),	5	5	5	5	5
Bus lane and	1	1	1	1	1
Bus Stop	1	1	1	1	1
The total	35	35	30	40	44
The mean	2.3	2.3	2	2.7	2.9

Notes: Excellent-5, Very Good=4, Good=3, Average=2, No exist=1

Figure 16 Some picture of the mobility practices of the streets in the investigated area

The respondents were asked about their perception of the safety of the streets, whether from other intentional incidents (crime) or accidents and traffic. The majority is skewed toward a sense of lack of safety, and more work is needed to improve this area through lighting and street cameras. Out of all the respondents, 71% of the women (98 out of 138) responded that they do not feel safe, and 29% (40 out of 138) answered maybe, contingent on the general conditions. While some people feel safe, more than half feel there is an issue of safety on the streets.

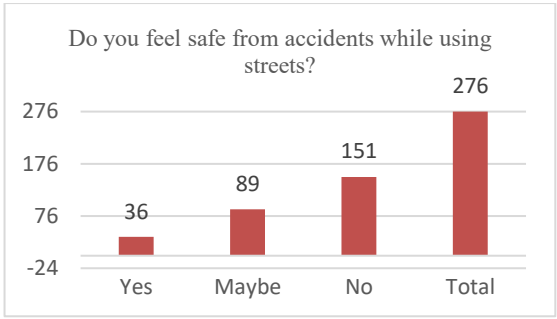

Figure 17 Perception of safety from accidents

The respondents also asked about the impact of the urban design of the streets on the promotion of public transport usage rather than private vehicles; 70 answered no because they have private cars. They consider this indicator does not affect the encouragement of people who have cars to move to public transport usage, while 126 answered Maybe they indicate that they use public transport because of its low cost compared to having their own car, and they also assert that if their income is improving, they will use private vehicles. 80 say yes, and they assert the importance of improving the transport system's efficiency and urban design.

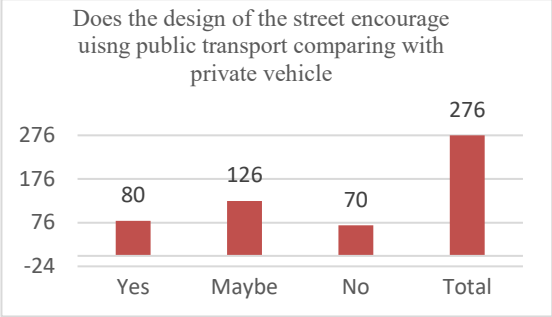

Figure 18 illustrates the impact of design of the street for encouraging the public transport comparing with private vehicle. Source (the researchers)

IX. Summary Of Results

A. Socio-demographic and economic variables influence transit usage. Variables such as income, age, gender, household size, occupation status, car ownership, license possession, attitude, and marital status impact transit use, but income, gender and license possession have the strongest correlations. Low-income individuals use public transportation more than high-income individuals who can afford private vehicles. Females also rely on public transit more than males due to cultural and educational factors, occupational status (women work less than men), and trip purpose (women do more shopping, visiting, and education-related trips). The few females who use private vehicles tend to work and have more responsibilities that require maintenance of a private vehicle, so the needs of female public transit riders must be considered. Age impacts youth under 18 who use public transit due to lack of a license, while marital status has little direct impact on travel behavior and mode choice, though it relates to income level.

B. Improving the efficiency of the transit system is needed to satisfy all riders by adding features like cooling systems (albeit it being expensive) and keeping vehicles clean (which is more doable with no cost).

C. Sustainable improvements in street design are needed to encourage private vehicle users to walk and use public transit. This involves enhancing public transit and improving open and green spaces on and off roads for pedestrians, in addition to safety features, removing haphazard buildings on sidewalks, and accommodating disabled travelers who use wheelchairs.

X. Recommentaions

The recommendations that are taken into account the requirements of the transport system and the sociodemographic variables have two considerations: policymakers, and urban design and transportation. These recommendations will enhance the public transport sustainability, as it is the most mode used by the largest segment of society

A. Policy Recommendations

1. Activate an institutional coordination mechanism such as the Ministry of Transport, Ministry of Public Works and Highways, the General Authority for Lands and Urban Planning, and the Local Council of the district, with the Local Authorities, with the consultation and coordination with the drivers' unions and groups to enhance both the public transport system and the urban design elements.
2. Establish a database for real-time mapping of the transport system, and a database for subjective socio-demographic economic variables (i.e income, gender, age…. etc.).
3. The government should promote education about public transportation as a sustainable option, not only financially but also socially and environmentally, especially that it serves as a source of income of many households.
4. Reduce private vehicle imports by increasing customs fees.
5. Encourage the private sector to introduce more market solutions for public transport such as ride sharing, taking into consideration the livelihood of young people who work or use the transportation sector.
6. Research and support more environmentally and economically sustainable fuel options, such as gas conversion kits for cars working on the costly petrol, hybrid buses, electrical vehicles charging stations from renewable sources, etc.

B. Urban DESIGN AND Transportation Recommendations

1. Improve the efficiency of the public transport system by arranging its operation, cooling system in buses for the comfort of users for those willing to pay an additional fee, promotion of safe driving practices, with consideration of preserving job opportunities for youth.
2. Improving the urn design elements and rebuild Street infrastructure by provide Adequate lighting (preferably solar-powered), cameras on main streets used for safety, security and traffic signs to regulate traffic, amenities such as chairs, waiting areas for young and old people when waiting for public transport , trees and green areas on streets, remove random obstacles by reducing random expansion , provider disability consideration for people who cannot walk ,enhance the crosswalks for safe street crossings and providing lanes for cycling with consideration for safety,

XI. CONCULATION

Mobility is vital for healthy social and economic livability, so people conduct activities in different places in response to economic opportunities, social and familial ties, and/or lifestyle preferences. The research paper discusses the impact of subjective sociodemographic and economic variables influencing travel behaviors and travel choices, where a large segment of the population depends on public transportation due to their sociodemographic and economic variables. This research relies on a case study using a mixed-methods approach based on qualitative and quantitative research. The study asserts that sociodemographic variables have an impact on travel behavior and mode choice. The most important sociodemographic variables that have a strong impact are income, gender, and possession of a driving license. The other variables have less impact. Also, most males with low income agree that if their income changes, they will depend more on private vehicles, compared to fewer females. The public transportation system is inefficient, and there is a need to improve the urban design of the investigated area to make walking to and from public transportation more comfortable, with safety considerations, especially for females at night. The study has two recommendations, one related to policies and the other related to urban design and transportation (with consideration of preserving job opportunities for youth and providing affordable transportation options for the population, as it is the mode used by the largest segment of society), that are economical (reducing traffic bottlenecks and wasted time on roads) and social (reducing expenses spent on transportation by private vehicles).

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APPENDIX

Appendix 1 INTERVIEW ABOUT THE URBAN PLANNING AND DESIGN AS WELL AS THE STYLES OF THE STREETS

There was an interview with the director of the Municipal office in AL-Mansoura district, Mr Rafat Rashed Qukani, to discuss urban planning and design as well as the styles of the streets.

Could you please give a brief about the investigated area?
The area of study is located in two neighborhood units (513, 516) (locally called the Al-Mansoura blocks). It is the oldest part of the Al-Mansoura district with a medium-sized area. It is surrounded by four main streets: from the north, Jail streets; from the east, Al-Mansoura streets; from the south, Jamila streets; and from the west, Ninety. In the recent period, especially after the 1990s, the district has witnessed a very large construction boom and an increase in the number of buildings, especially commercial buildings and service buildings such as hospitals, clinics, and commercial shopping malls. However, this boom created a problem manifested in the unintegrated urban land use planning with the transport planning, creating a problem in parking spots and traffic congestion, an increased number of private vehicles, and deteriorating air quality
What are the types of streets surround it and within it?
There are three types of streets in the area: the main streets, local streets, and collected streets. Within the area, there are only local streets, and the main and collected streets surround the area. It is surrounded by four main streets: from the north, Jail streets; from the east, Al-Ma Local streets: They are local streets within the area, creating blocks according to the intersection of the horizontal and vertical local streets; the width of them ranges from 12, 14,15,16 M, in addition, they are designed with one-way directions. However, due to the absence of the role of traffic regulation, the laws, and the general traffic recently, the local streets are now using two-way directions, which creates a lot of congestion and accidents within the area, as well as a part of the lane of local streets being used as parking in a random way. Collector streets: The area of the study is surrounded by two main streets: one from the north, Jil Street, with a width of 25 meters in both directions, and the other, Jamila Street, from the south, with a width of 20 meters. Main streets: The area is surrounded by two main streets, one from the east (Al-Mansoura Street), which consists of two directions, each with two lanes with a width of 30 m for both directions. The other one, Ninety Street, is from the west in one direction and consists of two lanes with a width of 30 Mansoura streets; from the south, Jamila streets; and from the west, Ninety streets.

APPENDIX **2** *INFORMAL INTERVIEW WITH BUS DRIVERS*

How much is the fare per trip?
The cost per trip within the Al Mansoura is 200 RY, to Al Shaikh Othman 400 RY, and to Khormaksar, Crater, Al Mualla, 500 RY.
What is the profit margin for you per day?
It varies. For me what remains after paying for fuel and my meal ranges between 5,000 to 15,000 RY
What is the biggest factor in determining your profit?
I used to have a petrol bus, but I shifted to this dabab (minivan) which is operated by LPG. The LPG is much cheaper, so I can move with less passengers without worrying about breaking even. An obstacle is the taxes in each district which takes around 200 RY per trip, when I have an average of four or five passengers paying 200 RY to 400 RY. These taxes may sound little but they accumulate throughout the day with the number of trips. Overall, it feels people are moving less these days due to the economic recession. When people are more economically prosperous, we can feel that through more movement of people and more business for us.

APPENDIX **3** *AQUESTIONNAIRE FOR NEIGHBOURHOOD RESIDENTS ON THE USE OF TRANSPORT FOR MOBILITY IN ARABIC AND ENGLISH*

The graduate student at the University of Aden seeks to carry out a study on (The Impact of the socio-demographic variables on travel behaviour Case Study: Neighbourhood Units (513,516), (Locally Called the Al-Mansoura Blocks). This questionnaire aims primarily to know that travel behaviour and transport mode choice during study the socio-demographic variables of the region's residents in the investigated are in Al-Mansoura district. We kindly ask you to cooperate with us through an objective and honest answer and not to leave any paragraph unanswered. We also stress the importance of your privacy and not to share your personal data with our sincere thanks to you.

NO.	Question	Answer.
.1	The gender	□ Female □ Male
.2	The Age	□ 17-14 □ 28-18 □ 39-29 □ 59-40 □ 60+
.3	What is your statue?	□ Student (if student how many student do you have in your family)

		□ employee full time □ employee part-time self-employee □ telework
.4	What are marital statues?	□ single □ married (if married how many children do you have)
.5	Are you Educated?	□ None-Educated □ Primary □ Secondary School □ Bachelor Mater Degree □ PHD Degree
.6	The income level	□ Low-income □ medium-income □ high-income
.7	How many cars do you have?	□ zero □ One □ two □ three □
.8	Do you have driving license?	□ Yes □ No
.9	How to travel?	□ walking □ bus (public transport) □ car □ motorcycle □ cycling
.10	□ The type of the private vehicle	□ Small size car (such as Hyundai Accent size, Kia Rio) □ Medium Size Car Machine (Hyundai Sonata, Honda Accord, Toyota Camry) □ Mini CarSUV (RAV Four, Toussaint) □ Medium SUV (Toyota Fortuner, Honday Santa Fe) □ Large Car SUV (Landcruiser, Nissan Patrol) □ Others (please specify type)
.11	If you own a car, what is your average fuel consumption per week? (Enter zero if you don't own a car)	□ Zero □ 10 liters □ 5 liters □ 20 liters □ 15 liters □ 40 liters
.12	Do you have access to public transport by walking?	□ Yes Always □ Often □ Rarely □ No
.13	How far to walk for public transport?	□ 3 minutes or less □ 5 to 10 minutes □ 10-15 minutes □ 15 minutes or more □ Other answer (please specify)
.14	Is it easy to get transportation from your site?	□ Yes, easy. □ Average ease

		☐ No, hard.
.15	Is work/school easily accessible from your home?	☐ Easy ☐ Average ☐ difficult ☐ Very difficult
.16	Are all services available in the investaged area such as services (residential - commercial - educational - medical - religious - etc.) and therefore do not need to be transported outside?	☐ Yes, most are available near me. ☐ Some of them sometimes make me move around. ☐ I don't have to move too much. ☐ Nothing is available around me, which always forces me to move around
.17	What is your assessment of the condition of the sidewalks in the neighborhood and at the bus parking lot?	☐ Good ☐ Medium ☐ Bad
.18	Do you feel safe from traffic accidents when you walk in your area?	☐ Yes ☐ Somewhat ☐ No ☐ Another answer
.19	Does the weather affect travel behavior?	☐ Yes ☐ Somewhat ☐ No ☐ Another answer
.20	Which of the following make you to use the car instead of public transportation? (Select all applicable answers)	☐ No bus lane near the area to be reached ☐ Sidewalks design is not helpful to walk ☐ Distances are far from services and work ☐ No street lighting at night ☐ Lack of security; crime ☐ Hot weather and sunshine in the day ☐ Lack of green space to give shade ☐ Lack of safety considerations from traffic accidents ☐ Poor bus service ☐ Maintain personal privacy ☐ High Transportation Cost ☐ Inefficient public transport (buses) ☐ Large number of family members ☐ Other answer (please specify)
.21	Are you satisfied with the "public transport" system?	☐ Very satisfied ☐ satisfied ☐ Average satisfaction ☐ Unsatisfied ☐ Not satisfied at all
.22	What is your assessment of the cost of public transportation relative to your income?	☐ Cheap cost and don't consume much of my monthly budget ☐ Medium cost and consume an average amount ☐ High cost and consume a large part of the monthly budget
.23	If you own a car, what is your assessment of the cost of spending on the car relative to your income?	☐ Cheap cost and don't consume much of my monthly budget ☐ Medium cost and consume an average amount ☐ High cost and consume a large part of the monthly budget

.24	What encourages you to use public transport?	☐ High fuel prices ☐ Good atmosphere ☐ Provide facilities such as bus access from anywhere ☐ Link (destinations) with each other without the need for hiking ☐ Diversity of services near transport routes ☐ Efficiency and performance of public transport (you can explain)
.25	Does the mix land use effect on the mobility?	☐ Yes ☐ No ☐ Maybe ☐ Please Clarify the answer
.26	Does the distance to public transport encourage using public transport instead of private vehicle?	☐ Yes ☐ No ☐ Maybe ☐ Please Clarify the answer
.27	Does the access to destination encourage using public transport instead of private vehicle?	☐ Yes ☐ No ☐ Maybe ☐ Please Clarify the answer
.28	Does the design of the street encourage using public transport instead of private vehicle?	☐ Yes ☐ No ☐ Maybe ☐ Please Clarify the answer
.29	What is the level of satisfaction for the following aspects in relation to public transport (public transportation), 1 to 5 level values where 1 is the lowest level of satisfaction and 5 is the highest level of satisfaction?	

Characteristics	1	2	3	4	5
Transport cost					
Ventilation and cooling considerations on the bus					
Safety					
Easy access to transport					
Provide chairs					
Disability consideration					
The cleanness of the buses					
Comfortability					
drivers					
Size of the bus and width					
Flexibility					
Bus Parking (Bus)					
Timing accuracy (wait time and arrival time)					
Deteriorating street infrastructure					