https://doi.org/10.3311/PPtr.21543

Periodica Polytechnica Transportation Engineering, 52(1), pp. 1–17, 2024

Analysing Associations between the Actual, Ideal and Maximum Willingness to Commute Time, as well as Satisfaction with Commuting: A Case Study of Jounieh, Lebanon

Dalia Falah[1], Melika Mehriar[2], Houshmand Masoumi[2,3*]

[1] Department of Civil and Environmental Engineering, Faculty of Engineering, Notre Dame University, 00000 Zouk Mosbeh, P.O.B. 72, Lebanon
[2] Center for Technology and Society, Technische Universität Berlin, Kaiserin-Augusta-Alle 104, 10623 Berlin, Germany
[3] Department of Transport and Supply Chain Management, College of Business and Economics, University of Johannesburg, Kingsway Campus, University Road & Kingsway, 2006 Auckland Park, South Africa
* Corresponding author, e-mail: masoumi@ztg.tu-berlin.de

Received: 16 November 2022, Accepted: 04 October 2023, Published online: 24 October 2023

Abstract

Many studies have been conducted worldwide to study travel behavior, specifically commuting times. Nevertheless, few or none have been conducted in the Middle East and North Africa region. The main objective of this paper is to understand the relationship between the actual, ideal and maximum willingness to commute times, and satisfaction with commuting in the city of Jounieh, Lebanon. Socio-economic and land use factors were included to investigate whether they influence commuting times. The average commuting time of the sample is 48.2 minutes, longer than their ideal commute time by about 20 minutes, while their maximum willingness to commute time is 53.46 minutes. The sample was neither satisfied nor dissatisfied with their commutes. After performing multivariate Ordinary Least Squares model, and fixing the socio-economic and land use variables, the model proved that the actual and ideal commuting times as well as the actual and maximum commuting times are positively correlated, but the actual commuting time and satisfaction are negatively correlated. A univariate Ordinary Least Square model was performed to determine the correlation between ideal and maximum commuting times; they are highly positively correlated. Finally, the average commuting times and satisfaction were compared for some categories. Women spend almost 13% less time commuting than men, yet they have lower level of satisfaction. Lebanese commuters are also shown to commute more than non-Lebanese ones by approximately 22%. University level commuters commute about 36% more than non-university level people, while unemployed and employed respondents commute for the same time.

Keywords

travel behaviour, socio-economic factors, land-use factors, urban transportation planning, commuting times, Middle East, North Africa

1 Introduction

Developing countries have been known to suffer greatly from issues associated with mobility. Cities in these countries have experienced a rapid growth in challenges related to transportation. Some are road-related, including traffic congestion, accidents, and low accessibility. Others affect the environment through environmental deterioration, energy exhaustion and climate change (Pojani and Stead, 2015). Gakenheimer (1999) also mentioned how mobility and accessibility in these countries are declining rapidly mainly due to the inability of the facilities to keep up with the high demand and the lack of sufficient and suitable road maintenance.

Lebanon, which is a country located in the Middle East and North Africa (MENA) region is one of these countries. The transportation crisis in Lebanon has been ever-growing, with no to minimal solutions found yet. This crisis is mainly due to the substandard designing and planning techniques applied in the Lebanese road network, both in design and maintenance (Rayess et al., 2021). The lack in proper urban transportation planning generated issues regarding commuting which Lebanese people go through on a daily basis.

The important change caused is the increase in the commuting time, where commuting is considered to be one of the least enjoyable activities within the time allocation of

Cite this article as: Falah, D., Mehriar, M., Masoumi, H. (2024) "Analysing Associations between the Actual, Ideal and Maximum Willingness to Commute Time, as well as Satisfaction with Commuting: A Case Study of Jounieh, Lebanon", Periodica Polytechnica Transportation Engineering, 52(1), pp. 1–17. https://doi.org/10.3311/PPtr.21543

an individual (Kahneman et al., 2004), and not surprisingly it is often perceived rather negatively (Cervero, 1989). Millions of workers spend time travelling on their working days and commuting to/from work, and these are among the most important trips in workers' daily activity. Given its importance, commuting plays a central role in daily mobility planning, and thus the analysis of commuting behavior is important for the correct design of mobility policy (Young and Morris, 1978).

An increase in commuting time has significant negative effects such as increasing the pressure on the infrastructure (Zhao et al., 2011), increasing air pollution and energy consumption (Nie and Sousa-Poza, 2018), and other consequences on individuals regarding commuting costs, as well as their well-being, including personal life contentment (Sha et al., 2019) and physical health (Jang et al., 2021).

The reason why people cannot simply opt to work or study closer to home or vice versa to avoid commuting, given the unpleasantness and potential harm of it, is that despite the discomfort and negative impact on the human's well-being and the environment, several factors prevent the avoidance of commuting. These factors, including property values, wages, commuting expenses, and living costs, are beyond individuals' control. Consequently, commuting time emerges as a product of the trade-offs necessitated by these influencing variables (So et al., 2001).

Studies have constantly shown that many factors influence the commuting time including socio-economic (Litman and Steele, 2017) and land use factors (Brockerhoff, 1998), which will be studied throughout this paper.

Some studies, such as the ones mentioned previously, emphasise the truth about the mobility conditions and travel behaviour in developing countries, the reasons behind them and the difficulties involved. However, these studies are scarce and developing countries are not researched enough in these topics. The importance of this study is shedding light on small cities that do not usually get attention or are often under-researched in travel behavior analysis, specifically regarding commuting behavior. The problem faced during this research is that not enough studies have been performed in this field in developing countries, particularly, for small cities. There is a huge knowledge gap in this topic between developed and developing countries. Hence, comes the significance of this research. This study will help expand the knowledge regarding the commuting behavior of the residents in Jounieh, which is the city of interest. It will enable us to understand how certain socio-economic and land use factors affect commuting times. It will also allow us to compare the commuting time of people in Jounieh with their desired commuting time and the maximum time they are willing to drive on the road.

The goal of this study is to gather sufficient data regarding socio-economic and land-use factors, as well as commuting behavior from the residents of a small town like Jounieh, to be able to compare the Actual Commuting Time (ACT), Ideal Commuting Time (ICT), and Maximum willingness to Commute Time (MCT), as well as deduce how some factors affect the commuting time. It is also essential to discover whether Jounieh residents are satisfied with their travel times and to which extent. Hence, the main objective of this research is to investigate socio-economic and land-use patterns and their influence on commuting times.

The first part of this research paper discusses the travel behavior in Lebanon in general as well as the objectives of the study. The introduction is followed by the literature review from previous research regarding the socio-economic and land-use factors that affect commuting time and the extent to which they influence it, it also includes studies that researched actual, ideal, and maximum commuting times, and their relations. The third part consists of the methodology including the research questions and hypothesis, information regarding the case study area, data, and variables, as well as the data analysis methods. The findings section follows the methodology, in which the survey data is analysed and the research questions are answered. Then, Section 5 includes the discussion of the findings and comparison to previous literature. Finally, the conclusion summarizes the paper and adds the limitations of the study and future work.

2 Literature review

Traveling is an innate part of everyday life. It could be a routine like going to work, school, etc, or it could be random such as going on vacation (Novaco et al., 1990). Commuting arises out of necessity rather than choice, as individuals often lack the option of working close to their home or living close to their work and most visited places. Hence, commuting results from optimising several factors such as housing prices, wages, commuting and living costs (So et al., 2001). Commuting could also stem from the presence of psychological barriers linked to environmental changes, established habits, or familiar relationships (Bergantino and Madio, 2015). In a way people tolerate longer commuting times in exchange for

other advantages. High wages attract commuters, while high housing prices discourage them from residing in an area. This shows that workers are willing to travel longer for work if it means they can save money on housing in areas located at a greater distance from their jobs. This trade-off involves comparing the costs of commuting to work to the savings gained from choosing a more affordable housing option located further away from their workplaces (White, 1977). A study on 9,438 residents, aged between 22–62, of a 31-county region in central Iowa revealed that a 10% increase in metropolitan wages is correlated to a 3.5% raise in total commuters (So et al., 2001). Similarily, Bergantino and Madio (2015) conducted a study in the United Kingdom (UK) involving 77,029 employed people aged between 23-65. The results showed that when a salary increase is greater than 20%, the probability of commuting longer than 45 minutes increases by an average of 2.6%. Plaut (2006) also concluded that homeowners are willing to endure longer commutes in exchange for better financial opportunities. The findings of Bergantino and Madio (2015) also showed that individuals working in London tend to come from different areas or regions due to the presence of more opportunities.

Moreover, the elevated cost of housing there leads individuals to choose a home in areas outside of London. This enables them to find a better balance between housing expenses and the costs associated with commuting to work. This observation confirms the findings of Muellbauer and Cameron (1998), which suggest that higher relative house prices encourage in-commuting.

A lot of time and effort has been devoted to investigating the connection between land use and transportation behavior, where a great percentage of this research has focused primarily on the connection between land use and commuting behavior (Cervero and Wu, 1998; McLafferty, 1997). During traveling or commuting, human satisfaction is the most important factor to consider. Human satisfaction and well-being depend on various travel conditions, such as travel congestion, long commutes, air pollution, interpersonal conflicts, and vehicle malfunctions (Giménez-Nadal et al., 2022). The focus here would be on one of the significant components that greatly affects commuting satisfaction, which is commuting time. Commuting time has always been an important issue that had been broadly examined (Hansson et al., 2011). For instance, commuting time has been linked to several negative outcomes and dissatisfaction in the UK (Künn-Nelen, 2016) and similarly in the Netherlands (Gimenez-Nadal and Molina, 2014). Previous research on commuting times indicated increasing trends in the Netherlands (Gimenez-Nadal and Molina, 2014; Susilo and Maat, 2007) and Sweden (Westin and Sandow, 2010).

Some of the factors that have been reported to be related to commuting time are gender, higher education levels and greater specialisation among employees, improved infrastructure, and the availability of faster travel modes. For instance, highly educated people may want to search for more specialised job opportunities, which may be far away from their home; this will require longer commuting distances and longer commuting times (Hanson and Pratt, 1995). In the Netherlands, a correlation was shown between longer commuting times and both higher income and education level (Susilo and Maat, 2007). Urban structure and geographic characteristics have also been found to be important determinants of commuting in different settings (Humphreys et al., 2013). A study for African American, Latino, and white workers also added that gender and race also influence the commuting time, in addition to other major determinants such as wages and means of transportation. This study concluded that male workers' commuting time is highly impacted by household characteristic. In addition, for white women, particularly in the suburbs, the presence of children leads to shorter work trips (Giménez-Nadal et al., 2022).

Another study was performed on fifteen European countries to understand the gender difference in commuting time and gather information on the factors that influence an increase or decrease in commuting time. The data used to perform this research was taken from the European Working Conditions Survey (EWCS) for the years 1995 to 2015 with 5-year increments. The total number of Individuals chosen for this research was 87,869 and they were from Denmark, Finland, Sweden (Nordic) Ireland, UK (Anglo-Saxon) Greece, Italy, Portugal, Spain (Mediterranean), as well as Austria, Belgium, France, Germany, Luxembourg, and Netherlands (Continental). For the analysis, demographic weighting was used to report the trends in commuting time, in which the sample was divided into demographic cells defined by age, gender, and employment status. In conclusion, increasing trends in commuting time have been noticed in nine countries, while decreasing ones have been observed in four of these countries.

Moreover, several socio-demographic factors have been associated with commuting times such as gender, education, employment status, family size, etc. Regarding the gender gap in commuting times, male workers were found

to commute more than female workers. This is present in Anglo-Saxon and Continental economies, but not in the rest. Whereas highly educated individuals may want to look for more specialised work opportunities; thus, they may experience different commuting behaviors. Moreover, part-time workers may not be willing to commute for a long time for short schedules (Giménez-Nadal et al., 2022).

A study conducted by Young and Morris (1978) investigated commuters' satisfaction by interviewing 1,049 people in three suburban areas of Melbourne, Australia in 1978 and 1979. They conducted their study by comparing a hypothetical/ideal commute length and satisfaction with commute. Most people were satisfied with a commute time of 15–19 minutes, which was consistent with the results of Redmond and Mokhtarian (2001) in San Francisco, USA. In addition, 7% of the sample reported that they commute too little, while about half of the sample wish to commute less than they actually do.

In 1998, a study performed by Redmond and Mokhtarian (2001) to understand the ideal and desired commute time gained its data from a survey mailed to 8,000 randomly selected households in three different neighborhoods in San Francisco, where half of the surveys were sent to urban areas, and the rest to suburban ones. The ACT and ICT were also investigated. The use of linear regression models enabled the generation of the following data. The sample reported a mean ICT of 16 minutes, where 89% of the sample reported an ICT less than 30 minutes. In addition, only 1.2% of the sample reported an ICT of zero. 42% of the sample's ACT was within 5 minutes; however, 52% of their ACT exceeded the ICT by more than 5 minutes.

O'Fallon and Wallis (2012) collected data via an online survey over a two-week period in early 2011 in Auckland and Wellington metropolitan area. Out of 512 respondents, 3% specified an ICT of zero. The mean ACT and ICT were 20 and 14 minutes, respectively. 29% of the respondents wished to commute less than 10 minutes, while 69% preferred an ICT between 10 and 30 minutes.

Based on an online survey of 628 commuters in Portland, Oregon, Humagain and Singleton (2020) found out that the average ACT is 33.5 minutes, while the ICT is 13.5 minutes. Almost half of the respondents had an ACT of 15–35 minutes and 65.8% of them had an ICT in the 0–20 minutes range. 8.4% of the sample wished for an ICT of zero.

In 2018, a survey was conducted in Xi'an, China, to analyse the dissonance association between the ACT and ICT and commute satisfaction. A total of 833 responses were reported. The ACT and ICT were self-reported, but the dissonance between them was obtained by subtracting the ICT from the ACT. Commute satisfaction was measured using the Satisfaction with Travel Scale (STS). An Ordinary Least Square (OLS) model was used to determine the ICT and investigate factors that might be associated with the ICT. The most important independent variable in the model was the ACT. Then, descriptive analysis was conducted to examine relations between commute time dissonance and influencing factors. 64% of the sample had longer ACT than their ICT. At the same time, 17% of them preferred a longer commute. At the same time, 19% of the respondents had similar ACT and ICT. Regression models were then developed to predict the dissonance with such influencing factors (Ye et al., 2020).

Another study done by Pritchard et al. (2021) investigated the relationships between commuting times based on a survey applied in the Greater London Area (GLA), Municipality of Sao Paulo (MSP), and the Dutch Randstad (NLR). The data collected was done between June 2017–2018, and a total of 2,664 people were interviewed. On average, respondents reported an ACT of approximately 29 minutes, but the ICT that was about 10 minutes shorter. They also reported a maximum average tolerance of 48 minutes. Besides, there was a positive correlation between the ACT and both the ICT and MCT. In the GLA, only 5.7% reported an ACT less than ICT, whereas 69.9% reported an ACT of more than ICT, and the rest commuted for a time equal to their desired one. More people in the NLR and MSP (12.1 and 18.7%, respectively) reported and ACT less than ICT. However, in these two locations, the same percentage of respondents (52%) reported an ACT higher than ICT.

It is clear that human satisfaction is the most important factor to consider while studying travel behavior and it depends on several factors, mainly the commuting time. This is why it is essential to understand the correlation between them. It is also important to acknowledge whether people are generally satisfied with their travel time or wish to commute more or less. This matter in question was answered by the previously mentioned studies; nevertheless, no conclusion was drawn regarding these issues for developing countries. All such research have been conducted in developed countries. However, there are scarce studies that have been conducted in the MENA region. This is why it is important to start researching these small cities in developing countries to understand the correlations between the different commuting times and compare the results to those of developed countries.

3 Methodology

3.1 Research questions and hypothesis

Four research questions were formulated, in the hope that this study could provide a response or answers to these questions. The questions are the following:

1. Are ACT and ICT correlated if socio-economic and land use factors are fixed?
2. Are ACT and MCT correlated if socio-economic and land use factors are fixed?
3. Are ACT and satisfaction with daily commuting correlated if socio-economic and land use variables are fixed?
4. Finally, are ICT and MCT correlated?

Along with the research questions, a few hypothesis statements were also predicted and formulated with the aim of being tested and either confirmed or rejected by the study. This study was performed to test the following hypotheses:

1. There is a significant difference between the ACT and ICT in Jounieh area, and most of Jounieh residents are discontented with their commuting times in which the time they commute is much greater than the commuting time they desire.
2. Commuting times are influenced by socio-economic factors such as gender, nationality, job status, education level, etc.
3. The values of ACT, ICT, and MCT in Jounieh are different from those in the first world countries.

3.2 Case study

Jounieh, a coastal city in Keserwan District, has been chosen as the target for this study. It is located about 16 km North of Beirut, the capital of Lebanon. Lebanon is a country located in the Middle East (ME), shown in Fig. 1. It has a total area of 10,452 km^2. Lebanon is divided into six governorates (Faour, 2015). Jounieh has been the capital of Keserwan-Jbeil Governate since 2017. Today, its population is approx. 96,315 (Geonames, 2022) and with an area of 16.28 km^2, the population density in inhabitants per square km is about 5,916, where that of Lebanon is 667. From 1980 to 1990, people migrated to Jounieh since copious amount of Beirut traders shifted to its markets, making it one of the most congested cities in Lebanon. Today, Jounieh is considered an urban area, with several educational centers, companies, governmental institutions, and more. Jounieh is not considered a part of Beirut suburbs; rather, it operates as a distinct city. However, due to its close geographical proximity to Beirut and being connected by major roadways like Beirut – Byblos Highway, a significant number of its population commute to Beirut. This situation implies that Jounieh, due to its proximity and interaction with Beirut, could be considered part of the broader area of Beirut (Localiban, 2008). Fig. 2 shows the location of Jounieh, Lebanon on the map.

It is also essential for this study that the area selected is an urban one, which means that it should be very developed, with a high density of structures such as houses, commercial buildings, roads, bridges, and railways.

Moreover, since this study focuses on analysing commuting times, it is important to choose a city where a great deal of the population commute to work, school, university, etc. Jounieh is exactly like that.

Countries and cities in the MENA region are very insufficiently researched, especially in travel behavior topics. There have been many research studies in countries like the USA, Canada, China, etc; however, countries

Fig. 1 Location of Lebanon on the map (Google, n.d.)

Fig. 2 Location of Jounieh, Lebanon on the map (Google, n.d.)

like Lebanon are often ignored in regards of this subject, even though Lebanon suffers from transportation crisis, and continuous research in this area of study could help improve the situation.

As mentioned earlier, cities in the MENA are rarely taken into consideration in research studies regarding travel behavior, and if such studies are conducted, they would be done on large cities, but not on small ones. Jounieh is an under researched small city that needs more investigation. Focusing on smaller developing countries is essential for approximately half of the world's 3.9 billion urban dwellers live in cities with fewer than 500,000 inhabitants, while only around one in eight live in the places with 10 million inhabitants or more. Overall, the urban population in developing countries is set to double from 2010 to 2050 while remaining stable in developed countries (Jang et al., 2021).

3.3 Data and variables

In order to collect precise data, face-to-face, live interviews were conducted with Jounieh residents via a quantitative survey, where data was directly reported to ensure accurate results. This survey took place during the month of November of 2021 in Jounieh, Lebanon with a total of 938 participants. These participants were chosen randomly in Jounieh area without any specific selection. The survey included 41 questions. These 41 questions were diverse and for the sake of this study, some of them that are not related to the subject, will not be considered. The questionnaire was divided into various sections: individual and household information, mobility habits, commuting, perceptions of security in public transportation, ride-sharing, and housing. At the end, the respondents were asked to mark the nearest intersection to their home and work/study place on Google maps that the interviewer showed them. The sections that are essential to the study are:

1. Individual and household in which general information regarding the interviewee was noted mainly the gender, age, nationality, employment status, education level, car ownerships, etc.
2. Commuting, which is the most essential part of the survey relating to this study, where people were asked about the frequency of their commuting to work/study place, the time they spend commuting, the desired time they wish to commute, and the threshold time they are willing to commute, as well as their satisfaction with their commuting times.

During the interviews, when the individuals were asked about their commuting preferences, it was not explicitly communicated to the respondents that they should answer these questions about their ideal commuting time and the maximum time they are willing to commute within the context of their current life situation such as their job position and income, family commitments, housing situation, etc. Table 1 shows all the binary and continuous data variables that will be used in generating the models. Some of the categorical variables such as gender, nationality, job status, education level, etc., have been converted into binary. These changes are explained throughout Table 1.

This study focuses on the relationships between the commuting times, as well as the satisfaction of the people with commuting. The commuting times are the most significant factors, and they were self-reported by the interviewees, who were asked to enter their ACT, ICT, and MCT. Some independent variables included in the analysis were socio-economic factors such as gender, nationality, job status, education level, age, household size, etc. These socio-economic variables were also input based on the answers received from the respondents. Another essential type of variables is the land use factors like commuting distance, intersection density around home, street length density around home, street length density around workplace, etc. These land use factors were obtained when the respondents pinned the intersections closest to their home and work/study place and were later generated through Arc Geographic Information System GIS (ArcGIS). After deducing all the data and variables needed, Statistical Package for the Social Sciences (SPSS) was used to generate models, deduce correlations between the variables, and answer the research questions.

3.4 Analysis methods

In order to answer the first three research questions regarding the correlations between ACT and ICT, MCT, and satisfaction with commuting, a multivariate OLS model on SPSS was generated, where the ACT was chosen as the dependent variable, and all the other 19 variables: binary and continuous, presented in Table 1, were chosen as the independent variables in the model. Model summary and model validation tables were generated in order to deduce the R square (R^2) value, which represents the proportion or percentage of the variance for a dependent variable that is explained by the independent variable(s), as well as the significance to check if the model is valid. A coefficient

Table 1 Variables used to generate the models

Type	Variable	Unit	Description	Measurement
Binary	Gender	–	Gender of respondent: Male or female	Male coded as 0 Female coded as 1
	Nationality	–	Nationality of respondent	Lebanese coded as 0 Non-Lebanese coded as 1
	Job-status	–	Employment status of respondent: unemployed, employed, self-employed, or working at home	Unemployed coded as 0 Employed, self-employed, or working at home coded as 1
	Education level	–	Education level of respondent: Brevet, Bac, technic, undergraduate, or higher	Non-university level coded as 0 University level coded as 1
	Residential self-selection	–	The reason respondent chose their residential location: affordability, close to work/school/ relatives, surrounding environment, price in the future, transportation availably, or childhood home	Non-transportation related coded as 0 Transportation-related coded as 1
	Frequency of smartphone usage	–	The frequency of smartphone usage of respondent: all the time, most of the times, sometimes, rarely, or never	Less-frequent coded as 0 More-frequent coded as 1
Continuous	Age	Years	Age of respondent	Scale, unbounded
	Household size	Individuals	Number of individuals living in the respondent's house	Scale, unbounded
	Car ownership	Cars	Number of cars owned by the respondent and household members	Scale, unbounded
	Actual commuting time in a weekday	Minutes	Time spent in commuting in a weekday by the respondent	Scale, unbounded
	Ideal commuting time in a weekday	Minutes	Desired time spent commuting in a weekday by the respondent	Scale, unbounded
	Satisfaction with commuting	–	Satisfaction level of the respondent with their commuting	Scale, (0–20 very dissatisfied, 20–40 dissatisfied, 40–60 neutral, 60–80 satisfied, 80–100 very satisfied)
	Maximum willingness to commute time in a weekday	Minutes	Maximum time a respondent is willing to commute in a weekday	Scale, unbounded
	Commuting distance	Km	Distance between a respondent's house and work/ study place	Scale, unbounded
	Intersection density-home	Intersections/m^2	The number of intersections per square meter of the home area.	Scale, unbounded
	Street length density-home	m/m^2	The length of streets per square meter of the home area.	Scale, unbounded
	Link-node ratio-home	–	Number of links divided by the number of nodes in the home area. Links represent the number of street segments of the street network. Nodes represent the street intersections of the street network.	Scale, unbounded
	Intersection density-work	Intersections/m^2	The number of intersections per square meter of the work/study area.	Scale, unbounded
	Street-length density-work	m/m^2	The length of streets per square meter of the work/ study area.	Scale, unbounded

Continuation of Table 1

Type	Variable	Unit	Description	Measurement
Continuous	Link-node ratio-work	–	Number of links divided by the number of nodes in the work/study area Links represent the number of street segments of the street network. Nodes represent the street intersections of the street network.	Scale, unbounded

table was also generated in order to show the Variance Inflation Factor (VIF), significance (p-value), and Beta coefficients (β), of each independent variable. Values for VIF greater than 1 show that there is no multicollinearity between the independent variables, meaning that the independent variables are not correlated. P-values of less than 0.05 were taken as significant. Some variables will have P-values greater than 0.05, meaning they are insignificant, and therefore will be removed from the model. Several iterations will be performed, in which, each time, one independent variable will be eliminated to improve the model. After all iterations are done, all socio-economic and land use factors will be fixed to study the correlations between the variables.

The fourth research question is regarding the correlation between ICT and MCT. To study this correlation, another model will have to be generated: A univariate OLS model, where MCT is the dependent variable and ICT is the independent one. Model summary, model validation and coefficient tables will also be generated to deduce the R^2, VIF, p-value, and β coefficients. Finally, the p-value and β coefficient will inform us about the significance of the independent variable and the correlation between the dependent (MCT) and independent (ICT) variables.

4 Findings

4.1 Descriptive analysis

There are various variables that may affect the investigated elements of this study, i.e., ACT, ICT, MCT, and commuting satisfaction. These variables are divided into different categories: Categorical, binary, and continuous, where the categorical variables were also converted into binary variables. The continuous variables are presented in Table 2, whereas the categorical/binary ones are presented in Table 3.

It can be deduced from Table 2 that among the interviewees, there were people as young as 12 and as old as 81 years where the mean was about 31 years. The average household size of the participants was 4 with an average of 2 cars. Regarding the gender distribution of the sample, 58.3% of the respondents were men, and the rest were women. Most of the respondents (86.9%) were Lebanese. In addition, the sample was roughly half unemployed and half employed, self-employed, and working at home. Also, most of the respondents (77.5%) had a university degree or higher. Concerning the commuting times, the maximum ACT and ICT are both 300 minutes, with an average of 48.20 and 28.76 minutes for the former and the latter, respectively, which means that on average, people of Jounieh commute 20 minutes more than they would like. The MCT averaged as 53.46 minutes, whereas the average satisfaction of commuting of the sample was 52.50 out of 100, meaning that on average the respondents were neutral towards their commuting. By analysing the mean values of the ICT and MCT, it appears that most respondents were rational in their answers and did not think in a hypothetical scenario where not commuting is an option for them, even though some participants did indicate that their ICT and MCT are zero. These individuals might have special reasons for these answers that might include a preference to work remotely, family commitments, health reasons, etc. They might also be individuals who do not seek higher education or employment and aspire to remain at home.

Nevertheless, this still shows that most individuals were not idealistic and seemed to take realistic considerations and factors into account while providing their responses. These factors include their job title, wage, family obligations, housing situation, etc. Basically, it can be assumed that the participants' answers were a balance between their personal preferences and the limitations of their lives.

According to Table 4, some of the values for ACT, ICT, MCT, and satisfaction for the selected categories are somewhat close; however, there are some differences. For example, the average ACT for men was 55.48 minutes, while that of women was less by about 7 minutes. However, the satisfaction level for women was lower by

Table 2 List of continuous variables used in the model

Variable	Number	Range	Minimum	Maximum	Mean	Standard deviation	Variance
Age (years)	863	69	12	81	31.64	13.04	170.09
Car ownership (cars)	866	10	0	10	2.02	1.30	1.70
Household size (individuals)	935	12	0	12	4.07	1.61	2.59
Actual commuting time in a weekday (minutes)	920	300	0	300	48.20	59.14	3497.08
Ideal commuting time in a weekday (minutes)	761	300	0	300	28.76	23.71	562.36
Satisfaction with commuting	893	100	0	100	52.50	30.70	942.21
Maximum willingness to commute time in a weekday (minutes)	876	300	0	300	53.46	39.32	1545.80
Commuting distance (km)	544	67.08	0.0022	67.08	8.96	8.72	76.06
Intersection density – home (intersections/m^2)	702	0.0008	0	0.0008	0.0002	0.0001	0
Street length density – home (m/m^2)	702	0.0773	0	0.0773	0.0125	0.0181	0
Link-node ratio – home	702	9.00	0	9.00	1.71	0.9941	0.9880
Street-length density – work (m/m^2)	360	1506.58	0	1506.58	131.30	190.91	36447.33
Intersection density – work (intersections/m^2)	359	21.95	0	21.95	3.26	4.16	17.31
Link-node ratio – work	331	7.18	0.8235	8.00	1.80	0.8945	0.8000

Table 3 List of binary variables used in the model

Variable	Categories	Number	Percent (%)
Gender	Male	547	58.3
	Female	391	41.7
Nationality	Lebanese	815	86.9
	Non-Lebanese	123	13.1
Job-status	Unemployed	458	48.8
	Employed – Self-employed – Working at home	480	51.2
Education level	Non-university education	205	21.9
	University education	727	77.5
Residential self-selection	Non-transport reasons	627	66.8
	Transport-related reason	150	16.0
Frequency of smartphone usage	Less frequent	360	38.4
	More frequent	374	39.9

Table 4 ACT, ICT, MCT, and satisfaction with commuting for different categories*

		ACT	ICT	MCT	Satisfaction with commuting
Gender	Male	55.48	28.75	58.71	60.06
	Female	48.33	25.97	53.15	51.52
Nationality	Lebanese	54.17	28.52	58.45	56.79
	Non-Lebanese	42.13	21.85	43.70	54.45
Job-status	Unemployed	52.78	26.01	58.34	57.28
	Employed, self-employed, and working at home	52.26	28.60	55.08	55.92
Education level	Non-university level	35.72	21.47	43.26	56.5
	University level	55.92	28.84	59.07	56.45

* Because of the missing values in the gender, nationality, job status, education level, ACT, ICT, MCT, and satisfaction variables, the sample size is reduced to 707

approximately 8 units. Lebanese commuters travelled more time than non-Lebanese; nevertheless, non-Lebanese preferred a lower ICT and MCT. It can also be seen that job status does not significantly affect the ACT, ICT, MCT, and satisfaction, since they are roughly the same for unemployed and employed, self-employed, and working at home respondents. There is a huge difference between the commuting times for non-university and university level people, in which the former commute 20 minutes less than the latter. University level commuters also are willing to commute more (59.07 minutes) than non-university level commuters (43.26 minutes), whereas their satisfaction levels are the same.

By analysing the data between the ACT and ICT, 75.9% of the respondents have an ACT greater than their ICT, while 24.1% have their ACT equal to the ICT, but none of the interviewees have an ICT greater than their ACT, meaning not a single person wishes to commute more than they actually do. Also, the majority of the sample (65.1%) have MCT greater than ACT, 19.8% have ACT equal to MCT, and the rest (15.1%) has ACT greater than MCT. Regarding the relation between the ICT and MCT, none of the respondents reported an ICT greater than MCT. Most of the sample (87.6%) claimed that the maximum time they are willing to commute is greater than the commuting time they desire (ICT), while 12.4% of the commuters reported an equal ICT and MCT.

Fig. 3 displays the distribution of ACT, ICT, and MCT grouping responses into 10-minute groups and then 130+ minutes since there were few respondents who answered a commuting time longer than 130 minutes. Most of the respondents (80.9%) commute for less than 60 minutes, while about half of them had an ACT of 10–40 minutes. The ICT was concentrated (57.8%) in the 10–30 minute range, and 20% of the sample had an ICT less than 10 minutes, while only 4.4% of the sample reported an ICT of zero minutes. 63.7% of the respondents had an MCT in the 20–60 minute range.

In terms of commuter satisfaction with their travel time, the survey revealed that 22.2% of the respondents are very dissatisfied, 12% are dissatisfied, 23.5% are neutral, 27.3% are satisfied, and 15% are very satisfied.

4.2 Influences on actual commuting times: Socio-economic and land use factors

A multivariate OLS model was first performed where the ACT was the dependent variable. Overall, the included variables explained about 38.3% (According to the adjusted R square) of the variations in the ACT. Continuing to the overall coefficient, all VIF values for all variables appear greater than 1; hence, no multicollinearity occurs between the independent variables. There is no association between the independent variables, which is a good indication. The results of the model summary, model validation, and coefficients are shown in Table 5.

According to Table 5, various variables (land use and socio-economic) have a p-value greater than 0.05, indicating that the variable is not significant. For this reason, the analysis will be repeated several times, in which each time one variable will be eliminated. A total of 14 iterations were performed with the variables being removed in the following order: street-length density – work,

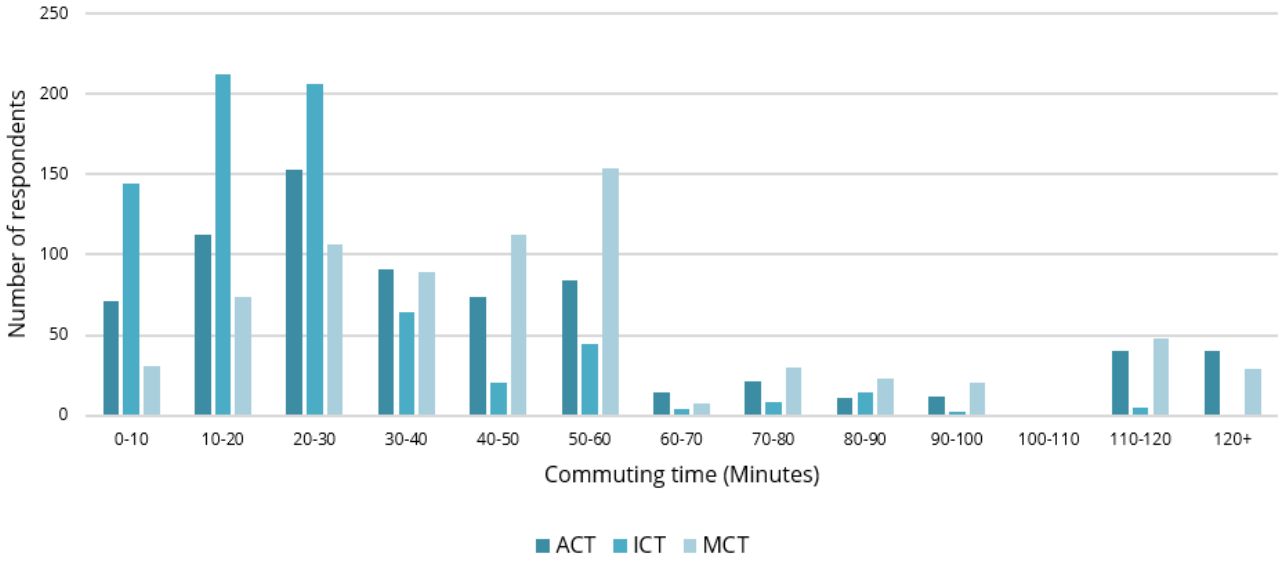

Fig. 3 Distributions of ACT, ICT, and MCT; because of the missing values in the ACT, ICT, and MCT, the sample size is reduced to 723

Table 5 Model summary, model validation, and coefficient table: first and final iteration

	First iteration			Final iteration	
	Standardised Beta coefficient	Significance	VIF	Standardised Beta coefficient	Significance
Constant		0.877			0.092
Ideal commuting time on a weekday (minutes)	0.255	0.066	2.883	0.267	<0.001
Satisfaction with commuting	−0.179	0.044	1.173	−0.151	<0.001
Maximum willingness to commute time on a weekday (minutes)	0.320	0.019	2.757	0.356	<0.001
Frequency of smartphone usage	0.174	0.100	1.683	0.170	<0.001
Age (years)	0.088	0.463	2.180		
Car ownership (cars)	0.085	0.391	1.490		
Household size (individuals)	−0.076	0.380	1.140		
Nationality	0.001	0.995	1.420		
Job-status	0.081	0.440	1.666		
Education level	0.038	0.693	1.401		
Residential self-selection	0.022	0.821	1.440		
Commuting distance (km)	−0.026	0.776	1.275		
Intersection density - home (intersections/m^2)	−0.013	0.886	1.199		
Street length density - home (m/m^2)	0.239	0.014	1.375		
Link-node ratio - home	−0.115	0.247	1.483		
Street-length density - work (m/m^2)	0.007	0.942	1.403		
Intersection density - work (intersections/m^2)	−0.014	0.901	1.916		
Link-node ratio - work	−0.021	0.840	1.637		

Model validation

	First iteration					Final iteration				
Model	Sum of squares	df	Mean square	F	Signifi-cance	Sum of squares	df	Mean square	F	Significance
Regression	225276.923	18	12515.385	4.271	<0.001	528884.863	4	132221.216	57.866	<0.001
Residual	225643.702	77	2930.438			742611.710	325	2284.959		
Total	450920.625	95				1271496.573	329			

Continuation of Table 5

Model summary							
First iteration				Final iteration			
R	R square	Adjusted R square	Standard error of estimate	R	R square	Adjusted R square	Standard error of estimate
0.707	0.500	0.383	54.134	0.645	0.416	0.409	47.801

nationality, intersection density – work, link-node ratio – work, residential self-selection, commute distance, link-node ratio – home, intersection density – home, car ownership, job status, education, age, household size, and finally street-length density – home. Removing such variables improved the model and increased the adjusted R square value to 0.409 (40.9%), as can be seen in Table 6. At the end of the iterations, only four variables remained: ICT in a weekday, satisfaction with commuting, MCT time in a weekday, and frequency of smartphones usage, all with a p-value less than 0.001 making them highly significant, this can also be seen in Table 5.

The prediction regression equation (Eq. (1)) of the model can be deduced from Table 5 as follows:

$$Y = 12.224 + 0.804X_1 - 0.337X_2 + 0.528X_3 + 21.097X_4, \quad (1)$$

where:

- Y: actual commuting time on a weekday;
- X_1: ideal commuting time on a weekday;
- X_2: satisfaction with commuting;
- X_3: maximum willingness to commute time on a weekday;
- X_4: frequency of smartphone usage.

Comparing the standardised β between in Table 5 and for the four remaining independent variables (ICT in a weekday, satisfaction with commuting, MCT in a weekday, and frequency of smartphone usage), it can be recognised that the values are very similar with a slight difference. For example, for the ICT in a weekday, the β was 0.255 and after 14 iterations it became 0.267, meaning a slight difference occurred. Hence, it is safe to adopt the results of the first generated trial of the model while fixing all socio-economic and land use variables since it includes more variables.

4.3 Correlation between ACT and ICT on a weekday

In order to understand the correlations between variables, it is essential to look at the standardised β from the first trial in Table 5. It can be seen that the standardised β for the ICT in a weekday is 0.255 (25.5%). Since this value is positive, it means that the ACT and ICT are positively correlated meaning if the predictor (ICT) increases, the dependent variable (ACT) increases. For every 1-unit increase in ICT, there is 25.5% increase in ACT. This points out that commuters who have an increased ICT, indicating that their preferred commuting time is higher than that of other commuters, show that their ACT is

Table 6 Model summary, model validation, and coefficient table

	Unstandardised coefficients		Standardised coefficients	t	Significance
	B	Standard error	Beta		
Constant	15.997	1.673		9.563	<0.001
Ideal commuting time on a weekday (minutes)	1.456	0.049	0.739	29.500	<0.001
Model validation					
Model	Sum of squares	df	Mean square	F	Significance
Regression	610576.350	1	610576.350	870.267	<0.001
Residual	506552.880	722	701.597		
Total	1117129.231	723			
Model summary					
	R	R square	Adjusted R square	Standard error of estimate	
	0.739	0.547	0.546	26.488	

going to be higher. It is also essential to mention that the p-value of the ICT is 0.066, indicating that this variable is marginally significant. The VIF value of the ICT is 2.883, which is greater than 1 indicating no intercorrelation between the variables. In this analysis the dependent variable was the ACT and the independent one was the ICT so the conclusion was made as to how the ACT varies with the ICT. To observe how much exactly the ICT changes in relation to the ACT, it is necessary to select the former as the dependent variable and the latter as the independent one. However, based on the analysis that individuals understand the need for commuting and that it is, in fact, not an option, this relationship can also be analysed. Commuters who have a higher ACT generally possess a deeper understanding of the necessity to commute to balance between the multiple considerations mentioned previously, and are usually satisfied with their existing commuting time. Consequently, those who have a higher ACT possess a more realistic perspective on their ICT, which tends to have a higher value.

4.4 Correlation between ACT and MCT on a weekday

Similarly, it can be seen from Table 5 that the ACT and MCT are also positively associated, and as the MCT increases by 1-unit, the ACT rises by 32%. Comparing this value to that of the ICT mentioned in Section 4.3, it is deduced that the MCT has more significant effects on the ACT but is also marginally significant (p-value is 0.019). Alike what was previously stated, commuters who have higher maximum tolerance commuting time, have a longer ACT. The VIF value of the MCT is 2.757, which is greater than 1, indicating that there is no intercorrelation between these two variables. For this case, the dependent variable was also the ACT and the independent one was the MCT so the conclusion was made as to how the ACT varies with the MCT. It is necessary to switch the two variables to observe how much exactly the MCT changes to the ACT. However, based on the previous analysis mentioned in Section 4.3, commuters who have a higher ACT tend to accept or tolerate a higher MCT.

4.5 Correlation between ACT on a weekday and satisfaction with commuting

Unlike the correlations between ACT and both ICT and MCT, the association between ACT and satisfaction with commuting is negative with marginal significance (p-value is 0.044). When the satisfaction increases by 1-unit (In this case since satisfaction is measured on a scale from 0 to 100, with increments of 1, 1-unit equals 1 measure in satisfaction), the ACT decreases by 17.9%. As expected, the ACT is negatively affected by the satisfaction because satisfaction depends on the amount of time spent commuting and the less time spent on the road means that commuters are more satisfied. The VIF value of the satisfaction with commuting is 1.173, which is greater than 1, indicating that there is no intercorrelation between these two variables. Here, the dependent variable was also the ACT and the independent one was the satisfaction with commuting so the conclusion was made as to how the ACT varies with the satisfaction. To observe exactly how much the satisfaction changes to the ACT, it is necessary to switch the variables.

Nevertheless, since these two variable are negatively correlated, so as such the analysis would also be that when the ACT is higher, the level of satisfaction will be lower. This pattern is easily understandable: as individuals spend more time commuting, their satisfaction naturally decreases, despite their awareness of the necessity of commuting to maintain their current lifestyle. This dissatisfaction associated with longer commutes remain difficult to mitigate.

4.6 Correlation between ICT and MCT on a weekday

Regarding this research question, a different model: Univariate OLS model was generated with MCT as the dependent variable and ICT as the independent one. From Table 6, it can be deduced that the included variable explained about 54.7% of the variation in the MCT, and that the model is valid since the p-value is less than 0.001.

The prediction regression equation (Eq. (2)) of the model can be deduced from Table 6 as follows:

$$T = 15.997 + 1.456\ U, \tag{2}$$

where:

- T: MCT on a weekday;
- U: ICT on a weekday.

It can be seen from Table 6 that the MCT and ICT are strongly positively associated, and as the ICT increases by 1-unit, the MCT rises by 73.9%, with high significance (p-value is less than 0.001). As anticipated the ICT has a huge effect on the MCT, when commuters have a higher ideal time to commute, their maximum time that they allocate to commute will definitely be higher. This increased willingness to commute could result from the individuals' acceptance of longer commutes to attain specific living conditions. As a result, when the ICT is higher, individuals are more likely to allocate a longer MCT, as their

mindset aligns with dedicating more time to commuting to balance with other factors. In this analysis the dependent variable was the MCT and the independent one was the ICT so the conclusion was made as to how the MCT varies with the ICT. It is necessary to switch the variables to observe how much exactly the ICT changes in relation to the MCT. However, if individuals express a willingness to commute for a long time, driven by certain advantages, it is reasonable that they would also desire a high ICT that aligns with this willingness.

5 Discussion

Regarding the hypothesis statements that we wanted to study, we found out that there is a huge difference between the ACT and ICT in Jounieh, as predicted. The difference is approximately 20 minutes which is highly significant, in addition to 75.9% of the sample were commuting for a time longer than they desire. However, the average satisfaction level of the 939 respondents was 52.50/100.00, which lies in the neutral range (40–60). Therefore, we can safely say that these people are neither dissatisfied nor satisfied with their commuting time and hypothesis 1 is proven to be incorrect. Socio-economic factors played a huge role in the determination of the commuting times, where men were said to commute more than women, Lebanese more than non-Lebanese, and university level respondents more than non-university level ones. However, the job status of the interviewees did not affect their commuting times. Hence, we can say that hypothesis 2 is correct. Regarding hypothesis 3, it was seen from previous literature that first world countries showed shorter ACT, ICT, and MCT than Jounieh due to several differences between these countries and Lebanon; therefore, hypothesis 3 stands true as well.

As previously presented in Section 4, findnings, the average ACT of the sample that was chosen in Jounieh is 48.20 minutes, whereas the ICT is 28.76 minutes and the MCT is 53.46 minutes. This means that Jounieh residents commute on average about 68% longer than their desired time. Considering the ICT, the value that was obtained from the sample was longer than those seen in previous studies that were done in developed countries like in Australia, ICT of 15–19 minutes (Young and Morris, 1978), San Francisco, ICT of 16 minutes (Redmond and Mokhtarian, 2001), Auckland and Wellington, ICT of 14 minutes (O'Fallon and Wallis, 2012), and Portland, Oregon, ICT of 13.5 minutes (Humagain and Singleton, 2020). Moreover, 20% of the sample in Jounieh responded with an ICT less than 10 minutes, and 57.8% wanted an ICT in the 10–30 minutes range. These percentages are lower than those recorded by O'Fallon and Wallis (2012) (69%). Humagain and Singleton (2020) noticed that most of their respondents (65.8%) had an ICT in the 0–20 minute range, while in Jounieh, the value was 49.2%. The difference between the desired times in Jounieh and other cities is expected due to the difference between the transportation conditions of the countries. In Lebanon, there is poor transportation planning, which obviously increases the commuting times; hence, people who live in Lebanon find it usual to commute for a long time, so when asked about their ICT, it is normal that it would be longer than that of people living in developed countries, where there is better transportation planning, design, and maintenance. In addition, 4.4% of the respondents in Jounieh wished for an ICT of zero minutes meaning the majority of the interviewees did not think in a hypothetical scenario where not commuting is an option for them. Comparing to the findings of Redmond and Mokhtarian (2001) 1.2%, O'Fallon and Wallis (2012) 3%, Humagain and Singleton (2020) 8.4%, the percentage of people wanting an ICT of zero minutes in Jounieh is normal and lower than that in Portland, Oregon. Another study based on a survey applied in GLA, MSP, and NLR showed on average an ACT, ICT, and MCT of 29, 19, and 48 minutes, respectively (Pritchard et al., 2021). O'Fallon and Wallis (2012) also recorded a lower ACT (20 minutes) in Auckland and Wellington, as well as Humagain and Singleton (2020), ACT of 33.5 minutes in Portland, Oregon. These commuting times are much lower than the ones of Jounieh residents.

In addition, 75.9% of the sample in Jounieh commute longer than they wish to, while the rest (24.1%) commute for a time equal to their desired time. None of the respondents desire to commute more than they actually do. Comparing these results to a study done by Ye et al. (2020) in Xi'an China, it can be seen that less people in China (64% of the sample) commute a total time longer than ICT, whereas 17% prefer a longer commute, and the rest (19%) are satisfied with their commuting time. The huge difference that can be seen here is that in Jounieh, not a single person wanted to commute more than they currently do; however, in Xi'an 17% of the sample or around 142 people wanted to commute for a longer time, which is surprising, but understandable if they work/study from home or if their work/study place is very close to where they live. Also, given the situation in Lebanon, and Jounieh being one of the most congested cities, it is also reasonable that no one wants to spend more time on the road than they should.

Moreover, we found that the ACT positively correlates with both the ICT and MCT. These findings are consistent with Pritchard et al. (2021).

The findings of Jounieh may be closest to those in GLA, also according to Pritchard et al. (2021), where 69.9% were not satisfied with their commuting time (75.9% was the percentage in Jounieh) and 24.4% commute their desired time, which is close to the case of Jounieh. However, in NLR and MSP more people reported an ACT less than ICT and less people reported an ACT longer than ICT, which makes the data in those two locations far from the results of Jounieh.

The data also show that university-level respondents commute for about 20 minutes longer than non-university respondents, which was mentioned by Hanson and Pratt (1995), who reported that highly educated people would want to search for more specialised job opportunities and hence commute for a longer time, and also by Susilo and Maat (2007) who found a positive correlation between longer commuting times and higher education level, as well as Giménez-Nadal et al. (2022). In Jounieh, men were found out to commute more than women by approximately 7 minutes, which is consistent with the findings of Giménez-Nadal et al. (2022) in Anglo-Saxon and Continental economies.

The findings of this study were very valuable and beneficial in providing information and associations between commuting times and people's satisfaction with their commuting times. The importance of this study is that it was done in a small city: Jounieh, in the MENA region, which is a very under-researched location in travel behavior studies. The main issue with the current travel behaviour of Jounieh residents is that their ACT is very high, and they are dissatisfied with it. Changing the ACT might involve home/school/university/job relocations, which might not be an option for many people, knowing they need to consider other factors.

However, there could be other solutions that can be done in order to reduce the commuting times of people while increasing satisfaction. Planning strategies such as job-housing balance, which refers to the equal distribution of employment relative to the distribution of workers within a given geographic area, and when available housing choices complement the earning potential of available jobs (Giuliano, 1991). Another strategy is compact development, which emphasises the intensification of development and activities, establishes limits to urban growth, encourages land use and social mixes, and focuses on the importance of public transportation and urban design quality (Bibri et al., 2020). These planning strategies can promote sustainability by diminishing the amount of travel, shortening commute time, and improving commute satisfaction (Ye et al., 2020).

However, there are also some personal decisions that people could take in order to improve their quantity and quality of commuting. People could choose public transportation services instead of riding in their cars. They could also consider carpooling with colleagues. Sharing a ride would reduce the number of vehicles on the road, which significantly reduces congestion, and in return shortens the commuting time. Knowing that Jounieh is a popular city and congestion is a major problem. Ridesharing could improve this issue hugely. Choosing a bicycle over a car could also be a solution if an individual's study/workplace is within biking distance.

Regarding the city's and government's duties, first, public transit should be made more accessible by expanding the area covered by public transit, building bus stops, and making them more appealing and more affordable. Second, by building safe bike lanes and bike highways, people would be encouraged to use them knowing that it is one hundred percent safe.

6 Conclusion

To conclude, this research study was conducted to study the ACT, ICT, MCT, and the commuting satisfaction of the residents of Jounieh. 938 people were chosen randomly to participate in this survey. After collecting data from the respondents using a questionnaire, this data was used to produce models to understand the correlations between the above variables and deduce how some factors affect commuting times. ACT and both ICT and MCT were positively correlated, as well as MCT and ICT. However, ACT and satisfaction with commuting were negatively correlated. As expected, the ACT is significantly larger than the ICT, but slightly shorter than the MCT, whereas the satisfaction with commuting is average. Most of the sample commute for a time longer than their desire, and some have an ACT equal to their ICT. None of the respondents wished for a longer commuting time. Some socio-economic factors such as gender, nationality, job status, and education level were chosen in order to study their effect on the commuting times and satisfaction with commuting of the sample. Men reported a longer commuting time than women, yet women showed lower satisfaction. Lebanese respondents also showed a longer ACT than the non-Lebanese, but approximately the same level of satisfaction. In addition, university-level respondents reported a significantly higher ACT than non-university-level respondents. Finally,

unemployed and employed people commute for approximately the same time. Although this research provided some valuable insights regarding the commuting time of the residents of Jounieh, as well as their satisfaction with commuting, and shed light on the factors that affect commuting times, this study has some limitations, resulting in various avenues for future work. First, out of all the population of Jounieh, only 938 people were interviewed. Furthermore, Lebanon has been experiencing an economic crisis for the past two years, and the fuel price has increased drastically, significantly affecting the transportation sector. This issue also needs to be addressed in the questionnaire and taken into consideration in the data analysis.

Future work should be directed to cover more areas and expand this research to other cities in Lebanon and the MENA region, which are also under-researched in travel behaviour. It is also essential to increase the number of participants that will be taking part in the study, improve the quality of the questionnaire by adding questions that can cover and help analyse more factors including socio-economic, demographic, cultural, individual, etc. Investigating the effects of the economic crisis is also essential to see how this has affected the travel behaviour of the people, in other words, how it affects their commuting time and satisfaction. Another domain that could be included in the model would be the commute modes. It would be interesting to visualise how the transportation mode, public transportation, personal car, taxi, or even walking, could affect a person's commuting time.

References

Bergantino, A. S., Madio, L. (2015) "Travel-to-work. Which factors matter? An analysis on regional labor markets in the UK", presented at 55th Congress of the European Regional Science Association: "World Renaissance: Changing roles for people and places", Lisbon, Portugal, Aug. 25–28. [online] Available at: http://hdl.handle.net/10419/124719 [Accessed: 26 August 2023]

Bibri, S. E., Krogstie, J., Kärrholm, M. (2020) "Compact city planning and development: Emerging practices and strategies for achieving the goals of sustainability", Developments in the Built Environment, 4, 100021. https://doi.org/10.1016/j.dibe.2020.100021

Brockerhoff, M., (1998) "World urbanisation prospects: The 1996 revision", Population and Development Review, 24(4), pp. 883–884. https://doi.org/10.2307/2808041

Cervero, R. (1989) "Jobs-housing balancing and regional mobility", Journal of the American Planning Association, 55(2), pp. 136–150. https://doi.org/10.1080/01944368908976014

Cervero, R., Wu, K.-L. (1998) "Sub-centring and commuting: evidence from the San Francisco Bay area", Urban Studies, 35(7), pp. 1059–1076. https://doi.org/10.1080/0042098984484

Faour, G. (2015) "Evaluating urban expansion using remotely-sensed data in Lebanon", Lebanese Science Journal, 16(1), pp. 23–32. [online] Available at: http://lsj.cnrs.edu.lb/wp-content/uploads/2015/12/gfaour.pdf [Accessed: 11 January 2022]

Gakenheimer, R. (1999) "Urban mobility in the developing world", Transportation Research Part A: Policy and Practice, 33(7–8), pp. 671–689. https://doi.org/10.1016/S0965-8564(99)00005-1

Geonames (2022) "Populations of cities in Lebanon", [online] Available at: https://worldpopulationreview.com/countries/cities/lebanon [Accessed: 03 January 2022]

Gimenez-Nadal, J. I., Molina, J. A. (2014) "Commuting time and labour supply in the Netherlands: A time use study", Journal of Transport Economics and Policy, 48(3), pp. 409–426. [online] Available at: http://www.jstor.org/stable/24396295 [Accessed: 04 January 2022]

Giménez-Nadal, J. I., Molina, J. A., Velilla, J. (2022) "Trends in commuting time of European workers: A cross-country analysis", Transport Policy, 116, pp. 327–342. https://doi.org/10.1016/j.tranpol.2021.12.016

Giuliano, G. (1991) "Is jobs-housing balance a transportation issue?", UC Berkeley: University of California Transportation Center, Transportation Research Record 1305, pp. 305–312. [online] Available at: https://escholarship.org/uc/item/4874r4hg [Accessed: 11 January 2022]

Google (n.d.) "Location of Lebanon on the map", [online] Available at: https://maps.app.goo.gl/1vcZnZgD5Z2vW9hX8 [Accessed: 03 October 2023]

Google (n.d.) "Location of Jounieh on the map", [online] Available at: https://maps.app.goo.gl/Wa4xc2ek5MaXT6mx6 [Accessed: 03 October 2023]

Hanson, S., Pratt, G. (1995) "Gender, Work and Space", Routledge. ISBN 9780203397411 https://doi.org/10.4324/9780203397411

Hansson, E., Mattisson, K., Björk, J., Östergren, P.-O., Jakobsson, K. (2011) "Relationship between commuting and health outcomes in a cross-sectional population survey in southern Sweden", BMC Public Health, 11(1), 834. https://doi.org/10.1186/1471-2458-11-834

Humagain, P., Singleton, P. A. (2020) "Investigating travel time satisfaction and actual versus ideal commute times: A path analysis approach", Journal of Transport & Health, 16, 100829. https://doi.org/10.1016/j.jth.2020.100829

Humphreys, D. K., Goodman, A., Ogilvie, D. (2013) "Associations between active commuting and physical and mental wellbeing", Preventive Medicine, 57(2), pp. 135–139. https://doi.org/10.1016/j.ypmed.2013.04.008

Jang, W., Yuan, F., Lopez, J. J. (2021) "Investigating Sustainable Commuting Patterns by Socio-Economic Factors", Sustainability, 13(4), 2180. https://doi.org/10.3390/su13042180

Kahneman, D., Krueger, A. B., Schkade, D. A., Schwarz, N., Stone, A. A. (2004) "A survey method for characterizing daily life experience: The day reconstruction method", Science, 306(5702), pp. 1776–1780. https://doi.org/10.1126/science.1103572

Künn-Nelen, A. (2016) "Does commuting affect health?", Health Economics, 25(8), pp. 984–1004. https://doi.org/10.1002/hec.3199

Litman, T., Steele, R. (2017) "Land use impacts on transport: How land use factors affect travel behavior", [pdf] Victoria Transport Policy Institute, Canada. Available at: https://www.vtpi.org/landtravel.pdf [Accessed: 15 November 2022]

Localiban (2008) "Jounieh", [online] Available at: https://www.localiban.org/jounieh-4473 [Accessed: 15 December 2021]

McLafferty, S. (1997) "Gender, race, and the determinants of commuting: New York 1990", Urban Geography, 18(3), pp. 192–212. https://doi.org/10.2747/0272-3638.18.3.192

Muellbauer, J., Cameron, G. (1998) "The housing market and regional commuting and migration choices", Centre for Economic Policy Research (CEPR) Discussion Papers, London, UK, No. 1945. [online] Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=139293 [Accessed: 26 August 2023]

Nie, P., Sousa-Poza, A. (2018) "Commute time and subjective well-being in urban China", China Economic Review, 48, pp. 188–204. https://doi.org/10.1016/j.chieco.2016.03.002

Novaco, R. W., Stokols, D., Milanesi, L. (1990) "Objective and subjective dimensions of travel impedance as determinants of commuting stress", American Journal of Community Psychology, 18(2), pp. 231–257. https://doi.org/10.1007/BF00931303

O'Fallon, C., Wallis, I. (2012) "A wider look at how travellers value the quality and quantity of travel time", NZ Transport Agency, Wellington, New Zealand, Rep. 469. [online] Available at: http://www.nzta.govt.nz/resources/research/reports/469/ [Accessed: 30 August 2023]

Plaut, P. O. (2006) "The intra-household choices regarding commuting and housing", Transportation Research Part A: Policy and Practice, 40(7), pp. 561–571. https://doi.org/10.1016/j.tra.2005.10.001

Pojani, D., Stead, D. (2015) "Sustainable urban transport in the developing world: beyond megacities", Sustainability, 7(6), pp. 7784–7805. https://doi.org/10.3390/su7067784

Pritchard, J. P., Geurs, K., Tomasiello, D. B., Slovic, A., Nardocci, A., Kumar, P., Giannotti, M., Hagen-Zanker, A. (2021) "Satisfaction with travel, ideal commuting, and accessibility to employment", Journal of Transport and Land Use, 14(1), pp. 995–1017. https://doi.org/10.5198/JTLU.2021.1835

Rayess, R., El-Zahab, S., Semaan, N., Al-Sakkaf, A. (2021) "Improving Road Networks Using Network Optimization: Case Study of Aley Lebanon", In: 2021 International Conference on Software Engineering & Computer Systems and 4th International Conference on Computational Science and Information Management (ICSECS-ICOCSIM), Pekan, Malaysia, pp. 212–216. ISBN 978-1-6654-1408-1 https://doi.org/10.1109/ICSECS52883.2021.00045

Redmond, L. S., Mokhtarian, P. L. (2001) "The positive utility of the commute: modeling ideal commute time and relative desired commute amount", Transportation, 28(2), pp. 179–205. https://doi.org/10.1023/A:1010366321778

Sha, F., Li, B., Law, Y. W., Yip, P. S. F. (2019) "Associations between commuting and well-being in the context of a compact city with a well-developed public transport system", Journal of Transport & Health, 13, pp. 103–114. https://doi.org/10.1016/j.jth.2019.03.016

So, K. S., Orazem, P. F., Otto, D. M. (2001) "The effects of housing prices, wages, and commuting time on joint residential and job location choices", American Journal of Agricultural Economics, 83(4), pp. 1036–1048. https://doi.org/10.1111/0002-9092.00228

Susilo, Y. O., Maat, K. (2007) "The influence of built environment to the trends in commuting journeys in the Netherlands", Transportation, 34(5), pp. 589–609. https://doi.org/10.1007/s11116-007-9129-5

Westin, K., Sandow, E. (2010) "People's preferences for commuting in sparsely populated areas: The case of Sweden", Journal of Transport and Land Use, 2(3), pp. 87–107. https://doi.org/10.5198/jtlu.v2i3.21

White, M. J. (1977) "A model of residential location choice and commuting by men and women workers", Journal of Regional Science, 17(1), pp. 41–52. https://doi.org/10.1111/j.1467-9787.1977.tb00471.x

Ye, R., De Vos, J., Ma, L. (2020) "Analysing the association of dissonance between actual and ideal commute time and commute satisfaction", Transportation Research Part A: Policy and Practice, 132, pp. 47–60. https://doi.org/10.1016/j.tra.2019.10.011

Young, W., Morris, J. (1978) "Evaluation by individuals of their travel time to work", Econometrica, 46, pp. 403–426. [online] Available at: https://onlinepubs.trb.org/Onlinepubs/trr/1981/794/794-007.pdf [Accessed: 04 January 2022]

Zhao, P., Lü, B., de Roo, G. (2011) "Impact of the jobs-housing balance on urban commuting in Beijing in the transformation era", Journal of Transport Geography, 19(1), pp. 59–69. https://doi.org/10.1016/j.jtrangeo.2009.09.008